

Specification for

General requirements for electromagnetically operated contactors for aircraft

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Foreword

This British Standard has been prepared at the request of the Aerospace Standards Committee and Society of British Aerospace Companies to cover electromagnetically operated a.c. and d.c. contactors for use in aircraft. It supersedes British Standard G 132:1951 which is therefore withdrawn.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

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1 Scope

This British Standard specifies the requirements for single and three-pole electromagnetically operated contactors, in the range 25 A to 600 A for use in nominal 28 V d.c. and 115/200 V three-phase 400 Hz a.c. systems in aircraft.

Two environmental classes and two enclosure categories are specified as follows.

Environmental classes

Class 1. Contactors suitable for high altitude and wide temperature conditions.

Class 2. Contactors suitable for lower altitudes and narrower temperature conditions.

Enclosure categories

Category A. Hermetically sealed contactors.

Category B. Non-hermetically sealed contactors.

2 References

This standard makes reference to the following standards publications.

BS 410, *Specification for test sieves*.

BS 2011, *Basic environmental testing procedures — Part 2.1Ea: Test Ea. Shock*.

BS 6001, *Sampling procedures and tables for inspection by attributes*.

2G 100, *General requirements for electrical equipment and indicating instruments for aircraft — Part 2: Environmental and operating conditions, paragraph 213, Leakage tests for hermetically sealed equipment*.

3G 100, *General requirements for equipment for use in aircraft — Part 0: Introduction —*

Part 1: Identification and declarations — Part 2: All equipment — Section 1 Construction — Section 3 Environmental conditions — Subsection 3.1

Vibration — Subsection 3.2 Temperature-pressure requirements — Subsection 3.3 Mould growth —

Subsection 3.5 Explosion-proofness —

Subsection 3.6 Acceleration requirements —

Subsection 3.8 Salt mist — Subsection 3.12 Fluid contamination — Part 3: Characteristics of aircraft electrical power supplies — Part 4: Electrical equipment — Section 1 Construction and general — Subsection 1.1 Electrical insulation tests.

G 176, *Cartridge fuses for aircraft*.

3G 178, *Crimped joints for aircraft electrical cables and wires*.

G 216, *Hand operated, thermally compensated, miniature single- and triple-pole circuit breakers*.

3 Definitions

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

3.1

normally open contacts

contacts which do not allow the passage of current when the contactor control coil(s) are de-energized and the contactor is not latched ON. These contacts will close to allow the passage of current when the control coil only is energized

3.2

normally closed contacts

contacts which allow the passage of current when the contactor control coil(s) are de-energized and the contactor is not latched ON. These contacts will open to prevent the passage of current when the control coil only is energized

3.3

control coil

a coil which has to be energized to cause the normally open contacts to change from the open to closed position and/or the normally closed contacts to change from the closed to open position

3.4

release coil

a coil which, in a latched contactor has to be energized to cause the normally open contacts to change from the closed to the open position and/or the normally closed contacts to change from the open to the closed position

3.5

pull in voltage

the minimum voltage, rising, which has to be applied to the control coil to ensure complete closure of the normally open main and auxiliary contacts, in one movement

3.6

drop out voltage

a) *for magnetically held contactors*. The maximum voltage, falling, at which complete closing of the normally closed main and auxiliary contacts occurs in one movement, in the case of a change-over contactor, or complete opening of all main and auxiliary normally-open contacts occurs in one movement, in the case of a one-way contactor.

b) *for latched contactors*. The minimum voltage rising, at which the latch is fully operated, allowing the contacts to revert to the de-energized position.

3.7**response time at closure**

the period of time between application of voltage to the control coil, and the closing of the last of the normally open contacts

3.8**response time on opening**

the period of time between removal of voltage to the control coil, or application of voltage to the release coil, and the closing of the last of the normally closed contacts in the case of a changeover contactor, or opening of the last of the normally open contacts in the case of a one way contactor

3.9**current rating**

the maximum current at each specified load condition which the contact can make, carry continuously and break, at the maximum permitted voltage for the specified number of operations

4 General requirements**4.1 Description and design requirements**

4.1.1 The contactors shall comply with the requirements of this British Standard.

4.1.2 Both categories of contactors, (A) hermetically sealed or (B) non-hermetically sealed, shall be suitable for one of the following temperature and altitude classifications.

Class 1. Contactors for use at altitudes up to 21 300 m and for temperatures within the range -54°C to $+85^{\circ}\text{C}$ shall not suffer damage nor deterioration when subjected to temperatures within the range -54°C to -62°C (non-operating).

Class 2. Contactors for use at altitudes up to 13 700 m at temperatures within the range -54°C to $+70^{\circ}\text{C}$ shall not suffer damage nor deterioration when subjected to temperatures within the ranges -54°C to -62°C and $+70^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ (non-operating).

4.1.3 The contactors shall be suitable for operation in an explosive environment as defined in 4.2 2) of 3G 100-2-3.5:1972.

4.1.4 The contactors shall operate satisfactorily when mounted in any attitude.

4.1.5 The contactors may be single or three pole type having normally open, normally closed, or normally closed change over main contacts. Auxiliary contacts may be provided.

4.1.6 The method of operation of the contactors shall be by means of a coil suitable for either 28 V d.c. or 115 V 400 Hz a.c. supplies and the mechanism shall be either magnetically held or latched.

4.1.7 The contactor terminals shall be identified as shown in Figure 1 and Figure 2.

4.2 Rating**4.2.1 Voltage**

4.2.1.1 All contacts shall be suitable for operating in systems having characteristics in accordance with 3G 100-3 at nominal 28 V d.c. or 115/200 V 400 Hz a.c. or both as appropriate.

In addition, auxiliary contacts shall be suitable for voltages down to 4 V d.c. or a.c., and requirements to operate down to 100 mV may be specified.

4.2.1.2 All operating coils shall be suitable for operating in systems having characteristics in accordance with 3G 100-3 at nominal 28 V d.c. or 115 V 400 Hz a.c. and shall be capable of a minimum life of 1 000 cycles of operation, each cycle consisting of 3 h at maximum voltage followed by 0.5 h un-energized, the cycles being divided in the ratio of 80 % at maximum ambient temperature and 20 % at minimum ambient temperature.

4.2.2 Current

4.2.2.1 Nominal rating. The preferred nominal current ratings of the contactor main contacts shall be 25 A, 50 A, 100 A, 150 A, 200 A, 300 A, 400 A and 600 A, and the auxiliary shall be 5 A.

The main contacts shall be capable of switching 100 % of nominal current rating for 50 000 operations in resistive and inductive load circuits, the inductive characteristics of which shall be:

d.c. loads, time constant 0.03 ± 0.005 s

a.c. loads, power factor 0.75 ± 0.05 lagging.

The auxiliary contacts shall be capable of switching load currents of 100 % nominal rated resistive current and 60 % nominal rated inductive current, the inductive characteristic of which shall be as for main contacts.

In addition, the contacts shall be capable of switching 100 mA resistive load at 4 V d.c. and a.c.

4.2.2.2 Overload rating. The main and auxiliary contacts shall be capable of switching resistive loads of 200 % nominal current rating at least 50 operations.

4.2.2.3 Short circuit rating. The main and auxiliary contacts shall be capable of closing on to and carrying prospective short circuit currents of 6 000 A d.c. and 3 000 A a.c. as applicable and as defined in 7.18.

The auxiliary contacts shall be compatible with a 5 A circuit breaker complying with the requirements of G 216.

4.3 Declarations. In addition to the declarations specified in 3G 100-1, the manufacturer shall declare:

- a) the classification;
- b) the category;
- c) the motor load or tungsten filament switching capability if required.

4.4 Marking. In addition to the terminal numbering (see Figure 1 and Figure 2), the following minimum information shall be clearly and indelibly marked on each contactor.

- a) The number of this British Standard¹⁾, i.e. BS 2G 132, the environmental classification and the enclosure category.
- b) The manufacturer's name or identification.
- c) The manufacturer's type number.
- d) Resistive current rating.
- e) Voltage rating (d.c. and a.c.).
- f) Coil voltage.
- g) Circuit diagram including auxiliary contacts, (see Figure 1 and Figure 2).
- h) Manufacturer's serial number.

5 Particular requirements

5.1 Operation

5.1.1 The contactors shall be of the single pole or three pole type (main contacts) with or without auxiliary contacts. They shall be electromagnetically operated and may be electromagnetically held, mechanically latched, or magnetically latched.

5.1.2 The auxiliary contacts of the contactor shall be mechanically connected to the main contacts such that only when all main contacts are in a specific position shall all auxiliary contacts be in their correspondingly correct position.

5.1.3 At the declared minimum pull-in voltage complete closing or opening of all contacts including contact over travel or wipe, shall result.

5.1.4 On a steadily falling voltage, the maximum voltage which allows the mechanism to move shall ensure the complete closing or opening of all contacts, including over travel or wipe.

5.2 Construction

5.2.1 The main terminals shall be studs of the following sizes.

Current rating (A)	Stud size (mm)	Cable size (AWG)
25	4	14
50	4	10
100	6	6
150	6	4
200	8	0
300	8	0000
400	10	2 × 0
600	10	2 × 0000

The terminals shall be capable of accepting crimped type copper terminations. The terminal seat shall have a diameter not less than that of the copper lug width. A flat washer having a diameter not less than that of the termination and a nut with approved means of locking shall be fitted to each terminal.

5.2.2 The auxiliary contacts and control coil(s) shall be electrically connected by means of a connector or screw terminals. Screw terminals shall each have a flat washer and locking washer.

5.2.3 Suitable barriers shall be disposed between all studs and terminals and shall be of sufficient height to prevent short circuiting of any two connections by a flat conductor. Terminal covers shall be provided.

5.2.4 For category A contactors, the enclosure shall contain dry air or inert gas having a dew point lower than -65°C , and the leakage rate from this enclosure shall not exceed 1×10^{-5} ml/h for each litre volume of the enclosure.

5.2.5 The category A contactor shall be designed in such a way that defective hermetic sealing will not result in catastrophic failure.

5.2.6 The contactors shall be so constructed that all contacts are suitable for performing at least 50 000 cycles of operation at maximum rated current and voltage. Where specified, new and unused auxiliary contacts shall be suitable for performing at least 50 000 cycles of operation at 5 mA 100 mV in a resistive load circuit.

5.2.7 All non-metallic parts shall be manufactured from material of low flammability as specified in 3G 100-2-1.

5.2.8 The casing shall not be connected electrically to the coil, nor to the contacts, and shall be capable of being earthed, if this is required, by the mounting.

¹⁾ Marking BS 2G 132 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

5.3 Environmental requirements. Contactors shall be designed to operate in all naturally encountered combinations of conditions listed in Table 1.

6 Tests

6.1 Nature and order of tests. Tests shall be carried out to prove compliance with the relevant requirements of this standard. It is not intended, nor recommended, that all these tests be made on every contactor supplied. The tests are therefore resolved into four groups as follows.

- a) *Type approval tests* (clause 7). This group of tests shall be made on a certain quantity of contactors to demonstrate that they comply with all the requirements of this British Standard.
- b) *Production acceptance tests* (clause 8). This group of tests shall be performed on every contactor.
- c) *Quality assurance tests* (clause 9). This group of tests shall be carried out on samples of contactors from time to time to demonstrate that the standard of manufacture is being maintained during production. A sample is defined as an individual contactor, for test, selected at random according to an agreed plan, and which is identified throughout testing by an arbitrary number allocated as required by this standard.
- d) *Serviceability tests* (clause 10). This group of tests is the minimum recommended to verify the serviceability of contactors after storage or at any other time.

6.2 Standard test conditions

6.2.1 Unless otherwise stated, all tests shall be conducted under conditions of ambient temperature, atmospheric pressure and relative humidity as follows.

Ambient temperature:	15 °C to 35 °C
Atmospheric pressure:	86 kPa to 106 kPa
Relative humidity:	45 % to 75 %

6.2.2 All test results shall be recorded.

6.2.3 If suitable apparatus is not available at the contractor's works for any of these tests, the tests may be carried out by an approved testing establishment.

6.3 Particular test requirements

6.3.1 Electrical tests shall be performed with contactors connected by copper cored cables of nominal rating appropriate to the contactor. Unless otherwise stated, each cable shall be 1 ± 0.05 m in length and shall be attached to the contactor using a termination of an approved design, crimped to the cable in accordance with the requirements of 3G 178.

The cable used shall be declared.

6.3.2 Except where otherwise stated all tests shall be conducted with the contactor mounted on a rigid aluminium alloy plate, nominally 1.5 mm thick, by means of its normal fixing arrangements and method. All external metallic parts not associated with the electrical circuits shall be connected electrically to the plate. The plate shall be connected to the d.c. negative, and/or a.c. neutral of the supply, as appropriate, via a 2 A fuse complying with the requirements of G 176-2 or G 176-3. If the fuse(s) is ruptured by a condition of the contactor the contactor shall be deemed not to comply with the requirements of this standard.

6.3.3 A cycle of operation shall consist of energizing and de-energizing each coil of the contactor in turn. The times spent with the main contacts of the contactor in the open and closed position shall be approximately the same.

6.3.4 All tests specified at a.c. voltages shall be related to 200 V (line to line) three-phase for three-pole contactors and to 115 V (line to neutral) for single-pole contactors.

All tests specified at d.c. voltages shall be related to 28 V for three-pole and single-pole contactors.

6.3.5 During any checks to ensure correct operation, main contacts shall be monitored by indicating lamps rated at 2.5 W to 3.5 W at 28 V. Auxiliary contacts shall be monitored by a device which requires the auxiliary contacts to switch a resistive current not exceeding 5 mA from a supply source not exceeding 100 mV.

6.3.6 During production tests and serviceability tests which require rated current to be passed through auxiliary contacts, e.g. contact voltage drop tests, the test current shall be controlled by a separately operated switch which shall be closed after the contacts under test have closed, and shall be opened before the contacts under test have been opened.