

British Standard: Aerospace Series

Specification for

Hand operated, thermally compensated,
miniature, single and triple pole circuit breakers

Spécification pour les coupe — circuits manuels, à compensation thermique, miniaturisés, monopolaires et tripolaires

Spezifikation für ein- und dreipolige Miniatur — Schutzschalter für Handbetätigung, temperaturkompensiert

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Foreword

This British Standard has been prepared at the request of the Aerospace Industry Standards Committee of BSI and of the Ministry of Defence (Procurement Executive).

This standard makes reference to the following British Standards:

BS 410 Test sieves

BS 2011 Methods for the environmental testing of electronic components and electronic equipment
Part 2Ea Shock

BS 4463 Crinkle washers for general engineering purposes (metric sizes)

BS 4752 Circuit-breakers of rated voltage up to and including 1000 volts a.c. and 1200 volts d.c.

3G 100 General requirements for equipment for use in aircraft

Part 0 Introduction

Part 1 Identification, declaration and construction

Part 2 All equipment

Section 1 Construction

Section 2 Magnetic influence

Section 3 Environmental conditions

Subsection 3.1 Vibration (1969*)

Subsection 3.2 Temperature-pressure requirements

Subsection 3.3 Mould growth

Subsection 3.5 Explosion-proofness

Subsection 3.6 Acceleration requirements

Subsection 3.7 Tropical exposure

Subsection 3.8 Salt mist

Subsection 3.12 Fluid contamination

Part 3 Characteristics of aircraft electrical systems

Part 4 Electrical equipment

Section 1 Construction and general

Subsection 1.1 Insulation tests

G 176 Cartridge fuses for aircraft

G 178 Crimped joints for aircraft electrical cables and wires

G 204 Copper terminal ends for crimping to electric cables with copper conductors

G 210 PTFE insulated equipment wires (with silver plated copper conductors)

The latest editions of these standards shall be used.

NOTE 1. The latest revision of an Aerospace Series standard is indicated by a prefix number.

NOTE 2. The figures in metric units are to be regarded as the standard. The conversions to imperial units are approximate. Accurate conversions should be based on the tables in BS 350 'Conversion factors and tables'.

* The requirements of the 1969 publication are specified in this standard. (Subsection 3.1 is being revised.)

Specification

Section one. General

1. Scope

This British Standard specifies requirements for hand-operated miniature single and triple pole, trip free circuit breakers having a thermally compensated, inverse time/current overload characteristic. They are for use in nominal 28 V d.c. and/or 115 V single phase, or 115/200 V three phase 400 Hz a.c. systems having the characteristics specified in 3G 100 in the range 0.5 A to 35 A. It is not envisaged that single pole circuit breakers will be used in 200 V line-to-line circuits and tests outside the scope of this standard will be necessary for such applications. The standard specifies two case sizes, both with a constant dimension from the mounting panel to the termination screws.

2. Definitions

For the purposes of this British Standard the relevant definitions of BS 4752, together with the following, apply.

2.1 push-pull circuit breaker. A circuit breaker with a single button to trip and reset the breaker, by pushing the button to close and pulling the button to open.

2.2 trip free circuit breaker. A circuit breaker so designed that the circuit cannot be maintained closed and cannot be held against a fault current when any pole is carrying overload currents that would automatically trip the breaker to the open position. Subsequent closure of the contacts cannot occur until the button has been returned to the open position and then reset.

2.3 ultimate trip current. The smallest value of current that will cause tripping of the circuit breaker under a given set of ambient conditions.

2.4 ultimate trip limits. The specified limits for ultimate trip current; these are maximum ultimate trip current and minimum ultimate trip current. At the maximum specified ultimate trip current the breaker will open within the specified time, and at the minimum specified ultimate trip current the breaker will not open.

2.5 normal rated current (NRC). The maximum current that the circuit breaker will carry continuously under all environmental conditions.

2.6 quality assurance. The description of those tests performed to verify that the standard, proven by type testing, has been maintained over an extended period until requalification is required.

2.7 sample. An individual circuit breaker, for test, selected according to an agreed plan, and which is identified throughout testing by an arbitrary number allocated as required by this standard.

3. Description and design requirements

3.1 The circuit breakers shall comply with the requirements of this British Standard and those of 3G 100 where mentioned. They shall be suitable for use in any ambient temperature from -54°C to $+120^{\circ}\text{C}$, and at any altitude up to 21 300 m (70 000 ft).

Two case sizes are specified, ratings from 3 A to 20 A inclusive shall be in the smaller case (size A). Other ratings may be in the larger case (size B).

3.2 All circuit breakers shall be of the trip free type.

3.3 The circuit breaker shall be tripped by operation of a thermal overload device if an overload current should flow in all, or any, of the poles. Compensation shall be provided to reduce variation in tripping time with change in ambient temperature. The contacts shall remain open after tripping on overload, and the operating button shall return automatically to the fully open position.

3.4 Manual operation of the circuit breaker shall be by means of a single push-pull button, by pushing the button to close the contacts and pulling the button to open. The portion of the button visible when the breaker is closed shall be black. A white band on the button shall be exposed when the breaker is open. The current rating shall be marked in white in the centre of the end of the button.

3.5 It shall not be possible for the button to remain in any intermediate position between the fully open and fully closed positions.

3.6 The circuit breaker mechanism shall be so constructed that it provides a positive snap action make of the contact independent of the speed of closure of the operating button.

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3.7 Three pole circuit breakers shall be so constructed that the three sets of contacts open and close together when operated manually and shall open on overload current in one or more lines. The difference in time between the making or breaking of the three sets of contacts shall not exceed 5.0 ms.

3.8 Circuit breakers shall be suitable for panel mounting, from the rear, by means of a single threaded bush having a M12 × 1.0 thread, and shall be located in the panel by a dowel as shown on figure 1. One hexagon nut and one lock washer shall be provided.

3.9 The circuit breakers, terminations shall be of the type shown in figures 2 and 3 with screw threads of M4 × 0.7. The terminations may be either in line or offset, and the form chosen shall be declared. Each terminal shall be capable of accommodating up to two crimped cable lugs complying with the requirements of G 204. Terminal screws shall be provided together with a suitable locking device. The terminals shall be identified as detailed on figures 2 and 3.

NOTE. It is not intended that the circuit breakers be mounted directly on to rigid busbars.

3.10 Circuit breakers shall not constitute an electrical hazard when close mounted, with side faces touching, and connected as detailed in 3.9. Insulation barriers shall be provided between the poles of three pole circuit breakers.

3.11 All exposed metal parts, with the exception of the terminals, shall be insulated from all current carrying parts.

3.12 The circuit breaker shall be so constructed that the calibration cannot be interfered with without dismantling the device or breaking a seal.

3.13 Circuit breakers shall be suitable for operation in any attitude, in any part of any aircraft except the power unit.

3.14 The overall dimensions of the circuit breaker shall be within the limits specified on figures 2 and 3, as applicable.

4. Rating

4.1 **Voltage.** The following shall apply.

- (a) Single pole circuit breakers shall be suitable for operation in a nominal 28 V d.c., and 115 V, single phase, 400 Hz a.c. supply (line to neutral circuit in a 200 V, three phase, 400 Hz a.c. system).
- (b) Triple pole circuit breakers shall operate in a nominal 200 V, three phase, 400 Hz a.c. supply.
- (c) The system characteristics shall be as specified in 3G 100:Part 3.

4.2 **Current.** The normal rated current of the individual types of circuit breaker shall be 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 7.5, 10.0, 15.0, 20.0, 25.0, 30.0, and 35.0 A.

5. Declarations

5.1 In addition to the declarations required by 3G 100:Part 1, the manufacturer shall declare the following.

- (a) The envelope of the time/current characteristics for each rating of circuit breaker, at each temperature listed in table 1, and at currents ranging from the minimum ultimate trip current up to the breaking capacity rating as specified in clause 7.4.
- (b) The envelope of trip times versus ambient temperature over the range 15 °C to 35 °C for an overload of 200 % NRC as specified in 12.2.5(a).
- (c) The maximum and minimum forces necessary to operate the circuit breakers manually.
- (d) The system of batching circuit breakers used for quality assurance test sampling.

6. Marking

6.1 The marking on the circuit breaker shall comply with that shown on the manufacturing drawing, but the following minimum marking shall be marked clearly and indelibly on each circuit breaker.

- (a) The number of this British Standard, G 216.
- (b) Manufacturer's name or identification.
- (c) Manufacturer's type number.
- (d) Current ratings. The normal rated current shall be engraved (recessed) in the centre of the top face of the operating button and coloured white.
- (e) Terminal identification.

NOTE. The marking G 216 shall be applied only to those types of circuit breaker for which a manufacturer holds a certificate of type approval effective at the time of delivery of the items. Reference to this aspect is also made in 9.1.

Section two. Particular requirements

7. Performance characteristics

The circuit breaker shall be designed to operate satisfactorily when subjected to the following test parameters, and there shall be no breakage, malfunction, or evidence of any damage which would impair the ability of the circuit breaker to comply with subsequent test requirements.

7.1 Normal rated current. The normal current rating of the circuit breakers shall be as specified in 4.2.

7.2 Voltage rating. The circuit breakers shall be suitable for voltage ratings as follows.

Alternating current, single phase	115 V nominal
400 Hz, line to neutral	125 V maximum
Alternating current, three phase	115 V nominal
400 Hz, line to neutral	125 V maximum
Direct current	28 V nominal
	30.5 V maximum

7.3 Trip time/current characteristics

7.3.1 Circuit breakers shall be provided with compensation against variations in overload tripping times due to variations in ambient temperature, over the range -54°C to $+120^{\circ}\text{C}$.

7.3.2 The circuit breakers shall have time/current characteristics within the limits shown in table 1.

Table 1. Trip time/current characteristics

Normal rated current	Ambient temperature	Rated current	Tripping time
amperes 0.5 to 35	$^{\circ}\text{C}$ 25 ± 2	% 200 400 600 1000	s 6.5 to 20 0.75 to 3.0 0.35 to 1.0 0.13 to 0.38
0.5 to 35	120 ± 2	200 400 600 1000	3.0 to 10.0 0.5 to 1.8 0.2 to 0.8 0.07 to 0.3
0.5 to 35	-54 ± 2	200 400 600 1000	10.0 to 30.0 1.5 to 6.0 4.5 to 1.8 0.2 to 0.65

7.4 Making and breaking capacity. Circuit breakers shall be capable of making and breaking prospective currents up to the maximum values as follows.

<i>Single pole</i>	28 V d.c.	6000 A	
	115 V a.c.	3000 A (r.m.s.)	400 Hz
<i>Triple pole</i>	200 V a.c.	3000 A (r.m.s.)	400 Hz

7.5 Endurance. Circuit breakers shall be capable of performing a minimum of 10 000 operations making and breaking normal rated current and voltage under the mechanical and environmental conditions specified, when tested in accordance with 9.19.

7.6 Vibration. Circuit breakers shall comply with the vibration requirements of 3G 100:Part 2:Section 3 :Subsection 3.1 (1969*) category 4, region A.

7.7 Acceleration. The circuit breakers shall comply with the acceleration requirements of 3G 100:Part 2: Section 3: Subsection 3.6.

Normal conditions	class 1A (i)	grade C
Crash conditions	class 11	grade E

* The requirements of the 1969 publication are specified in this standard. (Subsection 3.1 is being revised.)

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7.8 Climatic tests

7.8.1 Temperature/pressure/humidity. The circuit breakers shall comply with the requirements of 3G 100:Part 2:Section 3:Subsection 3.2, grade V — .1.

7.8.2 Tropical exposure. The circuit breakers shall comply with the requirements of 3G 100:Part 2:Section 3:Subsection 3.7.

7.8.3 Mould growth. The circuit breakers shall comply with the requirements of 3G 100:Part 2:Section 3:Subsection 3.3.

7.9 Driving sand. The circuit breakers shall comply with the driving sand test requirements described in appendix A.

7.10 Salt corrosion. The circuit breakers shall comply with the salt mist test requirements described in 3G 100:Part 2:Section 3:Subsection 3.8.

7.11 Fluid contamination. The circuit breakers shall comply with the contamination test requirements described in appendix B.

7.12 Resistance to fire (flammability). Circuit breakers may be exposed to fire and shall not constitute a fire hazard. They should whenever possible, as required by 3G 100:Part 2:Section 1, be manufactured from material of low flammability. When that is not practicable, flammable materials shall be so protected that the risk of promotion of fire is not occasioned by their use.

7.13 Altitude. The circuit breakers shall be suitable for operation at all altitudes up to 21 300 m (70 000 ft).

7.14 Ambient temperature range. The circuit breakers shall be suitable for operating in any ambient temperature between -54°C and $+120^{\circ}\text{C}$.

7.15 Mounting. The circuit breakers shall be suitable for mounting in any attitude, and in any part of any aircraft except the power unit.

7.16 Compass safe distance. The compass safe distance when carrying 100 % NRC shall be measured and declared in accordance with 3G 100:Part 2:Section 2.

7.17 Explosion proofness. The circuit breakers shall be tested in accordance with the requirements applicable to explosion proof equipment specified in 3G 100:Part 2:Section 3:Subsection 3.5, category C enclosure.

7.18 Operating forces. The force required to operate the circuit breakers manually shall be in accordance with 9.15.

7.19 Mass

The mass of single pole breakers shall not exceed	28 g	} case size A
The mass of three pole breakers shall not exceed	75 g	
The mass of single pole breakers shall not exceed	37 g	} case size B
The mass of three pole breakers shall not exceed	105 g	

Section three. Tests

8. General

8.1 Nature of tests. This standard states the requirements for four different categories of tests, as listed. The general conditions relating to each category are stated in the relevant subclauses.

- (a) Type approval tests, including tests for experimental flight approval (see 9.1 to 9.31).
- (b) Production acceptance tests (see 10.1 to 10.3).
- (c) Quality assurance tests (see 11.1 to 11.4).
- (d) Tests for the purpose of verifying the serviceability of the circuit breakers following storage or use (see clause 12).

8.2 Standard test conditions

8.2.1 Unless otherwise specified all tests shall be conducted under the 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 (860 mbar* to 1060 mbar)
Relative humidity	45 % to 75 %

8.2.2 Ambient temperature measurements shall be made with the temperature sensing device so positioned as to be unaffected by the temperature rise of the circuit breaker under test.

* 1 mbar = 0.1 kPa = 10^2 N/m².

8.2.3 During all tests which involve measurement of the circuit breaker current tripping time characteristics a time interval sufficient to allow the circuit breaker to return to the test ambient temperature shall elapse, before further measurements of performance characteristics are made.

8.3 General conditions of tests

8.3.1 All tests, except where otherwise stated, shall be conducted with the circuit breaker mounted on a rigid aluminium alloy plate, nominally 1.5 mm thick and approximately 150 mm square, by means of its normal fixing arrangements and hardware. The plate shall be connected to the d.c. negative or a.c. neutral, as appropriate, via a 100 mA fuse conforming to G 176. Rupturing of this fuse shall constitute a failure.

8.3.2 Three phase circuit breakers shall be monitored continuously throughout all tests to ascertain whether interphase arcing occurs. The circuit breaker shall be considered to have failed the test should such arcing occur.

8.3.3 During functional testing indicating lamps rated at 2.5 W to 3.5 W and a.c. or d.c. voltage appropriate to the circuit breaker shall be connected to the circuit breaker terminals as a means of monitoring the operation.

8.3.4 Unless otherwise specified for a particular test each terminal of the circuit breaker shall be connected into the test circuit with a cable conforming to G 210, type C and of the appropriate size stated in table 2. Each cable shall be 1 ± 0.05 m (36 ± 2 in) long and shall be attached to the circuit breaker by means of a terminal end conforming to G 204. The terminal end shall be crimped to the cable in accordance with the requirements of G 178.

8.3.5 All coils used for d.c. inductive load purposes shall be air cored.

9. Type approval tests

9.1 General nature of tests. Type approval tests comprise all those which have to be made to determine whether the circuit breaker complies fully with the specified requirements. Type approval shall be obtained by a manufacturer before he may offer circuit breakers purporting to comply with the requirements of this standard.

9.2 Order of tests. The specific tests which shall be performed for the type approval of the range of circuit breakers, the order in which they shall be conducted, and the number of samples to be tested are shown in table 3. A modified incidence of testing will be stipulated by the approving authority* should a manufacturer wish to seek type approval for fewer types of breaker than are embraced by the full range dealt with in this document.

9.3 Supervision by approving authority. All type approval tests shall be conducted under the supervision of the approving authority.

9.4 Preliminary requirements. Each circuit breaker submitted for type approval shall have complied satisfactorily with the production acceptance tests and shall have been inspected to verify its conformity with the design requirements of this standard, and with the manufacturer's drawings.

9.5 Sampling. Samples submitted for type approval shall be fully representative of the manufacturer's normal production and shall be selected at random from normal production batches by the approving authority.

9.6 Sample identification. The sample circuit breakers of each type selected for type approval test shall be numbered S1, S2, S3, etc., for the purposes of identification and allocation to individual tests. The actual serial numbers and/or batch numbers and the identification symbols assigned to individual circuit breakers shall be recorded.

9.7 Test records. All test results shall be recorded and shall be included in the type approval test report. A list of all test equipment and details of all test circuits, as appropriate, shall be prepared and shall be included in the type approval test report.

9.8 Action in event of failure. Should a circuit breaker fail to comply with any individual type approval test requirement two further circuit breakers shall be selected and shall be subjected to the same sequence of tests up to the conclusion of the test in which the first sample failed. One of the additional breakers shall then be subjected to the remaining tests of the schedule. Should either of the additional samples fail, the circuit breakers shall be deemed not to have complied with the requirements of the type approval test and the approving authority shall be notified. The latter will then direct what investigations shall be conducted and what subsequent action shall be taken. No investigation shall be made into the cause of failure of a circuit breaker during type approval testing without the prior agreement of the approving authority. In particular, any repair or rectification of a failed circuit breaker shall not be carried out without such agreement.

* The approving authorities for circuit breakers in British civil and military aircraft are respectively, the Airworthiness Division of the Civil Aviation Authority, and the Ministry of Defence (Procurement Executive), (through a design authority approved by them)

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9.9 Certificate of approval. Upon the successful conclusion of type approval tests a certificate of approval will be issued.

9.10 Experimental flight approval. For the purpose of obtaining Experimental Flight Approval (EFA) only those tests marked EFA and shown in table 3 need be performed.

Table 2. Cable sizes for test connections to circuit breakers

Circuit breaker normal rated current	Cable sizes	
	Cable size strands/diameter (in mm)	G 210, type C wire size
amperes 0.5 to 2.0	7/0.2	24
3.0 to 5.0	19/0.15	22
7.5	19/0.2	20
10.0	19/0.25	18
15.0	19/0.3	16
20.0	19/0.335	14
25.0 and 30	19/0.45	12
35	37/0.40	10

Table 3. Type approval and EFA tests

Subclause number	Test	a.c. and d.c. 0.5 A	a.c. and d.c. 1.0 A	a.c. and d.c. 2.0 A	a.c. and d.c. 3.0 A	a.c. and d.c. 4.0 A	a.c. and d.c. 5.0 A	a.c. and d.c. 7.5 A	a.c. and d.c. 10.0 A	a.c. and d.c. 15.0 A	a.c. and d.c. 20.0 A	a.c. and d.c. 25.0 A	a.c. and d.c. 30.0 A	a.c. and d.c. 35.0 A	EFA Tests
7.19	Mass	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	SI S2 S3	*
9.11	Terminal voltage drop	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.13	Dielectric strength	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.12	Insulation resistance	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.15	Operating forces	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.16	Contact action	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.14	Strength of actuator and threaded parts														
9.14.1	Strength of actuator	*			*						*			*	*
9.14.2	Strength of terminations	*			*						*			*	*
9.14.3	Strength of mounting means	*			*						*			*	*
9.17	Calibration tests														
9.17.2	Calibration of overload trip	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.17.3	Minimum limit of ultimate trip and temperature rise	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.17.4	Maximum limit of ultimate trip	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.17.5	Trip free calibration	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.17.6	Self reclosure at low temperature	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.20	Overload reclosure	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.21	Thermal shock	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.24	Acceleration	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.22	Vibration	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.23	Shock (impact)	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.19	Electrical endurance														
9.19.2	d.c. single pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.19.3	a.c. single pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.19.4	a.c. triple pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.18	Rupturing capacity														
9.18.2	d.c. single pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.18.3	a.c. single pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.18.4	a.c. triple pole	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.29	Compass safe distance	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.30	Explosion proofness	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.25	Climatic tests														
9.25.1	Combined, humidity, temperature and pressure	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.25.3	Tropical exposure	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.25.4	Mould growth	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.26	Driving sand	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.27	Salt corrosion	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9.28	Fluid contamination														
	Fluid No. 1	*													
	Fluid No. 2	*													
	Fluid No. 4	*													
	Fluid No. 5	*													
	Fluid No. 7	*													
	Fluid No. 9	*													
9.31	Fluid No. 10	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Strip examination and report	*	*	*	*	*	*	*	*	*	*	*	*	*	*

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9.11 Terminal voltage drop. The circuit breaker shall be closed and with normal rated direct current flowing through the terminals, the voltage drop across each pair of terminals shall be measured.

9.11.1 Standard of acceptance. The voltage drop shall not exceed the values given in table 4.

Table 4. Limiting values of millivolt drop

Normal rated current	Voltage drop (maximum)
amperes	V
0.5	1.5
1.0	1.1
2.0	0.7
3.0	0.4
4.0	0.37
5.0	0.35
7.5	0.30
10.0	0.28
15.0 to 35	0.25

9.12 Insulation resistance. The circuit breaker shall be subjected to the insulation resistance test specified in 3G 100:Part 4:Section 1:Subsection 1.1, the test voltage being applied across the following points.

- (a) Between each terminal and all others with the circuit breaker open.
- (b) Between each terminal and all exposed metal parts with the circuit breaker open and closed.
- (c) Between terminals of adjacent poles, for three pole circuit breakers, with the circuit breaker in both the open and closed positions.

9.12.1 Standard of acceptance. The insulation resistance shall be not less than 100 MΩ.

9.13 Dielectric strength. The circuit breakers shall be subjected to the high voltage test specified in 3G 100:Part 4:Section 1:Subsection 1.1 across the points enumerated in 9.12.

9.13.1 Standard of acceptance. There shall be no insulation breakdown.

9.14 Strength of actuator and threaded parts. In each of the tests outlined in 9.14.1 to 9.14.3 the specified force or torque shall be applied gradually.

9.14.1 Strength of actuator

9.14.1.1 A force of 110 N (25 lbf) shall be applied for 1 min in each direction successively along the line of push button travel. With the push button in the fully extended position and closed position, a force of 110 N (25 lbf) shall be applied at the extremity for 1 min in two mutually perpendicular directions successively, each normal to the line of push button travel.

9.14.1.2 Contacts shall not open or close inadvertently during these tests.

9.14.2 Strength of terminations. With the circuit breaker first in the normally open and then in the normally closed condition the tests given in 9.14.2.1 and 9.14.2.2 shall be carried out.

9.14.2.1 Each termination shall be subjected to a force of 45 N (10 lbf) which shall be applied for not less than 1 min in each of the following directions, successively:

- (a) vertically upward
 - (b) vertically downward
 - (c) outward from the rear of the breaker in a plane perpendicular to that of the mounting surface.
- } in a plane parallel to that of the circuit breaker mounting surface;

9.14.2.2 Each terminal screw shall be tightened and slackened 10 times to a minimum tightening torque of 1.7 N m (15 lbf in).

9.14.2.3 The contacts shall not open or close inadvertently during any of these tests.