

British Standard Aerospace Series : Specification for

Electric cables for general airframe or equipment interconnect use (260 °C), wrapped insulation with nickel plated conductors

Série aérospatiale. Câbles électriques à isolation enroulée (260 °C) à âmes recouvertes d'une couche de nickel, pour usage général et pour éléments de raccordement — Spécifications

Luft— und Raumfahrt-Reihe. Umwickelte elektrische Kabel mit vernickelten Leitern für Schaltungen in der Zelle oder zwischen Geräten (bis 260 °C)

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Foreword

This British Standard, having been prepared under the direction of the Aerospace Standards Committee, specifies requirements for a range of lightweight thin-wall insulation cables that are individually suitable for general airframe or equipment interconnect use.

The dielectric insulation material is spirally lapped with an overall coating to provide the necessary colour coding and to provide a base for printed identification legends. The standard requires the application of the dielectric material so as to provide the minimum penalties of weight and space whilst offering reliable performance over a full airframe life of not less than 50 000 h.

Cables manufactured to this standard are not required to meet the fire resistance requirements of British Standard 3G 100 : Subsection 3.13 but they are required to satisfy the flammability requirements of British Standard G 230.

Attention is drawn to British Standard G 230 which specifies the general requirements for aircraft electric cables (second series).

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies construction and performance requirements for a range of lightweight cables with wrapped insulation and nickel plated conductors suitable for general airframe use in the size range 24 to 0000, and for equipment interconnect in the size range 24 to 18.

The following types of cable are specified:

Type 01 interconnect	{	Single-core or twisted
Type 02 airframe		multi-cores only
Type 03 interconnect	{	Two or more cores,
Type 04 airframe		with an outer jacket
Type 05 interconnect	{	Single- or multi-core, with a
Type 06 airframe		screen and outer jacket

The cables are suitable for continuous use where the maximum stabilized conductor temperature does not exceed 260 °C. They are suitable for applications involving flexing at temperatures down to -65 °C.

The cables are suitable for use where the potential between conductors or between a conductor and screen, or the aircraft structure does not exceed 600 V r.m.s. and the frequency does not exceed 2000 Hz.

Interconnect cables are suitable for use in areas with some physical protection, such as behind panels or bulkheads. They also have an application for the internal wiring of equipment.

Airframe cables are of sufficiently robust construction to be used for open aircraft wiring.

The short-term and long-term current ratings for the cables are specified in this standard.

NOTE. The titles of the publications referred to in this standard are listed on the inside back page.

2 Classification

Cables are classified according to the number of cores as follows:

- class 1: single core
- class 2: two core
- class 3: three core
- class 4: four core

3 Construction

3.1 General

The materials and method of construction used for the formation of the cables shall be defined and controlled to the satisfaction of the Approving Authority*. No change shall be made to such materials or processes unless it can be shown to the satisfaction of the Approving Authority that the performance and handling properties of the cable have not been degraded. The cable shall be made of materials such that the performance requirements of this standard are satisfied.

3.2 Conductors

3.2.1 Conductors shall comply with British Standard G 231 before fabricating into completed cables.

3.2.2 Copper strands and copper alloy strands shall be nickel plated.

3.3 Insulation

The insulation for interconnect cables shall consist of one or more overlapped tapes of suitable insulating material, and for airframe cables, two or more overlapped tapes. An overall coating may also be provided which, for the purposes of this standard, shall be regarded as part of the cable. The insulating material shall be such that the performance requirements of this standard are satisfied. Only 100 % new materials that have been through only those processes essential to their manufacture and application shall be used.

3.4 Screen

The screen shall be constructed of a braid having a coverage of 85 % minimum, and a lay factor less than 3 when calculated in accordance with appendix A of British

* The Approving Authority is either:

- (a) for UK Civil Aviation products, the Civil Aviation Authority (or their accredited representatives); or
- (b) for UK military products, information is available from the Procurement Executive, Ministry of Defence, Directorate of Defence Quality Assurance, Directorate of Standardization, Kentigern House, 65 Brown Street, Glasgow G2 8EX.

Standard G 230. There shall be no joints in the complete screen. Where breaks in individual strands occur, the ends shall be brazed or tucked into the weave ensuring that the cut end is on the outside of the screen. There shall be not more than one such break in any 300 mm length of cable or in any 10 m length of individual strand. Strands from which the braid is constructed shall be nickel plated copper wire and comply with British Standard G 231 before braiding.

3.5 Jacket

The jacket shall be made of insulating material, and shall be constructed, such that the performance requirements of this standard are satisfied.

3.6 Single-core cables

The mass and dimensions of single-core cables shall be as given in tables 1 and 2 as appropriate.

3.7 Multicore cables

The mass and dimensions of multi-core cables shall be as given in tables 3 to 8 as appropriate. The cables shall consist of two or more single cores complying with 3.6, twisted together with a lay of approximately 12 times the pitch circle diameter for sizes 24 to 4 and approximately 16 times the pitch circle diameter for sizes 2 to 0000. Types 01 and 02 shall consist of twisted assemblies of single-core cable, types 03 and 04 of twisted assemblies with an outer jacket, and types 05 and 06 of twisted assemblies with a screen and outer jacket.

3.8 Colour

The colour of the insulation for class 1 cables, the core insulation for multi-core cables and the jackets shall comply with British Standard G 230.

4 Designation and marking

4.1 Manufacturer's marking and designation

The designation and marking of the cables shall be in accordance with British Standard G 230.

4.2 User applied marking

4.2.1 The surface of the insulation or coating of type 02 (airframe) cable shall be suitable for the acceptance of user applied identification marks by at least one of the following methods:

- (a) hot stamp marking;
- (b) laser marking;
- (c) ink jet.

The cable manufacturer shall declare which method is suitable and the tests given in clause 6 shall be performed using cables that have been so marked.

4.2.2 Appropriate methods of marking the outer jacket of cable types 03, 04, 05 and 06 shall be declared by the manufacturer who may specifically prohibit the use of hot stamp or laser marking.

4.2.3 Type 01 (interconnect) cable shall not be required to accept hot stamp or laser markings or any other method that may degrade the insulation material.

5 Packaging and labelling

The cables shall be packaged and labelled in accordance with British Standard G 230.

6 Tests

The following tests shall be carried out in accordance with British Standard G 230. Specific requirements of this standard are given against the appropriate test. The application of each test for qualification approval, production quality testing, inspection lot testing and production routine testing shall be as given in table 9. All qualification approval test specimens shall be marked in accordance with clause 4 before commencement of testing.

NOTE. For qualification approval testing, specimens selected from a particular size within the following groups may be considered as proving the requirements for all sizes within that group of a given type (see clause 1). Qualification of type 05 cable may be considered as proving the requirements of type 03, classes 2 to 4, and type 06 as proving type 04, classes 2 to 4.

- Group 1. Size 24, type 02, classes 1 to 4
- Group 2. Sizes 22 to 16, type 02, classes 1 to 4
- Group 3. Sizes 14 to 10, type 02, class 1
- Group 4. Sizes 8 to 2, type 02, class 1
- Group 5. Sizes 1 to 0000, type 02, class 1
- Group 6. Size 24, type 01, classes 1 to 4
- Group 7. Sizes 22 to 18, type 01, classes 1 to 4
- Group 8. Sizes 24 to 16, type 06, classes 1 to 4
- Group 9. Sizes 24 to 18, type 05, classes 1 to 4

British Standard G 230 test no.	Test applicable to cable types 01 and 02	Specific requirements of this standard																							
1.	Appearance and identification of finished cable	Maximum values shall be as given in tables 1 to 6 Minimum values shall be as given in tables 1 and 2 Minimum and maximum values shall be as given in tables 1 to 6 Values shall be as follows:																							
2.	Mass per unit length of finished cable																								
3.	Conductor composition																								
4.	Visual examination of strands																								
5.	Insulation thickness and concentricity																								
6.	Core and cable outer diameters																								
7.	Tensile strength and elongation at break of copper or copper alloy conductors																								
		<table><tr><th rowspan="2">Strand diameter</th><th colspan="2">Tensile strength</th><th>Elongation</th></tr><tr><th>Min.</th><th>Max.</th><th>Min.</th></tr><tr><td>mm</td><td></td><td></td><td></td></tr><tr><td>Copper alloy 0.08 to 0.12</td><td>N/mm² 350 (for 7 strands)</td><td>N/mm² —</td><td>% 6</td></tr><tr><td>Copper 0.08 to 0.12</td><td>220</td><td>300</td><td>9</td></tr><tr><td>0.15 to 0.45</td><td>220</td><td>300</td><td>10</td></tr></table>	Strand diameter	Tensile strength		Elongation	Min.	Max.	Min.	mm				Copper alloy 0.08 to 0.12	N/mm ² 350 (for 7 strands)	N/mm ² —	% 6	Copper 0.08 to 0.12	220	300	9	0.15 to 0.45	220	300	10
Strand diameter	Tensile strength			Elongation																					
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Copper 0.08 to 0.12	220	300	9																						
0.15 to 0.45	220	300	10																						
9.	Strand plating continuity	Maximum values shall be as given in tables 1 to 6 2500 ± 75 V r.m.s. 5000 ± 150 V r.m.s. 8000 ± 250 V peak Test temperature 285 ± 2 °C. Time 168 h. Mandrel diameter and force shall be as given in table 10. 50 000 h minimum at 260 ± 2 °C Minimum adherence forces shall be as given in table 10																							
10.	Strand plating adherence																								
11.	Strand plating thickness																								
12.	Electrical resistance of conductor																								
15.	Conductor strand adhesion																								
16.	High voltage																								
16(a).	Immersion																								
16(b).*	Dry spark																								
16(c).*	Dry impulse																								
17.	Insulation resistance																								
18.	Surface resistance																								
19.	Accelerated ageing	Five cycles from room temperature to 260 ± 2 °C holding the top temperature for 1 h and allowing the cable to return to room temperature between cycles. Maximum length of conductor exposed at each end is 3.0 mm for sizes 24 to 10, and one-half maximum outside diameter for sizes 8 to 0000 Mandrel diameter and tension shall be as given in table 10. Test temperature 260 ± 2 °C. Time 100 h																							
20.	Thermal endurance																								
21.	Adherence of insulation on conductor																								
22.	Delamination and shrinkage																								
23.	Delamination and insulation blocking																								

* Either test 16(b) or 16(c) may be carried out.

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British Standard G 230 test no.	Test applicable to cable types 01 and 02	Specific requirements of this standard
24. 25.	Room temperature bend Cold bend	Mandrel diameter and tension shall be as given in table 10 Mandrel diameter and tension shall be as given in table 10. Test temperature $-65 \pm 2^{\circ}\text{C}$. Time 6 h
26.	Dynamic cut-through	Test temperature $260 \pm 2^{\circ}\text{C}$, 6000 g/min $\pm 10\%$ at the sample. Minimum force to cut-through shall be as given in table 10.
27. 28. 28(a). 28(b). 29. 30.	Notch propagation resistance Flammability Method 1 Method 2 Resistance to fluids Scrape abrasion	Five specimens, 15 s exposure to flame Five specimens, 15 s exposure to flame Test temperature $260 \pm 2^{\circ}\text{C}$. Force and cycles shall be as given in table 10 $T_1 = 360 \pm 5^{\circ}\text{C}$ $T_2 = 510 \pm 10^{\circ}\text{C}$ Ageing temperature $T_2 = 310 \pm 5^{\circ}\text{C}$ Test temperature $T_1 = 260 \pm 5^{\circ}\text{C}$ Force shall be as given in table 10
31. 32.	Overload resistance Delamination	$T_1 = 360 \pm 5^{\circ}\text{C}$ $T_2 = 510 \pm 10^{\circ}\text{C}$ Ageing temperature $T_2 = 310 \pm 5^{\circ}\text{C}$ Test temperature $T_1 = 260 \pm 5^{\circ}\text{C}$ Force shall be as given in table 10
35.	Climatic	<i>Humidity.</i> Carry out the test in accordance with clause 2(c) of British Standard G 229*. Category A for type 01 and category B for type 02. Prepare the specimens by winding at least six turns on a mandrel of the diameter specified for test 23 in table 10. On removal from the chamber unwind the cable from the mandrel. It shall show no sign to normal vision of deterioration and the identification shall remain legible. The specimen shall then be subjected to the immersion test (test 16(a)) except that the specimen length may be reduced. <i>Fungus resistance.</i> Carry out the test in accordance with clause 2(j) of British Standard G 229†. Category F. There shall be no sign to normal vision of fungus growth.
36.	Identification durability	Test temperature $20 \pm 5^{\circ}\text{C}$. Minimum cycles 100. Applied force $2 \pm 0.1\text{ N}$
37.	Cable to cable abrasion	Test to be applied to type 02 class 1 size 20 only. Minimum cycles to failure: 0.5 kg $\pm 5\text{ g}$, 18×10^6 cycles 1.0 kg $\pm 10\text{ g}$, 6×10^6 cycles 2.5 kg $\pm 25\text{ g}$, 2.5×10^6 cycles
38. 38(a).	Pliability Method 1	To be carried out on sizes 24, 22, 20 and 18 only. Carefully straighten specimens by hand. Allow specimens to reach room temperature. Mandrel diameter is four times the maximum specified overall diameter of the cable. The maximum force and degrees of recoil shall be as given in table 10
39. 40. 42.	Colour fastness to light Current ratings Wet arc tracking	These shall be as given in table 11 The results shall be recorded and declared on the declaration of design and performance (DDP)

* British Standard G 229 refers to clause 6 of EUROCAE/ED-14A/RTCA/DO-160A for the humidity test.

† British Standard G 229 refers to clause 13 of EUROCAE/ED-14A/RTCA/DO-160A for the fungus resistance test.

British Standard G 230 test no.	Test applicable to cable types 05 and 06	Specific requirements of this standard
1.	Appearance and identification of finished cable	
2.	Mass per unit length of finished cable	Maximum values shall be as given in tables 7 and 8
5.	Jacket thickness and concentricity	Minimum values shall be as given in tables 7 and 8
6.	Cable outer diameter	Minimum and maximum values shall be as given in tables 7 and 8
12.	Electrical resistance of conductors	Maximum values shall be as given in tables 7 and 8
16.	High voltage	
16(b).	Dry spark	1000 ± 30 V r.m.s. on jacket
16(d).	Voltage test on completed cable	Core to core, plus core to screen. 2500 ± 75 V r.m.s.
19.	Accelerated ageing	To be carried out in class 1 only. Mandrel diameter for accelerated ageing, 10 times maximum specified cable diameter using force as given in table 10. Test temperature 285 ± 5 °C. Time 168 h. Mandrel diameter for subsequent room temperature bend test, 10 times maximum specified cable diameter using force as given in table 10 for test 24. On subsequent high voltage immersion test apply a voltage of 500 ± 50 V between screen and liquid
23.	Delamination and insulation blocking	Mandrel diameter is 10 times maximum specified in cable diameter using force as given in table 10. Test temperature 200 ± 2 °C
25.	Cold bend	Mandrel diameter is 10 times maximum specified cable diameter. Test temperature -65 ± 2 °C. Time 6 h. Applied force 25 ± 0.5 N. On subsequent high voltage immersion test apply a voltage of 500 ± 50 V between screen and liquid
26.	Dynamic cut-through	Test temperature 260 ± 2 °C, 6000 g/min ± 10 % at the sample. Minimum force to cut-through from jacket to screen shall be as given in table 10
28.	Flammability	
28(a).	Method 1	Five specimens, 15 s exposure to flame
28(b).	Method 2	Five specimens, 15 s exposure to flame
29.	Resistance to fluids	
30.	Scrape abrasion	Test temperature 260 ± 2 °C. Force and cycles to cut-through from jacket to screen shall be as given in table 10
35.	Climatic	<i>Humidity.</i> Carry out the test in accordance with clause 2(c) of British Standard G 229*. Category B. Prepare the specimens by winding at least six turns on a mandrel of diameter 10 times the maximum specified cable diameter. On removal from the chamber unwind the cable from the mandrel. It shall show no sign to normal vision of deterioration and the identification shall remain legible. The specimen shall then be subjected to the immersion test (test 16(a)) except that the specimen length may be reduced and a voltage of 500 ± 50 V is applied between screen and liquid. <i>Fungus resistance.</i> Carry out the test in accordance with clause 2(j) of British Standard G 229†. Category F. There shall be no sign to normal vision of fungus growth

* British Standard G 229 refers to clause 6 of EUROCAE/ED-14A/RTCA/DO-160A for the humidity test.

† British Standard G 229 refers to clause 13 of EUROCAE/ED-14A/RTCA/DO-160A for the fungus resistance test.