POLYIMIDE INSULATED WIRES AND CABLES,

LOW FREQUENCY, 600V, -200 TO +200 °C,

BASED ON TYPE SPL

ESCC Detail Specification No. 3901/019

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ESA/SCC Detail Specification No. 3901/019

space components
coordination group

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'A'	April '95	P1. Cover page P2. DCN P19. Para. 4.8.8 : Cut through loads corrected	None None 221196

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1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Polyimide Insulated Wires and Cables, Low Frequency, 600V, -200 to +200 °C, based on Type SPL.

It shall be read in conjunction with ESA/SCC Generic Specification No. 3901, the requirements of which are supplemented herein.

NOTES

1. These wires and cables shall not be used in the presence or vicinity of hydrazine or nitrogen tetroxide.
2. These wires and cables are light versions of SPC types according to ESA/SCC Detail Specification No. 3901/009; they are identical in production and test with the following exceptions:

- Conductor according to ISO 2635 (except AWG 28)
- Shield size # 40
- Shield type served wire shield (SWS)

  This leads to savings in diameter and weight according to Table 1(a).

1.2 TYPE VARIANTS

Variants of the basic types of wires and cables specified herein, which are also covered by this specification, are listed in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, applicable to the finished wires and cables specified herein, which shall not be exceeded at any time during use or storage in controlled space environment, are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The derating information applicable to the finished wires and cables specified herein is as follows:

- The maximum current for each wire used in a bundle shall be:-

$$I_{Bmax} = I_{max} \times \frac{29-n}{28} \quad (\text{for } 1 \leq n \leq 15)$$

$$I_{Bmax} = \frac{I_{max}}{2} \quad (\text{for } n > 15)$$

  where n = number of wires in the bundle;

- The temperature derating information is shown in Figure 1 with maximum current I_{max} for a single wire.
- The derating factors contained herein indicate maximum stress values and do not preclude further derating.

1.5 PHYSICAL CHARACTERISTICS

The physical characteristics of the wires and cables specified herein are shown in Figure 2 and Table 1(a).

1.6 FUNCTIONAL DIAGRAM

Not applicable.

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE ISO/ (AWG)	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS	
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	MAX WEIGHT (kg/km)
01		x	1	- /(30)	7x0.102	0.32	0.057	375			0.78	0.98
02		x	1	- /(28)	7x0.127	0.47	0.09	253			0.87	1.4
03		x	1	001/(26)	19x0.1 (1)	0.57	0.15	157			0.96	1.9
04		x	1	002/(24)	19x0.12 (1)	0.58	0.25	111			1.13	2.6
05		x	1	004/(22)	19x0.15 (1)	0.76	0.40	58			1.25	3.9
06		x	1	006/(20)	19x0.20 (1)	0.99	0.60	32			1.48	6.4
07		x	1	012/(16)	19x0.30 (1)	1.49	1.20	14			1.98	13
08		x	1	030/(12)	37x0.32 (1)	2.18	3.00	7.0			2.73	27
09		x	2	- /(30)	7x0.102	0.32	0.057	383		0.78	1.5	2.1
10		x	2	- /(28)	7x0.127	0.47	0.09	258		0.87	1.7	2.8
11		x	2	001 (26)	19x0.1 (1)	0.57	0.15	170		0.96	1.9	3.8
12		x	2	002 (24)	19x0.12 (1)	0.58	0.25	120		1.13	2.3	5.2
13		x	2	004 (22)	19x0.15 (1)	0.76	0.40	63		1.25	2.5	8.2
14		x	2	006 (20)	19x0.20 (1)	0.99	0.60	35		1.48	3.0	13.5
15		x	2	012/(16)	19x0.30 (1)	1.49	1.20	15		1.98	4.0	27.0
16		x	2	030/(12)	37x0.32 (1)	2.18	3.00	7.5		2.73	5.5	55.0
17		x	3	- /(30)	7x0.102	0.32	0.057	384		0.78	1.7	3.3
18		x	3	- /(28)	7x0.127	0.47	0.09	259		0.87	1.9	4.5
19		x	3	001/(26)	19x0.1 (1)	0.57	0.15	171		0.96	2.1	6.2
20		x	3	002/(24)	19x0.12 (1)	0.58	0.25	121		1.13	2.5	8.3
21		x	3	004/(22)	19x0.15 (1)	0.76	0.40	64		1.25	2.7	12.7
22		x	3	006/(20)	19x0.20 (1)	0.99	0.60	37		1.48	3.2	20.6
23		x	3	012/(16)	19x0.30 (1)	1.49	1.20	15		1.98	4.3	43.0
24		x	3	030/(12)	37x0.32 (1)	2.18	3.00	7.5		2.73	5.9	88.0

NOTES: See Page 9.

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE ISO/ (AWG)	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND ⊖ (mm)	CORE MAX ⊖ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS	
	YES	NO				MAX ⊖ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)			MAX ⊖ (mm)	MAX WEIGHT (kg/km)
25		x	4	- /(30)	7x0.102	0.32	0.057	385		0.78	1.9	4.4
26		x	4	- /(28)	7x0.127	0.47	0.09	260		0.87	2.1	6.0
27		x	4	001/(26)	19x0.1 (1)	0.57	0.15	171		0.96	2.3	8.2
28		x	4	002/(24)	19x0.12 (1)	0.58	0.25	122		1.13	2.7	11.0
29		x	4	004/(22)	19x0.15 (1)	0.76	0.40	64		1.25	3.0	16.9
30		x	4	006/(20)	19x0.20 (1)	0.99	0.60	37		1.48	3.6	27.3
31		x	4	012/(16)	19x0.30 (1)	1.49	1.20	16		1.98	4.8	57.0
32		x	4	030/(12)	37x0.32 (1)	2.18	3.00	7.9		2.73	6.5	118
33		x	5	- /(28)	7x0.127	0.47	0.09	260		0.87	2.4	7.8
34		x	5	001/(26)	19x0.1 (1)	0.57	0.15	172		0.96	2.6	10.7
35		x	5	002/(24)	19x0.12 (1)	0.58	0.25	123		1.13	3.1	14.3
36		x	5	004/(22)	19x0.15 (1)	0.76	0.40	64		1.25	3.4	21.8
37		x	5	006/(20)	19x0.20 (1)	0.99	0.60	37		1.48	4.0	35.0
38		x	6	- /(28)	7x0.127	0.47	0.09	261		0.87	2.6	9.6
39		x	6	001/(26)	19x0.1 (1)	0.57	0.15	172		0.96	2.9	13.1
40		x	6	002/(24)	19x0.12 (1)	0.58	0.25	124		1.13	3.4	17.6
41		x	6	004/(22)	19x0.15 (1)	0.76	0.40	65		1.25	3.7	26.6
42		x	6	006/(20)	19x0.20 (1)	0.99	0.60	38		1.48	4.4	48.2
43		x	7	- /(28)	7x0.127	0.47	0.09	261		0.87	2.6	10.5
44		x	7	001/(26)	19x0.1 (1)	0.57	0.15	172		0.96	2.9	14.4
45		x	7	002/(24)	19x0.12 (1)	0.58	0.25	124		1.13	3.4	19.3
46		x	7	004/(22)	19x0.15 (1)	0.76	0.40	65		1.25	3.7	29.6
47		x	7	006/(20)	19x0.20 (1)	0.99	0.60	38		1.48	4.4	47.8

NOTES: See Page 9.

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE ISO/ (AWG)	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND Θ (mm)	CORE MAX Θ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS	
	YES	NO				MAX Θ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)			MAX Θ (mm)	MAX WEIGHT (kg/km)
48	x		1	- /(30)	7x0.102	0.32	0.057	375	0.063	0.78	1.1	2.6
49	x		1	- /(28)	7x0.127	0.47	0.09	253	0.079	0.87	1.2	3.3
50	x		1	001/(26)	19x0.1 (1)	0.57	0.15	157	0.079	0.96	1.3	4.1
51	x		1	002/(24)	19x0.12 (1)	0.58	0.25	111	0.079	1.13	1.5	4.8
52	x		1	004/(22)	19x0.15 (1)	0.76	0.40	58	0.079	1.25	1.6	6.3
53	x		1	006/(20)	19x0.20 (1)	0.99	0.60	32	0.079	1.48	1.9	9.1
54	x		1	012/(16)	19x0.30 (1)	1.49	1.20	14	0.079	1.98	2.4	16.8
55	x		1	030/(12)	37x0.32 (1)	2.18	3.00	7.0	0.079	2.73	3.1	31.7
56	x		2	- /(30)	7x0.102	0.32	0.057	383	0.063	0.78	1.9	5.1
57	x		2	- /(28)	7x0.127	0.47	0.09	258	0.079	0.87	2.1	6.1
58	x		2	001/(26)	19x0.1 (1)	0.57	0.15	170	0.079	0.96	2.3	7.7
59	x		2	002/(24)	19x0.12 (1)	0.58	0.25	120	0.079	1.13	2.7	9.5
60	x		2	004/(22)	19x0.15 (1)	0.76	0.40	63	0.079	1.25	2.9	13.4
61	x		2	006/(20)	19x0.20 (1)	0.99	0.60	35	0.079	1.48	3.3	19.6
62	x		2	012/(16)	19x0.30 (1)	1.49	1.20	15	0.079	1.98	4.3	35.0
63	x		2	030/(12)	37x0.32 (1)	2.18	3.00	7.5	0.079	2.73	5.8	67.0
64	x		3	- /(30)	7x0.102	0.32	0.057	385	0.063	0.78	2.0	6.1
65	x		3	- /(28)	7x0.127	0.47	0.09	259	0.079	0.87	2.3	8.3
66	x		3	001/(26)	19x0.1 (1)	0.57	0.15	171	0.079	0.96	2.4	10.3
67	x		3	002/(24)	19x0.12 (1)	0.58	0.25	121	0.079	1.13	2.8	13.2
68	x		3	004/(22)	19x0.15 (1)	0.76	0.40	64	0.079	1.25	3.1	18.0
69	x		3	006/(20)	19x0.20 (1)	0.99	0.60	37	0.079	1.48	3.6	26.8
70	x		3	012/(16)	19x0.30 (1)	1.49	1.20	15	0.079	1.98	4.6	51.0
71	x		3	030/(12)	37x0.32 (1)	2.18	3.00	7.5	0.079	2.73	6.2	99.0

NOTES: See Page 9.

TABLE 1(a) - TYPE VARIANTS

VARIANT No.	SHIELDED		No. OF CORES	WIRE SIZE ISO/ (AWG)	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			SHIELD STRAND Θ (mm)	CORE MAX Θ (mm)	FINISHED WIRE OR CABLE CHARACTERISTICS	
	YES	NO				MAX Θ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)			MAX Θ (mm)	MAX WEIGHT (kg/km)
72	x		4	- /(30)	7x0.102	0.32	0.057	386	0.063	0.78	2.2	7.6
73	x		4	- /(28)	7x0.127	0.47	0.09	260	0.079	0.87	2.5	10.4
74	x		4	001/(26)	19x0.1 (1)	0.57	0.15	171	0.079	0.96	2.7	12.2
75	x		4	002/(24)	19x0.12 (1)	0.58	0.25	122	0.079	1.13	3.1	16.4
76	x		4	004/(22)	19x0.15 (1)	0.76	0.40	64	0.079	1.25	3.4	22.9
77	x		4	006/(20)	19x0.20 (1)	0.99	0.60	37	0.079	1.48	3.9	34.4
78	x		4	012/(16)	19x0.30 (1)	1.49	1.20	16	0.079	1.98	5.1	63.0
79	x		4	030/(12)	37x0.32 (1)	2.18	3.00	7.9	0.079	2.73	6.9	124
80	x		5	- /(28)	7x0.127	0.47	0.09	260	0.079	0.87	2.7	12.5
81	x		5	001/(26)	19x0.1 (1)	0.57	0.15	172	0.079	0.96	2.9	15.8
82	x		5	002/(24)	19x0.12 (1)	0.58	0.25	123	0.079	1.13	3.4	20.4
83	x		5	004/(22)	19x0.15 (1)	0.76	0.40	64	0.079	1.25	3.7	28.4
84	x		5	006/(20)	19x0.20 (1)	0.99	0.60	37	0.079	1.48	4.4	43.0
85	x		6	- /(28)	7x0.127	0.47	0.09	261	0.079	0.87	3.0	14.8
86	x		6	001/(26)	19x0.1 (1)	0.57	0.15	172	0.079	0.96	3.2	18.8
87	x		6	002/(24)	19x0.12 (1)	0.58	0.25	124	0.079	1.13	3.8	24.3
88	x		6	004/(22)	19x0.15 (1)	0.76	0.40	65	0.079	1.25	4.1	34.0
89	x		6	006/(20)	19x0.20 (1)	0.99	0.60	38	0.079	1.48	4.8	58.2
90	x		7	- /(28)	7x0.127	0.47	0.09	261	0.079	0.87	3.0	15.7
91	x		7	001/(26)	19x0.1 (1)	0.57	0.15	172	0.079	0.96	3.2	20.1
92	x		7	002/(24)	19x0.12 (1)	0.58	0.25	124	0.079	1.13	3.8	26.0
93	x		7	004/(22)	19x0.15 (1)	0.76	0.40	65	0.079	1.25	4.1	37.0
94	x		7	006/(20)	19x0.20 (1)	0.99	0.60	38	0.079	1.48	4.8	57.0

NOTES 1. According to ISO 2653 (AWG sizes given for information).

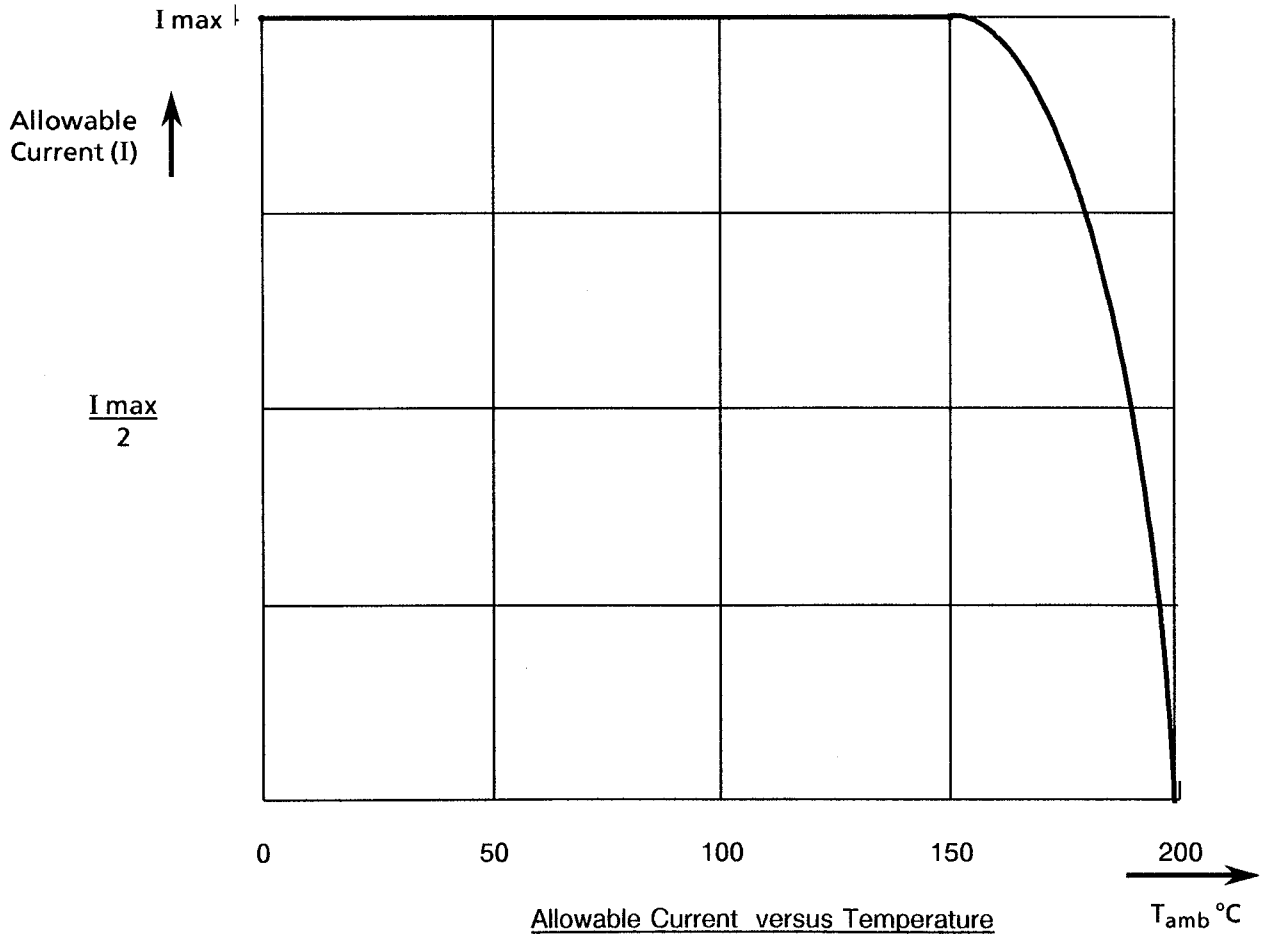
TABLE 1(b) - MAXIMUM RATINGS

NO	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Voltage	V_P	600	Vrms	
2	Maximum Current (Note 1)	I_{max}	1.5 2.5 3.5 5.0 7.5 13 23	A	For AWG 28 26 24 22 20 16 12
3	Operating Temperature Range	T_{amb}	-200 to +200	°C	
4	Storage Temperature Range	T_{stg}	-200 to +200	°C	

NOTES

1. The above specified current will generate a temperature rise of approximately 50°C above ambient temperature in a vacuum environment. Precautions shall be taken to prevent the total temperature of the wire (ambient plus rise) exceeding the continuous operating temperature of the wire.

FIGURE 1 - PARAMETER DERATING INFORMATION



Allowable Current versus Temperature

FIGURE 2 - PHYSICAL CHARACTERISTICS

Dimensions are given in Table 1(a)

FIGURE 2(a) - FINISHED WIRES

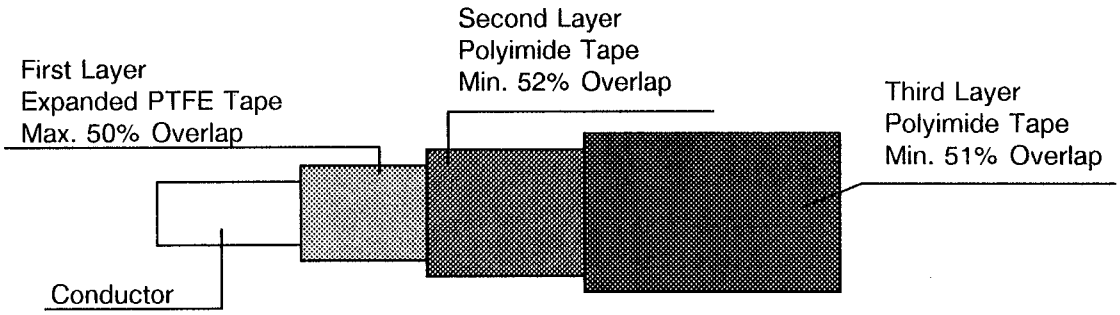
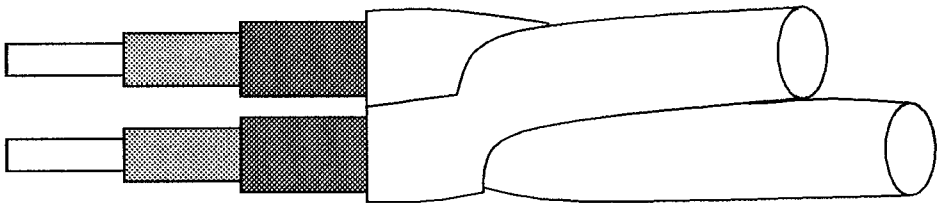


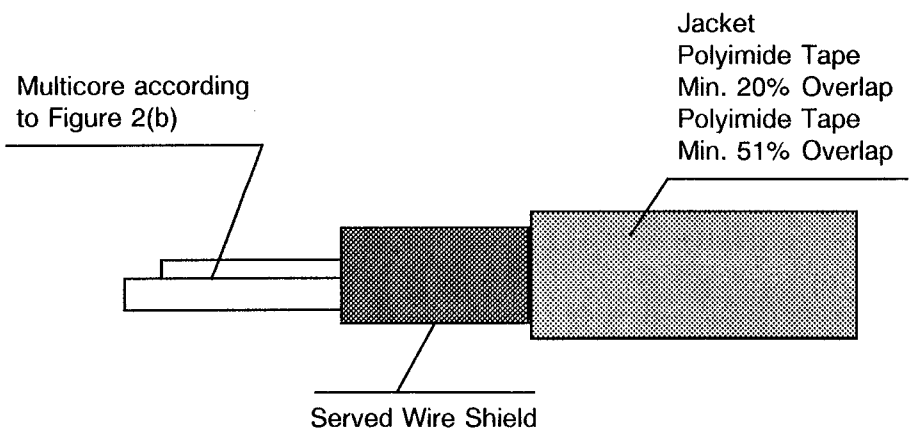
FIGURE 2(b) - MULTICORE CABLE



NOTES

1. Finished wire according to Figure 2(a).

FIGURE 2(c) - SHIELDED AND JACKETED CABLES



2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

- ESA/SCC Generic Specification No. 3901, Wires and Cables, Electrical, 600V, Low Frequency.
- MIL-STD-104, Limits for Electrical Insulation Colours.
- ISO 2635, Aircraft - Conductors for General Purpose Aircraft.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 and ESA/SCC Generic Specification No. 3901 shall apply.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the finished wires and cables specified herein are stated in this specification and ESA/SCC Generic Specification No. 3901. Deviations from the Generic Specification, applicable to this specification only, are listed in Para 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESA/SCC requirements and do not affect the components' reliability, are listed in the Appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviations from Special In-process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in Tests (Chart III)

Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.21, Resistance to Fluids: To be modified in accordance with Para. 4.8.11 of this specification.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the finished wires and cables specified herein shall be checked; they shall conform to those shown in Table 1(a), Figure 2 and Para 4.4 of this specification (see below for the list of parameters to be checked).

LIST OF PARAMETERS TO BE CHECKED

PARAMETER	TABLE 1(a)	FIGURE 2	PARA 4.4
COMPOSITION			
Number of conductors	X		
Gauge	X		
Shielding	X		
Jacket		X	
CONDUCTOR			
Nature			X
Outer diameter	X		
Number of strands	X		
Strand diameter	X		
Length of lay			X
Silver Thickness			X
INSULATION			
Composition		X	X
Thickness			X
Overlapping			X
Outer diameter	X		
SHIELDING			
Number of strands	X		
Type of shielding			X
Strand diameter	X		
Nature		X	X
Silver thickness			X
Shielding lay			X
Shield coverage			X
JACKET			
Composition		X	X
Protective tape wraps		X	X
Thickness			X
Overlapping			X
Outer diameter	X		

4.3.2 Weight

The maximum weight of the finished wires and cables specified herein shall be as specified in Table 1(a).

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the wires and cables specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Conductor

4.4.1.1 Material Characteristics

All strands used in the manufacture of the conductors shall be silver-coated, soft or annealed, oxygen-free high conductivity copper for ISO 004, 006, 012 and 030, and silver-coated high strength copper alloy for ISO 001 and 002 and AWG 28 inclusive.

On silver-coated strands, the thickness of silver shall be 2 microns minimum.

On all copper conductors, any strand shall show a 10% minimum elongation.

For high-strength copper alloy conductors, the tensile characteristics shall be not less than 6% in elongation and 35kg per square mm in tensile strength.

For determination of the conductor resistance at +20°C, as mentioned in Para 9.5 of ESA/SCC Generic Specification No. 3901, the α coefficient for copper alloy is 0.0035.

4.4.1.2 Stranding

The conductors shall be constructed of concentrically laid strands to produce a smooth and uniform conductor of circular cross-section and free from any high strands or other surface irregularities.

The length of lay of the external layer shall not be less than 8, nor more than 16, times the maximum conductor diameter specified in Table 1(a).

4.4.2 Insulation

4.4.2.1 Material

Any insulating material shall be virgin polyimide with only those additives that are necessary for processing and pigmentation.

4.4.2.2 Construction

The insulation shall have a uniform cross-section throughout the length of the cable and the conductor shall be evenly centred in the insulation.

The insulation shall consist of 2 wrapped layers of polyimide tapes as specified in Figure 2(a).

4.4.3 Shield

4.4.3.1 Material

Shield strands shall be silver-coated, annealed copper as specified in Para. 4.4.1.1 of this specification, but the thickness of silver shall be 2.5 microns minimum.

4.4.3.2 Construction

Shields shall be closely and helically wound around the single insulated wire or twisted bundle of insulated wires (core) and provide not less than 92% coverage as calculated by the following formula:

$$K = \frac{n \times d_w \sqrt{(\pi D)^2 + P^2}}{P\pi D} \times 100(\%)$$

K = coverage (%)
n = number of serving wires
d_w = shield strand diameter (mm)
D = diameter of core (mm)
P = serving pitch (mm)

4.4.4 Jacket

All shielded cables shall be provided with jackets of wrapped polyimide tapes as specified in Figure 2(c). The wrapped tapes shall be heat-sealed. The side of the tape of the first layer above the shield, which is not coated with FEP resin, shall be facing the shield.

4.4.5 Construction of Multicore Cables

Multicore cables shall be constructed by twisting the required number and size of finished wires to form a uniform cable without high strands, bends or other irregularities. Finished wires of only one size shall be used for one cable. The cabling shall be with a left-hand lay and the lay length shall not be less than 12 times and not be more than 16 times the outside diameter of the unshielded unjacketed cable. The construction of shielded and jacketed cables is shown in Figure 2(c). Fillers shall not be used in the construction of multicore cables except for the 5- and 6-core cable, where the 5/6 wires shall be twisted around a round, uncoloured filler made of polytetrafluorethylene. The diameter of the filler shall be 0.7 times the diameter of the wires used in the cable for the 5-core cable and the same diameter of the finished wire for the 6-core cable.

4.4.6 Colour Coding

4.4.6.1 Finished Wire Colour Coding

The colour of the finished wires shall be the natural colour of the top wrap on the insulation except when colouring is specifically required in the contract.

Colours:

- Black (not to be preferred)
- Brown
- Red
- Orange (not to be preferred)
- Yellow
- Green
- Natural

The colour of top wraps shall conform to the colour limits specified in MIL-STD-104, Class 1.

4.4.6.2 Multicore Cable Colour Coding

If the contract does not define any specific colour coding, all individual cores in multicore cables shall have the natural colour. If colour coding is desired, it is proposed that the individual cores in such cables shall be coloured according to the following scheme:

No. OF CORES IN CABLE	COLOUR OF RESPECTIVE CORES						
2	red	natural					
3	red	natural	yellow				
4	red	natural	yellow	green			
5	red	natural	yellow	green	brown		
6	red	natural	yellow	green	brown	black	
7	red	natural	yellow	green	brown	black	orange

4.4.6.3 Jacket colour

The colour of jackets shall normally be the natural colour of the polyimide tapes.

4.5 MARKING

4.5.1 General

The marking of all spools of finished wires or cables delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700. Each spool shall be marked in respect of:-

(a) The SCC Component Number.

(b) Characteristics.

(c) Traceability Information.

(d) Additional Marking.

4.5.2 The SCC Component Number

Each spool shall bear the SCC Component Number which shall be constituted and marked as follows:-

390101902B

Detail Specification Number
Type variant, (see Table 1(a))
Testing level

4.5.3 Characteristics

The characteristics shall show the length(s) of the finished wire or cable wound on each spool and shall be marked as follows:-

100m

Length in metres (see Note)
Symbol for metres

NOTES

1. Whenever the length is less than 100 metres, insert a zero in the first block (example: 075 m). If more than one length of finished wire or cable is wound on a spool, the characteristics of each length shall be marked as above.

4.5.4 Traceability Information

Each spool shall be marked in respect of traceability information in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

4.5.5 Additional Marking

Each spool shall bear the Manufacturer's Quality Control Inspector's stamp.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. The measurements shall be performed at T_{amb} = +22 ± 3 °C.

4.6.2 Electrical Measurements at High and Low Temperatures

Not applicable.

4.6.3 Circuits for Electrical Measurements

Not applicable.

4.7 BURN-IN TESTS

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS

4.8.1 Mechanical Properties of Conductor

As detailed in Para. 4.4.1.1 of this specification.

4.8.2 Accelerated Ageing

Ageing Temperature +230 ± 5 °C.

4.8.3 Wrap Test at Ambient Temperature

The mandrel diameters and applied loads for wrap testing of finished wires are given in Table A. The mandrel diameters and applied loads for shielded and jacketed cables are given in Table B.

TABLE A - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES

Wire Size ISO / (AWG)	Mandrel Diameter (mm)	Applied Weight (kg)
- / (30)	5.0	0.15
- / (28)	6.0	0.25
001 / (26)	6.0	0.25
002 / (24)	6.0	0.25
004 / (22)	6.0	0.40
006 / (20)	6.0	0.40
012 / (16)	10	0.50
030 / (12)	20	1.00

TABLE B - MANDREL DIAMETERS AND LOADS FOR SHIELDED AND JACKETED CABLES

CABLE SIZE ISO /(AWG)	NUMBER OF CORES	MANDREL DIAMETER (mm)	APPLIED WEIGHT (kg)
- / (30)	1	8.0	0.15
- / (28)	1	8.0	0.25
001 / (26)	1	10	0.25
002 / (24)	1	12	0.25
004 / (22)	1	15	0.50
006 / (20)	1	15	0.50
012 / (16)	1	20	1.00
030 / (12)	1	20	1.00
- / (30)	2	10	0.25
- / (28)	2	10	0.50
001 / (26)	2	15	0.50
002 / (24)	2	15	0.50
004 / (22)	2	20	0.80
006 / (20)	2	20	0.80
012 / (16)	2	25	1.00
030 / (12)	2	30	1.00
- / (30)	3	12	0.25
- / (28)	3	12	0.50
001 / (26)	3	15	0.75
002 / (24)	3	15	0.75
004 / (22)	3	20	1.20
006 / (20)	3	20	1.20
012 / (16)	3	30	1.50
030 / (12)	3	40	1.50
- / (30)	4	15	0.50
- / (28)	4	15	0.80
001 / (26)	4	15	1.00
002 / (24)	4	20	1.00
004 / (22)	4	20	1.50
006 / (20)	4	25	1.50
012 / (16)	4	30	1.50
030 / (12)	4	40	1.50
- / (28)	5	15	1.00
001 / (26)	5	20	1.50
002 / (24)	5	20	1.50
004 / (22)	5	25	2.00
006 / (20)	5	30	2.00
- / (28)	6/7	20	1.00
001 / (26)	6/7	20	1.50
002 / (24)	6/7	20	1.50
004 / (22)	6/7	25	2.00
006 / (20)	6/7	30	2.00

4.8.4 Voltage Test

No particular conditions are applicable.

4.8.5 Shrinkage

The shrinkage temperature shall be +200 ± 5 °C

4.8.6 Blocking

The blocking temperature shall be +230 ± 5 °C.

4.8.7 Cold Bend Test

The mandrel diameters and loads shall be as specified in Table C.

TABLE C - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES OR CORES

Wire Size ISO / (AWG)	Mandrel Diameter (mm)	Applied Weight (kg)
- / (30)	5.0	0.15
- / (28)	6.0	0.25
001 / (26)	6.0	0.25
002 / (24)	6.0	0.25
004 / (22)	6.0	0.40
006 / (20)	6.0	0.40
012 / (16)	10	0.50
030 / (12)	20	1.00

4.8.8 Cut-through Resistance

The mean load measured during 9 tests shall not be less than the relevant value specified below:-

Wire Size ISO Requirements	-	-	001	002	004	006	012	030
(AWG)	(30)	(28)	(26)	(24)	(22)	(20)	(16)	(12)
Cut-through Load (kg)	9.0	11	11	11	25	32	35	50

4.8.9 Notch Resistance

The depth of notch shall be 0.04mm.

4.8.10 Flammability Resistance

No particular conditions are applicable.

4.8.11 Resistance to Fluids

Tests (h), (i) and (j) shall not be performed.

4.8.12 Surface Resistance

No particular conditions are applicable.

4.8.13 Abrasion Resistance

The weight to be applied to the needle is specified below:-

Wire Size ISO Requirements	-	-	001	002	004	006	012	030
(AWG)	(30)	(28)	(26)	(24)	(22)	(20)	(16)	(12)
Scrape Abrasion (Load in grammes)	350	500	650	750	800	900	1050	1200

4.8.14 Soldering

No particular conditions are applicable.

4.8.15 Solderability

No particular conditions are applicable.

4.8.16 Radiation Resistance

No particular conditions are applicable.

4.8.17 Overload Resistance

No particular conditions are applicable.

4.8.18 Outgassing in Vacuum

No particular conditions are applicable.

4.8.19 Long-term Ageing Test

The long-term ageing temperature shall be +200°C.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

NO	CHARACTERISTICS	SPECIFICATION AND TEST METHOD	TEST CONDITION	LIMITS	UNIT
1	Conductor Resistance	ESA/SCC No. 3901, Section 9	Para 9.5	Table 1(a)	Ω/km
2	Spark Test	ESA/SCC No. 3901, Section 9	Para 9.6	Insulation :3 Jacket :1.5	kV
3	Voltage Test	ESA/SCC No. 3901, Section 9	Para 9.7	Para 9.7	kV
4	Insulation Resistance	ESA/SCC No. 3901, Section 9	Para 9.8	Insulation :750 Jacket : 30	MΩ.km
5	Surface Resistance	ESA/SCC No. 3901, Section 9	Para 9.22	:125	MΩ.mm

APPENDIX 'A'

AGREED DEVIATIONS FOR W.L. GORE & ASSOCIATES GmbH (D)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Figure 2	Expanded PTFE tape shall be GORE-TEX®
Para. 4.4.5	Expanded PTFE tape shall be GORE-TEX®

NOTES

1. GORE-TEX® = Registered Trade Mark of Gore.