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POWER WIRES FOR CRIMPING,

LOW FREQUENCY, 600V, -200 TO +200 °C,

BASED ON TYPE SPP

ESA/SCC Detail Specification No. 3901/017

space components
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'A'	Apr. '94	P1.	Cover Page	None
		P2.	DCN	None
		P3.	T. of Contents : Amended as relevant	None
		P9.	Para. 4.2.4 : Deviations about accelerated and long-term ageing added	221147
		P10.	Para. 4.2.5 : Deviation about accelerated ageing added	221147

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

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

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

1.2 TYPE VARIANTS

Variants of the basic types of wires 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 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 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.	WIRE SIZE AWG	STRANDING No. OF STRANDS x DIAMETER (mm)	CONDUCTOR CHARACTERISTICS			FINISHED CABLE CHARACTERISTICS	
			MAX ⊖ (mm)	NOM SECT. (mm^2)	MAX OHMIC RESISTANCE (Ω/km)	MAX ⊖ (mm)	MAX WEIGHT (kg/km)
01	0	19x55x0.254RC	10.5	53	0.38	11.8	542
02	4	19x7x0.454RU	6.5	22	0.91	7.7	232
03	8	19x7x0.287RC	4.2	8.6	2.38	5.3	98

NOTES 1. RC = ropelay; RU = rope unilay.

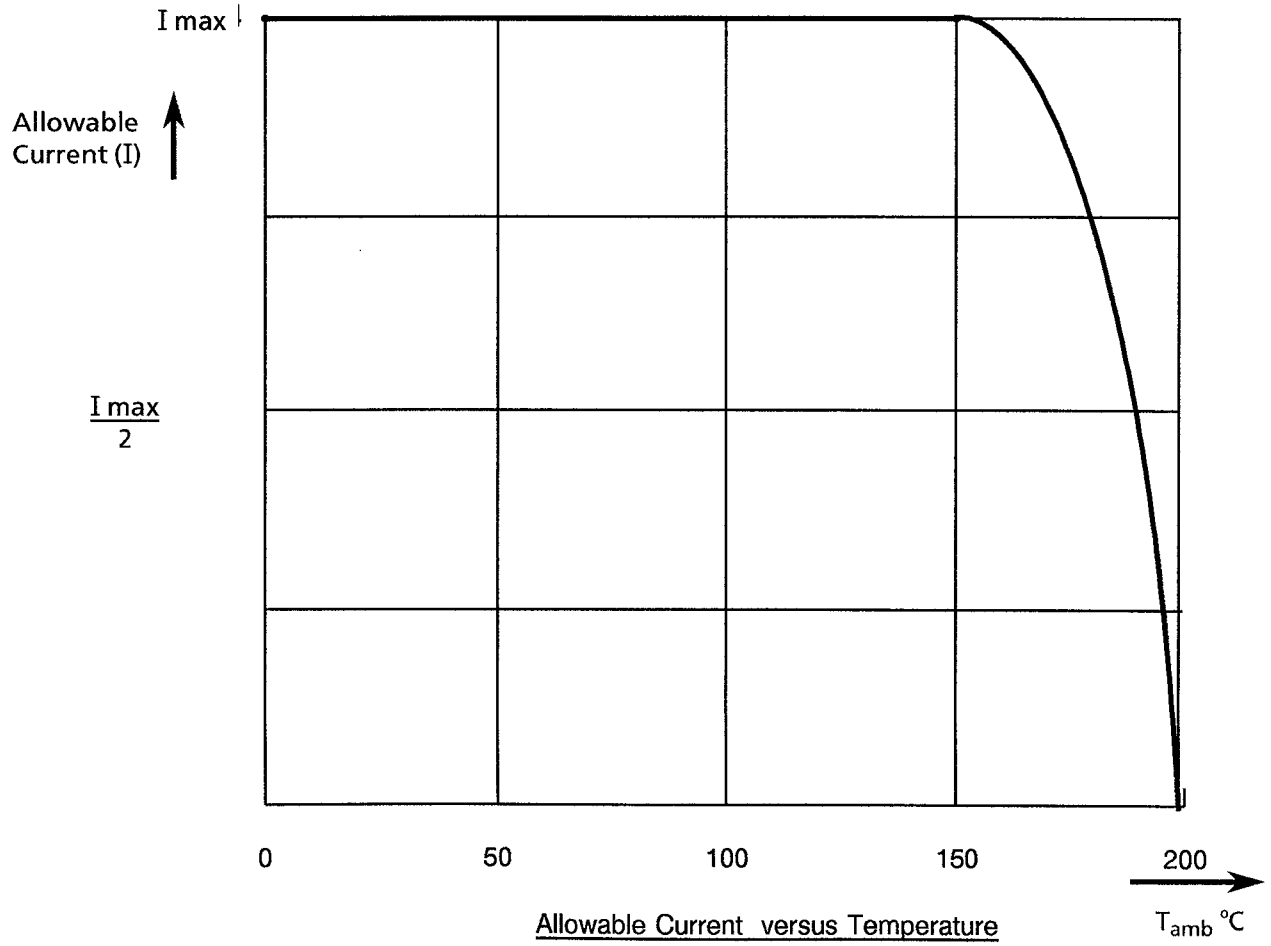
TABLE 1(b) - MAXIMUM RATINGS

NO	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Voltage	V_P	600	Vrms	
2	Maximum Current (Note 1)	I_{max}	45 81 133	A	For AWG 8 4 0
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

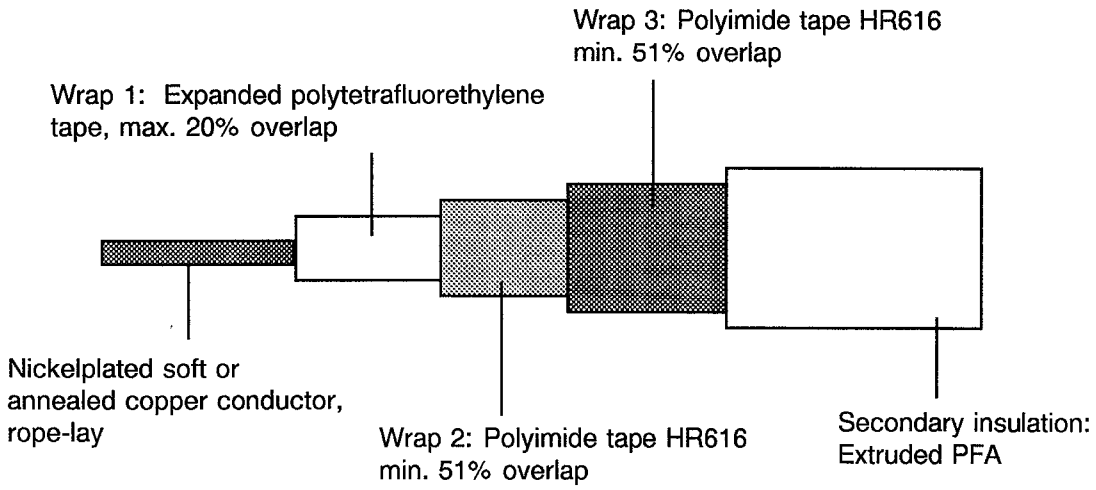


Allowable Current versus Temperature

FIGURE 2 - PHYSICAL CHARACTERISTICS

Dimensions are given in Table 1(a)

FINISHED WIRES



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.
- ASTM B355, Standard Specification for Nickel Coated Soft or Annealed Copper Wire.

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 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)

(a) Para. 9.25, Solderability: Not applicable.

4.2.3 Deviations from Burn-in Tests (Chart III)

Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.15, Shrinkage shall be less than 5mm.

(b) Para. 9.24, Soldering: Not applicable.

(c) Para. 9.25, Solderability: Not applicable.

(d) Para.9.10, Anthony & Brown test: Not applicable

(e) Para. 9.12, Accelerated Ageing: Para. 9.12.2 is applicable.

(f) Para. 9.29, Long-term Ageing: test samples shall be aged as free coils (as per Para. 9.12.2).

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.24, Soldering: Not applicable.

(b) Para.9.10, Anthony & Brown test: Not applicable.

(c) Para. 9.15, Shrinkage shall be less than 5mm.

(d) Para. 9.25, Solderability: Not applicable.

(e) Para. 9.12, Accelerated Ageing: Para. 9.12.2 is applicable.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the finished wires 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			
Gauge	X		
Insulation		X	
Jacket		X	
CONDUCTOR			
Nature			X
Outer diameter	X		
Number of strands	X		
Strand diameter	X		
Length of lay			X
Nickel thickness			X
INSULATION			
Composition		X	X
Thickness			X
Concentricity			X
Outer diameter	X		
Core identification			X

4.3.2 Weight

The maximum weight of the finished wires 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 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 nickel plated, oxygen free copper from AWG 0 to 8. On the nickel plated strands the thickness of the nickel shall be 1.2μm minimum.

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

4.4.1.2 Stranding

The conductors shall be rope lay as specified in Table 1(a). Strand and rope members shall be concentrically stranded using unilay concentric (commonly known as "unilay") or counter directional concentric (commonly known as "concentric") constructions.

Concentric stranding shall be defined as a central core surrounded by one or more layers of helically wound strands in a fixed round geometric arrangement.

In "unilay" constructions the successive layers have the same lay direction and lay length.

In "concentric" constructions the lay direction of successive layers are alternately reversed with increasing lay lengths.

The length of lay of the outer layer of stranded members forming the conductor shall be maximum:

- 127mm for AWG 0.
- 77mm for AWG 4.
- 51mm for AWG 8.

In all cases the standard direction of lay of the outer layer is left hand.

4.4.2 Insulation

4.4.2.1 Material

The primary insulating material shall be polyimide over expanded polytetrafluorethylene, both with only those additives that are necessary for processing.

The secondary insulation material shall be virgin perfluoralcoxycopolymer 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 1 wrapped layer of expanded polytetrafluroethylene tape and 2 wrapped layers of polyimide tapes as specified in Figure 2.

4.4.3 Colour Coding

The colour of the finished wires shall be the following colours of the secondary insulation.

Colours:

- AWG 8: Red.
- AWG 4: Yellow.
- AWG 0: Blue

4.5 MARKING

4.5.1 General

The marking of all spools of finished wires 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.

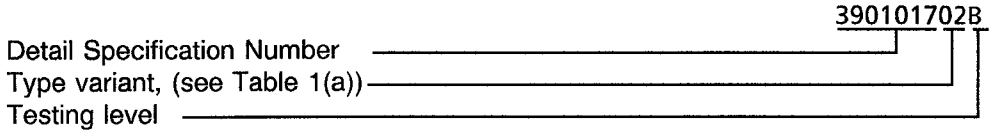
(b) Characteristics.

(c) Traceability Information.

(d) Additional Marking.

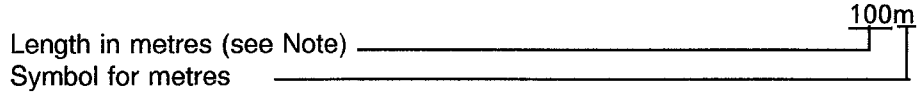
4.5.2 The SCC Component Number

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



4.5.3 Characteristics

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



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.

TABLE A - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES

Wire Size AWG	Mandrel Diameter (mm)	Applied Weight (kg)
0	100	3.5
4	75	1.8
8	50	1.3

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

Not applicable.

4.8.4 Voltage Test

No particular conditions are applicable.

4.8.5 Shrinkage

The shrinkage temperature shall be +200 ± 5 °C. The shrinkage shall be according to Para. 4.2.4. of this specification

4.8.6 Blocking

The blocking temperature shall be +230 ± 5 °C. Cooling down to room temperature: 16 hours for AWG 0 and 4.

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

Wire Size AWG	Mandrel Diameter (mm)	Applied Weight (kg)
0	80	3.5
4	60	1.8
8	30	1.3

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 AWG Requirements	0	4	8
Cut-through Load (N)	1200	680	800

4.8.9 Notch Resistance

The depth of notch shall be 0.1mm.

4.8.10 Flammability Resistance

No particular conditions are applicable.

4.8.11 Resistance to Fluids

No particular conditions are applicable.

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 AWG Requirements	0	4	8
Scrape Abrasion (Load in N)	35	17	12

4.8.14 Soldering

Not applicable.

4.8.15 Solderability

Not 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 ± 5°C.

4.8.20 Atomic Oxygen Resistance

The outer surface of the single insulated wires and the jackets of the cables are resistant against atomic oxygen and shall be verified according to the requirements of the Qualifying Space Agency.

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	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	MΩ.km
5	Surface Resistance	ESA/SCC No. 3901, Section 9	Para 9.22	125	MΩ.mm

APPENDIX 'A'

AGREED DEVIATIONS FOR GORE (D)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Figure 2	Expanded PTFE tape shall be GORE-TEX®
Para. 4.4.2	Expanded PTFE tape shall be GORE-TEX®

NOTES

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