



**POLYIMIDE INSULATED SHIELDED CABLES**  
**WITH DRAIN WIRE, LOW FREQUENCY,**  
**600V, -200 TO +200 °C**  
**BASED ON TYPE SPLD**  
**ESCC Detail Specification No. 3901/021**

**ISSUE 1**  
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|  |                           |  |                    |
|--|---------------------------|--|--------------------|
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Pages 1 to 20

**POLYIMIDE INSULATED SHIELDED CABLES**

**WITH DRAIN WIRE, LOW FREQUENCY,**

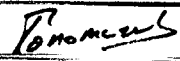
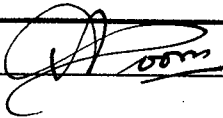
**600V, - 200 TO + 200 °C**

**BASED ON TYPE SPLD**

**ESA/SCC Detail Specification No. 3901/021**



**space components  
coordination group**

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**DOCUMENTATION CHANGE NOTICE**

| Rev.<br>Letter | Rev.<br>Date | Reference | CHANGE<br>Item | Approved<br>DCR No. |
|----------------|--------------|-----------|----------------|---------------------|
|                |              |           |                |                     |

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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 Cables with Drain Wire, Low Frequency, 600V, -200 to +200 °C, based on Type SPLD. It shall be read in conjunction with ESA/SCC Generic Specification No. 3901, the requirements of which are supplemented herein.

**NOTES**

1. These cables shall not be used in the presence of hydrazine or nitrogen tetroxide.

**1.2 TYPE VARIANTS**

Variants of the basic types of 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 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:-

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

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

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 finished cables specified herein are shown in Figure 2.

**1.6 FUNCTIONAL DIAGRAM**

Not applicable.



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**TABLE 1(a) - TYPE VARIANTS**

| VARIANT No. | DRAIN WIRE SIZE ISO/(AWG) | DRAIN WIRE No. OF STRANDS x DIAMETER (mm) | No. OF CORES | WIRE SIZE ISO/(AWG) | STRANDING No. OF STRANDS x DIAMETER (mm) | CONDUCTOR CHARACTERISTICS |                              |                             | SHIELD STRAND Ø (mm) | CORE MAX Ø (mm) | FINISHED WIRE OR CABLE CHARACTERISTICS |                    |
|-------------|---------------------------|---|--------------|---------------------|--|---------------------------|------------------------------|-----------------------------|----------------------|-----------------|--|--------------------|
|             |                           |   |              |                     |  | MAX Ø (mm)                | NOM SECT. (mm <sup>2</sup> ) | MAX OHMIC RESISTANCE (Ω/km) |                      |                 | MAX Ø (mm)                             | MAX WEIGHT (kg/km) |
| 01          | - / (30)                  | 07 x 0.102                                | 1            | - / (30)            | 07 x 0.102                               | 0.32                      | 0.057                        | 375                         | 0.063                | 0.78            | 1.4                                    | 3.4                |
| 02          | - / (28)                  | 07 x 0.127                                | 1            | - / (28)            | 07 x 0.127                               | 0.39                      | 0.09                         | 253                         | 0.079                | 0.87            | 1.6                                    | 4.4                |
| 03          | 001/(26)                  | 19 x 0.10 (1)                             | 1            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 157                         | 0.079                | 0.99            | 1.8                                    | 5.8                |
| 04          | 002/(24)                  | 19 x 0.12 (1)                             | 1            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 111                         | 0.079                | 1.13            | 2.1                                    | 7.4                |
| 05          | 004/(22)                  | 19 x 0.15 (1)                             | 1            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 58                          | 0.079                | 1.26            | 2.4                                    | 11                 |
| 06          | 006/(20)                  | 19 x 0.20 (1)                             | 1            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 32                          | 0.079                | 1.48            | 2.9                                    | 17                 |
| 07          | - / (18)                  | 19 x 0.25                                 | 1            | - / (18)            | 19 x 0.25                                | 1.29                      | 0.96                         | 21                          | 0.079                | 1.70            | 3.9                                    | 30                 |
| 08          | 012/(16)                  | 19 x 0.30 (1)                             | 1            | 012/(16)            | 19 x 0.30 (1)                            | 1.49                      | 1.20                         | 14                          | 0.079                | 1.98            | 4.0                                    | 34                 |
| 09          | 030/(12)                  | 37 x 0.32 (1)                             | 1            | 030/(12)            | 37 x 0.32 (1)                            | 2.18                      | 3.00                         | 7.0                         | 0.079                | 2.70            | 5.3                                    | 66                 |
| 10          | - / (30)                  | 07 x 0.102                                | 2            | - / (30)            | 07 x 0.102                               | 0.32                      | 0.057                        | 383                         | 0.063                | 0.78            | 2.2                                    | 5.7                |
| 11          | - / (28)                  | 07 x 0.127                                | 2            | - / (28)            | 07 x 0.127                               | 0.39                      | 0.09                         | 258                         | 0.079                | 0.87            | 2.5                                    | 7.0                |
| 12          | 001/(26)                  | 19 x 0.10 (1)                             | 2            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 170                         | 0.079                | 0.99            | 2.8                                    | 9.1                |
| 13          | 002/(24)                  | 19 x 0.12 (1)                             | 2            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 120                         | 0.079                | 1.13            | 3.3                                    | 11.4               |
| 14          | 004/(22)                  | 19 x 0.15 (1)                             | 2            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 63                          | 0.079                | 1.26            | 3.7                                    | 17                 |
| 15          | 006/(20)                  | 19 x 0.20 (1)                             | 2            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 35                          | 0.079                | 1.48            | 4.3                                    | 25                 |
| 16          | 012/(16)                  | 19 x 0.30 (1)                             | 2            | 012/(16)            | 19 x 0.30 (1)                            | 1.49                      | 1.20                         | 15                          | 0.079                | 1.98            | 5.9                                    | 48                 |
| 17          | 030/(12)                  | 37 x 0.32 (1)                             | 2            | 030/(12)            | 37 x 0.32 (1)                            | 2.18                      | 3.00                         | 7.5                         | 0.079                | 2.73            | 8.0                                    | 95                 |
| 18          | - / (30)                  | 07 x 0.102                                | 3            | - / (30)            | 07 x 0.102                               | 0.32                      | 0.057                        | 385                         | 0.063                | 0.78            | 2.3                                    | 6.7                |
| 19          | - / (28)                  | 07 x 0.127                                | 3            | - / (28)            | 07 x 0.127                               | 0.39                      | 0.09                         | 259                         | 0.079                | 0.87            | 2.7                                    | 9.2                |
| 20          | 001/(26)                  | 19 x 0.10 (1)                             | 3            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 171                         | 0.079                | 0.99            | 2.9                                    | 12                 |
| 21          | 002/(24)                  | 19 x 0.12 (1)                             | 3            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 121                         | 0.079                | 1.13            | 3.4                                    | 15                 |
| 22          | 004/(22)                  | 19 x 0.15 (1)                             | 3            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 64                          | 0.079                | 1.26            | 3.9                                    | 21                 |
| 23          | 006/(20)                  | 19 x 0.20 (1)                             | 3            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 37                          | 0.079                | 1.48            | 4.6                                    | 33                 |

**NOTES** 1. In accordance with ISO 2635. AWG sizes are given for reference.





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**TABLE 1(a) - TYPE VARIANTS (CONTINUED)**

| VARIANT No. | DRAIN WIRE SIZE ISO/(AWG) | DRAIN WIRE No. OF STRANDS x DIAMETER (mm) | No. OF CORES | WIRE SIZE ISO/(AWG) | STRANDING No. OF STRANDS x DIAMETER (mm) | CONDUCTOR CHARACTERISTICS |                              |                             | SHIELD STRAND Ø (mm) | CORE MAX Ø (mm) | FINISHED WIRE OR CABLE CHARACTERISTICS |                    |
|-------------|---------------------------|---|--------------|---------------------|--|---------------------------|------------------------------|-----------------------------|----------------------|-----------------|--|--------------------|
|             |                           |   |              |                     |  | MAX Ø (mm)                | NOM SECT. (mm <sup>2</sup> ) | MAX OHMIC RESISTANCE (Ω/km) |                      |                 | MAX Ø (mm)                             | MAX WEIGHT (kg/km) |
| 24          | - / (30)                  | 07 x 0.102                                | 4            | - / (30)            | 07 x 0.102                               | 0.32                      | 0.057                        | 386                         | 0.063                | 0.78            | 2.5                                    | 8.2                |
| 25          | - / (28)                  | 07 x 0.127                                | 4            | - / (28)            | 07 x 0.127                               | 0.39                      | 0.09                         | 260                         | 0.079                | 0.87            | 2.9                                    | 11                 |
| 26          | 001/(26)                  | 19 x 0.10 (1)                             | 4            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 171                         | 0.079                | 0.99            | 3.2                                    | 14                 |
| 27          | 002/(24)                  | 19 x 0.12 (1)                             | 4            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 122                         | 0.079                | 1.13            | 3.7                                    | 18                 |
| 28          | 004/(22)                  | 19 x 0.15 (1)                             | 4            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 64                          | 0.079                | 1.26            | 4.2                                    | 26                 |
| 29          | 006/(20)                  | 19 x 0.20 (1)                             | 4            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 37                          | 0.079                | 1.48            | 4.9                                    | 40                 |
| 30          | 001/(26)                  | 19 x 0.10 (1)                             | 5            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 172                         | 0.079                | 0.99            | 3.4                                    | 17                 |
| 31          | 002/(24)                  | 19 x 0.12 (1)                             | 5            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 123                         | 0.079                | 1.13            | 4.0                                    | 22                 |
| 32          | 004/(22)                  | 19 x 0.15 (1)                             | 5            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 64                          | 0.079                | 1.26            | 4.5                                    | 32                 |
| 33          | 006/(20)                  | 19 x 0.20 (1)                             | 5            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 37                          | 0.079                | 1.48            | 5.4                                    | 49                 |
| 34          | 001/(26)                  | 19 x 0.10 (1)                             | 6            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 172                         | 0.079                | 0.99            | 3.7                                    | 20                 |
| 35          | 002/(24)                  | 19 x 0.12 (1)                             | 6            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 124                         | 0.079                | 1.13            | 4.4                                    | 26                 |
| 36          | 004/(22)                  | 19 x 0.15 (1)                             | 6            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 65                          | 0.079                | 1.26            | 4.9                                    | 37                 |
| 37          | 006/(20)                  | 19 x 0.20 (1)                             | 6            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 38                          | 0.079                | 1.48            | 5.8                                    | 62                 |
| 38          | 001/(26)                  | 19 x 0.10 (1)                             | 7            | 001/(26)            | 19 x 0.10 (1)                            | 0.47                      | 0.15                         | 172                         | 0.079                | 0.99            | 3.7                                    | 22                 |
| 39          | 002/(24)                  | 19 x 0.12 (1)                             | 7            | 002/(24)            | 19 x 0.12 (1)                            | 0.58                      | 0.25                         | 124                         | 0.079                | 1.13            | 4.4                                    | 28                 |
| 40          | 004/(22)                  | 19 x 0.15 (1)                             | 7            | 004/(22)            | 19 x 0.15 (1)                            | 0.76                      | 0.40                         | 65                          | 0.079                | 1.26            | 4.9                                    | 40                 |
| 41          | 006/(20)                  | 19 x 0.20 (1)                             | 7            | 006/(20)            | 19 x 0.20 (1)                            | 0.99                      | 0.60                         | 38                          | 0.079                | 1.48            | 5.8                                    | 65                 |

**NOTES** 1. In accordance with ISO 2635. AWG sizes are given for reference.



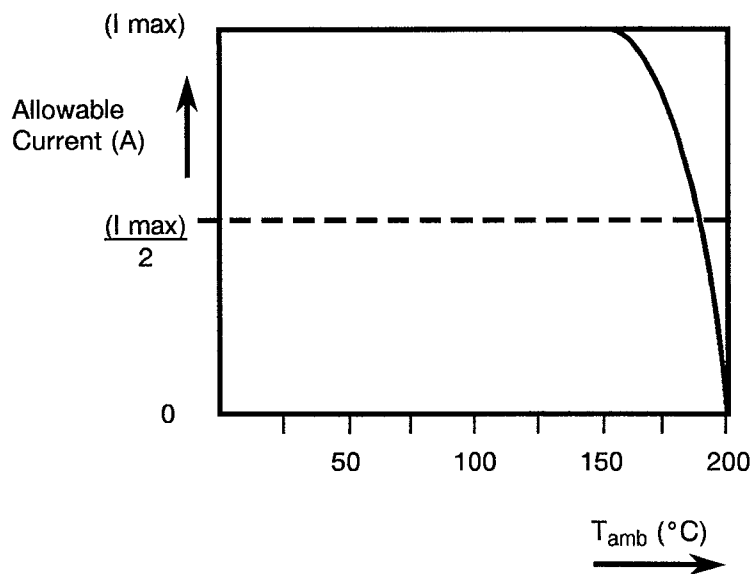
**TABLE 1(b) - MAXIMUM RATINGS**

| No. | CHARACTERISTICS             | SYMBOL    | MAXIMUM RATINGS  | UNIT | REMARKS  |
|-----|-----------------------------|-----------|--|------|--|
| 1   | Voltage                     | $V_p$     | 600  | Vrms |  |
| 2   | Maximum Current (Note 1)    | $I_{max}$ | 1.3<br>1.5<br>2.5<br>3.5<br>5.0<br>7.5<br>10<br>13<br>23 | A    | For AWG 30<br>28<br>26<br>24<br>22<br>20<br>18<br>16<br>12 |
| 3   | Operating Temperature Range | $T_{amb}$ | - 200 to + 200   | °C   |  |
| 4   | Storage Temperature Range   | $T_{stg}$ | - 200 to + 200   | °C   |  |

**NOTES**

- 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**



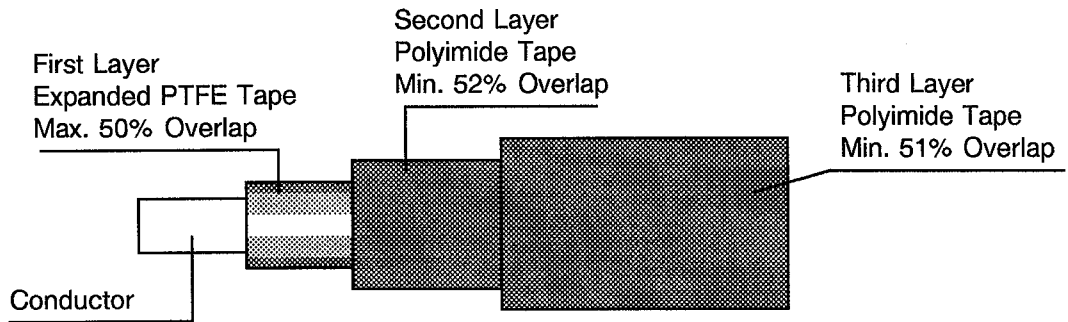
Allowable Current versus Temperature



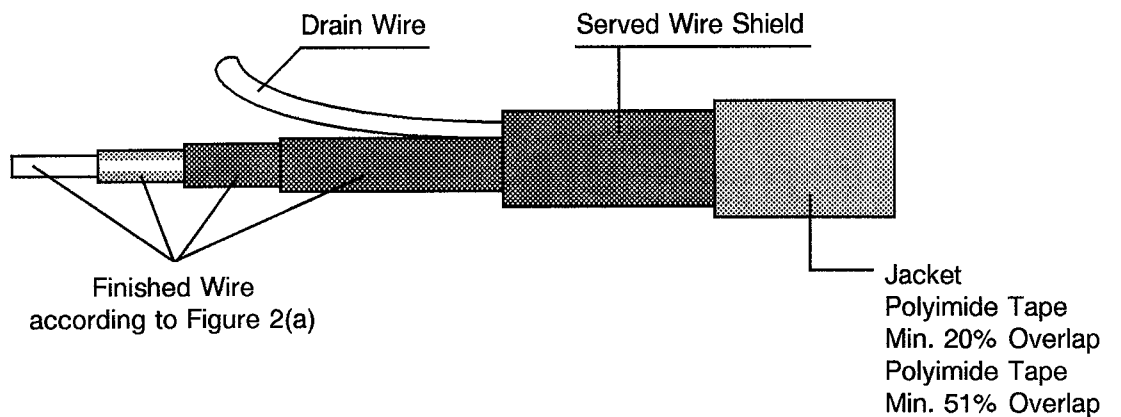
**FIGURE 2 - PHYSICAL CHARACTERISTICS**

Dimensions are given in Table 1(a)

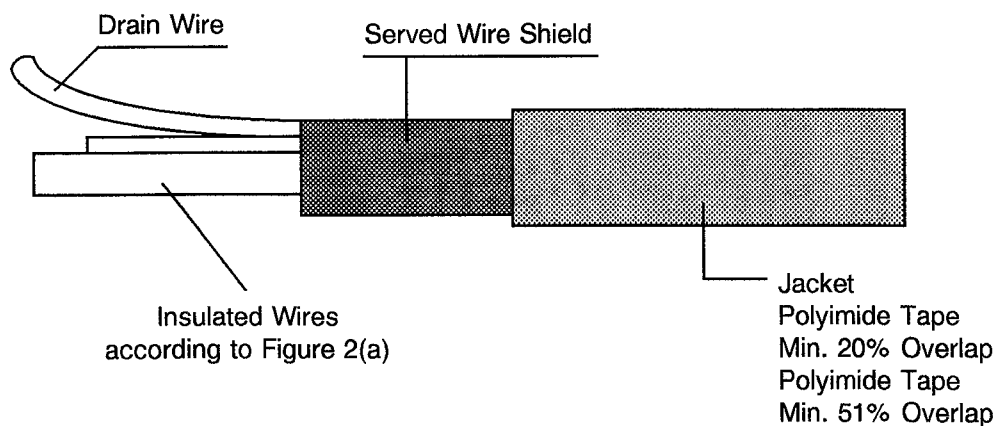
**FIGURE 2(a) - FINISHED WIRES**



**FIGURE 2(b) - SINGLE CABLE WITH SHIELD AND JACKET**



**FIGURE 2(c) - MULTICORE CABLE WITH SHIELD AND JACKET**



**2. APPLICABLE DOCUMENTS**

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

- (a) ESA/SCC Generic Specification No. 3901, Wires and Cables, Electrical, 600V, Low Frequency.
- (b) ISO 2635, Conductors for General Purpose Aircraft Electrical Cables and Aerospace Applications - Dimensions and Characteristics.

**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 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 and Electrical Measurements (Chart III)**

Not applicable.

**4.2.4 Deviations from Qualification, Environmental and Endurance 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 |
|------------------------|------------|----------|-----------|
| <u>COMPOSITION</u>     |            |          |           |
| Number of conductors   | X          |          |           |
| Gauge                  | X          |          |           |
| Shielding              | X          |          |           |
| Jacket                 |            | X        |           |
| <u>CONDUCTOR</u>       |            |          |           |
| Nature                 |            |          | X         |
| Outer diameter         | X          |          |           |
| Number of strands      | X          |          |           |
| Strand diameter        | X          |          |           |
| Length of lay          |            |          | X         |
| Silver thickness       |            |          | X         |
| <u>INSULATION</u>      |            |          |           |
| Composition            |            | X        | X         |
| Thickness              |            |          | X         |
| Concentricity          |            |          | X         |
| Outer diameter         | X          |          |           |
| Core identification    |            |          | X         |
| Colour                 |            |          | X         |
| <u>SHIELDING</u>       |            |          |           |
| Number of strands      | X          |          |           |
| Type of shielding      |            |          | X         |
| Strand diameter        | X          |          |           |
| Nature                 |            | X        |           |
| Shield strand adhesion |            |          | X         |
| Shielding lay          |            |          | X         |
| Shield coverage        |            |          | X         |
| <u>DRAIN WIRE</u>      |            |          |           |
| Nature                 |            | X        | X         |
| Outer diameter         | X          |          |           |
| Number of strands      | X          |          |           |
| Strand diameter        | X          |          |           |
| Length of lay          |            |          | X         |
| Silver thickness       |            |          | X         |
| <u>JACKET</u>          |            |          |           |
| Composition            |            | X        | X         |
| Protective Tape Wraps  |            | X        | X         |
| Thickness              |            |          | X         |
| Overlapping            |            | X        |           |
| Outer diameter         | X          |          |           |
| Colour                 |            |          | X         |



#### 4.3.2 Weight

The maximum weight of the finished 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, high strength copper alloy for ISO 004, 006, 012 and 030, AWG 18 and silver-coated, high strength copper alloy for ISO 001 and 002 and AWG 28 to AWG 30 inclusive. On silver-coated strands, the thickness of silver shall be 2.0 $\mu$ m minimum.

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

For high-strength copper alloy conductors, the tensile characteristics shall be 6% minimum in elongation and 35kg/mm<sup>2</sup> minimum in tensile strength.

For the determination of the conductor resistance, as mentioned in Para. 9.5 of ESA/SCC Generic Specification No. 3901, the  $\alpha$  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 over expanded PTFE 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 cables and the conductor shall be evenly centred in the insulation.

The insulation shall consist of 1 wrapped layer of expanded PTFE tape and 2 wrapped layers of polyimide tapes as specified in Figure 2(a).



#### 4.4.3 Shield

##### 4.4.3.1 Material

Shield strands shall meet the requirements for silver-coated, soft or annealed copper outlined in Para. 4.4.1.1 of this specification, but the thickness of silver shall be 2.5µm minimum.

##### 4.4.3.2 Construction

The shield 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. The coverage factor K is calculated as follows:-

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

where:-

- K = % coverage
- n = number of serving wires
- d<sub>w</sub> = shield strand diameter (mm)
- D = diameter of core (mm)
- P = serving pitch (mm)

#### 4.4.4 Drain Wire

Material, construction, stranding as well as size of the drain wire shall be exactly the same as the conductor of the single insulated wire. It shall be placed underneath the served wire shield.

#### 4.4.5 Jacket

All shielded cables shall be provided with jackets of wrapped polyimide tapes as specified in Figures 2(b) and 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.

The jacket shall have an even wall thickness of 0.1mm.

#### 4.4.6 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 left-hand lay and the length of lay shall not be less than 12, nor more than 16, times the outside diameter of the unshielded,unjacketed cable. The construction of shielded and jacketed cables is shown in Figures 2(b) and 2(c). Fillers shall not be used in the construction of multicore cables except for the 5- and 6-core cables, where the 5/6 wires shall be twisted around a round, uncoloured filler made of expanded polytetrafluorethylene. The diameter of the filler for the 5/6-core cables shall be 0.7/1.0 times the diameter of the wires used in the cables.



4.4.7 Colour Coding

4.4.7.1 Single and Multicore Cable Colour Coding

The colour coding of all cables shall be according to the following list, if not otherwise specified in the contract.

| Number 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 |

4.4.7.2 Jacket Colour

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

4.5 MARKING

4.5.1 General

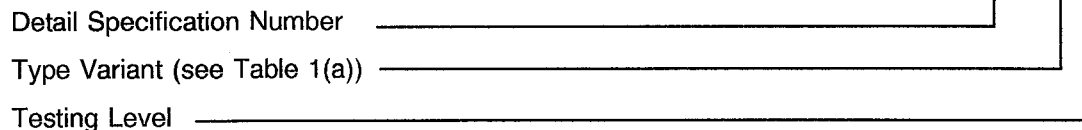
The marking of all spools of finished cables delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700. Each spool shall be marked in respect of:-

- (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:-

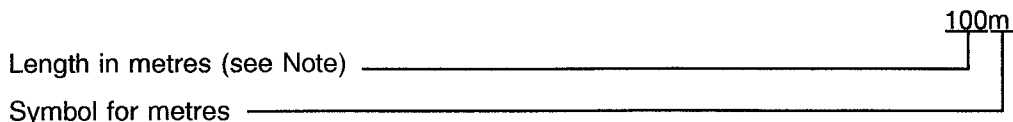
390102101B





4.5.3 Characteristics

The characteristics shall show the length(s) of the finished cable 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 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 or initials.

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  $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$ .

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's 4.4.1.1 and 4.4.4 of this Specification.

**4.8.2 Accelerated Ageing**Ageing Temperature  $+230 \pm 5$  °C.**TABLE A - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES**

| Wire Size<br>ISO/(AWG) | Mandrel Diameter<br>(mm) | Weight<br>(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           |
| - /(18)                | 10                       | 0.50           |
| 012/(16)               | 10                       | 0.50           |
| 030/(12)               | 20                       | 1.00           |

**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 screened and jacketed cables are given in Table B.

**4.8.4 Voltage Test**

No particular conditions are applicable.

**4.8.5 Shrinkage**The shrinkage temperature shall be  $+200 \pm 5$  °C**4.8.6 Blocking**The blocking temperature shall be  $+230 \pm 5$  °C.**4.8.7 Cold Bend Test**

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

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

| Cable Size<br>ISO/(AWG) | Number of<br>Cores | Mandrel<br>Diameter<br>(mm) | Load<br>(kg) |
|-------------------------|--------------------|-----------------------------|--------------|
| -/(30)                  | 1                  | 10                          | 0.15         |
| -/(28)                  | 1                  | 15                          | 0.25         |
| 001/(26)                | 1                  | 15                          | 0.25         |
| 002/(24)                | 1                  | 15                          | 0.25         |
| 004/(22)                | 1                  | 20                          | 0.50         |
| 006/(20)                | 1                  | 25                          | 0.50         |
| -/(18)                  | 1                  | 30                          | 1.00         |
| 012/(16)                | 1                  | 30                          | 1.00         |
| 030/(12)                | 1                  | 40                          | 1.00         |
| -/(30)                  | 2                  | 20                          | 0.25         |
| -/(28)                  | 2                  | 20                          | 0.50         |
| 001/(26)                | 2                  | 20                          | 0.50         |
| 002/(24)                | 2                  | 25                          | 0.50         |
| 004/(22)                | 2                  | 30                          | 0.80         |
| 006/(20)                | 2                  | 35                          | 0.80         |
| 012/(16)                | 2                  | 50                          | 1.00         |
| 030/(12)                | 2                  | 60                          | 1.00         |
| -/(30)                  | 3                  | 15                          | 0.25         |
| -/(28)                  | 3                  | 20                          | 0.50         |
| 001/(26)                | 3                  | 25                          | 0.75         |
| 002/(24)                | 3                  | 30                          | 0.75         |
| 004/(22)                | 3                  | 30                          | 1.20         |
| 006/(20)                | 3                  | 40                          | 1.20         |
| -/(30)                  | 4                  | 20                          | 0.50         |
| -/(28)                  | 4                  | 25                          | 0.80         |
| 001/(26)                | 4                  | 25                          | 1.00         |
| 002/(24)                | 4                  | 30                          | 1.00         |
| 004/(22)                | 4                  | 35                          | 1.50         |
| 006/(20)                | 4                  | 40                          | 1.50         |
| 001/(26)                | 5                  | 25                          | 1.50         |
| 002/(24)                | 5                  | 30                          | 1.50         |
| 004/(22)                | 5                  | 35                          | 2.00         |
| 006/(20)                | 5                  | 40                          | 2.00         |
| 001/(26)                | 6/7                | 35                          | 1.50         |
| 002/(24)                | 6/7                | 30                          | 1.50         |
| 004/(22)                | 6/7                | 35                          | 2.00         |
| 006/(20)                | 6/7                | 40                          | 2.00         |

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

| Wire Size<br>ISO/(AWG) | Mandrel Diameter<br>(mm) | Weight<br>(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           |
| -/(18)                 | 10                       | 0.50           |
| 012/(16)               | 10                       | 0.50           |
| 030/(12)               | 20                       | 1.00           |

**4.8.8 Cut-through Resistance**

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

| Wire Size ISO         | -    | -    | 001  | 002  | 004  | 006  | -    | 012  | 030  |
|-----------------------|------|------|------|------|------|------|------|------|------|
| (AWG)                 | (30) | (28) | (26) | (24) | (22) | (20) | (18) | (16) | (12) |
| Cut-through Load (kg) | 9.0  | 11   | 11   | 11   | 25   | 32   | 32   | 35   | 50   |

**4.8.9 Notch Resistance**

The depth of notch shall be 0.04mm.

**4.8.10 Flammability**

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             | -    | -    | 001  | 002  | 004  | 006  | -    | 012  | 030  |
|---------------------------|------|------|------|------|------|------|------|------|------|
| (AWG)                     | (30) | (28) | (26) | (24) | (22) | (20) | (18) | (16) | (12) |
| Scrape Abrasion Load (kg) | 350  | 500  | 650  | 750  | 800  | 900  | 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 Long-term Ageing Test**

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

**4.8.19 Anthony and Brown Test**

No particular conditions are applicable.

**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE**

| No. | CHARACTERISTICS       | SPEC. AND/OR 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 : 3.0<br>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<br>Jacket : 30  | MΩ.km |
| 5   | Surface Resistance    | ESA/SCC No. 3901, Section 9 | Para 9.22      | : 125                            | MΩ.mm |

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ISSUE 1

**APPENDIX 'A'**Page 1 of 1**AGREED DEVIATIONS FOR W.L. GORE & ASSOCIATES (GmbH)**

| ITEMS AFFECTED | DESCRIPTION OF DEVIATIONS              |
|----------------|--|
| Figure 2       | Expanded PTFE tape shall be GORE-TEX ® |
| Para. 4.4.2.1  | Expanded PTFE tape shall be GORE-TEX ® |

**NOTES**

1. GORE-TEX ® = Registered Trade Mark of W.L. Gore and Associates (GmbH).