



**POLYIMIDE INSULATED FINISHED WIRES AND CABLES,
LOW FREQUENCY, 600V, -100 TO +200°C**

ESCC Detail Specification No. 3901/002

| | |
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| DCR No. | CHANGE DESCRIPTION |
|---------|--------------------------------------------------------|
| 1615 | Specification upissued to incorporate changes per DCR. |

TABLE OF CONTENTS

| | | |
|-------|-----------------------------------------------------------------|----|
| 1 | GENERAL | 6 |
| 1.1 | SCOPE | 6 |
| 1.2 | COMPONENT TYPE VARIANTS | 6 |
| 1.3 | MAXIMUM RATINGS | 6 |
| 1.4 | PARAMETER DERATING INFORMATION | 6 |
| 1.5 | PHYSICAL CHARACTERISTICS | 6 |
| 1.6 | FUNCTIONAL DIAGRAM | 6 |
| 2 | APPLICABLE DOCUMENTS | 12 |
| 3 | TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS | 12 |
| 4 | REQUIREMENTS | 12 |
| 4.1 | GENERAL | 12 |
| 4.2 | DEVIATIONS FROM GENERIC SPECIFICATION | 12 |
| 4.2.1 | Deviations from Special In-process Controls | 12 |
| 4.2.2 | Deviations from Final Production Tests - Chart II | 12 |
| 4.2.3 | Deviations from Burn-in and Electrical Measurements - Chart III | 12 |
| 4.2.4 | Deviations from Qualification Tests - Chart IV | 12 |
| 4.2.5 | Deviations from Lot Acceptance Tests - Chart V | 12 |
| 4.3 | MECHANICAL REQUIREMENTS | 13 |
| 4.3.1 | Dimension Check | 13 |
| 4.3.2 | Weight | 13 |
| 4.4 | MATERIALS AND FINISHES | 14 |
| 4.4.1 | Conductor | 14 |
| 4.4.2 | Finished Wire/Core Insulation | 14 |
| 4.4.3 | Cable Assembly | 14 |
| 4.4.4 | Shield | 15 |
| 4.4.5 | Jacket | 15 |
| 4.4.6 | Colour Codes | 16 |
| 4.5 | MARKING | 17 |
| 4.5.1 | General | 17 |
| 4.5.2 | The ESCC Component Number | 17 |
| 4.5.3 | Traceability Information | 18 |
| 4.5.4 | Additional Marking | 18 |
| 4.6 | ELECTRICAL MEASUREMENTS | 18 |
| 4.6.1 | Electrical Measurements at Room Temperature | 18 |
| 4.6.2 | Electrical Measurements at High and Low Temperatures | 18 |
| 4.6.3 | Circuits for Electrical Measurements | 18 |

| | | |
|--------|------------------------------------|----|
| 4.7 | BURN-IN TESTS | 19 |
| 4.8 | ENVIRONMENTAL AND ENDURANCE TESTS | 19 |
| 4.8.1 | Mechanical Properties of Conductor | 19 |
| 4.8.2 | Accelerated Ageing | 19 |
| 4.8.3 | Wrap Test at Ambient Temperature | 20 |
| 4.8.4 | Voltage Test | 20 |
| 4.8.5 | Shrinkage | 20 |
| 4.8.6 | Blocking | 20 |
| 4.8.7 | Cold Bend Test | 21 |
| 4.8.8 | Cut-through Resistance | 21 |
| 4.8.9 | Notch Resistance | 21 |
| 4.8.10 | Flammability | 21 |
| 4.8.11 | Resistance to Fluids | 21 |
| 4.8.12 | Surface Resistance | 21 |
| 4.8.13 | Abrasion Resistance | 21 |
| 4.8.14 | Soldering | 21 |
| 4.8.15 | Solderability | 21 |
| 4.8.16 | Radiation Resistance | 21 |
| 4.8.17 | Overload Resistance | 21 |
| 4.8.18 | Long-term Ageing Test | 22 |
| 4.8.19 | Anthony and Brown Test | 22 |

1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Polyimide Insulated Finished Wires and Cables, Low Frequency, 600V, -100 to +200°C. It shall be read in conjunction with ESCC Generic Specification No. 3901, the requirements of which are supplemented herein.

NOTES:

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

1.2 COMPONENT TYPE VARIANTS

Variants of the basic types of finished 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 core used in a cable shall be:

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

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

where n = number of cores in the cable.

- The temperature derating information is shown in Figure 1 with maximum current I_{max} for a single wire/core.
- 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 wires and cables specified herein are shown in Figures 2(a), 2(b) and 2(c) and their dimensions in Table 1(a).

1.6 FUNCTIONAL DIAGRAM

Not applicable.



TABLE 1(a) – COMPONENT TYPE VARIANTS

| Variant No. | Shielded | Un-Shielded | No. of Cores | Wire Size (AWG) | Stranding No of Strands x Diameter (mm) | Conductor Characteristics | | | Shield Strand Ø (mm) | Core Max Ø (mm) | Finished Wire/Cable Characteristics | |
|------------------------------------------------|----------|-------------|--------------|-----------------|-----------------------------------------|---------------------------|--------------------------------|-----------------------------|----------------------|-----------------|-------------------------------------|--------------------|
| | | | | | | Max Ø (mm) | Nom Section (mm ²) | Max Ohmic Resistance (Ω/km) | | | Max Ø (mm) | Max Weight (kg/km) |
| Variants 01 through 30 deleted, not to be used | | | | | | | | | | | | |
| 31 | | x | 2 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | - | 0.78 | 1.64 | 4.42 |
| 32 | | x | 2 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | - | 0.88 | 1.84 | 5.91 |
| 33 | | x | 2 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | - | 1.08 | 2.24 | 9.41 |
| 34 | | x | 2 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | - | 1.28 | 2.64 | 14.2 |
| 35 | | x | 2 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | - | 1.53 | 3.15 | 21.3 |
| 36 | | x | 3 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | - | 0.78 | 1.76 | 6.45 |
| 37 | | x | 3 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | - | 0.88 | 1.97 | 8.81 |
| 38 | | x | 3 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | - | 1.08 | 2.4 | 14.3 |
| 39 | | x | 3 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | - | 1.28 | 2.84 | 21.1 |
| 40 | | x | 3 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | - | 1.53 | 3.4 | 31.6 |
| 41 | x | | 1 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 148 | 0.08 | 0.78 | 1.13 | 3.85 |
| 42 | x | | 1 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 105 | 0.08 | 0.88 | 1.23 | 4.75 |
| 43 | x | | 1 | 22 | 19x0.16 | 0.85 | 0.38 | 50.9 | 0.08 | 1.08 | 1.43 | 6.86 |
| 44 | x | | 1 | 20 | 19x0.20 | 1.04 | 0.60 | 32.2 | 0.08 | 1.28 | 1.63 | 9.43 |
| 45 | x | | 1 | 18 | 19x0.25 | 1.29 | 0.93 | 20.6 | 0.10 | 1.53 | 1.92 | 13.8 |
| 46 | x | | 2 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.08 | 0.78 | 2.01 | 8 |
| 47 | x | | 2 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | 0.10 | 0.88 | 2.24 | 10.5 |
| 48 | x | | 2 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | 0.10 | 1.08 | 2.65 | 14.8 |
| 49 | x | | 2 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | 0.10 | 1.28 | 3.03 | 20.2 |
| 50 | x | | 2 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | 0.12 | 1.53 | 3.58 | 29.6 |
| 51 | x | | 3 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.10 | 0.78 | 2.15 | 11.2 |
| 52 | x | | 3 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | 0.10 | 0.88 | 2.36 | 14 |



| Variant No. | Shielded | Un-Shielded | No. of Cores | Wire Size (AWG) | Stranding No of Strands x Diameter (mm) | Conductor Characteristics | | | Shield Strand Ø (mm) | Core Max Ø (mm) | Finished Wire/Cable Characteristics | |
|-------------|----------|-------------|--------------|-----------------|-----------------------------------------|---------------------------|--------------------------------|-----------------------------|----------------------|-----------------|-------------------------------------|--------------------|
| | | | | | | Max Ø (mm) | Nom Section (mm ²) | Max Ohmic Resistance (Ω/km) | | | Max Ø (mm) | Max Weight (kg/km) |
| 53 | x | | 3 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | 0.10 | 1.08 | 2.82 | 20.2 |
| 54 | x | | 3 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | 0.12 | 1.28 | 3.26 | 29.4 |
| 55 | x | | 3 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | 0.15 | 1.53 | 3.86 | 44.1 |
| 56 | | x | 1 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 148 | - | - | 0.78 | 1.93 |
| 57 | | x | 1 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 105 | - | - | 0.88 | 2.64 |
| 58 | | x | 1 | 22 | 19x0.16 | 0.85 | 0.38 | 50.9 | - | - | 1.08 | 4.25 |
| 59 | | x | 1 | 20 | 19x0.20 | 1.04 | 0.60 | 32.2 | - | - | 1.28 | 6.49 |
| 60 | | x | 1 | 18 | 19x0.25 | 1.29 | 0.93 | 20.6 | - | - | 1.53 | 9.79 |
| 61 | | x | 1 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 242 | - | - | 0.68 | 1.23 |
| 62 | | x | 2 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | - | 0.68 | 1.43 | 2.7 |
| 63 | | x | 3 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | - | 0.68 | 1.53 | 3.95 |
| 64 | x | | 1 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 242 | 0.08 | 0.68 | 1.07 | 3.05 |
| 65 | x | | 2 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.08 | 0.68 | 1.8 | 5.7 |
| 66 | x | | 3 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.10 | 0.68 | 1.92 | 8.1 |
| 67 | x | | 4 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.10 | 0.68 | 2.15 | 10.15 |
| 68 | x | | 4 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.10 | 0.78 | 2.4 | 13.3 |
| 69 | x | | 4 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | 0.10 | 0.88 | 2.65 | 16.5 |
| 70 | x | | 4 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | 0.12 | 1.08 | 3.17 | 26.4 |
| 71 | x | | 4 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | 0.15 | 1.28 | 3.7 | 38.8 |
| 72 | x | | 5 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.10 | 0.68 | 2.27 | 12.1 |
| 73 | x | | 5 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.10 | 0.78 | 2.56 | 15.8 |
| 74 | x | | 1 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 242 | 0.08 | 0.68 | 1.02 | 2.95 |
| 75 | x | | 1 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 148 | 0.08 | 0.78 | 1.09 | 3.75 |
| 76 | x | | 1 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 105 | 0.08 | 0.88 | 1.19 | 4.65 |



| Variant No. | Shielded | Un-Shielded | No. of Cores | Wire Size (AWG) | Stranding No of Strands x Diameter (mm) | Conductor Characteristics | | | Shield Strand Ø (mm) | Core Max Ø (mm) | Finished Wire/Cable Characteristics | |
|-------------|----------|-------------|--------------|-----------------|-----------------------------------------|---------------------------|--------------------------------|-----------------------------|----------------------|-----------------|-------------------------------------|--------------------|
| | | | | | | Max Ø (mm) | Nom Section (mm ²) | Max Ohmic Resistance (Ω/km) | | | Max Ø (mm) | Max Weight (kg/km) |
| 77 | x | | 1 | 22 | 19x0.16 | 0.85 | 0.38 | 50.9 | 0.08 | 1.08 | 1.39 | 6.75 |
| 78 | x | | 1 | 20 | 19x0.20 | 1.04 | 0.60 | 32.2 | 0.08 | 1.28 | 1.59 | 9.3 |
| 79 | x | | 1 | 18 | 19x0.25 | 1.29 | 0.93 | 20.6 | 0.10 | 1.53 | 1.87 | 13.65 |
| 80 | x | | 2 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.08 | 0.68 | 1.67 | 5.5 |
| 81 | x | | 2 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.08 | 0.78 | 1.87 | 7.4 |
| 82 | x | | 2 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | 0.10 | 0.88 | 2.1 | 9.8 |
| 83 | x | | 2 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | 0.10 | 1.08 | 2.5 | 14 |
| 84 | x | | 2 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | 0.10 | 1.28 | 2.9 | 19.4 |
| 85 | x | | 2 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | 0.12 | 1.53 | 3.4 | 28.2 |
| 86 | x | | 3 | 28 | 19x0.08 (1) | 0.43 | 0.10 | 254 | 0.10 | 0.68 | 1.81 | 7.9 |
| 87 | x | | 3 | 26 | 19x0.10 (1) | 0.53 | 0.15 | 155 | 0.10 | 0.78 | 2.2 | 10.6 |
| 88 | x | | 3 | 24 | 19x0.12 (1) | 0.64 | 0.21 | 110 | 0.10 | 0.88 | 2.24 | 13.3 |
| 89 | x | | 3 | 22 | 19x0.16 | 0.85 | 0.38 | 53.5 | 0.10 | 1.08 | 2.67 | 19.2 |
| 90 | x | | 3 | 20 | 19x0.20 | 1.04 | 0.60 | 33.8 | 0.12 | 1.28 | 3.14 | 28.4 |
| 91 | x | | 3 | 18 | 19x0.25 | 1.29 | 0.93 | 21.6 | 0.15 | 1.53 | 3.67 | 42 |

NOTES:

1. Copper alloy.

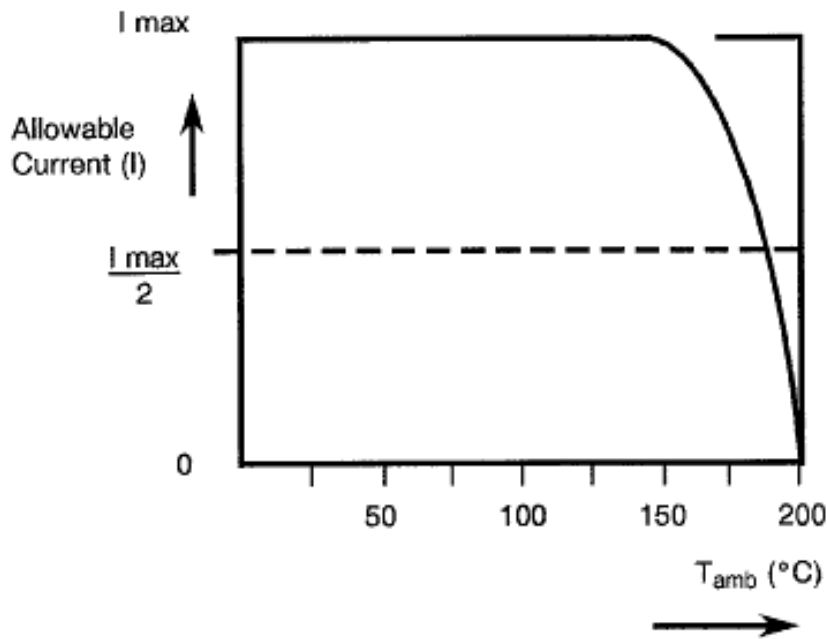
TABLE 1(b) MAXIMUM RATINGS

| No. | Characteristics | Symbols | Maximum Ratings | Units | Remarks |
|-----|----------------------------------------------------------|-----------|-------------------------------------|-------|----------------------------------------------|
| 1 | Voltage | V_P | 600 | Vrms | |
| 2 | Maximum Current (each finished wire/core) (Note 1) | I_{max} | 1.5 2.5 3.5 5 7.5 10 | A | For AWG: 28 26 24 22 20 18 |
| 3 | Operating Temperature Range | T_{amb} | -100 to +200 | °C | |
| 4 | Storage Temperature Range | T_{stg} | -100 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 WIRE / CORE

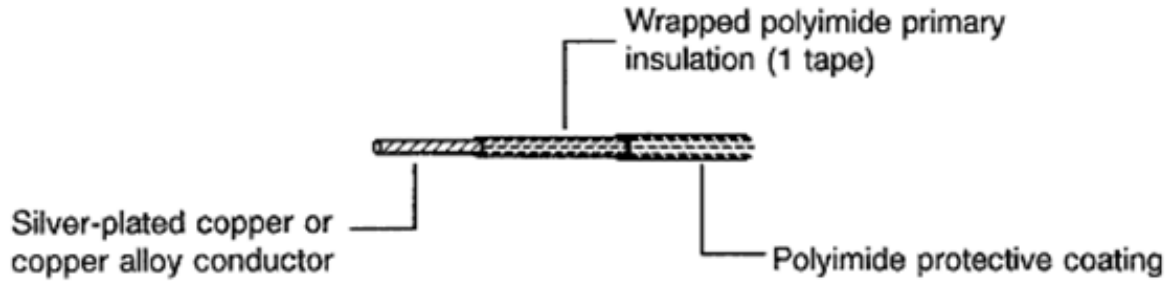


FIGURE 2(b) - SHIELDED AND JACKETED CABLES

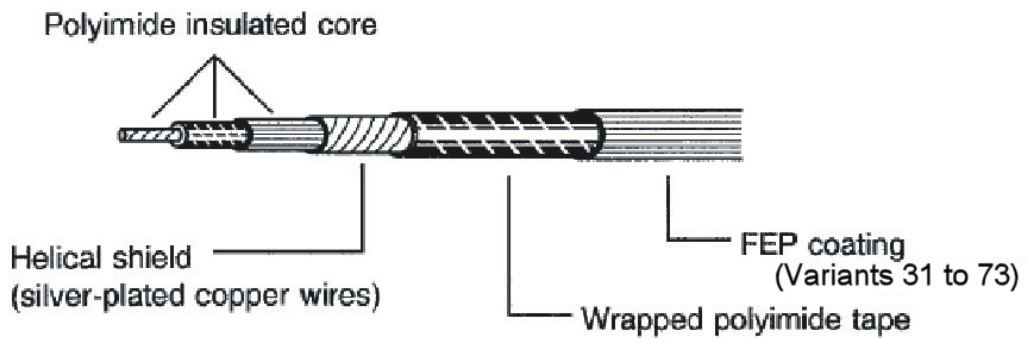
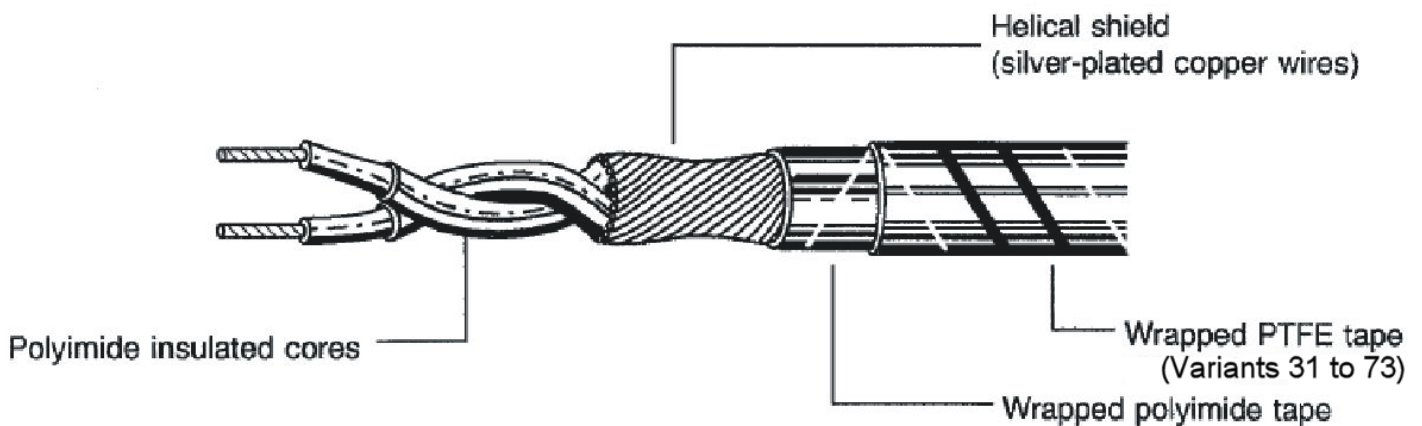


FIGURE 2(c) - SHIELDED AND JACKETED CABLES



2 **APPLICABLE DOCUMENTS**

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

- (a) ESCC Generic Specification No. [3901](#), Wires and Cables, Electrical, 600V, Low Frequency.
- (b) MIL-DTL-81381, Wire, Electric, Polyimide-insulated, Copper or Copper Alloy.

3 **TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. [21300](#) and ESCC Generic Specification No. [3901](#) shall apply.

4 **REQUIREMENTS**

4.1 **GENERAL**

The complete requirements for procurement of the finished wires/cables specified herein are stated in this specification and ESCC 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 ESCC 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 Tests - Chart IV**

- (a) Para. 9.21, Resistance to Fluids: To be modified as stated in 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/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 and Colour | | X | X |
| Protective coating | | X | X |
| Thickness | | | X |
| Overlapping | | | X |
| Outer diameter | X | | |
| <u>Shielding</u> | | | |
| Number of strands | X | | |
| Type of shielding | | | X |
| Strand diameter | X | | |
| Nature | | X | X |
| Silver thickness | | | X |
| Shielding lay | | | X |
| Shield coverage | | | X |
| <u>Jacket</u> | | | |
| Composition and Colour | | X | X |
| Protective coating | | X | X |
| Thickness | | | X |
| Overlapping | | | X |
| Outer diameter | X | | |
| Stripe dimensions | | | X |

4.3.2 Weight

The maximum weight of the finished wires/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 finished wires/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 from AWG 18 to 22 inclusive and silver-coated, high strength copper alloy from AWG 24 to 28. On silver-coated strands, the thickness of the silver shall be 2 microns minimum.

On all copper conductors, any strand shall show a 10% minimum elongation. On all high-strength copper alloy conductors, any strand shall show a 6% minimum elongation at break and a 350N/mm² minimum tensile strength.

The resistance of the conductors shall be determined at +20°C in accordance with Para. 9.5 of ESCC Generic Specification No. 3901, where 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 the left-hand 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 Finished Wire/Core 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 consist of 1 wrapped ribbon, the overlapping of which shall be equal to, or more than, 67%. Each ribbon (30µm of thickness) shall conform to 0.1/1.0/0.1 type according to MIL-DTL-81381. The insulation shall have a uniform cross-section throughout the length of the finished wire/core and the conductor shall be evenly centred in the insulation. The nominal wall thickness, including the polyimide protective coating, shall be 0.11mm.

4.4.2.3 *Insulation Colour*

See Para. 4.4.6.

4.4.3 Cable Assembly

A multicore cable shall be constructed by assembling the cores in a right-hand concentric lay. The length of lay shall not be less than 10, nor more than 14 times the maximum multicore assembly diameter as detailed in Table 1(a). A Teflon PTFE filler is necessary in the centre of the 4-core and 5-core cables.

4.4.4 Shield

4.4.4.1 *Material*

Shield strands shall meet the requirements for silver-coated annealed copper as outlined in Para. 4.4.1.1 of this specification.

4.4.4.2 *Construction*

The shield shall be wound closely and helically around the strands and provide not less than 92% coverage, 'K' being calculated by the following formula:

$$K = \frac{n \cdot d \sqrt{(L^2 + P^2)}}{P \cdot L}$$

where:

- K = % coverage
- n = total number of shield strands
- d = mean shield strand diameter
- L = apparent shielding lay
- P = outside perimeter of the shielded cable

where:

- for a single core cable: $P = \pi(D + d)$
- for a multicore cable: $P = \pi(D + d) + xD$

where:

- D = mean diameter of core insulation
- x = the number of cores

NOTE: The shield may exhibit an occasional gap between strands provided that:

- the coverage coefficient meets the required value
- the gap width and gap length are no more than 0.5mm and 50mm respectively

4.4.5 Jacket

For single-core shielded cable:

- 2 Layers minimum of polyimide tape, type .1/1/.1 according to MIL-DTL-81381, coated with pigmented FEP before identification by coloured stripes on the outside.
- or
- 2 layers minimum of polyimide tape type .1/1/.1 according to MIL-DTL-81381, with coloured stripes on the outside.

For multicore shielded cables:

- 1 Layer minimum of polyimide tape, type .1/1/.1 according to MIL-DTL-81381, plus 1 layer of coloured PTFE tape with coloured stripes on the outside.
- or
- 2 layers minimum of polyimide tape type .1/1/.1 according to MIL-DTL-81381, with coloured stripes on the outside.

For multicore unshielded cable: 1 Layer minimum of polyimide tape, type .1/1/.1 according to MIL-DTL-81381, with coloured stripes on the outside.

4.4.5.1 *Jacket Colour*

Jacket colour: see Para. 4.4.6.

Coloured stripes shall be helically applied on the jacket and grouped in accordance with the following:

- 1-core cable: 1 narrow stripe
- 2-core cable: 2 narrow stripes
- 3-core cable: 3 narrow stripes except AWG 28: no stripes
- 4-core cable: 1 wide stripe
- 5-core cable: 1 wide plus 1 narrow stripe

Jacket stripe colour shall be as specified in Para. 4.4.6.

Jacket stripe dimensions shall be as follows:

- Narrow stripe width: 0.6mm.
- Wide stripe width: 1.6mm.
- Space between stripes: 1mm.
- General tolerance: ±30%.

4.4.6 Colour Codes

- (a) Without Finished Wire/Core Colour Identification (see Para. 4.5.2(a)):
When the ESCC Component Number, as stipulated in the Purchase Order, does not include a finished wire/core colour identification, the default colour codes for the cable jacket and the jacket stripes as well as all finished wire/cable core(s) insulation shall be as follows:

DEFAULT COLOUR CODING

| Wire Size (AWG) | All Finished Wire/Cable Core(s) Insulation Colour | Cable Jacket Colour | | Cable Jacket Stripes Colour |
|-----------------|---------------------------------------------------|---------------------|---------------------|-----------------------------|
| | | Polyimide | PTFE or FEP Coating | |
| 28 | Brown | Amber | White | Brown |
| 26 | Black | Amber | White | Black |
| 24 | Khaki-Beige | Amber | Light blue | White |
| 22 | Red | Amber | White | Red |
| 20 | Green | Amber | White | Green |
| 18 | Yellow | Amber | White | Yellow |

- (b) With Finished Wire/Core Colour Identification (see Para. 4.5.2(b)):
When the ESCC Component Number, as stipulated in the Purchase Order, includes a finished wire/core colour identification, the custom colour(s) of the finished wire/cable core(s) insulation shall be as specified by the Orderer in any combination selected from the following 6 available (see Para. 4.5.2.2(b)):

- **Black, Brown, Red, Yellow, Green, Khaki-Beige**

The colour codes for the cable jacket and the jacket stripes shall be as specified in (a) above.

4.5 MARKING

4.5.1 General

The marking of all spools of finished wires/cables delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700.

Each spool shall be marked in respect of:

- (a) The ESCC qualified components symbol (for ESCC qualified components only).
- (b) The ESCC Component Number (see Note 1)
- (c) Traceability Information.
- (d) Additional Marking.

NOTES:

1. Whenever more than one length of finished wire/cable is wound on a single spool, the full marking for each length including the ESCC Component Numbers shall be marked on the spool. The characteristic code(s) for each length (see Para. 4.5.2.2(a)) may be marked separately on the spool.

4.5.2 The ESCC Component Number

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

- (a) Without finished wire/core colour identification (see Para. 4.4.6(a)):

Example: 390100272B100m

- Detail Specification Reference: 3901001
- Component Type Variant Number (see Table 1(a)): 72 (as required)
- Testing level (B is mandatory): B
- Characteristic code: wire/cable length: 100m (as required; see Para. 4.5.2.2(a))

- (b) With finished wire/core colour identification (see Para. 4.4.6(b)):

Example: 390100272B100m02459

- Detail Specification Reference: 3901001
- Component Type Variant Number (see Table 1(a)): 72 (as required)
- Testing level (B is mandatory): B
- Characteristic code: finished wire/cable length: 100m (as required; see Para. 4.5.2.2(a))
- Characteristic code: finished wire/core colour identification (**black**, **red**, **yellow**, **green**, **khaki-beige**): 02459 (as required; see Para. 4.5.2.2(b))

4.5.2.2 Characteristics Codes

Characteristics to be codified as part of the ESCC Component Number shall be as follows:

(a) Finished Wire/Cable Length:

The required length of the finished wire/cable expressed by means of the following codes. The unit quantity shall be metre (m).

| Nominal Length (m) | Code |
|--------------------|------|
| X | 00Xm |
| XX | 0XXm |
| XXX | XXXm |

(b) Finished Wire/Core Colour Identification:

When included as part of the ESCC Component Number, the required custom colour(s) of the finished wire/core(s) insulation expressed by means of up to 5 single digits as follows:

| No. of Cores | Code | Remarks |
|--------------|-------|--------------------------------------------|
| 1 | X | See Note 1. Also applies to finished wires |
| 2 | XX | See Note 1 |
| 3 | XXX | See Note 1 |
| 4 | XXXX | See Note 1 |
| 5 | XXXXX | See Note 1 |

NOTES:

1. The individual digits to be used for the 6 available colours are as follows:

- **Black:** 0
- **Brown:** 1
- **Red:** 2
- **Yellow:** 4
- **Green:** 5
- **Khaki-Beige:** 9

4.5.3 Traceability Information

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

4.5.4 Additional Marking

Each spool shall bear the finished wire/cable 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 $T_{amb} = +22 \pm 3^{\circ}C$.

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 $+230 \pm 5^{\circ}\text{C}$.

The mandrel diameter and appropriate weight used for accelerated age testing of the finished wires is given in Table A.

TABLE A - MANDREL DIAMETERS AND LOADS FOR FINISHED WIRES

| Wire Size (AWG) | Mandrel Diameter (mm) | Weight (kg) |
|-----------------|-----------------------|-------------|
| 28 | 6.0 | 0.125 |
| 26 | 6.0 | 0.25 |
| 24 | 6.0 | 0.25 |
| 22 | 6.0 | 0.4 |
| 20 | 6.0 | 0.4 |
| 18 | 10 | 0.5 |

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 cables are given in Table B.

TABLE B – MANDREL DIAMETERS AND LOADS FOR CABLES

| Cable Size (AWG) | Number of Cores | Mandrel Diameter (mm) | Load (kg) |
|------------------|-----------------|-----------------------|-----------|
| 28 | 1 | 6.0 | 0.125 |
| 26 | 1 | 6.0 | 0.25 |
| 24 | 1 | 6.0 | 0.25 |
| 22 | 1 | 6.0 | 0.4 |
| 20 | 1 | 6.0 | 0.4 |
| 18 | 1 | 10 | 0.5 |
| 28 | 2 | 6.0 | 0.25 |
| 26 | 2 | 6.0 | 0.5 |
| 24 | 2 | 12 | 0.5 |
| 22 | 2 | 12 | 0.8 |
| 20 | 2 | 12 | 0.8 |
| 18 | 2 | 12 | 1.0 |
| 28 | 3 | 12 | 0.4 |
| 26 | 3 | 12 | 0.75 |
| 24 | 3 | 12 | 0.75 |
| 22 | 3 | 12 | 1.2 |
| 20 | 3 | 12 | 1.2 |
| 18 | 3 | 12 | 1.5 |
| 28 | 4 | 12 | 0.5 |
| 26 | 4 | 12 | 1.0 |
| 24 | 4 | 12 | 1.0 |
| 22 | 4 | 12 | 1.6 |
| 20 | 4 | 12 | 1.6 |
| 28 | 5 | 12 | 0.7 |
| 26 | 5 | 12 | 1.2 |

4.8.4 Voltage Test

No particular conditions are applicable.

4.8.5 Shrinkage

The shrinkage temperature shall be +230 ±5°C

4.8.6 Blocking

The blocking temperature shall be +200 ±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/CABLE CORES

| Wire Size (AWG) | Mandrel Diameter (mm) | Weight (kg) |
|-----------------|-----------------------|-------------|
| 28 | 6.0 | 0.125 |
| 26 | 6.0 | 0.25 |
| 24 | 6.0 | 0.25 |
| 22 | 6.0 | 0.4 |
| 20 | 6.0 | 0.4 |
| 18 | 10 | 0.5 |

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 (AWG) | 28 | 26 | 24 | 22 | 20 | 18 |
|-----------------------|----|----|----|----|----|----|
| Cut-through Load (kg) | 9 | 12 | 14 | 18 | 23 | 31 |

4.8.9 Notch Resistance

The depth of notch shall be 0.04 mm.

4.8.10 Flammability

No particular conditions are applicable.

4.8.11 Resistance to Fluids

Tests (e) and (f) 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 (AWG) | 28 | 26 | 24 | 22 | 20 | 18 |
|---------------------------|-----|-----|-----|-----|-----|-----|
| Scrape Abrasion Load (kg) | 350 | 450 | 500 | 600 | 650 | 750 |

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 | ESCC No. 3901, Section 9 | Para. 9.5 | Table 1(a) | Ω/km |
| 2 | Spark Test | ESCC No. 3901, Section 9 | Para. 9.6 Insulation: 3kV Jacket: 1.5kV | Para. 9.6 | - |
| 3 | Voltage Test | ESCC No. 3901, Section 9 | Para. 9.7 | Para. 9.7 | - |
| 4 | Insulation Resistance | ESCC No. 3901, Section 9 | Para. 9.8 | Insulation: ≥ 750 Jacket: ≥ 30 | MΩ.km MΩ.km |
| 5 | Surface Resistance | ESCC No. 3901, Section 9 | Para. 9.22 | > 125 | MΩ.mm |