# COAXIAL, DOUBLE SHIELD COAXIAL, SHIELDED AND JACKETED

# COAXIAL CABLES, RADIO FREQUENCY, FLEXIBLE, 50Ω, MINIATURE,

# PTFE DIELECTRIC

# BASED ON TYPE 50 CIS

# ESCC Detail Specification No. 3902/001

| | |
|---|---|
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| DCR No. | CHANGE DESCRIPTION |
|---|---|
| 750 | Specification upissued to incorporate editorial changes per DCR. |

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## 1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Coaxial, Double Shield Coaxial, Shielded and Jacketed Cables, Radio Frequency, Flexible, 50Ω, Miniature, PTFE Dielectric, Based on Type 50 CIS. It shall be read in conjunction with ESCC Generic Specification No. 3902, the requirements of which are supplemented herein.

1.2 TYPE VARIANTS

Variants of the basic types of coaxial 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 coaxial cables specified herein, which shall not be exceeded at any time during use or storage, are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The parameter derating information applicable to the coaxial cables specified herein is scheduled in Figure 1(a).

1.5 PHYSICAL CHARACTERISTICS

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

1.6 FUNCTIONAL DIAGRAM

Not applicable.

## 2 APPLICABLE DOCUMENTS

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

(a) ESCC Generic Specification No. 3902, Wires and Cables, Electrical, 600V, Low Frequency.
(b) IEC Standard No. 1196-1, Coaxial Communication Cables Part 1: Generic Specification, General, Definitions and requirements.
(c) MIL-W-81381, Wires, Electrical, 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. 3902 shall apply.

**TABLE 1(a) – TYPE VARIANTS**

| Variant | Stranding No. of Strands × Ø | Inner Conductor Characteristics | | | Dielectric Core Ø | 1st Shield Strand Ø | 1st Inner Sheath Max. Ø | 2nd Inner Sheath Ø | Outer Shield Strand Ø | Outer Jacket Max. Ø | Max. Weight (kg/km) | Figure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Ø (mm) | Nom. Section ($mm^2$) | Max. Ohmic Resist. (Ω/km) | | | | | | | | |
| 01 | 7 x 0.175 | 0.56 | 0.17 | 122 | 1.52 ±0.03 | - | - | - | 0.07 | 2.05 | 9.5 | 2(a) |
| 02 | 7 x 0.175 | 0.56 | 0.17 | 122 | 1.52 ±0.03 | 0.07 | - | - | 0.07 | 2.7 | 20 | 2(b) |
| 03 | 7 x 0.175 | 0.56 | 0.17 | 122 | 1.52 ±0.03 | 0.07 | 2.05 | 2.25 ±0.05 | 0.1 | 3.3 | 24 | 2(c) |

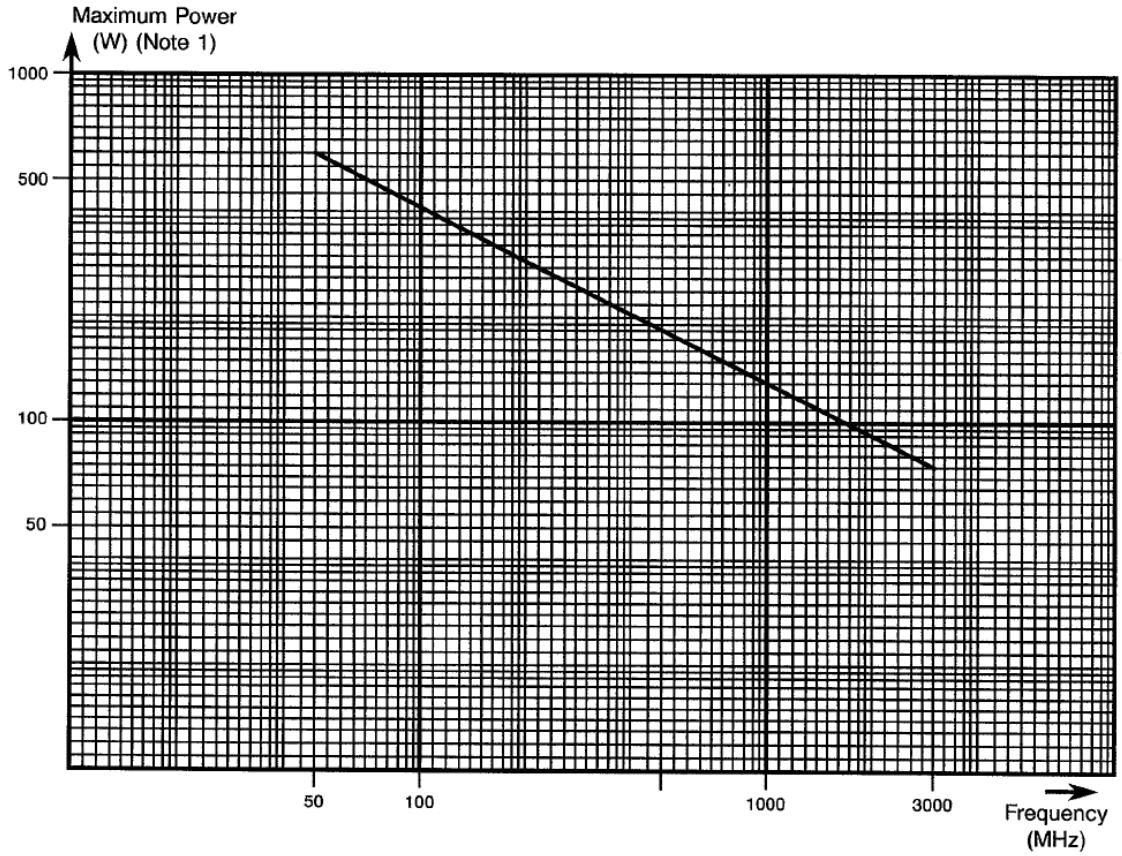
**NOTES:**
1. For Attenuation characteristics, See Figure 1(b).
2. For Return Loss characteristics, see Figure 1(c).
3. For Transfer Impedance characteristics, see Figure 1(d).

**TABLE 1(b) – MAXIMUM RATINGS**

| No. | Characteristics | Symbol | Maximum Rating | Unit | Remarks |
|---|---|---|---|---|---|
| 1 | Continuous Working Voltage | $V_P$ | 900 | $V_{rms}$ | |
| 2 | Operating Frequency | $f_M$ | 3 | GHz | |
| 3 | Power Rating | $P_R$ | See Figure 1(a) | W | Note 1 |
| 4 | Maximum Current | I | 2.5 | A | |
| 5 | Operating Temperature Range<br>Variant 01<br>Variants 02, 03 | $T_{op}$ | <br>-100 to +200<br>-80 to +200 | $^oC$ | $T_{amb}$ Note 1 |
| 6 | Storage Temperature Range<br>Variant 01<br>Variants 02, 03 | $T_{stg}$ | <br>-100 to +200<br>-80 to +200 | $^oC$ | |

**NOTES:**
1. Precautions must be taken to ensure that the aggregate temperature of the cables (ambient plus rise due to power dissipation in the cables) does not exceed the maximum operating temperature.

**FIGURE 1(a) – POWER RATING**




**NOTES:**

1. At +25°C, sea level.

**FIGURE 1(b) – MAXIMUM ATTENUATION**

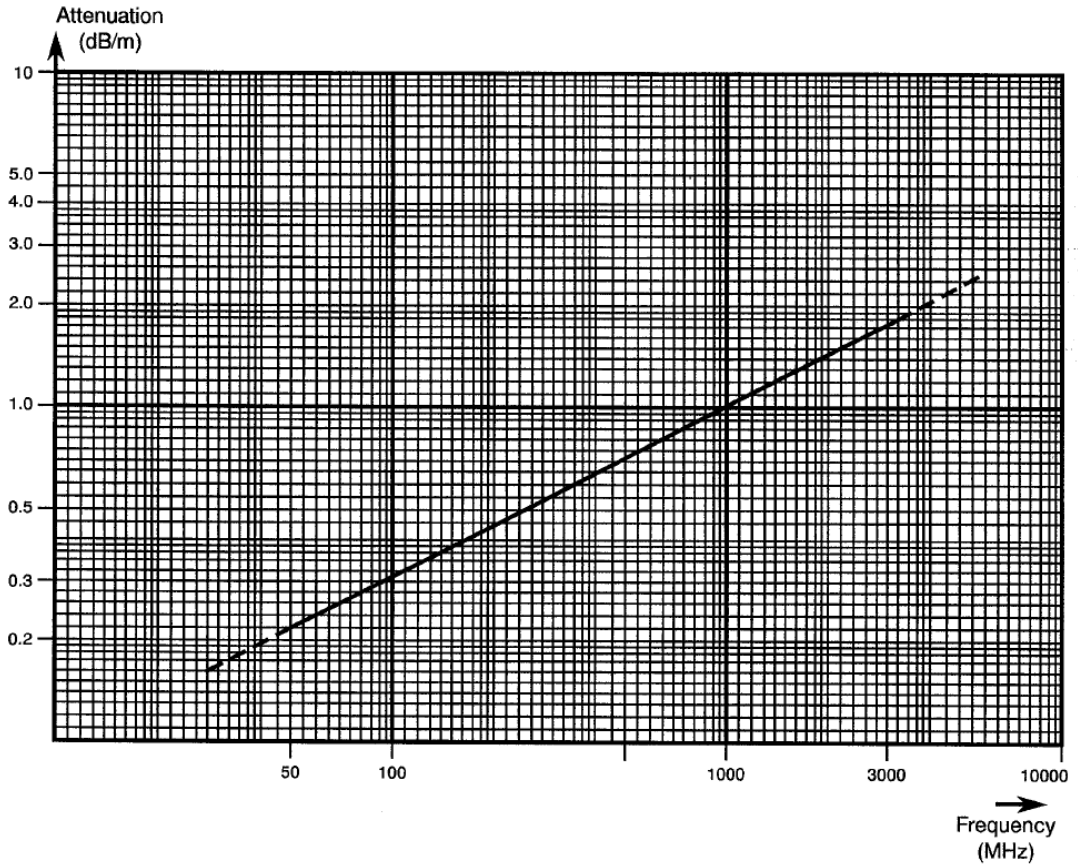


**FIGURE 1(c) – MINIMUM STRUCTURAL RETURN LOSS**

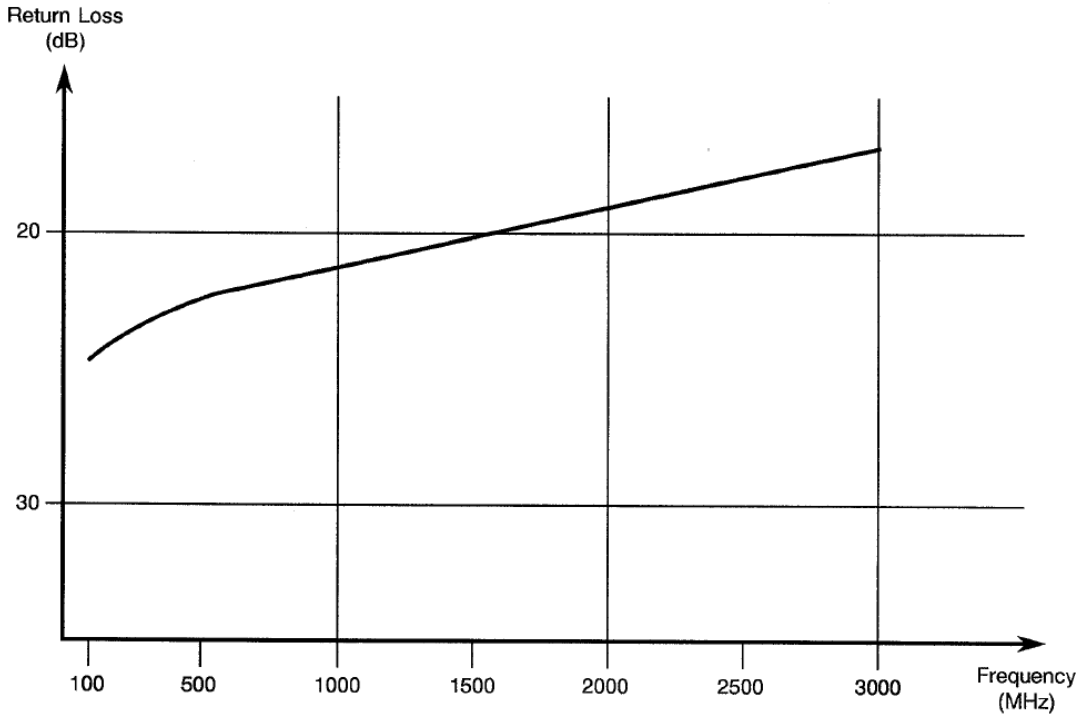


**FIGURE 1(d) – TRANSFER IMPEDANCE**

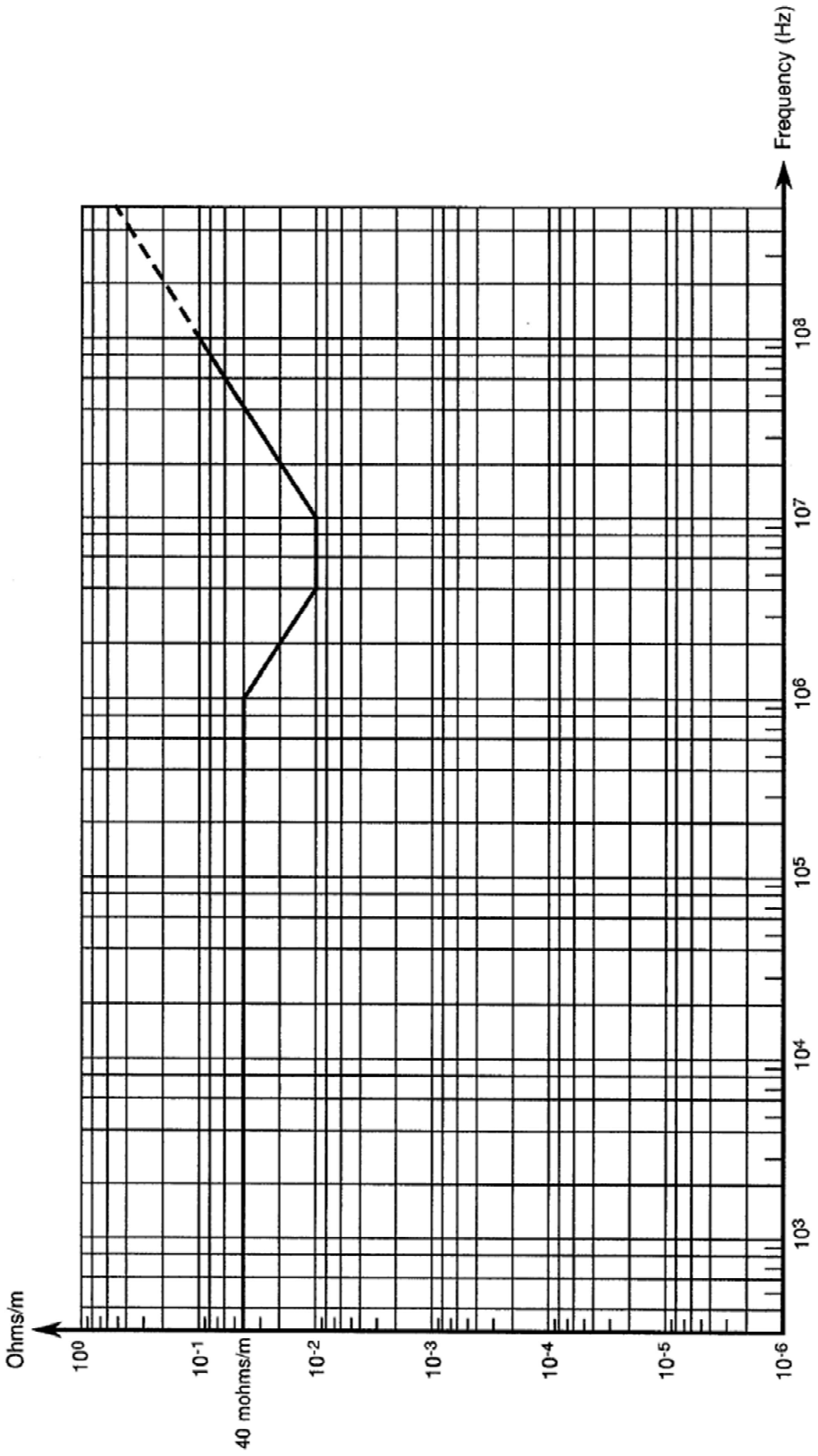


**FIGURE 2 – PHYSICAL CHARACTERISTICS**

FIGURE 2(a) – COAXIAL CABLE VARIANT 01

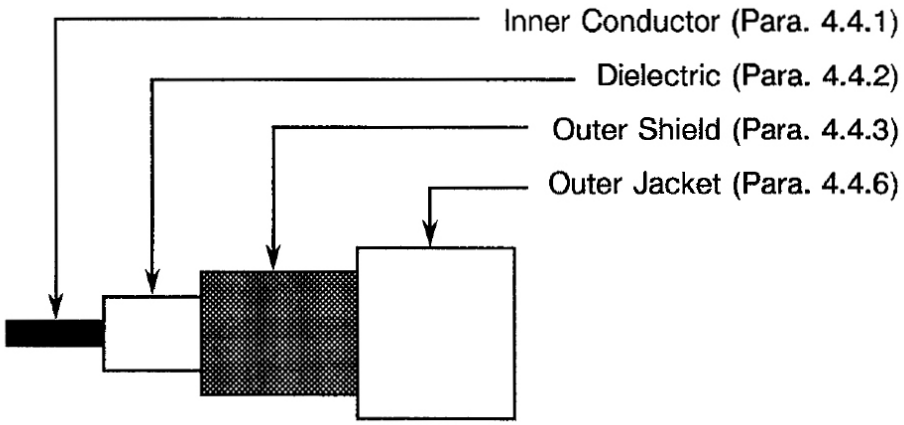



FIGURE 2(b) – DOUBLE SHIELD COAXIAL CABLE VARIANT 02

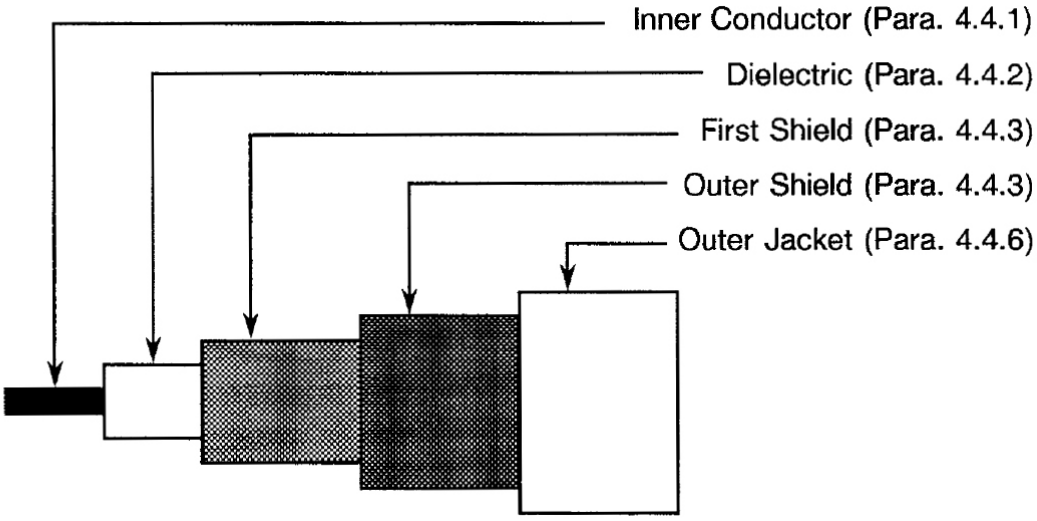
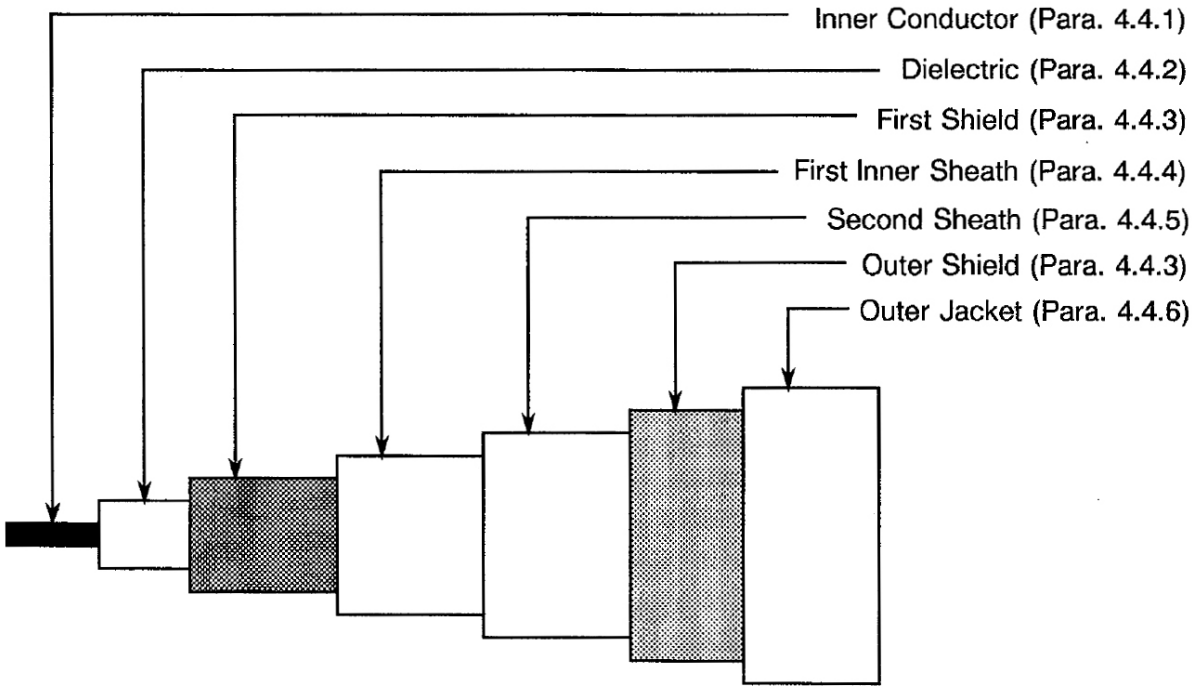


FIGURE 2(c) – SHIELDED AND JACKETED COAXIAL CABLE VARIANT 03



## 4 REQUIREMENTS

### 4.1 GENERAL

The complete requirements for procurement of the finished coaxial cables specified herein are stated in this specification and ESCC Generic Specification No. 3902. 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)

(a) Para. 9.11, Attenuation: Shall be verified at f = 500MHz only.

#### 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. 4.8.7 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 coaxial cables specified herein shall be checked. They shall conform to those shown in Figure 2, Table 1(a) 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 |
|---|---|---|---|
| INNER CONDUCTOR | | | |
| Nature | | | X |
| Outer diameter | X | | |
| Number of strands | X | | |
| Strand diameter | X | | |
| Length of lay | | | X |
| Silver thickness | | | X |
| DIELECTRIC CORE | | | |
| Nature | | X | X |
| Thickness | | | X |
| Concentricity | | | X |
| Outer diameter | X | | |
| INNER AND OUTER SHIELD | | | |
| Number of strands | | | X |
| Strand diameter | X | | |
| Nature | | X | X |
| Silver thickness | | | X |
| Shielding lay | | | X |
| Shield coverage | | | X |
| POLYIMIDE JACKET | | | |
| Composition | | X | X |
| Overlapping | | | X |
| Outer diameter | X | | |
| EXTRUDED PFA JACKETS | | | |
| Thickness | | | X |
| Concentricity | | | X |
| Outer diameter | X | | |

4.3.2 Weight

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

4.3.3 Stripping Capability

(a) Adhesion of Inner Conductor

The result of the test performed as specified in Para. 9.13 of ESCC Generic Specification No. 3902 shall be within the following limits:

- Minimum value: 9N.
- Maximum value: 35N.

(b) Polyimide Jacket Stripping (Variants 01 and 02)
Easy manual stripping of the jacket shall be verified by means of the following procedure:
- Using a thermal stripper, make an annular incision in the jacket at 40mm from the end of the sample to be stripped.
- Cause a clean, annular break of the jacket by alternate bendings.
- Strip off the jacket by hand. If necessary, use an abrasive cloth (grade 600).

(c) PFA Jackets Stripping Capability (Variant 03)
The adhesion between the outer PFA jacket and the screen and between the inner PFA sheath and the polyimide sheath will be determined as per Specification No. MIL-DTL-17, Para. 4.8.1.4 with the following deviations: measured length = 20mm.
The results of the tests will be within the following limits.

| | Second Inner Sheath | Outer Jacket |
|---|---|---|
| MIN. | 7N | 10N |
| MAX. | 30N | 50N |

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 coaxial 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 Inner Conductor

*4.4.1.1 Material Characteristics*
All strands used in the manufacture of the inner conductor shall be silver-coated, high strength copper alloy. The silver thickness of silver shall be 4 microns minimum.

The tensile characteristics shall be not less than 6% in elongation at break and a 40kg/mm$^2$ tensile strength.

For determination of the conductor resistance at +20°C, as mentioned in Para. 9.5 of ESCC Generic Specification No. 3902, the α coefficient for copper alloy is 0.0035.

*4.4.1.2 Stranding*
The inner conductor 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 each layer shall not be less than 8, nor more than 16, times the maximum conductor diameter specified in Table 1(a).

4.4.2 Dielectric Core

*4.4.2.1 Material*
Insulating material shall be virgin polytetrafluoroethylene with only those additives that are necessary for processing.

*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.

At any cross-section along the length of the coaxial cable, the minimum thickness of the insulation shall not be less than 43% of the difference between measured diameter over the insulation and measured diameter over conductor, nor less than 76% of the maximum thickness at that cross-section.

Nominal dielectric thickness = 0.5mm.

4.4.3 Shields

*4.4.3.1 Material Characteristics*

All strands used in the manufacture of the shields shall be silver-coated, soft or annealed, oxygen-free, high conductivity copper. The silver thickness shall be 2 microns minimum. Any strand shall show a 10% minimum elongation.

*4.4.3.2 Construction*

The shields shall be made of closely woven round strands and provide not less than 85% coverage, 'K' being calculated by the following formula:

$K = (2F - F^2) \times 100$,

where:

- K = percent coverage.
- $F = \frac{N.d.P}{\sin a}$

and where:

- N = number of strands per carrier.
- d = diameter of strands (mm).
- P = picks per mm.
- a = angle of shield with cable axis in degrees: $\tan a = \frac{2\pi(D+2d)P}{C}$
- D = effective diameter of cable under shield (mm).
- $D = (\pi+n)\ b/\pi$.
- n = number of basic wires
- b = basic wire diameter.
- C = number of carriers.

4.4.4 First Inner Sheath

*4.4.4.1 Material*

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

*4.4.4.2 Construction*

The sheath shall consist of 1 wrapped ribbon, the overlapping of which shall be equal to, or more than 51%. The ribbon (30µm of thickness) shall conform to 0.1/1.0/0.1 type in accordance with MIL-W-81381. The sheath shall have a uniform cross section throughout the length of the cable. The nominal wall thickness shall be 0.05mm.

4.4.5 Second Inner Sheath

*4.4.5.1 Material*

Sheath material shall be virgin perfluoroalkoxy (PFA) with only those additives that are necessary for processing and pigmentation.

*4.4.5.2 Construction*

The sheath shall have a uniform cross-section throughout the length of the cable. At any cross-section along the length of the cable, the minimum wall thickness shall not be less than 70% of the maximum thickness at that cross-section.

4.4.6 Outer Jacket

*4.4.6.1 Material*

Variant 01: Any insulating material shall be virgin polyimide with only those additives that are necessary for processing and pigmentation.

Variants 02 and 03: Jacket material shall be virgin perfluoroalkoxy (PFA) with only those additives that are necessary for processing and pigmentation.

*4.4.6.2 Construction*

Variant 01: The jacket shall consist of 1 wrapped ribbon, the overlapping of which shall be equal to, or more than 51%. The ribbon (30µm of thickness) shall conform to 0.1/1.0/0.1 type in accordance with MIL-W-81381. The jacket shall have a uniform cross section throughout the length of the cable. The nominal wall thickness shall be 0.05mm.

Variants 02 and 03: The jacket shall have a uniform cross-section throughout the length of the cable. At any cross-section along the length of the cable, the minimum wall thickness shall not be less than 70% of the maximum thickness at that cross-section.

4.4.7 Colour Coding

The dielectric and the inner sheath materials shall have the natural colour of its material. The colour of the outer jacket shall be as follows:

- Variant 01: Natural colour.
- Variant 02: Green.
- Variant 03: White.

4.5 MARKING

4.5.1 General

The marking of all spools of coaxial 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 Component Number.
(b) Characteristics.
(c) Traceability Information.
(d) Additional Marking.

4.5.2 The ESCC Component Number

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

Example: 390200101B

- Detail Specification Number: 3902001
- Type Variant (see Table 1(a)): 01
- Testing Level (B is mandatory): B

4.5.3 Characteristics

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

Example: 100m

- Length in metres (see Note): 100
- Symbol for metres: m

**NOTES:**

1. Whenever the length is less than 100 metres, insert a zero in the first block (example: 075m). If more than one length of coaxial 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 ESCC Basic Specification No. 21700.

4.5.5 Additional Marking

Each spool shall bear the cable 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 (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION NO. 3902)

4.8.1 Mechanical Properties of Conductor
As detailed in Paras. 4.4.1.1 and 4.4.3.1 of this specification.

4.8.2 Alternate Bending Resistance

| | | |
|---|---|---|
| Weight applied | : | 500g. |
| Minimum number of cycles | : | 1000. |

4.8.3 Accelerated Ageing Stability

| | | |
|---|---|---|
| Ageing temperature | : | +230±5 °C for samples 1 and 2. |
| | : | +200±5 °C for sample 3. |
| Maximum shrinkage or protrusion value | | |
| - Dielectric | : | 1mm. |
| - Inner and outer PFA jacket | : | 1.5mm. |
| Maximum capacitance change | : | 4%. |
| Maximum attenuation change | : | 8%. |
| Structural Return Loss | : | Shall stay under the specified limit (see Figure 1(c)). |

4.8.4 Cold Bend Test

| | | |
|---|---|---|
| Chamber temperature | : | -80±2 °C. |
| Mandrel diameter | : | 20mm – Variant 01. |
| | : | 30mm – Variants 02 and 03. |

4.8.5 Solderability
No particular conditions are applicable.

4.8.6 Corona Extinction Voltage
Minimum extinction voltage: 1200V.

4.8.7 Resistance to Fluids
Tests (e) and (f) shall be deleted.

4.8.8 Flammability Resistance
No particular conditions are applicable.

4.8.9 Radiation Resistance
No particular conditions are applicable.

4.8.10 Outgassing
No particular conditions are applicable.

4.8.11 Long-term Ageing Test
Long-term ageing temperature: +200°C.

4.8.12 Transfer Impedance
This test shall be performed in accordance with IEC 1196-1, Para. 12.2, triaxial method.

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

| No. | Characteristics | Symbol | ESCC 3902 Test Method and Conditions | Limits | Unit |
|---|---|---|---|---|---|
| 1 | Insulation Flaws (Dielectric Core) | - | Para 5.3.1 50Hz | 5 | kVrms |
| 2 | Inner Conductor Resistance | R | Para. 9.5 | Table 1(a) | Ω/km |
| 3 | Dielectric Strength of Polyimide Jacket | $V_P$ | Para. 9.6 | 1.5 | kVrms |
| 4 | Voltage Test (Dielectric Core) | $V_T$ | Para. 9.7 | 2 | kVrms |
| 5 | Insulation Resistance | Ri | Para. 9.8 | 5000 | MΩkm |
| 6 | Capacitance | c | Para. 9.9 | 95±4 | pF/m |
| 7 | Characteristic Impedance | z | Para. 9.10 | 50±2 | Ω |
| 8 | Attenuation | IL | Para. 9.11 | Figure 1(b) | dB/m |
| 9 | Structural Return Loss | SRL | Para. 9.12 | Figure 1(c) | dB |
| 10 | Dielectric Strength of PFA Outer Jacket (Variants 02 and 03) | v | Para. 9.6 | 1.75 | kVrms |
| 11 | Voltage Test Between Shields (Variant 03) | v | Para. 9.7 | 1 | kVrms |
| 12 | Transfer Impedance (Variant 02) | $Z_T$ | Para. 4.8.12 of this spec. | Figure 1(d) | Ω/m |