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**RESISTORS, FIXED, SURFACE MOUNT, FILM,
NON-HERMETICALLY SEALED**

BASED ON TYPE MS1


ESCC Detail Specification No. 4001/022

ISSUE 2

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DOCUMENTATION CHANGE NOTICE

(Refer to <https://escies.org> for ESCC DCR content)

| DCR No. | CHANGE DESCRIPTION |
|---------|--|
| 293 | Specification upissued to incorporate technical and editorial changes per DCR. |


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APPENDICES (Applicable to specific Manufacturers only)

None.

| | | | |
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1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistors, Fixed, Surface Mount, Film, Non-hermetically Sealed, based on Type MS1. It shall be read in conjunction with ESCC Generic Specification No.4001, the requirements of which are supplemented herein.

1.2 RANGE OF COMPONENTS

The range of resistors covered by this specification are given in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the resistors specified herein, are as scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The parameter derating information applicable to the resistors specified herein is given in Figure 1.

1.5 PHYSICAL DIMENSIONS

The physical dimensions of the resistors specified herein, are shown in Figure 2.

1.6 FUNCTIONAL DIAGRAM

The functional diagram for the resistors specified herein, is shown in Figure 3.

2. APPLICABLE DOCUMENTS

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

- (a) ESCC Generic Specification No. 4001, Resistors, Fixed, Film.

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 shall apply. In addition, the following symbols are used:-

- V_T = Test Voltage.
- TC = Temperature Coefficient.

TABLE 1(a) - RANGE OF COMPONENTS

| Resistance Range (Note 1) | | Tolerance (±%) | Value Series | Temperature Coefficient (± 10 ⁻⁶ /°C) |
|------------------------------|--------------|-------------------|-----------------|---|
| MIN. (Ω) | MAX. (MΩ) | | | |
| 43.2 | 1.0 | 0.1 | E96 | 50 |
| 10.0 | 1.0 | 0.5 | E96 | 50 |
| 2.21 | 5.11 | 1.0 | E96 | 50 |
| 43.2 | 1.0 | 0.1 | E96 | 25 |
| 10.0 | 1.0 | 0.5 | E96 | 25 |
| 10.0 | 1.0 | 1.0 | E96 | 25 |
| 43.2 | 0.221 | 0.1 | E96 | 15 |
| 10.0 | 0.511 | 0.5 | E96 | 15 |

NOTES

1. Critical resistance = 160 000Ω

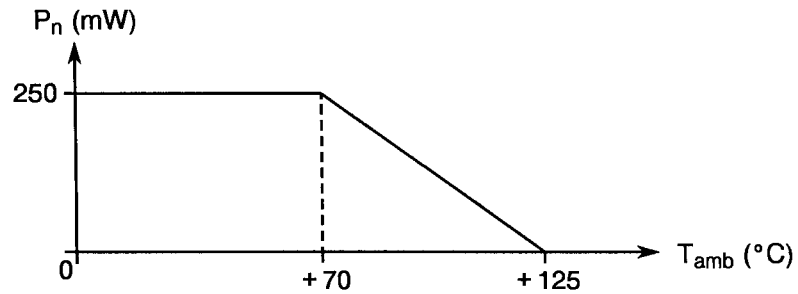
TABLE 1(b) - MAXIMUM RATINGS

| No. | Characteristics | Symbol | Limits | Unit | Remarks |
|-----|-----------------------------|------------------|-------------------|------------------|------------------|
| 1 | Rated Dissipation | P _n | 0.25 | W | Note 1 |
| 2 | Limiting Element Voltage | U _L | 200 | V | - |
| 3 | Rated Voltage | U _R | $\sqrt{0.25 R_n}$ | V | Note 2 |
| 4 | Insulation Voltage | U _I | > 500 | V _{rms} | - |
| 5 | Operating Temperature Range | T _{op} | - 55 to + 125 | °C | T _{amb} |
| 6 | Storage Temperature Range | T _{stg} | - 65 to + 155 | °C | - |
| 7 | Soldering Temperature | T _{sol} | + 260 | °C | Note 3 |

NOTES

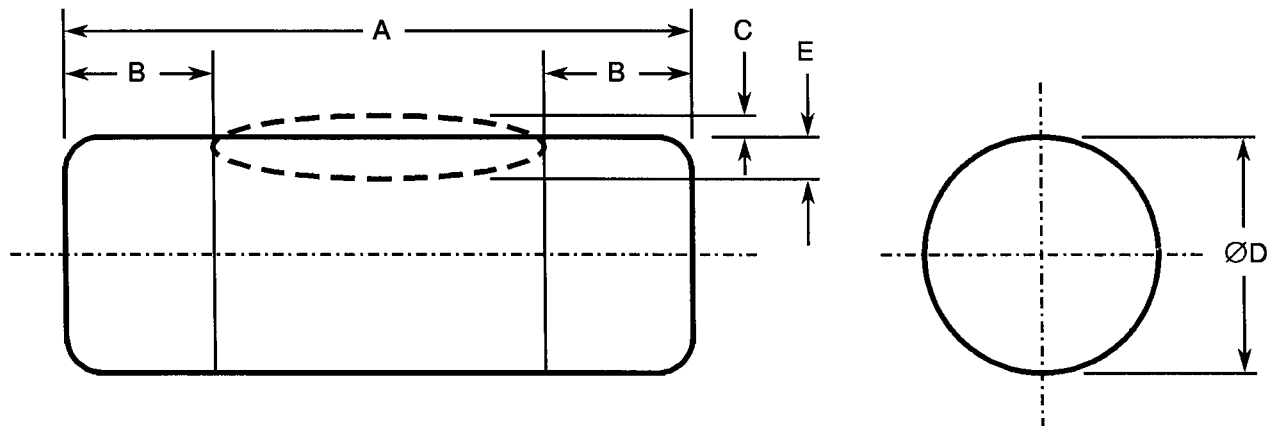
1. At T_{amb} ≤ + 70 °C. For derating at T_{amb} > + 70 °C, see Figure 1.
2. Shall never exceed Limiting Element Voltage.
3. Duration 10 seconds maximum.

FIGURE 1 - PARAMETER DERATING INFORMATION



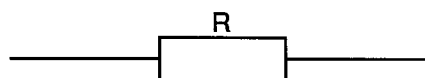
Rated Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



| Symbol | Millimetres | | Notes |
|--------|-------------|------|-------|
| | Min. | Max. | |
| A | 3.4 | 3.6 | |
| B | 0.5 | 0.9 | |
| C | - | 0.05 | |
| ØD | 1.3 | 1.5 | |
| E | - | 0.1 | |

FIGURE 3 - FUNCTIONAL DIAGRAM



4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the resistors specified herein shall be as stated in this specification and ESCC Generic Specification No. 4001. 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. 9.1, Overload: The test conditions shall be as follows:-

Voltage : $\sqrt{2.5 R_n}$ or 630V, whichever is less.

Duration : (0.1 ± 0.01) s

$\Delta R/R$: $\leq \pm (0.25\% R_n + 0.05\Omega)$

4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

(a) No serialisation of parts.

(b) Para. 9.5.2, Parameter Drift Value Measurements: not applicable.

(c) Para. 7.1.1, Conditions for Burn-in Test, and Para. 9.18, Burn-in: not applicable.

(d) Para. 9.3, Seal Test: not applicable.

(e) Para. 9.17, External Visual Inspection: In addition to the applicable ESCC Basic Specification, the following specific requirements must be considered:

- There shall be no gap at the lacquer-cap junction. However, after temperature testing hairline cracks shall be allowed between the lacquer and the cap.
- The termination (cap) must be free of any lacquer for the dimension "B min" given in Figure 2.
- Pretinning shall exhibit a clean smooth surface, without pin holes or rough spots concentrated in one place, and without irregular solder balling.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.1, Overload: Test conditions as Para. 4.2.2(a).

(b) Para. 9.10.2.3, Bend Strength of the End Face Plating: Not applicable.

(c) Para. 9.12, Rapid Change of Temperature: Not applicable.

(d) Para. 9.13, Vibration: Not applicable.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.10.2.3, Bend Strength of the End Face Plating: Not applicable.

(b) Para. 9.13, Vibration: Not applicable.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the resistors specified herein shall be verified in accordance with the requirements set out in Para. 9.4 of ESCC Generic Specification No. 4001 and shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the resistors specified herein shall be 0.1 grammes.

4.3.3 Robustness of Terminations

The requirements and test conditions for robustness of terminations are specified in Section 9 of ESCC Generic Specification No. 4001.

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 components 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 Case

As a minimum, the resistance element shall be protected by a suitable laquer coating.

4.4.2 Terminations

The end-cap material shall be steel with 1.0µm nickel plating and with a tin-lead plated finish (minimum 6% lead).

4.4.3 Films

Films shall be uniformly deposited. They shall be free from blisters, thin spots, areas inadequately bonded to the core, discoloured spots or other blemishes likely to cause flaking or non-uniform ribbons when spiralled (helixed). When used, spiralling shall occupy at least 70% of the active length of the resistance element.

4.5 MARKING

4.5.1 General

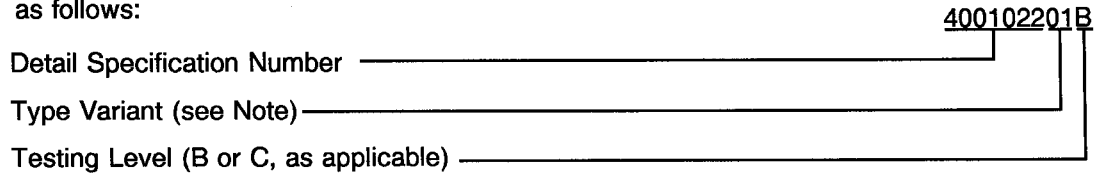
The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany each component in its primary package.

The information to be marked and the order of precedence, shall be as follows:-

- (a) The ESCC Component Number.
- (b) The Electrical Characteristics and Ratings.
- (c) Traceability Information.

4.5.2 The ESCC Component Number

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



N.B.

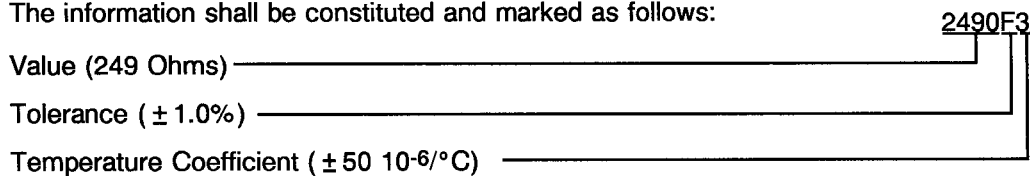
Marking of the Type Variant Number is mandatory. No further reference to type variants is made in this specification.

4.5.3 Electrical Characteristics and Ratings

The electrical characteristics and ratings to be marked in the following order of precedence are:-

- (a) Resistance Value.
- (b) Tolerance.
- (c) Temperature Coefficient.

The information shall be constituted and marked as follows:



4.5.3.1 Resistance Values

Resistance values shall be expressed by means of the following codes. The unit quantity for marking shall be ohms (Ω).

| Resistance Value | Code |
|--------------------|------|
| XX.X | XXRX |
| XXX | XXX0 |
| XXX10 ¹ | XXX1 |
| XXX10 ² | XXX2 |
| XXX10 ³ | XXX3 |
| XXX10 ⁴ | XXX4 |

For values of 100 Ω and above, the first 3 digits (X) represent significant figures and the last digit specifies the number of zeros to follow.

When values of less than 100 Ω are required, the letter 'R' is used to indicate the decimal point. When the letter is used, all successive digits represent significant figures.

4.5.3.2 Tolerance

The tolerance on resistance values shall be indicated by the code letters specified hereafter.

| Tolerance ($\pm\%$) | Code Letter |
|-----------------------|-------------|
| 0.1 | B |
| 0.5 | D |
| 1.0 | F |

4.5.3.3 Temperature Coefficient

The temperature coefficient shall be indicated by the numerical codes specified hereafter.

| Digit | Temperature Coefficient ($\pm 10^{-6}/^{\circ}\text{C}$) |
|-------|---|
| 1 | 15 |
| 2 | 25 |
| 3 | 50 |

4.5.3.4 Marking of the Resistors

A colour code shall be applied in accordance with ESCC Basic Specification No. 21700.

Marking of the temperature coefficient shall be either with a colour dot or with a body colour as specified hereafter.

| TC ($\pm 10^{-6}/^{\circ}\text{C}$) | Colour Dot | Body Colour |
|--|------------|-------------|
| 15 | Orange | Violet |
| 25 | Yellow | Pink |
| 50 | None | Beige |

4.5.4 Traceability Information

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

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. Unless otherwise specified, the measurements shall be performed at $T_{\text{amb}} = +22 \pm 3$ °C.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured on a sample basis at high and low temperatures are scheduled in Table 3.

The distribution of the sample shall be as follows:

- 1/3 with the lowest resistance value.
- 1/3 with the highest resistance value.
- 1/3 with the median resistance value or the critical resistance value if procured, of the procured range.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

| No. | Characteristics | Symbol | ESCC 4001 Test Method | Test Conditions | Tolerance (± %) | Limits | | Unit |
|-----|-----------------|----------------|-----------------------|-----------------|--------------------|----------|----------|------|
| | | | | | | Min. | Max. | |
| 1 | Resistance | R _A | Para. 9.5.1 | Para. 9.5.1 | 0.1 | 0.999 Rn | 1.001 Rn | Ω |
| | | | | | 0.5 | 0.995 Rn | 1.005 Rn | |
| | | | | | 1.0 | 0.990 Rn | 1.010 Rn | |

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

| No. | Characteristics | Symbol | ESCC 4001 Test Method | Test Conditions (Note 1) | Limits | | Unit |
|-----|--|----------------------|-----------------------|---|--------|-------|------|
| | | | | | Min. | Max. | |
| 2 | Resistance Change between -55(+3-0) °C and +22±3 °C | $\frac{\Delta R}{R}$ | Para. 9.5.1 | Para. 9.5.1 ±15 10 ⁻⁶ /°C ±25 10 ⁻⁶ /°C ±50 10 ⁻⁶ /°C | -0.12 | +0.12 | % |
| | | | | | -0.2 | +0.2 | |
| | | | | | -0.4 | +0.4 | |
| 3 | Resistance Change between +125(+0-3) °C and +22±3 °C | $\frac{\Delta R}{R}$ | Para. 9.5.1 | Para. 9.5.1 ±15 10 ⁻⁶ /°C ±25 10 ⁻⁶ /°C ±50 10 ⁻⁶ /°C | -0.16 | +0.16 | % |
| | | | | | -0.26 | +0.26 | |
| | | | | | -0.55 | +0.55 | |

NOTES

- The measurements shall be performed on a sample basis in accordance with General Inspection Level II, Table IIA, AQL = 0.65% of IEC Publication No. 410 on the total production lot. In addition, see Para. 4.6.2 for distribution of the sample.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

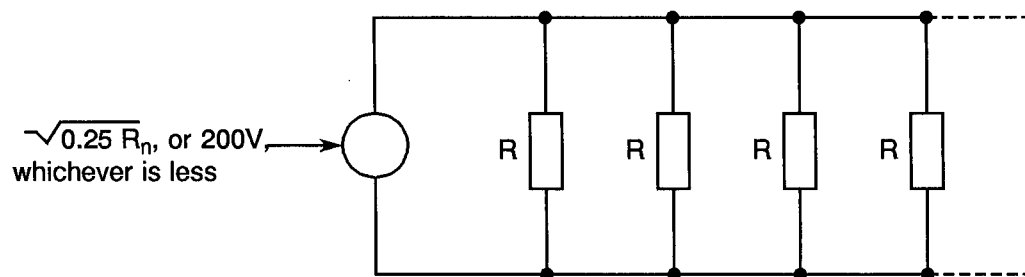
TABLE 4 - PARAMETER DRIFT VALUES

Not applicable.

TABLE 5 - CONDITIONS FOR OPERATING LIFE TEST

| No. | Characteristics | Symbol | Condition | Unit |
|-----|---------------------|-----------|---|------|
| 1 | Ambient Temperature | T_{amb} | + 70(+ 0 - 3) | °C |
| 2 | Test Voltage | V_T | $\sqrt{0.25 R_n}$, or 200V, whichever is less | V |

FIGURE 5 - ELECTRICAL CIRCUIT FOR OPERATING LIFE TEST



| | | |
|--|---|----------------------------|
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4.7 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION No. 4001)

The resistors shall be mounted as prescribed in ESCC Generic Specification No. 4001, Para. 9.20. The substrate material shall be epoxy glass laminated board.

4.7.1 Measurements and Inspections on Completion of Environmental Tests

The parameters to be measured and inspections to be performed on completion of environmental tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$.

4.7.2 Measurements and Inspections at Intermediate Points during Endurance Tests

The parameters to be measured and inspections to be performed at intermediate points during endurance tests are scheduled in Table 6 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$.

4.7.3 Measurements and Inspections on Completion of Endurance Tests

The parameters to be measured and inspections to be performed on completion of endurance testing are scheduled in Table 6 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$.

4.7.4 Conditions for Operating Life Tests (Part of Endurance Testing)

The requirements for operating life testing are specified in Section 9 of ESCC Generic Specification No. 4001. The conditions for operating life testing shall be as specified in Table 5 of this specification.

4.7.5 Electrical Circuits for Operating Life Tests

Circuits for use in performing the operating life tests are shown in Figure 5 of this specification.

4.7.6 Conditions for High Temperature Storage Test (Part of Endurance Testing)

The requirements for the high temperature storage test are specified in ESCC Generic Specification No. 4001. The conditions for high temperature storage shall be $T_{amb} = +125(+0 - 5) \text{ }^\circ\text{C}$.

TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

| No. | ESCC GENERIC SPEC. No. 4001 | | MEASUREMENTS AND INSPECTIONS | | SYMBOL | LIMITS | | UNIT |
|-----|--|--|--|---|--|--|-------------------|--------------------------|
| | ENVIRONMENTAL AND ENDURANCE TESTS (1) | TEST METHOD AND CONDITIONS | IDENTIFICATION | CONDITIONS | | MIN. | MAX. | |
| 01 | Overload | Para. 9.1 and Paras. 4.2.2 and 4.2.4 of this spec. | Initial Measurements Chart IV Resistance Final Measurements Visual Examination Chart II Resistance Chart IV Resistance Change | Table 2 Item 1 After a recovery period of 1-2 hours No evidence of damage and marking legible Table 2 Item 1 Table 2 Item 1 | R _A - R _A ΔR _A /R _A | Record Values - - Table 2 Item 1 ± (0.25 + $\frac{0.05\Omega \times 100}{R_n}$) | - | % |
| 02 | Seal Test (Hermetically Sealed only) | Para. 9.3 | Not applicable | | | | | |
| 03 | Insulation Resistance (Insulated only) | Para. 9.6 | Final Measurements Insulation Resistance | Para. 9.6.2 of ESCC 4001 (2) | R _i | 1000 | - | MΩ |
| 04 | Temperature Coefficient | Para. 9.7 Procedure I | Temperature Coefficient | Para. 9.5.1 of ESCC 4001 | TC | -15 -25 -50 | +15 +25 +50 | 10 ⁻⁶ / °C |
| 05 | Voltage Proof | Para. 9.8 | During Test Visual Examination | 1.4xU _i (3) for 60 ± 5 sec No breakdown or flashover | - | - | - | - |
| 06 | Solderability | Para. 9.9 Procedure I | Initial Measurements Resistance Final Measurements Resistance Change | After Drying Table 2 Item 1 24 ± 4 hrs after soldering Table 2 Item 1 | R _A ΔR _A /R _A | Record Values ± (0.15 + $\frac{0.05\Omega \times 100}{R_n}$) | | % |
| 07 | Robustness of Terminations | Para. 9.10.2 Adhesion Paras. 4.2.4 and 4.2.5 of this spec. Bend Strength of End Plate Facing | - Initial Measurements Resistance Final Measurements Resistance Change Visual Examination Not applicable | After mounting Table 2 Item 1 Table 2 Item 1 No damage, lifting, cracking or dry joints | - R _A ΔR _A /R _A - | - - - Record Values ± (0.25 + $\frac{0.05\Omega \times 100}{R_n}$) - | | % |
| 08 | Resistance to Soldering Heat | Para. 9.11 Procedure I | Initial Measurements Resistance Final Measurements Visual Examination Resistance Change | After drying Table 2 Item 1 No evidence of damage and marking legible After 24 ± 4 hours Table 2 Item 1 | R _A - ΔR _A /R _A | Record Values - - ± (0.15 + $\frac{0.05\Omega \times 100}{R_n}$) | | % |
| 09 | Rapid Change of Temperature | Para. 9.12 and Para. 4.2.4 of this spec. | Not applicable | | | | | |
| 10 | Vibration | Para. 9.13 and Paras. 4.2.4 and 4.2.5 of this spec. | Not applicable | | | | | |

- NOTES**
- The tests in this Table refer to either Chart IV or V and shall be use as applicable.
 - Test Voltage: V_T = 100V.
 - For value of U_i, see Table 1(b) Item 4.

TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING (CONT'D)

| No. | ESCC GENERIC SPEC. No. 4001 | | MEASUREMENTS AND INSPECTIONS | | SYMBOL | LIMITS | | UNIT | | | | |
|-----|---------------------------------------|----------------------------|---|---|---|---|--|---|---|-----------|---|---|
| | ENVIRONMENTAL AND ENDURANCE TESTS (1) | TEST METHOD AND CONDITIONS | IDENTIFICATION | CONDITIONS | | MIN. | MAX. | | | | | |
| 11 | Climatic Sequence | Para. 9.14 Procedure I | Initial Measurements Resistance | After Drying Table 2 Item 1 Following completion of D.C. load test and after a recovery period of 1-2 hrs No evidence of damage and marking legible | R_A | Record Values | | | | | | |
| | | | Final Measurements | | - | - | - | | | | | |
| | | | Visual Examination | | - | - | - | | | | | |
| | | | Insulation Resistance | | R_i | 1000 | - | | $M\Omega$ | | | |
| | | | Resistance Change | Table 2 Item 1 | $\Delta R_A/R_A$ | $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$ | | % | | | | |
| 12 | Operating Life | Para. 9.15 Chart IV | Initial Measurements Resistance | Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage | R_A | Record Values | | | | | | |
| | | | Intermediate Measurements (1000 hrs) | | - | - | - | | | | | |
| | | | Visual Examination | | - | - | - | | | | | |
| | | | Resistance Change | | $\Delta R_A/R_A$ | $\pm (0.35 + \frac{0.05\Omega \times 100}{R_n})$ | | | % | | | |
| | | | | | Final Measurements (2000 hrs) | After a recovery period of 1-2 hrs No evidence of damage | - | - | - | | | |
| | | | | | Visual Examination | | - | - | - | | | |
| | | | | | Resistance Change | | $\Delta R_A/R_A$ | $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$ | | % | | |
| | | | | | Insulation Resistance | | R_i | 1000 | - | $M\Omega$ | | |
| | | Para. 9.15 Chart V | Initial Measurements Resistance | Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage | R_A | Record Values | | | | | | |
| | | | | | Final Measurements (1000 hrs) | - | - | | - | | | |
| | | | | | Visual Examination | - | - | | - | | | |
| | | | | | Resistance Change | $\Delta R_A/R_A$ | $\pm (0.35 + \frac{0.05\Omega \times 100}{R_n})$ | | % | | | |
| | | | Insulation Resistance | Para. 9.6 of ESCC 4001 (2) | R_i | 1000 | - | $M\Omega$ | | | | |
| 13 | High Temperature Storage | Para. 9.16 | Initial Measurements Resistance | Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage | R_A | Record Values | | | | | | |
| | | | Intermediate Measurements (1000 hrs) | | - | - | - | | | | | |
| | | | Visual Examination | | - | - | - | | | | | |
| | | | Resistance Change | | $\Delta R_A/R_A$ | $\pm (0.35 + \frac{0.05\Omega \times 100}{R_n})$ | | | % | | | |
| | | | | | | | Final Measurements (2000 hrs) | | After recovery period of 1-2 hrs No evidence of damage | - | - | - |
| | | | | | | | Visual Examination | | | - | - | - |
| | | | Resistance Change | $\Delta R_A/R_A$ | $\pm (0.5 + \frac{0.05\Omega \times 100}{R_n})$ | | % | | | | | |
| | | | Insulation Resistance | Para. 9.6 of ESCC 4001 (2) | R_i | 1000 | - | $M\Omega$ | | | | |
| 14 | Permanence of Marking | Para. 9.19 | Final Measurements Visual Examination | No corrosion or ablation of marking | | | | | | | | |

NOTES: See Page 15.