RESISTORS, FIXED, WIREWOUND, ACCURATE,

BASED ON TYPE RBR 55

ESCC Detail Specification No. 4002/007

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BASED ON TYPE RBR 55

ESA/SCC Detail Specification No. 4002/007

space components
coordination group

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications defined in Revisions 'A', 'B', 'C' and 'D' to Issue 1 and the changes agreed in the following DCRs:-		
		Cover page		None
		DCN		None
		Para. 2	: Item (b) deleted	21025
		Table 1(b)	: Items 5(a), 5(b) and 6 deleted and Item 7 renumbered as "5"	221509
		Figure 1	: Title amended and new subtitle added	23910
		Para. 4.1	: Second paragraph added	21019
		Para. 4.2.2	: Deviation (a) added	221509
		Para. 4.3.3	: Test reference added	23910
		Para. 4.4.2	: Text rewritten	21025
		Para. 4.5.1	: Existing text deleted and new text added	23910
		Para. 4.5.2	: Type Variant added	21021
		Para. 4.5.5	: Paragraph deleted in toto	23910
		Table 2	: Test Method and Test Conditions columns amended	221509
		Table 3	: Test Method and Test Conditions columns amended	221509
		Table 4	: Table amended	23910
		Para. 4.8.1	: Title and text amended	23910
		Para. 4.8.2	: Title and text amended and second sentence added	23910
		Para. 4.8.3	: Title and text amended	23910
		Table 6	: No 4, entry amended	221509

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FIGURES

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistors, Fixed, Wirewound, Accurate, based on Type RBR 55. It shall be read in conjunction with ESA/SCC Generic Specification No. 4002, the requirements of which are supplemented herein.

1.2 RANGE OF COMPONENTS

The range of resistors covered by this specification is scheduled 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 scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The applicable derating information for the resistors specified herein is shown 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) ESA/SCC Generic Specification No. 4002, Resistors, Fixed, Wirewound.

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 shall apply. In addition, the following symbols are used in this specification:

R_A = Resistance value measured at ambient temperature ($+22 \pm 3°C$).
Ri = Insulation Resistance.
U_T = Test voltage.
U_{proof} = d.c. or r.m.s. voltage proof.
$U_{over\ L}$ = Overload voltage.

TABLE 1(a) - RANGE OF COMPONENTS

Tolerance (%)	Resistance Range Rn (Ω)	Rated Dissipation Pn (mW)	Critical Resistance Rc (kΩ)
±0.01	100 to 2.5M	150	261
±0.1	5.0 to 2.5M	150	261
±0.25	5.0 to 2.5M	150	261
±0.5	5.0 to 2.5M	150	261
±1.0	5.0 to 2.5M	150	261
Temperature Coefficient TCR		±25 ppm/°C from 5.0Ω to 100Ω ±5.0 ppm/°C above 100Ω	

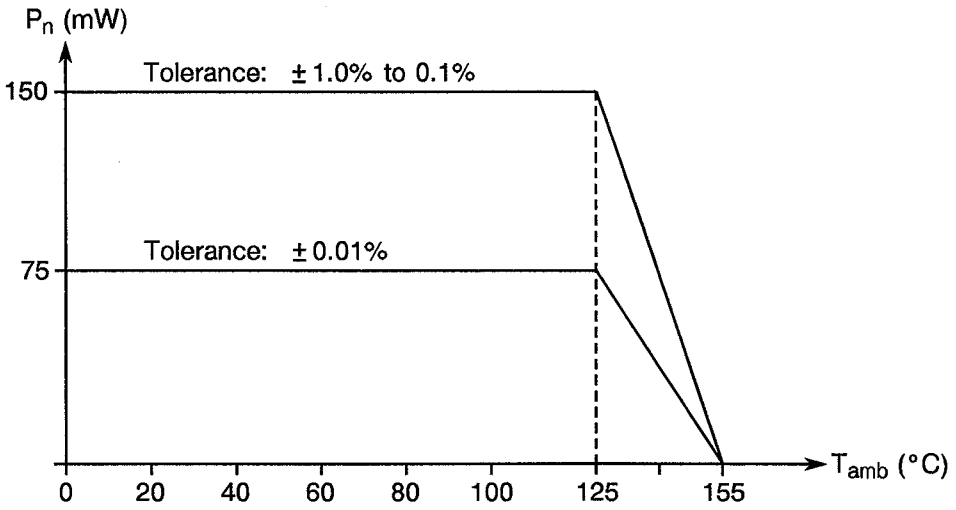
TABLE 1(b) - MAXIMUM RATINGS

No.	Characteristics	Symbol	Maximum Rating	Unit	Remarks
1	Rated Dissipation	Pn	150	mW	At T_{amb} = +125°C
2	Limiting Element Voltage	U_L	200	V	
3	Rated Voltage	U_R	$\sqrt{PnRn}$ (1) or U_L	V	Rn is the rated resistance
4	Operating Temperature Range	T_{op}	−55 to +155	°C	T_{amb}
5	Soldering Temperature	T_{sol}	+245	°C	Soldering Time ≤10s distance from body ≥1.5mm

NOTES

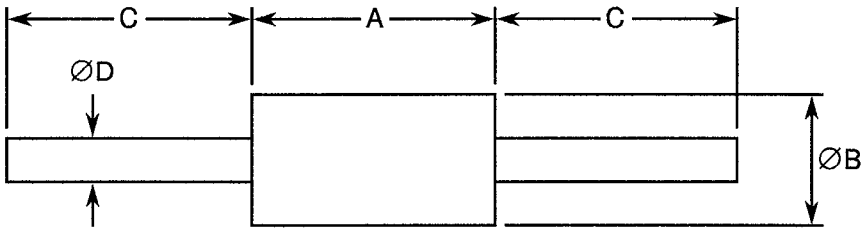
1. Whichever is smaller.

FIGURE 1 - PARAMETER DERATING INFORMATION



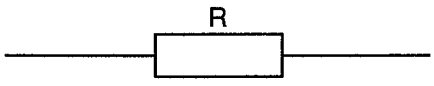
Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	11.90	13.20
ØB	5.90	6.90
C	35.00	-
ØD	0.70	0.90

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 ESA/SCC Generic Specification No. 4002 for Resistors, Fixed, Wirewound. 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 afect 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 conditions shall be as follows:

Voltage: $\sqrt{2PnRn}$ or $2U_L$, whichever is less.

Duration: 10 minutes.

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

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the resistors specified herein shall be checked. They shall conform to those shown in Figure 2.

4.3.2 Weight

The maximum weight of the resistors specified herein shall be 1.25 grammes.

4.3.3 Robustness of Terminations

The requirements for robustness of termination testing are specified in Section 9 of ESA/SCC Generic Specification No. 4002. The test conditions shall be as follows:-

Test Ua1 : **Tensile**

Applied Force : 10 Newtons.

Duration : 5 to 10 seconds.

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 Enclosure or Protective Coating

Resistor assemblies shall be protected by a coating or enclosure of moisture-resistant insulating material which shall completely cover the outside of the resistor element, including connections of terminations. The coating shall not crack, craze, drip, run or form globules at any temperature up to and including +155°C, regardless of the mounting position of the resistor.

The protective coating or enclosure shall be such that it minimises the establishment of leakage paths between the terminals resulting from collection of moisture film on the outside surface of the resistor.

4.4.2 Lead Material and Finish

The lead material shall be Type 'A' with Type '3 or 4' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.

4.4.3 Wire

Each resistor shall be wound with a conductor having no joints, welds or bands within each terminated resistance element.

4.5 MARKING

4.5.1 General

The marking of all components delivered to this specification shall be in accordance with with the requirements of ESA/SCC 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 the component in its primary package.

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

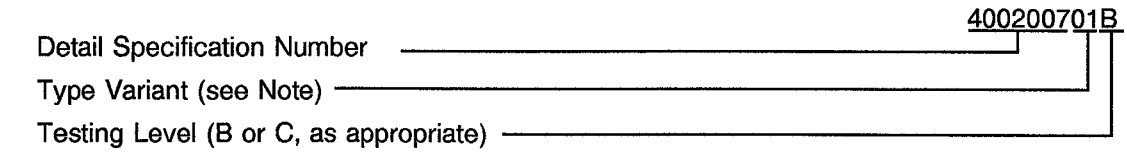
(a) The SCC Component Number.

(b) Electrical Characteristics and Ratings.

(c) Traceability Information.

4.5.2 The SCC Component Number

The SCC Component Number 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

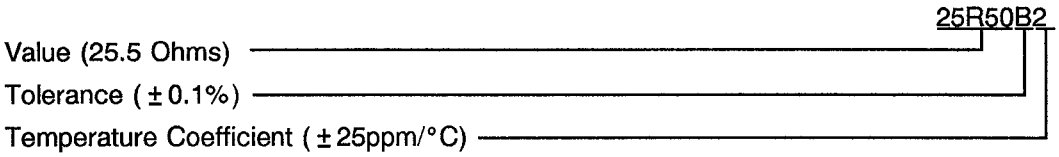
The electrical characteristics and ratings to be marked in the following order of precedence are:-

(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
X.XXX	XRXXX
XX.XX	XXRXX
XXX.X	XXXRX
XXXX	XXXX0
XXXX10^1	XXXX1
XXXX10^2	XXXX2
XXXX10^3	XXXX3

For values of 1000 and above, the first 4 digits (X) represent significant figures and the last digit specifies the number of zeros to follow.

When values of less than 1000 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 letter codes specified hereafter.

Tolerance (±%)	Code Letter
0.01	L
0.1	B
0.25	C
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 (±ppm/°C)
1	5.0
2	25

4.5.4 Traceability Information

Traceability information shall be marked in accordance with the requirements of ESA/SCC 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 stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °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. AQL shall be 0.65% out of the total production lot.

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.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

4.7 BURN-IN TESTS

4.7.1 Parameter Drift Values

The parameter drift values applicable to burn-in are specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values (Δ) applicable to the parameters scheduled, shall not be exceeded. In addition to these drift value requirements, the appropriate limit value specified in Table 2 for a given parameter shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 4002. The conditions for burn-in shall be as specified in Table 5 of this specification.

The resistors shall be tested with a d.c. voltage with a ripple that shall not exceed 5.0%.

A voltage of 200V or $\sqrt{PnRn}$ (see Figure 5) shall be applied in cycles of 90 minutes "on" and 30 minutes "off" throughout the test.

The resistors shall be connected by their terminations to suitable clips on a rack of insulating material. They shall be so arranged that the temperature of any one resistor does not appreciably influence the temperature of any other resistor. There shall be no undue draft over the resistors. After the period specified in the Generic Specification, the resistors shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 4 hours.

4.7.3 Electrical Circuits for Burn-in

The circuit for use in performing the burn-in test is shown in Figure 5 of this specification.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	Characteristics	Symbol	ESA/SCC 4002 Test Method	Test Conditions	Tolerance (±%)	Limits		Unit
						Min.	Max.	
1	Resistance	R_A	Para. 9.5.1.1	Para. 9.5.1.1	0.01	0.9999 Rn	1.0001 Rn	Ω
					0.1	0.9990 Rn	1.0010 Rn	
					0.25	0.9975 Rn	1.0025 Rn	
					0.5	0.995 Rn	1.005 Rn	
					1.0	0.990 Rn	1.010 Rn	
2	Insulation Resistance	Ri	Para. 9.5.1.2	Para. 9.5.1.2.1 (Note 1)	All	1 000	-	MΩ
3	Voltage Proof	U_{proof}	Para. 9.5.1.3	Para. 9.5.1.3.1	All	750	-	Vrms

NOTES

1. Measurements shall be performed on a sample basis; sample size as specified in Para. 4.6.2, Level II, AQL = 0.65%.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	Characteristics	Symbol	ESA/SCC 4002 Test Method	Test Conditions (Note 1)	Resistance Range	Limits		Unit
						Min.	Max.	
1(a)	Resistance Change between −55(+3−0)°C and +22±3°C	$\frac{\Delta R}{R}$	Para. 9.5.1.1	Para. 9.5.1.1	Rn ≤ 100 Rn > 100	−0.2 −0.04	+0.2 +0.04	%
1(b)	Resistance Change between +155(+0−3)°C and +22±3°C	$\frac{\Delta R}{R}$	Para. 9.5.1.1	Para. 9.5.1.1	Rn ≤ 100 Rn > 100	−0.35 −0.07	+0.35 +0.07	%

NOTES

1. Sample size as specified in Para. 4.6.2: Level II, AQL = 0.65%.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

TABLE 4 - PARAMETER DRIFT VALUES

Characteristics	Symbol	Spec. and /or Test Method	Test Conditions	Change Limits (Δ)	Unit
Resistance Change	$\frac{\Delta R_A}{R_A}$	As per Table 2	As per Table 2	±0.01 or (1) ±0.02	Ω %

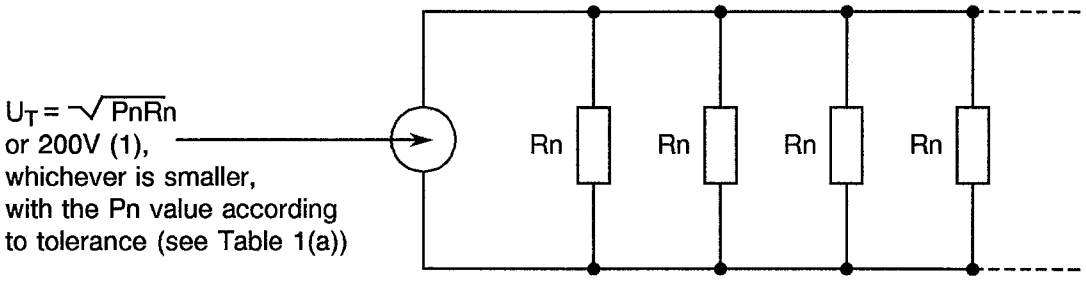
NOTES
1. Whichever is greater.

TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS

No.	Characteristics	Symbol	Condition	Unit
1	Ambient Temperature for Initial Measurement	T_{amb}	+22 ±3	°C
2	Temperature for Burn-in and Operating Life	T_{amb}	+125 ±3	°C
3	Voltage Applied	U_T	$\sqrt{PnRn}$, or 200V, whichever is less (1)	V
4	Temperature for Final Measurement	T_{amb}	+22 ±3	°C

NOTES
1. For tolerance better than 0.1%, use Figure 1 derating curve for burn-in only.

FIGURE 5 - CIRCUIT FOR BURN-IN AND OPERATING LIFE TESTS



NOTES
1. For 0.01% tolerance, use the Figure 1 derating curve.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION NO. 4002)

4.8.1 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 $T_{amb} = +22 \pm 3$ °C.

4.8.2 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 as scheduled in Table 6 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.8.3 Measurements and Inspections on Completion of Endurance Tests

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

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

The requirements for operating life testing are specified in Section 9 of ESA/SCC Generic Specification No. 4002. The conditions for operating life testing shall be as specified in Table 5 and Para. 4.7.2 of this specification.

4.8.5 Electrical Circuits for Operating Life Tests

The circuit for use in performing the operating life tests is shown in Figure 5.

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

The requirements for the high temperature storage test are specified in Section 9 of ESA/SCC Generic Specification No. 4002. The conditions for high temperature storage shall be $T_{amb} = +155(+0-5)$ °C.

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

NO.	ESA/SCC GENERIC SPEC. No. 4002		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 Para. 4.2.2 of this specification	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change	 Table 2 Item 1 After 1 to 2 hrs recovery No damage Legible marking Table 2 Item 1	 R_A - $\Delta R_A/R_A$	 Table 2 Item 1 - $\pm(0.25+\frac{0.05}{Rn}\times 100)$	 - -	 - %
02	Permanence of Marking	Para. 9.6	**Final Measurements** Visual Examination	 No corrosion or obliteration of marking	-	-	-	-
03	Temperature Characteristic of Resistance	Para. 9.7 Procedure II	**During Test** Temperature Characteristic of Resistance	 Para. 9.7.3 of ESA/SCC No. 4002	TCR	Table 1(a)		ppm/°C
04	Voltage Proof (Altitude)	Para. 9.8	**During Test** Visual Examination	200Vrms for 5 seconds No breakdown or flashover	-	-	-	-
05	Solderability	Para. 9.9 Procedure II	**Final Measurements** Visual Examination	 No damage Legible marking	-	-	-	-
06	Robustness of Terminations	Para 9.10 and Para. 4.3.3 of this specification	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change	 Table 2 Item 1 No damage Table 2 Item 1	 R_A - $\Delta R_A/R_A$	 Table 2 Item 1 - $\pm(0.01\%+0.1\Omega)$	 - -	 - Ω
07	Resistance to Soldering Heat	Para. 9.11 Procedure I	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change	 Table 2 Item 1 After 24 ± 4 hours recovery No damage Legible marking Table 2 Item 1	 R_A - $\Delta R_A/R_A$	 Table 2 Item 1 - $\pm(0.01\%+0.1\Omega)$	 - -	 - Ω
08	Rapid Change of Temperature	Para. 9.12 and Table 1(b) of this spec.	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change	 Table 2 Item 1 After 1 to 2 hrs recovery No damage Table 2 Item 1	 R_A - $\Delta R_A/R_A$	 Table 2 Item 1 - $\pm(0.05\%+0.01\Omega)$	 - -	 - Ω
09	Vibration	Para. 9.13	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change	 Table 2 Item 1 No damage Table 2 Item 1	 R_A - $\Delta R_A/R_A$	 Table 2 Item 1 - $\pm(0.01\%+0.01\Omega)$	 - -	 - Ω

NOTES

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.

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

NO.	ESA/SCC GENERIC SPEC. NO. 4002		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
10	Climatic Sequence	Para. 9.14 Procedure I	**Initial Measurements** Resistance **Final Measurements** Visual Examination Resistance Change Insulation Resistance	After Drying Table 2 Item 1 After 1 to 2 hrs recovery No damage Legible marking Table 2 Item 1 Table 2 Item 2	R_A $\Delta R_A/R_A$ Ri	Table 2 Item 1 $\pm(0.01\% + 0.01\Omega)$ 1000	- -	 Ω MΩ
11	Operating Life	Para. 9.15 Chart IV	**Initial Measurements** Resistance **Intermediate Measurements** Resistance Change **Final Measurements** Resistance Change Visual Examination	 Table 2 Item 1 1000 ± 48 hrs After 1 to 2 hrs recovery Table 2 Item 1 2000 ± 48 hrs After 1 to 2 hrs recovery Table 2 Item 1 No damage	 R_A $\Delta R_A/R_A$ $\Delta R_A/R_A$ -	 Table 2 Item 1 $\pm(0.07\% + 0.01\Omega)$ $\pm(0.1\% + 0.01\Omega)$ -	 - -	 Ω Ω -
		Para. 9.15 Chart V	**Initial Measurements** Resistance **Final Measurements** Resistance Change Visual Examination	 Table 2 Item 1 1000 ± 48 hrs After 1 to 2 hrs recovery Table 2 Item 1 No damage	 R_A $\Delta R_A/R_A$ -	 Table 2 Item 1 $\pm(0.07\% + 0.01\Omega)$ -	 - -	 Ω -
12	High Temperature Storage	Para. 9.16	**Initial Measurements** Resistance **Intermediate Measurements** Resistance Change **Final Measurements** Resistance Change	 Table 2 Item 1 1000 ± 48 hrs Table 2 Item 1 2000 ± 48 hrs Table 2 Item 1	 R_A $\Delta R_A/R_A$ $\Delta R_A/R_A$	 Table 2 Item 1 $\pm(0.07\% + 0.01\Omega)$ $\pm(0.1\% + 0.01\Omega)$	 	 Ω Ω
13	External Visual Inspection	Para. 9.17	Visual Inspection	ESA/SCC No. 20500	-	-	-	-
14	Maximum Time Constant (Not applicable to inductive resistors)	Para. 9.18	Time Constant	Para. 9.18.1 of ESA/SCC No. 4002	L/R	Table 1(b)		ns

NOTES: See Page 15.