THERMISTORS

(RESISTORS, THERMALLY SENSITIVE)

ESCC Generic Specification No. 4006

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Pages 1 to 40

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(RESISTORS, THERMALLY SENSITIVE)

ESA/SCC Generic Specification No. 4006

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 3	June 1997		
Revision 'A'	April 1999		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 2 and incorporates all modifications defined in Revisions 'A', 'B', 'C' and 'D' to Issue 2 and the changes agreed by the following DCR's which also complete the implementation of Policy DCR 21107:-		
		Cover page		None
		DCN		None
		Para. 4.1	: Second paragraph amended	23858
			: New paragraph added	23858
		Para. 4.1.3	: Second sentence amended	23858
		Para. 4.1.4	: Text amended	23858
		Chart I	: "(1)" added to Lot Acceptance Boxes and Note 1 added	23858
		Para. 8.2.1	: In the last paragraph, both sentences amended	23858
		Para. 8.2.3	: Text added to the beginning of (e)	23858
		Para. 8.4	: In the last paragraph, "either" and all after "months" deleted	23858
		Para. 9	: Text added	23858
		Para. 10.1	: "(when applicable)" added to (h)	23858
		Para. 10.1.2	: Existing text deleted and new text added	23858
		Para. 10.1.3	: Existing text deleted and new text added	23858
		Para. 10.1.4	: New paragraph added	23858
		Para. 10.2	: (e) amended	23858
		Para. 10.3	: First sentence amended	23858
		Para. 10.6	: In the second paragraph, second sentence amended	23858
			: Last paragraph deleted	23858
		Para. 10.7.1	: In the second sentence, "provided" replaced by "recorded"	23858
		Para. 10.7.2	: In the text, "provided" replaced by "prepared"	23858
		Para. 11	: In (b), "(when applicable)," added after "testing"	23858
			: In the last sentence, ", when requested," added after "copied"	23858
'A'	Apr. '99	P1. Cover page		None
		P2. DCN		None
		P13. Para. 8.2.1	: New second sentence added to last paragraph	21111
		P33. Para. 10.1.2.1	: Item (b), "PDA figure and" deleted from text	21119
			: Item (c) rewritten	21119
		P34. Para. 10.1.3.1	: Item (a), "(including PDA figure)" deleted	21119

TABLE OF CONTENTS

1. INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification approval, procurement, including lot acceptance testing, and delivery of Thermistors, (Resistors, Thermally Sensitive), for space applications.

This specification contains the appropriate inspection and test schedules and also specifies the data documentation requirements.

1.2 APPLICABILITY

This specification is primarily applicable to the granting of qualification approval to a component in accordance with ESA/SCC Basic Specification No. 20100 and the procurement of such components from qualified Manufacturers.

2. APPLICABLE DOCUMENTS

The following documents form part of, and shall be read in conjunction with, this specification. The relevant issues shall be those in effect on the date of placing the purchase order.

2.1 ESA/SCC SPECIFICATIONS

No. 20100, Requirements for the Qualification of Standard Electronic Components for Space Application.

No. 20400, Internal Visual Inspection.

No. 20500, External Visual Inspection.

No. 20600, Preservation, Packaging and Despatch of SCC Electronic Components.

No. 20900, Radiographic Inspection.

No. 21300, Terms, Definitions, Abbreviations, Symbols and Units.

No. 21700, General Requirements for the Marking of SCC Components.

No. 22800, ESA/SCC Non-conformance Control System.

No. 23500, Lead Materials and Finishes for Components for Space Application.

No. 24600, Minimum Quality System Requirements.

No. 24800, Resistance to Solvents of Marking, Materials and Finishes.

With the exception of ESA/SCC Basic Specifications Nos. 20100, 21700, 22800 and 24600, where Manufacturers' specifications are equivalent to, or more stringent than, the ESA/SCC Basic Specifications listed above, they may be used in place of the latter, subject to the approval of the appropriate Qualifying Space Agency.

Such replacements shall be clearly identified in the applicable Process Identification Document (P.I.D.) and listed in an appendix to the appropriate Detail Specification.

Unless otherwise stated herein, references within the text of this specification to "the Detail Specification" shall mean the relevant ESA/SCC Detail Specification.

2.2 OTHER (REFERENCE) DOCUMENTS

MIL-STD-105, Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-202, Test Methods for Electronic and Electrical Component Parts.

MIL-STD-414,Sampling Procedures and Tables for Inspection by Variables for Percent Defective.

ESA PSS-01-702, A Thermal Vacuum Test for the Screening of Space Materials.

2.3 ORDER OF PRECEDENCE

For the purpose of interpretation and in case of conflict with regard to documentation, the following order of precedence shall apply:-

(a) ESA/SCC Detail Specification.

(b) ESA/SCC Generic Specification.

(c) ESA/SCC Basic Specification.

(d) Other documents, if referenced herein.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 shall apply.

4. REQUIREMENTS

4.1 GENERAL

The test requirements for qualification approval of a component shall comprise final production tests (see Chart II), burn-in and electrical measurements to testing level "B" (see Chart III) and qualification testing (see Chart IV).

The test requirements for procurement of components shall comprise final production tests (Chart II), burn-in and electrical measurements to testing level "B" or "C" as required (Chart III) together with, when applicable, a level of lot acceptance testing (see Chart V) to be specified by the Orderer.

If a Manufacturer elects to eliminate a final production test by substituting an in-process control or statistical process control procedure, the Manufacturer is still responsible for delivering components that meet all of the performance, quality and reliability requirements defined in this specification and the Detail Specification.

4.1.1 Specifications

For qualification approval, procurement (including lot acceptance testing) and delivery of components in conformity with this specification, the specifications listed in Section 2 of this document shall apply in total unless otherwise specified herein or in the Detail Specification.

4.1.2 Conditions and Methods of Test

The conditions and methods of test shall be in accordance with this specification, the ESA/SCC Basic Specifications referenced herein and the Detail Specification.

4.1.3 Manufacturer's Responsibility for Performance of Tests and Inspections

The Manufacturer shall be responsible for the performance of tests and inspections required by the applicable specifications. These tests and inspections shall be performed at the plant of the Manufacturer of the components unless it is agreed by the Qualifying Space Agency prior to commencing qualification testing, or procurement, to use an approved external facility.

4.1.4 Inspection Rights

The Qualifying Space Agency (for qualification approval or for a procurement) reserves the right to monitor any of the tests and inspections scheduled in the applicable specifications.

4.1.5 Pre-encapsulation Inspection

The Manufacturer shall notify the Orderer at least 2 working weeks before the commencement of pre-encapsulation inspection.

The Orderer shall indicate immediately whether or not he intends to witness the inspection.

4.2 QUALIFICATION APPROVAL REQUIREMENTS ON A MANUFACTURER

To obtain and maintain the qualification approval of a component, or family of components, a Manufacturer shall satisfy the requirements of ESA/SCC Basic Specification No. 20100.

4.3 DELIVERABLE COMPONENTS

Components delivered to this specification shall be processed and inspected in accordance with the relevant Process Identification Document (P.I.D.). Each delivered component shall be traceable to its production lot. Components delivered to this specification shall have completed satisfactorily all tests to the testing level and lot acceptance level specified in the purchase order (see Para. 4.3.2).

ESA/SCC qualified components delivered to this specification shall be produced from lots that are capable of passing all tests, and sequences of tests, that are defined in Charts IV and V. The Manufacturer shall not knowingly supply components that cannot meet this requirement. In the event that, subsequent to delivery and prior to operational use, a component is found to be in a condition such that it could not have passed these tests at the time of manufacture, this shall be grounds for rejection of the delivered lot.

Components failing inspections and tests of the higher testing level (i.e level "B") shall not be supplied against any order for components of the lower testing level.

4.3.1 Lot Failure

Lot failure may occur during final production tests (Chart II), burn-in and electrical measurements (Chart III), qualification testing (Chart IV) or lot acceptance testing (Chart V).

Should such failure occur, the non-conformance procedure shall be initiated in accordance with ESA/SCC Basic Specification No. 22800.

Should such failure occur during procurement, the Manufacturer shall notify the Orderer by telex within 2 working days, giving details of the number and mode of failure and the suspected cause.

In the case where qualification approval has been granted to the component, he shall, at the same time by the same means, inform the Qualifying Space Agency in order that the latter may consider its implications.

No further testing shall be performed on the failed components except on instruction from the Orderer. The Orderer shall inform the Manufacturer and the Qualifying Space Agency within 2 working days of receipt of the telex, by the same means, what action shall be taken.

In the case when lot failure occurs during qualification testing, the Manufacturer shall immediately notify the appropriate Qualifying Space Agency who will define a course of action to be followed. No further testing shall be performed on the failed components.

4.3.2 Testing and Lot Acceptance Levels

This specification defines 2 levels of testing severity which are designated by the letters "B" and "C" (see Chart I) and 3 levels of lot acceptance testing (see Chart V).

The lot acceptance levels are designated 1, 2 and 3 and are comprised of tests as follows:-

Level 3 (LA3) - Electrical Subgroup.

Level 2 (LA2) - Endurance Subgroup
plus Electrical Subgroup.

Level 1 (LA1) - Environmental and Mechanical Subgroup
plus Endurance Subgroup
plus Electrical Subgroup.

The required testing level and lot acceptance level shall both be specified in a purchase order.

4.4 MARKING

All components procured and delivered to this specification from a source qualified according to ESA/SCC Basic Specification No. 20100 shall be marked in accordance with ESA/SCC Basic Specification No. 21700. Thus, they shall bear the ESA symbol to signify their conformance to the ESA/SCC qualification approval requirements and full compliance with the requirements of this specification and the Detail Specification.

Components procured from sources which are not ESA/SCC qualified, provided that they fully comply with the procurement requirements of this specification and the Detail Specification, may bear the SCC marking **with the exception of the ESA symbol**.

4.5 MATERIALS AND FINISHES

All non-metallic materials and finishes, that are not within a hermetically sealed enclosure, of the components specified herein shall meet the outgassing requirements as outlined in ESA PSS-01-702.

Specific requirements for materials and finishes are specified in the Detail Specification.

5. PRODUCTION CONTROL

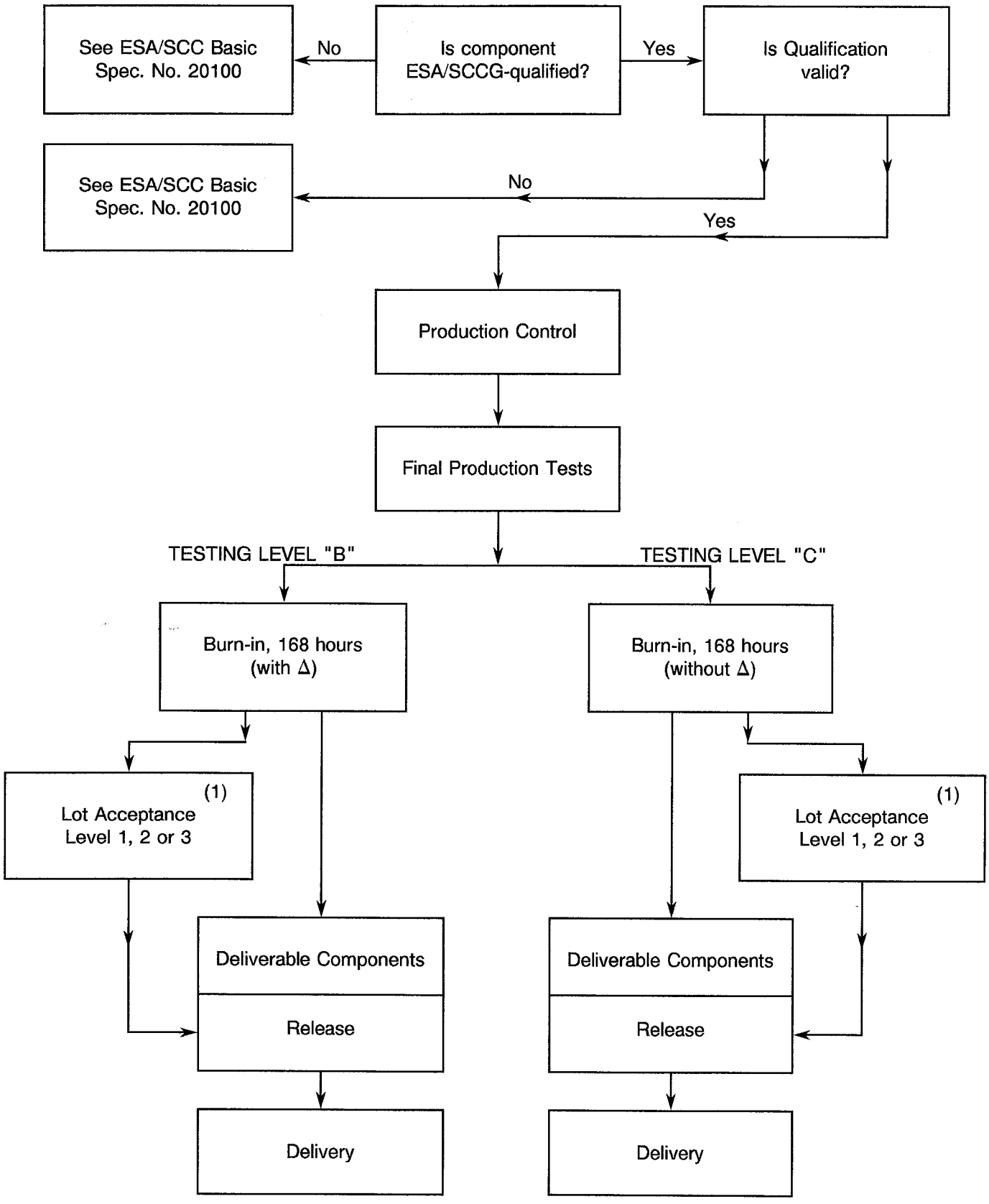
5.1 GENERAL

The minimum requirements for production control, which are equally applicable to procurement, are defined in ESA/SCC Basic Specification No. 20100, Paras. 5.1 and 5.2.

5.2 SPECIAL IN-PROCESS CONTROLS

Where applicable, special in-process controls shall apply as specified in the Detail Specification.

CHART I - TESTING LEVELS



NOTES

1. When applicable.

6. FINAL PRODUCTION TESTS

6.1 GENERAL

Unless otherwise specified in the Detail Specification, all components used for qualification testing and all components for delivery, including those submitted to lot acceptance tests, shall be subjected to tests and inspections in accordance with Chart II.

Unless otherwise specified in the Detail Specification, the tests shall be performed in the order shown.

Any components that do not meet these requirements shall be removed from the lot and at no future time be re-submitted to the requirements of this specification.

6.2 TEST METHODS AND CONDITIONS

The applicable test methods and conditions are specified in the paragraphs referenced in Chart II of this specification.

6.3 DOCUMENTATION

Documentation of final production test data shall be in accordance with the requirements of Para 10.6 of this specification.

7. BURN-IN AND ELECTRICAL MEASUREMENTS

7.1 GENERAL

Unless otherwise specified in the Detail Specification, all components used for qualification testing and all components for delivery, including those submitted to lot acceptance tests, shall be subjected to tests and inspections in accordance with Chart III.

Unless otherwise specified in the Detail Specification, the tests shall be performed in the order shown.

The applicable test methods and conditions are specified in the paragraphs referenced in Chart III.

Components of testing level "B" shall be serialised prior to the tests and inspections.

7.1.1 Conditions of Test

The conditions for burn-in shall be as shown in Table 5 of the Detail Specification.

Unless otherwise specified in the Detail Specification, components of both Levels "B" and "C" shall be subjected to a total burn-in period of 168 hours.

7.1.2 Data Points

For components of testing level "B", undergoing a total burn-in period of 168 hours, the data points for parameter drift measurement shall be 0 hours (initial) and 168(+24 -0) hours (final).

For components of testing level "C", undergoing a total burn-in period of 168 hours, the data point for post-burn-in electrical measurements shall be 168(+24 -0) hours.

7.2. FAILURE CRITERIA

7.2.1 Parameter Drift Failure

The acceptable delta limits are shown in Table 4 of the Detail Specification. A component of testing level "B" shall be counted as a parameter drift failure if the changes during burn-in are larger than the delta (Δ) values specified.

7.2.2 Parameter Limit Failure

A component shall be counted as a limit failure if one or more parameters exceed the limits shown in Tables 2 or 3 of the Detail Specification.

Any component which exhibits a limit failure prior to the burn-in sequence shall be rejected and not counted when determining lot rejection.

7.2.3 Other Failures

A component shall be counted as a failure in any of the following cases:

- Mechanical failure.
- Handling failure.
- Lost component.

7.3 FAILED COMPONENTS

A component shall be considered as a failed component if it exhibits one or more of the failure modes described in Para. 7.2 of this specification.

7.4 LOT FAILURE

In case of lot failure, the Manufacturer shall act in accordance with the requirements of Para. 4.3.1 of this specification.

7.4.1 Lot Failure during 100% Testing

If the number of components failed on the basis of the failure criteria described in Para. 7.2 exceeds 10% (rounded upwards to the nearest whole number) of the number of components submitted to burn-in and electrical measurements, the lot shall be considered as failed.

If a lot is composed of groups of components of one family defined in one ESA/SCC Detail Specification, but separately identifiable for any reason, then the lot failure criteria shall apply separately to each identifiable group.

7.4.2 Lot Failure during Sample Testing

A lot shall be considered as failed if the number of allowable failures during sample testing, in accordance with General Inspection Level II of MIL-STD-105 and the applicable AQL as specified in the Detail Specification, is exceeded.

In the case where an LTPD to MIL-STD-414 is specified in the Detail Specification, a lot shall be considered as failed if the number of failures allowed is exceeded (see Annexe I for LTPD Sampling Plan).

If a lot failure occurs in either case, a 100% testing may be performed with the lot failure criteria given in Para. 7.4.1.

7.5 DOCUMENTATION

Data documentation of burn-in and electrical measurements shall be in accordance with Para. 10.7 of this specification.

8. QUALIFICATION APPROVAL AND LOT ACCEPTANCE TESTS

8.1 QUALIFICATION TESTING

8.1.1 General

Qualification testing shall be in accordance with the requirements of Chart IV of this specification. The tests to Chart IV shall be performed on the specified sample, chosen at random from components which have successfully passed the tests in Charts II and III for Testing Level "B". This sample constitutes the qualification test lot.

The qualification test lot is divided into subgroups of tests and all components assigned to a subgroup shall be subjected to all of the tests in that subgroup, in the sequence shown.

The applicable test requirements are detailed in the paragraphs referenced in Chart IV.

The conditions governing qualification testing are given in ESA/SCC Basic Specification No. 20100, Para. 5.3 and, for the extension or renewal of qualification approval, in Paras. 6.3 and 6.4.

8.1.2 Distribution within the Qualification Test Lot

A minimum sample of 70 components shall be submitted to qualification testing (Chart IV). The distribution within the sample shall be as follows:

- 1/2 of the lot with the lowest zero power resistance.
- 1/2 of the lot with the highest zero power resistance.

The selected distribution shall be agreed with the Qualifying Space Agency.

8.2 LOT ACCEPTANCE TESTING

8.2.1 General

The sample sizes of the 3 lot acceptance levels are specified in Chart V. All components assigned to a subgroup shall be subjected to all of the tests of that subgroup in the sequence shown.

The tests to Chart V shall be performed on the specified sample which shall have been chosen, whenever possible, at random from the proposed delivery lot (but see Para. 8.2.3(b)).The applicable test requirements are detailed in the paragraphs referenced in Chart V.

As a minimum for procurement of non-qualified components, lot acceptance level 3 tests shall apply. For procurement of qualified components, lot acceptance testing shall be performed if specified in a purchase order. Procurement lots ordered with a lot acceptance test level shall be delivered only after successful completion of lot acceptance testing.

8.2.2 Distribution within the Sample for Lot Acceptance Testing

Where a Detail Specification covers a range or series of components that are considered similar, then it may be necessary that the sample for lot acceptance testing be comprised of component types so selected that they adequately represent all of the various mechanical, structural and electrical peculiarities of the procured range or series.

The distribution of the component types will normally vary from procurement to procurement and shall be as specified by the Orderer, following as closely as possible the requirements prescribed in Para. 8.1.2. of this specification.

8.2.3 Lot Acceptance Level 3 Testing (LA3)

Lot acceptance level 3 tests are designated as the electrical subgroup and comprise electrical measurements of characteristics and tests to prove the assembly capability of the component. For LA3 testing, the following requirements and conditions shall apply:-

(a) LA3 testing shall be performed by the Manufacturer's quality assurance personnel using dedicated quality assurance equipment whenever possible. LA3 testing shall not be a repetition of routine measurements made by production personnel during final production tests and burn-in and electrical measurements.

(b) When tests to Tables 2 and 3 of the Detail Specification have been performed on a sample basis, then the components for LA3 testing shall be selected from this sample.

(c) The electrical measurements for LA3 are considered to be non-destructive and therefore components so tested may form part of the delivery lot.

(d) The solderability and terminal strength tests are considered to be destructive and therefore components so tested shall not form part of the delivery lot. Post-burn-in electrical rejects may be used for these tests.

(e) When required in the purchase order, the Manufacturer shall notify the Orderer at least 2 working weeks before the commencement of LA3 testing. The Orderer shall indicate immediately whether or not he intends to witness the tests.

8.2.4 Lot Acceptance Level 2 Testing (LA2)

Lot acceptance level 2 testing shall comprise the tests for LA3 (electrical subgroup) plus tests on an endurance subgroup. For the electrical subgroup, the requirements and conditions as for LA3 (see Para. 8.2.3) shall apply.

For the endurance subgroup, the following shall apply:-

(a) Components of testing level "C", selected for the endurance subgroup, shall be serialised prior to the tests.

(b) The tests in this subgroup are considered to be destructive and therefore components (of testing level "B" or "C") so tested shall not form part of the delivery lot.

8.2.5 Lot Acceptance Level 1 Testing (LA1)

Lot acceptance level 1 testing shall comprise the tests for LA3 (electrical subgroup) and LA2 (endurance subgroup) plus tests on an environmental and mechanical subgroup. For the electrical and endurance subgroups, the requirements and conditions for LA3 (see Para. 8.2.3) and LA2 (see Para. 8.2.4) respectively shall apply.

For the environmental subgroup, the following shall apply:-

(a) Components of testing level "C", selected for the environmental subgroup, shall be serialised prior to the tests.

(b) The tests in this subgroup are considered to be destructive and therefore components (of testing level "B" or "C") so tested shall not form part of the delivery lot.

8.3 FAILURE CRITERIA

The following criteria shall apply to qualification testing and to lot acceptance testing.

8.3.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:

- Components which fail during tests for which the pass/fail criteria are inherent in the test method, e.g. solderability, terminal strength, etc..

8.3.2 Electrical Failures

The following shall be counted as component failures:-

(a) Components which, when subjected to electrical measurements on completion of environmental tests, in accordance with either Table 2 or Table 6, as specified in the Detail Specification, fail one or more of the applicable limits.

(b) Components which, when subjected to electrical measurements at intermediate and end-points during endurance testing, in accordance with Table 6 of the Detail Specification, fail one or more of the applicable limits.

(c) Components which, when subjected to measurement of electrical characteristics, in accordance with Tables 2 and 3 of the Detail Specification, fail one or more of the applicable limits.

8.3.3 Other Failures

The following additional failures may also occur during qualification testing or lot acceptance testing:-

(a) Components failing to comply with the requirements of ESA/SCC Basic Specification No. 20500.

(b) Lost components.

8.4 FAILED COMPONENTS

A component shall be considered as failed if it exhibits one or more of the failure modes detailed in Para. 8.3 of this specification. The allowable number of failed components per Subgroup, the aggregate failure constraints and the permitted distribution of such failures are shown at the foot of Charts IV and V of this specification.

When requested by the Qualifying Space Agency or the Orderer, failure analysis of failed components shall be performed by the Manufacturer and the results provided.

Failed components from successful lots shall be marked as such and be stored at the Manufacturer's plant for 24 months.

8.5 LOT FAILURE

A lot shall be considered as failed if the allowable number of failures according to Chart IV or V of this specification, as relevant, has been exceeded.

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.1 of this specification.

8.6 DOCUMENTATION

For qualification testing, the qualification test data shall be documented in accordance with the requirements of Para. 10.8 of this specification.

In the case of lot acceptance testing, the data shall be documented in accordance with the requirements of Para. 10.9 of this specification.

CHART II- FINAL PRODUCTION TESTS

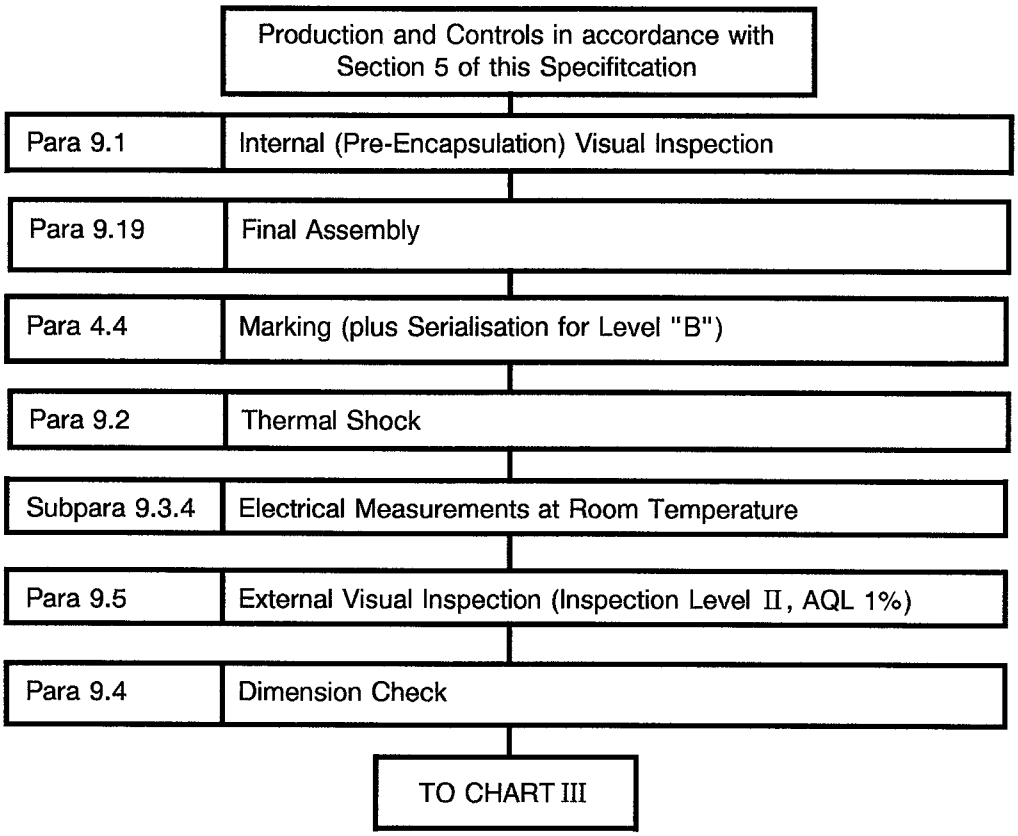


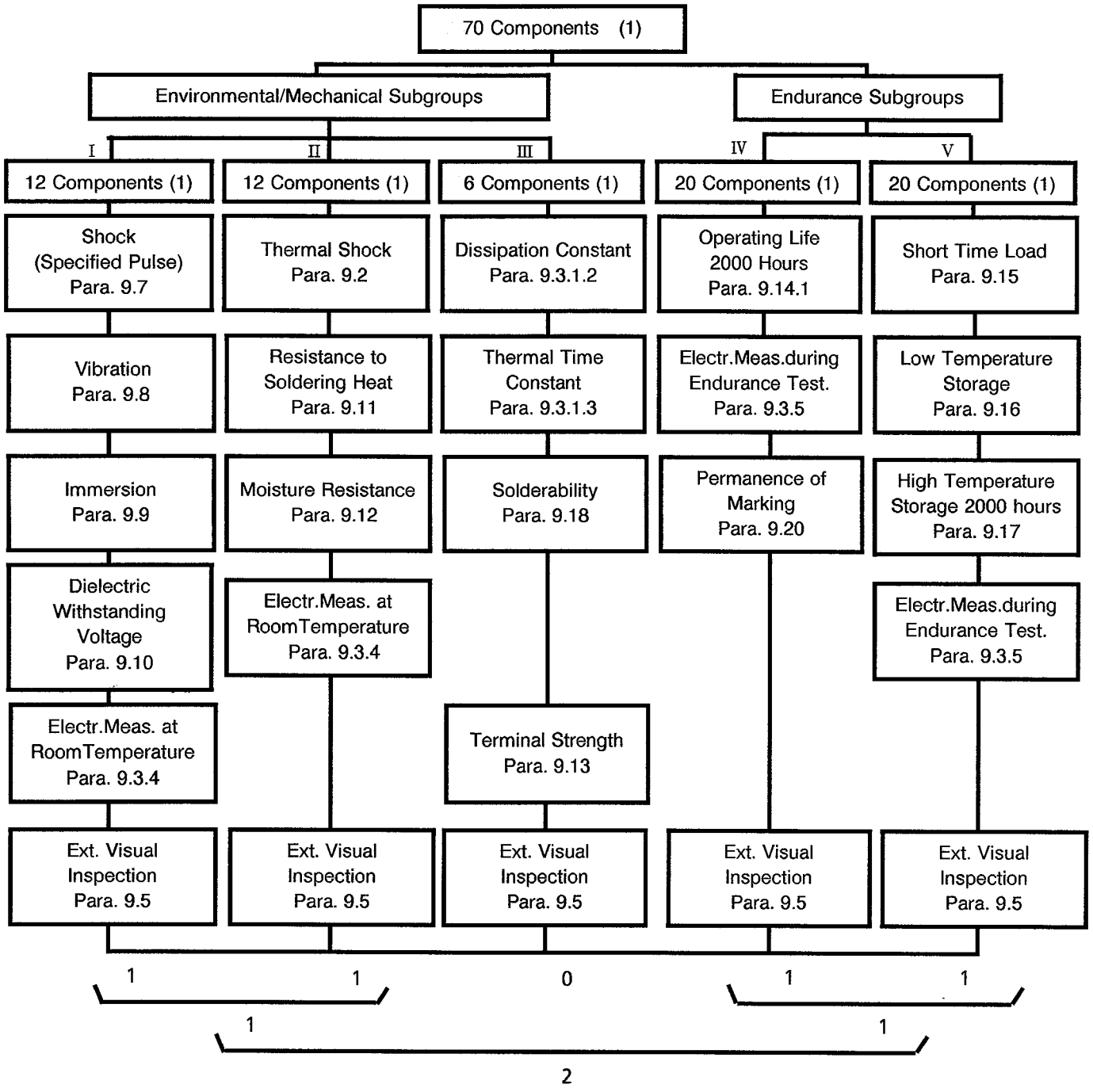
CHART III- BURN-IN AND ELECTRICAL MEASUREMENTS

	Components from Final Production Tests	Testing Levels	
		B	C
Para. 9.3.2	Parameter Drift Value, Initial Measurements	X	-
Para. 7.1.	Burn-in, 168 hours	X	X
Para. 9.3.2	Parameter Drift Value, Final Measurements	X	-
Para. 9.3.3	Electrical Measurements at High and Low Temperatures	X	X
Para. 9.3.4	Electrical Measurements at Room Temperature (1)	X	X
Para. 9.6	Radiographic Inspection (2) (3) (4)	X	-
Para. 9.5	External Visual Inspection	X	X
Para. 7.4	Check for Lot Failure	X	X
	TO CHART IV or V		

NOTES

1. The measurement of parameters for the purpose of drift value measurements need not be repeated for electrical measurements at room temperature.
2. Radiographic inspection may be performed at any point during the test sequence shown in this Chart.
3. Radiographic inspection rejects not to be counted for lot failure.
4. Unless otherwise specified in the Detail Specification.

CHART IV - QUALIFICATION TESTS

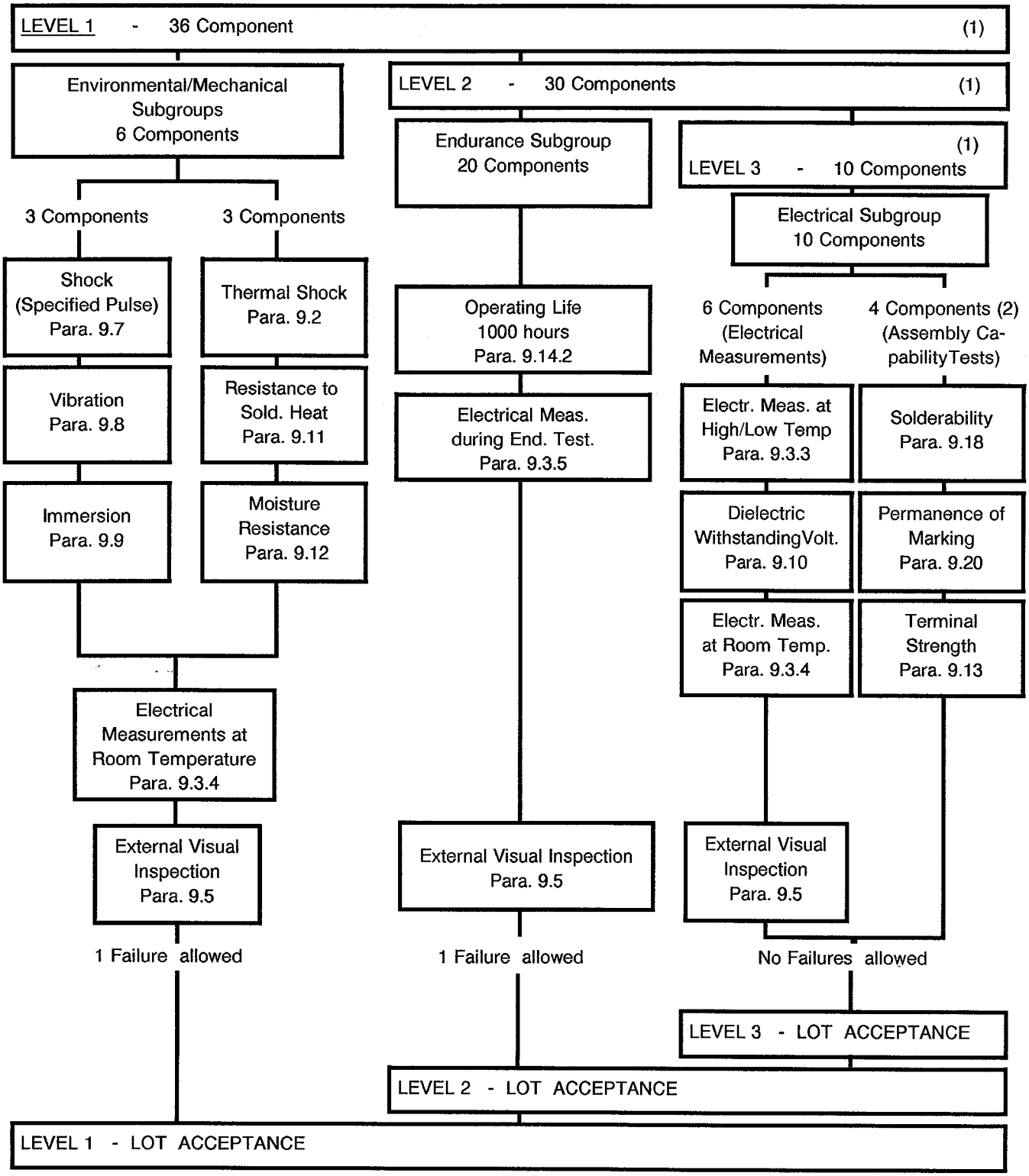


Allowable number of failed components: 2

NOTES

1. For distribution within the subgroups, see Para. 8.1.2.

CHART V - LOT ACCEPTANCE TESTS



NOTES

1. For distribution within the subgroups, see Para. 8.2.2.
2. Post-burn-in electrical rejects may be used for this test.

9. TEST METHODS AND PROCEDURES

If a Manufacturer elects to eliminate or modify a test method or procedure, the Manufacturer is still responsible for delivering components that meet all of the performance, quality and reliability requirements defined in this specification and the Detail Specification.

Documentation supporting the change shall be approved by the Qualifying Space Agency and retained by the Manufacturer. It shall be copied, when requested, to the Qualifying Space Agency.

The change shall be specified in the Detail Specification and in the P.I.D.

9.1 INTERNAL VISUAL INSPECTION

In accordance with ESA/SCC Basic Specification No. 20400.

9.2 THERMAL SHOCK

Thermistors shall be tested in accordance with Method 107 of MIL-STD-202. The following details shall apply:-

(a) Test Condition

'B' for thermistors rated at +125°C.

'C' for thermistors rated at +200°C.

'C' for thermistors rated at +275°C, except that the maximum temperature shall be +275°C.

(b) Dwell Time

Dwell time between temperature extremes shall be not less than 10 minutes and not more than 15 minutes.

(c) Measurements before and after Cycling

Not applicable.

9.3 ELECTRICAL MEASUREMENTS

9.3.1 General

Electrical Measurements and methods shall be as follows.

9.3.1.1 Zero Power Resistance

(1) Measurements

All resistance measurements shall be made in a controlled uniform medium capable of maintaining an accuracy of:-

(a) ±0.01°C for beads, beads in rods and beads in probes.

(b) ±0.05°C for all other types.

(2) Equipment Sensitivity

(a) Resistance

A Wheatstone Bridge, or equivalent, accurate to ±0.05% or better.

(b) Temperature

The time response of the temperature indicator shall be compatible with that of the thermistor under test.

(c) Sensitivity

The equipment sensitivity shall be such as to provide a precision of measurement greater than the accuracy required.

(3) Test Procedure

The test procedure shall be as follows:-

(a) Mounting

The thermistors shall be mounted by normal mounting means in corrosion-resistant clips mounted on brass rods as follows:-

(i) Beads: flat clips shall be used. The clips shall grip the leads 6.35 ± 1.59 mm from the end of the thermistor body.

(ii) All other types: suitable clips shall be selected. The clips shall grip the leads 25.4 ± 1.59 mm from the end of the thermistor body.

(b) Mounting Plates

The mounting plates shall be of micarta, polytetrafluoroethylene or an equivalent insulating material.

(c) Temperature Stabilisation

Sufficient time must be allowed between measurements for the medium and the thermistors to stabilise at the required temperatures.

(d) Measurements

The zero power resistance shall be measured at +25 and +125 °C. With the input voltage source disconnected, adjust the output indicator to the zero output position.

Connect the input voltage source, measure the zero power resistance and then disconnect the input voltage source. If the output indicator does not return to its initial zero output position within a tolerance equivalent to ±0.05% of the resistance value, the thermistor shall be classified as defective.

9.3.1.2 Dissipation Constant

(1) Test Procedure

The test procedure shall be as follows:-

(a) Mounting

See Para. 9.3.1.1(3).

(b) Power Supply

A regulated d.c. or battery power supply shall be used.

(c) Measurement

The zero power resistance shall be measured and recorded at +25 and +75°C in accordance with Para. 9.3.1.1.

(d) Test Chamber

The thermistors shall be placed in a still-air controlled chamber with a minimum volume of 1000 times the thermistor body and test fixture combined. The chamber temperature shall be +25 ±1 °C.

(e) Loading (See Figure I)

E_{TH} and I_{TH} shall be adjusted for the zero power resistance values of +75°C and the loading shall be maintained for a maximum of 15 minutes.

(f) Recording

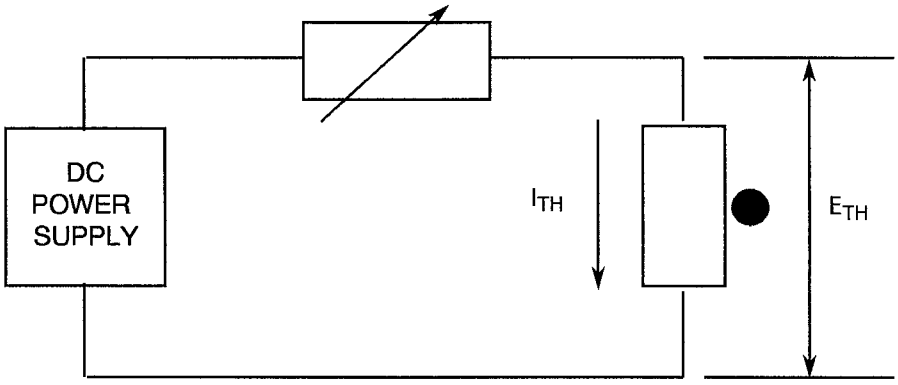
E_{TH} and I_{TH} shall be recorded. Voltage and current measurements shall be performed with a high impedance measuring circuit of an accuracy of ±1% or better.

(g) Dissipation Constant

The dissipation constant shall be calculated using the following formula and shall be recorded.

$$P = \frac{E_{TH} \times I_{TH}}{(75°C - 25°C)} \text{ (Milliwatts/°C)}$$

FIGURE I - TEST CIRCUIT FOR DISSIPATION CONSTANT



9.3.1.3 Thermal Time Constant

(1) Disks, Rods and Beads

The test procedure shall be as follows:-

(a) Mounting

See Para. 9.3.1.1(3).

(b) Power Supply

A regulated d.c. or battery power supply shall be used.

(c) Measurement

The zero power resistance shall be measured and recorded at +43.4 and +75°C in accordance with Para. 9.3.1.1.

(d) Test Chamber

The thermistors shall be placed in a still-air controlled chamber with a minimum volume of 1000 times the thermistor body and test fixture combined. The chamber temperature shall be +25 ±1 °C.

(e) Test Circuit

See Figure II A.

(f) Measurement

The measurement shall be performed as follows:-

(i) With switch AA closed, adjust the E_{TH}/I_{TH} ratio equal to the zero power resistance at +75°C, allowing 15 minutes maximum for thermistor stabilisation.

(ii) Set the bridge for "Null" with the zero power resistance value measured at +43.4°C in step (c).

(iii) Throw switch to position BB and measure and record the time from the instant the switch is thrown to the time when the bridge indicator passes through the "Null" point. This time is the thermal time constant of the thermistor.

(2) Beads in Probes and Beads in Rods

The test procedure shall be as follows:-

(a) Perform steps (a) and (c) of Para. 9.3.1.3(1).

(b) Test Circuit: See Figure IIB.

(c) Test Method

The test method shall be as follows:-

(i) Submerge the complete thermistor in a temperature-controlled ($+75 \pm 1$ °C) bath of low viscosity liquid (e.g. Dow Corning DC200) with a viscosity of 1 centistoke. The medium must not be subject to surface evaporation when the thermistor is removed.

(ii) Locate a still-air test chamber over the liquid ($+75 \pm 1$ °C) bath. The chamber shall have a minimum volume of 1000 times the thermistor body and test fixture combined. The chamber temperature shall be $+25 \pm 1$ °C.

(iii) Set the bridge for "Null" with the zero power resistance value measured at $+43.4$°C in step (a).

(iv) Throw switch to position BB.

(v) Using a controlled drive mechanism or other means, lift the thermistor from the bath into the still air chamber at a uniform speed of 50.80 ± 6.35 mm per second. The vertical travel of the thermistor shall be 101.60 ± 25.4 mm from the surface of the liquid bath.

(d) Measurement

Measure and record the time from the instant the thermistor bead (contained in the probe or rod) leaves the surface of the bath to the time when the bridge indicator passes through the "Null" point. This time is the thermal time constant of the thermistor.

N.B.
A low-persistence screen oscilloscope with a graduated time scale may be used for this measurement.

FIGURE II - TEST CIRCUITS FOR THERMAL TIME CONSTANT

FIGURE IIA

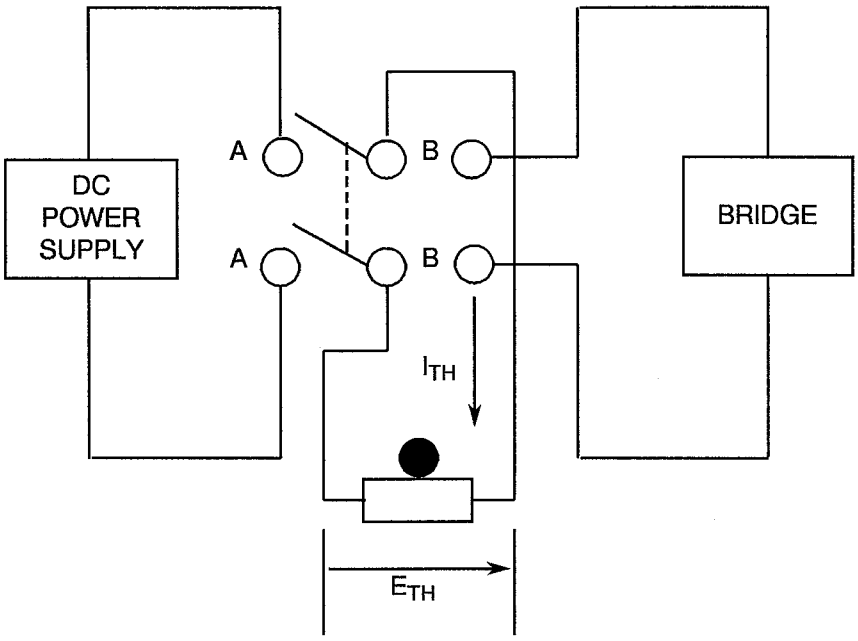
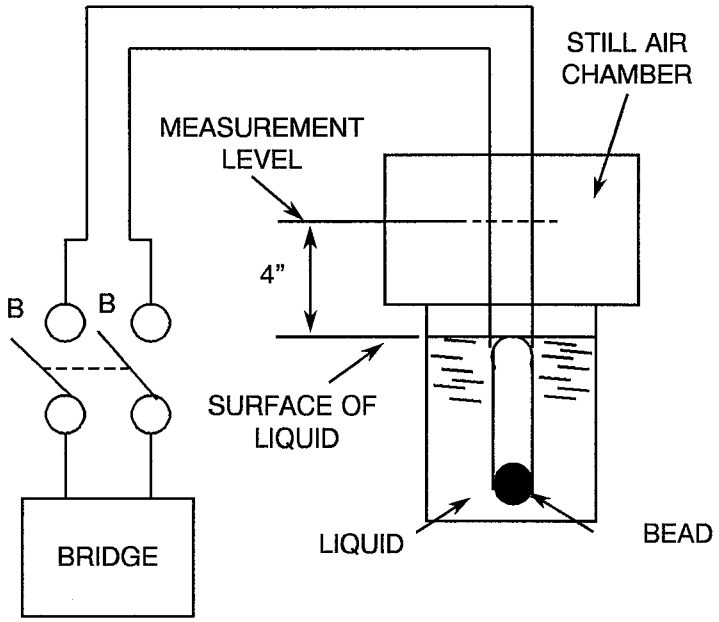


FIGURE IIB



9.3.1.4 Insulation Resistance

Insulation resistance shall be tested in accordance with Method 302 of MIL-STD-202. The following details shall apply:-

(a) Test Condition: 'A'.

(b) Special Preparations

Thermistors shall be clamped in the trough of a 90° metallic V-block of such size that the body does not extend beyond the extremities of the block. The clamping force shall be such that adequate contact between the thermistor and the block is guaranteed.

The thermistor leads shall be so positioned that the distance between them and any point of the V-block is not less than the radius of the thermistor minus the radius of the lead wire.

(c) Points of Measurement

Between the thermistor terminals (shorted together) and the V-block.

9.3.2 Parameter Drift Value Measurements

At each of the relevant data points for components of testing level "B", measurements shall be made of all parameters listed in Table 4 of the Detail Specification. All values obtained shall be recorded against serial numbers and the parameter drift calculated.

9.3.3 Electrical Measurements at High and Low Temperatures

For components of testing levels "B" and "C", the electrical measurements at high and low temperatures shall be made in accordance with Table 3 of the Detail Specification. Where sample testing is applied, note the requirements of Para. 8.2.3(b). For testing level "B", all values obtained shall be recorded against serial numbers.

9.3.4 Electrical Measurements at Room Temperature

For components of testing levels "B" and "C", the measurements of electrical characteristics shall be made in accordance with Table 2 of the Detail Specification. Where sample testing is applied, note the requirements of Para. 8.2.3(b). For testing level "B", all values obtained shall be recorded.

9.3.5 Electrical Measurements during Endurance Testing

At each of the relevant data points specified for endurance testing, measurements shall be made of all parameters listed in Table 6 of the Detail Specification. All values obtained shall be recorded against serial numbers and the parameter drift calculated, if required.

9.4 DIMENSION CHECK

In accordance with ESA/SCC Basic Specification No. 20500 and the Detail Specification. To be performed on 5 samples only.

If 1 failure occurs, the complete lot shall be checked.

9.5 EXTERNAL VISUAL INSPECTION

In accordance with ESA/SCC Basic Specification No. 20500.

9.6 RADIOGRAPHIC INSPECTION

In accordance with ESA/SCC Basic Specification No. 20900.

9.7 SHOCK (SPECIFIED PULSE)

Thermistors shall be tested in accordance with Method 213 of MIL-STD-202. The following details shall apply:-

(a) Mounting Method

The thermistors shall be mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of 6.35mm from the thermistor body. These fixtures shall be contructed in a manner so as to ensure that the points of the thermistor mounting-supports will have the same motion as the test table.

Thermistors shall be mounted in relation to the test equipment in such a manner that the most detrimental stress is applied. The test leads used during this test shall be no larger than AWG size 20 stranded wire so that the influence of the test lead on the thermistors will be held to a minimum. The test lead length shall be no longer than necessary.

(b) Test Condition: 'D'.

(c) Number and Direction of Applied Shocks

The thermistors shall be subjected to a total of 10 shocks in each of 2 mutually perpendicular planes (1 perpendicular and the other parallel to, the longitudinal axis of the thermistors).

(d) Measurements Before Shock

Zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1.

(e) Measurements During Shock

During shock, an electrical measurement shall be made to determine intermittent contact or open or short-circuiting. The accuracy of the detection equipment shall be sufficient to detect any interruption of 0.1ms or longer duration.

(f) Measurements After Shock

Zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1.

After shock, the change in zero power resistance with regard to the initial measurement shall not exceed the limits specified in Table 6 of the Detail Specification.

(g) Visual Examination After Test

The thermistors shall be visually examined for evidence of damage.

9.8 VIBRATION

Thermistors shall be tested in accordance with Method 204 of MIL-STD-202. The following details shall apply:-

(a) Mounting Method

As Para. 9.7(a) with the exception that the body of the thermistor shall not be restrained in any manner and shall be allowed to respond to the vibration forces applied.

(b) Test Condition: 'D'.

(c) Direction of Motion

In each of 2 mutually perpendicular directions (1 perpendicular and the other parallel to, the longitudinal axis of the thermistors).

(d) Measurements Before Vibration: As Para. 9.7(d).

(e) Measurements During Vibration: As Para. 9.7(e).

(f) Measurements After Vibration: As Para. 9.7(f).

(g) Visual Examination After Test: As Para. 9.7(g)

9.9 IMMERSION

Thermistors shall be tested in accordance with Method 104 of MIL-STD-202. The following details shall apply:-

(a) Test Condition: 'B'.

(b) Visual Examination After Final Cycle

The thermistors shall be visually examined. There shall be no evidence of damage.

9.10 DIELECTRIC WITHSTANDING VOLTAGE

Dielectric withstanding voltage shall be tested in accordance with Method 301 of MIL-STD-202. The following details shall apply:

(1) At Atmospheric Pressure

(a) Special Preparations: See Para. 9.3.1.4(b).

(b) Magnitude of Test Voltage: 500V r.m.s.

(c) Nature of Potential

An a.c. supply of commercial line frequency and waveform (but not more than 100Hz).

(d) Duration of Application of Test Voltage: 2 Minutes.

(e) Rate of Application of Test Voltage: 100V per second.

(f) Points of Application of Test Voltage

Between the thermistor terminals (shorted together) and the V-block.

(g) Visual Examination after Test

There shall be no sign of breakdown or flash-over during the test period and, after completion of the test, the thermistors shall be further visually examined for evidence of damage, arcing or breakdown.

(2) At Reduced Barometic Pressure

Following the test specified in Para. 9.10(1), the dielectric withstanding voltage shall again be tested using the conditions specified in Method 105 of MIL-STD-202. The following details shall apply:-

(a) Method of Mounting

See Para. 9.3.1.4(b) (Special Preparations).

(b) Test Condition: 'C'.

(c) Magnitude of Test Voltage: 200V r.m.s.

(d) Nature of Potential: See Para. 9.10(1)(c).

(e) Duration of Application of Test Voltage: 2 minutes.

(f) Points of Application of Test Voltage: See Para. 9.10(1)(f).

(g) Visual Examination after Test: See Para. 9.10(1)(g).

9.11 RESISTANCE TO SOLDERING HEAT

Thermistors shall be tested in accordance with Method 210 of MIL-STD-202. The following details and exceptions shall apply:-

(a) Special Preparation of Specimen

Sample units shall not have been soldered in any previous tests.

(b) Depth of Immersion in Molten Solder

To a point between 3.18 and 4.76mm from the thermistor body.

(c) Temperature of Solder: 300 ±10 °C.

(d) Duration of Immersion: 2 ±0.5 seconds.

(e) Cooling Time Prior to Final Measurement and Visual Examination: 24 ±4 hours.

(f) Measurement and Visual Examination After Test

The zero power resistance shall be measured as specified in Para. 9.3.1.1. The value shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The thermistors shall be visually examined. There shall be no evidence of damage.

9.12 MOISTURE RESISTANCE

Thermistors shall be tested in accordance with Method 106 of MIL-STD-202. The following details and exceptions shall apply:-

(a) Mounting

Thermistors shall be soldered by their leads to insulated stand-off terminals on a suitable panel so that there will be at least 25.4 mm of free air space around each thermistor. The spacing of the mounts shall be such that the length of each thermistor lead is 19.05mm (maximum) when measured from the edge of the supporting terminal to the thermistor body.

(b) Initial Measurements

Not less that 1.5 hours after the thermistors have been removed from the drying oven, the zero power resistance shall be measured at +25 ±0.05 °C as specified in Para. 9.3.1.1.

(c) Loading

During the first 2 hours of steps 2 and 5, a test potential which will maintain the thermistors at their maximum power as specified in the Detail Specification shall be applied to 50% of the thermistors, The remaining 50% of the thermistors will be tested with no application of voltage.

(d) Final Measurements

Upon completion of step 6 of the final cycle, the thermistors shall be maintained at the high-humidity conditions and a temperature of +25 ±2 °C for a period of 1.5 to 3.5 hours.

The thermistors shall be removed from the chamber and, within 24 hours, the zero power resistance at +25 ±0.05 °C and the insulation resistance shall be measured as specified in Paras. 9.3.1.1 and 9.3.1.4 respectively.

The change in zero power resistance with regard to the initial measurement and the insulation resistance shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The sample units shall not be subjected to forced circulating air during these measurements.

9.13 TERMINAL STRENGTH

(1) Disk and All Bead-type Thermistors

Thermistors shall be tested in accordance with Method 211 of MIL-STD-202. The following details and exceptions shall apply:-

(a) Test Condition: 'A'

(b) Initial Measurements

The zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1.

(c) Clamping

The thermistors shall be firmly clamped.

(d) Applied Force

Each terminal shall be individually subjected to the pull conditions specified in the Detail Specification.

(e) Final Measurement and Visual Examination

The zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1 and the change with regard to the initial measurement shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The thermistors shall be visually examined. There shall be no evidence of damage.

(2) Rod-type Thermistors

Thermistors shall be tested in accordance with Method 211 of MIL-STD-202. The following details and exceptions shall apply:-

(a) Test Conditions: 'A' and 'C'.

(b) Initial Measurements

The zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1.

(c) Clamping

The thermistors shall be firmly clamped.

(d) Applied Force

(i) Pull Test

Each terminal shall be individually subjected to the pull conditions specified in the Detail Specification.

(ii) Bend Test

Each terminal shall be individually subjected to the load conditions specified in the Detail Specification.

(e) Final Measurement and Visual Examination

The zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1 and the change with regard to the initial measurement shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The thermistors shall be visually examined. There shall be no evidece of damage.

9.14 OPERATING LIFE

9.14.1 Operating Life during Qualification Testing

MIL-STD-202, Test Method 108.

(a) Duration: 2000 hours.

(b) Temperature Measurements

Distance of temperature measurements from specimens: No requirement.

(c) Method of Mounting

The thermistors shall be mounted by a suitable mounting means and be so located that the temperature of each individual thermistor does not appreciably influence the temperature of any other. There shall be no undue draught over the thermistors. Only natural convection resulting from the hot thermistors may occur.

(d) Test Circuit: See Figure I.

(e) Operating Conditions: As specified in the Detail Specification.

(f) Data Points

Measurements at intermediate and end points in accordance with Table 6 of the Detail Specification at 0, 1000 ±48 and 2000 ±48 hours.

In the case where Table 6 specifies "changes", the drift shall always be related to the 0-hour measurement.

9.14.2 Operating Life during Lot Acceptance Testing

MIL-STD-202, Test Method 108.

(a) Duration: 1000 hours.

(b) Temperature Measurements

Distance of temperature measurements from specimens: No requirement.

(c) Method of Mounting

The thermistors shall be mounted by a suitable mounting means and be so located that the temperature of each individual thermistor does not appreciably influence the temperature of any other. There shall be no undue draught over the thermistors. Only natural convection resulting from the hot thermistors may occur.

(d) Test Circuit: See Figure I.

(e) Operating Conditions: As specified in the Detail Specification.

(f) Data Points

Measurements at end points in accordance with Table 6 of the Detail Specification at 0 and 1000 ±48 hours.
In the case where Table 6 specifies "changes", the drift shall always be related to the 0-hour measurement.

9.15 SHORT TIME LOAD

Thermistors shall be tested using the following procedure:-

(a) Ambient Temperature: +25 ±3 °C.

(b) Maximum Power Rating

Using the values of nominal zero power resistance and dissipation constant specified in the Detail Specification, calculate the average values of E_{TH} and I_{TH} required to raise the thermistor to the maximum power rating.

(c) Power Supply

A filtered regulated d.c. or battery power supply shall be used.

(d) Method

(i) Place the thermistor into a suitable circuit to produce the maximum power rating calculated according to (b) above.

(ii) Energise the circuit for 5 minutes, de-energise for 10 minutes; then repeat for 10 complete cycles.

(e) Measurement and Visual Examination

On completion of the test, the zero power resistance at +25°C shall be measured as specified in Para. 9.3.1.1. The value shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The thermistors shall be visually examined for evidence of arcing, burning or charring.

9.16 LOW TEMPERATURE STORAGE

(a) Method of Mounting

Mounting as per Para. 9.3.1.1 is optional. However, the thermistors shall be isolated from the metal surfaces of cold boxes.

(b) Procedure

(i) The zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1.

(ii) Within 1 hour of this measurement, the thermistors shall be placed in a cold chamber at room temperature. The temperature shall then be reduced to -62 ± 3 °C and the thermistors shall be maintained at that temperature for a period of not less than 3 hours.

(iii) The thermistors shall then be removed from the chamber and be stabilised at room ambient temperature.

(c) Final Measurement and Visual Examination

On completion of the test, the zero power resistance shall be measured at +25°C as specified in Para. 9.3.1.1. The change shall not exceed the limits prescribed in Table 6 of the Detail Specification.

The thermistors shall be visually examined for evidence of damage.

9.17 HIGH TEMPERATURE STORAGE

(a) Duration: 2000 hours.

(b) Method of Mounting

Mounting as per Para. 9.3.1.1 is optional. However, the thermistors shall be isolated from the metal surfaces of ovens.

(c) Test Conditions

(i) The temperature shall be within ±2°C of the maximum storage temperature defined in Table 1(b) of the Detail Specification.

(ii) No load.

(d) Data Points

Measurements at intermediate and end-points in accordance with Table 6 of the Detail Specification at 0, 1000 ± 48 and 2000 ± 48 hours. In the case where Table 6 specifies changes, the drift shall always be related to he 0-hour measurement.

9.18 SOLDERABILITY

Thermistors shall be tested in accordance with Method 208 of MIL-STD-202. The following details shall apply:-

(a) Special Preparation of Specimen

Sample units shall not have been soldered in any previous tests.

(b) Number of Terminations to be tested of each Thermistor

All terminations.

(c) Depth of Immersion in Flux and Solder

Terminals shall be immersed to within 1.25mm of the thermistor body.

9.19 FINAL ASSEMBLY

Final assembly shall be performed in accordance with the Process Identification Document (P.I.D.).

9.20 PERMANENCE OF MARKING

In accordance with ESA/SCC Basic Specification No. 24800.

10. DATA DOCUMENTATION

10.1 GENERAL

For the qualification approval records and with each component delivery, a data documentation package is required. Depending on the testing level and lot acceptance level specified for the component, this package shall be compiled from:-

(a) Cover sheet (or sheets).

(b) List of equipment (testing and measuring).

(c) List of test references.

(d) Special in-process control test data (when required by the Detail Specification).

(e) Final production test data (Chart II) (but see Para. 10.6).

(f) Burn-in and electrical measurement data (Chart III).

(g) Qualification test data (Chart IV).

(h) Lot acceptance test data (Chart V) (when applicable).

(i) Failed component list (see Paras. 7.3 and 8.4) and failure analysis report (see Para. 8.4).

(j) Certificate of Conformity.

(k) Radiographic inspection photographs.

Items (a) to (k) inclusive shall be grouped, preferably as subpackages and, for identification purposes, each page shall include the following information:

- ESA/SCC Component number.
- Manufacturer's name.
- Lot identification.
- Date of establishment of the document.
- Page number.

10.1.1 Qualification Approval

In the case of qualification approval, the items listed in Para 10.1 (a) to (k) less item (h) are required.

10.1.2 Testing Level "B"

10.1.2.1 Qualified Components

For deliveries of qualified components, the following documentation shall be supplied:-

(a) Cover sheet (if all of the information is not included on the Certificate of Conformity).

(b) Certificate of Conformity (including range of delivered serial numbers).

(c) Attributes record of measurements, tests and inspections performed in Chart II, Chart III (including PDA figure) and Chart V (where applicable).

(d) Failed components list.

10.1.2.2 Unqualified Components

For deliveries of unqualified components, the documentation to be supplied shall be in accordance with Para. 10.1.2.1 plus the following:-

(a) Read and record data from Chart III.

(b) Special in-process control data (where applicable).

(c) Failure analysis report on failed components.

10.1.3 Testing Level "C"

10.1.3.1 Qualified Components

For deliveries of qualified components, the following documentation shall be supplied:-

(a) Certificate of Conformity.

10.1.3.2 Unqualified Components

For deliveries of unqualified components, the documentation to be supplied shall be in accordance with Para. 10.1.3.1 plus the following:-

(a) Cover sheet (if all of the information is not included on the Certificate of Conformity).

(b) Attributes record of all measurements, tests and inspections performed in Charts II, III and V (when applicable).

(c) Failed components list (including Failure Analysis Report).

(d) Special in-process control data (when applicable).

10.1.4 Data Retention/Data Access

If not delivered, all data shall be retained by the Manufacturer for a minimum of 5 years during which time it shall be available to the Qualifying Space Agency and the Orderer, if requested, for review. The Manufacturer shall deliver variables Data/Reports to the Orderer if required by the Purchase Order.

10.2 COVER SHEET(S)

The cover sheet(s) of the data documentation package shall include as a minimum:-

(a) Reference to the Detail Specification, including issue and date.

(b) Reference to the applicable ESA/SCC Generic Specification, including issue and date.

(c) Component type and number.

(d) Lot identification.

(e) Range of delivered serial numbers (for components of testing level "B").

(f) Number of purchase order.

(g) Information relative to any additions to this specification and/or the Detail Specification.

(h) Manufacturer's name and address.

(j) Location of the manufacturing plant.

(k) Signature on behalf of Manufacturer.

(l) Total number of pages of the data package.

10.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be prepared, if not in accordance with the data given in the Process Identification Document (P.I.D.). Where applicable, this list shall contain inventory number, Manufacturer's type number, serial number, etc. This list shall indicate for which tests such equipment was used.

10.4 LIST OF TEST REFERENCES

This list shall include all Manufacturer's references or codes which are necessary to correlate the test data provided with the applicable tests specified in the tables of the Detail Specification.

10.5 SPECIAL IN-PROCESS CONTROL DATA

As specified in the Detail Specification.

10.6 FINAL PRODUCTION TEST DATA (CHART II)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after, each of the following tests:

- Overload (Para. 9.1).
- Third harmonic control or Current noise (Para. 9.2).
- Electrical measurements at room temperature (Para. 9.5.4).
- External visual inspection (Para. 9.17).
- Dimension check (Para. 9.4).

The final production test data shall form an integral part of the data documentation package, but it is not a mandatory requirement that it be delivered with the qualification lot or delivery lot. However, the data package to be delivered shall contain the information as detailed in Paras. 10.1.2 and 10.1.3 or at least shall contain a list of final production tests actually performed and a certification that the data is available for review.

10.7 BURN-IN AND ELECTRICAL MEASUREMENT DATA (CHART III)

10.7.1 Testing Level "B"

For components of testing level "B", all data shall refer to the relevant serial numbers. Against these serial numbers, data shall be recorded of the following:-

(a) 0-hour measurement for burn-in.

(b) 168-hour measurement for burn-in.

(c) Delta values after burn-in.

(d) Values obtained during measurements at high and low temperatures (Table 3 of the Detail Specification).

(e) Values obtained during measurements of electrical characteristics (Table 2 of the Detail Specification).

(f) Failures during external visual inspection.

(g) Photographs from radiographic inspection, including those of reject components.

10.7.2 Testing Level "C"

For components of testing level "C", a test result summary (i.e. the total number of components subjected to, and the total number rejected from, each of the tests and inspections) shall be prepared.

10.8 QUALIFICATION TEST DATA (CHART IV)

All data shall be referenced to the relevant serial numbers. Detailed records shall be provided of the components submitted to each test in each of the subgroups and of those rejected. Detailed data shall be provided of all electrical measurements made in accordance with Tables 2 and 6 of the Detail Specification, as and where applicable.

10.9 LOT ACCEPTANCE TEST DATA (CHART V)

10.9.1 Testing Level "B"

All data shall be referenced to the relevant serial numbers. Detailed records shall be provided of the components submitted to each test in each of the subgroups (as relevant to the lot acceptance level) and of those rejected.

Detailed data shall be provided of all electrical measurements made in accordance with Tables 2, 3 and 6 of the Detail Specification, as and where applicable.

10.9.2 Testing Level "C"

A test result summary (i.e. the total number of components submitted to, and and the total number rejected from, each of the tests and inspections) as relevant to the lot acceptance level shall be provided.

In the case of lot acceptance 2 testing, all data in respect of electrical measurements made in accordance with Table 6 of the Detail Specification shall be referenced to the relevant serial numbers (see Para. 8.2.4(a)).

In the case of lot acceptance 1 testing, all data in respect of electrical measurements made in accordance with Tables 2 and 6 of the Detail Specification shall be referenced to the relevant serial numbers (see Para. 8.2.5(a)).

10.10 FAILED COMPONENT LIST AND FAILURE ANALYSIS REPORT

The failed component list and failure analysis report shall provide full details of:-

(a) The reference number and description of the test or measurement performed as defined in this specification and/or the Detail Specification.

(b) The serial number (if applicable) of the failed component.

(c) The failed parameter and the failure mode of the component.

(d) Detailed failure analysis, if requested.

10.11 CERTIFICATE OF CONFORMITY

A Certificate of Conformity shall be established as defined in ESA/SCC Basic Specification No. 20100.

11. DELIVERY

For qualification approval, the disposition of the qualification test lot and its related documentation shall be as specified in ESA/SCC Basic Specification No. 20100 and the relevant paragraphs of Section 10 of this specification.

For procurement, for each order, the items forming the delivery are:-

(a) The delivery lot.

(b) The components used for lot acceptance testing, (when applicable), but not forming part of the delivery lot (see Paras. 8.2.3(d), 8.2.4(b) and 8.2.5(b)).

(c) The relevant documentation in accordance with the requirements of Section 10 of this specification.

In the case of a component for which a valid qualification approval is in force, all data of all components submitted to LA1 and LA2 testing shall also be copied, when requested, to the relevant Qualifying Space Agency.

12. PACKAGING AND DESPATCH

The packaging and despatch of components to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 20600.

ANNEXE I

LTPD SAMPLING PLAN FOR LOT SIZES GREATER THAN 200 DEVICES

Minimum size of sample to be tested to assure with a 90% confidence that a lot whose Percent Defective equals the specified LTPD is not accepted (single sample).

Max. Percent Defective (LTPD) or λ	50	30	20	15	10	7	5	3	2	1.5	1	0.7	0.5	0.3	0.2	0.15	0.1
Acceptance Number (c) (r = c + 1)	MINIMUM SAMPLE SIZES (FOR DEVICE-HOURS REQUIRED FOR LIFE TEST, MULTIPLY BY 1000)																
0	5 (1.03)	8 (0.64)	11 (0.46)	15 (0.34)	22 (0.23)	32 (0.16)	45 (0.11)	76 (0.07)	116 (0.04)	153 (0.03)	231 (0.02)	328 (0.02)	461 (0.01)	767 (0.007)	1152 (0.005)	1534 (0.003)	2303 (0.002)
1	8 (4.4)	13 (2.7)	18 (2.0)	25 (1.4)	38 (0.94)	55 (0.65)	77 (0.46)	129 (0.28)	195 (0.18)	258 (0.14)	390 (0.09)	555 (0.06)	778 (0.045)	1296 (0.027)	1946 (0.018)	2592 (0.013)	3891 (0.009)
2	11 (7.4)	18 (4.5)	25 (3.4)	34 (2.24)	52 (1.6)	75 (1.1)	105 (0.78)	176 (0.47)	266 (0.31)	354 (0.23)	533 (0.15)	759 (0.11)	1065 (0.080)	1773 (0.045)	2662 (0.031)	3547 (0.022)	5323 (0.015)
3	13 (10.5)	22 (6.2)	32 (4.4)	43 (3.2)	65 (2.1)	94 (1.5)	132 (1.0)	221 (0.62)	333 (0.41)	444 (0.31)	668 (0.20)	953 (0.14)	1337 (0.10)	2226 (0.062)	3341 (0.041)	4452 (0.031)	6681 (0.018)
4	16 (12.3)	27 (7.3)	38 (5.3)	52 (3.9)	78 (2.6)	113 (1.8)	158 (1.3)	265 (0.75)	398 (0.50)	531 (0.37)	798 (0.25)	1140 (0.17)	1599 (0.12)	2663 (0.074)	3997 (0.049)	5327 (0.037)	7994 (0.025)
5	19 (13.8)	31 (8.4)	45 (6.0)	60 (4.4)	91 (2.9)	131 (2.0)	184 (1.4)	308 (0.85)	462 (0.57)	617 (0.42)	927 (0.28)	1323 (0.20)	1855 (0.14)	3090 (0.085)	4638 (0.056)	6181 (0.042)	9275 (0.028)
6	21 (15.6)	35 (9.4)	51 (6.6)	68 (4.9)	104 (3.2)	149 (2.2)	209 (1.6)	349 (0.94)	528 (0.62)	700 (0.47)	1054 (0.31)	1503 (0.22)	2107 (0.155)	3509 (0.093)	5267 (0.062)	7019 (0.047)	10533 (0.031)
7	24 (16.6)	39 (10.2)	57 (7.2)	77 (5.3)	116 (3.5)	166 (2.4)	234 (1.7)	390 (1.0)	589 (0.67)	783 (0.51)	1178 (0.34)	1680 (0.24)	2355 (0.17)	3922 (0.101)	5886 (0.067)	7845 (0.051)	11771 (0.034)
8	26 (18.1)	43 (10.9)	63 (7.7)	85 (5.6)	128 (3.7)	184 (2.6)	258 (1.8)	431 (1.1)	648 (0.72)	864 (0.54)	1300 (0.36)	1854 (0.25)	2599 (0.18)	4329 (0.108)	6498 (0.072)	8660 (0.054)	12995 (0.036)
9	28 (19.4)	47 (11.5)	69 (8.1)	93 (6.0)	140 (3.9)	201 (2.7)	282 (1.9)	471 (1.2)	709 (0.77)	945 (0.58)	1421 (0.38)	2027 (0.27)	2842 (0.19)	4733 (0.114)	7103 (0.077)	9468 (0.057)	14206 (0.038)
10	31 (19.9)	51 (12.1)	75 (8.4)	100 (6.3)	152 (4.1)	218 (2.9)	306 (2.0)	511 (1.2)	770 (0.80)	1025 (0.60)	1541 (0.40)	2199 (0.28)	3082 (0.20)	5133 (0.120)	7704 (0.080)	10268 (0.060)	15407 (0.040)
11	33 (21.0)	54 (12.8)	83 (8.3)	111 (6.2)	166 (4.2)	238 (2.9)	332 (2.1)	555 (1.2)	832 (0.83)	1109 (0.62)	1664 (0.42)	2378 (0.29)	3323 (0.21)	5546 (0.12)	8319 (0.083)	11092 (0.062)	16638 (0.042)
12	36 (21.4)	59 (13.0)	89 (8.6)	119 (6.5)	178 (4.3)	254 (3.0)	356 (2.2)	594 (1.3)	890 (0.86)	1187 (0.65)	1781 (0.43)	2544 (0.3)	3562 (0.22)	5936 (0.13)	8904 (0.086)	11872 (0.065)	17808 (0.043)
13	38 (22.3)	63 (13.4)	95 (8.9)	126 (6.7)	190 (4.5)	271 (3.1)	379 (2.26)	632 (1.3)	948 (0.89)	1264 (0.67)	1896 (0.44)	2709 (0.31)	3793 (0.22)	6321 (0.134)	9482 (0.089)	12643 (0.067)	18964 (0.045)
14	40 (23.1)	67 (13.8)	101 (9.2)	134 (6.9)	201 (4.6)	288 (3.2)	403 (2.3)	672 (1.4)	1007 (0.92)	1343 (0.69)	2015 (0.46)	2878 (0.32)	4029 (0.23)	6716 (0.138)	10073 (0.092)	13431 (0.069)	20146 (0.046)
15	43 (23.3)	71 (14.1)	107 (9.4)	142 (7.1)	213 (4.7)	305 (3.3)	426 (2.36)	711 (1.41)	1066 (0.94)	1422 (0.71)	2133 (0.47)	3046 (0.33)	4265 (0.235)	7108 (0.141)	10662 (0.094)	14216 (0.070)	21324 (0.047)
16	45 (24.1)	74 (14.0)	112 (9.7)	150 (7.2)	225 (4.8)	321 (3.37)	450 (2.41)	750 (1.44)	1124 (0.96)	1499 (0.72)	2249 (0.48)	3212 (0.337)	4497 (0.241)	7496 (0.144)	11244 (0.096)	14992 (0.072)	22487 (0.048)
17	47 (24.7)	79 (14.7)	118 (9.86)	158 (7.36)	236 (4.93)	338 (3.44)	473 (2.46)	788 (1.48)	1182 (0.98)	1576 (0.74)	2364 (0.49)	3377 (0.344)	4728 (0.246)	7880 (0.148)	11819 (0.098)	15759 (0.074)	23639 (0.049)
18	50 (24.9)	83 (15.0)	124 (10.0)	165 (7.54)	248 (5.02)	354 (3.51)	496 (2.51)	826 (1.51)	1239 (1.0)	1652 (0.75)	2478 (0.50)	3540 (0.351)	4956 (0.251)	8260 (0.151)	12390 (0.100)	16520 (0.075)	24780 (0.050)
19	52 (25.5)	86 (15.4)	130 (10.2)	173 (7.76)	259 (5.12)	370 (3.58)	518 (2.56)	864 (1.53)	1296 (1.02)	1728 (0.77)	2591 (0.52)	3702 (0.358)	5183 (0.256)	8638 (0.153)	12957 (0.102)	17276 (0.077)	25914 (0.051)
20	54 (26.1)	90 (15.6)	135 (10.4)	180 (7.82)	271 (5.19)	386 (3.65)	541 (2.60)	902 (1.56)	1353 (1.04)	1803 (0.78)	2705 (0.52)	3864 (0.364)	5410 (0.260)	9017 (0.156)	13526 (0.104)	18034 (0.078)	27051 (0.052)
26	65 (27.0)	109 (16.1)	163 (10.8)	217 (8.08)	326 (5.38)	466 (3.76)	652 (2.69)	1086 (1.61)	1629 (1.08)	2173 (0.807)	3259 (0.538)	4656 (0.376)	6518 (0.269)	10863 (0.161)	16295 (0.108)	21726 (0.081)	32589 (0.054)

(1) Sample sizes are based upon the Poisson exponential binomial limit.
(2) The minimum quality (approximate AQL) required to accept (on the average) 19 of 20 lots is shown in parentheses for information only.

ANNEXE I

LTPD SAMPLING PLAN FOR LOT SIZES LESS THAN, OR EQUAL TO, 200 DEVICES

C=0

N	10		20		30		40		50		60		80		100		120		150		160		200	
n	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD
2	2.2	65	2.5	66	2.5	67	2.5	67	2.5	67	2.5	68	2.5	68	2.5	68	2.5	68	2.5	68	2.5	68	2.5	68
4	1.2	36	1.2	40	1.2	42	1.2	42	1.3	42	1.3	43	1.3	43	1.3	43	1.3	43	1.3	43	1.3	44	1.3	44
5	1.0	29	1.0	33	1.0	34	1.0	35	1.0	35	1.0	35	1.0	36	1.0	36	1.0	37	1.0	37	1.0	37	1.0	37
8	0.5	15	0.6	20	0.6	22	0.6	23	0.6	23	0.6	23	0.6	24	0.7	24	0.7	24	0.7	24	0.7	24	0.7	25
10			0.4	15	0.5	17	0.5	19	0.5	19	0.5	19	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20	0.5	20
16			0.2	6.9	0.25	10	0.25	11	0.3	11	0.3	12	0.3	12	0.3	13	0.3	13	0.3	13	0.3	13	0.3	13
20					0.2	6.8	0.2	8.0	0.25	8.7	0.25	9.0	0.25	9.4	0.25	10	0.25	10	0.25	10	0.25	10	0.25	11
25					0.15	4.3	0.15	5.7	0.2	6.4	0.2	6.9	0.2	7.4	0.2	7.5	0.2	7.6	0.2	7.7	0.2	7.8	0.2	7.9
32							0.1	3.7	0.1	4.4	0.1	5.0	0.1	5.5	0.1	5.9	0.15	6.0	0.15	6.2	0.15	6.3	0.15	6.3
40									0.1	3.0	0.1	3.4	0.1	4.0	0.1	4.5	0.1	4.6	0.1	4.9	0.1	5.0	0.15	5.0
50											0.1	2.3	0.1	2.9	0.10	3.3	0.10	3.5	0.10	3.7	0.10	3.7	0.10	3.9
64													0.08	1.7	0.08	2.2	0.08	2.5	0.08	2.7	0.08	2.8	0.08	2.9
80															0.07	1.5	0.07	1.7	0.07	2.0	0.07	2.1	0.07	2.2
100																	0.05	1.1	0.05	1.5	0.05	1.5	0.05	1.7
125																			0.04	0.8	0.04	0.9	0.04	1.2
128																			0.04	0.8	0.04	0.9	0.04	1.1
160																							0.03	0.7

C=1

N	10		20		30		40		50		60		80		100		120		150		160		200	
n	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD
2	27	95	24	95	24	95	23	95	23	95	23	95	23	95	23	95	23	95	22	95	22	95	22	95
4	15	62	12	66	12	66	11	67	11	67	10	67	10	67	10	67	10	67	9.8	67	9.7	67	9.7	68
5	13	51	10	55	8.8	56	8.5	57	8.4	57	8.1	58	7.9	58	7.6	58	7.5	58	7.5	58	7.5	58	7.5	58
8	11	28	7.2	35	6.2	38	5.8	38	5.4	39	5.0	39	4.7	39	4.5	39	4.3	39	4.3	40	4.2	40	4.2	40
10			6.2	30	5.0	30	4.6	31	4.2	32	4.2	32	4.2	32	3.9	33	3.5	33	3.3	33	3.3	33	3.3	33
16			5.6	15	4.2	18	3.8	18	3.4	20	3.0	20	2.9	21	2.6	21	2.5	21	2.3	21	2.3	22	2.2	22
20					4.0	13	3.2	15	2.8	16	2.5	16	2.4	16	2.3	16	2.1	17	2.0	17	2.0	17	2.0	18
25					3.8	9.2	3.1	11	2.5	12	2.2	13	2.0	13	1.8	13	1.7	13	1.6	14	1.6	14	1.6	14
32							3.1	7.4	2.4	8.2	2.1	9.0	1.8	9.9	1.6	10	1.5	10.5	1.4	11	1.3	11	1.3	11
40									2.4	5.9	2.1	6.8	1.6	7.6	1.4	7.8	1.3	8.2	1.2	8.3	1.2	8.4	1.2	8.6
50											1.7	4.6	1.4	5.6	1.2	6.1	1.2	6.4	1.0	65	0.9	6.7	0.9	6.7
64													1.3	3.8	1.1	4.4	1.0	4.7	0.8	5.0	0.8	5.0	0.7	5.2
80															1.1	3.0	1.0	3.4	0.8	3.7	0.7	3.8	0.6	4.0
100																	0.9	2.5	0.7	2.8	0.7	2.8	0.6	3.0
125																			0.7	1.9	0.7	2.0	0.5	2.2
128																			0.7	1.7	0.7	1.9	0.5	2.2
160																							0.5	1.5

C=2

N	10		20		30		40		50		60		80		100		120		150		160		200	
n	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD	AQL	LTPD
4	33	82	28	83	27	84	27	85	27	85	26	85	26	85	26	86	26	86	25	86	25	86	25	86
5	27	69	23	73	21	74	20	74	20	74	20	75	20	75	19	75	19	75	19	75	19	75	19	75
8	22	42	15	49	14	49	13	52	13	52	13	52	12	53	12	53	12	53	11	53	11	53	11	53
10			13	39	11	42	11	42	10	43	10	43	9.6	43	9.2	44	9.1	44	8.9	44	8.9	44	8.7	44
16			11	22	8.6	25	6.9	27	6.8	27	6.4	27	6.0	28	6.0	29	5.9	29	5.9	29	5.7	29	5.5	30
20					7.7	19	6.2	21	5.9	22	5.6	22	5.1	23	4.8	23	4.8	23	4.6	23	4.5	24	4.5	24
25					7.4	13	6.0	16	4.9	17	4.5	17	4.3	18	4.1	18	3.9	18	3.7	18	3.7	19	3.7	19
32							5.5	11	4.8	12	4.3	13	3.6	14	3.4	14	3.2	14	3.0	14.5	3.0	15	2.9	15
40									4.6	8.9	3.9	9.8	3.1	11	2.8	12	2.6	12	2.4	12	2.4	12	2.3	12
50											3.5	6.9	2.8	8.1	2.4	8.4	2.3	8.6	2.1	9.0	2.1	9.3	2.0	9.5
64													2.6	5.7	2.2	6.2	2.0	6.6	1.8	7.1	1.7	7.1	1.6	7.4
80															2.1	4.5	1.8	4.9	1.6	5.4	1.5	5.4	1.4	5.6
100																	1.8	3.5	1.4	3.9	1.4	4.0	1.2	4.4
125																			1.4	2.8	1.3	2.9	1.1	3.3
128																			1.4	2.6	1.3	2.9	1.1	3.2
160																							1.1	2.3

ANNEXE I

This table gives the AQL and LTPD values associated with certain single sampling plans (Acceptance Number "C", Sample Size "n" and Lot Size "N"). The table has the following features:-

(a) Calculations are based upon the hyper-geometric distribution (exact theory) for lot sizes of 200 devices or less.

(b) The AQL of a sampling plan is defined as the interpolated Percent Defective for which there is a 0.95 probability of acceptance under the plan. The AQL so defined need not be a realisable Lot Percent Defective for the lot size involved (e.g., 12 percent is not a realisable Percent Defective for a lot size of 20 devices).

(c) The LTPD of a sampling plan is defined as the interpolated Percent Defective for which there is a 0.10 probability of lot acceptance under the plan. The LTPD so defined need not be a realisable Lot Percent Defective for the lot size involved.

(d) The sequence of sample sizes and lot sizes are generated by taking products of preceding numbers in the respective sequences and the numbers 2 and 5.