RESISTORS, FIXED, WIREWOUND,

ESCC Generic Specification No. 4002

ISSUE 1

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RESISTORS, FIXED, WIREWOUND,

ESA/SCC Generic Specification No. 4002

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	September 1996		
Revision 'A'	May 1997		
Revision 'B'	December 1997		
Revision 'C'	April 1999		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE		Approved DCR No.
		Reference	Item	
		This Issue supersedes Issue 3 and incorporates all modifications defined in Revisions 'A', 'B' and 'C' to Issue 3 and the changes agreed in the following DCR's:-		
		Cover page		None
		DCN		None
		Para. 4.1	: Second paragraph amended	21100
		Para. 4.1.3	: Last sentence amended	21101
		Para. 4.1.4	: Text amended	21101
		Chart I	: Note 1 references and Note added	21100
		Para. 8.2.1	; last 2 sentences amended	21100
		Para. 8.2.3(e)	: First sentence expanded	21101
		Para. 8.4	: Text of last sentence amended	21101
		Para. 10.1	: "(when applicable)" added to (h)	21100
		Para. 10.1.3	: New sentence added to the first alinea	21100
			: Second alinea amended	21100
		Para. 10.6	: Data retention amended to "10" years	21100
		Para. 11	: "(when applicable)" added to (b)	21100
			: "when requested" added to the last sentence	21100
'A'	May '97	Implementation of Policy DCR 21107 is completed by the changes introduced by the following DCR:-		
		P1. Cover page		None
		P2. DCN		None
		P4. T of C	: Para. 9.2.2 and 9.3 entries renumbered to Page 22A	None
		P5. T of C	: Para. 10.1.3 entry renumbered to Page 35A	None
			: Para. 10.1.4 entry added	23859
		P8. Para. 4.1	: In second paragraph, "so qualified" deleted	23859
			: New paragraph added	23859
		P11. Chart I	: "(1)" deleted from Burn-in Boxes and added to Lot Acceptance Boxes	23859
		P22. Para. 9	: Text added	23859
		Paras. 9.2.1 and 9.3	: Moved to Page 22A	None
		P22A.	: Page added	None
		Paras. 9.2.1 and 9.3	: Added from Page 22	None
		P35. Para. 10.1.2	: Existing text deleted and new text added	23859
		Para. 10.1.3	: Moved to Page 35A	None
		P35A.	: Page added	None
		Para. 10.1.3	: Title added from Page 35, existing text deleted and new text added	23859
		Para. 10.1.4	: New paragraph added	23859
		P36. Para. 10.2	: (e) amended	23859
		Para. 10.3	: First sentence amended	23859
		Para. 10.6	: Second paragraph, second sentence amended	23859
			: Last sentence deleted	23859
		P37. Para. 10.7.1	: In the second sentence, "provided" replaced by "recorded"	23859
		Para. 10.7.2	: In the text, "provided" replaced by "prepared"	23859
'B'	Dec. '97	P1. Cover page		None
		P2. DCN		None
		P2A. DCN	: Page added	None
		P4. T of C	: Para. 9.7.3 page number amended to "26"	None
			: Para. 9.10.1 amended to read "Leaded Resistors"	221412
			: Para. 9.10.2 amended to read "Surface Mount Resistors" and page number amended to "28"	221412
			: Para. 9.10.3 entry deleted	221412
		P5. T of C	: Paras. 9.11 to 9.12.3 renumbered to "28A"	None
			: Para. 9.20 entry added	221412

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		P15. Para. 8.2.3	In "(c)" first sentence amended	221412
		P20. Chart IV	In Subgroup I, Temperature Characteristics of Resistance moved to the end of the Subgroup	221412
			In Subgroup III, Robustness of Terminations and Resistance to Soldering Heat reversed in sequence	221412
		P21. Chart V	In Level 3, "Mounting" box added	221412
			",Temperature Characteristic" moved to follow "Max. Time Constant"	221412
			,In "Max. Time Constant" Box "(4)" added	221412
			Notes 3 and 4 added	221412
		P22. Para. 9.1.1	New second sentence added	221412
		P23. Para. 9.5.1.2	Para. 9.5.1.2.1 Title added above "(a) Mounting"	221412
		P24. Para. 9.5.1.2.2	Paragraph added	221412
		Para. 9.5.1.3	Para. 9.5.1.3.1 Title added above "(a) Mounting"	221412
		P25. Para. 9.5.1.3.2	Paragraph added	221412
		Para. 9.7	"N.B." added before first sentence	221412
		Para. 9.7.3	Moved to Page 26	None
		P26. Para. 9.7.3	Added from Page 25	None
		P27. Para. 9.10.1	New title added and existing paragraph renumbered to "9.10.1.1"	221412
		Para. 9.10.2	Renumbered to "9.10.1.2"	221412
		P28. Para. 9.10.3	Renumbered to "9.10.1.3"	221412
		Para. 9.10.2	Complete new paragraph added	221412
		Paras. 9.11 to 9.12.3	Moved to Page "28A"	None
		P28A.	New page added	None
		Paras. 9.11 to 9.12.3	Added from Page "28"	None
		P30. Para. 9.15.1	New last sentence added	221412
		P31. Para. 9.15.2	New last sentence added	221412
		P34. Para. 9.20	New paragraph added	221412
'C'	Apr.. '99	P1. Cover page		None
		P2A. DCN		None
		P4. T of C	Para. 9.8.1 entry deleted	221509
		P15. Para. 8.2.1	New second sentence added to last paragraph	21111
		P26. Para. 9.8.1	Number and Title deleted	221509
			First sentence amended from "Table 1(b)" to "Table 6"	221509
		P35. Para. 10.1.2.1	Item (b), "PDA figure and" deleted from text	21119
			Item (c) rewritten	21119
		P35A. Para. 10.1.3.1	Item (a), "(including PDA figure)" deleted	21119

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ANNEXES

1. INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification approval, procurement, including lot acceptance testing, and delivery of Resistors, Fixed, Wirewound 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. 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 No. 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

IEC Publication No. 68, Basic Environmental Testing Procedures.

IEC Publication No. 115, Fixed Resistors for Use in Electronic Equipment.

IEC Publication No. 195, Method of Measurement of Current Noise generated in Fixed Resistors.

IEC Publication No. 410, Sampling Plans and Procedures for Inspection by Attributes or,

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

IEC Publication No. 440, Method of Measurement of Non-linearity in Resistors.

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

Not applicable.

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 external 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

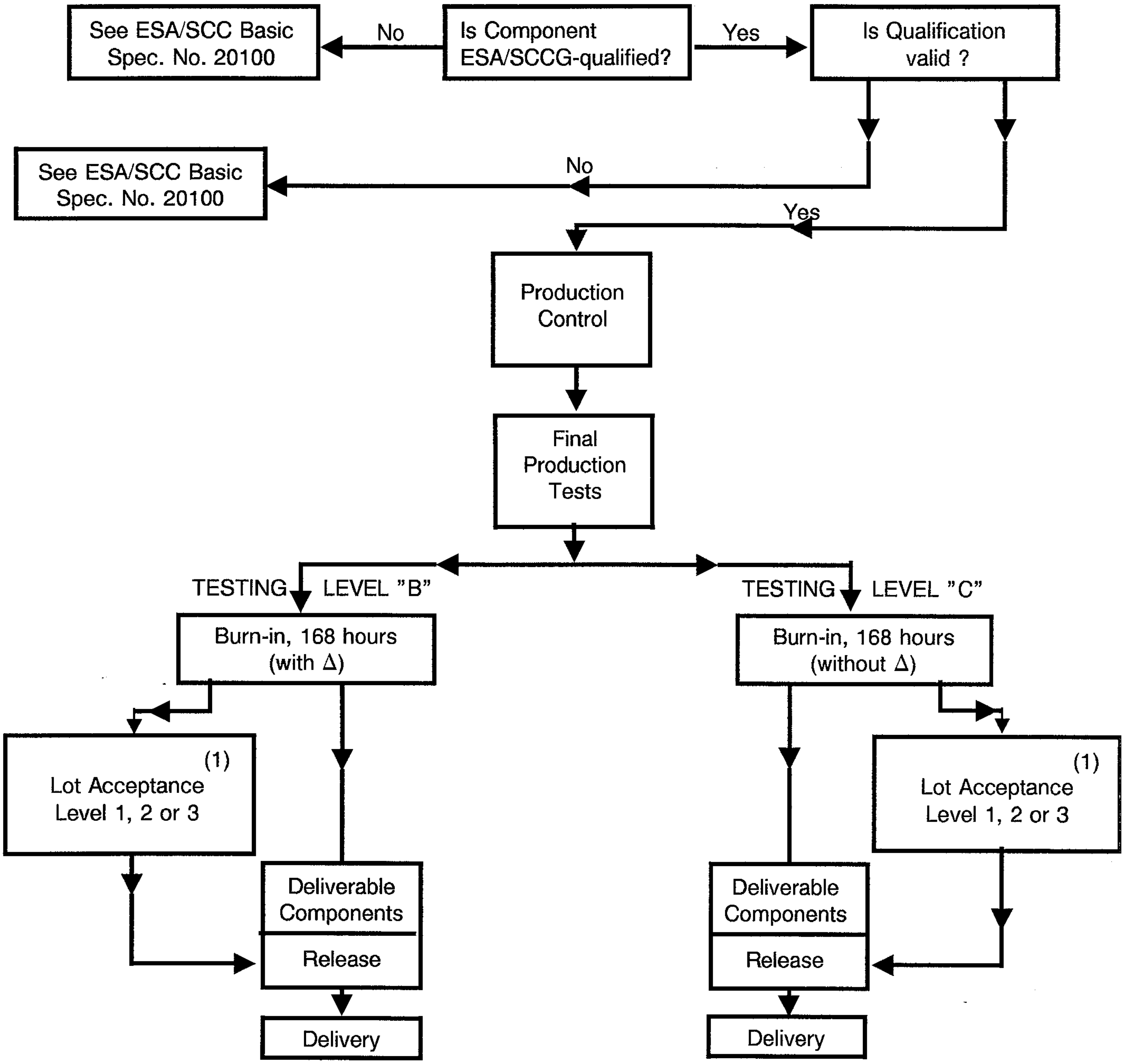
5.1 GENERAL

The minimum requirements for production control, which are equally applicable to procurement, are defined in ESA/SCC Basic Specification No. 20100, Para's 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 resubmitted 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. For the applicable test methods and procedures, see Para. 9.19.

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 5% (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 IEC Publication No. 410 or 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 Annex 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 Para's 6.3 and 6.4.

8.1.2 Distribution within the Qualification Test Lot

A minimum sample of 102 components shall be submitted to qualification testing (Chart IV). The distribution within the sample shall be as follows:-

First case

If the critical resistance is within the range to be qualified:

- 1/3 of the lot with the critical resistance value.
- 1/3 of the lot with the lowest resistance value.
- 1/3 of the lot with the highest resistance value.

Second case

If the critical resistance is outside the range to be qualified:

- 1/3 of the lot with the lowest resistance value.
- 1/3 of the lot with the highest resistance value.
- 1/3 of the lot with the resistance value in the middle of the range.

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 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) If the tests can be performed without mounting the components, 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 robustness of terminations 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, robustness of terminations, 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.

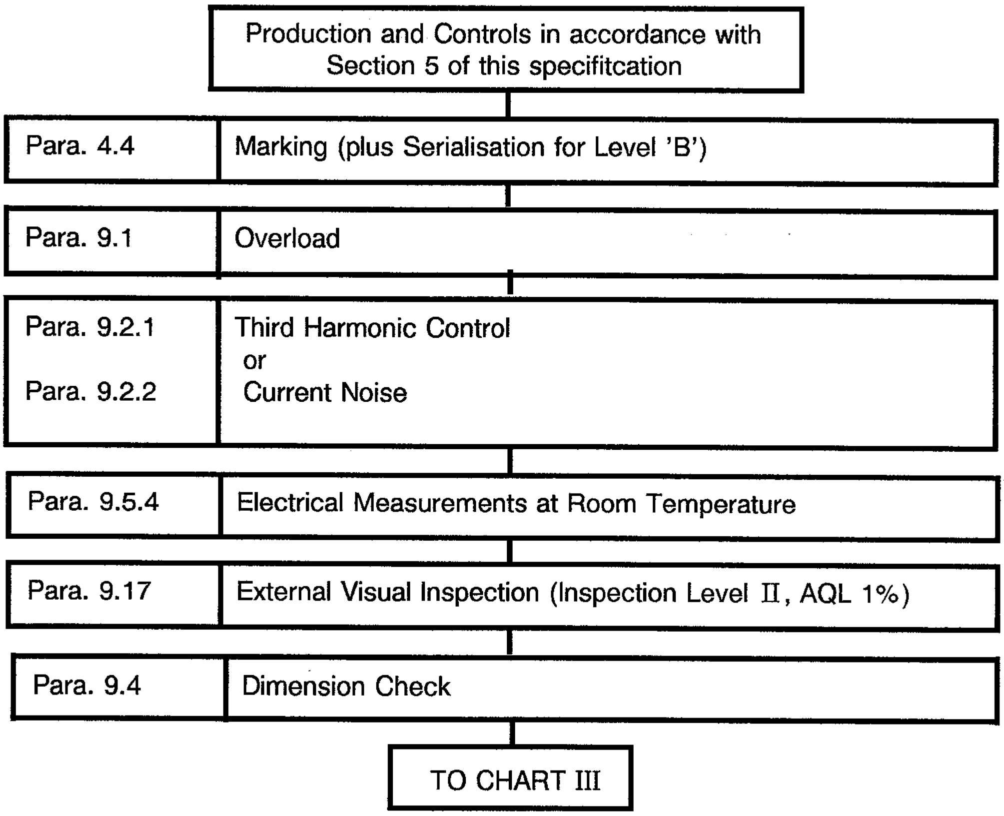
In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.1 of this specification.

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.

CHART II- FINAL PRODUCTION TESTS



Production and Controls in accordance with Section 5 of this specifitcation

Para. 4.4 Marking (plus Serialisation for Level 'B')

Para. 9.1 Overload

Para. 9.2.1 Third Harmonic Control
or
Para. 9.2.2 Current Noise

Para. 9.5.4 Electrical Measurements at Room Temperature

Para. 9.17 External Visual Inspection (Inspection Level II, AQL 1%)

Para. 9.4 Dimension Check

TO CHART III

CHART III- BURN-IN AND ELECTRICAL MEASUREMENTS

Components from Final Production Tests

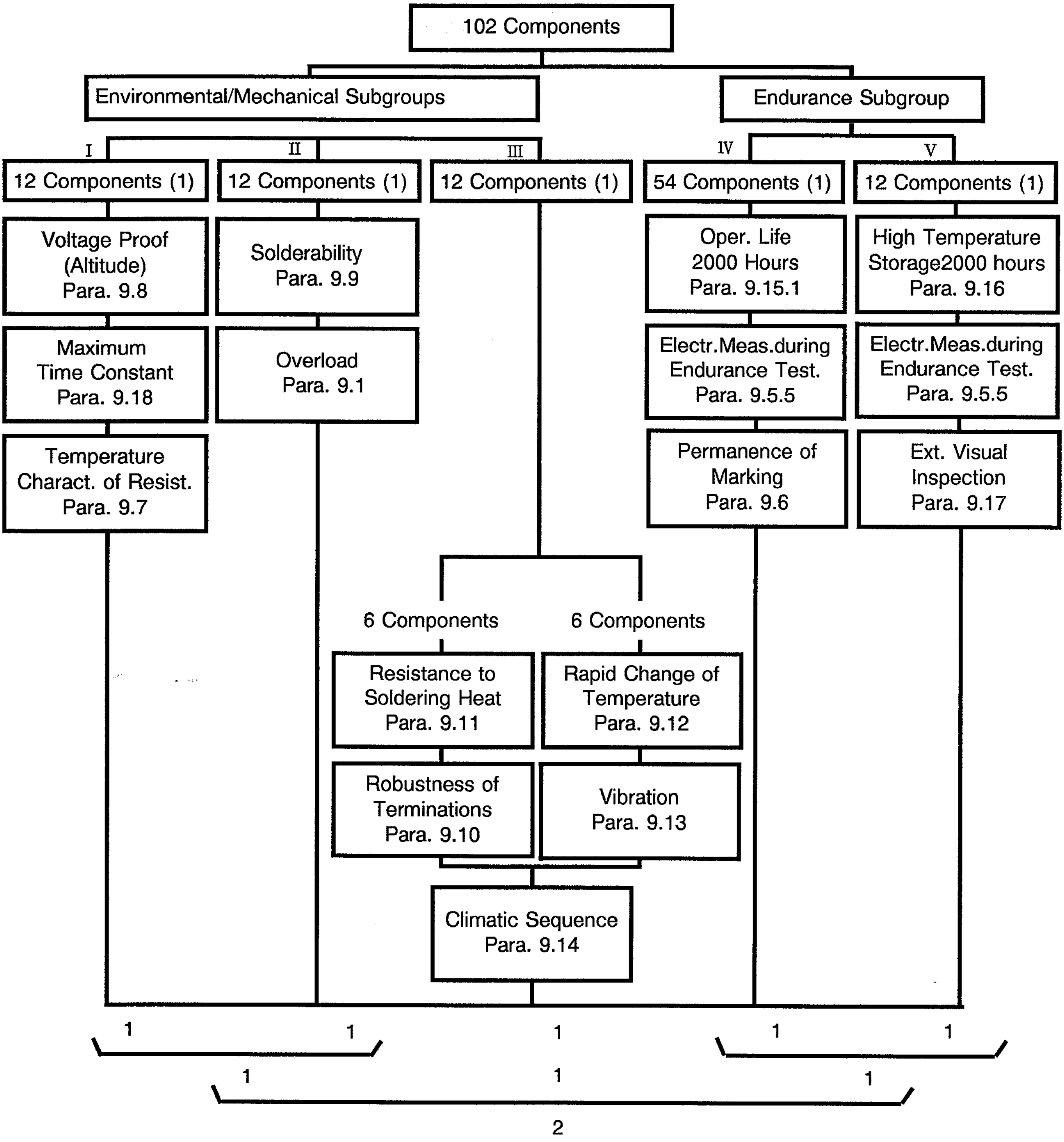
		Testing Levels B	Testing Levels C
Para. 9.5.2	Parameter Drift Value, Initial Measurements	X	-
Paras 7.1, 9.19	Burn-in, 168 hours	X	X
Para. 9.5.2	Parameter Drift Value Measurements	X	-
Para. 9.5.3	Electrical Measurements at High and Low Temperatures	X	X
Para. 9.5.4	Electrical Measurements at Room Temperature (1)	X	X
Para. 9.3	Radiographic Inspection (2) (3) (4)	X	-
Para. 9.17	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

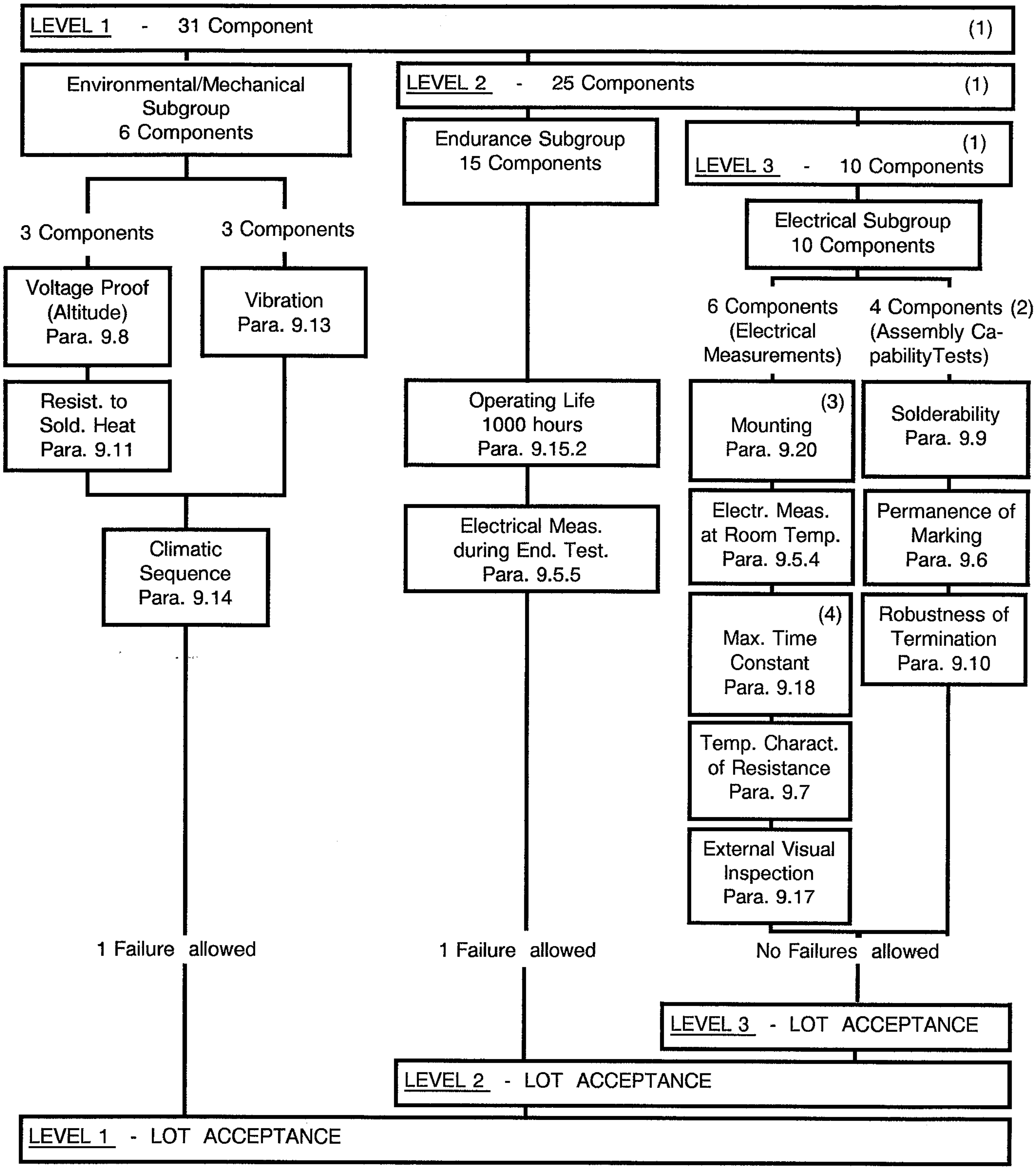
CHART IV - QUALIFICATION TESTS



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 sample, see Para. 8.2.2.
2. Post-burn-in electrical rejects may be used for this test.
3. This operation is at the discretion of the Manufacturer, see Para. 8.2.3(c). If mounted, the components are not deliverable.
4. Applicable only to non-inductive resistors.

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 OVERLOAD

9.1.1 Mounting

The resistors shall be mounted horizontally in free space with no object closer than 70mm to the resistor case, except the mounting base, which shall be not closer than 50 mm below the resistors.

Surface mount resistors shall be mounted on a suitable test substrate with an end-cap contact system, in such a way that their temperature does not affect the adjoining resistors.

They shall be mounted in still air with no circulation other than that caused by the heat of the resistors being operated. The ambient temperature shall be between +15 and +35 °C.

9.1.2 Initial Measurement

DURING CHART IV

The resistance shall be measured as specified in Para. 9.5.1.1.

9.1.3 Procedure

A voltage shall be applied to the terminations of the resistors. Its duration and the maximum voltage which may be applied to the resistor type are given in the Detail Specification.

9.1.4 Recovery and Visual Examination

After a recovery period of not less than 1 hour, nor more than 2 hours, the resistors shall be visually examined. There shall be no evidence of damage and the marking shall be legible.

9.1.5 Final Measurement

DURING CHART II

The resistance shall be measured as specified in Para. 9.5.1.1. The value shall not exceed the limits specified in Table 2 of the Detail Specification.

DURING CHART IV

The resistance shall again be measured. The change in resistance compared to the value measured according to Para. 9.1.2 shall not exceed the limit prescribed in Table 6 of the Detail Specification.

9.2 THIRD HARMONIC CONTROL OR CURRENT NOISE

Either of the following tests may be performed.

9.2.1 Third Harmonic Control

The resistors shall be submitted to the measurement of the third harmonic voltage according to IEC Publication No. 440. Acceptance of the units shall be determined by statistical method.

Limits are the mean ± twice the standard deviation unless otherwise specified in the Detail Specification.

9.2.2 Current Noise

The resistors shall be submitted to the measurement of current noise according to IEC Publication No. 195.

9.3 RADIOGRAPHIC INSPECTION

Radiographic inspection shall be performed on all components in the plane parallel to the longitudinal axis in accordance with ESA/SCC Basic Specification No. 20900.

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 Electrical Measurements

9.5.1 General

Electrical measurements and methods shall be as follows:-

9.5.1.1 Resistance

Measurement of resistance shall be made by using a direct voltage of small magnitude for as short a time as practicable so that the temperature does not rise appreciably during measurement. In the event of conflicting results attributable to such test voltages, the voltage specified in the following table shall be used for reference purposes:-

RATED RESISTANCE (Rn) (Ω)	MEASURING VOLTAGE V(+ 0 -10 %)
< 10	0.1 (see Note)
10 to 99	0.3
100 to 999	1
1 000 to 9 999	3
10 000 to 99 999	10
100 000 to 999 999	22
≥ 1 MΩ	50

The accuracy of the measuring equipment shall be such that the error does not exceed 10% of the tolerance. Where the measurement forms part of a test sequence, it shall be possible to measure a change in resistance with an error not exceeding 10% of the maximum change permitted for that test.

The resistance limits at +22 ± 3 °C are given in Table 2 of the Detail Specification.

N.B.

The measuring voltage shall be chosen such that the resistor dissipates less than 10% of its rated dissipation without exceeding 0.1V.

9.5.1.2 Insulation Resistance

9.5.1.2.1 Leaded Resistors

This test applies only to insulated resistors.

(a) Mounting

For types having axial terminations, a V-block method can be used. For other types, a metal foil shall be wrapped closely around the whole body of the resistor. A space of 1 to 1.5mm shall be left between the edge of the foil and each termination.

V-block Method

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

The terminations shall be so positioned that the distance between then and any point of the V-block is not less than:-

for cylindrical resistors

- The radius of the resistor body minus the radius of the circumscribed circle of the terminations (the larger circle in the case that the 2 terminations have different dimensions).

for rectangular resistors

- Half the smaller side of the resistor body minus the radius of the circumscribed circle of the terminations (the larger circle in the case that the 2 terminations have different dimensions).

Any out-of-centre positioning of the termination at its emergence from the resistor body shall be ignored.

(b) Procedure

The insulation resistance shall be measured with a direct voltage of either 100 ± 15V for resistors with an isolation voltage of less than 500V, or 500 ± 50V for resistors with an isolation voltage equal to or above 500V, between both terminations of the resistor connected together as one pole and the metal foil, or the mounting devices (i.e. V-block) as the other pole.

The voltage shall be applied for 1 minute or such shorter time as is necessary to obtain a stable reading.

The insulation resistance shall be read at the end of that period and shall not be less than that prescribed in the Detail Specification.

9.5.1.2.2 Surface Mount Resistors

The insulation resistance shall be measured with a voltage as specified in Para. 9.5.1.2.1 between test points A and B as shown in Figure 7a or 7b of IEC Publication No. 115-1, Clauses 4.6.1.4 and 4.6.1.5.

The voltage shall be applied for 1 minute or the time necessary to obtain a stable reading. The insulation resistance shall be not less than that prescribed in the Detail Specification.

9.5.1.3 Voltage Proof

9.5.1.3.1 Leaded Resistors

(a) Mounting

For types without mounting devices, a metal foil shall be wrapped closely around the whole body of the resistor. For types without axial terminations, a space of 1 to 1.5 mm shall be left between the edge of the foil and each termination.

For types with axial terminations, the foil shall be wrapped around the whole body of the resistor and protrude at least 5mm from each end provided that the minimum space of 1mm between foil and termination can be maintained. The ends of the foil shall not be folded over the ends of the resistor. A V-block mounting method can also be used.

For types with mounting devices the resistor shall be mounted in the normal manner on a metal plate (or between 2 metal plates) extending in all directions at least 12.5mm beyond the mounting surface of the resistor.

(b) Procedure

A voltage as specified in Table 2 of the Detail Specification shall be applied for a period of 60 ± 5 seconds between the terminations of the resistor, connected together as one pole, and the metal foil or mounting plate(s) as the other pole.

The voltage shall be applied gradually at a rate of approximately 100V/second. When tested as specified, using one of the above mentioned mounting methods, there shall be no breakdown or flash-over.

9.5.1.3.2 Surface Mount Resistors

The electrical conditions and voltage shall be as specified in Para. 9.5.1.3.1 and applied between test points A and B as shown in Figure 7a or 7b of IEC Publication No. 115-1.

9.5.2 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.

9.5.3 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.

9.5.4 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 against serial numbers.

9.5.5 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.

9.6 PERMANENCE OF MARKING

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

9.7 Temperature Characteristic of Resistance (Temperature Coefficient)

N.B. Surface mounted resistors may be mounted as prescribed in Para. 9.20.

The resistors shall be dried as prescribed in the Detail Specification by applying either Procedure I or II as follows:-

9.7.1 Procedure I

For 24 ± 4 hours in an oven at a temperature of +55 ± 2 °C and with a relative humidity not exceeding 20%.

9.7.2 Procedure II

For 96 ±4 hours in an oven at +100 ± 5 °C. The resistors shall then be allowed to cool in a desiccator, using a suitable desiccant such as activated alumina or silica gel, and be kept therein from the time of removal from the oven until the beginning of the test.

9.7.3 Test Procedure

The resistors shall be maintained at each of the following temperatures in turn:-

(a) +22 ±3 °C,

(b) lower category ± 3 °C,

(c) +22 ± 3 °C,

(d) upper category ± 2 °C,

(e) +22 ± 3 °C.

10 to 15 minutes after the resistors have reached thermal stability, resistance measurements shall be made at each of the above mentioned temperatures, using the method specified in Para. 9.5.1.1. The temperature of the resistors at the time of measurement shall be recorded. The error of temperature measurement shall not exceed 1°C.

Thermal stability will have been reached when no further change in resistance is observed between 2 successive measurements taken at 15-minute intervals.

The temperature characteristic of resistance between +22°C and each of the other specified temperatures shall be calculated from the following formula:
Temperature characteristic of resistance (temperature coefficient) =

$$\text{(in Percent/°C) } 100 \frac{\Delta R}{R\Delta T} \text{ x K or (in 10-6/°C) } 106 \frac{\Delta R}{R\Delta T} \text{ x K, where}$$

$$\text{'K'} = \frac{\text{difference between nominal specified temperatures}}{\text{difference between recorded temperatures}}$$

'ΔT' = difference between recorded temperatures and where, if the resistances recorded above are designated Ra, Rb, Rc, Rd and Re, 'R' and 'Δ R' are given as shown in the table below.

	LOWER CATEGORY TEMPERATURE	UPPER CATEGORY TEMPERATURE
R	1/2 (Ra + Rc)	1/2 (Rc + Re)
Δ R	Rb - R	Rd - R

The temperature characteristic of resistance, determined as described above, shall not exceed the value prescribed in the Detail Specification for the appropriate category temperature. Where the resistance value is greater than 5Ω but less than 10Ω, the temperature characteristic of resistance shall not exceed twice the value prescribed in the Detail Specification.

N.B.
The temperature characteristic of resistance is not specified for resistance values of less than 5Ω due to difficulty of accurate measurement.

9.8 VOLTAGE PROOF (ALTITUDE)

The resistors shall be tested as specified in Para. 9.5.1.3 but at a reduced barometric pressure of 8mm of mercury, equivalent to an altitude of 33 000 metres, and with a voltage applied as specified in Table 6 of the Detail Specification. When tested as specified there shall be no breakdown or flashover.

9.9 SOLDERABILITY

The resistors shall be dried as prescribed in the Detail Specification by application of either Procedure I or II (see Para's 9.7.1 and 9.7.2 of this specification).

9.9.1 Procedure

The resistors shall then be subjected to Test 'Ta' of IEC Publication No. 68-2-20, using either Method 1 (solder bath) or Method 3 (solder globule).

When using the solder bath method, the wire terminations stated by the Manufacturer to be suitable for use with printed wiring shall be immersed up to 2 +0.5 -0 mm from the point where the termination emerges from the body, with a suitable heat shield which will simulate a printed wiring board.

9.9.2 Visual Examination

When the test procedures have been carried out, the resistors shall be visually examined. There shall be no evidence of damage and the marking shall be legible.

9.10 ROBUSTNESS OF TERMINATIONS

The resistors shall be subjected to Tests 'Ua', 'Ub', 'Uc' and 'Ud' of IEC Publication No. 68-2-21, as applicable and as specified in the Detail Specification.

N.B.

Tests 'Ub' and 'Uc' shall not be applied if the Detail Specification describes the terminations as rigid.

9.10.1 Leaded Resistors

9.10.1.1 Initial Measurement

The resistance shall be measured as specified in Para. 9.5.1.1.

9.10.1.2 Procedure

Test 'Ua': Tensile.The force shall be:

- For terminations other than wire terminations: 20N.
- For wire terminations: See table below.

NOMINAL CROSS-SECTIONAL AREA (mm2)	CORRESPONDING DIAMETER FOR CIRCULAR-SECTION WIRES (mm)	FORCE (N)
$S \leq 0.05$	$d \leq 0.25$	1
$0.05 < S \leq 0.07$	$0.25 < d \leq 0.3$	2.5
$0.07 < S \leq 0.2$	$0.3 < d \leq 0.5$	5
$0.2 < S \leq 0.5$	$0.5 < d \leq 0.8$	10
$0.5 < S \leq 1.2$	$0.8 < d \leq 1.25$	20
$S > 1.2$	$1.25 < d$	40

The applicable force shall be stated in the Detail Specification.

<u>Test 'Ub' Bending (half the number of terminations)</u>: Method 1

<u>Test 'Uc' Torsion (other half of terminations)</u>: Method 'A', Severity 2

<u>Test 'Ud' Torque (for nuts, threaded terminations and fixing screws)</u>: Severity 2

9.10.1.3 Final Measurement

(a) After each of these tests, the resistors shall be visually examined. There shall be no evidence of damage.

(b) The resistance shall then be measured. The change in resistance compared to the value measured according to Para. 9.10.1 shall not exceed the value prescribed in Table 6 of the Detail Specification.

9.10.2 <u>Surface Mount Resistors</u>

9.10.2.1 Mounting

Mounting shall be performed as specified in Para. 9.20.

9.10.2.2 Adhesion

9.10.2.2.1 Initial Measurement

The resistance shall be measured as specified in Para. 9.5.1

9.10.2.2.2 Procedure

Surface mount resistors shall be tested in accordance with IEC Publication No. 115-1, Clause 4.32.

9.10.2.2.3 Final Measurement

The resistance shall be measured in the mounted state. The change in resistance compared to the value measured in accordance with Para. 9.10.2.2.1 shall not exceed the limit prescribed in Table 6 of the Detail Specification.

The resistors shall be visually examined (approximately 10X magnification). There shall be no sign of damage, cracking, lifting, or dry solder joints.

9.10.2.3 Bend Strength of the End Face Plating

9.10.2.3.1 Initial Measurement

The resistance shall be measured as specified in Para. 9.5.1.

9.10.2.3.2 Procedure

Surface mount resistors shall be tested in accordance with IEC Publication No. 115-1, Clause 4.33.

9.10.2.3.3 Final Measurement

The resistance shall be measured in the mounted state. The change in resistance compared to the value measured in accordance with Para. 9.10.2.2.1 shall not exceed the limit prescribed in Table 6 of the Detail Specification.

The resistors shall be visually examined (approximately 10X magnification). There shall be no sign of damage, cracking, lifting, or dry solder joints.

9.11 RESISTANCE TO SOLDERING HEAT

The resistors shall be dried by applying either Procedure I or II, specified in Para's 9.7.1 and 9.7.2, as prescribed in the Detail Specification.

The resistance shall then be measured as prescribed in Para. 9.5.1.1. Subsequently, the resistors shall be subjected to one of the procedures for resistance to soldering heat (see Test 'Tb' of IEC Publication No. 68-2-20A) as prescribed in the Detail Specification and remain under standard atmospheric conditions for recovery.

The resistors shall be visually examined. There shall be no evidence of damage and the marking shall be legible. The resistance shall be measured as specified in Para. 9.5.1.1, 24 ±4 hours after soldering, unless it can be demonstrated that stability is reached earlier. The change in resistance compared to the value measured initially shall not exceed the limit prescribed in Table 6 of the Detail Specification.

9.12 RAPID CHANGE OF TEMPERATURE

9.12.1 Initial Measurement

The resistance shall be measured as specified in Para. 9.5.1.1.

9.12.2 Procedure and Recovery

The resistors shall be submitted to Test 'Na' of IEC Publication No. 68-2-14 for 5 cycles. The duration of exposure at each of the temperature extremes given in Table 1(b) of the Detail Specification shall be 30 minutes.

The resistors shall then remain under standard atmospheric conditions for recovery for not less than 1 hour, nor more than 2 hours. After recovery, the resistors shall be visually examined. There shall be no evidence of damage.

9.12.3 Final Measurement

The resistance shall be measured. The change in resistance compared to the value measured according to Para. 9.12.1 shall not exceed the limit prescribed in Table 6 of the Detail Specification.

9.13 VIBRATION

9.13.1 Initial Measurement

The resistance shall be measured as specified in Para. 9.5.1.1.

9.13.2 Procedure

The resistors shall be subjected to Test 'Fc', Subclause 8.2.1, of IEC Publication No. 68-2-6, taking into account the following details and exceptions:

- If the component is provided with specific mounting means, these shall be used.
- Frequency range: 10 to 2000 Hz.
- Vibration amplitude: Displacement 1.5 mm, Acceleration 196m/s^2 .
- Duration: 20 cycles in each of the two axes.
- Axes of vibration: Perpendicular and parallel to the longitudinal axis of the resistor.
- Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or record automatically any discontinuity having a duration of 0.1 millisecond as well as those of greater duration.

9.13.3 Final Measurement

After the test, the resistors shall be visually examined and there shall be no evidence of damage. The resistance shall be measured. The change in resistance compared to the value measured according to Para. 9.13.1 shall not exceed the limit prescribed in Table 6 of the Detail Specification.

9.14 CLIMATIC SEQUENCE

9.14.1 Initial Measurement

The resistors shall be dried, using either Procedure I or II, specified in Para's 9.7.1 and 9.7.2, as prescribed in the Detail Specification.

The resistance shall then be measured as specified in Para. 9.5.1.1.

9.14.2 Dry Heat

The resistors shall be subjected to Test 'Ba' of IEC Publication No. 68-2-2 at the upper category temperature, taking into account the following deviation:-

The resistors shall be removed from the chamber and exposed to standard atmospheric conditions for recovery, for not less than 4 hours.

9.14.3 Damp Heat (Accelerated), First Cycle

The resistors shall be subjected to Test 'Db' of IEC Publication No. 68-2-30, for 1 cycle of 24 hours. After recovery, the resistors shall be immediately subjected to the cold test.

9.14.4 Cold Test

The resistors shall be subjected to Test 'Aa' of IEC Publication No. 68-2-1 at the lower category temperature. After 1 hour of stabilisation at this temperature, full rated continuous voltage as specified in Table 1(b) of the Detail Specification shall be applied for 45 minutes.

The resistors may be loaded individually or in parallel. They shall be removed from the chamber and exposed to standard atmospheric conditions for recovery for not less than 4 hours.

9.14.5 Low Air Pressure

The resistors shall be subjected to Test 'M' of IEC Publication No. 68-2-13, using a pressure of 20 ± 1 mbar with full rated continuous voltage applied. The test shall be performed at a temperature between +15 and +35 °C. The duration of the test shall be 1 hour.

9.14.6 Damp Heat (Accelerated), Remaining Cycles

The resistors shall be subjected to Test 'Db' of IEC Publication No. 68-2-30 for 5 cycles of 24 hours.

9.14.7 D.C. Load

At the end of the conditioning period, the resistors shall be subjected to the standard atmospheric conditions for recovery. The time of transfer shall be as brief as possible and in any case not exceed 5 minutes.

At 30 ± 5 minutes after removal from the chamber for the damp heat cyclic test, the resistors shall be subjected to a d.c. voltage for 1 minute. The voltage shall be the rated or limiting element voltage, whichever is the smaller.

The resistors shall then be subjected to the standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours.

9.14.8 Final Measurement

The resistors shall then be visually examined; there shall be no evidence of damage and the marking shall be legible.

The resistance and, for insulated types only, the insulation resistance shall then be measured as specified in Para. 9.5.1.1 and Para. 9.5.1.2 respectively.

The change in resistance compared to the value measured according to Para. 9.14.1 shall not exceed the value prescribed in Table 6 of the Detail Specification. The insulation resistance shall be not less than that prescribed in Table 6 of the Detail Specification.

9.15 OPERATING LIFE

9.15.1 Operating Life during Qualification Testing

(a) **Duration:** 2000 hours.

(b) **Method of Mounting**

The resistors shall be connected by their terminations to suitable clips on a rack of insulating material. They shall be mounted in a horizontal position in 1 layer only. The distance between the axes of the resistors shall be not less than 7 times the diameter of the resistors.

There shall be no undue draught over the resistors. Only natural convection resulting from the hot resistors may occur.

For surface mount resistors, when necessary, mounting shall be performed as specified in Para. 9.20.

(c) **Test Conditions**

As specified in the Detail Specification.

The resistors shall be tested with a direct voltage or a full wave rectified a.c. voltage provided that the ripple does not exceed 5%. The voltage shall be applied in cycles of 1.5 hours "on" and 0.5 hours "off" throughout the test. The 0.5 hour "off" periods are included in the total test duration.

The voltage shall be either the rated or limiting element voltage, whichever is less. The applied voltage shall be within ±5% of this voltage. The size of the testing chamber and the number of resistors under test shall be such that when all resistors are fully loaded, the heat produced by them shall be less than that required to maintain the atmosphere in the chamber at the prescribed temperature, so that the temperature can still be controlled by the heating elements.

The temperature-controlling elements shall be suitably spaced from the resistors and shall be shielded so as not to be directly influenced by the radiation from the resistors. For the purpose of this test, it shall be assumed that the ambient temperature of the resistors is the prescribed temperature.

For intermediate and end-point data measurements, the resistors shall initially be removed from the chamber and allowed to cool at room temperature for not less than 1 hour and not more than 2 hours. The removal from the chamber shall take place at the end of the 0.5 hours "off" period.

After intermediate measurements, the resistors shall be returned to the test chamber. The interval between the removal of any resistor from the chamber and its return to the conditions of the test shall not exceed 12 hours.

(d) **Intermediate and End Data Points**

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

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

(e) **Visual Examination**

At intermediate points and on completion of the operating life tests, the resistors shall be visually examined. There shall be no evidence of damage.

9.15.2 <u>Operating Life during Lot Acceptance Testing</u>

(a) **Duration:** 1000 hours.

(b) **Method of Mounting**

The resistors shall be connected by their terminations to suitable clips on a rack of insulating material. They shall be mounted in a horizontal position in 1 layer only. The distance between the axes of the resistors shall be not less than 7 times the diameter of the resistors.

There shall be no undue draught over the resistors. Only natural convection resulting from the hot resistors may occur.

For surface mount resistors, when necessary, mounting shall be performed as specified in Para. 9.20.

(c) **Test Conditions**

As specified in the Detail Specification.

The resistors shall be tested with a direct voltage or a full wave rectified a.c. voltage provided that the ripple does not exceed 5%.

The voltage shall be applied in cycles of 1.5 hours "on" and 0.5 hours "off" throughout the test. The 0.5 hours "off" periods are included in the total test duration.

The voltage shall be either the rated or limiting element voltage, whichever is less. The applied voltage shall be within ±5% of this voltage.

The size of the testing chamber and the number of resistors under test shall be such that when all resistors are fully loaded, the heat produced by them shall be less than that required to maintain the atmosphere in the chamber at the prescribed temperature, so that the temperature can still be controlled by the heating elements.

The temperature-controlling elements shall be suitably spaced from the resistors and shall be shielded so as not to be directly influenced by the radiation from the resistors. For the purpose of this test, it shall be assumed that the ambient temperature of the resistors is the prescribed temperature.

For end-point data measurements, the resistors shall initially be removed from the chamber and allowed to cool at room temperature for not less than 1 hour and not more than 2 hours. The removal from the chamber shall take place at the end of the 0.5 hour "off" period.

(d) **End 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.

(e) **Visual Examination**

On completion of the operating life tests, the resistors shall be visually examined. There shall be no evidence of damage.

9.16 HIGH TEMPERATURE STORAGE

(a) **Duration** : 2000 hours.

(b) **Method of Mounting**: Unspecified.

(c) **Test Conditions**

As specified in the Detail Specification. The test shall be performed at zero dissipation.

(d) **Intermediate and End Data Points**

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

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

9.17 EXTERNAL VISUAL INSPECTION

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

9.18 MAXIMUM TIME CONSTANT

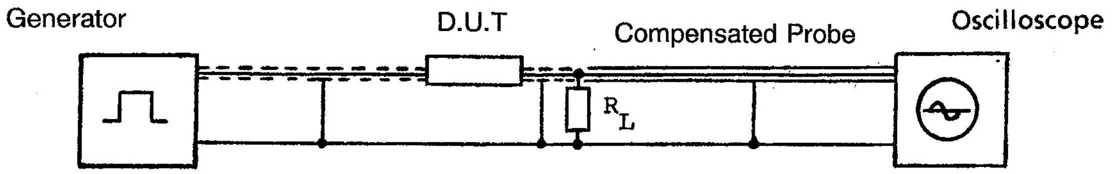
The maximum time constant (L/R) attributable to the reactance of the resistor shall be measured and shall not exceed the value specified in Table 1(b) of the Detail Specification.

9.18.1 Procedure

Using the circuit shown in Figure I A, the maximum time constant can be derived from the oscilloscope trace shown in Figure I B, as the time between the start of the input pulse and when the voltage attains 63.2% of the maximum.

N.B.
If there is noise or distortion at the start of the rise, the zero point may be determined by extension of the curve.

FIGURE I A - TEST CIRCUIT



V⎍<5V

Z_{OUT} = 50Ω

t_w > 100ns, t_r on load (10 to 90%) < 18ns.

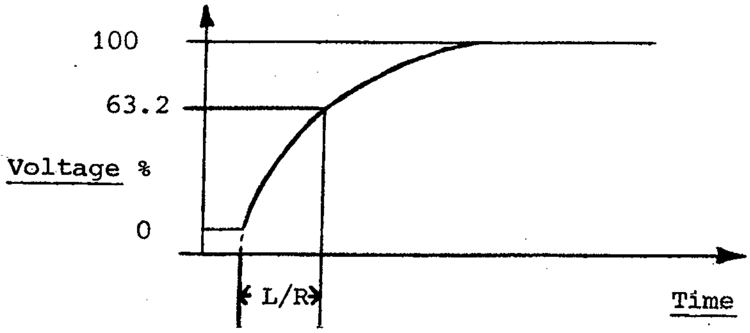
f > 10KHz.

t_r (10 to 90%) < 12ns.

Time Base ≤ 20ns/cm

NOTES
1. The length of connecting leads between generator and resistor < 5cm.
2. R_L = non-inductive resistor of value ≥ 0.1 times the value of D.U.T.
3. Maximum input capacitance at R_L = 25pF.
4. Prior to measurement, the circuit should be calibrated with D.U.T short circuited.

FIGURE I B - OSCILLOSCOPE TRACE



9.19 BURN-IN

The test shall be conducted in accordance with IEC Publication No. 115-1, Clause 4.25.

9.20 SURFACE MOUNT RESISTOR MOUNTING

Surface mount resistors may be mounted on a suitable substrate in accordance with IEC Publication No. 115-1, Clause 4.31.

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 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 COMPONENTS 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 Para's 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

Page 1 of 3

LTPD SAMPLING PLAN 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

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LTPD SAMPLING PLAN 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.