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CAPACITORS, FIXED, FILM DIELECTRIC


ESCC Generic Specification No. 3006

ISSUE 1

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CAPACITORS, FIXED, FILM DIELECTRIC

ESA/SCC Generic Specification No. 3006



**space components
coordination group**

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DOCUMENTATION CHANGE NOTICE

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		Para. 9.11	: New 3rd paragraph added	221588



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1. INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification approval, procurement, including lot acceptance testing, and delivery of Capacitors, Fixed, Film Dielectric, 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

IEC Publication No. 68, Basic Environmental Testing Procedures.

IEC Publication No. 384, Fixed Capacitors for use in Electronic Equipment.

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

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.

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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

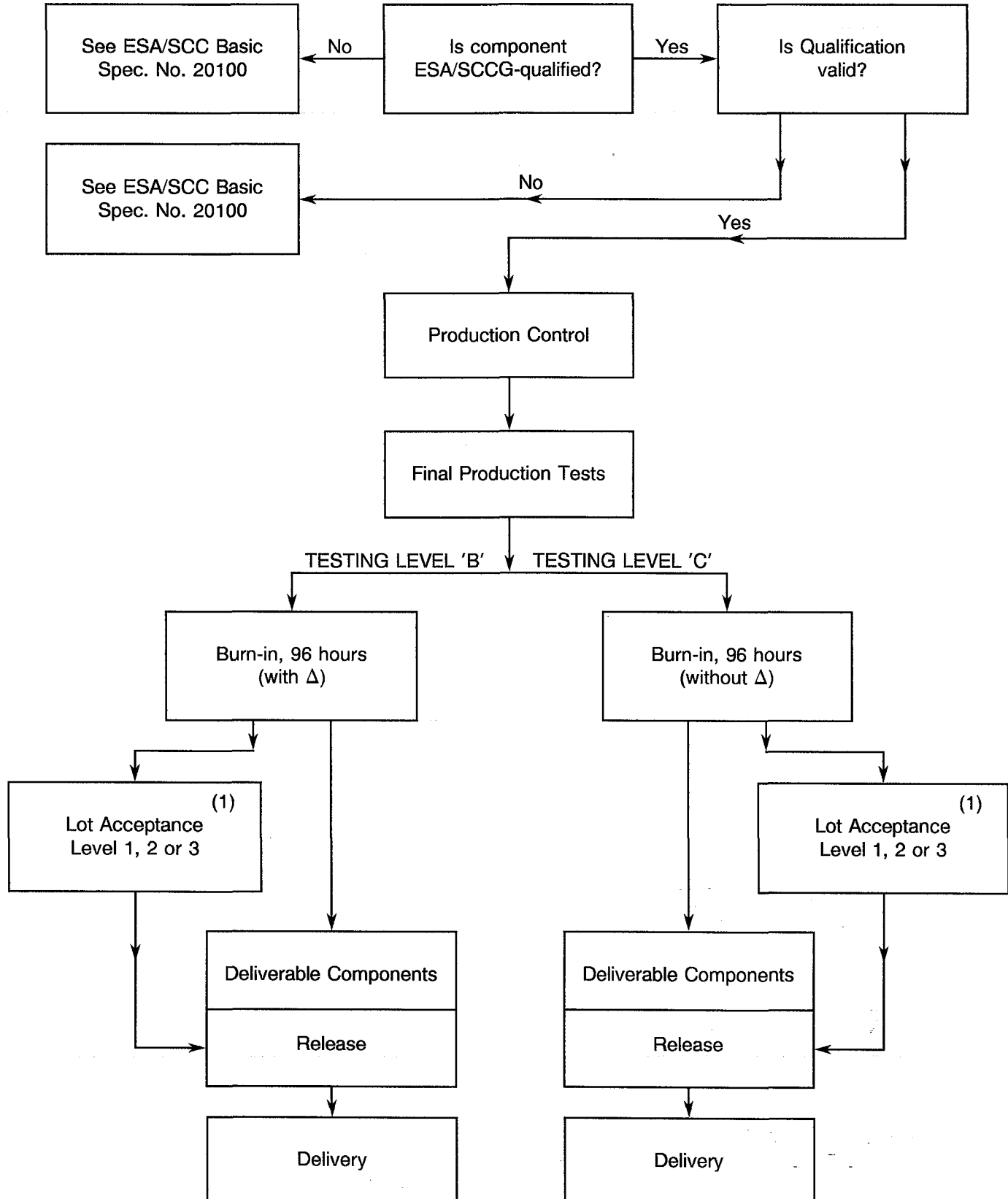
The minimum requirements for production control, which are equally applicable to procurement, are defined in ESA/SCC Basic Specification No. 20100, Para's 5.1 and 5.2.

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.

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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 96 hours. For the applicable test methods and procedures, see Para. 9.20.

7.1.2 Data Points

For components of testing level 'B', undergoing a total burn-in period of 96 hours, the data points for parameter drift measurement shall be 0 hours (initial) and 96 (+24 - 0) hours (final).

For components of testing level 'C', undergoing a total burn-in period of 96 hours, the data point for post-burn-in electrical measurements shall be 96 (+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 3% (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 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.

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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 88 components shall be submitted to qualification testing (Chart IV). The sample shall consist of test vehicles having the lowest and highest voltages and, for these voltages, the smallest and largest case size. If there are more than 4 sizes, an intermediate size shall also be tested. Of each of these size/voltage combinations, the highest capacitance value and, for that value the tightest tolerance shall be chosen. If there are differing lead diameters, each different lead diameter shall be represented. If a value, within the capacitance range to be qualified, is judged to be critical and is not covered by the selected test vehicles, it shall be tested.

Thus, for the qualification approval of a series, testing is required on either 2, 3 4 or more test vehicles.

Where a series comprises more than 4 test vehicles, the minimum quantity of components per test vehicle must be:-

- Subgroup I - 3 components.
- Subgroup II - 10 components.
- Subgroup III - 10 components.



Where a series comprises less than 4 test vehicles, the sample shall be evenly distributed between the test vehicles.

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.

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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 test is 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 this test.
- (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.

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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. seal, solderability, vibration, bump, 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.

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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.

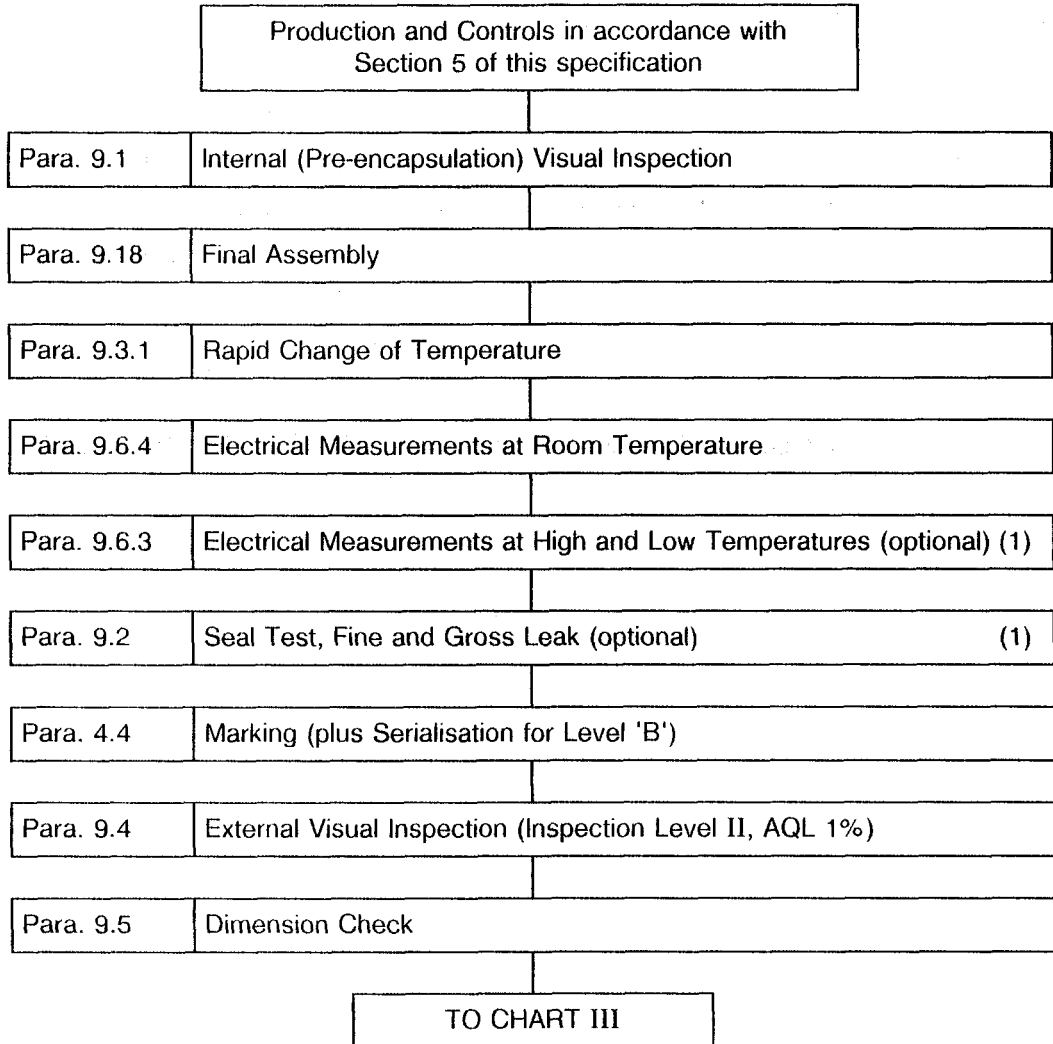
8.6 DOCUMENTATION

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.

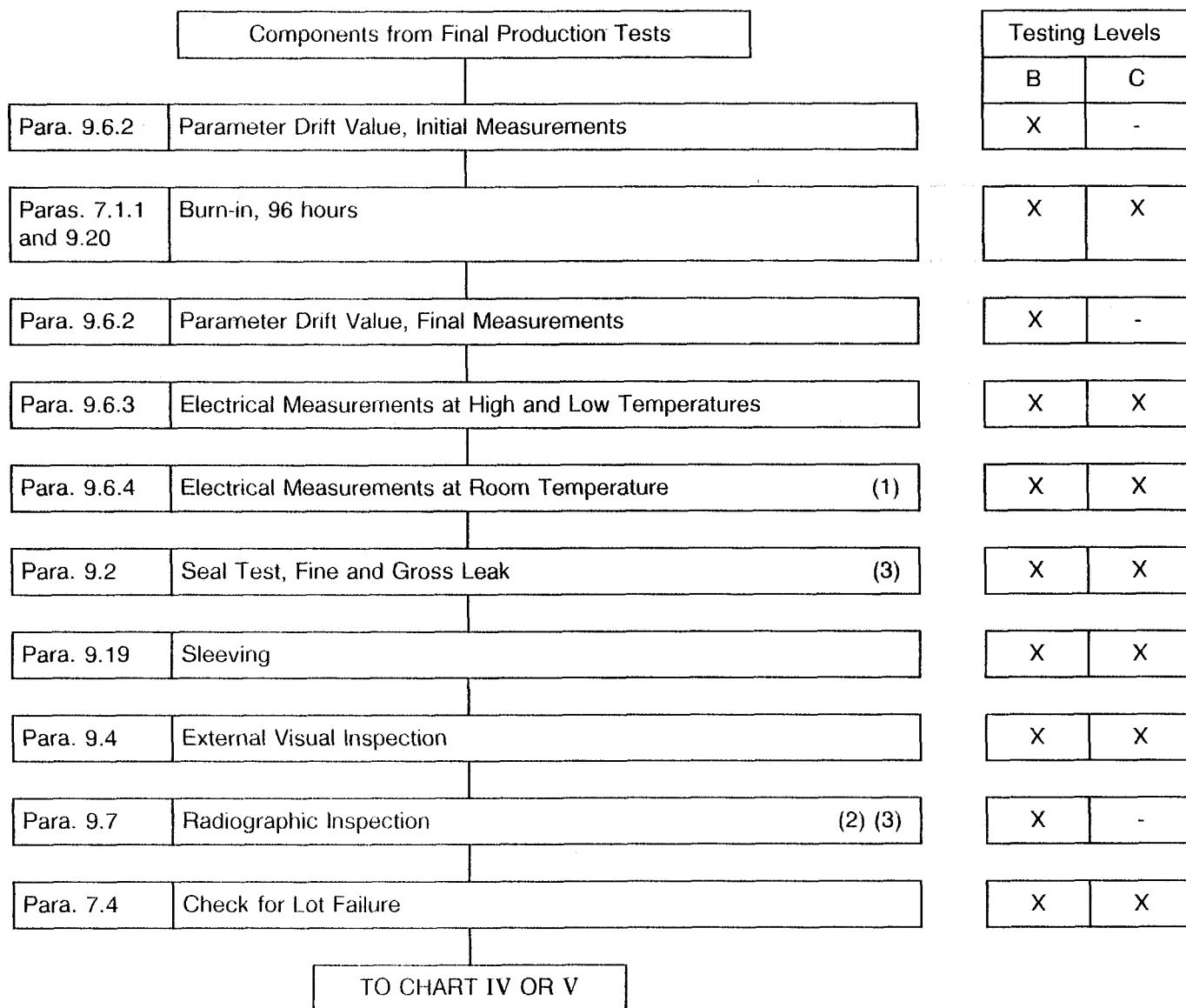


CHART II - FINAL PRODUCTION TESTS



NOTES

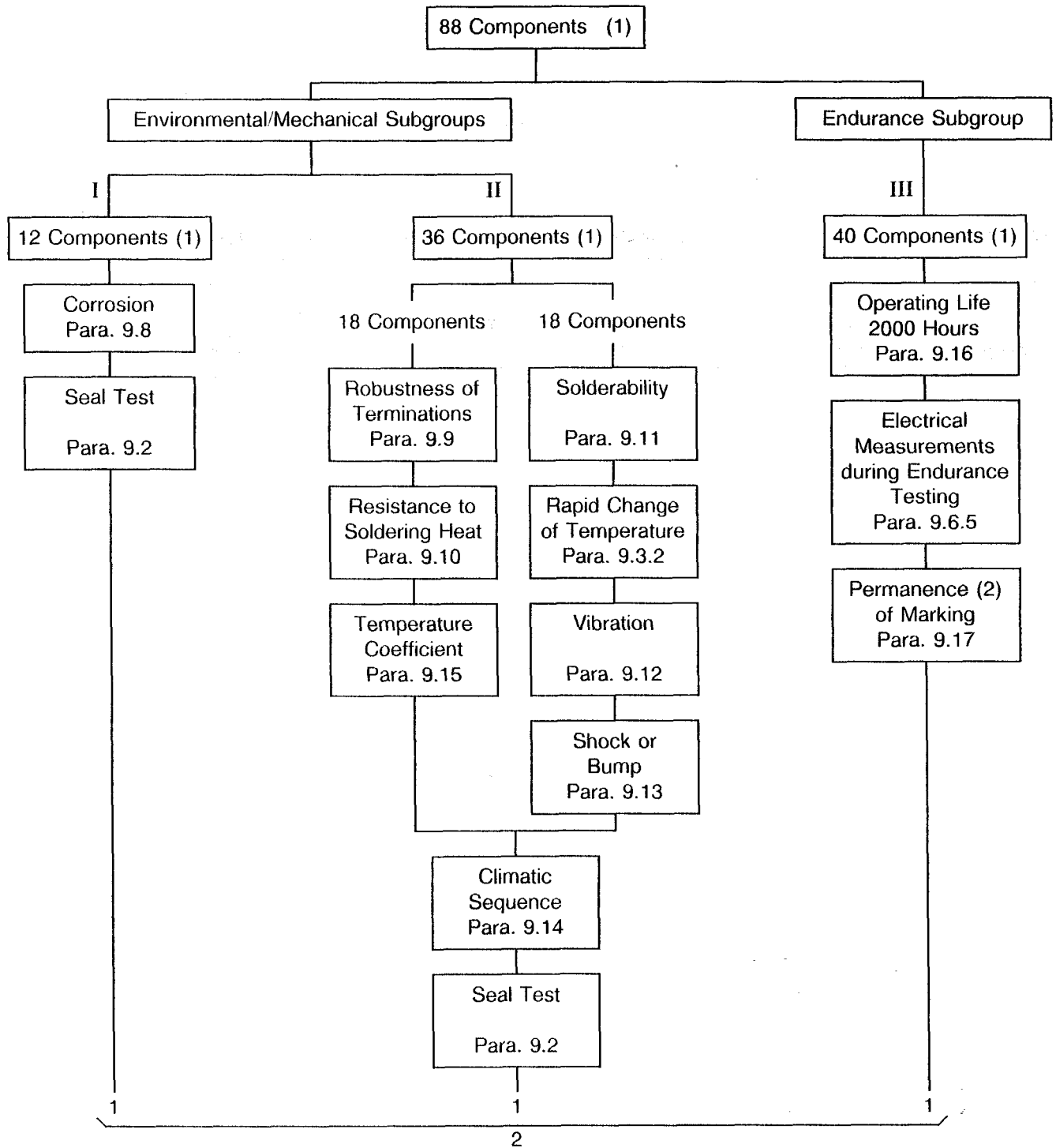
1. The performance of these tests is left to the Manufacturer's discretion.

**CHART III - BURN-IN AND ELECTRICAL MEASUREMENTS****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 and Seal Test rejects not to be counted for lot failure.



CHART IV - QUALIFICATION TESTS



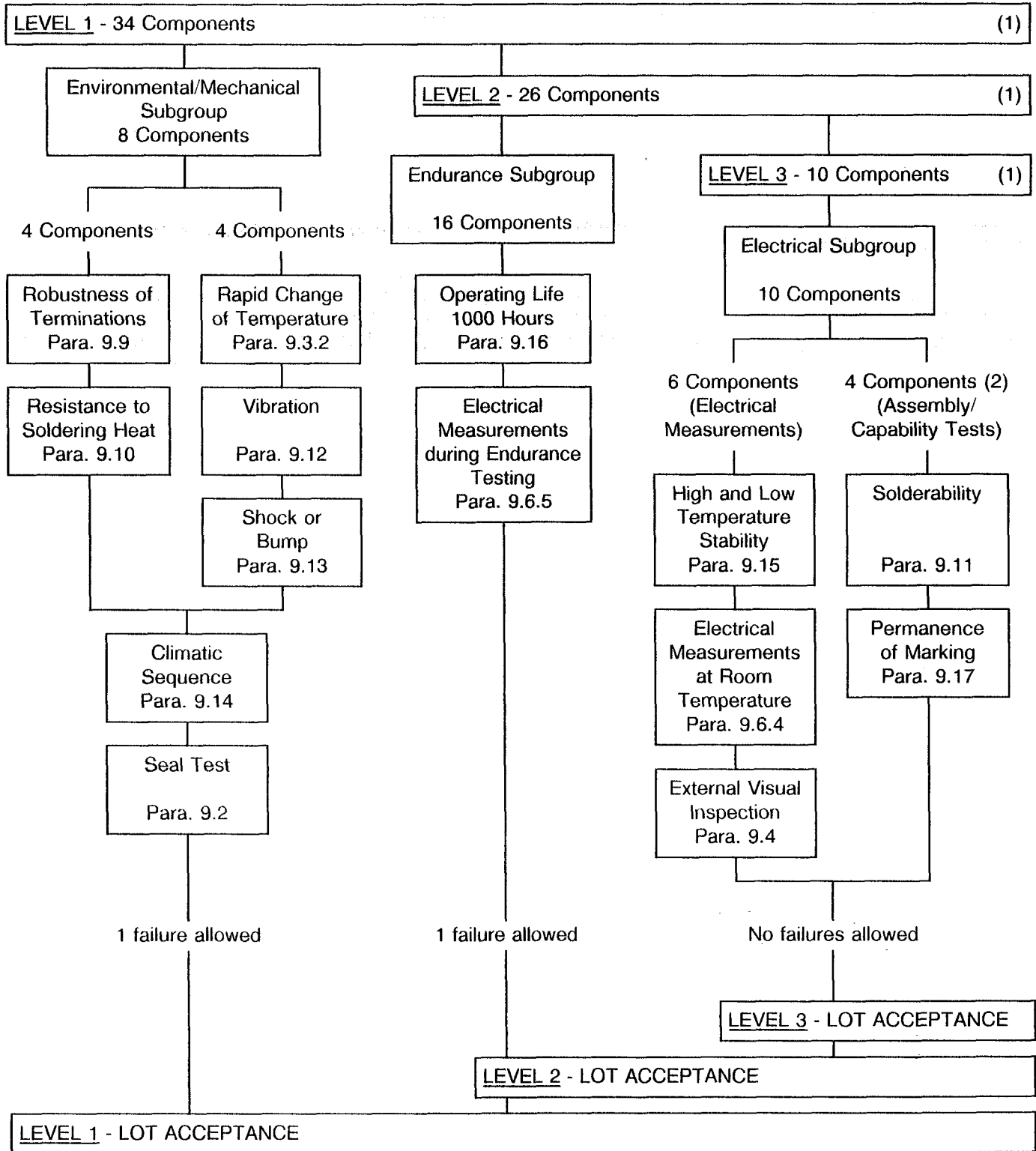
Total allowable number of failed components: 2.

NOTES

1. For distribution within the subgroups, see Para. 8.1.2.
2. Permanence of Marking test shall be performed on 6 components, selected to be representative of all case sizes being qualified.



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.

Prior to testing, surface mount capacitors may be mounted on a suitable substrate in accordance with IEC Publication No. 384-1, Clause 4.33.

9.1 INTERNAL VISUAL INSPECTION

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

9.2 SEAL TEST (HERMETICALLY SEALED DEVICES ONLY)**9.2.1 Gross Leak**

The capacitors shall be subjected to Test 'Qc', Method 1, of IEC Publication No. 68-2-17.

9.2.2 Fine Leak

The capacitors shall be subjected to Test 'Qk', Method 1, of IEC Publication No. 68-2-17, Severity 1000 hours. Unless otherwise stated in the Detail Specification, immersion pressure shall not exceed 4 bars.

9.3 RAPID CHANGE OF TEMPERATURE**9.3.1 Procedure for Final Production Tests (Chart II)**

The capacitors shall be submitted to Test 'Na' of IEC Publication No. 68-2-14 for 10 cycles. The following details shall apply:-

- T_A = Minimum operating temperature as defined in Table 1(b) of the Detail Specification.
- T_B = Maximum operating temperature as defined in Table 1(b) of the Detail Specification.
- t_1 = 30 minutes.
- t_2 = 1.0 minute.

9.3.2 Procedure for Qualification Tests (Chart IV) and Lot Acceptance Tests (Chart V)

The capacitance shall be measured as specified in Para. 9.6.1.2.

The capacitors shall be submitted to Test 'Na' of IEC Publication No. 68-2-14 for 10 cycles. The following details shall apply:-

- T_A = Minimum operating temperature as defined in Table 1(b) of the Detail Specification.
- T_B = Maximum operating temperature as defined in Table 1(b) of the Detail Specification.
- t_1 = 30 minutes.
- t_2 = 1.0 minute.

After a recovery period of 24 ± 2 hours at standard atmospheric conditions the capacitors shall be visually examined and there shall be no evidence of damage. The capacitance change and tangent of loss angle shall be measured and shall be within the limits specified in Table 6 of the Detail Specification.

9.4 EXTERNAL VISUAL INSPECTION

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

9.5 DIMENSION CHECK

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

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



9.6 ELECTRICAL MEASUREMENTS

9.6.1 General

Unless otherwise stated in the Detail Specification, the following measurements shall be made under standard conditions.

9.6.1.1 Voltage Proof

The measuring points shall be terminal-to-terminal and terminals-to-case. The test voltage V_T shall be:-

1.6 U_R terminal-to-terminal for procurement (and qualification when $U_R > 1000V$).

2.0 U_R terminal-to-terminal (qualification).

2.0 U_R (1.6 U_R when $U_R > 1000V$) terminals-to-case (when the case is not a terminal), with a minimum of 200V.

The test voltage shall be applied for a period of 1 minute between the test points. The internal resistance of the voltage source R_S shall be such that $R_S C_R \leq 1.0s$.

The charging current shall not exceed the following values:-

For $C \leq 1000pF$, $i_c = 50\mu A/pF$.

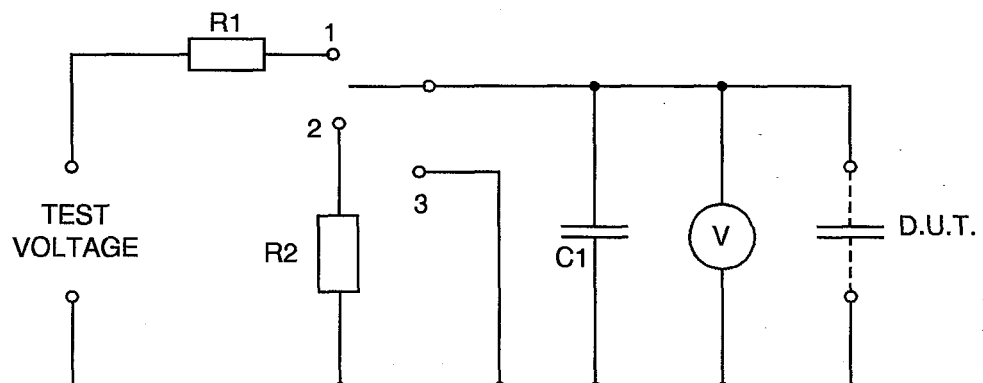
For $C > 1000pF$, $i_c = 0.05A$.

After voltage application, capacitors with a rated voltage of greater than 500V shall be short-circuited for 24 hours minimum.

ADDITIONAL MEASUREMENTS FOR CHARTS IV AND V

For sleeved capacitors of 10mm diameter, 27mm length (or greater) a test voltage of 4kVdc, (unless otherwise specified in the Detail Specification), shall be applied between two wire windings placed 12.7 ± 0.5 mm apart around the sleeve of the capacitor. Each winding shall consist of three close turns of 1.0 ± 0.1 mm bare copper wire.

FIGURE I - VOLTAGE PROOF TEST CIRCUIT



NOTES

1. The resistance of the Voltmeter shall be not less than $20\ 000\Omega/V$. The capacitance of C_1 shall be at least 10 times that of the D.U.T.
2. The resistances of R_1 and R_2 shall be such that the initial charging and discharging current does not exceed the specific value at the highest test voltage.

**9.6.1.2 Capacitance**

Unless otherwise specified in the Detail Specification, the frequency or frequencies of measurements and the maximum peak a.c. voltage shall be:-

For $C \leq 1.0 \mu\text{F}$, $f_M = 1000 \pm 200\text{Hz}$, $V_M \leq 0.04 U_R$

For $C > 1.0 \mu\text{F}$, $50 \leq f_M \leq 120\text{Hz}$, $V_M \leq 0.2 U_R$ or $70 V_{\text{rms}}$,

whichever is less.

The accuracy of the measuring equipment shall be such that the error does not exceed:

- For absolute capacitance measurements: 10% of the rated capacitance tolerance.
- For measurement of variation in capacitance: 10% of the specified change in capacitance.

Temperature variation due to handling shall be avoided.

9.6.1.3 Tangent of Loss Angle

The tangent of loss angle shall be measured under the same conditions as those specified in Para. 9.6.1.2 for measurement of capacitance at one or more frequencies. The measuring method shall be such that the error is not greater than 0.001.

9.6.1.4 Insulation Resistance**9.6.1.4.1 Measurement**

Before this measurement is made, the capacitors shall be fully discharged. Unless otherwise specified in the Detail Specification, the insulation resistance shall be measured with the voltage specified below and between the appropriate "Measuring Points" specified herein.

RATED VOLTAGE OF CAPACITOR U_R (V)	MEASURING VOLTAGE V_T (V)
$U_R \leq 10$	$U_R \pm 10\%$
$10 < U_R \leq 100$	$10 \pm 1.0\text{V}$ (Note 1)
$100 < U_R < 500$	$100 \pm 15\text{V}$
$U_R \geq 500$	$500 \pm 50\text{V}$

NOTES

1. When it can be demonstrated that the voltage has no influence on the measuring result, or that a known relationship exists, measurement can be performed at voltages up to the rated voltage (10V shall be used in case of dispute).

U_R is the rated voltage for use in defining the measuring voltage to be used under standard atmospheric conditions for testing. Unless otherwise specified in the Detail Specification, the insulation resistance shall be measured after the voltage has been applied for 1 minute \pm 5 seconds.

The internal resistance of the voltage source R_S shall be such that $R_S C_R \leq 1$ second (where C_R = rated capacitance of the capacitor under test). The charging current shall not exceed 0.05A.

The measuring points shall be as defined in the table of Para. 9.6.1.4.2 and shall be as follows:

- For insulated capacitors: 1(a) and 1(c).
- For non-insulated capacitors: 1(a).

The requirements for insulation resistance shall be as stated in the Detail Specification.

**ADDITIONAL MEASUREMENTS FOR CHARTS IV AND V**

For sleeved capacitors of 10mm diameter, 27mm length (or greater) the insulation resistance shall be measured between two wire windings placed 12.7 ± 0.5 mm apart around the sleeve of the capacitor. Each winding shall consist of three close turns of 1.0 ± 0.1 mm bare copper wire.

9.6.1.4.2 Measuring Points

MEASURING POINTS FOR INSULATION RESISTANCE TESTS

Test	1 Single section capacitors	2 Multiple section capacitors having a common termination for all sections	3 Multiple section capacitors having no common termination
A Between terminations (Note 1)	1(a) Between terminations	2(a) Between each of the terminations and the common termination	3(a) Between terminations of each section
B Internal insulation (Note 1)	1(b) Between terminations connected together and the case (except where the case is one termination) (Metal cased types only)	2(b) Between all terminations connected together and the case (except where the case is one of the terminations) (Metal cased types only) 2(c) Between the non-common termination of each section and all the other terminations connected together	3(b) Between all terminations connected together and the case (metal cased types only) 3(c) Between the terminations of separate sections, the 2 terminations of each section being connected together
C External insulation (Note 2)	1(c) Between terminations connected together and the metal plate or foil (insulated types not employing metal cases) 1(d) Between case and the metal plate or foil (insulated metal cased types only)	2(d) Between all terminations connected together and the metal plate or foil (insulated types not employing metal cases) 2(e) Between case and the metal plate or foil (insulated metal cased types only)	3(d) Between all terminations connected together and the metal plate or foil (insulated types not employing metal cases) 3(e) Between case and the metal plate or foil (insulated metal cased types only)

NOTES



- To be performed 100%.
- This test shall be performed on 5 samples only. If 1 failure occurs out of the 5 parts, then test 100%. 1% reject maximum allowed in the case of 100% testing.

9.6.1.4.3 Measuring Methods

For test points B and C of the table in Para. 9.6.1.4.2 when the case of the capacitor is non-metallic or when the capacitor has a metallic case with an insulating sleeve. The test voltage shall be applied in one of the following ways:-

1. Foil Method

A metal foil shall be closely wrapped around the body of the capacitor to a distance of not less than 0.5mm from the terminations.

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2. Method for Capacitors with Mounting Devices

The capacitor shall be mounted in its normal manner on a metal plate which extends at least 12.5mm in all directions beyond the mounting face of the capacitor.

3. V-block Method

The capacitor shall be clamped in the trough of a 90° metallic V-block of such size that the capacitor body does not extend beyond the extremities of the block. The clamping force shall be such as to guarantee adequate contact between the capacitor and the block. The clamping force is to be chosen in such a way that no destruction or damage to the capacitor occurs. The capacitor shall be positioned in accordance with the following:-

For cylindrical capacitors

The capacitor shall be positioned in the block so that the termination furthest from the axis of the capacitor is nearest to the one of the faces of the block.

For rectangular capacitors

The capacitor shall be positioned in the block so that the termination nearest to the edge of the capacitor is nearest to one of the faces of the block.

For cylindrical and rectangular capacitors with axial leads any out-of-centre positioning of the point of emergence of the terminations from the capacitor body shall be ignored.

9.6.2 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.

9.6.3 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 to be applied, not the requirements of Para. 8.2.3(b). For testing level 'B', all values obtained shall be recorded against serial numbers.

9.6.4 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 to be applied, not the requirements of Para. 8.2.3(b). For testing level 'B', all values obtained shall be recorded against serial numbers, except during Final Production Tests (Chart II).

9.6.5 Electrical Measurements during Endurance Testing

At each of the relevant data points required 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.

9.7 RADIOGRAPHIC INSPECTION

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

9.8 CORROSION (HERMETICALLY SEALED DEVICES ONLY)

The components shall be submitted to Test 'Ka' of IEC Publication No. 68-2-11 for 48 hours. Half of the components shall be tested with the sleeving (when applicable) removed. After exposure, they shall be brushed with a non-reacting cleaning fluid, shaken, lightly brushed and then allowed to dry at +40°C for 24 hours. The components shall then be inspected and no base metal shall be exposed. Particular attention shall be paid to the observation of galvanic action and the unwrapping of, or damage to, the sleeving (when applicable). After the test, sleeves (when applicable) shall be removed.

**9.9 ROBUSTNESS OF TERMINATIONS****9.9.1 Procedure**

The capacitors shall be subjected to Tests 'Ua', 'Ub', 'Uc' and 'Ud' of IEC Publication No. 68-2-21, as applicable.

NOTES

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

9.9.2 Final Examination

After each of the tests, the capacitors shall be visually examined. There shall be no evidence of damage, but cracking of the coating extending down the wire is permitted.

9.10 RESISTANCE TO SOLDERING HEAT**9.10.1 Initial Measurement**

Capacitance shall be measured according to Para. 9.6.1.2.

9.10.2 Procedure

Capacitors designed for mounting on printed circuit boards shall be subjected to Test 'Tb', Method 1A of IEC Publication No. 68-2-20. The terminations shall be immersed to the minimum soldering distance defined in Table 1(b) of the Detail Specification and for the maximum soldering time defined in Table 1(b) of the Detail Specification.

Other capacitors shall be subjected to Test 'Tb', method 1B of IEC Publication No. 68-2-20 with the terminations immersed to within 6.0 ± 1.0 mm of the capacitor body.

For surface mount capacitors, only the part of the termination designed to be soldered shall be tested.

As an alternative for surface mount capacitors, the tests may be performed in accordance with IEC Publication No. 68-2-58 using the conditions specified in Table 6 of the Detail Specification.

Table 6 of the Detail Specification shall prescribe the applicable method.

9.10.3 Recovery and Final Measurement

Recovery time shall be 1 to 2 hours under standard atmospheric conditions. The insulation resistance terminal-to-terminal, capacitance change and tangent of loss angle shall be measured and shall meet the requirements of Table 6 of the Detail Specification.

9.11 SOLDERABILITY

The capacitors shall be subjected to Test 'Ta' of IEC Publication No. 68-2-20 using the solder bath method (Method 1), with the terminations immersed up to the minimum soldering distance from the case as defined in Table 1(b) of the Detail Specification, or the solder globule method (Method 3), with the soldering time defined in the Detail Specification.

Unless otherwise stated in the Detail Specification the first method shall be used. For surface mount capacitors only the part of the termination designed to be soldered shall be tested. When neither of the two specified methods are practicable the soldering iron method (Method 2) shall be used with soldering iron size A.

As an alternative for surface mount capacitors, the tests may be performed in accordance with IEC Publication No. 68-2-58 using the conditions specified in Table 6 of the Detail Specification.



9.12 VIBRATION

9.12.1 Mounting

The specimen shall be mechanically connected to the vibration generator, either directly or by means of a fixture as specified below.

Mounting fixtures shall be such as to enable the specimen to be vibrated in three mutually perpendicular axes in turn, which should be chosen so that faults are most likely to be revealed. If the component is provided with specific means of mounting, these shall be used as prescribed in the Detail Specification, and any additional restraining straps should be avoided.

Unless otherwise specified, components not provided with specific means of mounting shall be clamped both the body and the leads (leads shall be clamped at 6.0 ± 1 mm from the body). Care shall be taken to avoid pinching the leads. If external connections, necessary for measuring and supply purposes are prescribed in the Detail Specification, they should add the minimum restraint and mass.

9.12.2 Procedure

The capacitors shall be subjected to Test 'Fc' of IEC Publication No. 68-2-6.

Sweep frequency: 10 - 2000 - 10 Hz.

The entire frequency range of 10 to 2000Hz and return to 10Hz shall be traversed in 10 minutes. This cycle shall be performed 12 times in each of the three directions (total of 36 times), so that the motion shall be applied for a total period of approximately 6 hours.

The vibration amplitude shall be 1.5mm from 10Hz to the higher cross-over frequency and then 20g acceleration to 2000Hz.

A d.c. potential equal to 50% of the rated voltage U_R shall be applied between the terminals of the capacitors.

9.12.3 Measurement during Vibration

During the last cycle in each direction, an electrical measurement shall be made to determine intermittent contacts of 0.5ms or longer duration or open or short circuit.

9.12.4 Visual Examination

After vibration, the capacitors shall be visually examined and there shall be no evidence of damage.

9.13 SHOCK OR BUMP

9.13.1 Shock

9.13.1.1 Mounting

As specified in Para. 9.12.1, the word "vibration" to be replaced by "shock".



9.13.1.2 Procedure

The capacitors shall be subjected to Test 'Ea' of IEC Publication No. 68-2-7. Unless otherwise specified in the Detail Specification, the following conditions shall apply:

- Shape of shock pulse : Half sine.
- Peak acceleration : 50g.
- Duration of pulse : 11ms.
- Number of shocks : 18 (3 shocks in each direction along the 3 mutually perpendicular axes of the test specimen).

A d.c. potential equal to 50% of the rated voltage U_R shall be applied between the terminals of the capacitors.

9.13.1.3 Measurement during Shock

As specified in Para. 9.12.3.

9.13.1.4 Visual Examination

After shock the capacitors shall be visually examined and there shall be no evidence of damage, breakdown, arcing or fractures.

9.13.2 Bump

9.13.2.1 Mounting

As specified in Para. 9.12.1, the word "vibration" to be replaced by "bump".

9.13.2.2 Procedure

The capacitors shall be subjected to Test 'Eb' of IEC Publication No. 68-2-29, unless otherwise specified in the Detail Specification. The following conditions shall apply:

- Peak acceleration : 390m/s².
- Number of bumps : 4000 ± 10.

A d.c. potential equal to 50% of the rated voltage U_R shall be applied between the terminals of the capacitors.

9.13.2.3 Measurement during Bump

As specified in Para. 9.12.3.

9.13.2.4 Visual Examination

As specified in Para. 9.13.1.4, the word "shock" to be replaced by "bump".

9.14 CLIMATIC SEQUENCE

9.14.1 Initial Measurements

Capacitance shall be measured as specified in Para. 9.6.1.2.

9.14.2 Dry Heat

The capacitors shall be subjected to Test 'Ba' of IEC Publication No. 68-2-2.

Duration: 2 hours. Maximum storage temperature as prescribed in the Detail Specification (Table 1(b)).

**9.14.3 Damp Heat (Accelerated) First Cycle**

Unless otherwise specified in the Detail Specification, the capacitors shall be subjected to Test 'Db', severity b, Variant 2 of IEC Publication No. 68-2-30 for one cycle of 24 hours. After recovery, the capacitors shall be subjected immediately to the cold test.

9.14.4 Cold Test

The capacitors shall be subjected to Test 'Aa' of IEC Publication No. 68-2-1. Duration: 2 hours. Minimum storage temperature as specified in the Detail Specification (Table 1(b)).

9.14.5 Low Air Pressure

The capacitors shall be subjected to Test 'M' of IEC Publication No. 68-2-13 with the following conditions:

- 1 to 2 minutes at 85mBar.
- Temperature +15 to +35°C.
- 1.25 times the rated voltage U_R shall be applied for 1 to 2 minutes immediately after the pressure of 85mBar has been attained.

9.14.6 Damp Heat (Accelerated) Remaining Cycles

The capacitors shall be subjected to Test 'Db', severity b, Variant 2 of IEC Publication No. 68-2-30 for 5 cycles.

9.14.7 Final Measurements

After a recovery period of 24 hours maximum, the capacitors shall be visually examined. There shall be no evidence of corrosion, and unwrapping of, or mechanical damage to the sleeve (where applicable). When applicable, the voltage proof - sleeve test shall be performed, and the insulation resistance - sleeve shall be measured. The limits specified in Table 6 of the Detail Specification shall be met.

Sleeves (where applicable) shall be removed and the voltage proof - terminal-to-terminal and terminals-to-case, insulation resistance - terminal-to-terminal and terminals-to-case, capacitance change and tangent of loss angle shall meet the requirements of Table 6 of the Detail Specification.

9.15 TEMPERATURE COEFFICIENT

The capacitance shall be measured at each of the temperatures specified hereafter.

The components shall be brought to thermal stability at each temperature. Thermal stability will have been reached when no further change in capacitance is observed between 2 successive measurements taken at 5 minute intervals. The capacitance change shall not exceed the limits defined in Table 6 of the Detail Specification.

STEP	TEST TEMPERATURE (°C)
1	+ 25 ± 3
2	Maximum Operating Temperature ± 3 (Detail Specification Table 1(b))
3	+ 25 ± 3
4	Minimum Operating Temperature (+ 0 - 3) (Detail Specification Table 1(b))
5	+ 25 ± 3

**9.16** OPERATING LIFE

The following requirements shall apply:-

(a) Initial Measurements:

The capacitance shall be measured and shall meet the requirements of Table 6 of the Detail Specification.

(b) Method of Mounting:

The capacitors shall be mounted by their leads.

(c) Operating Conditions:

The capacitors shall be submitted to an endurance test of 2000 hours or 1000 hours respectively, as required by Chart IV or V, at upper category temperature. The applied voltage shall be $1.4U_R$.

(d) Intermediate Measurements:

After 1000 hours for qualification testing, the capacitance change shall be measured, (the recovery period shall be 24 ± 2 hours under standard atmospheric conditions), and shall meet the requirements of Table 6 of the Detail Specification.

(e) Final Measurements:

After 2000 hours for qualification testing and 1000 hours for lot acceptance testing the sleeves (if applicable) shall be removed and the capacitance change, tangent of loss angle and insulation resistance - terminal-to-terminal and terminals-to-case shall be measured, (the recovery period shall be 24 hours at standard atmospheric conditions), and shall meet the requirements of Table 6 of the Detail Specification. The capacitors shall be visually examined and there shall be no evidence of damage or corrosion.

9.17 PERMANENCE OF MARKING

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

9.18 FINAL ASSEMBLY

In accordance with the Process Identification Document (P.I.D.).

9.19 SLEEVING

In accordance with the Process Identification Document (P.I.D.).

9.20 BURN-IN

The test shall be conducted in accordance with IEC Publication No. 384-1, Clause 4.23.

**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.

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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:

- Internal visual inspection (Para. 9.1).
- Rapid change of temperature (Para. 9.3).
- Electrical measurements at room temperature (Para. 9.6.4).
- Electrical measurements at high and low temperatures (Para. 9.6.2) (when applicable).
- Seal test (Para. 9.2) (when applicable).
- External visual inspection (Para. 9.4).
- Dimension check (Para. 9.5).

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) 96-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 seal test.
- (g) Failures during external visual inspection.
- (h) 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 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**



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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.

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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.