RELAYS, ELECTROMAGNETIC,

NON-LATCHING

ESCC Generic Specification No. 3601

ISSUE 1

October 2002

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Pages 1 to 38

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ESA/SCC Generic Specification No. 3601

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 5	April 1999		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference	Item	Approved DCR No.
		This issue supersedes Issue 4 and incorporates all modifications defined in Revisions 'A', 'B', 'C' and 'D' to Issue 4 and the changes agreed by the following DCRs:-		
		Cover page		None
		DCN		None
		Para. 8.2.1	: New second sentence added to last paragraph	21111
		Para. 10.1.2.1	: Item (b), "PDA figure and" deleted from text	21119
			: Item (c) rewritten	21119

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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 Relays, Magnetic, Non-latching, 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. 21300, Terms, Definitions, Abbreviations, Symbols and Units.

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

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

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

No. 24600, Minimum Quality System Requirements.

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

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

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

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

2.2 OTHER (REFERENCE) DOCUMENTS

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

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

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

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

2.3 ORDER OF PRECEDENCE

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

(a) ESA/SCC Detail Specification.

(b) ESA/SCC Generic Specification.

(c) ESA/SCC Basic Specification.

(d) Other documents, if referenced herein.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

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

4. REQUIREMENTS

4.1 GENERAL

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

4.3.1 Lot Failure

Lot failure may occur during final production tests (Chart II), screening 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 1 level of testing severity which is designated by the letter "B" (see Chart I) and 3 levels of lot acceptance testing (see Chart V).

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

Level 3 (LA3) - Electrical Subgroup.

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

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

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

4.4 MARKING

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

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

4.5 MATERIALS AND FINISHES

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

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

5. PRODUCTION CONTROL

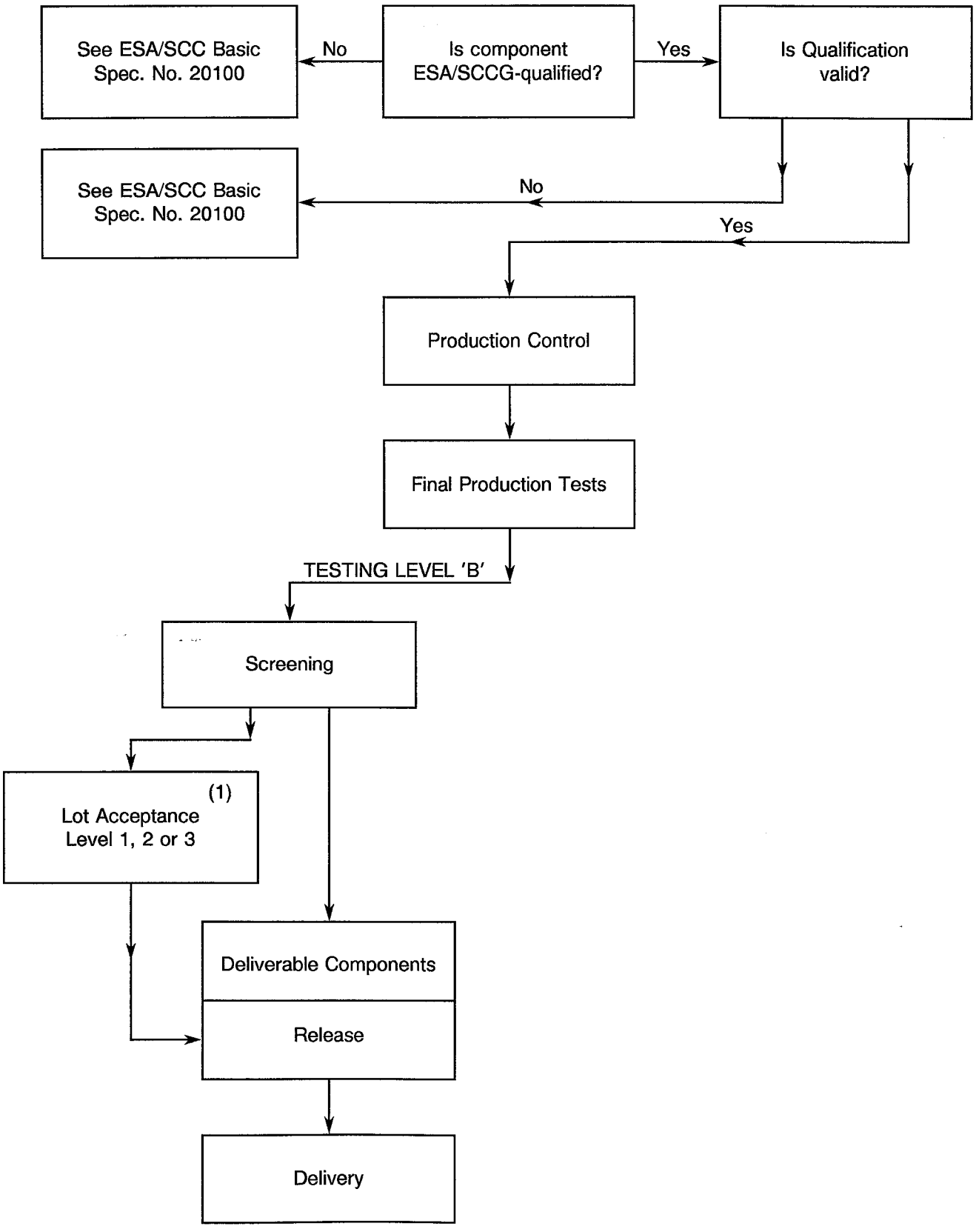
5.1 GENERAL

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

5.2 SPECIAL IN-PROCESS CONTROLS

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

CHART I - TESTING LEVELS



NOTES

1. When applicable.

6. FINAL PRODUCTION TESTS

6.1 GENERAL

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

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

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

6.2 TEST METHODS AND CONDITIONS

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

6.3 DOCUMENTATION

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

7. SCREENING 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 screening shall be as shown in Table 5 of the Detail Specification.

7.1.2 Data Points

Not applicable.

7.2. FAILURE CRITERIA

7.2.1 Parameter Drift Failure

Not applicable.

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 screening sequence shall be rejected and not counted when determining lot rejection.

7.2.3 Other Failures

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

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

7.3 FAILED COMPONENTS

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

7.4 LOT FAILURE

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

7.4.1 Lot Failure during 100% Testing

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

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

7.4.2 Lot Failure during Sample Testing

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

In the case where an LTPD to MIL-STD-414 is specified in the Detail Specification, a lot shall be considered as failed if the number of failures allowed is exceeded (see 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 screening and electrical measurements shall be in accordance with Para. 10.7 of this specification.

8. QUALIFICATION APPROVAL AND LOT ACCEPTANCE TESTS

8.1 QUALIFICATION TESTING

8.1.1 General

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

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

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

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

8.1.2 Distribution within the Qualification Test Lot

A minimum sample of 42 components shall be submitted to qualification testing (Chart IV).

Where a Detail Specification covers a range, or series of components that are considered to be similar, then the qualification test lot shall be comprised of components, so selected, that they adequately represent all of the various mechanical, structural and electrical peculiarities of that range or series.

The selected distribution shall be as specified by, or agreed with, the Qualifying Space Agency.

8.2 LOT ACCEPTANCE TESTING

8.2.1 General

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

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

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

8.2.2 Distribution within the Sample for Lot Acceptance Testing

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

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

8.2.3 Lot Acceptance Level 3 Testing (LA3)

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

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

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

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

(d) The solderability and terminal strength tests are considered to be destructive and therefore components so tested shall not form part of the delivery lot. Post-screening 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) The tests in this subgroup are considered to be destructive and therefore components of testing level "B" 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) The tests in this subgroup are considered to be destructive and therefore components of testing level "B" so tested shall not form part of the delivery lot.

8.3 FAILURE CRITERIA

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

8.3.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:

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

8.3.2 Electrical Failures

The following shall be counted as component failures:-

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

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

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

8.3.3 Other Failures

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

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

(b) Lost components.

8.4 FAILED COMPONENTS

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

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

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

8.5 LOT FAILURE

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

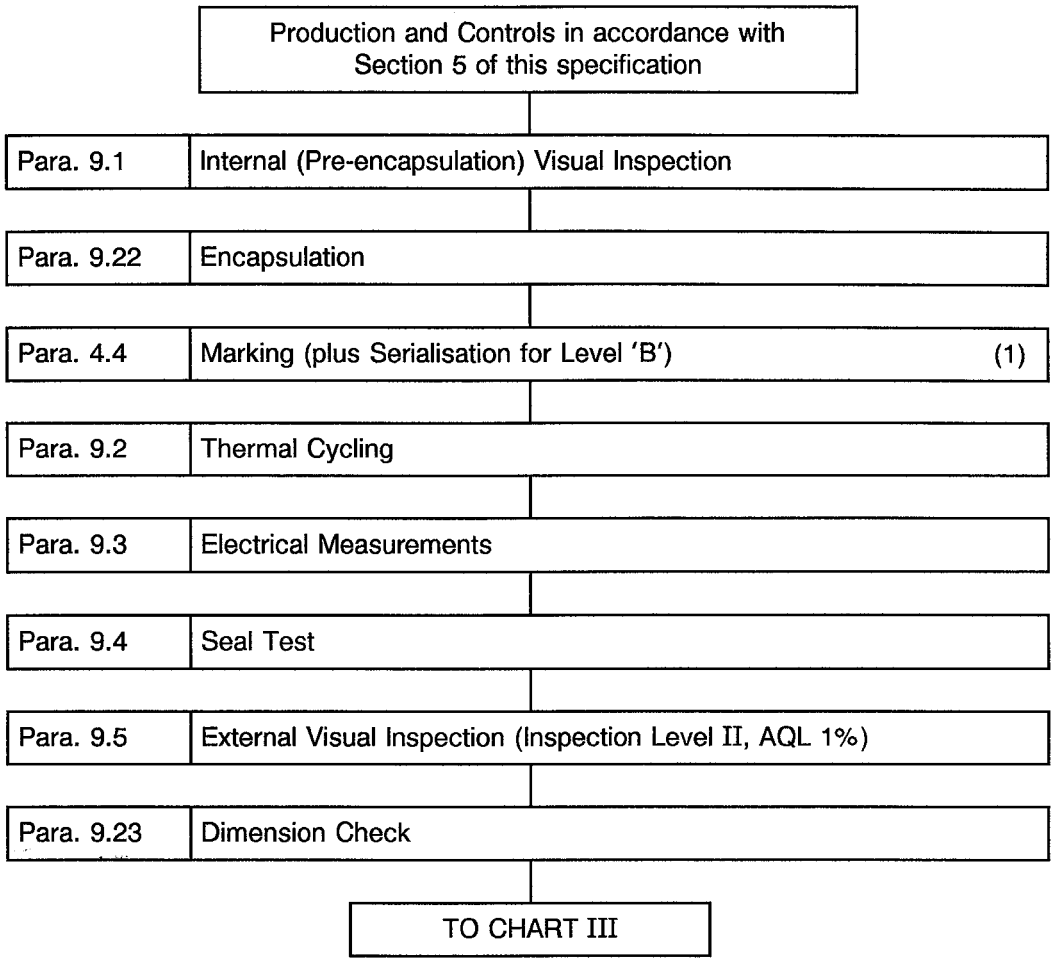
In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.1 of this specification.

8.6 DOCUMENTATION

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

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

CHART II - FINAL PRODUCTION TESTS



NOTES

1. Marking and serialisation may take place at a different stage of the sequence.

CHART III - SCREENING AND ELECTRICAL MEASUREMENTS

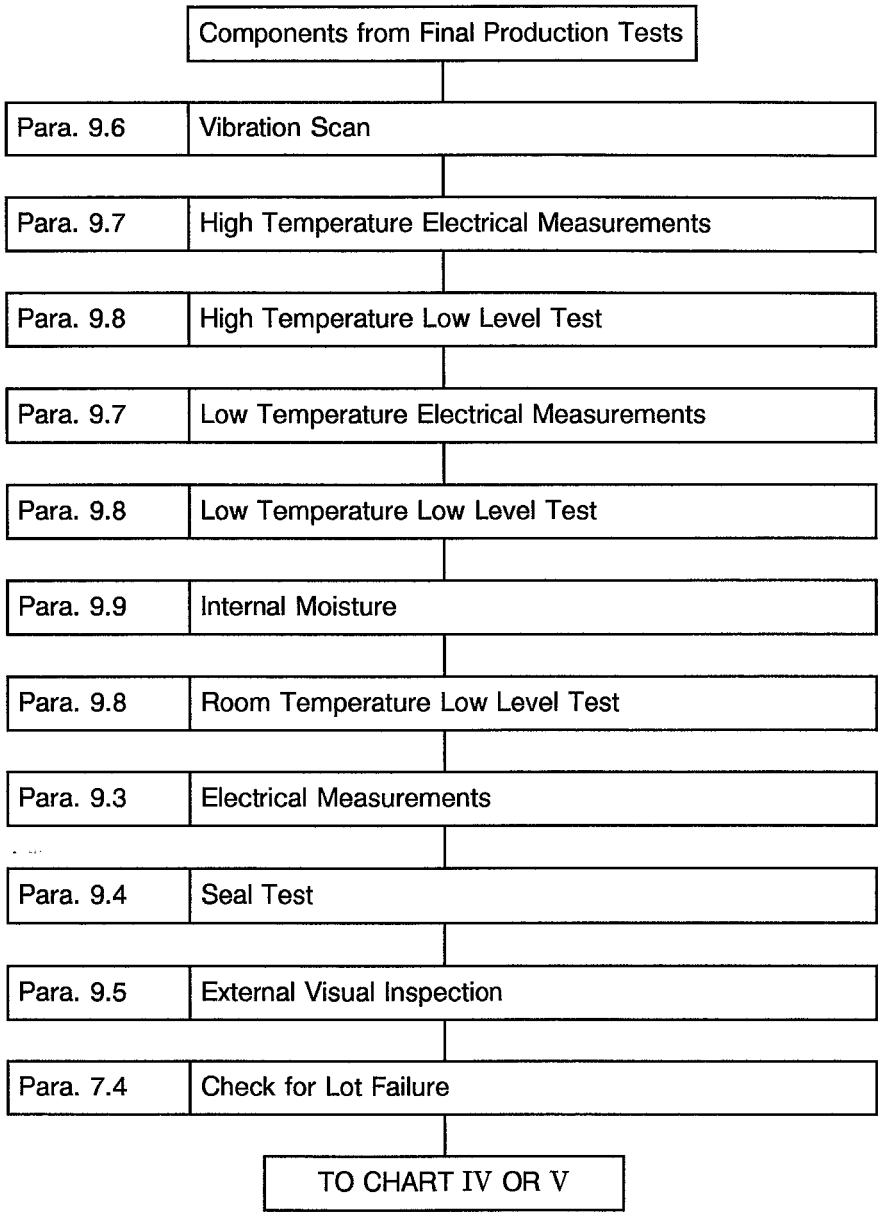
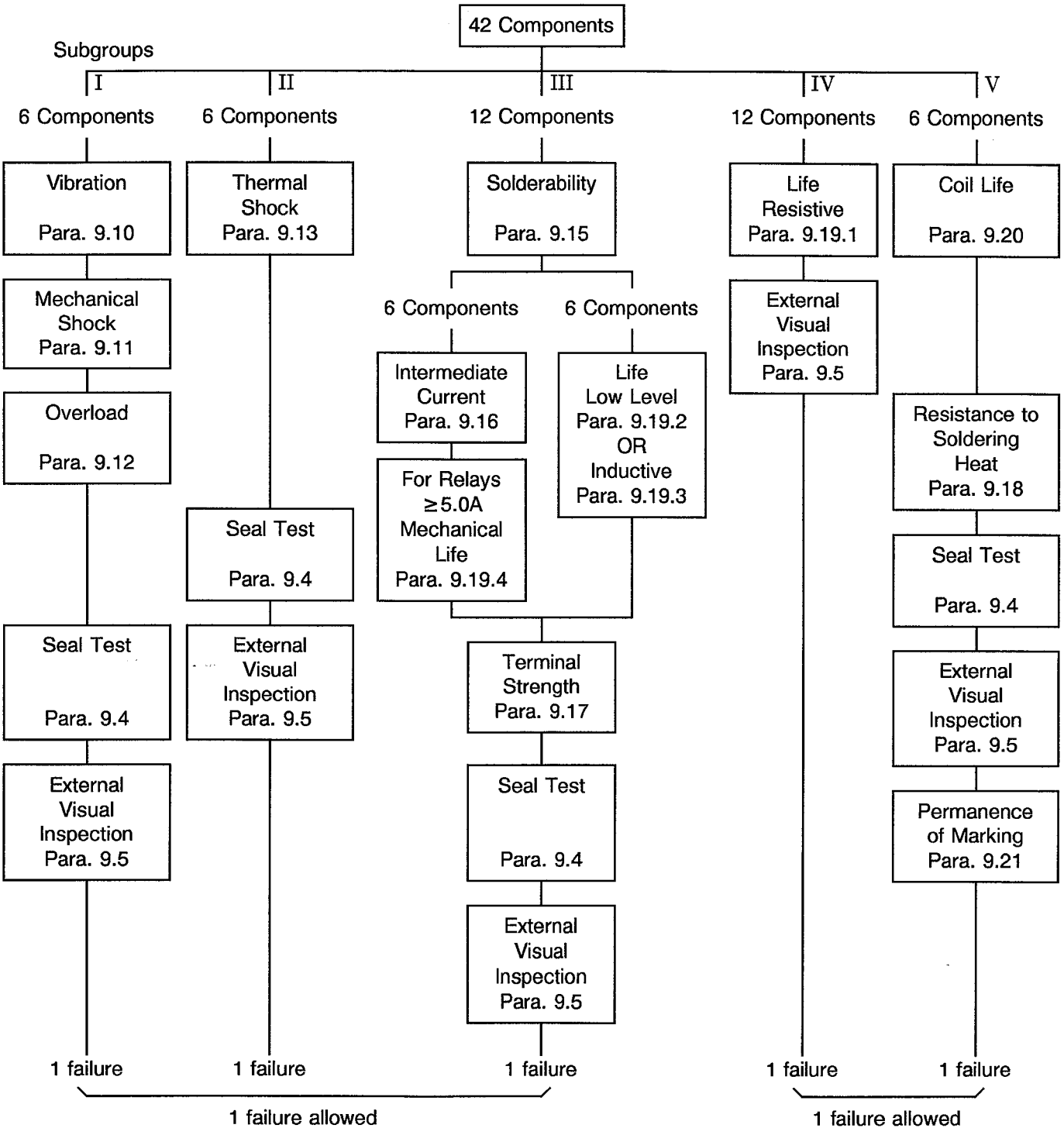


CHART IV - QUALIFICATION TESTS

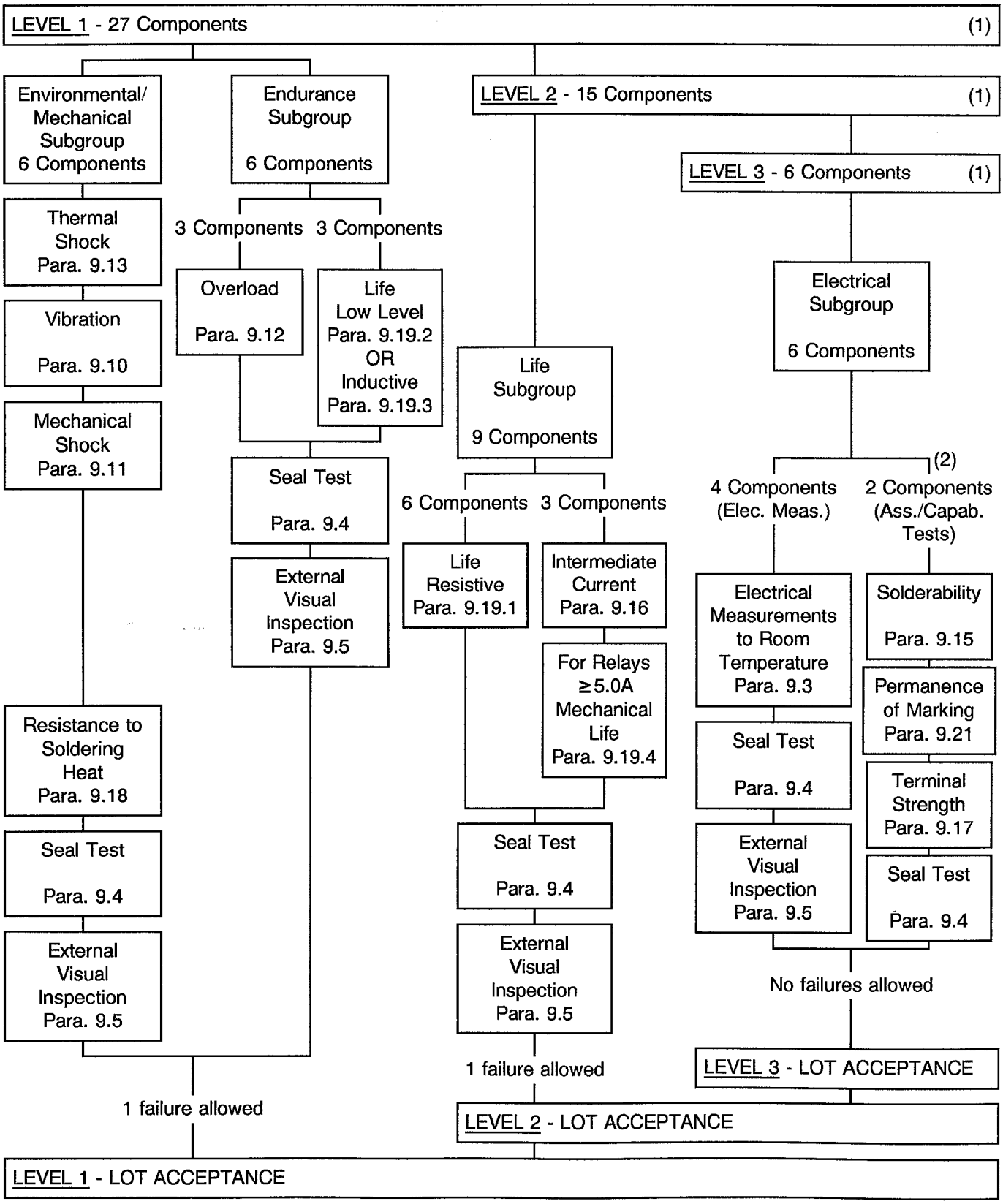


Total allowable number of failed components = 2.

NOTES

1. For distribution within the subgroups, see Para. 8.1.2.
2. If intermediate current and low level life tests are not applicable to particular contacts (e.g. Tungsten), they shall be replaced by an appropriate contact test.

CHART V - LOT ACCEPTANCE TESTS



NOTES

1. For distribution within the sample, see Para. 8.2.2.
2. Post screening electrical rejects may be used for this test.

9. TEST METHODS AND PROCEDURES

The test methods, procedures and conditions are specified in the following paragraphs.

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

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

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

9.1 INTERNAL VISUAL INSPECTION

Internal visual inspection shall be performed in accordance with the requirements of ESA/SCC Basic Specification No. 20400.

9.2 THERMAL CYCLING

The relays shall be tested in accordance with MIL-STD-202, Method 107, Test Condition 'B'.

9.3 ELECTRICAL MEASUREMENTS

9.3.1 Pick-up Voltage

Rated coil voltage shall be applied to the coil for a period of 1 to 3 seconds. The coil voltage shall be gradually reduced to zero and then gradually increased until the relay operates. The pick-up voltage shall be read when all contacts have transferred. Suitable means shall be provided for the monitoring of break and make of contacts.

9.3.2 Drop-out Voltage

Rated coil voltage shall be applied and gradually reduced until the contacts return to their initial position. The drop-out voltage shall be read when all contacts have transferred. Suitable means shall be provided for the monitoring of break and make of contacts.

9.3.3 Contact Resistance (Contact Voltage Drop)

The relays shall be tested in accordance with MIL-STD-202, Method 307. The measurements shall be made using either the d.c. or the a.c. method. In case of dispute, the d.c. method shall govern. The following details shall apply:-

(a) **Method of Connection:**

For relays with wire lead terminals, this measurement shall be made 3.0mm maximum from the emergence of the lead from the relay.

(b) **Test Current:** Maximum 100mA d.c. or 100mA rms.

(c) **Test Voltage:** 6.0V d.c. or 6.0V a.c. peak (f_{max} = 2.0kHz).

(d) **Points of Measurement:**

All contacts in their closed position. The coil shall be energised with rated coil voltage, if necessary, to close the contacts.

(e) **Number of Activations prior to Measurements:** None.

(f) **Number of Test Activations:** 3

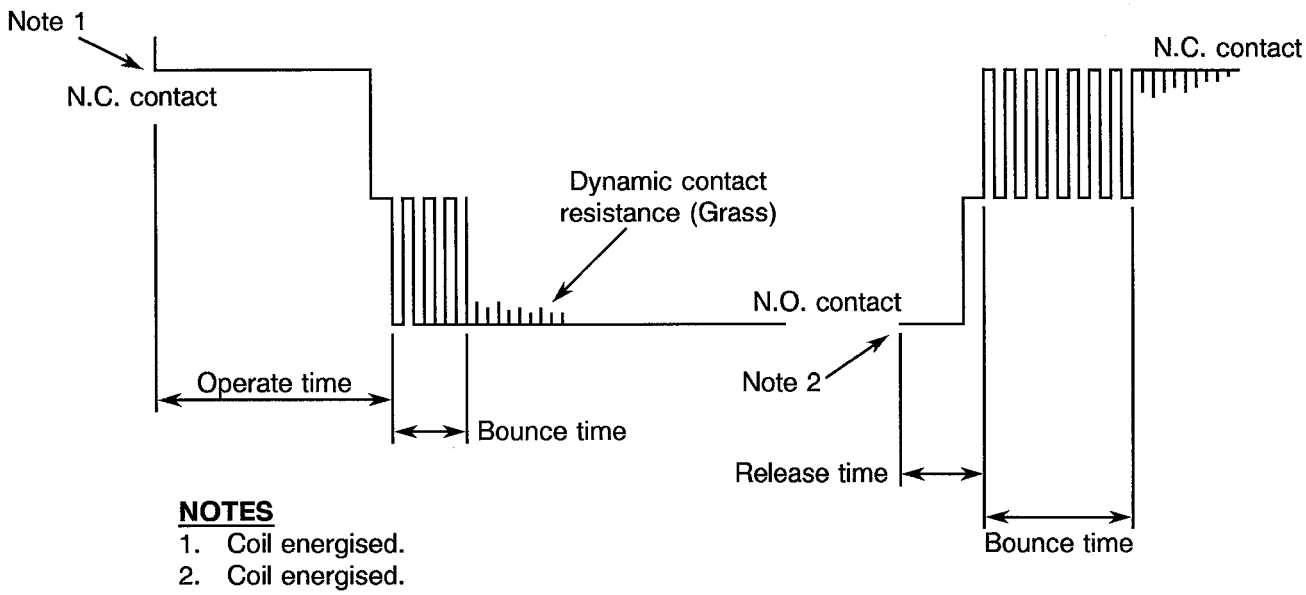
No load shall be applied to the contacts during contact transfer.

(g) **Number of Measurements per Activation:** 1 in each closed contact position.

9.3.4 Operate, Release and Bounce Times

These times shall be measured using an oscilloscope. The trace shall show contact switching at "operate" and "release". Rated coil voltage shall be applied. Contacts shall be loaded with 6.0Volts d.c. maximum at 10mA maximum. The operate and release times shall be exclusive of contact bounce. Timing and bounce measurements shall be made on all contact sets.

FIGURE 1 - TYPICAL OSCILLOSCOPE FIGURE OF OPERATE, RELEASE AND CONTACT BOUNCE TIMES



NOTES
1. Coil energised.
2. Coil energised.

9.3.5 Coil Resistance

The relay coils shall be tested in accordance with MIL-STD-202, Method 303.

9.3.6 Voltage Proof

The relays shall be tested in accordance with MIL-STD-202, Method 301. The following details shall apply:-

(a) **Test Voltage:** As shown in the Detail Specification.

(b) **Maximum Leakage Current:** 1.0mA.

(c) **Duration of Application:** 5.0 seconds.

(d) **Points of Application:**

- Between terminals (except coil) and case; coil de-energised.
- Between terminals (except coil) and case; coil energised.
- Between open contacts; coil energised.
- Between open contacts; coil de-energised.
- Between coil and case.
- Between coil and other terminals.
- Between switching circuits; coil energised.
- Between switching circuits; coil de-energised.

9.3.7 Insulation Resistance

The relays shall be tested in accordance with MIL-STD-202, Method 302. The following details shall apply:-

(a) **Test Condition:**
'A' for relays with coil and contact voltage ratings less than 60V, 'B' for all other relays.

(b) **Points of Measurement:** See Para. 9.3.6(d).

(c) **Test Voltage:** As specified in the Detail Specification.

9.4 SEAL TEST

The seal test shall be performed according to MIL-STD-202, Method 112.

9.4.1 Gross Leak

The following details shall apply:-

(a) **Test Condition:** 'B'.

(b) **Deviation:** De-ionised water may be used instead of mineral oil.

(c) **Requirement:** No bubble shall emanate from the relay case or header.

9.4.2 Fine Leak

The following details shall apply:-

(a) **Test Condition:** 'C', Procedure IIIa..

(b) **Duration of Pressurisation:** 12 hours minimum.

(c) **Recovery Time:** 2 hours minimum at room ambient conditions.

(d) **Requirement:** There shall be no leakage exceeding 1.10^{-8} atm/cc/second.

9.5 EXTERNAL VISUAL INSPECTION

External visual inspection shall be performed in accordance with ESA/SCC Basic Specification No. 20500.

9.6 VIBRATION SCAN

The relays shall be tested in accordance with MIL-STD-202, Method 204. The following details and exceptions shall apply:-

(a) **Method of Mounting:**

The relays shall be mounted rigidly by normal mounting means.

(b) **Test Condition:** 'G'.

(c) **Test Duration:**

Only 1 cycle shall be performed, i.e. 5 minutes sweep-up and 5 minutes sweep-down.

(d) **Test Phase:**

The relays shall be vibrated once in the direction of contact motion and once in the direction of the coil axis.

(e) **Electrical Conditions:**

The relays shall be tested with coils energised during sweep-up and coils de-energised during sweep-down.

(f) **Measurements during Vibration:**

Closed and open contacts shall be monitored as specified in MIL-STD-202, Method 310, Test Circuit B, Test Condition 'A'.

(g) **Measurements after Vibration:** None.

9.7 ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

The electrical parameters to be measured shall be as specified in Table 3 of the Detail Specification. The measurements shall be performed in accordance with Para. 9.3 of this specification. Before performing high temperature measurements, the relays shall be soaked in an oven at the maximum rated temperature for 1 hour with coils energised with rated coil voltage and contacts unloaded. Before performing low temperature measurements, the relays shall be soaked in an oven at the minimum rated temperature for 1 hour with coils de-energised and contacts unloaded.

9.8 LOW LEVEL TEST (MISS TEST)

The relays shall be submitted to a low level test as specified in Chart III and MIL-STD-202, Method 311. The following details and exceptions shall apply:-

(a) **Environment:**
As specified in Chart III of this specification and Table 5 of the Detail Specification.

(b) **Number of Misses Allowed:** 0.

(c) **Maximum Contact Resistance:** See Table 4 of the Detail Specification.

(d) **Monitoring of Contacts for Sticking:** Not applicable.

(e) **Cycling Rate:** 1 to 5 operations per second.

(f) **Number of Operations:** 2 000 at each temperature.

9.9 INTERNAL MOISTURE

Before testing, the relays shall remain at room temperature for 1 hour. The insulation resistance of all contact pins to case only shall be measured and recorded. The relay coil shall be energised with 140% of rated coil voltage for 2.5 minutes. The insulation resistance of all contact pins to case only shall be monitored continuously during this period and the lowest value recorded. The insulation resistance value shall be at least 10% of its initial value and 10 000MΩ or higher.

9.10 VIBRATION

The test shall be run in accordance with MIL-STD-202, Method 204. The following details and exceptions shall apply:-

(a) **Method of Mounting:**

The relays shall be mounted rigidly by their normal mounting means. Connections to the relays shall be made by soldering flexible stranded wires to the relay terminals for contact monitoring.

(b) **Test Condition:** 'G'.

(c) **Electrical Conditions:**

The relays shall be tested with coils energised at rated coil voltage for 2 hours and with coils de-energised for 2 hours in each of the three mutually perpendicular planes.

(d) **Measurements during Vibration:**

Closed and open contacts shall be monitored as specified in MIL-STD-202, Method 310, Test Circuit B, Test Condition 'A'.

(e) **Examination after Vibration:**

The relays shall be inspected for evidence of loosening of parts.

9.11 MECHANICAL SHOCK

The relays shall be tested in accordance with MIL-STD-202, Method 213. The following details and exceptions shall apply:-

(a) **Method of Mounting:**

The relays shall be mounted rigidly by normal mounting means. Connections to the relays shall be made by soldering flexible stranded wires to the relay terminals.

(b) **Test Conditions:**

As specified in the Detail Specification.

(c) **Electrical Load Conditions:**

In each direction of shock, the coil shall be de-energised during 2 shocks and energised with rated coil voltage during 1 shock.

(d) **Measurements during Shock:**

Closed and open contacts shall be monitored as specified in MIL-STD-202, Method 310, Test Circuit B, Test Condition 'A'.

(e) **Measurements and Examination after Shock:**

- Voltage proof: See Para. 9.3.6.
- Contact resistance: See Para. 9.3.3.
- Pick-up and drop-out voltages: See Paras. 9.3.1 and 9.3.2.

The relays shall then be examined for evidence of loosening of parts.

9.12 OVERLOAD

Relays shall be subjected to the tests specified in Paras. 9.12.1, 9.12.2 or 9.12.3 as applicable.

9.12.1 Relays with a Contact Rating less than 5.0 Amperes

(a) The voltage drop across closed contacts shall not be more than 5.0% of applied circuit load voltage (failure to make) and the voltage across open contacts shall not be less than 95% of applied circuit voltage (failure to break).

(b) The coils shall be energised at rated coil voltage.

(c) The cycling rate shall be 20 ± 2 cycles per minute with approximately equal "ON" and "OFF" times.

(d) All contacts shall make, carry and break an overload current which is twice the rated resistive current.

For double throw relays, separate tests may be performed for the Normally Open and for the Normally Closed contacts. If both NO and NC contacts of double throw relays are tested simultaneously, a separate load shall be provided for each NO and NC contact. The movable contacts shall be connected to the power supply. All loads shall be connected between the fixed contacts and power supply ground.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

(e) The opening and closing of the contacts shall be monitored throughout the test to detect switching of the contacts. The equipment shall automatically shut off when a failure occurs or shall record any failure.

The equipment shall be capable of monitoring at least 50% of the actual opened or closed time of each contact.

(f) The number of operations shall be 100.

(g) The relays shall be tested at room ambient temperature.

(h) The continuity of the fuse specified in (d) above shall then be checked. Blowing of the fuse shall constitute a relay failure. After continuity testing, the electrical measurements specified in Table 2 of the Detail Specification shall be performed and shall meet the requirements of Table 6 of the Detail Specification.

9.12.2 Relays with a Contact Rating of 5.0 to 20 Amperes

The same as Para. 9.12.1 shall apply except:-

(a) The voltage drop across closed contacts shall not be more than 10% of the applied circuit load voltage (failure to make) and the voltage across open contacts shall not be less than 95% of applied circuit voltage (failure to break).

(c) "ON" time shall be 0.2 ± 0.05 seconds and "OFF" time shall be 20 ± 1.0 seconds.

(d) All contacts shall make, carry and break an overload current which is 4 times the rated resistive current.

(e) The equipment shall be capable of monitoring 10% of the actual opened or closed time of each contact.

(f) The number of operations shall be 50.

9.12.3 Relays with a Contact Rating above 20 Amperes

The same as Para. 9.12.1 shall apply except:-

(a) The voltage drop across closed contacts shall not be more than 10% of the applied circuit load voltage (failure to make) and the voltage across open contacts shall not be less than 95% of applied circuit voltage (failure to break).

Auxiliary contacts, if any, shall be simultaneously tested at rated current.

(c) "ON" time shall be 0.2 ± 0.05 seconds and "OFF" time shall be 20 ± 1.0 seconds.

(f) The number of operations shall be 50.

9.13 THERMAL SHOCK

The relays shall be tested in accordance with MIL-STD-202, Method 107. The following details and exceptions shall apply:-

(a) **Special Mounting:**

The relays shall be suspended in the test chamber by twine or other non-heat-conducting material, in a plane parallel to the normal air flow. Test leads may be used for mounting; however, they shall not constitute a heatsink.

(b) **Test Condition:**

Test Condition 'B' except exposure time at temperature extreme during the 5th cycle shall be 2 hours each.

(c) **Measurements:**

Measurements at each temperature extreme during steps 1 and 3 of this 5th cycle at the end of each temperature exposure and with the relays still in the conditioning chamber, the insulation resistance, pick-up and drop-out voltages and operate and release times shall be measured as specified in Paras. 9.3.7, 9.3.1, 9.3.2 and 9.3.4 respectively. The measured values shall meet the requirements of Table 3 of the Detail Specification.

(d) **Measurements after Cycling:**

The relays shall be visually examined for cracking, peeling and flaking of the finish and the voltage proof test shall then be run as specified in Para. 9.3.6.

9.14 NOT APPLICABLE

9.15 SOLDERABILITY

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

(a) **Number of Terminals of each Relay to be Tested:** All.

9.16 INTERMEDIATE CURRENT

The relays shall be tested as specified in MIL-STD-202, Method 312 with the following details and exceptions.

9.16.1 Relays with a Contact Rating less than 5.0 Amperes

(a) The voltage drop across closed contacts shall not be more than 300mV and the voltage across open contacts shall not be less than 95% of applied circuit voltage.

(b) The coils shall be energised at rated coil voltage.

(c) The cycling rate shall be 10 ± 2 operations per minute and "ON" and "OFF" times shall be approximately equal.

(d) The contact current and voltage shall be 100mA and 28Vdc.

Normally Open and Normally Closed contacts shall be tested simultaneously.

(e) Monitoring of contact resistance shall be performed at least 40% of the closed time of each contact during each operation.

(f) The number of operations shall be 50 000.

(g) The relays shall be tested at their maximum high temperature as specified in Table 1(b) of the Detail Specification.

(h) After testing, the electrical measurements specified in Table 2 of the Detail Specification shall be performed and shall meet the requirements of Table 6 of the Detail Specification.

9.16.2 Relays with a Contact Rating of 5.0 to 20 Amperes

The same as Para. 9.16.1 shall apply except:-

(a) The voltage drop across closed contacts shall be as specified hereafter:

RATING	ALLOWABLE mV DROP AFTER TEST BEGINS			
	0.5A	0.3A	0.1A	RATED RESIST. LOAD
5.0	40	24	8.0	175
10	32	24	7.0	175
15	30	18	6.0	175
20	30	18	6.0	175

(d) Contact Current and Voltage:

For 1 pole double throw or 2 pole single throw relays, the Normally Closed contact shall switch 10% of the rated resistive current while the Normally Open contact shall switch rated resistive current.

For 2 pole double throw relays, the relays to be tested shall be separated into 3 equal groups and:

- One pole of each relay shall be connected to rated resistive load.
- The remaining pole of each relay shall be connected to loads as specified herewith:-

	Loads
Group 1	0.5A resistive 28Vdc.
Group 2	0.3A inductive 28Vdc L/R = 15ms.
Group 3	0.1A resistive 28Vdc.

For 4 pole double throw relays, the 4 loads specified in the Table of (a) above shall be simultaneously connected to each relay, with each individual pole carrying 1 of the specified loads.

For 2 and 4 pole double throw relays, both Normally Open and Normally Closed contacts shall make, carry and break the loads specified above, without failure, throughout the test.

9.16.3 Relays with a Contact Rating above 20 Amperes

The same as Para. 9.16.2 shall apply except:-

(a) The voltage drop across any closed contacts shall not be more than 200mV.

(d) For 1 pole double throw or 2 pole single throw relays, the Normally Closed contact shall switch 10% of rated current while the Normally Open contact will switch rated current.

1 pole of relay power contacts shall make, carry and break rated resistive current and all other poles shall make, carry and break 10% of rated resistive current simultaneously.

Auxiliary contacts, if any, shall be simultaneously tested in accordance with Para. 9.16.1.

9.17 TERMINAL STRENGTH

The relays shall be tested in accordance with MIL-STD-202, Method 211, and, where applicable, the requirements specified in the following paragraphs. Unless otherwise specified herein, 2 terminals of each discrete design, size and configuration shall be tested.

9.17.1 Pull Test (all Terminal Types)

The terminals shall be tested as specified in Test Condition 'A', the force shall be as specified in the ESA/SCC Detail Specification.

9.17.2 Bend Test (Flat and Wire Lead Terminals)

The terminals shall be tested as specified in Test Condition 'B', (2 bends), or 'C', as applicable. Loads for Test Condition 'C' shall be as specified in the Detail Specification.

9.17.3 Twist Test (Wire Lead Terminals only)

All terminals shall be tested as specified in Test Condition 'D', but, during application of torsion, each terminal shall be rotated 45° in 1 direction, then returned to start; 45° in the opposite direction, then returned to start. Each terminal shall be subjected to 2 such rotations and returns. Each terminal shall be held at a point 19mm from the point of emergence from the relay and, in one plane, be rotated $20 \pm 5°$ in one direction, then returned to start; rotated $20 \pm 5°$ in the opposite direction, then returned to start. This procedure shall then be repeated in the perpendicular plane. Following these tests, the relays shall be examined for evidence of loosening or breaking of the terminals and other damage that could adversely affect their normal operation.

9.18 RESISTANCE TO SOLDERING HEAT

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

(a) **Depth of Immersion of Terminals in Molten Solder:**

Within 1.5 ± 0.5mm of the relay header.

(b) **Test Condition:** 'B'.

(c) **Measurement after Test:**

- Insulation resistance : See Para. 9.3.7.
- Contact resistance : See Para. 9.3.3.
- Pick-up and drop-out voltages : See Paras. 9.3.1 and 9.3.2.
- Coil resistance : See Para. 9.3.5.

9.19 LIFE

Relays shall be subjected to the tests specified in Para's. 9.19.1, 9.19.2, 9.19.3 or 9.19.4 as applicable.

9.19.1 Resistive Life

(a) The voltage drop across closed contacts shall not be more than 10% of applied circuit load voltage.

(b) The coils shall be energised at rated coil voltage.

(c) The cycling rate shall be 20 ± 2 operations per minute and "ON" and "OFF" times shall be approximately equal.

(d) The test current shall be rated resistive current as specified in Table 5(b) of the Detail Specification.

All contacts in each sample unit shall make, carry and break identical loads.

The direction of current flow in the contacts of half the quantity of samples shall be in the opposite direction; this requirement does not apply to double make or double break contacts.

The movable contacts shall be connected to the power supply.

All loads shall be connected between the fixed contacts and power supply ground.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

(e) The opening and closing of the contacts shall be continuously monitored to detect switching of the contacts. The contact resistance or voltage drop, as applicable, shall be monitored during 40% minimum of each "ON" and "OFF" period. The equipment shall automatically shut off when a failure occurs or shall record any failure.

(f) Relays shall be cycled for 100 000 operations minimum.

(g) The relays shall be tested at their maximum high temperature as specified in Table 1(b) of the Detail Specification.

(h) The continuity of the fuse specified in (d) above shall then be checked. Blowing of this fuse shall constitute a relay failure. After continuity testing, the electrical measurements specified in Table 2 of the Detail Specification shall be performed and shall meet the requirements of Table 6 of the Detail Specification.

9.19.2 Low Level Load and Mechanical Life (Relays rated less than 5.0 Amperes)

The same as Para. 9.19.1 shall apply except:-

(a) A miss is defined as a voltage drop across closed contacts greater than 10% of applied circuit load voltage of a duration greater than 100µs.

The number of allowed misses = 0.

(b) The coil shall be energised during 50 ± 10% of each operation.

(c) The minimum cycle time shall be 10 times the sum of the maximum operate and release times for the relay under test.

(d) The test current shall not exceed 10mA with an open circuit voltage of 10 to 50mV (d.c. or peak a.c.). No fuse is necessary between the relay case and system ground.

(f) Relays shall be cycled for 1 000 000 operations minimum.

The first 100 000 operations only are to be monitored.

The remaining 900 000 operations need not be monitored.

(g) The relays shall be tested at the maximum operating temperature as specified in Table 1(b) of the Detail Specification for the first 100 000 operations and at room ambient temperature for the remaining operations.

9.19.3 Inductive Life (Relays rated 5.0 Amperes or greater)

The same as Para. 9.19.1 shall apply except:-

(c) "ON" time shall be 0.5 ± 0.05 seconds and "OFF" time shall be 3.0 ± 0.1 seconds.

(d) The test current shall be rated inductive current as specified in Table 1(b) of the Detail Specification with a time constant L/R of 5.0ms.

(f) Relays shall be cycled for 20 000 operations minimum.

(g) The relays shall be tested at their maximum high temperature as specified in Table 1(b) of the Detail Specification.

9.19.4 Mechanical Life (Relays rated 5.0 Amperes or greater)

(a) The coils shall be energised at rated coil voltage.

(b) The minimum cycle time shall be 10 times the sum of the maximum operate and release times for the relay under test.

(c) Contacts shall not be loaded, nor monitored.

(d) Relays shall be cycled for 350 000 operations minimum.

(e) The relays shall be tested at room ambient temperature.

(f) After testing, the contact voltage drop, pick-up and drop-out voltages, operate, release and bounce times and coil resistancce shall be measured as specified in Paras. 9.3.3, 9.3.1, 9.3.2, 9.3.4 and 9.3.5 respectively, and shall meet the requirements of Table 6 of the Detail Specification.

9.20 COIL LIFE

The relays shall be tested for 1 000 hours as follows (see Figure II):-

(a) The relays may be mounted on a heatsink in accordance with the following:-

Each relay may be attached by its normal mounting means to a 1.6mm thick minimum, flat aluminium plate heatsink. The heatsink shall be designed to place each relay in the centre of its own square space whose total surface area (both sides) is 8 times the outside surface area of the relay, excluding mounting. Relays without mounts shall be held to the heatsink with a metal strap with a width of 6.35mm and a maximum thickness of 0.3mm. The heatsink assembly shall be suspended by twine or other non-heat-conducting material in a plane parallel to the normal air flow in the oven. The leads shall not constitute a heatsink. The chamber temperature shall be controlled to maintain the temperature at the specified ambient extremes (see Table 1(b) of the Detail Specification). Each terminal shall be connected as specified in Para. 9.3.3(a).

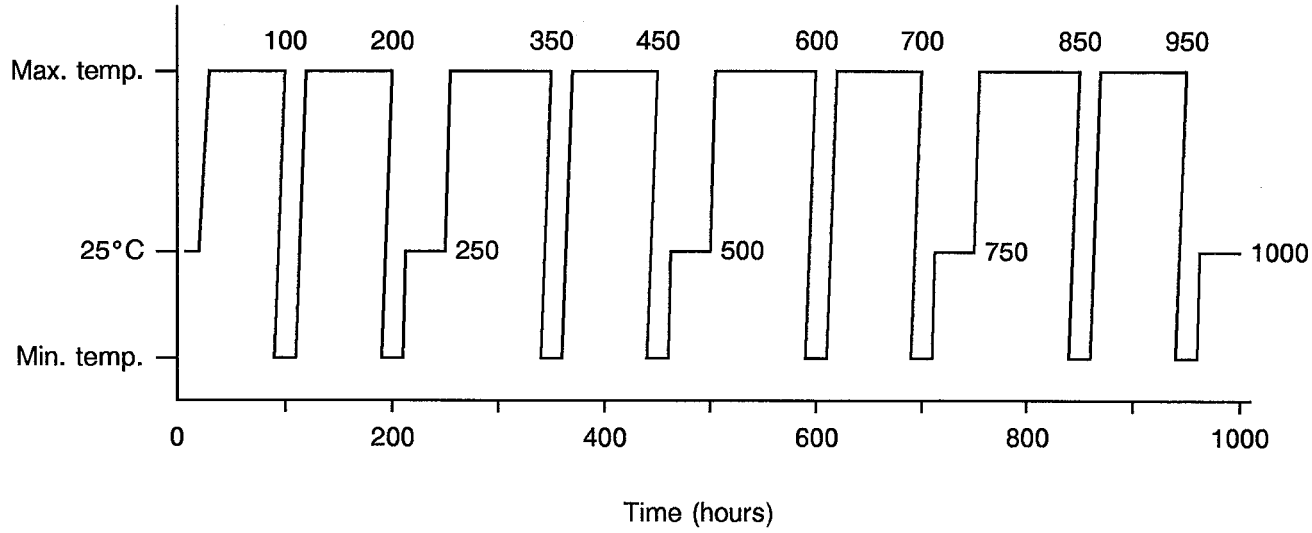
(b) During the maximum temperature portion of the test, rated coil voltage (see the Detail Specification) shall be applied continuously and at least half of the 'normally open' contacts shall carry rated contact current. During room temperature and minimum temperature exposure, the coil shall be de-energised and contacts shall not be loaded.

Ambient temperature shall be varied as shown in Figure II, with heating and cooling rates not exceeding 1°C per second average. The portion of the cycle run at minimum temperature shall be approximately 10% of the test cycle time.

(c) After the first 100 hours and while still at the low temperature extreme, the contact resistance as well as the operate and release times shall be measured as specified in Paras. 9.3.3 and 9.3.4 and the values recorded. Measurements of coil resistance and contact resistance as specified in Paras. 9.3.5 and 9.3.3 shall be made initially at room temperature and then again after 250 ± 24, 500 ± 24 and 750 ± 24 hours; the values shall be recorded. Pick-up and drop-out voltage measurements shall be made as specified in Paras. 9.3.1 and 9.3.2 during the last temperature cycle after allowing the relay to stabilise, coil de-energised, at each of the temperature extremes; the values shall be recorded. Measurements shall then be made at room temperature of voltage proof, insulation resistance, contact resistance, coil resistance, operate and release times and contact bounce, as specified in Paras. 9.3.6, 9.3.7, 9.3.3, 9.3.5 and 9.3.4 respectively.

The relays shall then be examined for evidence of damage.

FIGURE II - AMBIENT TEMPERATURES



9.21 PERMANENCE OF MARKING

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

9.22 ENCAPSULATION

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

9.23 DIMENSION CHECK

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

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

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) Screening 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 Para's 7.3 and 8.4) and failure analysis report (see Para. 8.4).

(j) Certificate of Conformity.

Items (a) to (j) 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 (j) 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"

Not 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.

(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:

- Pre-encapsulation internal visual inspection (Para. 9.1).
- Thermal cycling (Para. 9.2).
- Electrical measurements (Para. 9.3).
- Seal test (fine or gross leak) (Para. 9.4).
- External visual inspection (Para. 9.5).
- Dimension check (Para. 9.23).

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 Para. 10.1.2 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 SCREENING 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) Failures during vibration scan.

(b) Failures during the low level test at each temperature and the number of misses.

(c) Failures during internal moisture test. For each component, the lowest value of insulation resistance.

(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) Failures during seal test.

10.7.2 Testing Level "C"

Not applicable.

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, 3 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"

Not applicable.

10.10 FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT

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

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

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

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

(d) Detailed failure analysis, if requested.

10.11 CERTIFICATE OF CONFORMITY

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

11. DELIVERY

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

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

(a) The delivery lot.

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

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

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

12. PACKAGING AND DESPATCH

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

ANNEXE I

LTPD SAMPLING PLAN LOT SIZES GREATER THAN 200 DEVICES

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

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

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

ANNEXE I

LTPD SAMPLING PLAN 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.