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EVALUATION TEST PROGRAMME

FOR ELECTROMAGNETIC RELAYS

ESA/SCC Basic Specification No. 2263600

space components
coordination group

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1. PURPOSE

The purpose of this specification is to establish the procedure to be followed in the evaluation of component capabilities as required for space applications and thereby to anticipate, as far as possible, component behaviour during qualification testing. Therefore, the aim of such testing shall be to overstress specific characteristics of the component concerned with a view to the detection of possible failure modes. Additionally, a detailed construction analysis shall be performed to detect any design and construction defects which may affect the reliability of the component and to facilitate failure analysis activities.

2. APPLICABLE DOCUMENTS

2.1 GENERAL

The following documents form part of, and shall be read in conjunction with, this specification.

2.2 ESA/SCC SPECIFICATIONS

No. 3601, Relays, Electro-Magnetic, Non-latching.

No. 3602, Relays, Electro-Magnetic, Latching.

No. 20400, Internal Visual Inspection.

No. 20500, External Visual Inspection.

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

2.3 OTHER (REFERENCE) DOCUMENTS

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

3. PROCEDURE

Standard components shall be selected from a homogeneous lot at the Manufacturer to be evaluated. These components shall not have been submitted to any screening, but must have been manufactured in conformity with high reliability practice and an established Process Identification Document (P.I.D.) or an identifiable process which shall form the basis for the P.I.D.

The tests specified in the programme shall be performed in the sequence shown in Chart I.

All results shall be recorded and failed components submitted to a failure analysis.

Probable failure modes and mechanisms shall be determined.

The evaluation test programme shall be performed, under the supervision of the Qualifying Space Agency (QSA) for whom the evaluation of the component concerned is required, by the Manufacturer or at a test laboratory approved by the QSA.

4. TEST PROGRAMME SEQUENCE AND SAMPLE DISTRIBUTION

4.1 SELECTION OF COMPONENTS FOR EVALUATION TESTING

The number of components chosen for evaluation testing shall depend upon whether a single component type or a family of parts is evaluated and the number of component types chosen to represent the family.

Not less than 56 specimens shall be used for each test programme.

The component types chosen to represent a family shall cover the range of components to be evaluated and be representative of the different configurations and contact types under consideration. They shall also be the most suitable for highlighting those characteristics and parameters that are pertinent to an investigation into failure modes and weaknesses.

The above mentioned quantity shall be submitted to the full evaluation procedure whenever a new technology has been applied to the components concerned, where there is insufficient experience in their production.

4.2 DETAIL SPECIFICATION(S)

Should a Detail Specification(s) for the device(s) to be evaluated not exist, the Manufacturer shall prepare such a document(s) in accordance with the established ESA/SCC format and submit it to the appropriate QSA for provisional approval. This shall then serve as a basis for the ordering and testing of the relevant components.

4.3 INSPECTION RIGHTS

The QSA reserves the right to inspect at any time the components processed for evaluation purposes. The Manufacturer shall notify the QSA at least three working days in advance of the date of internal visual inspection (but see Para. 4.4).

4.4 CONTROL DURING FABRICATION

The components shall be produced as defined in Para. 3 of this specification. Internal visual inspections shall be performed on the lot to be tested to the extent that this forms part of the Manufacturer's standard procedures. Progress of the components shall be observed closely and recorded together with an analysis of any rejects. A chart showing the number in/out and failure cause for each fabrication stage shall be submitted to the QSA.

5. INSPECTION

5.1 GENERAL

The components shall be checked to verify their suitability for the Evaluation Test Programme. Defects or deviations from the established ESA/SCC requirements may invalidate the evaluation. For each measurement or inspection performed, the results shall be summarised in terms of quantity tested, quantity passed and quantity rejected. If devices are rejected, the reason shall be clearly identified.

5.2 DIMENSIONS (10 RELAYS)

10 devices shall be measured in accordance with Figure 2 of the Detail Specification (go-no-go). Where gauges exist for the performance of measurements, these may be used. Rejected components shall be replaced.

5.3 WEIGHT (10 RELAYS)

10 components shall be weighed. Any devices that exceed the weight defined in the Detail Specification shall be rejected and replaced.

5.4 ELECTRICAL MEASUREMENTS (100%)

These measurements shall be performed in accordance with Table 2 of the Detail Specification at an ambient temperature of $+22 \pm 3$ °C (go-no-go). Rejected components shall be replaced.

5.5 EXTERNAL VISUAL INSPECTION (100%)

All devices shall be inspected in accordance with ESA/SCC Basic Specification No. 20500. Rejected components shall be replaced.

5.6 SEAL TEST (100%)

Fine and gross leak tests shall be performed on all components in accordance with the requirements of Para. 9.4 of ESA/SCC Generic Specification No. 3601 or 3602. Rejected components shall be replaced.

5.7 MARKING AND SERIALISATION (100%)

All components shall be marked and serialised in accordance with the standard procedures of the Manufacturer concerned.

5.8 COMPLETION OF INSPECTION

The completion of inspection shall result in a batch of components that have been verified as to their suitability for the Evaluation Test Programme, i.e. each component has satisfied the requirements of Paras. 5.2 to 5.7 inclusive.

6. INITIAL ELECTRICAL MEASUREMENTS (100% READ AND RECORD)

Electrical measurements shall be performed in accordance with Tables 2 and 3 of the Detail Specification. All characteristics shall be recorded against serial number.

7. EVALUATION TEST PROGRAMME

7.1 GENERAL

The evaluation tests shall be performed as specified in Chart I. The components shall be randomly divided into three groups and their associated subgroups in the proportions indicated in Chart I. When a family of components is under investigation, the variations within that family must be represented in each group/subgroup.

All failed components shall be analysed. The depth of analysis shall depend upon the circumstances in which failure occurred and upon whether useful information may be gained. As a minimum, the failure mode shall be determined in each case. Components not failing catastrophically, i.e. those displaying out-of-tolerance electrical parameters, shall not be removed from the test sequence, but monitored to observe degradation trends.

7.2 GROUP 1 - CONTROL GROUP

This group shall be retained for comparison purposes. Whenever measurements are made on any devices under test, these devices shall also be measured.

7.3 GROUP 2 - ENVIRONMENTAL TESTS

7.3.1 General

This group shall be randomly divided into 3 subgroups in the proportions indicated in Chart I.

7.3.2 Subgroup 2A - Miss Test Under Vibration

7.3.2.1 Procedure

The test shall be performed as follows.

The vibration shall be sinusoidal with an acceleration of 10g. The entire frequency range of 50 to 300 Hertz and return to 50 Hertz shall be traversed in 20 minutes.

The power source for the open-circuit voltage shall not exceed 30 millivolts dc maximum or peak ac at 10 milliamperes maximum.

In each axis, relays shall be submitted to 2 400 cycles of contact operations at a frequency of 2 Hertz while they are vibrated.

7.3.2.2 Intermediate Measurements

During the last 100 cycles in each axis, contact voltage shall be monitored on a suitable oscilloscope and any irregularity in the waveform shall be recorded.

7.3.2.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.3.3 Subgroup 2B - Sinusoidal Vibration Step Stress

7.3.3.1 Procedure

The test shall be performed in accordance with Para. 9.10 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- Test Conditions
  The steps shall be 10g increments, starting at the vibration level specified in the Detail Specification. The final step shall be twice the specified vibration level.

  The frequency range shall be as specified in the applicable Detail Specification.

- Electrical Conditions
  Instead of 2 hours, the duration shall be 20 minutes.

- Measurements During Vibration
  Should a contact opening or any closing of open contacts occur, the test shall be repeated at the preceding level for one frequency sweep to confirm the fault.

7.3.3.2 Intermediate Measurements

After each 20 minute period in each axis and each step, Pick-up and Drop-out voltages for non-latching relays or Latch and Reset voltages for latching relays shall be measured in accordance with Table 2 of the Detail Specification and recorded.

7.3.3.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.3.4 Subgroup 2B - Mechanical Shock Step Stress Test

7.3.4.1 Procedure

The test shall be performed in accordance with Para. 9.11 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- Test Conditions
  The relays shall be split into 3 equal subgroups which shall be respectively submitted to 1, 1.5 and 2 times the shock level specified in the Detail Specification.

  The waveform shall be as specified in the applicable Detail Specification.

- Measurements During Shock
  Should a contact opening or any closing of open contacts occur, the test shall be repeated at the preceding level to confirm the fault.

7.3.4.2 Final Measurements and Inspections

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.3.5 Subgroup 2B - Salt Spray (Corrosion)

7.3.5.1 Procedure

The relays shall be tested in accordance with MIL-STD-202, Method 101. The following details and exceptions shall apply:-

(a) Applicable salt solution : 5%.

(b) Test condition : B.

7.3.5.2 Final Examination

The relays shall be examined for evidence of peeling, chipping, blistering of the finish and exposure of the base metal due to corrosion.

7.3.6 Subgroup 2C - Resistance to Soldering Heat Step Stress Test

7.3.6.1 Applicability

Only solderable terminals shall be submitted to this test.

7.3.6.2 Procedure

The test shall be performed in accordance with Para. 9.18 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- Test Conditions

  The relays shall be split into 3 equal subgroups which shall be respectively submitted to the following steps :

  - 260°C 10 seconds, 260°C 20 seconds, 260°C 30 seconds.
  - 280°C 10 seconds, 280°C 20 seconds, 280°C 30 seconds.
  - 300°C 10 seconds, 300°C 20 seconds, 300°C 30 seconds.

Before each new terminal immersion step, care shall be taken that the case temperature has returned to room ambient.

7.3.6.3 Intermediate Measurements

After each immersion, electrical measurements shall be performed in accordance with Table 2 of the Detail Specification and recorded and a fine leak test shall be performed in accordance with Para 9.4.2 of ESA/SCC Generic Specification No. 3601 or 3602 with the exception of steps (b) and (c).

7.3.6.4 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4 GROUP 3 - ENDURANCE TESTS

7.4.1 General

This group shall be randomly divided into 5 subgroups in the proportions indicated in Chart I.

7.4.2 Subgroup 3A - Resistive Load Life Test

7.4.2.1 Procedure

The test shall be performed in accordance with Para. 9.19.1 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- The test current shall be 1.5 times rated resistive current (Table 1(b) of the Detail Specification).
- The relays shall be tested in the position where their terminals are downwards.

7.4.2.2 Intermediate Measurements

Every 10 000 operations, dynamic contact resistance and operating voltages shall be measured. Alternatively, a minimum, maximum and average value of dynamic contact resistance over each 10 000 operations is acceptable.

7.4.2.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.3 Subgroup 3B - Intermediate Current

7.4.3.1 Procedure

The test shall be performed in accordance with ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, Para. 9.16 with the following exceptions:

- The number of cycles shall be 100 000 minimum.
- Relays with a contact rating equal to or less than 1.0 ampere shall be tested with a current of 10 milliamperes.

7.4.3.2 Intermediate Measurements

At 50 000 operations and then every 10 000 operations, dynamic contact resistance and operating voltages shall be measured. Alternatively, minimum, maximum and average values of dynamic contact resistance over each 10 000 operations is acceptable.

7.4.3.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.4 Subgroup 3B - Terminal Strength Step Stress Test

7.4.4.1 Procedure

The test shall be performed in accordance with Para. 9.17 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- The relays shall be split into 3 equal subgroups which shall be respectively submitted to the following steps:
  - Pull test (applicable to all terminal types) starting at the value defined in the Detail Specification and steps increasing by the initial value until failure occurs.
  - Bend test starting at the value defined in the Detail Specification and steps increasing by the initial value until failure occurs
  - Twist test at 20, 45 and 90 degrees (also applicable to solder hook terminals). The 90 degree rotations shall only be applied to the 4 corner terminals.

  For larger terminals (screw type), a torque meter may be used.

7.4.4.2 Intermediate Measurements

After each step, electrical measurements shall be performed in accordance with Table 2 of the Detail Specification and recorded and a fine leak test shall be performed in accordance with Para 9.4.2 of ESA/SCC Generic Specification No. 3601 or 3602 with the exception of steps (b) and (c).

7.4.4.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.5 Subgroup 3C - Low Level Mechanical Life Tests

7.4.5.1 Applicability

This test is only applicable to relays rated at less than 5.0 Amperes.

7.4.5.2 Procedure

The test shall be performed in accordance with Para. 9.19.2 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- The test shall be run for 200 000 operations with contact resistance monitoring.
- Subsequently, the relays shall be cycled without contact resistance monitoring up to 1.5 million operations.

7.4.5.3 Intermediate Measurements

After 200 000, 500 000 and 1 million operations, electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.5.4 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.6. Subgroup 3C - Inductive Load and Mechanical Life Tests

7.4.6.1 Applicability

This test is only applicable to relays rated at 5.0 Amperes or greater.

7.4.6.2 Inductive Load

7.4.6.2.1 Procedure

The test shall be performed in accordance with Para. 9.19.3 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- Relays shall be cycled for 50 000 operations.
- The relays shall be tested in the position where their terminals are downwards.

7.4.6.2.2 Intermediate Measurements

Every 10 000 operations, dynamic contact resistance and operating voltages shall be measured. Alternatively, minimum, maximum and average values of dynamic contact resistance over each 10 000 operations is acceptable.

Additionally, insulation resistance and voltage proof shall be measured in accordance with Table 2 of the Detail Specification.

7.4.6.2.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.6.3 Mechanical Life Test

7.4.6.3.1 Procedure

The test shall be performed in accordance with Para. 9.19.4 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- Test Conditions

  Relays shall be cycled for 500 000 operations.

7.4.6.3.2 Intermediate Measurements

Every 100 000 operations, electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.6.3.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.7 Subgroup 3D - Inrush Current

7.4.7.1 Procedure

The test shall be performed in accordance with Para. 9.19.1 of ESA/SCC Generic Specification No. 3601 for non-latching relays or 3602 for latching relays, with the following exceptions:

- The test current shall be 10 times rated current when the contacts are closing and the pulse duration shall be 100 milliseconds.

- The number of operations shall be 100. The Normally Open and Normally Closed contacts of each individual switching circuit shall be tested.

7.4.7.2 Intermediate Measurements

Contact resistance as well as insulation resistance and voltage proof shall be monitored after each 10 operations.

7.4.7.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601 or 3602.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.4.8 Subgroup 3E - Coil Life

7.4.8.1 Procedure

The test shall be performed in accordance with Para. 9.20 (a) and (b) of ESA/SCC Generic Specification No. 3601 with the following exceptions:

- Maximum coil voltage instead of rated coil voltage shall be applied during the applicable portions of the test. For latching relays, maximum coil voltage shall be continuously applied to either one of the 2 coils.

7.4.8.2 Intermediate Measurements.

As per Para. 9.20 (c) of ESA/SCC Generic Specification No. 3601 with the following exceptions:

- 2 hours prior to the end of the last high temperature cycle, rated current shall be removed from the contacts and the coil shall be de-energised.

- 1 hour prior to the end of the last high temperature cycle, operating voltages shall be measured. Then, maximum coil voltage shall be applied to the relays during the last hour.

- At the end of the last high temperature cycle, the coil shall remain energised while the relays are brought to the minimum temperature extreme. The transfer shall be done in less than 2 minutes.The relay shall remain energised for 1 hour. Then, the coil voltage shall be removed and the contact resistance of the Normally Closed contacts immediately measured and recorded.

7.4.8.3 Final Measurements and Inspection

Seal test shall be performed in accordance with Para 9.4 of ESA/SCC Generic Specification No. 3601.

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

Electrical measurements shall be performed in accordance with Table 2 of the Detail Specification.

7.5 CONSTRUCTION ANALYSIS

7.5.1 General

The purpose of this analysis, consisting of a series of examinations and evaluations, is to examine the construction of a device and to assess potential reliability hazards.

It shall also be used to evaluate the amount of degradation after tests as specified in Chart I.

It shall be performed on any relay of interest from any subgroup, with a minimum of 8 relays to be analysed.

7.5.2 Materials and Finishes

All non-metallic materials and finishes shall be tested for outgassing in accordance with ESA PSS – 01 – 702.

7.5.3 Equipment

- Iso-Propyl Alcohol and brush.
- Can opening tool appropriate to the relay being opened.
- Laminar flow bench cleanliness class < 10 000.
- Binocular magnifying glass with annular light and magnification 10X to 40X.
- Finger cots, fine scalpel.
- Clean compartmented box.

7.5.4 Procedure

The relay and the opening tool shall be inspected for cleanliness under a magnification of 10X to 20X. If necessary, brush the relay and the tooling clean with alcohol.

The relay shall be inspected externally in accordance with ESA/SCC Basic Specification No. 20500.

The relay shall be opened with extreme caution using an appropriate tooling.

Particles from the opening operation shall be removed from the outside of the relay.

Prior to the opening with a fine scalpel, it is recommended to wrap the opening area with adhesive tape to prevent introduction of opening debris into the can.

The relay shall be brought under the laminar flow bench.

Using finger cots, the relay shall be held with the terminals pointing upwards and the can shall be separated from the relay.

The can shall be inspected internally for any particle or contamination under a 40X magnification.

The relay shall be inspected for any particle under a 40X magnification.

Particles due to the opening operation are easily identifiable (shape and magnetism).

Then the relay, held by its terminals, shall be inspected in accordance with ESA/SCC Basic Specification No. 20400.

Degradation due to previous tests of the sequence shall be observed during this inspection and commented : mechanical degradation for Subgroups 2A and 2B, contact degradation for subgroups 3C and 3D.

The coil(s) shall be removed and the finishing tape unwound in order to expose the coil wire to lead wire connection. The solder shall be smooth and bright. At least 3 turns of coil wire around the lead shall be free from solder to act as a strain relief. There shall be no flux residues.

7.5.5 Report

Each step shall be recorded separately and a summary of the entire process and the results shall be written. Photographs shall be supplied for significant points.

7.6 RESIDUAL GAS ANALYSIS

Residual Gas Analysis shall be performed on 4 relays for each of the applicable subgroups as shown in Chart I.

Results shall be evaluated with respect to nitrogen and moisture content in particular.

8. DATA DOCUMENTATION

8.1 GENERAL REQUIREMENTS

An evaluation test report shall be established. This shall comprise of the following:-

(a) Cover sheet(or sheets).

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

(c) List of test references.

(d) Sample identification.

(e) Production data.

(f) Initial measurements.

(g) Group 1 - Control group data.

(h) Subgroup 2A - Miss test under vibration.

(j) Subgroup 2A - Sinusoidal vibration step stress test.

(k) Subgroup 2B - Mechanical shock step stress test.

(l) Subgroup 2B - Salt spray (Corrosion).

(m) Subgroup 2C - Resistance to soldering heat step stress test.

(n) Subgroup 3A - Resistive load life test.

(o) Subgroup 3B - Intermediate current test.

(p) Subgroup 3B - Terminal strength step stress test.

(q) Subgroup 3C - Low level mechanical life tests.

(r) Subgroup 3C - Inductive load and mechanical life tests.

(s) Subgroup 3D - Inrush current.

(t) Subgroup 3E - Coil life and internal moisture.

(u) Construction analysis.

(v) Summary of results and conclusion.

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

- Manufacturer's/test house's name.
- Lot identification.
- Date of establishment of the document.
- Page number.

8.2 COVER SHEET(S)

The cover sheet (or sheets) of the evaluation test report shall include as a minimum:-

(a) Reference to this document, including issue and date.

(b) Component type and number.

(c) Lot identification.

(d) Manufacturer's/test house's name and address.

(e) Location of the Manufacturer/test house.

(f) Signature on behalf of the Manufacturer/test house.

(g) Total number of pages of the evaluation test report.

8.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be included in the evaluation test report. Where applicable, this list shall contain the inventory number, Manufacturer type number, serial number, etc. This list shall indicate for which tests such equipment was used.

8.4 LIST OF TEST REFERENCES

This list shall include all references or codes which are necessary to correlate the test data provided with the applicable tests.

8.5 SAMPLE IDENTIFICATION (Para. 4.1)

This shall identify the criteria used for the selection of the particular components used for the tests, when evaluating a range of components by means of representative samples.

8.6 PRODUCTION DATA (Para. 4.4)

The progress of the components through the normal manufacturing processes shall be documented. The components failing a particular process step shall be detailed, together with the reason for their removal.

8.7 INSPECTION DATA (Para. 4.5)

The number of components subjected to each test shall be identified together with the number and reason for any rejects.

8.8 INITIAL ELECTRICAL MEASUREMENTS (Para. 6)

All data shall be recorded against serial numbers. A histogram of device parameters shall be produced. Minimum, maximum and average values and the standard deviation shall also be produced. For latching relays, the difference between latch and reset voltages shall be provided.

8.9 GROUP 1 - CONTROL GROUP DATA (Para. 7.2)

All data shall be recorded against serial numbers.

8.10 GROUP 2 ENVIRONMENTAL TESTS

8.10.1 Subgroup 2A - Miss Test Under Vibration Data (Para. 7.3.2)

All data shall be recorded against serial numbers. This shall include:-

(a) Number of contact misses.

(b) Contact voltage wave irregularities, if any.

(c) Seal test results.

(d) Electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times.

8.10.2 Subgroup 2A - Sinusoidal Vibration Step Stress Test Data (Para. 7.3.3)

All data shall be recorded against serial numbers. This shall include:-

(a) Any contact opening or closing of open contacts.

(b) After each axis and each step, deltas for Pick-up and Drop-out (Latch and Reset) voltages.

(c) Seal test results.

(d) Results of external visual inspection.

(e) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times.

8.10.3 Subgroup 2B - Mechanical Shock Step Stress Test (Para. 7.3.4)

All data shall be recorded against serial numbers. This shall include:-

(a) Any contact opening or closing of open contacts.

(b) After each axis and each step, deltas for Pick-up and Drop-out (Latch and Reset) voltages.

(c) Seal test results.

(d) Results of external visual inspection.

(e) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times.

8.10.4 Subgroup 2B - Salt Spray (Corrosion) (Para. 7.3.5)

All data shall be recorded against serial numbers.

The results of the examination after test shall be clearly documented.

8.10.5 Subgroup 2C - Resistance to Soldering Heat Step Stress Test (Para. 7.3.6)

All data shall be recorded against serial numbers. This shall include:-

(a) After each step, electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and coil resistance.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and coil resistance.

8.11 GROUP 3 - ENDURANCE TESTS

8.11.1 Subgroup 3A - Resistive Load Life Test (Para. 7.4.2)

All data shall be recorded against serial numbers. This shall include:-

(a) Dynamic contact resistance and operating voltages measurements with deltas after each 10 000 operations.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times, Contact resistance and coil resistance.

8.11.2 Subgroup 3B - Intermediate Current Test (Para. 7.4.3)

All data shall be recorded against serial numbers. This shall include:-

(a) Dynamic contact resistance and operating voltages measurements with deltas after each 10 000 operations.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times, Contact resistance and coil resistance.

8.11.3 Subgroup 3B - Terminal Strength Step Stress Test (Para. 7.4.4)

All data shall be recorded against serial numbers. This shall include:-

(a) After each step, electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and contact resistance.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and contact resistance.

8.11.4 Subgroup 3C - Low level Mechanical Life Tests (Para. 7.4.5)

All data shall be recorded against serial numbers. This shall include:-

(a) Number of misses during the first 200 000 operations.

(b) Intermediate electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and contact resistance.

(c) Seal test results.

(d) Results of external visual inspection.

(e) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and contact resistance.

8.11.5 Subgroup 3C - Inductive Load and Mechanical Life Tests (Para. 7.4.6)

All data shall be recorded against serial numbers. This shall include:-

(a) Dynamic contact resistance and operating voltages measurements with deltas, insulation resistance and voltage proof after each 10 000 operations.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times and contact resistance.

8.11.6 Subgroup 3D - Inrush Current (Para. 7.4.7)

All data shall be recorded against serial numbers. This shall include:-

(a) Static contact resistance and insulation resistance measurements with deltas and voltage proof after each 10 000 operations.

(b) Seal test results.

(c) Results of external visual inspection.

(d) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operate and Release (Latch and Reset) times, contact resistance and insulation resistance.

8.11.7 Subgroup 3E - Coil Life and Internal Moisture (Para. 7.4.8)

All data shall be recorded against serial numbers. This shall include:-

(a) After the first 100 hours, results of contact resistance, operate and release times at low temperature.

(b) At 250, 500 and 750 hours, results of coil resistance and contact resistance at room temperature with deltas.

(c) Pick-up and Drop-out (Latch and Reset) voltages during the last cycle at high temperature with coil de-energised and temperature stabilisation.

(d) Contact resistance at low temperature (first measurement).

(c) Pick-up and Drop-out (Latch and Reset) voltages during the last cycle at high and last cycle at low temperature with coil de-energised and temperature stabilisation.

(d) Seal test results.

(e) Results of external visual inspection.

(f) Final electrical measurements results (Table 2 of the Detail Specification) with deltas for Pick-up and Drop-out (Latch and Reset) voltages, Operating times, contact resistance and coil resistance.

8.12 CONSTRUCTION ANALYSIS (Para. 7.5)

All data shall be recorded against serial numbers. This shall include:-

(a) Deviations against the applicable specifications.

(b) Photographs of points of interest.

(c) Comments on the effects of the previous test(s).

8.13 RESIDUAL GAS ANALYSIS (Para. 7.6)

All data shall be recorded against serial numbers.

8.14 SUMMARY OF RESULTS AND CONCLUSIONS

The above shall be briefly reviewed, indicating the success or otherwise of the evaluation test programme. Any production screens that need to be introduced in the P.I.D. shall be outlined.

Recommendations/deviations pertaining to the Detail Specifications or the qualification programme shall also be outlined.

CHART I - EVALUATION TEST PROGRAMME

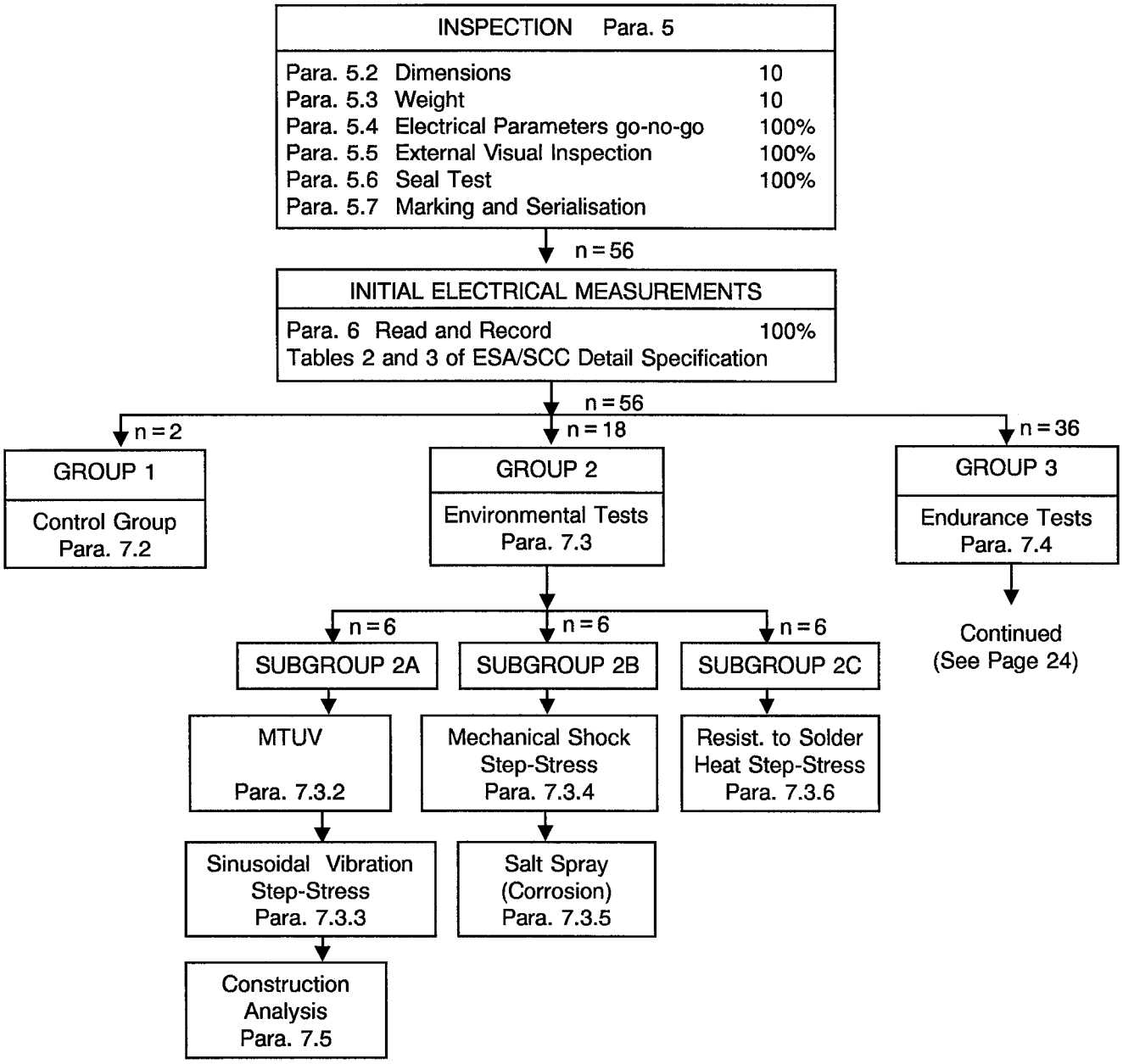

CHART I - EVALUATION TEST PROGRAMME (CONTINUED)