EVALUATION TEST PROGRAMME FOR CRYSTAL CONTROLLED OSCILLATORS IN HYBRID TECHNOLOGY

ESCC Basic Specification No. 2263503

Issue 1	November 2015

Document Custodian: European Space Agency – see https://escies.org

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DCR No.	CHANGE DESCRIPTION

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1 INTRODUCTION

1.1 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 destructive physical 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. The evaluation shall also include a check of the susceptibility of the component to ESD damage.

1.2 SCOPE

This specification covers Crystal Controlled Oscillators using microelectronic (hybrid) technology (Class 2) as detailed in ESCC Generic Specification No. 3503.

2 APPLICABLE DOCUMENTS

2.1 GENERAL

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

2.1.1 ESCC SPECIFICATIONS

Unless otherwise stated herein, reference within the text of this specification to ''the Basic, Generic or Detail Specification'' shall mean the relevant ESCC Basic, Generic or Detail Specification.

- No. 3503: Generic Specification for Crystal Controlled Oscillators.
- No. 20400: Internal Visual Inspection.
- No. 20500: External Visual Inspection.
- No. 20900: Radiographic Inspection.
- No. 22700: Requirements and guidelines for the Process Identification Document (PID)
- No. 22900: Total Dose Stead-State Irradiation test method
- No. 23800: Electrostatic Discharge sensitivity Test method
- No. 24800: Resistance to Solvents of Marking, Materials and Finishes

2.1.2 OTHER (REFERENCE) DOCUMENTS

- ECSS-Q-ST-70-02: Thermal vacuum outgassing test for the screening of space materials
- IEC Publication No. 60068: Basic Environmental Testing Procedures.
- MIL-STD-1580: Destructive Physical Analysis for Electronic, Electromagnetic, and Electromechanical Parts.
- MIL-STD-883: Test Methods for Standard Microcircuits.
- MIL-STD-202: Test Methods for Standard Electronic and Electrical Component parts.

3 PROCEDURE

Standard components shall be selected from a homogenous lot at the Manufacturer(s) to be evaluated. These components shall not have been submitted to any screening or burn-in, but must have been manufactured in conformity with high reliability practice and an established Process Identification Document (PID), or an identifiable process which shall form the basis for a PID, in sufficient quantities to permit a random sample to be chosen for the evaluation test programme from a quantity of x2 to x5 of that required.

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 ESCC Executive, by the Manufacturer or at a test laboratory approved by the ESCC Executive.

4 TEST PROGRAMME SEQUENCE AND SAMPLE DISTRIBUTION

4.1 SELECTION OF COMPONENTS FOR EVALUATION TESTING

The number of components to be selected 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 92 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 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 samples shall be as specified by, or as agreed with, the ESCC Executive.

The above mentioned quantity shall be submitted to the full evaluation procedure whenever a new technology has been applied to the components concerned, such that 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 ESCC format and submit it to the ESCC Executive for provisional approval. This shall then serve as a basis for the ordering and testing of the relevant components.

4.3 INSPECTION RIGHTS

The ESCC Executive reserves the right to inspect at any time the components processed for evaluation purposes. The Manufacturer shall notify the ESCC Executive at least 3 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 numbers in/out and failure cause for each fabrication stage shall be submitted to the ESCC Executive.

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 ESCC requirements may invalidate the evaluation.

For each measurement or inspection performed, the results shall be summarized in terms of quantity tested, quantity passed and quantity rejected. If devices are rejected, the reason shall be clearly identified.

5.2 DIMENSIONS (100%)

All devices shall be inspected in accordance with Physical Dimensions of the Detail Specification and the results recorded together with any non-conformances. For packages with a high pin count, the measurements may be performed using a sampling scheme which shall be approved by the ESCC Executive. Rejected components shall be replaced.

5.3 WEIGHT (100%)

All devices shall be weighted. 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 Room Temperature Electrical Measurements of the Detail Specification at an ambient temperature of +22 ±3°C (go-no-go). Rejected components shall be replaced.

5.5 EXTERNAL VISUAL INSPECTION (100%)

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

5.6 PARTICAL IMPACT NOISE DETECTION (PIND) (100%)

All devices shall be tested in accordance with the requirements of MIL-STD-883 Test Method 2020 Condition B for class 2 oscillators. Rejected components shall be replaced.

5.7 RADIOGRAPHIC INSPECTION (100%)

Unless otherwise stated in the Generic and/or Detail Specification, all devices shall be inspected in accordance with Basic Specification No. 20900. Additional axes to those specified in the ancillary specifications of Basic Specification No. 20900 may be radiographed if, by so doing, it is possible to observe any faults. Rejected components shall be replaced.

5.8 HERMETICITY (100%)

Unless otherwise stated in the Generic and/or Detail Specifications, fine and gross leak tests shall be performed on all components in accordance with the requirements of the appropriate paragraph in the relevant Generic Specification. Rejected components shall be replaced.

5.9 MARKING AND SERIALISATION (100%)

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

5.10 MATERIALS AND FINISHES

All non-metallic materials and finishes that are not within a hermetically sealed enclosure, of the components specified herein shall be tested in accordance with ECSS-Q-ST-70-02 to verify compliance to outgassing requirements, unless relevant data is available.

Pure tin is forbidden. It shall contain at least 3% of lead (Pb)

5.11 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 Para. 5.2 to Para. 5.10 inclusive.

6 INITIAL ELECTRICAL MEASUREMENTS (100% READ AND RECORD)

These measurements shall be made in accordance with Room Temperature Electrical Measurements in the Detail Specification. In addition, frequency stability over the operating temperature range shall be measured. All characteristics shall be recorded against serial numbers.

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 4 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. The Subgroup 2A tests shall be completed and the results analysed before the Group 3 tests are commenced.

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

7.2 GROUP 1 - CONTROL GROUP

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

7.3 GROUP 2 - DESTRUCTIVE TESTS

7.3.1 General

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

7.3.2 Subgroup 2A – Temperature Step-Stress Tests

7.3.2.1 General

The step-stress sequence shall be terminated when 50% (rounded up) of the specimens have been destroyed, unless practical reasons prevent this.

The tests in this subgroup shall be performed as specified in Chart IIA. Electrical measurements shall be made as defined in Para. 7.3.2.2. The starting temperature (which will be not higher than the maximum operating temperature as defined in the Detail Specification) and the temperature steps (with a maximum step of 25°C) to be employed will be decided by the ESCC Executive.

7.3.2.2 Parameters to be measured during Step-Stress Tests

During Step-Stress Tests, electrical measurements at room temperature shall be made in accordance with the requirements of the Details Specification. In addition frequency stability over the operating temperature range shall be measured.

At the termination of the step-stress sequence, any surviving devices shall have been measured.

7.3.2.3 Failure Analysis

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 shall be monitored to observe degradation trends.

7.3.2.4 Analysis of Subgroup 2A

The analysis of Subgroup 2A shall be presented to the ESCC Executive in a graphical form, supported by the actual results, as follows:

- The number of functional failures shall be plotted against each temperature applied; the cumulative failure rate shall also be plotted.
- The parameters (as defined in Para. 7.3.2.2 above) shall be monitored, recorded and plotted against time for each temperature.
- The average drift of the parameters at each temperature shall be plotted against temperature.

The analysis of the results of Subgroup 2A shall be used to determine the most effective temperature for the accelerated electrical endurance test (Group 3)

7.3.3 Subgroup 2B – Voltage Step-Stress Tests

7.3.3.1 General

The step-stress sequence shall be terminated when 50% (rounded up) of the specimens have been destroyed, unless practical reasons prevent this.

The tests in this Subgroup shall be performed as specified in Chart IIB. Electrical measurements shall be made as defined in Para. 7.3.2.2. The starting voltage (which will be no lower than the maximum operating voltage as defined in Maximum Ratings of the Detail Specification) and the voltage steps to be employed will be decided by the ESCC Executive.

7.3.3.2 Parameters to be measured during Step-Stress Tests

During step-stress Tests, electrical measurements at room temperature shall be made in accordance with the requirements of the Detail Specification. In addition frequency stability over the operating temperature range shall be measured.

At the termination of the step-stress sequence, any surviving devices shall have been measured.

7.3.3.3 Failure Analysis

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 shall be monitored to observe degradation trends.

7.3.3.4 Analysis of Subgroup 2B

The analysis of Subgroup 2B shall be presented to the ESCC Executive in a graphical form, supported by the actual results, as follows:

- The number of functional failures shall be plotted against each voltage applied; the cumulative failure rate shall also be plotted.
- The parameters (as defined in Para. 7.3.2.2 above) shall be monitored, recorded and plotted against time for each voltage.
- The average drift of the parameters at each voltage shall be plotted against voltage.

7.3.4 Subgroup 2C – Radiation Test

7.3.4.1 Total Dose Steady-State radiation test

The test shall be performed in accordance with ESCC Basic Specification No. 22900.

Test conditions, especially Dose rate and limit of the test, shall be decided/approved by the ESCC Executive.

7.3.5 Subgroup 2D – Construction Analysis

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. Each step shall be recorded separately, and a summary of the entire process and the results thereof shall be made.

Quantity to be submitted to this analysis is given in Chart I.

The analysis shall be conducted in accordance with MIL-STD-1580 requirement 16.

Removal of the crystal could be required for a thorough inspection of the package interior.

The sequence detailed below shall be followed.

7.3.5.1 External Visual Inspection

External visual examination shall be conducted on all samples to determine conformance with MIL-STD-883 Test Method 2009, and the applicable device specification.

7.3.5.2 Radiographic Inspection

Radiographic inspection shall be performed in accordance with MIL-STD-883 Test Method 2012. It shall be required before de-lidding to examine cavity devices for loose particles, die attach, improper interconnecting wires and to determine internal clearances. It is also useful as an aid in locating de-lidding and sectioning cuts and to non-destructively investigate suspected defects.

7.3.5.3 Particle Impact Noise Detection (PIND)

Devices shall be tested in accordance with the requirements of MIL-STD-883 Test Method 2020 Condition B

7.3.5.4 Seal

Fine and gross leaks tests shall be performed on all analysed samples in accordance with MIL-STD-883 Test Method 1014 or IEC 60068-2-17 Test Qc and Qk.

Both fine and gross leak rates shall be recorded and compared with results obtained during inspection tests per Para. 5.8.

7.3.5.5 Internal Water Vapour Content

Testing shall be performed in accordance with MIL-STD-883 Test Method 1018 Procedure 1

7.3.5.6 Opening

Devices shall be opened using a technique which does not contaminate the internal structure/cavity or in any way impair the ability to observe defects.

7.3.5.7 Internal Visual Inspection

Each device shall be visually inspected in accordance with ESCC Basic Specification No. 2043503. Should this specification not be available, the inspection shall be in accordance with ESCC Basic Specification No. 20400, and ancillary specifications 2049000 for the hybrid part and 2043501 for the quartz crystal and its assembly.

The crystal and its assembly shall be inspected first when removal of the crystal is required for a thorough inspection of the rest of the package interior.

Photographs shall be taken as follows:

- Overall photograph(s) of the opened devices.
- Photograph(s) focused on the Crystal.
- Photograph(s) of the substrate assembly. If there are several dice mounted, one picture of each shall be taken at least.
- Photographs of any anomalies found.

7.3.5.8 Bond pull testing

This testing shall be performed on the quantity of sample defined below in accordance with MIL-STD-883 Test Method 2011 condition D:

- Quantity of internal bond wires 8 or less; Test samples = 3, Test all bonds
- Quantity of internal bond wires 9 to 24; Test samples = 2, Test all bonds
- Quantity of internal bond wires 25 or more; Test samples = 2, Test 50% of bonds

Individual separation forces and categories shall be recorded for further statistical analysis.

In the event an anomalous condition is noted during bond pull testing, SEM shall be utilized to examine the failed interface(s) and appropriate images recorded.

7.3.5.9 Scanning Electron Microscope (SEM) Inspection

The inspection shall include, but shall not necessarily be limited to, examination of the following:

- Detailed examination of the anomalies identified by the internal visual inspection. Photographs shall be taken.
- Low magnification (up to x500) shall be used to assess: (Photographs to be taken)
  - Clearance of bond wires at the die edge
  - Quality of bonding at the dice
  - Quality of bonding at the post
  - Quality of Crystal to holders bonding
- High magnification (x1000 or higher) shall be used to assess: (Photographs to be taken)
  - Metallisation coverage and consistency at steps
  - Metallisation coverage at contact windows, bonding pads, etc.

In case of devices with glassivated surfaces, the examination shall first be attempted through the glassivation. If the resolution is inadequate, the glassivation shall be removed. This step must be postponed until the bond pull test has been performed.

7.3.5.10 Die shear

The test shall be performed in according with MIL-STD-883 Test Method 2019 to evaluate the integrity of materials and procedure used for Die-to-Substrate, Passive chips-to-Substrate or crystal holders-to-substrate attachment. The same samples submitted to Bond Strength test shall be used.

Individual separation forces and categories shall be recorded.

NOTES: FOR PASSIVE PARTS:

(a) Acceptance criteria shall be that found in MIL-STD-883 Test Method 2019.

(b) The shear force will be applied as stated in Method 2019, in a plane perpendicular to the longest axis of the passive element. The attachment area will be defined by measuring the actual possible area of attachment to a device as practical for its design, for example: a ceramic chip capacitor is typically attached by its end metallization areas. The attachment area would be determined by measuring one of those two end metal areas optically from an incident angle. This value would then be multiplied by two to obtain the attachment area prior to testing. Non-conductive staking material beneath the capacitor body will not be measured as it is commonly used to ensure adequate mechanical support but is not typically required for electrical attachment purposes. If any element has been intentionally attached by its bottom surface area, then that area will be considered the attachment area for the purposes of this evaluation.

(c) The elements will be sheared to separation as practical from the substrate in order to provide more quantitative results useful in further evaluations and assessments of the device.

(d) Care shall be taken to ensure that all previously noted anomalous conditions have been resolved prior to shear testing and destruction of the evidence.

7.3.5.11 Substrate attach Strength

The test shall be performed in accordance with MIL-STD-883 Test Method 2027 to evaluate the integrity of materials and procedure used for Substrate-to-case attachment on the same samples submitted to Bond Strength and Die Shear test.

Individual separation forces and categories shall be recorded.

7.3.6 Subgroup 2E - Environmental Tests

7.3.6.1 General

The devices in this Subgroup shall be randomly divided as detailed in Chart III.

7.3.6.2 Thermal Tests

The following tests shall be run on electrically good devices.

(a) Temperature cycling
All devices shall be subjected to this test in accordance with MIL-STD-883 Test Method 1010 Condition B with the following change: 250 cycles -55°C / +125°C instead of 10 cycles.

(b) Seal Tests
All devices shall be subjected to the tests in accordance with:
- Fine leaks: MIL-STD-883, Test Method 1014, Test Condition A2
- Gross leaks: MIL-STD-883, Test Method 1014, Test Condition C

(c) Electrical Measurements
The tests shall be made at room temperature in accordance with the requirements of the Detail Specification.

(d) Thermal Shocks
All devices shall be subjected to this test in accordance with MIL-STD-883 Test Method 1011 Condition B with the following change: 250 cycles -55°C / +125°C instead of 10 cycles.

(e) Seal Tests
All devices shall be subjected to the test in accordance with:
- Fine leaks: MIL-STD-883, Test Method 1014, Test Condition A2
- Gross leaks: MIL-STD-883, Test Method 1014, Test Condition C

(f) Electrical Measurements
The tests shall be made at room temperature in accordance with the requirements of the Detail Specification.

(g) DPA
DPA shall be performed on one sample successfully submitted to thermal tests in accordance with MIL-STD-1580 requirement 16.

7.3.6.3 Mechanical Tests

The following tests shall be run on electrically good devices

(a) Mechanical shocks
All devices shall be subjected to Mechanical Shock in according with MIL-STD-883 Test Method 2002. The test conditions shall be decided/approved by the ESCC Executive.

(b) Seal Tests
All devices shall be subjected to the tests in accordance with:
- Fine leaks: MIL-STD-883, Test Method 1014, Test Condition A2
- Gross leaks: MIL-STD-883, Test Method 1014, Test Condition C

(c) Electrical Measurements
The tests shall be made at room temperature in accordance with to the requirements of the Detail Specification.

(d) Vibration
All devices shall be subjected to Sine and Random Vibration in sequence in accordance with:
- Sine Vibration: MIL-STD-202 Test Method 204. The test conditions shall be decided/approved by the ESCC Executive.
- Random Vibration: MIL-STD-202 Test Method 214. The test conditions shall be decided/approved by the ESCC Executive.

(e) Seal Tests
All devices shall be subjected to the test in accordance with:
- Fine leaks: MIL-STD-883, Test Method 1014, Test Condition A2
- Gross leaks: MIL-STD-883, Test Method 1014, Test Condition C

(f) Electrical Measurements
The tests shall be made at room temperature in accordance with the requirements of the Detail Specification.

(g) Constant Acceleration
All devices shall be subjected to Constant Acceleration in accordance with MIL-STD-202 Test Method 212. The test conditions shall be decided/approved by the ESCC Executive.

(h) Seal Tests
All devices shall be subjected to the tests in accordance with:
- Fine leaks: MIL-STD-883, Test Method 1014, Test Condition A2
- Gross leaks: MIL-STD-883, Test Method 1014, Test Condition C

(i) Electrical Measurements
The tests shall be made at room temperature in accordance with the requirements of the Detail Specification.

(j) DPA
DPA shall be performed on one sample successfully submitted to mechanical tests, in accordance with MIL-STD-1580 requirement 16.

7.3.6.4 Solderability

Devices can be selected within the electrical rejects of previous tests per Para. 7.3.6.2 or Para. 7.3.6.3.

They shall be subjected to the test in according with MIL-STD-883 Test Method 2003, to be performed on all terminals.

For components with gold plated lead finish, the test shall be performed in 2 steps: de-golding followed by a pre-tinning. Activated fluxes (RMA only) may be used but shall be immediately cleaned off after dipping using an acceptable solvent.

Upon conclusion of the test, seal tests and a visual inspection shall be performed in accordance with Para. 7.3.6.3(e) and ESCC Basic Specification No. 20500 respectively.

7.3.6.5 Permanence of marking

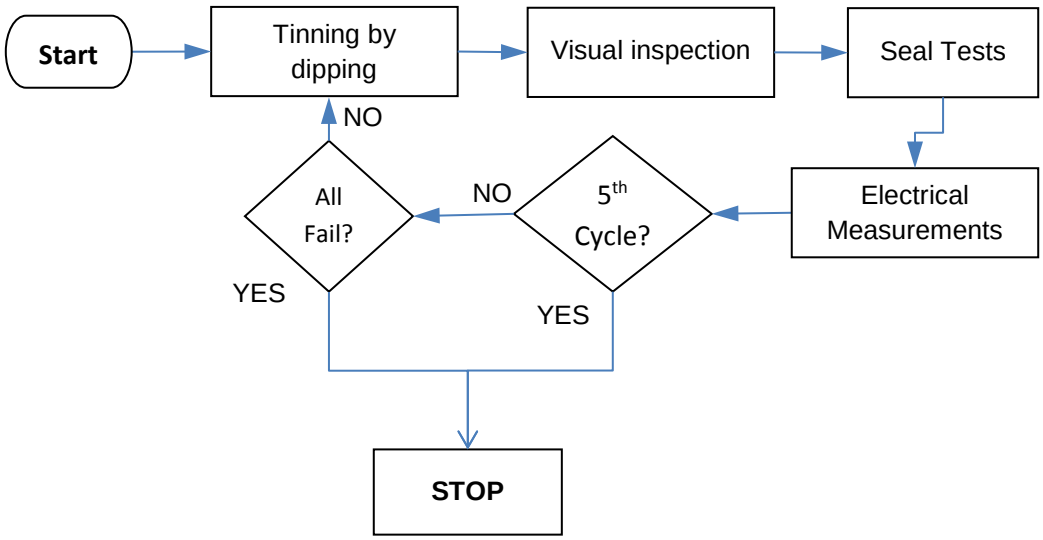
Not applicable when marking is made by engraving.

Otherwise, the all samples from the solderability test shall be submitted to the test in accordance with ESCC Basic Specification No. 24800.

7.3.6.6 Resistance to Soldering Heat

The following test shall be run on electrically good devices selected from the electrically good devices remaining from previous tests per Para. 7.3.6.2 or Para. 7.3.6.3. They shall be subjected to the test in accordance with IEC 60068-2-20 Test Ta Method 1.

The test shall be repeated until all devices fail or 5 cycles have been performed whichever is the sooner. Between each cycle, seal and electrical tests shall be performed as per Para. 7.3.6.3(e) and Para. 7.3.6.3(i) respectively.



7.3.6.7 Lead Integrity

Devices can be selected within the electrical rejects of previous tests per Para. 7.3.6.2 or Para. 7.3.6.3.

This test is designed to check the capability of the leads, lead finish, lead welds, and seals (if any) of the devices to withstand stresses to the leads and seals (if applicable) which might reasonably be expected to occur from actual handling and assembly of the devices in application.

Unless the test has been performed at package level in the frame of the procurement, devices shall be submitted to the test "bending stress" in accordance with MIL-STD-883 Test Method 2004 Condition B1 on 15 pins of 3 samples.

Upon conclusion of the test, seal tests and a visual inspection shall be performed in accordance with Para. 7.3.6.3(e) and ESCC Basic Specification No. 20500 respectively.

7.4 GROUP 3 – ACCELERATED LIFE TESTS

7.4.1 General

This Group shall be randomly divided into 3 Subgroups in the proportions indicated in Chart I.

7.4.2 Accelerated Electrical Endurance Test

The applicable tests shall not be performed until the Subgroup 2A tests have not been completed, test results analysed and 3 test conditions selected. The test in this Subgroup shall be performed as specified in Chart IV.

The temperature T_1 shall be chosen such that within approximately 1000 hours the parameters defined in Para. 7.3.2.2 above can be expected to have drifted to an extreme of the permitted range. T_2 and T_3 shall be similarly chosen, but the drift durations are then 700 and 400 hours respectively.

If a power step-stress is not applicable, the devices shall operate at their nominal power dissipation. Intermediate electrical measurements shall be performed in accordance with Para. 7.3.2.2 above at the following times:

T_1 °C (1000hrs)	T_2 °C (700hrs)	T_3 °C (400hrs)
200 ±24hrs 400 ±24hrs 700 ±24hrs 1000 (+24 -0)hrs	200 ±24hrs 400 ±24hrs 700 (+24 -0)hrs -	200 ±24hrs 400 (+24 -0)hrs - -

Failed devices shall be removed for analysis as specified in Para. 7.1.

7.5 GROUP 4 – ESD TESTING

ESD testing shall be performed in accordance with Basic Specification No. 23800. If the device under examination is not categorised into 1 of the 3 classes listed, then it shall be termed "Unclassified". With the agreement of the ESCC Executive, the test structure may be used as an alternative.

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) Inspection data.
(g) Initial electrical measurements.
(h) Group 1 - Control Group Data.
(i) Subgroup 2A - Temperature Step-stress Tests Data.
(j) Subgroup 2B - Voltage Step-stress Tests Data.
(k) Subgroup 2C - Radiation Test data
(l) Subgroup 2D - Construction Analysis Data.
(m) Subgroup 2E - Environmental Tests Data
(n) Group 3 - Accelerated Life Test Data.
(o) Group 4 - ESD Testing Data.
(p) Summary of results and conclusions.

Items (a) to (p) inclusive shall be grouped, preferably as sub-packages, 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 configuration, type and number.
(c) Lot identification.
(d) Manufacturer's/test house's name and address.
(e) Location of the manufacturing plant/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, calibration status, 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 shall be detailed, together with the reason for their removal.

8.7 INSPECTION DATA (PARA. 5)

The number of components subjected to each test shall be identified together with the number and reason for any rejects. Radiographs (where applicable) of any failed components shall be presented.

8.8 INITIAL ELECTRICAL MEASUREMENTS (PARA. 6)

All data shall be recorded against serial numbers. A histogram of device parameters shall be produced.

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

All data shall be recorded against serial numbers.

8.10 SUBGROUP 2A - TEMPERATURE STEP-STRESS TESTS DATA (PARA. 7.3.2)

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

(a) Starting temperature.
(b) Temperature steps.
(c) Electrical measurements tabulated for each step.
(d) Graphical output as defined in Para. 7.3.2.4
(e) Analysis of any failed components as defined in Para. 7.3.2.3.

8.11 SUBGROUP 2B - VOLTAGE STEP-STRESS TESTS DATA (PARA. 7.3.3)

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

(a) Starting voltage.
(b) Voltage steps.
(c) Electrical measurements tabulated for each step.
(d) Graphical output as defined in Para. 7.3.3.4
(e) Analysis of any failed components as defined in Para. 7.3.3.3.

8.12 SUBGROUP 2C – RADIATION DATA (PARA. 7.3.4)

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

(a) Test conditions.
(b) Radiation steps used.
(c) Electrical measurements tabulated for each step/test conditions.

8.13 SUBGROUP 2D - CONSTRUCTION ANALYSIS DATA (PARA. 7.3.5)

All data shall be recorded against serial number. This shall include:

(a) Photographs.
(b) Sequence and inspections performed
(c) Description of the observation.
(d) Non-conformances and weak points identified

8.14 SUBGROUP 2E - ENVIRONMENTAL TESTS DATA (PARA. 7.3.6)

All data, as applicable, shall be recorded against serial numbers. This shall include:

(a) Temperature cycling test results.
(b) Thermal shocks test results.
(c) Mechanical shocks test results
(d) Vibration test results
(e) Constant Acceleration test results.
(f) All seal test results
(g) Resistance to soldering Heat test results
(h) Lead integrity test results
(i) Permanence of marking test results.
(j) Solderability test results.
(k) DPA results

8.15 GROUP 3 - ACCELERATED LIFE TEST DATA (PARA. 7.4)

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

(a) Temperatures chosen for each group.
(b) Electrical measurements tabulated and plotted for each intermediate time as defined in Para. 7.4.
(c) Drift values referred to the initial electrical measurements (Para. 6).
(d) Analysis of any failed components as defined in Para. 7.4.

8.16 GROUP 4 - ESD TEST DATA (PARA 7.5)

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

(a) ESD classification.
(b) Critical path failure voltage.

8.17 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 into the PID shall be outlined.

9 CHARTS

CHART I: EVALUATION TEST PROGRAMME

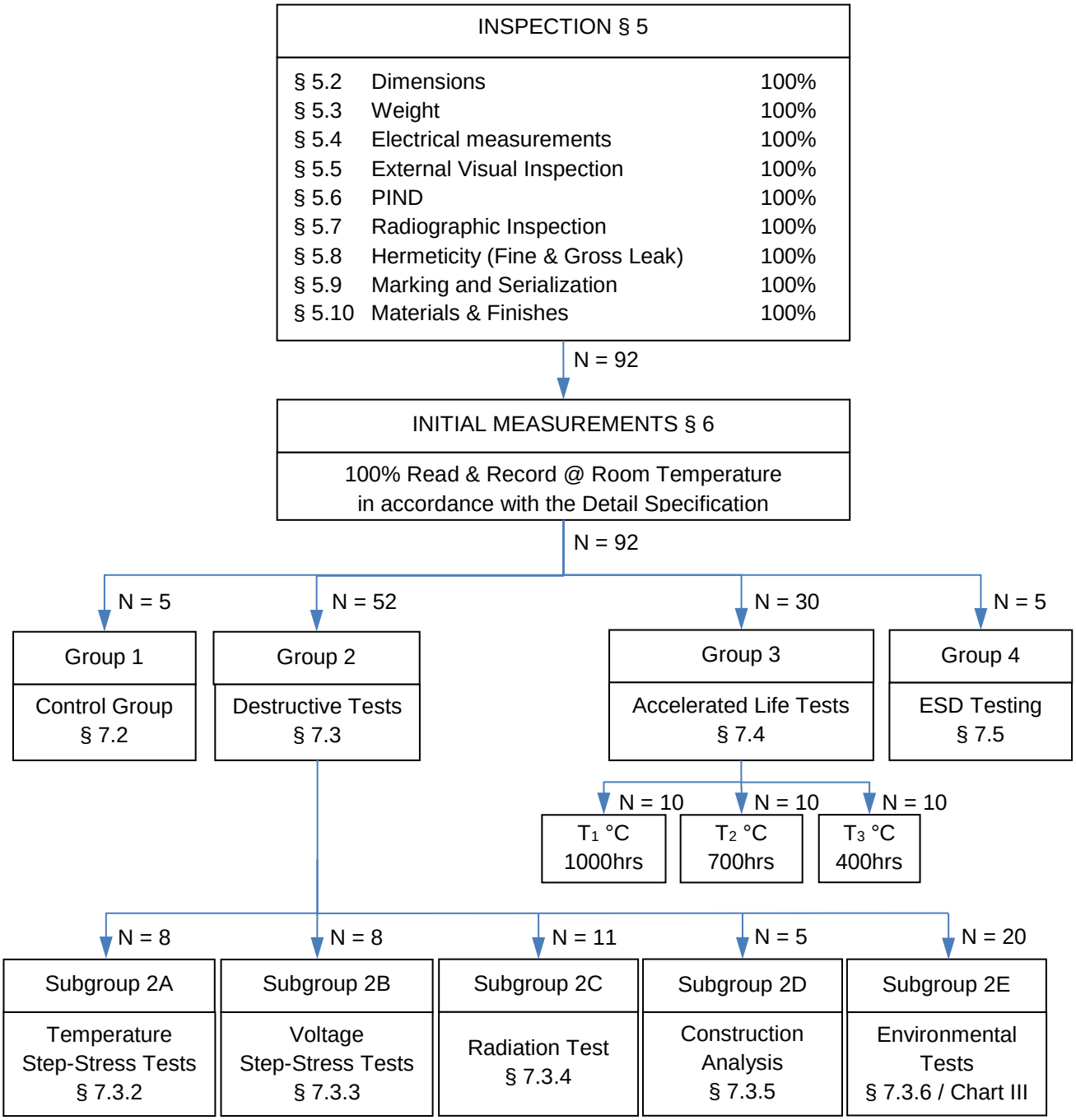
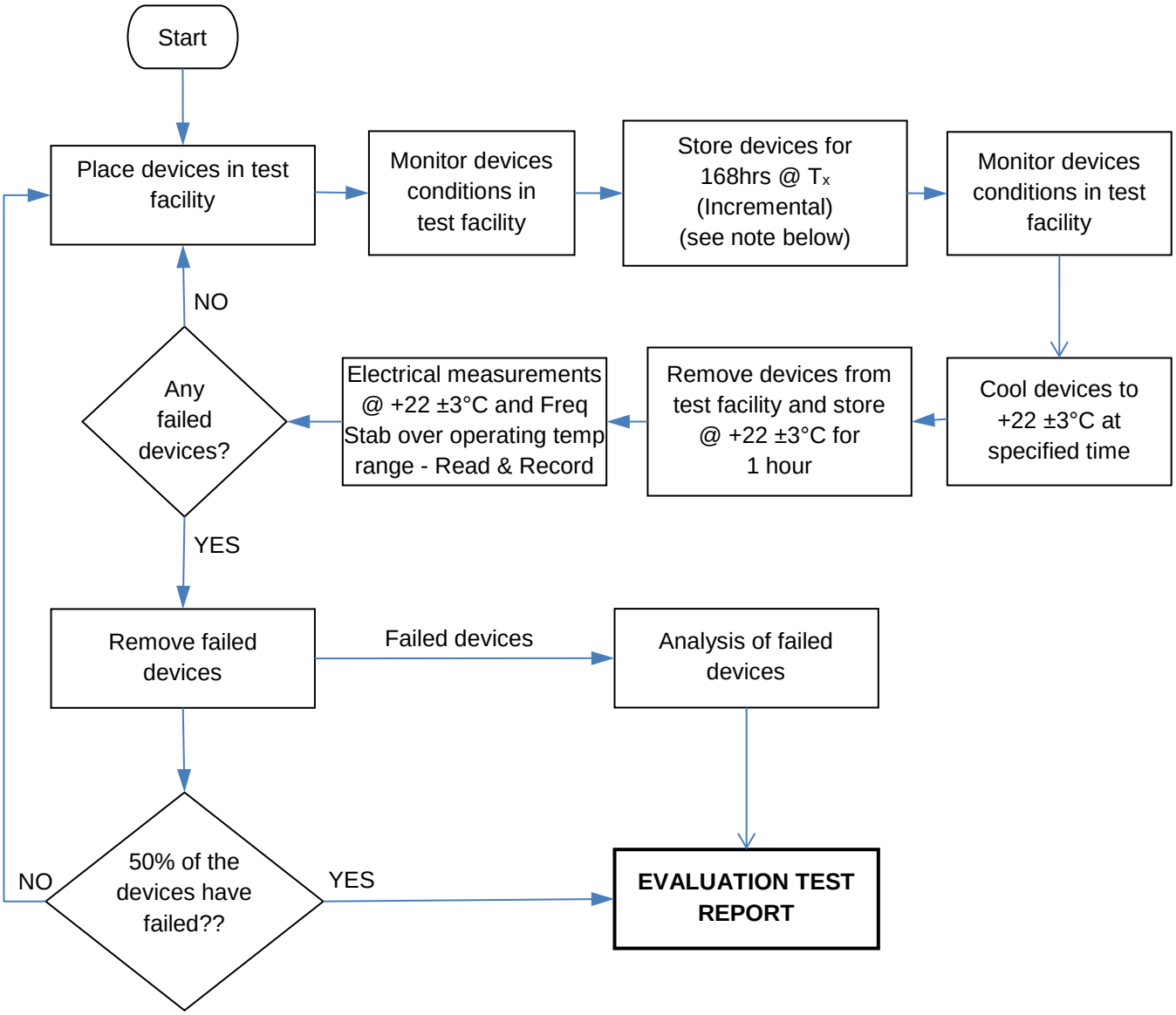


CHART IIA: TEMPERATURE STEP-STRESS SEQUENCE



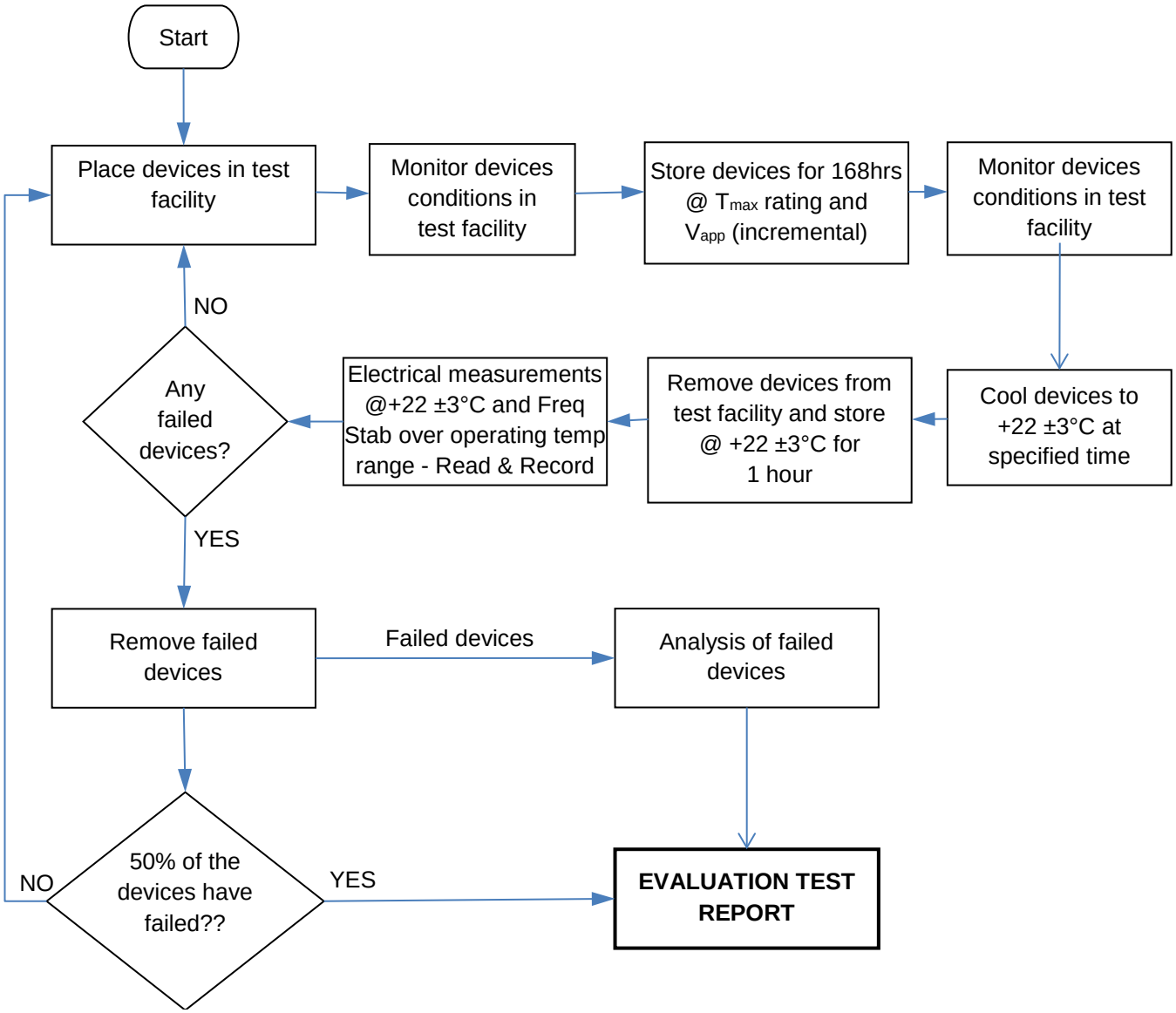
NOTES:

Temperature steps T_x at T_{amb}:

First step:	T_0	°C
	T_1	°C
	T_2	°C
Last step:	T_n	°C

With (T_n >...T_2 > T_1 > T_0)

CHART IIB: VOLTAGE STEP-STRESS SEQUENCE



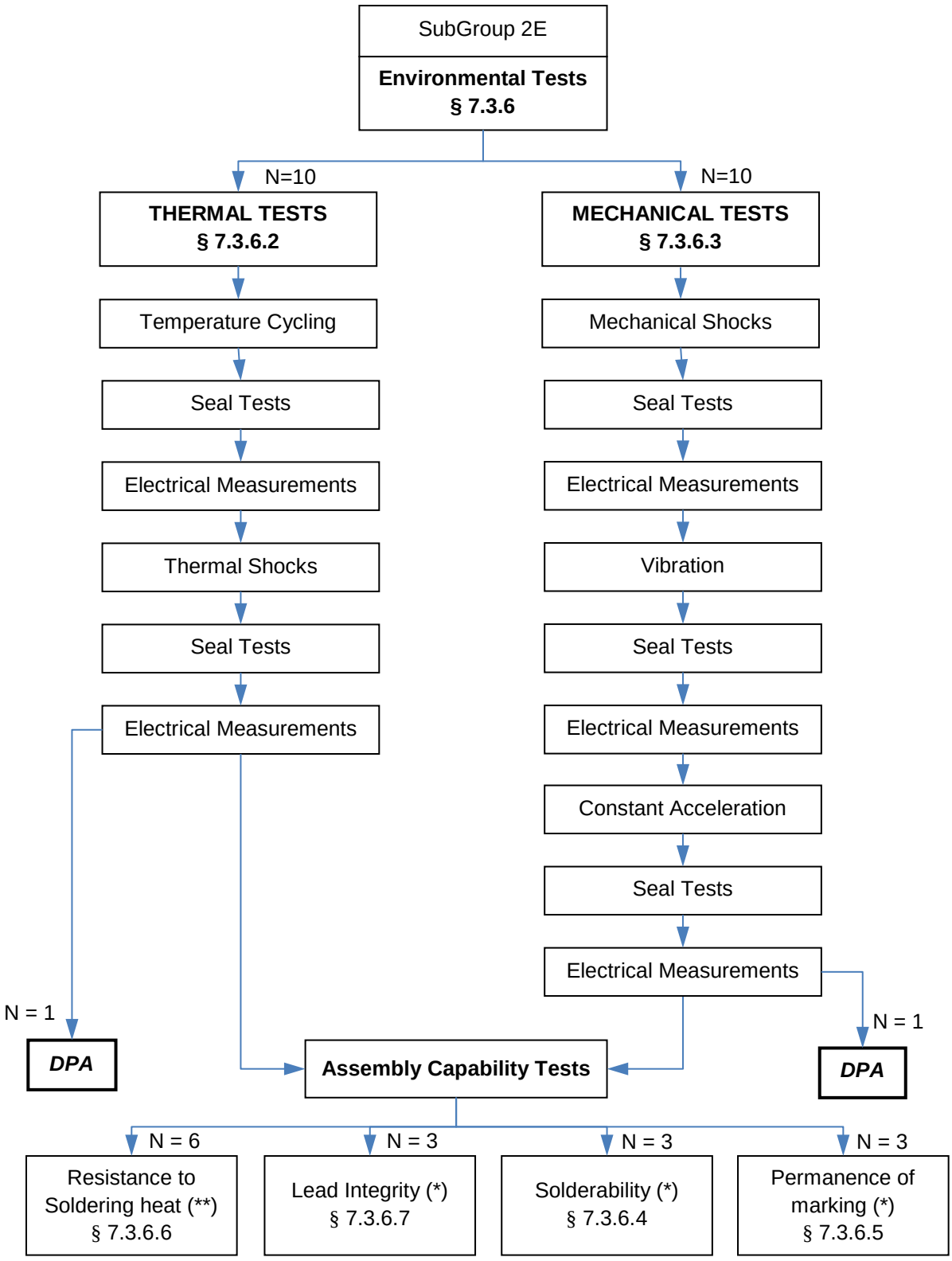
NOTES:

Voltage steps V_{app}:

First step:	V_0	V
	V_1	V
	V_2	V
Last step:	V_n	V

With (V_n >...V_2 > V_1 > V_0)

CHART III: ENVIRONMENTAL TESTS SEQUENCE



Notes: (*) Test can be performed on electrical rejects

(**) Tests shall be performed on electrically good devices

CHART IV: ACCELERATED LIFE TEST