



**VALIDATION AND PROCUREMENT GUIDELINES FOR  
MICRO ELECTRO-MECHANICAL SYSTEMS (MEMS)**

**ESCC Basic Specification No. 23203**

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## 1 INTRODUCTION

### 1.1 PURPOSE

The purpose of this guideline specification is to recommend an approach and pertinent requirements for the validation and procurement of Micro Electro-Mechanical Systems (MEMS) for use in space applications.

This guideline specification contains the appropriate inspection and test schedules and also specifies the data documentation requirements.

### 1.2 SCOPE

This guideline specification is applicable to all MEMS components with the following characteristics (see Para. 3):

- Packaging:
  - Non-Packaged
  - Non-Hermetic Package
  - Hermetic Package
- Mechanical Movement:
  - Non-Moving Structure
  - Moving Structure with No Impact Motion
  - Moving Structure with Impact Motion
- Electrical Principle:
  - Resistive
  - Capacitive
  - Inductive

The particular characteristics of a component shall be classified by the Manufacturer and agreed by the Orderer prior to initiating any inspection or test schedules. The agreed particular characteristics of a component shall be given in the applicable component Detail Specification.

**NOTE:** MEMS components that include add-on components are not considered to be within the scope of this specification.

### 1.3 APPLICABILITY

This specification is applicable to the validation and procurement of unqualified components, recommendations for which are given in ESCC Basic Specification No. [23100](#).

## 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 ESCC SPECIFICATIONS

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

- No. [20600](#), Preservation, Packaging and Despatch of ESCC Components.
- No. [21300](#), Terms, Definitions, Abbreviations, Symbols and Units.
- No. [21700](#), General Requirements for the Marking of ESCC Components.
- No. [22700](#), Requirements and Guidelines for the Process Identification Document (PID).
- No. [23100](#), Recommendations on the use of the ESCC Specification System for the Evaluation and Procurement of Unqualified Components.
- No. [23500](#), Lead Materials and Finishes for Components for Space Application.
- No. [23800](#), Electrostatic Discharge Sensitivity Test Method (subject to the component being confirmed as being ESD sensitive).
- No. [24600](#), Minimum Quality System Requirements.

For procurement, where Manufacturers' specifications are equivalent to or more stringent than the ESCC Basic Specifications listed above, they may be used in place of the latter subject to the approval of the Orderer.

Unless otherwise stated herein, references within the text of this specification to "the Detail Specification" shall mean the applicable component Detail Specification

### 2.2 OTHER (REFERENCE) DOCUMENTS

- ECSS-E-ST-32-02, Structural factors of safety for spaceflight hardware.
- [MIL-STD-883](#), Test Methods and Procedures for Micro-electronics.

### 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) The Detail Specification.
- (b) ESCC Basic Specification: Validation and Procurement Guidelines (this guideline specification).
- (c) Other documents, if referenced herein.



### 3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply. In addition, the following definitions shall apply:

Non-Packaged:	A naked die component, or a die mounted on a substrate/carrier that does not contain any type of encapsulation.
Non-Hermetic Package:	A component encapsulation which by design or construction is unable to pass a seal test.
Hermetic Package:	A component encapsulation which by design and construction is able to pass a seal test.  <b>NOTE:</b> Hermetic Packages are hereby defined to contain a cavity. If a hermetic package has no cavity, it shall be treated as a Non-Hermetic Package.
Mechanical Movement - Non-Moving structure:	A MEMS where the structure is not designed to move and for which movement is not required for the operation of the MEMS device.
Mechanical Movement - Moving structure with no impact motion:	A MEMS that has moving mechanical structures where the motion of these structures do not contact any surface within the entire range of movement.
Mechanical Movement - Moving structure with impact motion:	A MEMS that has moving mechanical structures where the motion of these structures do contact any surface within the entire range of movement.
Electrical Principle:	The applicable sensing or actuating principle of the component: resistive, capacitive or inductive.
Production Lot	A unique, homogeneous lot with respect to die processing and component assembly (if applicable), with a single date and trace code.

## 4 REQUIREMENTS

### 4.1 GENERAL

The test requirements for validation and procurement (see [Chart 1](#)) of a single production lot of a particular MEMS component shall comprise:

(a) For Non-Hermetic Package and Hermetic Package components:

- Production Control
- Screening Tests
- Validation Testing (on Test Sub-lot samples):
  - Phase B: Testing
  - Phase C: Final Inspection

(b) For Non-Packaged components:

- Production Control
- Validation Testing (on Test Sub-lot samples):
  - Phase A: Initial Inspection
  - Phase B: Testing
  - Phase C: Final Inspection

#### 4.1.2 Specifications

For validation and delivery of components in conformity with this specification, the applicable specifications listed in Section 2 of this document shall apply in total, unless otherwise specified herein or in the Detail Specification.

#### 4.1.3 Conditions and Methods of Test

The conditions and methods of test shall be in accordance with this specification and the Detail Specification.

#### 4.1.4 Manufacturer's Responsibility for Performance of Tests and Inspections

The Manufacturer of the components 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 unless it is agreed by the Orderer to use an approved external facility.

#### 4.1.5 Inspection Rights

The Orderer reserves the right to monitor any of the tests and inspections scheduled in the applicable specifications.

#### 4.1.6 Customer Source Inspections

##### 4.1.6.1 *Pre-Encapsulation Customer Source Inspection*

Where feasible and if stipulated in the Purchase Order, the Orderer may perform a source inspection at the Manufacturer's facility prior to encapsulation (e.g. perform an internal visual inspection or an inspection of component piece parts prior to assembly; etc.). Details of the inspections to be performed or witnessed and the required period of notification shall be as stipulated in the Purchase Order.

#### 4.1.6.2 *Final Customer Source Inspection*

Where feasible and if stipulated in the Purchase Order, the Orderer may perform a source inspection at the Manufacturer's facility prior to delivery at an appropriate point during testing that has been agreed with the Manufacturer (e.g. perform an external visual inspection; review of the data documentation package; etc.). Details of the inspections to be performed or witnessed and the required period of notification shall be as stipulated in the Purchase Order.

## 4.2 DELIVERABLE COMPONENTS

Each component, delivered to this Basic Specification, shall be processed and inspected in accordance with the relevant Process Identification Document (PID) and shall:

- be traceable to its production lot.
- have satisfactorily completed all the tests required by the relevant issues of the applicable specifications.
- be produced from lots that are considered by the Manufacturer to be capable of passing all applicable tests, and sequences of tests, that are defined in this specification. 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, demonstrably, it could not have passed these tests at the time of manufacture, this shall be grounds for rejection of the delivered lot.

### 4.2.1 Lot Failure

Lot failure may occur during Validation Testing (Charts [2B](#), [3](#) and [4](#)) (see Para. 7.1.4).

Should such failure occur during procurement of components, the Manufacturer shall notify the Orderer by any appropriate written means within 5 working days, giving details of the number and mode of failure and the suspected cause. No further testing or analysis shall be performed on the failed components until so instructed by the Orderer. The Orderer shall inform the Manufacturer within 5 working days of receipt of notification what action shall be taken.

### 4.2.2 Marking

All components procured and delivered to this specification should be marked in accordance with ESCC Basic Specification No. [21700](#).

For Non-Packaged components, the specified marking shall not be marked on the component but shall accompany the component, in full, in its primary package.

## 4.3 MATERIALS AND FINISHES

Specific requirements for materials and finishes are specified in the Detail Specification. Where a definite material or finish is not specified a material or finish shall be used so as to ensure that the component meets the performance requirements of this specification and the Detail Specification. Acceptance or approval of any constituent material or finish does not guarantee acceptance of the finished product.

All materials and finishes of the components specified in the Detail Specification shall comply with the restrictions on materials specified in ESCC Basic Specification No. [22600](#).

## 5 PRODUCTION CONTROL

Each production lot of components used for delivery shall be subject to tests and inspections in accordance with the Manufacturer's PID or equivalent (ref. ESCC Basic Specification no. [22700](#)). Tests and inspections to be performed on the production lot being procured shall comply with the Manufacturer's standard procedures.

Documentation of production control shall be in accordance with Para. 9.5.

### 5.1 PRODUCTION CONTROL FOR NON-PACKAGED COMPONENTS ONLY

For Non-Packaged components, in addition to the requirements of Para. 5, as a minimum, the following tests and inspections shall be performed on all components intended for delivery:

- (a) 100% External Visual Inspection in accordance with [MIL-STD-883, Test Method 2009, 2010](#), as applicable.
- (b) 100% go-no-go Room Temperature Electrical Measurements as specified in Para. 8.8.3 and in the Detail Specification.

## 6 SCREENING TESTS

Only applicable to Non-Hermetic Package and Hermetic Package components.

### 6.1 GENERAL

Unless otherwise specified herein or in the Detail Specification, all lots of Non-Hermetic Package and Hermetic Package components used for Validation Testing and for delivery, shall be subjected to tests and inspections in accordance with [Chart 2A](#) in the sequence shown.

Any components which do not meet these requirements shall be removed from the lot and at no future time be resubmitted to the requirements of this specification.

The applicable test methods and conditions are specified in the paragraphs referenced in [Chart 2A](#).

### 6.2 FAILURE CRITERIA

#### 6.2.1 Environmental and Mechanical Test Failure

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. External Visual Inspection, Seal.

#### 6.2.2 Parameter Limit Failure

A component shall be counted as a limit failure if one or more parameters exceed the limits shown in Room Temperature Electrical Measurements or High and Low Temperatures Electrical Measurements in the Detail Specification.

#### 6.2.3 Other Failures

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

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

### 6.3 FAILED COMPONENTS

A component shall be considered as a failed component if it exhibits one or more of the failure modes described in Para. 6.2.

### 6.4 DOCUMENTATION

Documentation of Screening Tests shall be in accordance with Para. 9.6.

## 7 VALIDATION TESTING

### 7.1 GENERAL

Unless otherwise specified, each production lot of components used for delivery shall be subject to Validation Testing in accordance with the tests and inspections of Charts 3 and 4 for Non-Hermetic Package and Hermetic Package components, and Charts 2B, 3 and 4 for Non-Packaged components, in the sequences shown, on the specified sample components (see Paras. 7.2, 7.3, 7.4).

The applicable test and inspection requirements are detailed in the paragraphs referenced in the applicable Chart (ref. Para. 8).

All components shall be serialised prior to the tests and inspections.

#### 7.1.1 Test Sub-Lot

For Non-Hermetic Package and Hermetic Package components, unless otherwise specified, a minimum quantity of 41 sample components shall be selected at random from each production lot that has completed Screening Tests (see Chart 2A), to be subjected to Phase B and C Validation Testing.

For Non-Packaged components, unless otherwise specified, a minimum quantity of 41 sample components shall be selected at random from each production lot that has completed Production Control (see Para. 5.1), to be subjected to Phase A, B and C Validation Testing.

Each of these sets of samples constitute the relevant Test Sub-Lot.

For Non-Packaged components, the test Sub-Lot components may be assembled into suitable packages in order to facilitate the testing.

Components of the Test Sub-lot shall not form part of the delivery lot.

#### 7.1.2 Failure Criteria

The following criteria shall apply for all failures during Validation Testing.

##### 7.1.2.1 *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.

#### 7.1.2.2 *Electrical Failures*

The following shall be counted as component failures:

- Components which fail one or more of the applicable limits at each of the relevant data points specified for testing in Room Temperature Electrical Measurements or High and Low Temperatures Electrical Measurements in the Detail Specification.

#### 7.1.2.3 *Other Failures*

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

- Visual failure
- Mechanical failure
- Handling failure
- Lost component

#### 7.1.3 Failed Components

A component shall be considered a failed component if it exhibits one or more of the failure modes detailed in Para. 7.1.2.

When requested by the Orderer, failure analysis of failed components shall be performed under the responsibility of the Manufacturer in order to determine probable failure modes and mechanisms. The results shall be provided to the Orderer for final disposition.

For Non-Hermetic Package and Hermetic Package components, unless otherwise specified, failures during [Chart 3](#) may only be replaced with the specific agreement of the Orderer as part of their final disposition on the failures.

For Non-Packaged components, unless otherwise specified, failures during [Chart 2B](#) (during Dimension Check, or during or subsequent to Burn-in) or [Chart 3](#) may only be replaced with the specific agreement of the Orderer as part of their final disposition on the failures.

Additional sample components may be included in the Test Sub-Lot, at the Manufacturer's discretion, to be used as replacements for failures.

Failed components shall be retained at the Manufacturer's plant until the final disposition has been agreed and certified.

#### 7.1.4 Lot Failure

For Non-Hermetic Package and Hermetic Package components, the lot shall be considered as failed if one component in any test specified for [Chart 3](#) or [Chart 4](#) is a failed component as specified in Para. 7.1.3

For Non-Packaged components, the lot shall be considered as failed if one component in any test specified for [Chart 2B](#) (during Dimension Check, or during or subsequent to Burn-in), [Chart 3](#) or [Chart 4](#) is a failed component as specified in Para. 7.1.3.

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.2.1.

#### 7.1.5 Documentation

Documentation of Validation Testing shall be in accordance with Para. 9.7.

## 7.2 PHASE A – INITIAL INSPECTION (CHART 2B) (NON-PACKAGED COMPONENTS ONLY)

For Non-Packaged components only, unless otherwise specified in the Detail Specification, the components of the Test Sub-Lot shall be subjected to the tests and inspections in accordance with [Chart 2B](#) in the sequence shown.

Any failures within the Test Sub-Lot that occur during [Chart 2B](#) may be replaced with additional components from the same production lot (see Para. 7.1.3). Replacement components shall be serialised and subjected to the tests and inspections of [Chart 2B](#).

Upon completion of Phase A, the components that have successfully passed the tests and inspections of [Chart 2B](#) shall be subjected to Phase B (see Para. 7.3).

Documentation of Phase A shall be in accordance with Para. 9.7.1.

## 7.3 PHASE B – TESTING (CHART 3)

Unless otherwise specified in the Detail Specification, the components of the Test Sub-Lot shall be randomly divided into various groups and subgroups, and subjected to the tests and inspections in accordance with [Chart 3](#) in the sequences shown.

Any failures within the Test Sub-Lot that occur during [Chart 3](#) may be replaced with additional components from the same production lot subject to agreement by the Orderer (see Para. 7.1.3). Replacement components shall be serialised and subjected to the tests and inspections of [Chart 2B](#) (where applicable) and [Chart 3](#).

Upon completion of Phase B, the components shall be subjected to Phase C (see Para. 7.4).

Documentation of Phase B shall be in accordance with Para. 9.7.2.

## 7.4 PHASE C – FINAL INSPECTION (CHART 4)

Unless otherwise specified in the Detail Specification, the components of the Test Sub-Lot shall be subject to the tests and inspections in accordance with [Chart 4](#) in the sequence shown.

Documentation of Phase C shall be in accordance with Para. 9.7.3.

# 8 TEST METHODS AND PROCEDURES

## 8.1 GENERAL

Unless otherwise specified, all tests and inspections shall be performed under normal atmospheric conditions in conformance with the following:

- $T_{amb} = +22 \pm 3^{\circ}\text{C}$
- Relative humidity =  $55 \pm 10\%$

Specific test and inspection criteria applicable to the particular characteristics of a component shall be given in the Detail Specification.

## 8.2 DIMENSION CHECK

[MIL-STD-883, Test Method 2016](#) and the Detail Specification, on a sample of 3 components.

For Non-Hermetic Package and Hermetic Package components only, in the event of any failure, a 100% Dimension Check shall be performed.

## 8.3 WEIGHT

The maximum weight of the component specified in the Detail Specification shall be guaranteed but not tested.

## 8.4 PARTICLE IMPACT NOISE DETECTION (PIND)

Applicable to Hermetic Package components only.

[MIL-STD-883, Test Method 2020](#), Test Condition A.

## 8.5 RADIOGRAPHIC INSPECTION

[MIL-STD-883, Test Method 2012](#) unless otherwise specified in the Detail Specification.

## 8.6 PIN-TO-PIN ISOLATION

[MIL-STD-883, Test Method 1003](#), Test Condition D unless otherwise specified in the Detail Specification.

## 8.7 BURN-IN

[MIL-STD-883, Test Method 1015](#), Test Condition B unless otherwise specified in the Detail specification. The following details shall apply:

- Test Duration and Temperature: Unless otherwise specified in the Detail Specification, components shall be subjected to a total Burn-in period of 240 (+24 -0) hours at  $T_{amb} = +125^{\circ}\text{C}$ .
- Test Conditions: as specified in the Detail Specification.

## 8.8 ELECTRICAL MEASUREMENTS

### 8.8.1 General

#### 8.8.1.1 *Functional Test*

- (a) For components with a Resistive or Capacitive Electrical Principle:  
A go-no-go Functional Test shall be performed as specified in the Detail Specification.
- (b) For components with an Inductive Electrical Principle:  
A non-destructive go-no-go magnetic test shall be performed in steps as follows:
  1. Apply a magnetic field pulse to the components. The gauss and duration of the pulse shall be as specific in the Detail Specification.
  2. Apply a set/reset pulse to the component.
  3. Repeat steps 1) and 2) for a total quantity of cycles as specified in the Detail Specification. Measurements of Electrical Characteristics per Para. 8.8.1.2(c) shall be performed at regular intervals as specified in the Detail Specification.



### 8.8.1.2 *Measurements of Electrical Characteristics*

- (a) For components with a Resistive Electrical Principle:  
The current vs. voltage curves for the full voltage range shall be recorded with the following test conditions:
  - 1. With DC voltage applied as specified in the Detail Specification.
  - 2. With low frequency AC voltage applied as specified in the Detail Specification.
  - 3. With high frequency AC voltage applied as specified in the Detail Specification.
- (b) For components with a Capacitive Electrical Principle:  
The Dynamic Capacitance shall be measured as specified in the Detail specification by subjecting the components to an AC electric field of increasing frequency in steps from DC up to 1 decade above the component's resonance frequency as specified in the Detail specification. The components' capacitance, and phase shift with respect to the applied field shall be recorded for each step. The frequency steps shall be as specified in the Detail Specification.
- (c) For components with an Inductive Electrical Principle:  
Dynamic Inductance shall be measured as specified in the Detail Specification by subjecting the components to an AC magnetic field of increasing frequency steps. The components' inductance, and phase shift with respect to the applied field shall be recorded for each step. The frequency range and frequency steps shall be as specified in the Detail Specification.

### 8.8.2 High and Low Temperatures Electrical Measurements

High and Low Temperatures Electrical Measurements shall be performed as specified in the Detail Specification.

During Validation Testing only (Charts [2B](#), [3](#) and [4](#)), unless otherwise specified, all values obtained shall be recorded against serial numbers.

### 8.8.3 Room Temperature Electrical Measurements

A Functional Test and Measurements of Electrical Characteristics shall be performed as specified in Para. 8.8.1 and in the Detail Specification.

During Validation Testing only (Charts [2B](#), [3](#) and [4](#)), unless otherwise specified, all values obtained shall be recorded against serial numbers, and the parameter drift calculated, if specified.

### 8.9 SEAL

Applicable to Hermetic Package components only.

#### 8.9.1 Seal, Fine Leak

[MIL-STD-883, Test Method 1014](#), Condition A or B.

#### 8.9.2 Seal, Gross Leak

[MIL-STD-883, Test Method 1014](#), Condition C.

### 8.10 PERIODIC EXCITATION RESPONSE ANALYSIS (PERA)

Applicable to Moving Structure components only.

The components shall be subjected to a periodic mechanical or electrical excitation (depending on the active principle of the component under test) in order to measure the resulting response. The test details, conditions and accept/reject criteria shall be as specified in the Detail Specification.

8.11 EXTERNAL VISUAL INSPECTION  
[MIL-STD-883, Test Method 2009](#).

8.12 CONTROLS

Control components shall be used during Phase B and Phase C Validation Testing for comparison purposes. Whenever electrical measurements are performed on any components during testing in accordance with [Chart 3](#) and [Chart 4](#), the control components shall also be measured.

8.13 TEMPERATURE CYCLING

[MIL-STD-883, Test Method 1010](#), Test Condition B unless otherwise specified in the Detail Specification (see note below). The following details shall apply:

- Mounting: Components shall be unmounted.
- Number of test cycles: 10 minimum.
- Temperature transfer rate:
  - Cold to hot:  $\leq 3.5^{\circ}\text{C}/\text{minute}$
  - Hot to cold:  $\leq 4^{\circ}\text{C}/\text{minute}$
- Dwell time: 40 minutes minimum

**NOTE:**

1. If Test Condition B as above is not applied, the least severe load temperatures permitted during testing shall be as follows:
  - Cold:  $-45 (+0 -5)^{\circ}\text{C}$
  - Hot:  $+65 (+10 -0)^{\circ}\text{C}$

8.14 THERMAL SHOCK

[MIL-STD-883, Test Method 1011](#), Test Condition B unless otherwise specified in the Detail Specification (see note below). The following details shall apply:

- Mounting: Components shall be unmounted.
- Number of test cycles: 15 minimum.
- Total transfer time: 10s
- Dwell time: 2 minutes minimum

**NOTE:**

1. If Test Condition B as above is not applied, the least severe load temperatures permitted during testing shall be as follows:
  - Cold:  $-45 (+0 -5)^{\circ}\text{C}$
  - Hot:  $+65 (+10 -0)^{\circ}\text{C}$

8.15 MECHANICAL SHOCK

[MIL-STD-883, Test Method 2002](#), Test Condition B.

8.16 VIBRATION (VARIABLE FREQUENCY AND RANDOM)

[MIL-STD-883, Test Method 2007](#), Test Condition A immediately followed by [MIL-STD-883, Test Method 2026](#), Test Condition IG.

#### 8.17 CONSTANT ACCELERATION

[MIL-STD-883, Test Method 2001](#), Test Condition E except for components with weight > 5gm or inner cavity perimeter > 5cm, for which Test Condition D shall apply.

#### 8.18 PRESSURE CYCLING

Applicable to Hermetic Package components only.

Components shall be subjected to pressure cycling based on ECSS-E-ST-32-02 with the following details:

- Pressure cycles: 50 cycles minimum from zero differential pressure to maximum design pressure as specified in the Detail Specification, or 300kPa, whichever is greater, and back to zero differential pressure.
- Dwell time at each pressure extreme: 40s to 60s.
- Pressure transfer rate: 10 to 20kPa/s.
- Maximum pressure variation at maximum pressure extreme: 5kPa.
- Test temperature:  $T_{amb} = +25 \pm 5^{\circ}\text{C}$  with a 20 minute soak at this temperature prior to the test.
- Upon completion of testing, the components shall be subjected to External Visual Inspection per Para. 8.11. There shall be no evidence of any damage.

#### 8.19 LOW TEMPERATURE OPERATING LIFE

Components shall be subjected to a Low Temperature Operating Life test with the following details:

- Duration: 1000 hours minimum.
- Mounting: Components shall be mounted on a suitable testing board.
- Test temperature: minimum operating temperature (+5 -0) $^{\circ}\text{C}$ , as specified in the Detail Specification.
- Operating conditions during test: operating at maximum actuation (voltage or current) as specified in the Detail Specification.
- Data Points:  
Room Temperature Electrical Measurements per Para. 8.8.3 shall be performed at 0 hours, 24 hours, 168 hours, 500 hours and 1000 hours, after the operating actuation has been reduced to 0 (V or A) and the components held at  $T_{amb} = +22 \pm 3^{\circ}\text{C}$  for 1 hour minimum.

#### 8.20 HIGH TEMPERATURE OPERATING LIFE

Components shall be subjected to a High Temperature Operating Life test with the following details:

- Duration: 1000 hours minimum.
- Mounting: Components shall be mounted on a suitable testing board.
- Test temperature: maximum operating temperature (+0 -5) $^{\circ}\text{C}$ , as specified in the Detail Specification.
- Operating conditions during test: operating at maximum actuation (voltage or current) as specified in the Detail Specification.
- Data Points:  
Room Temperature Electrical Measurements per Para. 8.8.3 shall be performed at 0 hours, 24 hours, 168 hours, 500 hours and 1000 hours, after the operating actuation has been reduced to 0 (V or A) and the components held at  $T_{amb} = +22 \pm 3^{\circ}\text{C}$  for 1 hour minimum.

**8.21 MOISTURE RESISTANCE**

[MIL-STD-883, Test Method 1004](#). The following details shall apply:

- Mounting: Components shall be unmounted.
- Operating conditions during test: unbiased.
- Number of cycles: 10.

**8.22 DESTRUCTIVE PHYSICAL ANALYSIS**

Destructive Physical Analysis shall be performed as follows on 1 sample randomly selected from each of the samples previously subjected to each of the 10 subgroups of Groups I, II and III of [Chart 3](#) (i.e. 10 samples).

For Hermetic Packaged components, an additional 2 samples shall be taken after [Chart 2A](#) testing to be used for Residual Gas Analysis.

- (a) Residual Gas Analysis in accordance with Para. 8.23 (on 2 additional Hermetic Packaged components only)
- (b) Internal Visual Inspection in accordance with Para. 8.24.
- (c) Material Analysis in accordance with Para. 8.25.
- (d) Bond Strength in accordance with Para. 8.26 (Applicable to Non-Hermetic and Hermetic Package components only).
- (e) Die Shear in accordance with Para. 8.27 (Applicable to Non-Hermetic and Hermetic Package components only).

**8.23 RESIDUAL GAS ANALYSIS**

Applicable to Hermetic Package components only.

[MIL-STD-883, Test Method 1018](#), Test Condition A on a sample of 2 components. The following details shall apply:

- The maximum allowable water vapor content: 5000ppmv.

**8.24 INTERNAL VISUAL INSPECTION**

[MIL-STD-883, Test Method 2010](#), Condition A (Class level S).

**NOTES:**

1. Blowing with nitrogen is allowed for the removal of foreign material. After blowing, the devices shall be re-inspected in order to ensure that the foreign material has been removed.
2. For any structure smaller than 1 $\mu$ m, Scanning Electron Microscope Inspection (SEM) in accordance with [MIL-STD-883, Test Method 2018](#) shall be performed to observe the structure.

**8.25 MATERIAL ANALYSIS**

Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS) techniques shall be used to determine the materials of the component die surfaces. The materials shall comply with the requirements of the Detail specification.

**NOTE:**

1. Non-Hermetic Package and Hermetic Package components shall be de-encapsulated using suitable means to facilitate the material analysis such that there is no contamination of the surfaces of the die.

8.26 BOND STRENGTH  
Applicable to Non-Hermetic and Hermetic Package components only.  
[MIL-STD-883, Test Method 2011.](#)

8.27 DIE SHEAR  
Applicable to Non-Hermetic and Hermetic Package components only.  
[MIL-STD-883, Test Method 2019.](#)

## 9 DOCUMENTATION

9.1 GENERAL  
For procurement, for each lot, a data documentation package shall exist in a printed or electronic form.

This package shall be compiled from:

- (a) Cover sheet (or sheets).
- (b) List of equipment (testing and measuring).
- (c) List of test references.
- (d) Production Control data.
- (e) Screening Tests data.
- (f) Validation Testing data.
- (g) Failed components list and failure analysis report (when applicable).
- (h) Certificate of Conformity.

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

- Manufacturer's name.
- Production Lot identification.
- Date of establishment of the document.
- Page number.

Whenever possible, documentation should preferably be available in electronic format suitable for reading using a compatible PC. The format supplied shall be legible, durable and indexed. The preferred storage medium is CD-ROM and the preferred file format is PDF.

9.1.1 Component Procurement and Delivery  
For all deliveries of components procured to this specification the following documentation shall be supplied:

- (a) Cover sheet (if all of the information is not included on the Certificate of Conformity).
- (b) A Certificate of Conformity.

9.1.2 Additional Documentation  
If stipulated in the Purchase Order, the Manufacturer shall deliver additional documentation containing data and reports to the Orderer.

### 9.1.3 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 for review, if requested, by the Orderer.

### 9.2 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 this specification, including issue and date.
- (c) Manufacturer's part type number.
- (d) Production Lot identification.
- (e) Number of the Purchase Order.
- (f) Information relative to any additions to this specification and/or the Detail Specification.
- (g) Manufacturer's name and address.
- (h) Location of the manufacturing plant (specify place of diffusion, assembly and test).
- (i) Signature on behalf of Manufacturer.
- (j) Total number of pages of the data package.

### 9.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be prepared. 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.

### 9.4 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 Detail Specification.

### 9.5 PRODUCTION CONTROL DATA

A production lot traveller or equivalent shall be provided that, as a minimum, shows the total number of components submitted to, and the cause and total number rejected after each fabrication stage, and inspection and test point during production up to the point of delivery.

### 9.6 SCREENING TESTS DATA (CHART 2A)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after each of the tests.

### 9.7 VALIDATION TESTING DATA (CHARTS 2B, 3, 4)

#### 9.7.1 Phase A – Initial Inspection Data (Chart 2B)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after each of the tests. For each test requiring electrical measurements, the results shall be recorded against component serial number. Where a drift value is specified during a test, the drift calculation shall be recorded against component serial number. For Radiographic Inspection, photographic results shall be recorded against component serial number.

#### 9.7.2 Phase B – Testing Data (Chart 3)

A test result summary shall be compiled showing the components submitted to and the number rejected after each test in each group. Component serial numbers for each group and subgroup shall be identified. For each test requiring electrical measurements, the results shall be recorded against component serial number. Where a drift value is specified during a test, the drift calculation shall be recorded against component serial number.

#### 9.7.3 Phase C – Final Inspection Data (Chart 4)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after each of the tests. For each test requiring electrical measurements, the results shall be recorded against component serial number. Where a drift value is specified during a test, the drift calculation shall be recorded against component serial number.

#### 9.8 FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT

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

- (a) The reference and description of the test or measurement performed as defined in this specification and/or the Detail Specification during Validation Testing.
- (b) Traceability information including serial number of the failed component.
- (c) The failed parameter and the failure mode of the component.
- (d) Detailed failure analysis (if requested by the Orderer).

#### 9.9 CERTIFICATE OF CONFORMITY

A certificate of conformity shall be provided with each delivery of components.

The certificate may be the standard Manufacturer's certificate but must contain, as a minimum, the following information:

- (a) Manufacturer's name
- (b) Manufacturer's address
- (c) The applicable component type designation
- (d) Delivered quantity
- (e) Production Lot identification
- (f) Purchase Order number
- (g) The Detail Specification and this specification
- (h) A statement of compliance
- (i) A signature on behalf of the Manufacturer
- (j) The date the certificate was signed

#### 10 DELIVERY

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

- (a) The delivery lot.
- (b) The components used for Validation Testing, but not forming part of the delivery lot.
- (c) The relevant documentation in accordance with the requirements of Paras. 9.1.1 and 9.1.2.

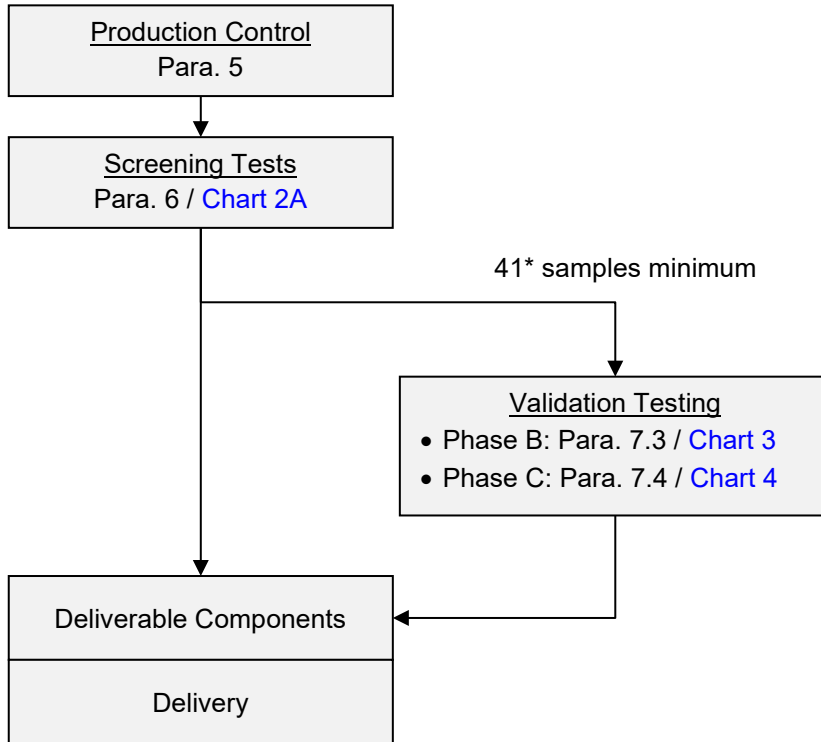
#### 11 PACKAGING AND DESPATCH

The packaging and despatch of components to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 20600. Non-Hermetic Package and Non-Packaged components shall be hermetically sealed in a dry nitrogen atmosphere.

**12 CHARTS**

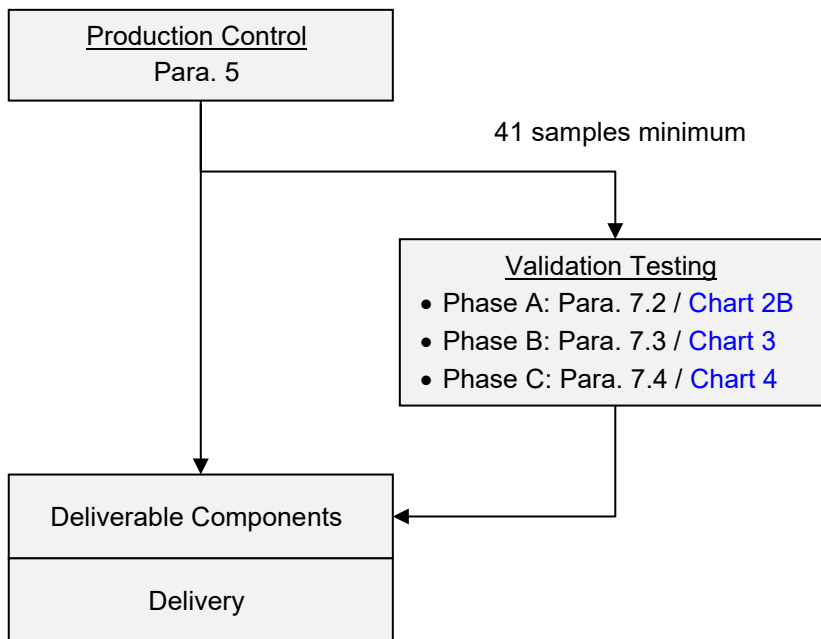
**12.1 CHART 1 - GENERAL FLOW FOR PROCUREMENT**

**12.1.1 Chart 1A – General Flow for Procurement of Non-Hermetic Package and Hermetic Package Components**



\* **NOTE:** 43 samples minimum for Hermetic Package Components

**12.1.2 Chart 1B – General Flow for Procurement of Non-Packaged Components**





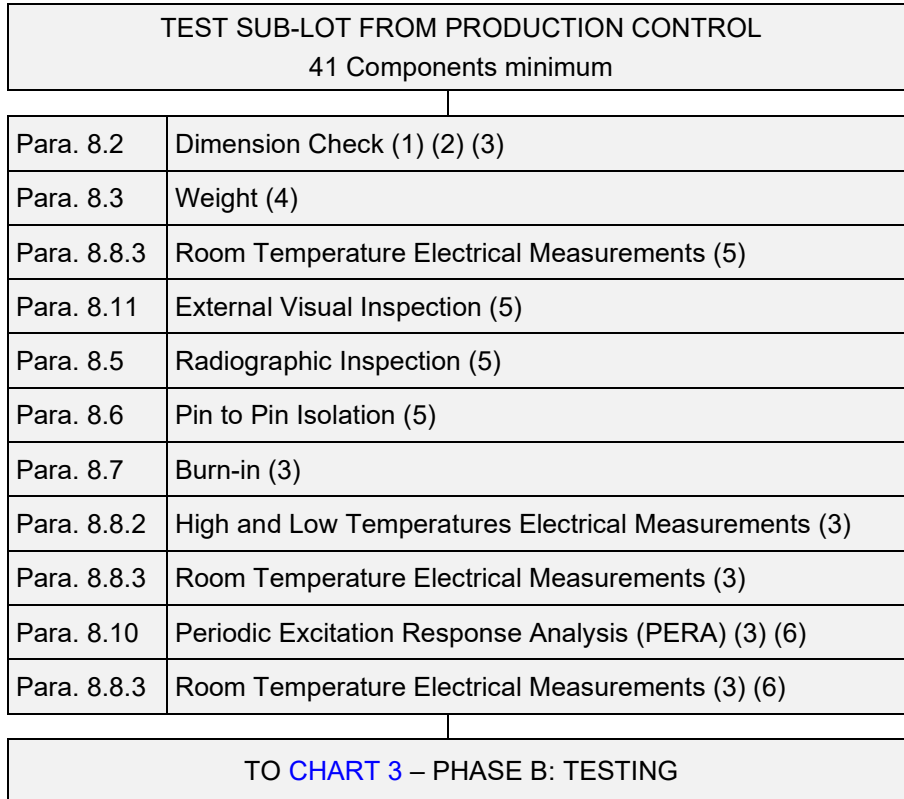
12.2 CHART 2A – SCREENING TESTS  
 (For Non-Hermetic Package and Hermetic Package components only)

COMPONENTS FROM PRODUCTION CONTROL	
Para. 8.2	Dimension Check (1) (2)
Para. 8.3	Weight (3)
Para. 8.4	Particle Impact Noise Detection (PIND) (4)
Para. 8.5	Radiographic Inspection (2)
Para. 8.6	Pin to Pin Isolation (2)
Para. 8.7	Burn-in
Para. 8.8.2	High and Low Temperatures Electrical Measurements
Para. 8.8.3	Room Temperature Electrical Measurements
Para. 8.9	Seal (Fine and Gross Leak) (4)
Para. 8.10	Periodic Excitation Response Analysis (PERA) (5)
Para. 8.8.3	Room Temperature Electrical Measurements (5)
Para. 8.11	External Visual Inspection
TO DELIVERY / TEST SUB-LOT TO <a href="#">CHART 3</a> – PHASE B: TESTING	

**NOTES:**

1. Performed on 3 components only.
2. Any failures prior to Burn-in shall be immediately replaced with additional components from the same production lot (without the need to inform the Orderer).
3. Guaranteed but not tested.
4. Hermetic Package components only.
5. Moving Structure components only.

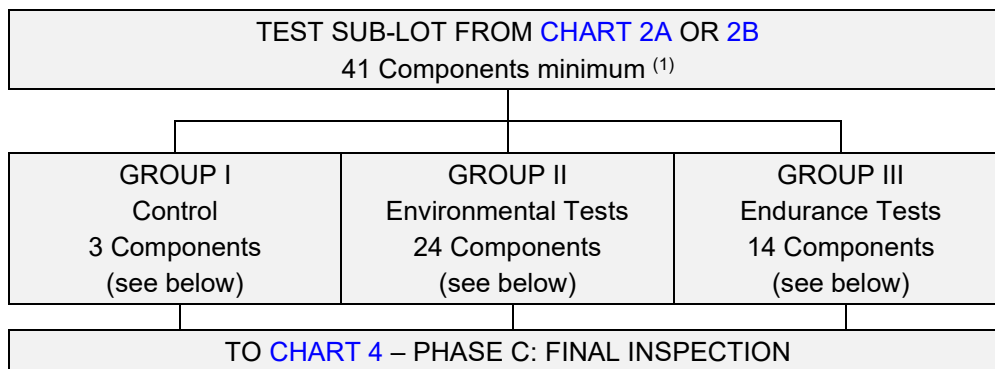
12.3 **CHART 2B – VALIDATION TESTING PHASE A: INITIAL INSPECTION**  
(For Non-Packaged components only)

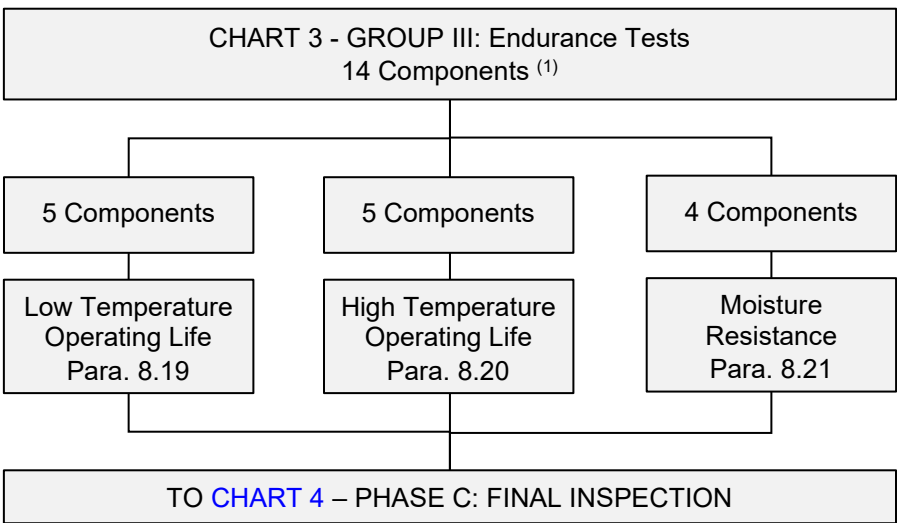
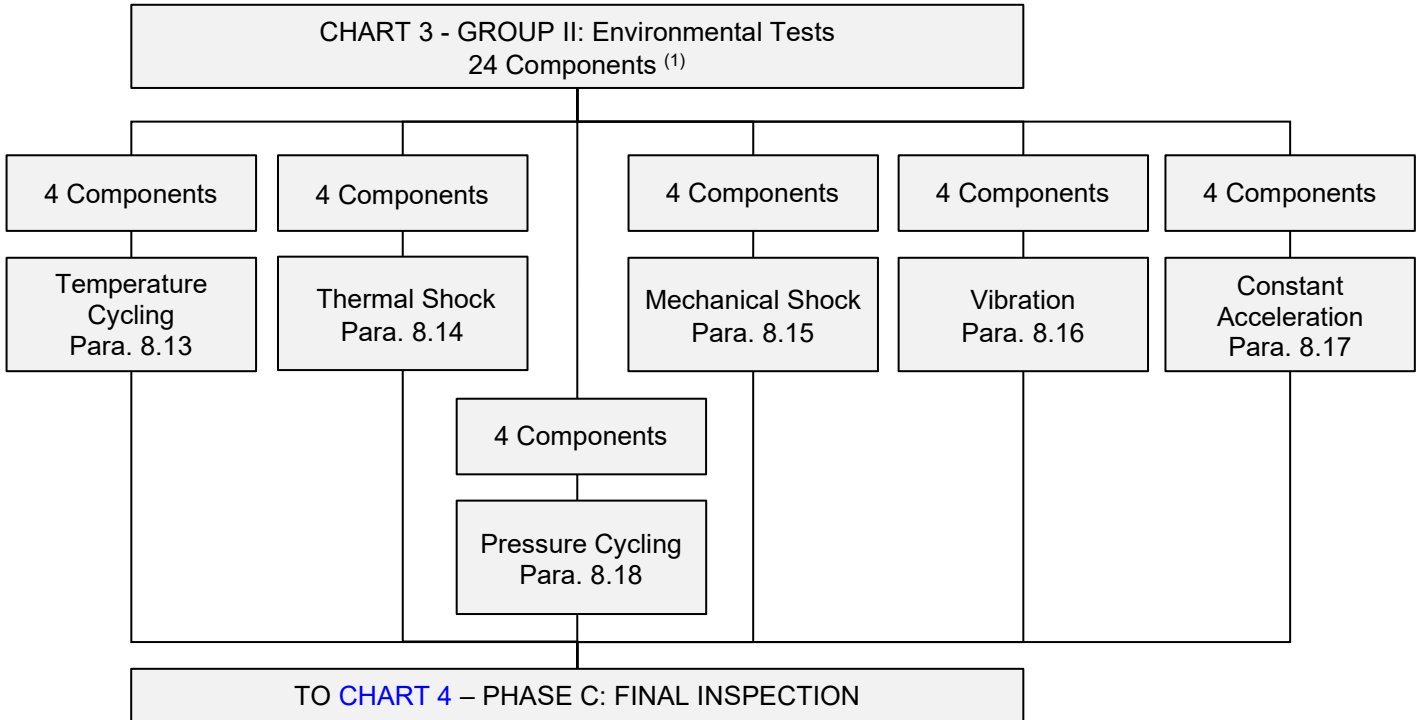
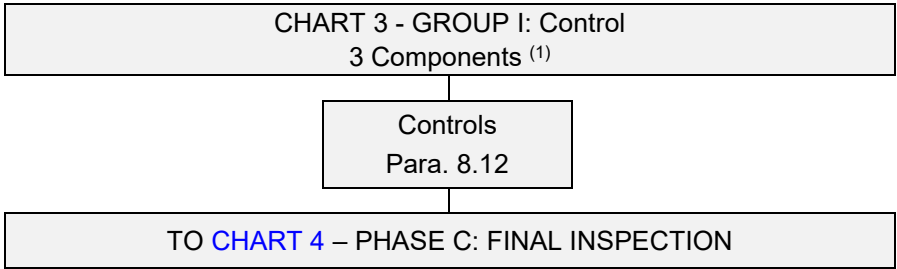


**NOTES:**

1. Performed on 3 components only.
2. This test only applies to the Non-Packaged component itself.
3. No failures are permitted. In the event of any failure, see Para. 7.1.4.
4. Guaranteed but not tested.
5. Any failures prior to Burn-in shall be immediately replaced with additional components from the same production lot (without the need to inform the Orderer). Replacement components shall be serialised and subjected to the tests and inspections of [Chart 2B](#).
6. Moving Structure components only.

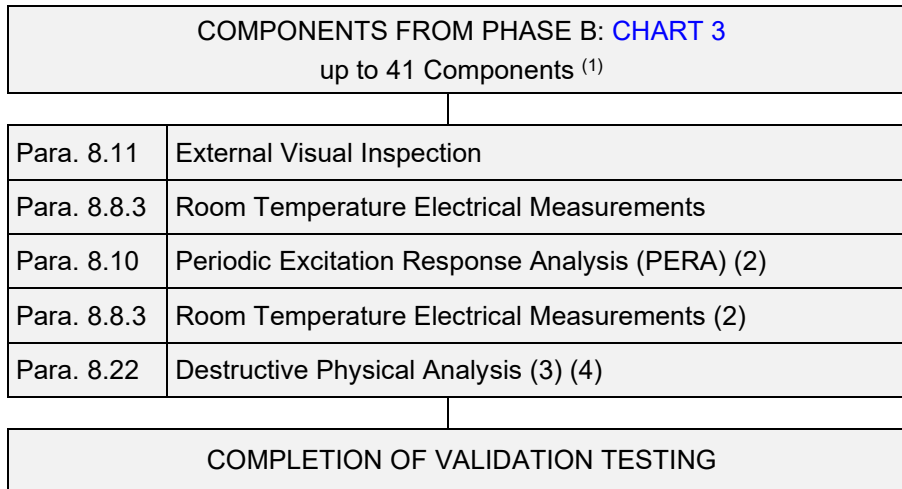
12.4 **CHART 3 – VALIDATION TESTING PHASE B: TESTING**





**NOTE:**

1. No failures are permitted. In the event of any failure, see Para. 7.1.4.

12.5 CHART 4 – VALIDATION TESTING PHASE C: FINAL INSPECTION**NOTES:**

1. No failures are permitted. In the event of any failure, see Para. 7.1.4.
2. Moving Structure components only.
3. Unless otherwise specified, to be performed on 1 sample randomly selected from each of the samples subjected to the 10 subgroups of Groups I, II, and III in [Chart 3](#) (i.e. 10 samples).
4. For Hermetic Packaged components, an additional 2 samples shall be taken after [Chart 2A](#) testing to be used for Residual Gas Analysis during Destructive Physical Analysis.