CAPACITORS, VARIABLE, CONCENTRIC TRIMMER

ESCC Generic Specification No. 3010

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DOCUMENTATION CHANGE NOTICE

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DCR No.	CHANGE DESCRIPTION
1586	Specification upissued to incorporate changes per DCR.

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1 INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification, qualification maintenance, procurement, and delivery of concentric trimmer variable capacitors for space applications. This specification contains the appropriate inspection and test schedules and also specifies the data documentation requirements.

1.2 APPLICABILITY

This specification is primarily applicable to the granting of qualification approval to components qualified in accordance with one of the following ESCC methods:

- Qualification of Standard Components per ESCC Basic Specification No. 20100.
- Technology Flow Qualification per ESCC Basic Specification No. 25400.

It is also primarily applicable to the procurement of components so qualified.

This specification may also be applied to the 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 starting qualification or placing the Purchase Order.

2.1 ESCC SPECIFICATIONS

- No. 20100, Requirements for the Qualification of Standard Electronic Components for Space Application.
- No. 20400, Internal Visual Inspection.
- No. 20500, External Visual Inspection.
- No. 20600, Preservation, Packaging and Despatch of ESCC Components.
- No. 21300, Terms, Definitions, Abbreviations, Symbols and Units.
- No. 21700, General Requirements for the Marking of ESCC Components.
- No. 22600, Requirements for the Evaluation of Standard Electronic Components for Space Application.
- No. 22800, ESCC Non-Conformance Control System.
- No. 23100, Recommendations on the use of the ESCC Specification System for the Evaluation and Procurement of Unqualified Components.
- No. 24600, Minimum Quality System Requirements.
- No. 24800, Resistance to Solvents of Marking, Materials and Finishes.
- No. 25400, Requirements for the Technology Flow Qualification of Electronic Components for Space Application.

For qualification and qualification maintenance or procurement of qualified components, with the exception of ESCC Basic Specifications Nos. 20100, 21700, 22800, 24600 and 25400, 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 ESCC Executive.

Such replacements shall be clearly identified in the applicable Process Identification Document (PID).

For procurement of unqualified components, 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.

Such replacements may be listed in an appendix to the appropriate Detail Specification at the request of the Manufacturer or Orderer, subject to the approval of the ESCC Executive.

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

2.2 OTHER (REFERENCE) DOCUMENTS

- IEC Publication No. 60068 Part 2, Basic Environmental Testing Procedures.

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) ESCC Detail Specification.
(b) ESCC Generic Specification.
(c) ESCC Basic Specification.
(d) 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.

4 REQUIREMENTS

4.1 GENERAL

The requirements for the qualification of a component shall be in accordance with ESCC Basic Specification No. 20100.

The requirements for Technology Flow Qualification and the listing of qualified component types shall be in accordance with ESCC Basic Specification No. 25400.

The test requirements for procurement of both qualified and unqualified components (see Chart F1) shall comprise:

- Special In-Process Controls.
- Screening Tests.
- Periodic Testing (for qualified components only).
- Lot Validation Testing if stipulated in the Purchase Order.

4.1.1 Specifications

For qualification, qualification maintenance, procurement 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.

4.1.2 Conditions and Methods of Test

The conditions and methods of test shall be in accordance with this specification, the ESCC Basic Specifications referenced herein and the Detail Specification.

4.1.3 Manufacturer's Responsibility for Performance of Tests and Inspections

The Manufacturer shall be responsible for the performance of tests and inspections required by the applicable specifications. These tests and inspections shall be performed at the plant of the Manufacturer of the components unless it is agreed by the ESCC Executive (for qualification, qualification maintenance, or procurement of qualified components) or the Orderer (for procurement of unqualified components), to use an approved external facility.

4.1.4 Inspection Rights

The ESCC Executive (for qualification, qualification maintenance, or procurement of qualified components) or the Orderer (for procurement of unqualified components if stipulated in the Purchase Order) reserves the right to monitor any of the tests and inspections scheduled in the applicable specifications.

4.1.5 Pre-Assembly Customer Source Inspection

If stipulated in the Purchase Order, the Orderer may perform a source inspection at the Manufacturer's facility prior to assembly (including, for example, performance of Pre-Encapsulation Inspection, review of Special In-Process Controls data). 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 QUALIFICATION AND QUALIFICATION MAINTENANCE REQUIREMENTS ON A MANUFACTURER

To obtain and maintain the qualification of a component, or family of components, a Manufacturer shall satisfy the requirements of ESCC Basic Specification No. 20100.

To obtain and maintain the qualification of a component produced using a qualified Technology Flow, a Manufacturer shall satisfy the requirements of ESCC Basic Specification No. 25400.

4.3 DELIVERABLE COMPONENTS

4.3.1 ESCC Qualified Components

Components delivered to this specification shall be processed and inspected in accordance with the relevant Process Identification Document (PID).

4.3.2 ESCC Components

Each component, irrespective of qualification status, identified with an ESCC component number and delivered to this specification 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 Chart F4. 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.

4.3.3 Lot Failure

Lot failure may occur during, Screening Tests (Chart F3), or Qualification, Periodic Testing and Lot Validation Testing (Chart F4).

Should such failure occur during qualification, qualification maintenance or procurement of qualified components the Manufacturer shall initiate the non-conformance procedure in accordance with ESCC Basic Specification No. 22800. The Manufacturer shall notify the Orderer and the ESCC Executive 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 ESCC Executive.

Should such failure occur during procurement of unqualified 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.

4.4 MARKING

All components procured and delivered to this specification shall be marked in accordance with ESCC Basic Specification No. 21700.

4.5 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

5.1 GENERAL

Unless otherwise specified herein or in the Detail Specification all lots of components used for qualification and qualification maintenance, Lot Validation Testing and for delivery shall be subject to tests and inspections in accordance with Chart F2 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 requirements are detailed in the paragraphs referenced in Chart F2.

For qualified components the full production control provisions are defined in the PID.

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.3.

5.2 SPECIAL IN-PROCESS CONTROLS

5.2.1 Internal Visual Inspection

Internal Visual Inspection shall be performed in accordance with Para. 8.1.

5.2.2 Dimension Check

Dimension Check shall be performed in accordance with Para. 8.5 on 3 samples only.

In the event of any failure a 100% Dimension Check shall be performed.

5.2.3 Weight

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

5.2.4 Documentation

Documentation of Special In-Process Controls shall be in accordance with Para. 9.5.

6 SCREENING TESTS

6.1 GENERAL

Unless otherwise specified herein or in the Detail Specification, all lots of components used for qualification and qualification maintenance, Lot Validation Testing, and for delivery, shall be subjected to tests and inspections in accordance with Chart F3 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 F3.

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, i.e. External Visual Inspection.

6.2.2 Parameter Limit Failure

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

Any component which exhibits a limit failure prior to the submission to Burn-in shall be rejected and not counted when determining lot rejection.

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 LOT FAILURE

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.3.

6.4.1 Lot Failure during 100% Testing

If the number of components failed on the basis of the failure criteria specified in Para. 6.2.2 exceeds 10% (rounded upwards to the nearest whole number) of the components submitted to Burn-in of Chart F3, the lot shall be considered as failed.

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

6.4.2 Lot Failure during Sample Testing

A lot shall be considered as failed if the number of allowable failures during sample testing as specified herein or in the Detail Specification, is exceeded.

Unless otherwise specified, if a lot failure occurs, a 100% testing may be performed but the cumulative percent defective shall not exceed that specified in Para. 6.4.1.

6.5 DOCUMENTATION

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

7 QUALIFICATION, QUALIFICATION MAINTENANCE AND LOT VALIDATION TESTING

The requirements of this paragraph are applicable to the tests performed on components or test structures as part of qualification or qualification maintenance in accordance with either ESCC Basic Specification No. 20100 or 25400 as applicable. They are also applicable to Lot Validation Testing as part of the procurement of qualified or unqualified components.

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

7.1 QUALIFICATION TESTING

7.1.1 General

Qualification testing shall be in accordance with the requirements specified in Chart F4. The tests of Chart F4 shall be performed on the specified sample, chosen at random from components which have successfully passed the tests in Chart F3. This sample constitutes the Qualification Test Lot.

The Qualification Test Lot is divided into subgroups of tests and all components assigned to a subgroup shall be subjected to all of the tests in that subgroup, in the sequence shown. The applicable test requirements are detailed in the paragraphs referenced in Chart F4.

The conditions governing qualification testing are specified in ESCC Basic Specification No. 20100.

7.1.2 Distribution within the Qualification Test Lot

Where a Detail Specification covers a range, or series of components that are considered similar, then the Qualification Test Lot shall be comprised of component types so selected that they adequately represent all of the various mechanical, structural and electrical peculiarities of that range or series.

The distribution may be specified by, but in any case shall be agreed with, the ESCC Executive.

7.2 QUALIFICATION WITHIN A TECHNOLOGY FLOW

The qualification of a component produced using a qualified Technology Flow shall be in accordance with ESCC Basic Specification No. 25400.

7.3 QUALIFICATION MAINTENANCE (PERIODIC TESTING)

Qualification is maintained through periodic testing and the test requirements of Para. 7.1 shall apply. For each subgroup the sample size and the period between successive subgroup testing shall be as specified in Chart F4. The conditions governing qualification maintenance are specified in ESCC Basic Specification No. 20100.

Qualification of a component, produced using a qualified Technology Flow, is maintained by the maintenance of the Technology Flow Qualification itself in accordance with ESCC Basic Specification No. 25400.

7.4 LOT VALIDATION TESTING

For procurement of qualified components, Lot Validation Testing is not required and shall only be performed if specifically stipulated in the Purchase Order.

For procurement of unqualified components, the need for Lot Validation Testing shall be determined by the Orderer (ref. ESCC Basic Specification No. 23100).

When Lot Validation Testing is required, it shall consist of the performance of one or more of the tests or subgroup test sequences of Chart F4. The testing to be performed and the sample size shall be as stipulated in the Purchase Order.

When procurement of more than one component type is involved from a family, range or series, the selection of representative samples shall also be stipulated in the Purchase Order.

7.5 FAILURE CRITERIA

The following criteria shall apply to qualification, qualification maintenance and Lot Validation Testing.

7.5.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:

- Components which fail during tests for which the pass/fail criteria are inherent in the test method, e.g. Robustness of Terminations, Solderability, etc.

7.5.2 Electrical and Mechanical 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 environmental, mechanical, endurance and electrical testing in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

7.5.3 Other Failures

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

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

7.6 FAILED COMPONENTS

A component shall be considered as failed if it exhibits one or more of the failure modes detailed in Para. 7.5.

When requested by the ESCC Executive (for qualification, qualification maintenance or procurement of qualified components) or the Orderer (for procurement of qualified or unqualified components), failure analysis of failed components shall be performed under the responsibility of the Manufacturer and the results provided.

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

7.7 LOT FAILURE

For qualification and qualification maintenance, the lot shall be considered as failed if one component in any subgroup of Chart F4 is a failed component based on the criteria specified in Para. 7.5.

For procurement, the lot shall be considered as failed if one component in any test specified for Lot Validation Testing is a failed component based on the criteria specified in Para. 7.5.

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.3.

7.8 QUALIFICATION, QUALIFICATION MAINTENANCE AND LOT VALIDATION TESTING SAMPLES

All tests of Chart F4 are considered to be destructive and therefore components so tested shall not form part of the delivery lot.

7.9 DOCUMENTATION

Documentation of qualification, qualification maintenance and Lot Validation Testing shall be in accordance with Para. 9.7.

8 TEST METHODS AND PROCEDURES

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

For a qualified component, documentation supporting the change shall be approved by the ESCC Executive and retained by the Manufacturer. It shall be copied, when requested, to the ESCC Executive. The change shall be specified in an appendix to the Detail Specification and in the PID.

For an unqualified component the change shall be approved by the Orderer. The change may be specified in an appendix to the Detail Specification at the request of the Manufacturer or Orderer, subject to the approval of the ESCC Executive.

8.1 INTERNAL VISUAL INSPECTION

ESCC Basic Specification No. 20400.

8.2 RAPID CHANGE OF TEMPERATURE

Components shall be subjected to Test Na of IEC Publication No. 60068-2-14. The following details shall apply:

- Test Conditions:
  - Low temperature: minimum storage temperature rating as specified in the Detail Specification.
  - High temperature: maximum storage temperature rating as specified in the Detail Specification.
  - Exposure time (each cycle, each temperature): 30 minutes
  - Transition time: 1 minute
  - Recovery time: 4 hours minimum.

- Data Points:
  Only applicable to Qualification, Periodic Testing and Lot Validation Testing.

  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  On completion of testing, the components shall be subjected to standard atmospheric conditions for recovery for 24 ±3 hours.

  After recovery, Capacitance and Capacitance Drift shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.3 ELECTRICAL AND MECHANICAL MEASUREMENTS

8.3.1 General

Unless otherwise specified in the Detail Specification, the following electrical and mechanical measurements, and test methods, apply.

8.3.1.1 Capacitance

The component's maximum and minimum capacitance shall be measured by means of a suitable test jig incorporating a guard provision. The following details shall apply:

- Measuring frequency: 1MHz ±100kHz
- Accuracy of measurement: ±0.1% or 0.02pF, whichever is greater.

8.3.1.2 Change in Capacitance

The rate of change in capacitance shall be monitored by any suitable method while the capacitance of the component is adjusted from its minimum specified value to its maximum specified value and back to the minimum specified value. The rate of change in capacitance as a function of the change in adjustment shall not change sign over the entire range of adjustment.

8.3.1.3 Insulation Resistance

The Insulation Resistance shall be measured with the rotor set at the minimum and maximum capacitance positions between terminals.

- Test voltage: 500V.

For Screening Tests, the insulation resistance shall be read 5 seconds after application of the test voltage.

For Qualification and Periodic Testing, the insulation resistance shall be read 60 seconds after application of the test voltage.

8.3.1.4 Voltage Proof

Components shall be tested at their maximum specified capacitance.

- Test voltage: 200% of rated DC voltage, applied between terminals.

For Screening Tests, the test voltage shall be maintained for a period of 5 seconds.

For Qualification and Periodic Testing, the test voltage shall be maintained for a period of 60 seconds.

8.3.1.5 Quality Factor

The sample of components shall be tested at their maximum specified capacitance.

- Measuring frequency: 100MHz ±1kHz, unless otherwise specified in the Detail Specification.

The samples shall be mounted in such a way that the means of mounting does not affect the result of the measurement. Measurements shall be made using a test jig designed for a minimum stray capacitance effect with an accuracy sufficient to guarantee the minimum quality factor specified in the Detail Specification.

8.3.1.6 Operating Torque

The torque required to start and maintain rotation of the rotor shall be measured by a gradually applied force sufficient to turn the rotor through at least 50% of the total number of rotations.

8.3.1.7 Temperature Coefficient

The components shall be dried for 1 hour at the maximum storage temperature followed by recovery for 24 hours. Capacitance shall then be measured at each of the following temperatures with the rotor set at approximately 75% of the component's maximum specified capacitance value:

(a) +22 ±2°C (measured value Ca)
(b) Minimum operating temperature, as specified in the Detail Specification, ±2°C (measured value Cb)
(c) +22 ±2°C (measured value Cc)
(d) Maximum operating temperature, as specified in the Detail Specification, ±2°C (measured value Cd)
(e) +22 ±2°C (measured value Ce)

The temperature coefficient of capacitance between +22°C and each of the other specified temperatures shall be calculated from the following formula:

Temperature coefficient of capacitance in parts per million per °C = $(\Delta C/C\Delta T)10^6 \times K$

Where:

- $K = \frac{\text{difference between nominal specified temperatures}}{\text{difference between recorded temperatures}}$
- ΔT = difference between recorded temperatures

C and ΔC are derived as shown in the table below:

Symbol	Lower Temperature	Upper Temperature
C	1/2 (Ca + Cc)	1/2 (Cc + Ce)
ΔC	Cb - C	Cd - C

The limits of Temperature Coefficient, specified in the Detail Specification, shall not be exceeded.

8.3.2 Room Temperature Electrical and Mechanical Measurements

Room Temperature Electrical and Mechanical Measurements shall be performed as specified in the Detail Specification.

8.3.3 High and Low Temperatures Electrical Measurements

High and Low Temperatures Electrical Measurements shall be performed as specified in the Detail Specification. Unless otherwise specified, measurements shall be performed on a sample of 5 components from each manufacturing lot with 0 failures allowed. In the event of any failure a 100% inspection may be performed.

8.3.4 Intermediate and End-Point Electrical and Mechanical Measurements

At each of the relevant data points during Qualification, Periodic Testing and Lot Validation Testing, Intermediate and End-Point Electrical and Mechanical Measurements shall be performed as specified in the Detail Specification. All values obtained shall be recorded against serial numbers and the parameter drift calculated if specified.

8.4 BURN-IN

Components shall be subjected to a burn-in. Unless otherwise specified, the following details shall apply:

- Duration: 168 hours minimum.
- Temperature: maximum operating temperature rating (+0 -3)°C, as specified in the Detail Specification.
- Applied voltage: as specified in the Detail Specification.

8.5 EXTERNAL VISUAL INSPECTION AND DIMENSION CHECK

External Visual Inspection shall be performed in accordance with ESCC Basic Specification No. 20500.

Dimension Check shall be performed in accordance with ESCC Basic Specification No. 20500.

8.6 VIBRATION

Components shall be subjected to Test Fc of IEC Publication No. 60068-2-6. The following details shall apply:

- Test Conditions:
  - Mounting: The components shall be mounted by their normal mounting means. Lead-mounted capacitors, designed for printed circuit mounting, shall be seated firmly against a printed circuit board or comparable support to withstand forces occurring in service. Leads shall pass through mounting holes in the board and be soldered onto the reverse side of the printed circuit board.
  - Frequency Range: 10 to 2000Hz
  - Duration: 10 sweep cycles in each of the 3 mutually perpendicular planes unless otherwise specified in the Detail Specification.
  - Vibration amplitude: Displacement below the cross-over frequency of 57 to 62 Hz shall be 2mm and then acceleration of 294m/s2 above this frequency.
  - Applied voltage: 125% of DC rated voltage, applied between rotor and stator.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  During vibration, observation shall be made for momentary arcing or short circuiting of 0.5ms or greater duration.

  After vibration, Capacitance and Capacitance Drift shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.7 SHOCK

Components shall be subjected to Test Ea of IEC Publication No. 60068-2-27. The following details shall apply:

- Test Conditions:
  - Mounting: The components shall be mounted by their normal mounting means. Lead-mounted capacitors, designed for printed circuit mounting, shall be seated firmly against a printed circuit board or comparable support to withstand forces occurring in service. Leads shall pass through mounting holes in the board and be soldered onto the reverse side of the printed circuit board.
  - Acceleration: 1000m/s2
  - Duration: 6ms
  - Waveform: ½-sine pulse.
  - Number of shocks: 10 shocks shall be applied in each of the 3 mutually perpendicular planes unless otherwise specified in the Detail Specification.
  - Applied voltage: 125% of DC rated voltage, applied between rotor and stator.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  During shock, observation shall be made for momentary arcing or short circuiting of 0.5ms or greater duration.

  After shock, Capacitance and Capacitance Drift shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.8 ROBUSTNESS OF TERMINATIONS

Components shall be subjected to Test Ub_2, (Bending: for Tag Termination), Method 1 of IEC Publication No. 60068-2-21.

All terminations shall be bent at the mid-point of their total length. The Detail Specification shall indicate to which Component Type Variants the test applies or otherwise (e.g. non-tag termination, leadless types - test not applicable).

8.9 RESISTANCE TO SOLDERING HEAT

Components shall be subjected to Test Tb of IEC Publication No. 60068-2-20. Unless otherwise specified, the following details shall apply:

- Test Conditions:
  - Test method: 1A (+260 ±5°C)
  - Immersion depth: as specified in the Detail Specification.
  - Immersion time: as specified in the Detail Specification.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  On completion of testing, the components shall be subjected to standard atmospheric conditions for recovery for 24 ±3 hours.

  After recovery, Capacitance, Capacitance Drift, Voltage Proof and Quality Factor shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.10 CLIMATIC SEQUENCE

- Data Points (Initial Measurements)
  Prior to the commencement of Climatic Sequence, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

8.10.1 Dry Heat

Components shall be subjected to Test Bb of IEC Publication No. 60068-2-2. The following details shall apply:

- Duration: 2 hours minimum.
- Test temperature: maximum storage temperature as specified in the Detail Specification.

Following the period of dry heat the components shall be visually examined for evidence of mechanical damage.

8.10.2 Damp Heat (First Cycle)

Unless otherwise specified in the Detail Specification, components shall be subjected to Test Db of IEC Publication No. 60068-2-30, upper temperature severity +55°C, Variant 1 for 1 cycle. Following the damp heat cycle the components shall be subjected to standard atmospheric conditions for recovery for 24 ±3 hours. The components shall be subjected to Cold immediately after the recovery period.

8.10.3 Cold

Components shall be subjected to Test Ab of IEC Publication No. 60068-2-1. The following details shall apply:

- Duration: 2 hours minimum.
- Test temperature: minimum storage temperature as specified in the Detail Specification.

Following the period of low temperature the components shall be visually examined for evidence of mechanical damage.

8.10.4 Low Air Pressure

Components shall be subjected to Test M of IEC Publication No. 60068-2-13. The following details shall apply:

- Test pressure: 8kPa
- Test temperature: +15 to +35°C.
- Duration: 5 minutes.
- Applied voltage: rated voltage U_R shall be applied immediately after the test pressure has been obtained for a period of 1 to 2 minutes.

8.10.5 Damp Heat (Remaining Cycles)

Components shall be subjected to Test Db of IEC Publication No. 60068-2-30, upper temperature severity +55°C, Variant 1 for 5 cycles.

- Data Points (Final Measurements)
  After the final Damp Heat cycle the components shall be subjected to standard atmospheric conditions for recovery for 24 ±3 hours.

  After recovery, the components shall be visually examined for evidence of damage.

  Capacitance, Capacitance Drift, Quality Factor, Insulation Resistance, Voltage Proof and Operating Torque shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.11 DAMP HEAT, STEADY STATE

Components shall be subjected to Test Cab of IEC Publication No. 60068-2-78. Unless otherwise specified, the following details shall apply:

- Test Conditions:
  - Severity: temperature 40 ±2°C; relative humidity 85 ±3%.
  - Applied voltage: no voltage shall be applied.
  - Duration: 56 days.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  On completion of testing, the components shall be maintained at a temperature of +25 (+10, -5)°C and relative humidity of 50 ±5% for recovery for a period of 12 to 24 hours.

  After recovery, Capacitance, Capacitance Drift, Quality Factor, Insulation Resistance, Voltage Proof and Operating Torque shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Capacitance Drift shall be related to the initial measurements.

8.12 OPERATING LIFE

Components shall be subjected to an endurance test as follows:

- Test Conditions:
  - Duration:
    - 2000 ±48 hours; applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
    - 1000 ±24 hours; applicable to Periodic Testing for extension of qualification.
  - Temperature: maximum operating temperature rating (+0 -3)°C, as specified in the Detail Specification.
  - Applied Voltage: as specified in the Detail Specification.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  For a 2000 hour Operating Life, testing shall be stopped after approximately 500 and 1000 hours for intermediate measurements. For a 1000 hour Operating Life, testing shall be stopped after approximately 500 hours intermediate measurements. The components shall be subjected to standard atmospheric conditions for recovery for 4 ±2 hours prior to the intermediate measurements.

  After recovery, Capacitance, Capacitance Drift, Insulation Resistance, Voltage Proof, Quality Factor and Operating Torque shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Change in Capacitance shall be related to the initial measurements. On completion of the intermediate measurements, the components shall be returned to Operating Life testing.

  On completion of testing (1000 or 2000 hours), the components shall be subjected to standard atmospheric conditions for recovery for 24 ±2 hours.

  After recovery, Capacitance, Capacitance Drift, Insulation Resistance, Voltage Proof, Quality Factor and Operating Torque shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. Change in Capacitance shall be related to the initial measurements.

8.13 AXIAL THRUST

The components shall be mounted by their normal mounting means. The axial thrust specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification shall be applied to the operating end of the actuating device.

- Data Points:
  Prior to the test, Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

  Capacitance shall also be measured while the axial thrust is being applied.

  The Capacitance Drift shall be calculated and shall meet the limit specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

8.14 MECHANICAL ENDURANCE

Components shall be subjected to Mechanical Endurance as follows. The components shall be mounted by their normal mounting means and each component's rotor screw shall initially be set at approximately 20% of the maximum specified capacitance value.

- Mechanical Endurance Cycling Procedure:
  Mechanical Endurance shall consist of the following cycle, repeated a total of 50 times at a rate of 5 cycles per minute:
  - The rotor screw shall be rotated 4 complete revolutions in the direction of increasing capacitance and then returned to its original position.
- Data Points (after Mechanical Endurance Cycling):
  After the final cycle, Voltage Proof shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification. The components shall then be subjected to Change in Capacitance versus Rotation.
- Change in Capacitance versus Rotation:
  The components shall be set at approximately 10% of the maximum specified capacitance value above the minimum specified capacitance value or 1pF, whichever is greater, and the rotor screw shall then be rotated in steps of 2 turns until 90% of maximum specified capacitance is reached.

  Capacitance shall be measured after each step at a frequency of 1MHz ±10%, and shall be continuously monitored for reversals. A minimum of three capacitance measurements shall be recorded. The accuracy of the rotation shall be within ±5° per revolution. Reproducibility of the measurements shall be within ±0.1% or 0.01pF, whichever is greater.

  Any change in capacitance versus rotation of the rotor shall not deviate from a straight line by more than 10% and show no reversals in direction.

- Data Points (Final Measurements):
  On completion of Change in Capacitance versus Rotation, Operating Torque, Insulation Resistance (measured between rotor screw and mounting base) and Quality Factor shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

8.15 SOLDERABILITY

Components shall be subjected to Test Ta, Method 1 of IEC Publication No. 60068-2-20.

All solderable terminations of each component shall be tested.

The dipped surface of the leads shall be covered by at least 95% with a new, smooth, solder coating. The remaining 5% of the lead surface shall show only small pin-holes or rough spots; these shall not be concentrated in one area. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solderability and shall be cause for rejection. In case of dispute, the percentage of areas covered with pin-holes or rough spots shall be determined by actual measurement.

8.16 PERMANENCE OF MARKING

ESCC Basic Specification No. 24800.

8.17 END-STOP TORQUE

Components shall be subjected to an end-stop torque test as follows:

- Mounting: The components shall be mounted by their normal mounting means.
- Applied Torque: The torque to be applied to the rotor, at both end-stops, shall be as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.
- Duration: 5 ±1 seconds for each end-stop, unless otherwise specified in the Detail Specification.
- Data Points:
  Following the test, the components shall be visually examined for evidence of damage. Capacitance shall be measured as specified in Intermediate and End-Point Electrical and Mechanical Measurements in the Detail Specification.

9 DATA DOCUMENTATION

9.1 GENERAL

For the qualification, qualification maintenance and 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) Special In-Process Controls data (Chart F2).
(e) Screening Tests data (Chart F3).
(f) Qualification, Periodic Testing and Lot Validation Testing (when applicable) data (Chart F4).
(g) Failed components list and failure analysis report (when applicable).
(h) Certificate of Conformity.

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

- ESCC Component Number.
- Manufacturer's name.
- 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 Qualification and Qualification Maintenance

In the case of qualification or qualification maintenance, the items listed in Para. 9.1(a) to (h) are required.

9.1.2 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) Certificate of Conformity.

9.1.3 Additional Documentation

The Manufacturer shall deliver additional documentation containing data and reports to the Orderer, if stipulated in the Purchase Order.

9.1.4 Data Retention/Data Access

If not delivered, all data shall be retained by the Manufacturer for a minimum of 5 years during which time it shall be available for review, if requested, by the Orderer or the ESCC Executive (for qualified components).

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 the applicable ESCC Generic Specification, including issue and date.
(c) ESCC Component Number and the Manufacturer's part type number.
(d) 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.
(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 tables of the Detail Specification.

9.5 SPECIAL IN-PROCESS CONTROLS DATA (CHART F2)

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.

9.6 SCREENING TESTS DATA (CHART F3)

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 QUALIFICATION, PERIODIC TESTING AND LOT VALIDATION TESTING DATA (CHART F4)

9.7.1 Qualification Testing

A test result summary shall be compiled showing the components submitted to, and the number rejected after each test in each subgroup. Component serial numbers for each subgroup shall be identified. For each test requiring electrical and mechanical 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.

9.7.2 Periodic Testing for Qualification Maintenance

A test result summary shall be compiled showing the components submitted to and the number rejected after each test in each subgroup. Component serial numbers for each subgroup shall be identified. For each test requiring electrical and mechanical 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.

In addition to the full test data, a report shall be compiled for each subgroup of Chart F4 to act as the most recent Periodic Testing summary. These reports shall include a list of all tests performed in each subgroup, the ESCC Component Numbers and quantities of components tested, a statement confirming all the results were satisfactory, the date the tests were performed and a reference to the full test data.

9.7.3 Lot Validation Testing

A test result summary shall be compiled showing the components submitted to and the number rejected after each test in each subgroup (as applicable). Component serial numbers for each subgroup shall be identified. For each test requiring electrical and mechanical 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 Special In-Process Controls, Screening Tests and Qualification, Periodic Testing and Lot Validation Testing.
(b) Traceability information including serial number (if applicable) of the failed component.
(c) The failed parameter and the failure mode of the component.
(d) Detailed failure analysis (if requested by the ESCC Executive or Orderer).

9.9 CERTIFICATE OF CONFORMITY

A Certificate of Conformity shall be established in accordance with the requirements of ESCC Basic Specification Nos. 20100 or 25400.

10 DELIVERY

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

(a) The delivery lot.
(b) The components used for Lot Validation Testing (as applicable), but not forming part of the delivery lot, if stipulated in the Purchase Order.
(c) The relevant documentation in accordance with the requirements of Paras. 9.1.2 and 9.1.3.

In the case of a component for which a valid qualification is in force, all data of all components submitted to Lot Validation Testing shall also be copied, when requested, to the ESCC Executive.

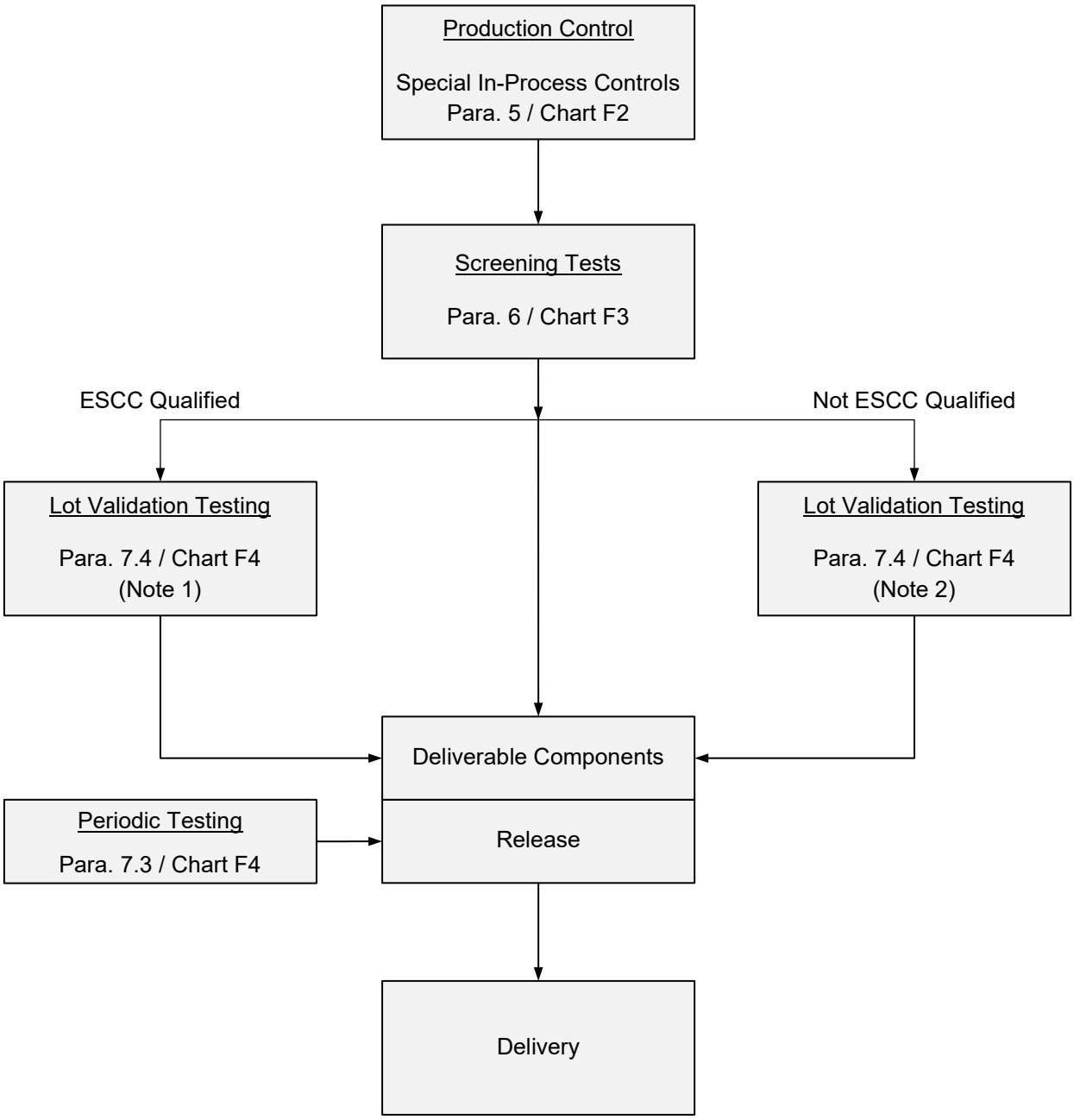
For qualification or qualification maintenance, the disposition of the Qualification Test Lot and its related documentation shall be as specified in ESCC Basic Specification Nos. 20100 or 25400 and the relevant paragraphs of Section 9 of this specification.

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.

12 CHARTS

12.1 CHART F1 – GENERAL FLOW OF PROCUREMENT



NOTES:

1. Lot Validation Testing is not required for qualified components unless specifically stipulated in the Purchase Order.
2. For unqualified components the need for Lot Validation Testing shall be determined by the Orderer and the required testing shall be as stipulated in the Purchase Order (ref. ESCC Basic Specification No. 23100).

12.2 CHART F2 – PRODUCTION CONTROL

COMPONENT LOT MANUFACTURING	
SPECIAL IN-PROCESS CONTROLS	
Para. 5.2.1	Internal Visual Inspection
-	Final Assembly
Para. 5.2.2	Dimension Check (1)
Para. 5.2.3	Weight (2)
TO CHART F3 – SCREENING TESTS	

NOTES:
1. Performed on a sample basis.
2. Guaranteed but not tested.

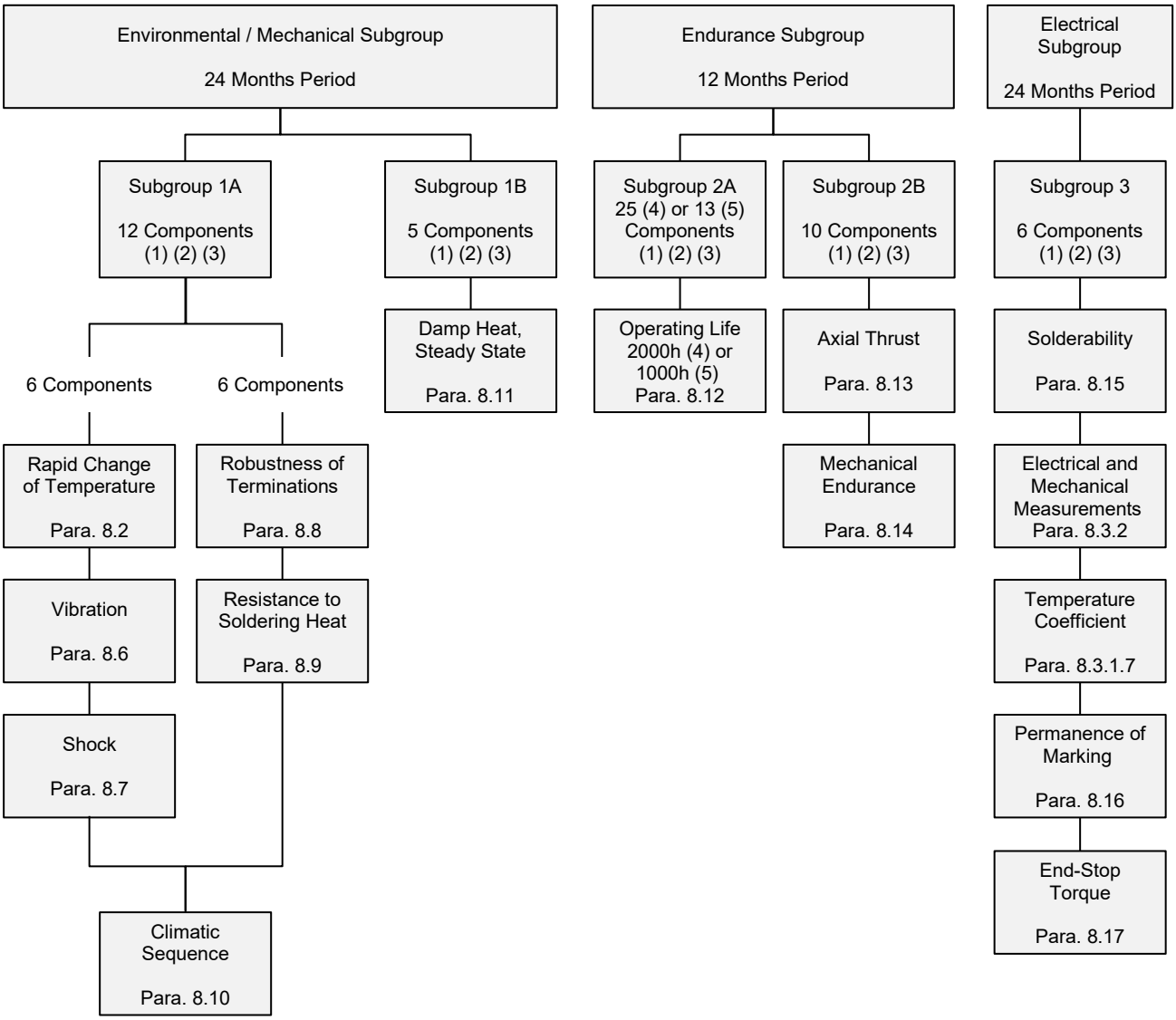
12.3 CHART F3 – SCREENING TESTS

COMPONENTS FROM PRODUCTION CONTROL	
Para. 8.2	Rapid Change of Temperature
Para. 8.3.2	Room Temperature Electrical and Mechanical Measurements (1)
Para. 8.4	Burn-in
Para. 8.3.3	High and Low Temperatures Electrical Measurements (2) (3)
Para. 8.3.2	Room Temperature Electrical and Mechanical Measurements (2)
Para. 6.4	Check for Lot Failure (4)
Para. 8.5	External Visual Inspection
TO CHART F4 WHEN APPLICABLE	

NOTES:

1. Optional at the Manufacturer's discretion.
2. The lot failure criteria of Para. 6.4 apply to this test.
3. Performed on a sample basis.
4. Check for Lot Failure shall take into account all electrical and mechanical parameter failures that may occur during Screening Tests in accordance with Para. 8.3.2 and 8.3.3 subsequent to Burn-in.

12.4 CHART F4 – QUALIFICATION, PERIODIC TESTING AND LOT VALIDATION TESTING



NOTES:

1. For distribution within the subgroups, see Para. 7.1.2 for qualification and qualification maintenance, and Para. 7.4 for Lot Validation Testing.
2. All components shall be serialised prior to testing.
3. No failures are permitted.
4. Applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
5. Applicable to Periodic Testing for extension of qualification.