



QUARTZ CRYSTAL UNITS

ESCC Generic Specification No. 3501

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1 INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification, qualification maintenance, procurement, and delivery of Quartz Crystal Units 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 Dispatch of ESCC Components.
- No. [20900](#), Radiographic Inspection of Electronic 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. [23500](#), Lead Materials and Finishes for Components for Space Application.
- No. [24600](#), Minimum Quality System Requirements.
- No. [24800](#), Resistance to Solvents of Marking, Materials and Finishes.
- 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.
- IEC Publication No. 60115-1, Fixed Resistors for Use in Electronic Equipment.
- IEC Publication No. 60122-1, Quartz Crystal Units of Assessed Quality - Part 1: Generic Specification.
- IEC Publication No. 60444-1, Measurement of quartz crystal unit parameters by zero phase technique in a pi-network - Part 1: Basic method for the measurement of resonance frequency and resonance resistance of quartz crystal units by zero phase technique in a pi-network.
- IEC Publication No. 60444-2, Measurement of quartz crystal unit parameters by zero phase technique in a pi-network. Part 2: Phase offset method for measurement of motional capacitance of quartz crystal units.
- IEC Publication No. 60444-4, Measurement of quartz crystal unit parameters by zero phase technique in a pi-network. Part 4: Method for the measurement of the load resonance frequency, load resonance resistance and the calculation of other derived values of quartz crystal units, up to 30 MHz.
- IEC Publication No. 60444-5, Measurement of quartz crystal units parameters - Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyzer techniques and error correction.
- IEC Publication No. 60444-6, Measurement of quartz crystal unit parameters - Part 6: Measurement of drive level dependence.
- IEC Publication No. 60444-7, Measurement of quartz crystal unit parameters - Part 7: Measurement of activity and frequency dips of quartz crystal units.
- IEC Publication No. 60444-8, Measurement of quartz crystal unit parameters - Part 8: Test fixture for surface mounted quartz crystal units.
- IEC Publication No. 60444-9, Measurement of quartz crystal unit parameters - Part 9: Measurement of spurious resonances of piezoelectric crystal units.
- IEC Publication No. 60444-11, Measurement of quartz crystal unit parameters - Part 11: Standard method for the determination of the load resonance frequency and the effective load capacitance using automatic network analyzer techniques and error correction.
- [MIL-STD-883](#), Test Methods and Procedures for Microelectronics.

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. In addition the following abbreviations and symbols shall apply:

Abbreviations:

| | |
|---|------|
| Clock Crystal Oscillator: | XO |
| Temperature Compensated Crystal Oscillator: | TCXO |
| Voltage Controlled Crystal Oscillator: | VCXO |
| Oven Controlled Crystal Oscillator: | OCXO |

Symbols:

| | | | |
|----------------------------|----------|----------------------------|----------|
| Resonance Frequency: | f_r | Static Capacitance: | C_0 |
| Load Resonance Frequency: | f_L | Load Capacitance: | C_L |
| Reference Temperature: | T_o | Motional Capacitance: | C_1 |
| Resonance Resistance: | R_r | Motional Inductance: | L_1 |
| Load Resonance Resistance: | R_L | Response Resistance: | R_P |
| Rated Drive Level: | P_o | Response Impedance: | $ Z_P $ |
| Minimum Drive Level: | P_{S1} | Insulation Resistance: | R_i |
| Maximum Drive Level: | P_{S2} | Turning Point Temperature: | T_{TP} |

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 Customer Source Inspections

4.1.5.1 *Pre-Encapsulation Customer Source Inspection*

If stipulated in the Purchase Order, the Orderer may perform a source inspection at the Manufacturer's facility prior to encapsulation (e.g. perform Internal Visual Inspection). Details of the inspections to be performed or witnessed and the required period of notification shall be as stipulated in the Purchase Order.

4.1.5.2 *Final Customer Source Inspection*

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. witness of final Reference Temperature Electrical Measurements; performance of External Visual Inspection and Dimension Check; review of the data documentation package). 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. Each Component 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.

Unless otherwise specified in the Detail Specification, components shall be hermetically sealed.

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 on assembled but unencapsulated components in accordance with Para. 8.1.

5.2.2 Dimension Check

Dimension Check shall be performed in accordance with Para. 8.7 on 3 samples.

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.

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

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 except as specifically permitted in Chart F4.

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, e.g. Mechanical Shock, Radiographic Inspection, Seal and External Visual Inspection.

6.2.2 Parameter Drift Failure

The acceptable change limits are shown in Parameter Drift Values in the Detail Specification. A component shall be counted as a parameter drift failure if the changes during Burn-in are larger than the drift values (Δ) specified.

6.2.3 Parameter Limit Failure

A component shall be counted as a limit failure if one or more parameters exceed the limits shown in Reference Temperature Electrical 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 or after Check for Lot Failure shall be rejected and not counted when determining lot failure.

6.2.4 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 Paras. 6.2.2 and 6.2.3 exceeds 10% (rounded upwards to the nearest whole number) or 2 components, whichever is greater, 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 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.

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 the 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, unless otherwise specified, 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.

In addition, the Qualification Test Lot components shall be selected in accordance with the following provisions:

- 1/3 of the sample at the lower end of the frequency range proposed for qualification.
- 1/3 of the sample near the middle of the frequency range proposed for qualification.
- 1/3 of the sample at the upper end of the frequency range proposed for qualification.

The distribution shall be as specified by, or 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, the test requirements 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 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. Seal, Solderability, Robustness of Terminations, etc.

7.5.2 Electrical Failure

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 and endurance testing in Reference Temperature Electrical Measurements and Intermediate and End-Point Electrical 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, PERIODIC TESTING AND LOT VALIDATION TESTING SAMPLES

All tests of Charts F4 excluding those tests of the Endurance Subgroup applicable to Periodic Testing, are considered to be destructive and therefore components so tested shall not form part of the delivery lot.

Endurance Subgroup samples that have been successfully tested during Periodic Testing may form part of the delivery lot.

7.9 DOCUMENTATION

Documentation of Qualification, Periodic Testing 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 MECHANICAL SHOCK

8.2.1 During Screening Tests (Chart F3)

Components shall be subjected to Test Ea of IEC Publication No. 60068-2-27. Unless otherwise specified, the following details shall apply:

- Test Conditions:
 - (a) Pulse shape: Half-sine
 - (b) Peak acceleration: 490m/s² (50g)
 - (c) Pulse duration: 6ms
 - (d) Number of shocks: 3 (1 shock in each of the 3 mutually perpendicular axes).
 - (e) Operating mode: Non-operating.
 - (f) Mounting: The components shall be mechanically connected to the shock equipment either directly or by means of a fixture. Mounting fixtures shall enable the components to be shocked in 3 mutually perpendicular axes in turn, which should be so chosen that faults are most likely to be revealed. If the component is provided with specific means of mounting, they shall be used and any additional restraining straps should be avoided. Unless otherwise specified, components not provided with specific means of mounting shall be clamped by the body and leads (leads clamped at 10 ±1mm from the body). Any external connections should add the minimum restraint and mass. Care shall be taken to avoid pinching the leads. For non-leaded SMDs, the components shall be clamped on the body.

8.2.2 During Qualification, Periodic Testing and Lot Validation Testing (Chart F4)

Components shall be subjected to Test Ea of IEC Publication No. 60068-2-27. Unless otherwise specified, the following details shall apply:

- Test Conditions:
 - (a) Pulse shape: Half-sine
 - (b) Peak acceleration and pulse duration:
 - For packages similar to style TO-5: 9800m/s² (1000g); 0.5ms
 - For packages similar to style TO-8: 4900m/s² (500g); 1ms
 - For other package types: 980m/s² (100g); 6ms
 - (c) Number of shocks: 18 (3 shocks in each direction of the 3 mutually perpendicular axes).
 - (d) Operating mode: Non-operating.
 - (e) Mounting: The components shall be mechanically connected to the shock equipment either directly or by means of a fixture. Mounting fixtures shall enable the components to be shocked in 3 mutually perpendicular axes in turn, which should be so chosen that faults are most likely to be revealed. If the component is provided with specific means of mounting, they shall be used and any additional restraining straps should be avoided. Unless otherwise specified, components not provided with specific means of mounting shall be clamped by the body and leads (leads clamped at 10 ±1mm from the body). Any external connections should add the minimum restraint and mass. Care shall be taken to avoid pinching the leads. For non-leaded SMDs, the components shall be clamped on the body.
- Data Points:

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

On completion of testing, the components shall be visually examined and there shall be no evidence of damage. Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.3 PRE-BURN-IN AND BURN-IN

8.3.1 Pre-Burn-in

Unless otherwise specified, components shall be subjected to an endurance test in a non-operating condition.

The following details shall apply:

- Test Conditions:
 - (a) Duration: 240 (+48 -0) hours
 - (b) Temperature: $T_{amb} = +105 (+0, -5)^{\circ}\text{C}$.

8.3.2 Burn-in

8.3.2.1 *For Components with OCXO as the Intended Application*

Unless otherwise specified, components shall be subjected to an endurance test with the component operating at the Turning Point Temperature, T_{TP} , as specified in the Detail Specification, as part of a suitable oscillator circuit.

The following details shall apply:

- Test Conditions:
 - (a) Duration: 720 hours minimum
 - (b) Temperature: $T_{amb} = T_{TP} \pm 1^{\circ}\text{C}$.

8.3.2.2 *For Components with an Intended Application other than OCXO*

Unless otherwise specified, components shall be subjected to an endurance test in a non-operating condition.

The following details shall apply:

- Test Conditions:
 - (a) Duration: 240 (+48 -0) hours
 - (b) Temperature: $T_{amb} = +105 (+0, -5)^{\circ}\text{C}$.

8.4 ELECTRICAL MEASUREMENTS

8.4.1 General

Unless otherwise specified, all electrical measurements shall be performed in accordance with IEC Publication No. 60122-1, 60444-x (as applicable, see Para. 2.2), or equivalent, and the Detail Specification.

Unless otherwise specified, the following test details shall apply.

8.4.1.1 *Resonance Frequency and Resonance Resistance*

(a) At the Reference Temperature, T_o

Measurement of Resonance Frequency and Resonance Resistance shall be performed at the reference temperature, T_o , and rated drive level $P_o \pm 20\%$.

Resonance Frequency may be measured without or with a load capacitance, C_L :

- Resonance Frequency (without C_L): $f_r = 1/(2\pi\sqrt{L_1 \times C_1})$
- Load Resonance Frequency with C_L : $f_L = 1/\left(2\pi\sqrt{L_1 \times \left\{\frac{C_0 C_1}{C_0 + C_1}\right\}}\right)$

Resonance Resistance may be measured without or with a load capacitance, C_L :

- Resonance Resistance without C_L : R_r
- Resonance Resistance with C_L : R_L

In the case of measurement of f_L and R_L , the value of the C_L shall be checked at a frequency close to the resonance frequency of the component under test and the accuracy of the frequency measurement shall be better than 1×10^{-6} .

(b) Variation with Drive Level

Measurement of Resonance Frequency and Resonance Resistance shall be performed as specified in (a) above at the minimum and maximum drive levels, P_{S1} and P_{S2} .

(c) Variation with Temperature

Measurement of Resonance Frequency and Resonance Resistance shall be performed as specified in (a) above over the operating temperature range.

Starting with the component at one extreme of the operating temperature range, Resonance Frequency and Resonance Resistance shall be measured at discrete temperature intervals of not greater than 1.5°C , allowing the component to reach thermal equilibrium at each measurement temperature.

When the intended application is TCXO, VCXO or OCXO, the maximum deviation ($\Delta f/f$) of each measurement of Resonance Frequency to the least squares fit to 4th order polynomial shall not be more than $\pm 1 \times 10^{-6}$, and the difference (Δf) between two consecutive measurements shall not be more than 5×10^{-7} .

When the intended application is OCXO, there shall be no peak in the frequency over the reference temperature range.

8.4.1.2 *Motional Capacitance and Motional Inductance*

Measurement of Motional Capacitance, C_1 , and Motional Inductance, L_1 , shall be performed at the reference temperature, T_o , and rated drive level, P_o , using either the load capacitance method or the phase offset method.

8.4.1.3 *Static Capacitance*

Measurement of Static Capacitance, C_0 , shall be the mean value of the capacitance measured equidistant above and below the component's Resonance Frequency, sufficiently far removed to be independent of any response.

8.4.1.4 *Unwanted Responses*

The frequency range shall be scanned to determine all unwanted responses within the range. Resonance Resistance, R_p , (for zero phase resonance) or Response Impedance, $|Z_p|$, (for non-zero phase resonance) shall be measured for each unwanted response and used to calculate the Ratio of Unwanted Response Resistance (or Impedance) to Resonance Resistance.

8.4.1.5 *Insulation Resistance*

The insulation resistance shall be measured with $20 \pm 1\text{Vdc}$ for 60 ± 5 seconds, or less if stable conditions are obtained, between:

- (a) Terminations
- (b) Terminations connected together and metal parts of the case, if any.

Note: Voltages other than $20 \pm 1\text{Vdc}$ may be applied providing correlation can be established.

8.4.1.6 *Quality Factor*

Quality Factor, Q , is calculated from previous measurements by:

- $Q = 1/(2\pi f_r \times R_r \times C_1)$ or
- $Q = (2\pi f_r \times L_1) \div R_r$

Quality Factor shall be determined using the largest value of R_r measured over the temperature range. If necessary, R_r shall be calculated from R_L using the following equation:

- $R_r = R_L \div \left\{ \frac{C_L + C_0}{C_L} \right\}^2$

8.4.2 Parameter Drift Value Measurements

At each of the relevant data points during Screening Tests (Chart F3), Parameter Drift Values shall be measured as specified in the Detail Specification. All values obtained shall be recorded against serial numbers and the parameter drift calculated.

8.4.3 Reference Temperature Electrical Measurements

At each of the relevant data points during Screening Tests (Chart F3) and Qualification, Periodic Testing and Lot Validation Testing (Chart F4), Reference Temperature Electrical Measurements shall be performed as specified in the Detail Specification. All values obtained shall be recorded against serial numbers.

8.4.4 High and Low Temperatures Electrical Measurements

At the relevant data point during Screening Tests (Chart F3), High and Low Temperatures Electrical Measurements shall be performed as specified in the Detail Specification. All values obtained shall be recorded against serial numbers.

8.4.5 Intermediate and End-Point Electrical Measurements

At each of the relevant data points during Qualification, Periodic Testing and Lot Validation Testing (Chart F4), Intermediate and End-Point Electrical Measurements shall be performed as specified in the Detail Specification. All values obtained shall be recorded against serial numbers and the parameter drift calculated as specified.

8.5 RADIOGRAPHIC INSPECTION

ESCC Basic Specification No. [20900](#).

8.6 SEAL (FINE AND GROSS LEAK)

Components shall be subjected to a seal (fine, and gross leak if applicable) test in accordance with IEC Publication No. 60068-02-17. Unless otherwise specified, the following details shall apply:

- Test Conditions:
 - (a) Fine leak: Test Qk, sealing tracer gas method with mass spectrometer:
 - Test method 1
 - Severity: 1000 hours
 - Maximum immersion pressure: 400kPa
 - (b) Gross leak: Test Qc, container sealing, gas leakage:
 - Test method 1

Note: Components sealed under vacuum shall not be tested for Gross Leak

8.7 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](#).

8.8 VIBRATION

Components shall be subjected to Test Fc of IEC Publication No. 60068-2-6. Unless otherwise specified, the following details shall apply:

- Test Conditions:
 - (a) Frequency Range: 10Hz to 2000Hz, by sweeping.
 - (b) Amplitude: 10Hz to 2000Hz: 3mm or 400m/s² (40g) whichever is the less severe.
 - (c) Duration: 10 cycles in each of the three mutually perpendicular axes, with a sweep rate of 1 octave/minute.
 - (f) Mounting: The components shall be mechanically connected to the vibration equipment either directly or by means of a fixture. Mounting fixtures shall enable the components to be vibrated in 3 mutually perpendicular axes in turn, which should be so chosen that faults are most likely to be revealed. If the component is provided with specific means of mounting, they shall be used and any additional restraining straps should be avoided. Unless otherwise specified, components not provided with specific means of mounting shall be clamped by the body and leads (leads clamped at 10 ±1mm from the body). Any external connections should add the minimum restraint and mass. Care shall be taken to avoid pinching the leads. For non-leaded SMDs, the components shall be clamped on the body.

- Data Points:

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

On completion of testing, the components shall be visually examined and there shall be no evidence of damage. Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.9 CLIMATIC SEQUENCE

Unless otherwise specified, the following details shall apply.

8.9.1 Dry Heat

The components shall be subjected to Test Bb of IEC Publication No. 60068-2-2 at the maximum storage temperature rating as specified in the Detail Specification for 16 hours.

- **Data Points:**

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

On completion of testing, the components shall be visually examined and there shall be no evidence of damage. Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.9.2 Damp Heat (First Cycle)

The components shall be subjected to Test Db, Severity b (+55°C), Variant 2, of IEC Publication No. 60068-2-30, for one cycle of 24 hours. On completion of testing after recovery, the components shall be immediately subjected to Para. 8.9.3 Cold.

8.9.3 Cold

The components shall be subjected to Test Ab of IEC Publication No. 60068-2-1 at the minimum storage temperature rating as specified in the Detail Specification for a duration of 2 hours.

- **Data Points:**

On completion of testing, the components shall be visually examined and there shall be no evidence of damage. Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification using the measurements on completion of Para. 8.9.1 Dry Heat as initial values.

8.9.4 Damp Heat (Remaining Cycles)

The components shall be subjected to Test Db, Severity b (+55°C), Variant 2, of IEC Publication No. 60068-2-30 for 6 cycles of 24 hours.

- **Data Points:**

On completion of testing, the components shall be visually examined and there shall be no evidence of damage. Resonance Frequency, Resonance Frequency Drift, Resonance Resistance, Resonance Resistance Drift and Insulation Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification using the measurements on completion of Para. 8.9.3 Cold as initial values.

8.10 RAPID CHANGE OF TEMPERATURE

Components shall be subjected to Test Na of IEC Publication No. 60068-2-14. Unless otherwise specified, the following details shall apply:

- Test Conditions:
 - (a) Low temperature: minimum storage temperature rating as specified in the Detail Specification.
 - (b) High temperature: maximum storage temperature rating as specified in the Detail Specification.
 - (c) Number of cycles: 50
 - (d) Exposure time (each cycle, each temperature): 15 minutes
 - (e) Transition time: $\leq 30s$

- Data Points:

On completion of testing and after a recovery period of 2 hours, the components shall be visually examined and there shall be no evidence of damage.

Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification using the measurements on completion of Para. 8.9.4 Damp Heat (Remaining Cycles) as initial values.

8.11 LIFE

8.11.1 For Components with OCXO as the Intended Application

Unless otherwise specified, components shall be subjected to an operating life test with the component operating at the Turning Point Temperature, T_{TP} , as specified in the Detail Specification, as part of a suitable oscillator circuit.

Surface mount components shall be mounted on a suitable substrate in accordance with IEC Publication No. 60115-1.

The following details shall apply:

- Test Conditions:
 - (a) 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
 - (b) Temperature: $T_{amb} = T_{TP} \pm 1^{\circ}C$.

- Data Points:

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

Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured on completion of testing as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification at 1000 ± 48 hours or 2000 ± 48 hours (as applicable). Drift shall always be related to the 0 hour measurements. In addition, Resonance Frequency shall be measured on a daily basis with a minimum of 4 measurements recorded per week for the full duration of the test.

On completion of testing, the components shall be visually examined and there shall be no evidence of damage.

8.11.2 For Components with an Intended Application other than OCXO

Unless otherwise specified, components shall be subjected to high temperature storage in a non-operating condition.

Surface mount components shall be mounted on a suitable substrate in accordance with IEC Publication No. 60115-1.

The following details shall apply:

- Test Conditions:
 - (a) Duration:
 - 2000 \pm 48 hours; applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
 - 1000 \pm 24 hours; applicable to Periodic Testing for extension of qualification
 - (b) Temperature: $T_{amb} = +105 (+0, -5)^{\circ}\text{C}$.
- Data Points:

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

Resonance Frequency, Resonance Frequency Drift, Resonance Resistance and Resonance Resistance Drift shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification at 500 \pm 48 hours, 1000 \pm 48 hours and 2000 \pm 48 hours (when applicable). Drift shall always be related to the 0 hour measurements.

On completion of testing, the components shall be visually examined and there shall be no evidence of damage

8.12 PERMANENCE OF MARKING

ESCC Basic Specification No. [24800](#).

8.13 SOLDERABILITY

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

- Test Conditions:
 - (a) Test method: 1 (solder bath at $+235 \pm 5^{\circ}\text{C}$), with immersion depth: minimum soldering distance as specified in the Detail Specification.
 - or:
 - (b) Test method: 3 (solder globule at $+235 \pm 2^{\circ}\text{C}$), with soldering time: as specified in the Detail Specification.

NOTES:

1. Unless otherwise specified, test method 1 shall apply.
 2. For surface mount components, only the part of the termination designed to be soldered shall be tested.
 3. When neither test method 1 or 3 is practicable, test method 2 (soldering iron at $+350 \pm 10^{\circ}\text{C}$) shall apply with soldering iron size A.
 4. For components with gold plated terminals, the test shall be performed in two steps as follows:
 - i. Degolding in solder bath A at $+250 \pm 5^{\circ}\text{C}$
 - ii. Tinning in separate solder bath B at $+235 \pm 5^{\circ}\text{C}$
- Final Inspection:

On completion of testing, the components shall be visually examined. There shall be no evidence of damage, and the marking shall be legible.

8.14 ROBUSTNESS OF TERMINATIONS

8.14.1 Leaded Components

Components shall be subjected to both a tensile strength and a bending test as follows:

- (a) Tensile strength test: test U_{a1} of IEC Publication No. 60068-2-21.
- (b) Bending test:
 - i. For Undercut Pin Terminals:

The body or base of the component shall be held or clamped by any convenient means. A bending tool suitable for the specific enclosure shall be used to engage that segment of the pin terminals which is beyond the undercut portion.

To ensure that bending will occur primarily at the undercut portion, a plate with two clearance holes for the pins may be placed over the pins. Its thickness may be such that it permits inclusion of part of the undercut section of the pins.

The pins shall be bent by the tool through $15 \pm 2^\circ$ in 1 direction and then through $30 \pm 2^\circ$ in the opposite direction, followed by a bend of $15 \pm 2^\circ$ for return to the starting position. The bending rate shall be approximately 3 seconds per bend in each direction.
 - ii. For Wire Lead Terminals:

Test U_b of IEC Publication No. 60068-2-21. 3 consecutive bends shall be performed with a load equal to half the load specified for the tensile strength test (a).

- Data Points:

After each test, the components shall be visually examined. There shall be no evidence of damage to, or loosening or breaking of the terminals, but cracks in the coating of the components, extending down to the terminal, are permitted.

8.14.2 Non-leaded SMD Components

Unless otherwise specified, components shall be subjected to an adhesion test in accordance with [MIL-STD-883, Test Method 2019](#). The following details shall apply:

- Test Conditions:
 - (a) Mounting: Components shall be mounted on a suitable substrate in accordance with IEC Publication No. 60115-1.
 - (b) Shear Force: 20N
- Data Points:

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

On completion of testing, the components shall be visually examined at a magnification of x10 (approximately) in a still mounted condition. There shall be no evidence of damage, cracking, lifting or dry solder joints.

Resonance Frequency and Resonance Frequency Drift shall be measured in still mounted condition, as specified in Intermediate and End-Point Electrical 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 (including range of delivered serial numbers).

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) Range of delivered serial numbers.
- (f) Number of the Purchase Order.
- (g) Information relative to any additions to this specification and/or the Detail Specification.
- (h) Manufacturer's name and address.
- (i) Location of the manufacturing plant.
- (j) Signature on behalf of Manufacturer.
- (k) 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. For each test requiring electrical measurements the results shall be recorded against component serial number. Component drift calculations shall be recorded for each specified test against component serial number. For Radiographic Inspection, photographic results shall be recorded against component serial number.

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 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 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 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.

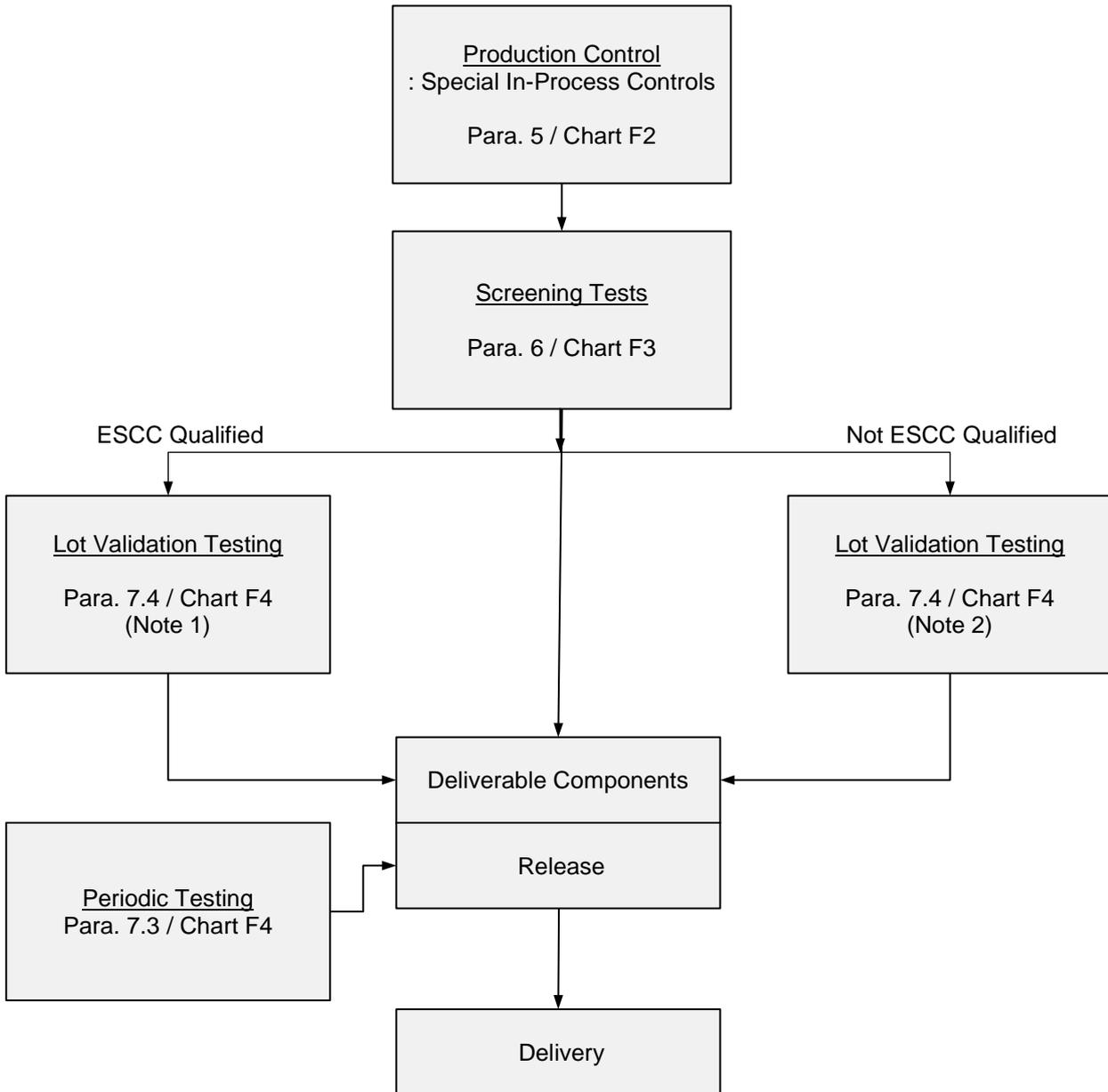
For qualification or qualification maintenance, the disposition of the Qualification Test Lot and its related documentation shall be as specified in ESCC Basic Specification No. [20100](#) or [25400](#) and the relevant paragraphs of Section 9 of this specification.

11 PACKAGING AND DISPATCH

The packaging and dispatch 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 FOR PROCUREMENT**



NOTES:

1. Lot Validation Testing is not required for qualified Packaged Components unless specifically stipulated in the Purchase Order.
2. For unqualified Packaged 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 |
| - | Encapsulation |
| 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.

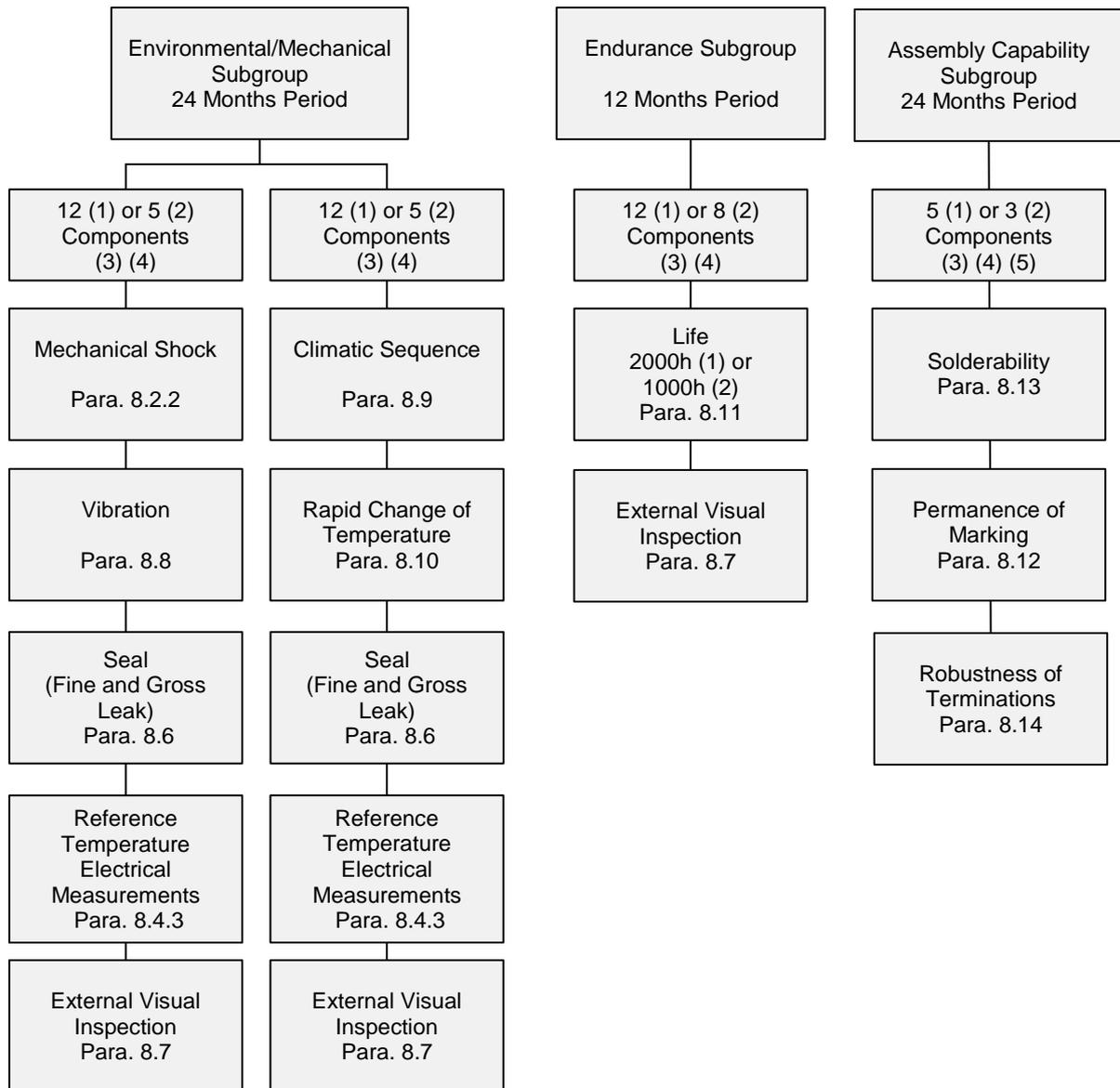
12.3 CHART F3 - SCREENING TESTS

| | |
|---|---|
| PACKAGED COMPONENTS FROM PRODUCTION CONTROL | |
| Para. 6.1 | Serialisation |
| Para. 8.2.1 | Mechanical Shock |
| Para. 8.3.1 | Pre-Burn-in (1) |
| Para. 8.4.2 | Parameter Drift Values (Initial Measurements) |
| Para. 8.3.2 | Burn-in |
| Para. 8.4.2 | Parameter Drift Values (Final Measurements) (2) |
| Para. 8.4.3 | Reference Temperature Electrical Measurements (2) (3) |
| Para. 8.4.4 | High and Low Temperatures Electrical Measurements (2) |
| Para. 6.4.1 | Check for Lot Failure (4) |
| Para. 8.5 | Radiographic Inspection (5) |
| Para. 8.6 | Seal (Fine and Gross Leak) |
| Para. 8.7 | External Visual Inspection |
| TO CHART F4 WHEN APPLICABLE | |

NOTES:

1. Pre-Burn-in may be performed at any point during Screening Tests prior to the initial Parameter Drift Values.
2. The lot failure criteria of Para. 6.4.1 apply to this test.
3. Measurements of Parameter Drift Values need not be repeated in Reference Temperature Electrical Measurements.
4. Check for Lot Failure shall take into account all electrical parameter failures that may occur during Screening Tests in accordance with Paras. 8.4.2, 8.4.3 and 8.4.4 subsequent to Burn-in.
5. Radiographic Inspection may be performed at any point during Screening Tests after Serialisation.

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



NOTES:

1. Applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
2. Applicable to Periodic Testing for extension of qualification.
3. For distribution within the subgroups, see Para. 7.1.2 for qualification and qualification maintenance and Para. 7.4 for Lot Validation Testing.
4. No failures are permitted.
5. Post-Burn-in electrical rejects may be used for these tests.