RESISTORS, HEATERS, FLEXIBLE

ESCC Generic Specification No. 4009

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TBD	Specification upissued to incorporate editorial and technical 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 Resistors, Heaters, flexible 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 a component in accordance with ESCC Basic Specification No. 20100 and the procurement of such components from qualified Manufacturers. It may also be applied for procurement of unqualified components.

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. 20500, External Visual Inspection.
– No. 20600, Preservation, Packaging and Dispatch of ESCC Electronic Components.
– No. 21300, Terms, Definitions, Abbreviations, Symbols and Units.
– No. 21700, General Requirements for the Marking of ESCC Components.
– No. 22800, ESCC Non-conformance Control System.
– 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.

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

– REP005, ESCC Qualified Parts List.
– ECSS-Q-70-02, Thermal Vacuum Test for the Screening of Space Materials.
– IEC Publication No. 68, Basic Environmental Testing Procedures.

– IEC Publication No. 115, Fixed Resistors for Use in Electronic Equipment.

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 test requirements for the component type qualification of a component shall comprise Special In-Process Controls, Screening Tests and Component Type Qualification Testing.

The test requirements for procurement of components shall comprise Special In-Process Controls, Screening Tests, together with Periodic Testing for qualified components and Lot Validation Testing for qualified (if required in the Purchase Order) and unqualified components.

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

4.2 QUALIFICATION AND QUALIFICATION MAINTENANCE REQUIREMENTS ON A MANUFACTURER

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

4.3 DELIVERABLE COMPONENTS

Components delivered to this specification shall be processed and inspected in accordance with the relevant Process Identification Document (PID). Each delivered component shall be traceable to its production lot. Components delivered to this specification shall have satisfactorily completed all the required tests.

ESCC qualified components delivered to this specification shall be produced from lots that are 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 it could not have passed these tests at the time of manufacture, this shall be grounds for rejection of the delivered lot.

4.3.1 Lot Failure

Lot failure may occur during Screening Tests (Chart F3) or Qualification and Periodic Tests (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 shall be performed on the failed components.

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 shall be performed on the failed components. 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 non-metallic materials and finishes, of the components specified herein shall meet the outgassing requirements as outlined in ECSS-Q-70-02.

4.5.1 Terminal Leads Requirements

Wires used for terminal leads shall be as specified in the applicable wire ESCC Detail specification as

referenced in the heater ESCC Detail Specification. The wires shall be ESCC Qualified as evidenced by a listing in the current ESCC Qualified Parts List REP005.

5. PRODUCTION CONTROL

5.1 GENERAL

The minimum requirements for production control are defined in the Process Identification Document (PID).

Unless otherwise specified 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.

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.

5.2 SPECIAL IN-PROCESS CONTROLS

5.2.1 Robustness of Terminations

In accordance with Para. 8.6 and the Detail Specification on a 100% basis.

5.2.2 Dimension Check

In accordance with Para. 8.5 on 3 samples only.

If a failure occurs, the complete lot shall be checked.

5.2.3 Weight

The maximum weight of the components specified in the Detail Specifications 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 in the Detail Specification, all 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.

Unless otherwise specified in the Detail Specification, the tests shall be performed in the order 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 Parameter Limit Failure

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

6.2.2 Other Failures

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

– Visual Inspection 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. 4.3.1.

6.4.1 Lot Failure during 100% Testing

If the number of components failed on the basis of the failure criteria specified in Para. 6.2.1 exceeds 5% (rounded upwards to the nearest whole number) of the components submitted to burn-in in 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.

If a lot failure occurs, a 100% testing may be performed but the cumulative percent defective shall not exceed that given 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

Requirements of this paragraph are applicable to the tests performed for component type qualification and qualification maintenance, and also for Lot Validation Testing. All components shall be serialised prior to the tests and inspections.

7.1 COMPONENT TYPE QUALIFICATION TESTING

7.1.1 General

Qualification testing shall be in accordance with the requirements given 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 (Screening Tests). 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 component type qualification testing are given in ESCC Basic Specification No. 20100.

7.1.2 Distribution within the Qualification Test Lot

The qualification test lot shall be comprised in accordance with the following provisions:.

– 1/3 of the lot with the maximum resistive density.
– 1/3 of the lot with the average resistive density (10 to 30 Ohms/cm^2).
– 1/3 of the lot of the double layer type with separate outputs.

The component types may be specified by, but in any case shall be agreed with, the ESCC Executive, prior to the commencement of qualification testing and the justification for the selection shall be declared in the qualification test report.

7.2 QUALIFICATION MAINTENANCE (PERIODIC TESTING)

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

7.3 LOT VALIDATION TESTING

7.3.1 General

For qualified components, Lot Validation Testing as defined in compliance with Chart F4, Subgroup 2, shall only be performed on the procured lot if required in the Purchase Order.

If unqualified components are procured using this specification then the Orderer shall define in the Purchase Order the required subgroups from Chart F4 to be used for Lot Validation Testing.

7.3.2 Distribution within the Sample for Lot Validation Testing

Where a Detail Specification covers a range, or series, of components that are considered similar, then it is only necessary to perform Lot Validation Testing on representative types if a number of different types are procured together. The sample for Lot Validation Testing should be comprised of component types so selected that they adequately represent all of the various mechanical, structural and electrical peculiarities of the components procured from the range or series.

The distribution of component types will vary from procurement to procurement and shall be as required in the Purchase Order.

7.4 FAILURE CRITERIA

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

7.4.1 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.

7.4.2 Electrical Failures

The following shall be counted as component failures:

Components which fail one or more of the applicable limits at each of the relevant data points specified for environmental, mechanical and endurance testing in Intermediate and End-point Electrical Measurements in the Detail Specification.

7.4.3 Other Failures

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

– Visual Inspection failure
– Mechanical failure
– Handling failure
– Lost component

7.5 FAILED COMPONENTS

A component shall be considered as failed if it exhibits one or more of the failure modes detailed in Para. 7.4.

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 by 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.

7.6 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 given in Para. 7.4.

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 given in Para. 7.4.

In the case of lot failure, the Manufacturer shall act in accordance with Para. 4.3.1.

7.7 QUALIFICATION, QUALIFICATION MAINTENANCE AND LOT VALIDATION TESTING SAMPLES

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

7.8 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 qualifed 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 ELECTRICAL MEASUREMENTS

8.1.1 General

Electrical measurements and methods shall be as follows.

8.1.1.1 Resistance

Measurements of resistance shall be made by using a direct voltage of small magnitude for as short a time as practicable so that the temperature does not rise appreciably during measurement.

The resistance of terminal leads attached to the heaters shall be calculated and subtracted from the actual measurement. The terminal lead resistance shall be calculated from data found in the applicable wire specification. Additionally, for High and Low temperatures and Temperature Coefficient measurements, the heaters and the whole length of their terminal leads shall be placed inside the temperature chamber. In this case, the terminal lead resistance, adjusted for temperature coefficient resistance, shall be subtracted from the actual measurement.

The resistance limits at $+22 \pm 3\ ^{\circ}C$ are given in Room Temperature Electrical Measurements in the Detail Specification.

In the event of conflicting results, attributable to test voltages, the voltage specified in the following table shall be used for reference purposes.

Rated Resistance (R_n) (Ω)	Measuring Voltage V (+0-10)%
less than 10	0.1 (Note 1)
10 to 99	0.3
100 to 999	1
1000 to 9999	3

NOTES:

1. The accuracy of the measuring equipment shall be such that the error does not exceed 10% of the

tolerance. Where the measurement forms part of a test sequence, it shall be possible to measure a change in resistance with an error not exceeding 10% of the maximum change permitted for that test.

8.1.1.2 Insulation Resistance

– Mounting
The heaters shall be clamped between 2 conducting plates connected together.
– Test Conditions
The insulation resistance shall be measured with a direct voltage of 500 ± 50V. The measurement shall be performed between all terminations of the heater connected together as one pole and the mounting device as the other pole; for heaters with more than one resistor, the measurement shall also be performed between each resistor, with each resistor having both terminations connected together to form one pole.

The voltage shall be applied for 1 minute or such shorter time as is necessary to obtain a stable reading. The insulation resistance shall be read at the end of that period and shall not be less than that specified in Room Temperature Electrical Measurements in the Detail Specification. There shall be no evidence of breakdown or flash-over.

8.1.1.3 Voltage Proof

– Mounting
The heaters shall be clamped between 2 conducting plates connected together.
– Test Conditions
A voltage as specified in Room Temperature Electrical Measurements in the Detail Specification shall be applied for a period of 60 ± 5 seconds between all terminations of the heater connected together as one pole and the mounting device as the other pole; for heaters with more than one resistor, the measurement shall also be performed between each resistor, with each resistor having both terminations connected together to form one pole. The voltage shall be applied gradually at a rate of approximately 100V/second. There shall be no evidence of breakdown or flash-over.

8.1.2 High and Low Temperatures Electrical Measurements

High and Low Temperatures Electrical Measurements shall be performed as specified in the Detail Specification. Measurements shall be performed during Screening Tests on a sample of 3 components. In the event of any failure a 100% inspection shall be performed.

8.1.3 Room Temperature Electrical Measurements

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

8.1.4 Intermediate and End-Point Electrical Measurements

At each of the relevant data points during Qualification and Periodic Tests 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, if specified.

8.2 RAPID CHANGE OF TEMPERATURE

The heaters shall be subjected to Test ‘Na’ of IEC Publication No. 68-2-14 with the following details:

– Mounting
The heaters shall be suspended by their terminal leads in still air.

– Test Conditions
The duration of exposure at the maximum and minimum storage temperature ratings as specified in the Detail Specification shall be 15 minutes each. The number of cycles shall be 10.

– Data Points
During the 10 exposures to high temperature, electrical continuity shall be checked. On completion of testing the heaters shall be subjected to standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours. Resistance shall be measured as specified in Room Temperature Electrical Measurements in the Detail Specification.

8.3 OVERLOAD

Overload shall be performed during Screening Tests on a sample of 5 components with the following details:
In the event of any failure a 100% inspection shall be performed.

– Mounting
The heaters shall be suspended by their terminal leads in still air. Heaters shall be positioned such that one heater does not unduly influence the temperature of any other.
– Test Conditions
The ambient temperature shall be between +15 and + 35 ˚C.
The heaters shall be tested with a power of 1.5 times the rated power as specified in the Detail Specification for a period of 1 minute minimum.
Each layer of double layer heaters shall be tested successively for the period specified. Resistors of multiple resistor single layer heaters shall be tested simultaneously.
– Data Points
On completion of testing the heaters shall be subjected to standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours. Resistance shall be measured as specified in Room Temperature Electrical Measurements in the Detail Specification.

8.4 BURN-IN

Burn-in shall be performed in accordance with IEC Publication No. 115.1, Clause 4.25 with the following details:

– Mounting
The heaters shall be suspended and connected by their terminal leads in still air. Heaters shall be positioned such that one heater does not unduly influence the temperature of any other.
– Test Conditions
As specified in Burn-in in the Detail Specification.
The duration of the burn-in shall be 168 (+24-0) hours.
Each layer of double layer heaters shall be tested successively for 84 hours.
Resistors of multiple resistor single layer heaters shall be tested simultaneously.
The voltage (dc or full-wave rectified ac with ripple less than 5%) shall be increased until either rated power density or the maximum rated operating temperature, both as specified in the Detail Specification, are reached.
The voltage shall be in cycles of 1.5 hours “ON” and 0.5 hours “OFF”(The “OFF” cycles are included in the test duration).

– Data Points
On completion of testing the heaters shall be subjected to standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours. Resistance shall be measured as

specified in Room Temperature Electrical Measurements 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.

The heater surface shall be free of cuts or abrasion. The heaters shall not exhibit bubbles or delamination.

Dimension check (during Special In-Process Controls only) shall be performed in accordance with ESCC Basic Specification No. 20500 and the Detail Specification on a sample of 3 components. If a failure occurs the complete lot shall be checked.

8.6 ROBUSTNESS OF TERMINATIONS

The heaters shall be subjected to Test 'Ua 1' of IEC Publication No. 68-2-21 with the following details:

– Test Conditions
  The strength and duration of the pull shall be as specified in the Detail Specification.

– Data Points
  (a) During Special In-Process Controls: Not applicable.
  (b) During Qualification and Periodic Tests: Resistance and Change in Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification both before and after the test. Change in Resistance shall be related to the initial measurements.

8.7 CLIMATIC SEQUENCE

8.7.1 Initial Measurements

The resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.7.2 Dry Heat

The heaters shall be subjected to Test 'Ba' of IEC Publication No. 68-2-2 at the maximum storage temperature rating as specified in the Detail Specification for 2 hours.

On completion of testing the heaters shall be subjected to standard atmospheric conditions for recovery, for not less than 1 hour before being subjected to Damp Heat (first cycle).

8.7.3 Damp Heat (Accelerated) First Cycle

The heaters, suspended by their terminal leads, shall be subjected to Test Db, Severity a, Variant 2, of IEC Publication No. 68-2-30, for one cycle of 24 hours. On completion of testing after recovery, the heaters shall be immediately subjected to the Cold Test.

8.7.4 Cold Test

The heaters shall be subjected to Test 'Ad' of IEC Publication No. 68-2-1 at the minimum storage temperature rating as specified in the Detail Specification. After 1 hour of stabilisation at this temperature, the heaters shall be tested with rated power as specified in the Detail Specification, for 45 minutes.

Each layer of double layer heaters shall be tested successively for the period specified.

Resistors of multiple resistor single layer heaters shall be tested simultaneously.

On completion of testing the heaters shall be removed from the chamber and subjected to standard atmospheric conditions for recovery for not less than 4 hours before being subjected to Low Air Pressure.

8.7.5 Low Air Pressure

The heaters, operated with rated power as specified in the Detail Specification, shall be subjected to Test 'M' of IEC Publication No. 68-2-13, using a pressure of 20±1 mbar.

Each layer of double layer heaters shall be tested successively for the period specified.

Resistors of multiple resistor single layer heaters shall be tested simultaneously.

The test shall be performed at a temperature between +15 and + 35 ˚C.

The duration of the test shall be 1 hour.

On completion of testing the heaters shall immediately be subjected to Damp Heat (remaining cycles).

8.7.6 Damp Heat (Accelerated) Remaining Cycles

The heaters, suspended by their terminal leads, shall be subjected to Test 'Db', Severity a, Variant 2, of IEC Publication No. 68-2-30 for 5 cycles of 24 hours.

On completion of testing the heaters shall be removed from the chamber and subjected to standard atmospheric conditions for recovery for 30 ± 5 minutes before being subjected to DC Load.

8.7.7 DC Load

The heaters suspended and connected by their terminal leads in still air shall be operated at rated power as specified in the Detail Specification for 1 minute.

Each layer of double layer heaters shall be tested successively for the period specified.

Resistors of multiple resistor single layer heaters shall be tested simultaneously.

On completion of testing the heaters shall be subjected to standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours before being subjected to Final Measurements.

8.7.8 Final Measurements

Resistance, Change in Resistance, Insulation Resistance and Voltage Proof, shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Change in Resistance shall be related to the initial measurements

8.8 OPERATING LIFE

Operating Life shall be performed in accordance with the following details:

– Mounting
  The heaters shall be suspended and connected by their terminal leads in still air. Heaters shall be positioned such that one heater does not unduly influence the temperature of any other.
– Test Conditions
  As specified in Operating Life in the Detail Specification
  The duration of Operating Life shall be 2000 ± 48 hours.

Each layer of double layer heaters shall be tested successively for 1000 ± 48 (2000 ± 48 hours total).
Resistors of multiple resistor single layer heaters shall be tested simultaneously.
The voltage (dc or full-wave rectified ac with ripple less than 5%) shall be increased until either rated power density or the maximum rated operating temperature, both as specified in the Detail Specification, are reached.
The voltage shall be in cycles of 1.5 hours “ON” and 0.5 hours “OFF”(The “OFF” cycles are included in the test duration).

– Data Points
As specified in Intermediate and End-Point Electrical Measurements in the Detail Specification at 0 hours, 1000±48 hours and 2000±48 hours.
If drift values are specified, the drift shall always be related to the 0-hour measurement.
At each data point the heaters shall be subjected to standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours prior to electrical measurements.
After the 1000 hour measurement the heaters shall be returned to the test conditions. The interval between removal from and return to the test conditions for any heater shall not exceed 12 hours.

8.9 PERMANENCE OF MARKING
Permanence of Marking shall be performed in accordance with ESCC Basic Specification No. 24800

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 and Periodic Tests data including Lot Validation Testing data (when applicable) (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 subpackages 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 supplied in electronic format suitable for reading using a compatible PC. The format supplied shall be legible, durable and indexed. The preferred storage media are 3 1/2 inch diskettes or CD-ROMs and the preferred file formats are ASCII or 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 required 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, if not in accordance with the data given in the PID. 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 AND PERIODIC TESTS DATA (CHART F4)

9.7.1 Qualification Tests

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 and Periodic Tests.
(b) The 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 as defined in ESCC Basic Specification No. 20100.

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 (when applicable), but not forming part of the delivery lot.
(c) The relevant documentation in accordance with the requirements of Section 9.

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.

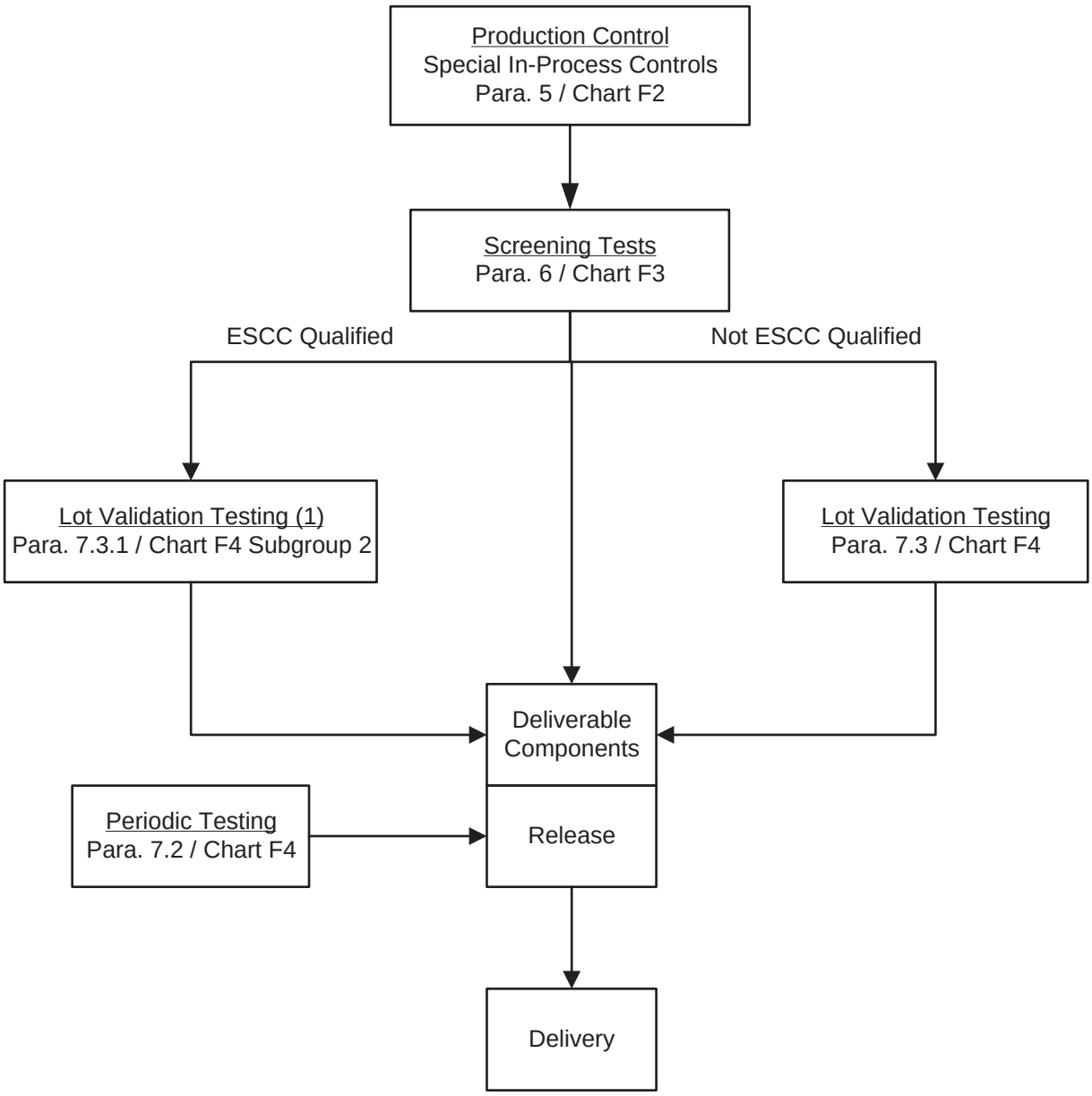
For qualification or qualification maintenance, the disposition of the test lot and its related documentation shall be as specified in ESCC Basic Specification No. 20100 and the relevant paragraphs of Section 9 of this specification.

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

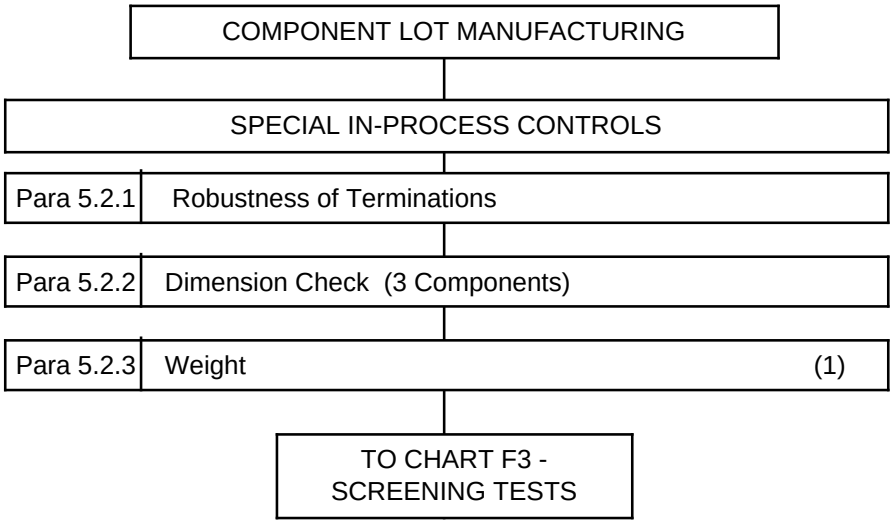
12.1 CHART F1 - GENERAL FLOW FOR PROCUREMENT



NOTES:

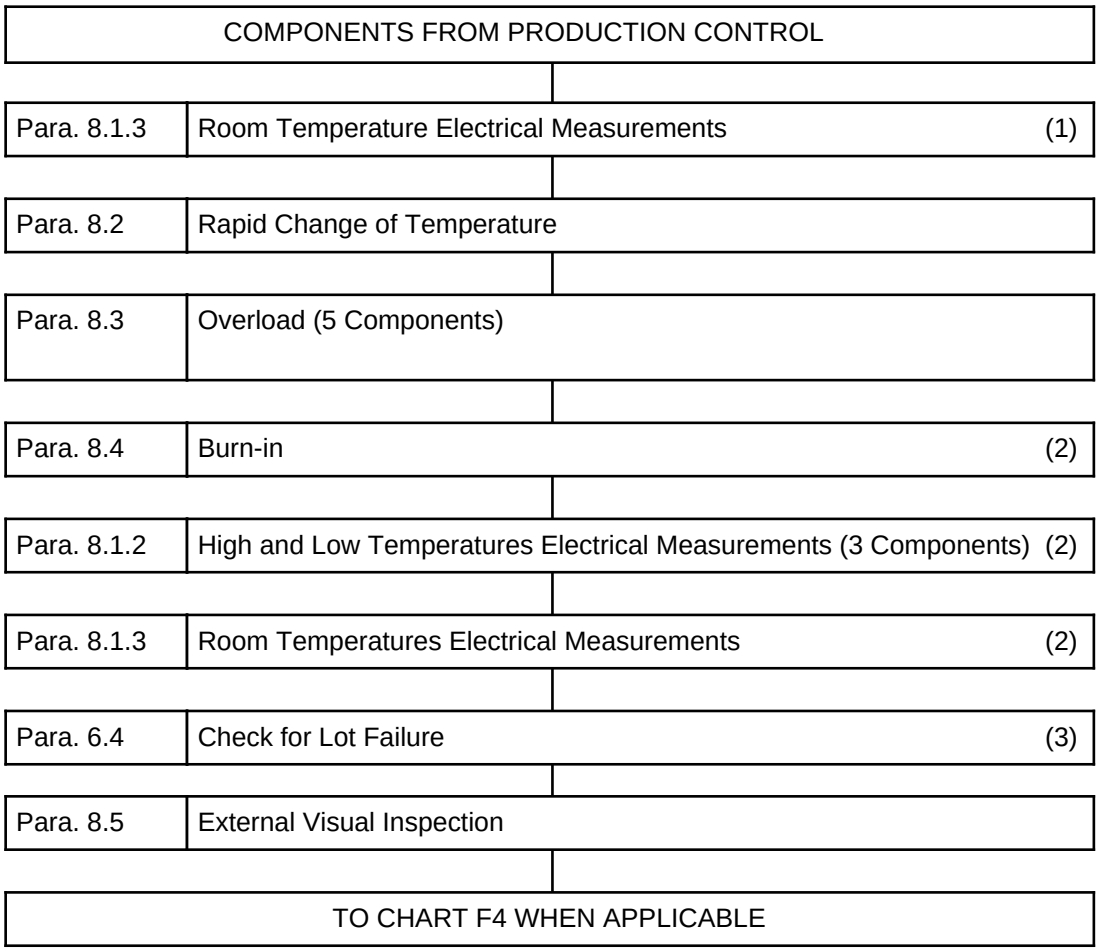
1. Lot Validation Testing is optional for qualified components and shall only be performed if required in the Purchase Order.

12.2 CHART F2 - PRODUCTION CONTROL



NOTES:
1. Guaranteed but not tested.

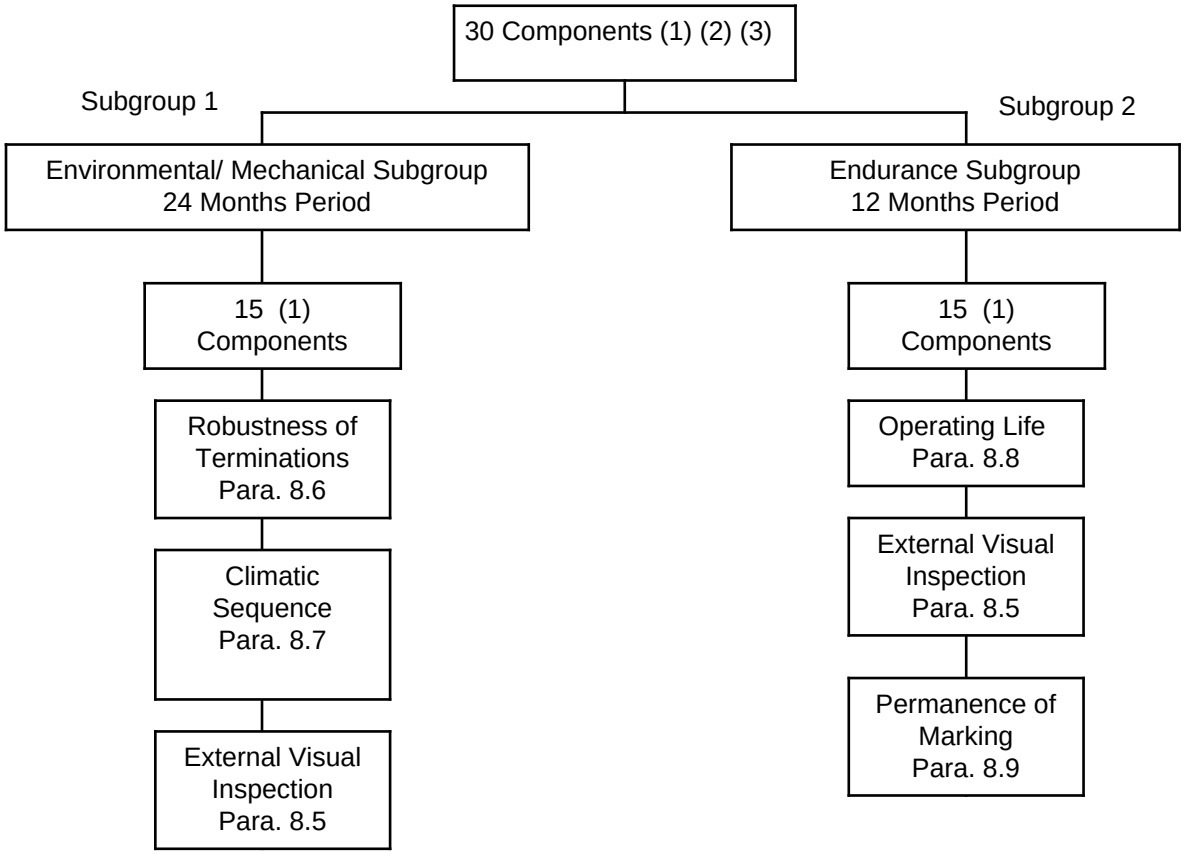
12.3 CHART F3 - SCREENING TESTS



NOTES:

1. Optional at the manufacturer's discretion.
2. The lot failure criteria of Para. 6.4.1 apply to this test.
3. Check for Lot Failure shall take into account all electrical parameter failures that may occur during Screening Tests in accordance with Para. 8.4, 8.1.2 and 8.1.3 following completion of burn-in testing.

12.4 CHART F4 - QUALIFICATION AND PERIODIC TESTS



NOTES:

1. For distribution within the subgroups, see Para. 7.1.2.
2. No failures are permitted.
3. All components shall be serialised prior to testing.