DOCUMENT CHANGE REQUEST

DCR number 100	Changes required for: N/A	Originator: Steve Thacker
Date: 2004/10/13	Date sent: 2004/10/13	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Generic Specification for Resistors Heaters Flexible		
Number:	4009	Issue:	1

Other documents affected:

Page:

See Appendices 1 & 2

Paragraph:

See Appendices 1 & 2

Original wording:

Proposed wording:

Specification 4009 rewritten as issue draft 2F (Appendix 3) to incorporate editorial, policy and technical changes as described and detailed in Appendices 1 & 2.
. Appendix 1 details all changes and identifies if each change is considered as Editorial, Policy or Technical .
. Appendix 2 is a complete mark-up of ESCC 4009 Draft 1B showing all the changes incorporated into draft 2F.

Attached:
. Appendix 1 - Detailed changes to ESCC 4009 issue 1 draft B
. Appendix 2 - Mark-up of ESCC 4009 issue 1 draft B
. Appendix 3 - ESCC 4009 issue 2 draft F

Justification:

All changes have been defined and included to serve the purposes of clarification, accuracy, completeness, simplification and consistency. The aim is to simplify and improve the interpretation of the specification and it's requirements whilst maintaining the same overall structure and technical baseline as per the previous ESCC 4009 issue 1 (ESA/SCC 4009 issue 3B) and ESCC 4009 draft 1B specifications.
For Policy and Technical changes specific explanations and justifications are provided in Appendix 1.

Attachments:
Appendix_2_Markup_of_4009_draft_1B_13.10.04.pdf, Appendix_3_4009_draft_2F.pdf, Appendix_1_Details_of_changes_in_4009_draft_2F.pdf, null
Modifications:
N/A
Approval signature:

Date signed:
2004-10-13

RESISTORS, HEATERS, FLEXIBLE

ESCC Generic Specification No. 4009

Issue 2 -Draft F	September 2004

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

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DCR No.	CHANGE DESCRIPTION
TBD	Specification upissued to incorporate editorial and technical changes per DCR.

TABLE OF CONTENTS

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.

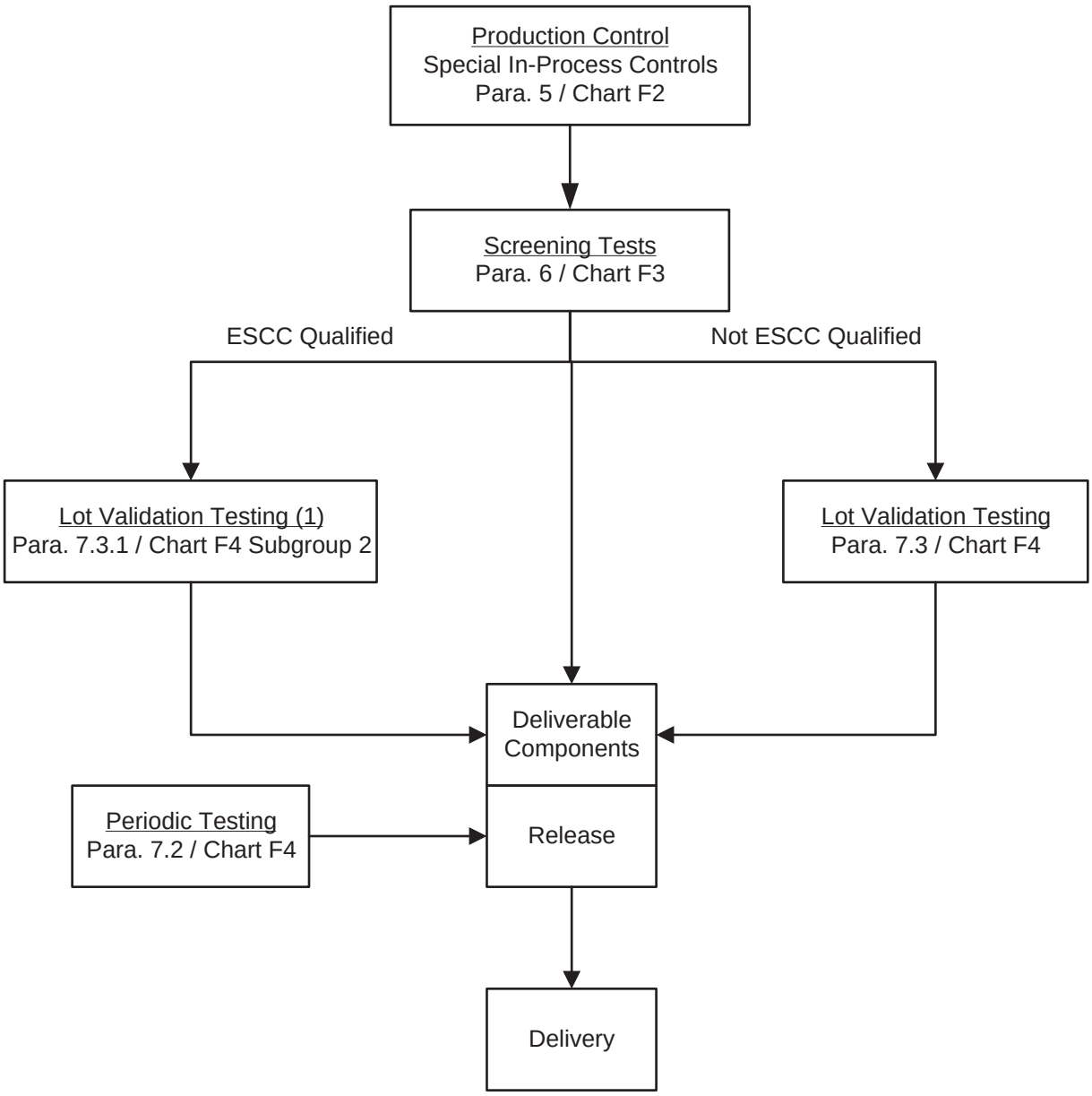
For qualification or qualification maintenance, the disposition of the test lot and its related documentation shall be as specified in ESCC Basic Specification No. 20100 and the relevant paragraphs of Section 9 of this specification.

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

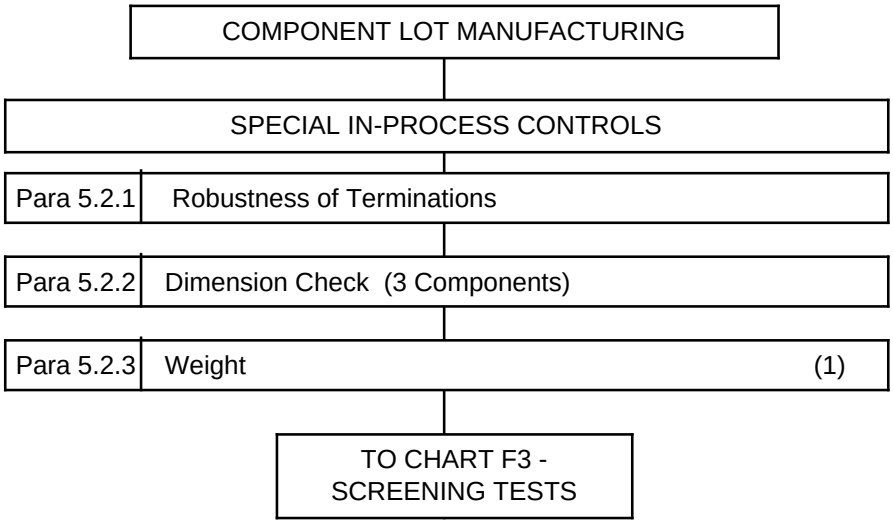
12.1 CHART F1 - GENERAL FLOW FOR PROCUREMENT



NOTES:

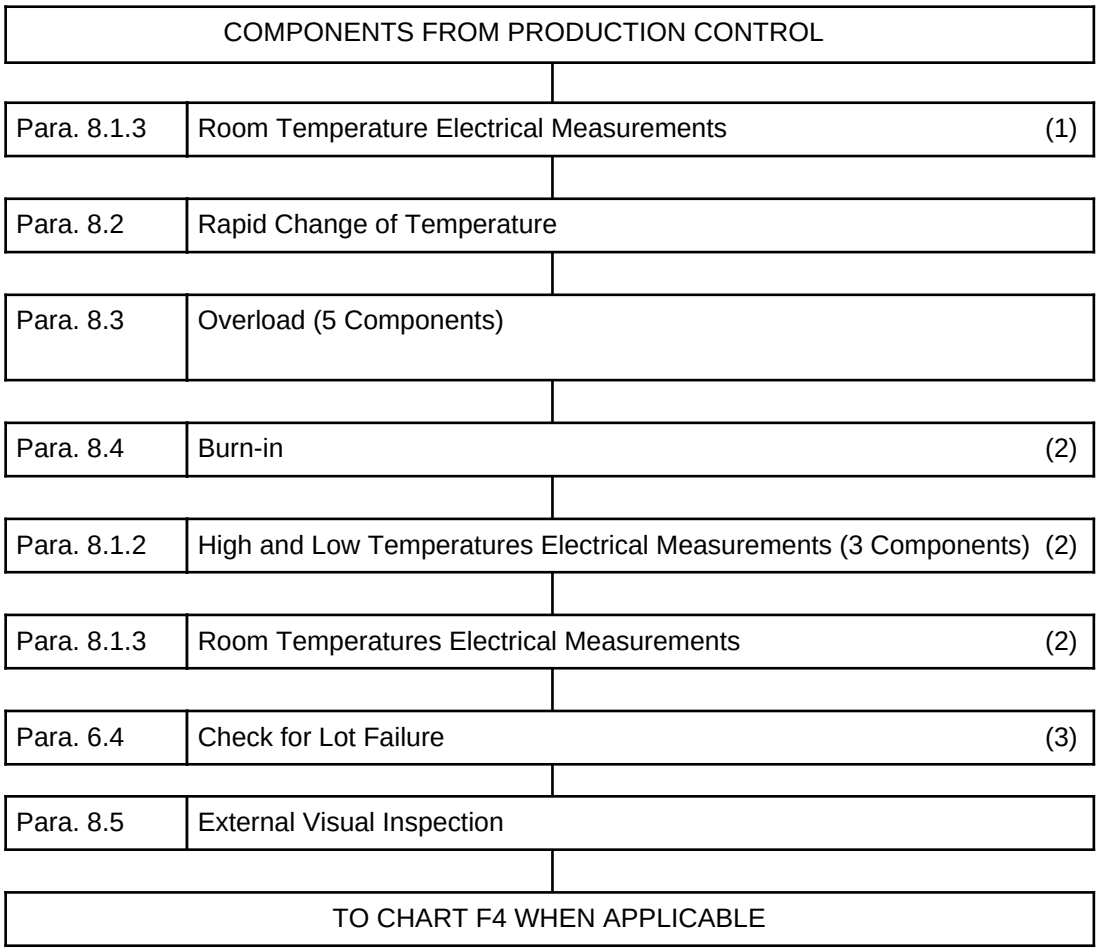
1. Lot Validation Testing is optional for qualified components and shall only be performed if required in the Purchase Order.

12.2 CHART F2 - PRODUCTION CONTROL



NOTES:
1. Guaranteed but not tested.

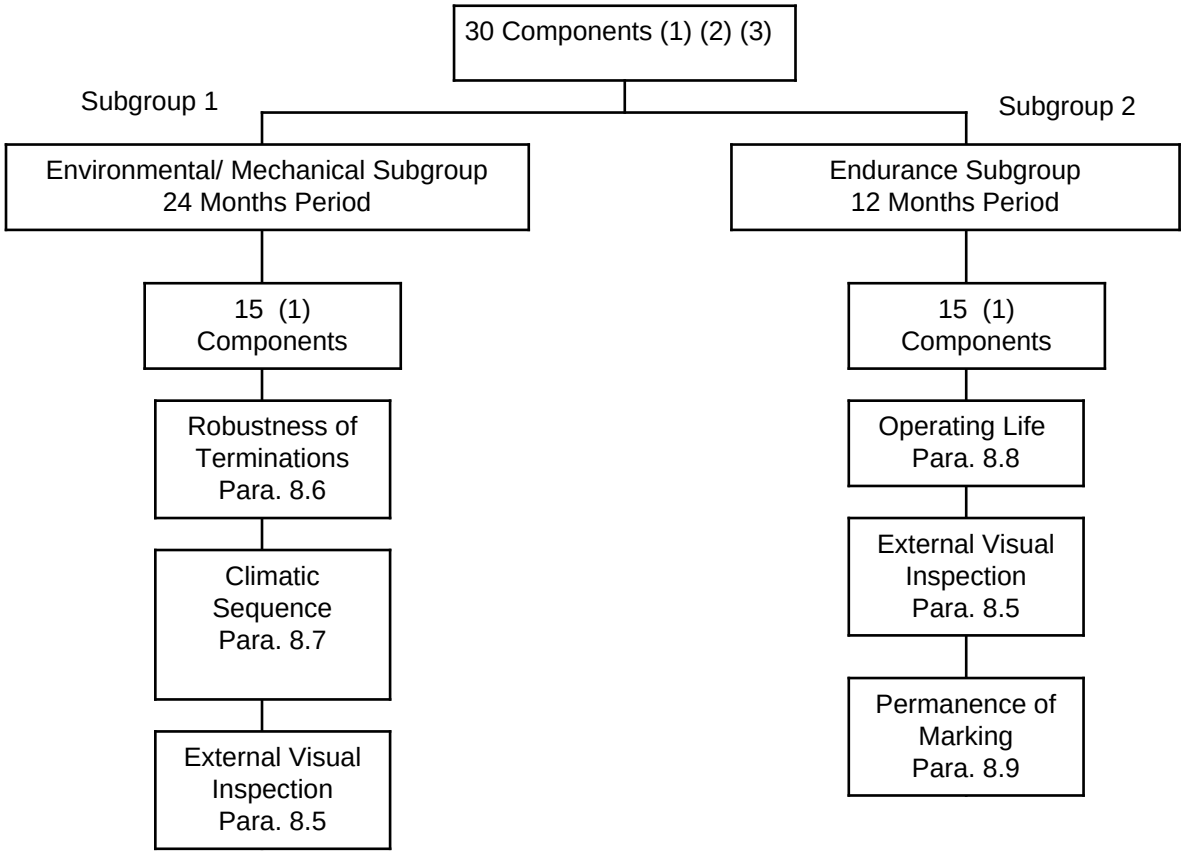
12.3 CHART F3 - SCREENING TESTS



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.

APPENDIX 2

MARK-UP Showing all changes from 4009 draft 1B to 2F

european space agency
agence spatiale européenne

Replace by ESCC Symbol/logo

Pages 1 to ~~28~~

RESISTORS, HEATERS, FLEXIBLE

ESCC Generic Specification No. 4009

ISSUE ~~1~~ 2, DRAFT '~~B~~ F', ~~JANUARY 2002~~

space components
coordination group

"Disdaimer" sheet

Draft F on all sheets.

LEGAL DISCLAIMER AND COPYRIGHT

Symbol changed to ESCC on all pages

Add "disclaimer" sheet as attached.

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		~~I.T. 32 MOM.~~	use new DCN sheet (see attached example)	

New Doc/Change/Notice.

DOCUMENTATION CHANGE NOTICE

(Refer to https://escies.org for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
TBD	Specification upissued to incorporate editorial and technical changes per DCR

TABLE OF CONTENTS

Table rewritten to reflect actual contents

1. INTRODUCTION

1.1 SCOPE

This specification defines the general requirements for the qualification approval, qualification maintenance, procurement, ~~lot validation~~ 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 the 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 Despatch 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) ~~(P.I.D.) and listed in an appendix to the appropriate Detail Specification~~.

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

REPOOS, 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.

~~IEC Publication No. 410, Sampling Plans and Procedures for Inspection by Attributes~~.

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.

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 component type qualification ~~approval~~ of a component shall comprise Screening Tests ~~(see Chart F2)~~ and Qualification Testing ~~(see Chart F3)~~.

The test requirements for procurement of components shall comprise Screening Tests ~~(see Chart F2)~~, together with Lot Validation Testing for unqualified components ~~(see Para. 7.3.1)~~. ~~Chart F1 summarises the requirements for procurement~~.

If a Manufacturer elects to eliminate an in-process control by substituting a statistical process 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.

4.1.1 Specifications

For qualification ~~approval~~, procurement ~~(including lot validation testing)~~ and delivery of components in conformity with this specification, the 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 ~~prior to commencing qualification testing, or procurement~~, to use an approved external facility.

4.1.4 Inspection Rights

The ESCC Executive ~~(for qualification approval or for a procurement)~~ reserves the right to monitor any of the tests and inspections scheduled in the applicable specifications.

~~4.1.5 Pre-encapsulation Inspection Witnessing~~

~~Not applicable.~~

4.5.1 ~~4.1.6 Wires for Terminal Leads~~

~~Wires used for terminal leads shall be ESCC qualified.~~

see attached.

4.2 QUALIFICATION ~~APPROVAL~~ AND QUALIFICATION MAINTENANCE REQUIREMENTS ON A MANUFACTURER

To obtain and maintain the component type qualification ~~approval~~ 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 (~~P.I.D.~~ (PID)). Each delivered component shall be traceable to its production lot. Components delivered to this specification shall have satisfactorily completed all tests ~~specified in the Purchase Order.~~ the required

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 ~~F3~~ 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 ~~Special In Process Controls~~, Screening Tests (Chart F3) ~~(Chart F2)~~ or ~~lot validation testing using Chart F3.~~ Qualification and Periodic Tests (Chart F4).

~~Should such failure occur, the non-conformance procedure shall be initiated in accordance with ESCC~~ Basic Specification No. 22800.

replace by attached

Should such failure occur during procurement, 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.

In the case where qualification approval has been granted to the component, he shall, at the same time by the same means, inform the ESCC Executive in order that the latter may consider its implications.

No further testing shall be performed on the failed components except on instruction from the Orderer. for qualified components The Orderer shall inform the Manufacturer and the ESCC Executive within 5 working days of receipt of the notification, what action shall be taken.

In the case when lot failure occurs during qualification or qualification maintenance ~~testing~~, the Manufacturer shall immediately notify the ESCC Executive who will define a course of action to be followed. No further testing shall be ~~performed on the failed components.~~

4.4 MARKING

All components procured and delivered to this specification ~~from a source qualified according to ESCC Basic Specification No. 20100~~ shall be marked in accordance with ESCC Basic Specification No. 21700, ~~and the Detail Specification. Thus, they shall bear the ESA symbol to signify their conformance to the ESCC qualification approval requirements and full compliance with the requirements of this specification and the Detail Specification~~.

Components procured from sources which are not ESCC qualified, provided that they fully comply with the procurement requirements of this specification and the Detail Specification, may bear the ESCC marking **with the exception of the ESA symbol**.

Replacement for Para 4.3.1 2nd to 5th sub-para's:

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.

Para 4.5.1 replaces Para 4.1.6:

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.

4.5 MATERIALS AND FINISHES

All non-metallic materials and finishes, that are not within a hermetically sealed enclosure, of the components specified herein shall meet the outgassing requirements as outlined in ECSS-Q-70-02.

Specific requirements for materials and finishes are specified in the Detail Specification.

5. PRODUCTION CONTROL ~~FOR PROCUREMENT AND QUALIFICATION~~

5.1 GENERAL

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

5.2 SPECIAL IN-PROCESS CONTROLS

~~Where applicable, additional special in-process controls to those described below shall be specified in the Detail Specification~~.

5.2.1 Robustness of Terminations

~~All flexible heaters may be subjected to Test 'Ua1' of IEC Publication No. 68-2-21. The strength and duration of the pull forces are given in the Detail Specification~~.

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 ~~with ESCC Basic Specification No. 20500 and the Detail Specification. To be performed~~ 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 Specification shall be guaranteed but not tested.

5.2.4 Documentation

Documentation of Special In-Process Controls shall be in accordance with the requirements of Para. 9.5 . ~~of this specification and shall be supplied if specified in the Purchase Order~~.

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.

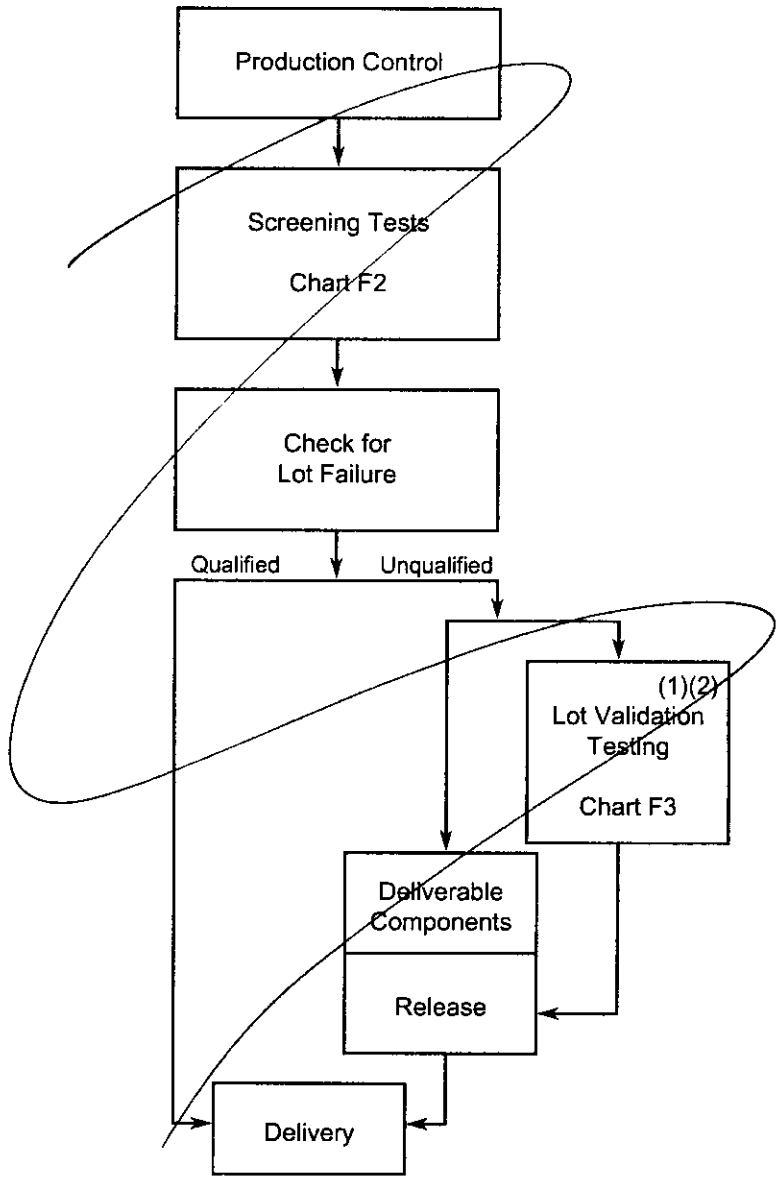
Unless otherwise specified in the Detail Specification all lots of components used for qualification and qualification maintenance, Lot Validation Testing and for delivery shall be subject to tests and inspections in accordance with Chart F2. The applicable test requirements are detailed in the paragraphs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

12 CHARTS

12.1 **CHART F1 - GENERAL FLOW**

Chart re-drawn – see attached

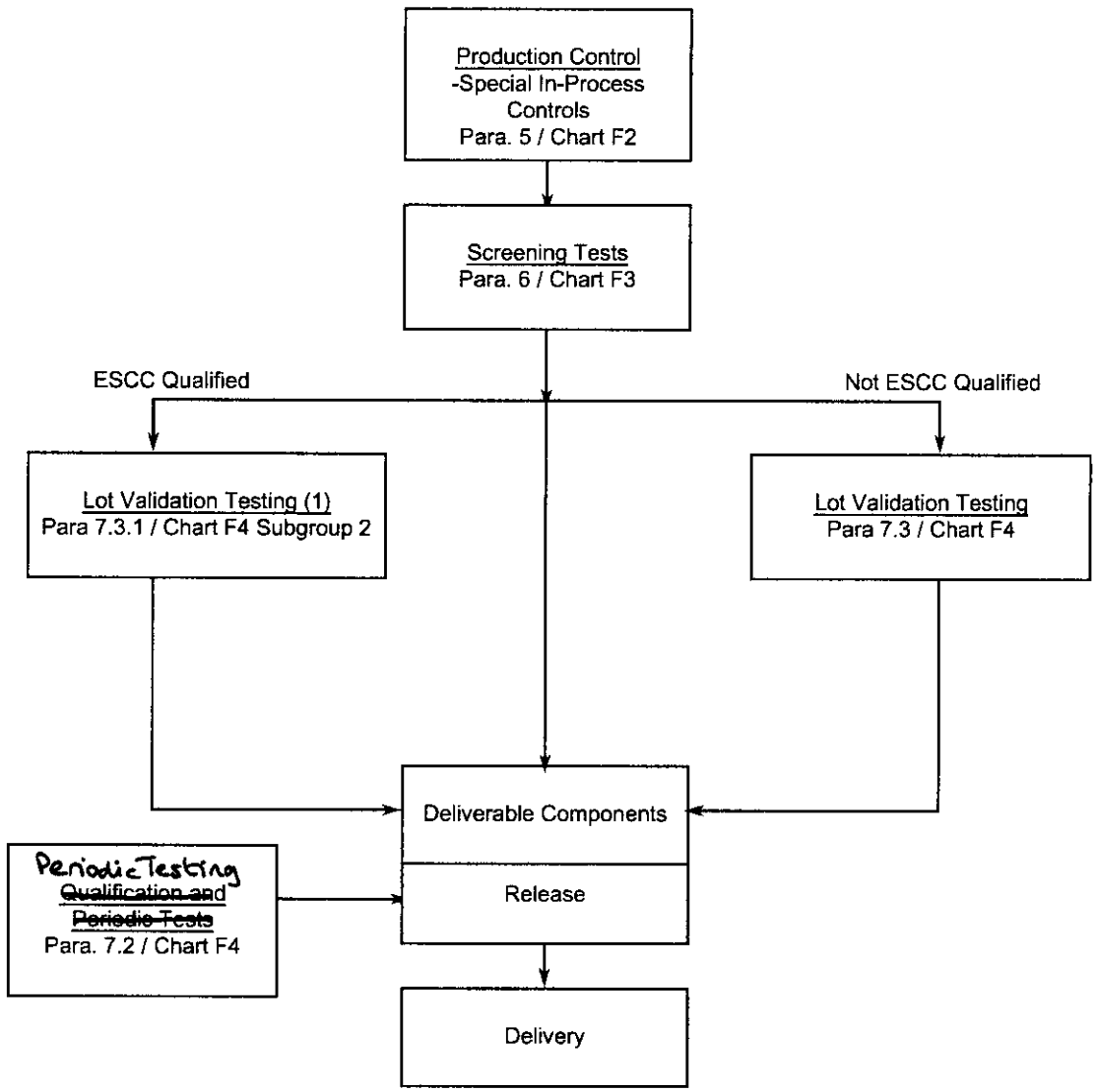


NOTES
1. See Para. 7.3.1.
2. Subgroup 2 optional for qualified components if specified by the Orderer.

Replacement Chart F1

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.

6. SCREENING TESTS

6.1 GENERAL

Unless otherwise specified in the Detail Specification, all components used for qualification ~~testing~~, and qualification maintenance lot Validation Testing and for delivery, shall be subjected to tests and inspections in accordance with Chart ~~F2~~ F3

~~Components selected for qualification and lot validation shall be serialised prior to the tests and inspections.~~

Unless otherwise specified in the Detail Specification, the tests shall be performed in the order shown.

Any components that do not meet these requirements shall be removed from the lot and at no future time be re-submitted to the requirements of this specification.

The applicable test methods and conditions are specified in the paragraphs referenced in Chart ~~F2~~. 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 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:

- Mechanical failure. Visual Inspection 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 ~~of this specification~~.

6.4 LOT FAILURE

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

6.4.1 Lot Failure during 100% Testing

If the number of components failed on the basis of the failure criteria ~~described~~ specified in Para. 6.2.1 exceeds 5% (rounded upwards to the nearest whole number) of the number of components submitted to ~~the~~ burn-in ~~and electrical measurements section of~~ in Chart ~~F2~~ 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 ~~in accordance with General Inspection Level II of IEC Publication No. 410 and the applicable AQL~~ as specified in the Detail Specification, is exceeded.

herein or percent defective

If a lot failure occurs, a 100% testing may be performed but the cumulative ~~P.D.A.~~ shall not exceed that given in Para. 6.4.1.

6.5 DOCUMENTATION

Screening Tests

~~Data~~ Documentation of ~~burn-in and electrical measurements~~ shall be in accordance with Para. 9.6 ~~of this specification~~.

QUALIFICATION MAINTENANCE

7. QUALIFICATION AND LOT VALIDATION ~~TESTS~~ TESTING

Component type

Requirements of this paragraph are applicable to the tests performed for ~~device~~ qualification and qualification maintenance and also for Lot Validation ~~of non-qualified components~~.

Testing.

All components shall be serialised prior to the tests and inspections

7.1 COMPONENT TYPE QUALIFICATION TESTING

7.1.1 General

F3 F4 F4

Qualification testing shall be in accordance with the requirements of Chart ~~F3~~. The tests of Chart ~~F3~~ shall be performed on the specified sample, chosen at random from components which have successfully passed the tests in Chart ~~F2~~ (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 ~~F3~~. F4

Component type

The conditions governing 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:

~~The distribution within the sample shall be as follows:~~

- 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 seperate outputs.

~~The selected distribution shall be agreed with the ESCC Executive~~.

7.2 ~~MAINTENANCE OF~~ 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, ~~test periodicity is~~ given in Chart ~~F3~~. F4

The conditions governing qualification maintenance are given in ESCC Basic Specification No. 20100.

the period between successive subgroup testing shall be as

7.3 LOT VALIDATION TESTING

7.3.1 General

F4

For qualified components, Lot Validation Testing, as defined in compliance with Chart ~~F3~~, Subgroup 2 shall be performed on the procured lot if requested in the Purchase Order.

unqualified define in the Purchase Order the required

If ~~non-qualified~~ components are procured using this specification then the ~~Procurer~~ shall ~~select~~ ~~suitable~~ subgroups from Chart ~~F3~~ F4 to be used for Lot Validation Testing.

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.

7.3.2 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 shall be comprised of component types so selected that they adequately represent all of the various mechanical, structural and electrical peculiarities of the procured range or series.

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

~~7.3.3~~ 7.7 ~~Lot Validation Samples~~ Qualification, Qualification Maintenance and Lot Validation Testing Samples

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

7.4 FAILURE CRITERIA

The following criteria shall apply to qualification ~~testing~~ and ~~to~~ Lot Validation Testing.

7.4.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:

- Components which fail tests for which the pass/fail criteria are inherent in the test method, e.g. robustness of terminations, ~~etc~~.

7.4.2 Electrical Failures

~~The following shall be counted as component failures:-~~

(a) Components which, when subjected to electrical measurements on completion of environmental tests, in accordance with either Electrical Measurements at Room Temperature or Measurements and Inspections, as specified in the Detail Specification, fail one or more the applicable limits.

(b) Components which, when subjected to electrical measurements at intermediate and end-points during endurance testing, in accordance with Measurements and Inspections in the Detail Specification, fail one or more of the applicable limits.

(c) Components which, when subjected to measurement of electrical characteristics, in accordance with Electrical Measurements at Room, High and Low Temperatures in the Detail Specification, fail one or more of the applicable limits.

7.4.3 Other Failures

The following additional failures may also occur during qualification testing or lot validation testing:-

(a) Components failing to comply with the requirements of ESCC Basic Specification No. 20500.

(b) Lost components.

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 ~~of this specification~~.

When requested by the ESCC Executive or the Orderer, failure analysis of failed components shall be performed by the Manufacturer and the results provided.

Failed components ~~lots~~ shall be retained at the Manufacturer's plant until final disposition ~~of the qualification or procurement lot~~ has been agreed and certified.

Replacement Paras 7.4.2, 7.4.3

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 [redacted] 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

7.6 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 ~~of unqualified components~~, the lot shall be considered as failed if one component in any test specified ~~by the Orderer~~ 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 ~~of this specification~~.

8

7.7 DOCUMENTATION

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

7.7.1 Qualification Approval

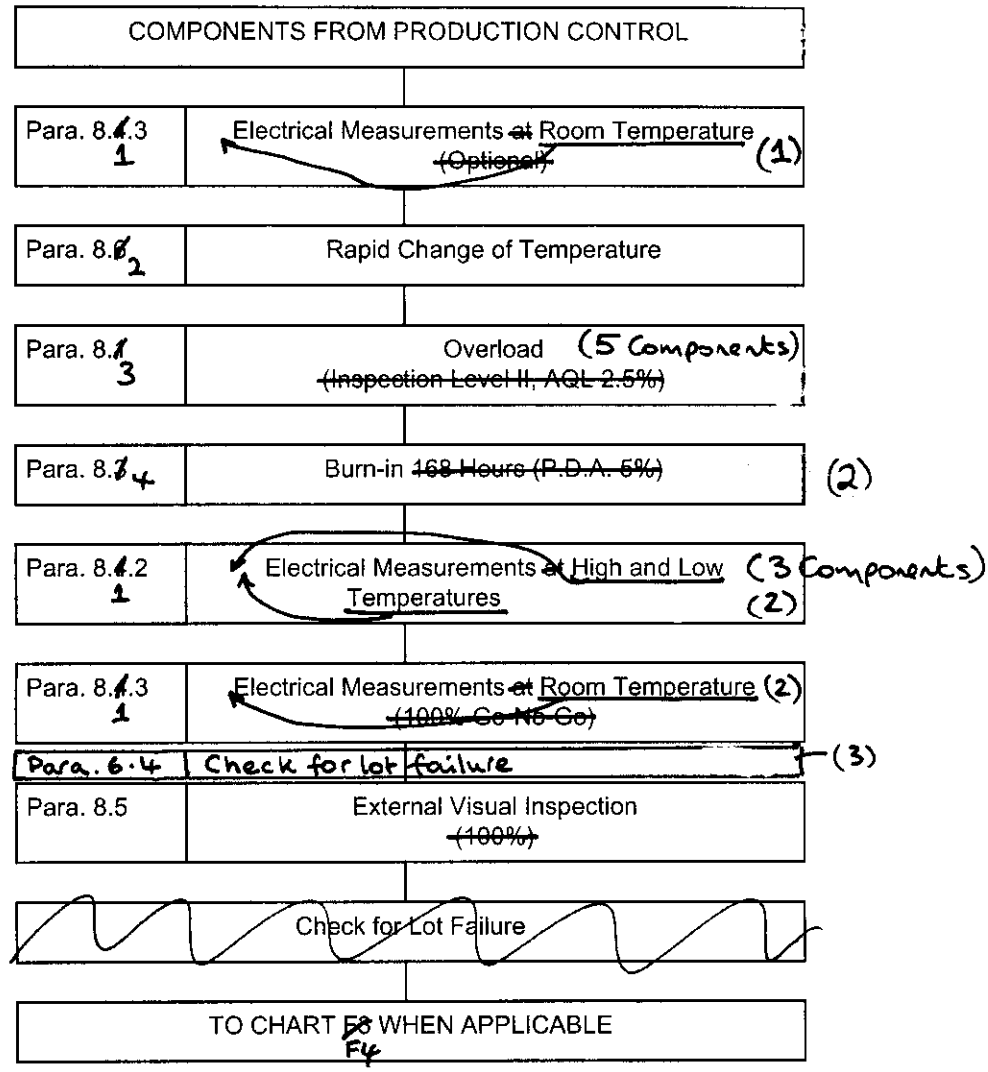
For qualification testing, the qualification test data shall be documented in accordance with the requirements of Para. 9.7 of this specification.

7.7.2 Periodic and Lot Validation Testing

In the case of periodic and lot validation testing, the data shall be documented in accordance with the requirements of Para. 9.8 of this specification.

12.3

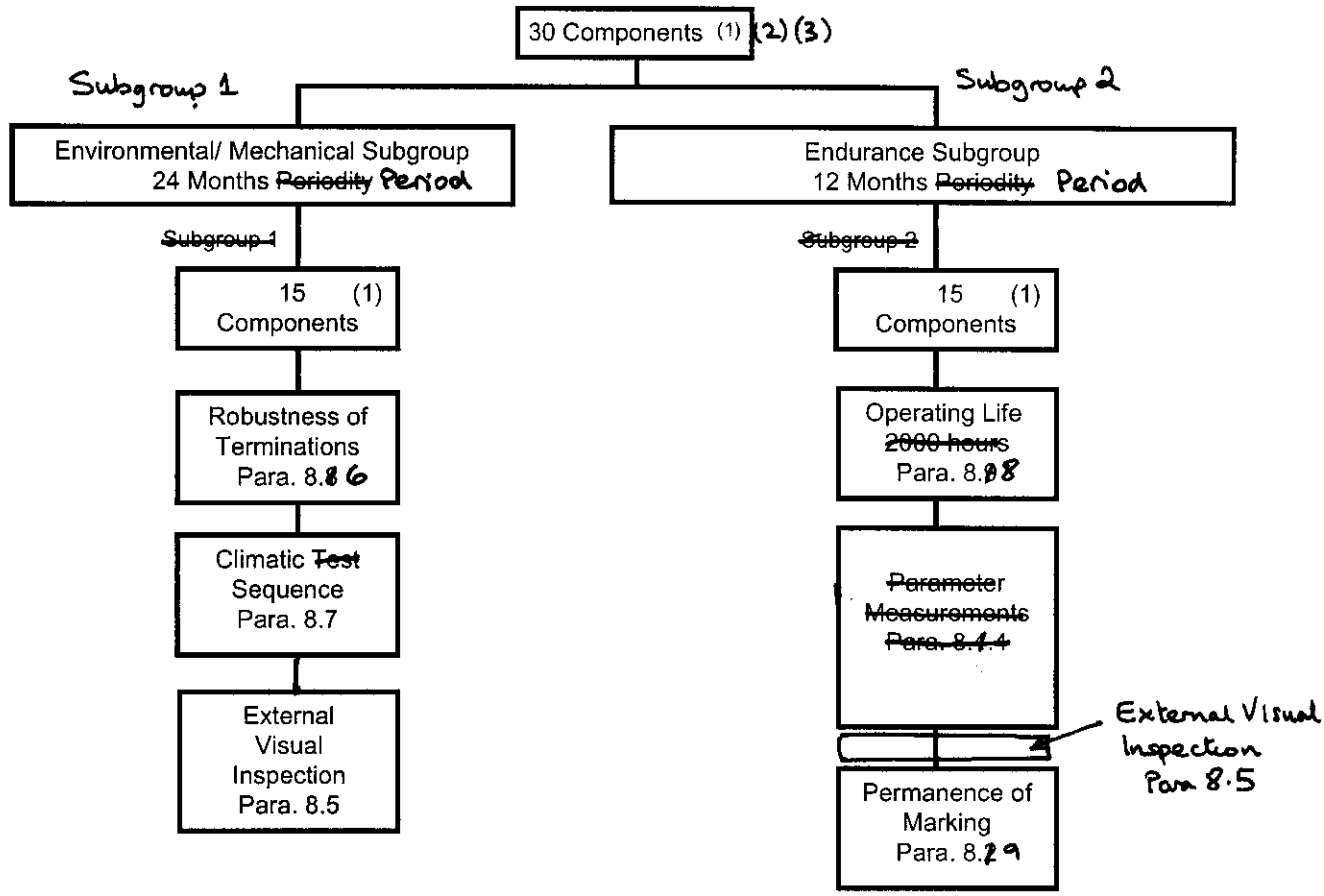
F3
CHART ~~F2~~ - SCREENING TESTS



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. 8.4.1, 8.1.2 and 8.1.3 following completion of Burn-in Testing.

12.4 F4

CHART ~~F3~~ - 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.

"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. 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.

~~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 the Detail Specification and in the P.I.D.~~ PID

8.1 OVERLOAD

8.1.1 Mounting

The ~~flexible~~ heaters shall be suspended by their terminal leads in still air ~~with no circulation other than that caused by the heat of the flexible heaters being operated~~.

The ambient temperature shall be between +15 and +35 °C.
Each layer of double layer heaters shall be tested ~~separately~~, ~~each~~ for the ~~times~~ specified hereunder.

Resistors of multiple resistor heaters shall be tested simultaneously, ~~unless otherwise specified by the Orderer~~.

Para Reformated see attached Some amendments included

8.1.2 Procedure

The following requirements shall apply:-

~~(a) Initial Measurements~~

~~The resistance shall be measured as specified in Para. 8.4.1.1.~~

(b) **Test Conditions**

The ~~flexible~~ heaters shall be tested with a power of 1.5 times the rated power for a period of 1 minute minimum.

(c) **Recovery and Final Measurements**

After a recovery period not less than 1 hour and not more than 2 hours the resistance shall be measured. ~~The change in resistance compared to the value measured in (a) above shall not exceed the value prescribed in Electrical Measurements at Room Temperature in the Detail Specification~~.

8.2 PERMANENCE OF MARKING

In accordance with ESCC Basic Specification No. 24800.

Permanence of Marking shall be performed

8.3 BURN-IN

The method for mounting heaters and the test set-up shall be ~~as specified in Paras. 8.9 (b) and (c)~~.

The test shall be conducted in accordance with IEC Publication No. 115-1, Clause 4.25. Each layer of double layer heaters shall be tested ~~successfully~~ for 84 hours. Resistors of multiple resistor single layer heaters shall be tested similtaneously.

Para Reformated see attached some

The conditions for burn-in shall be as specified in Burn-in in the Detail Specification.

For components undergoing a total burn-in of 168 hours, the data point for post burn-in electrical measurements shall be 168 (+24-0).

Reformated and amended Para 8.1, 8.1.1, 8.1.2

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.

Reformated and amended Para 8.3

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.~~4~~ 1 ELECTRICAL MEASUREMENTS

8.~~4~~.1 General

1 Electrical measurements and methods shall be as follows.

8.4.1.1 Resistance

Measurement 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 ~~flexible~~ heaters shall be calculated and subtracted from the actual measurement. The terminal lead resistance shall be calculated from data found in the applicable wire ~~and cable Generic and Detail~~ Specification. Additionally, for high and low temperatures and Temperature Coefficient measurements, the ~~flexible~~ 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.

In the event of conflicting results, attributable to ~~such~~ 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. The resistance limits at +22 ±3 °C are given in Electrical Measurements ~~at~~ Room Temperature in the Detail Specification.

1
8.~~4~~.1.2 Insulation Resistance

~~8.4.1.2.1~~ - Mounting

The ~~flexible~~ heaters shall be clamped between 2 conducting plates connected together.

~~8.4.1.2.2~~ - ~~Procedure~~ 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 ~~prescribed~~ specified in Room Temperature Electrical Measurements in the Detail Specification.

8.4.1.3 Voltage Proof

There shall be no evidence of breakdown or flashover.

~~8.4.1.3.1~~ - Mounting

The ~~flexible~~ heaters shall be clamped between 2 conducting plates connected together.

~~8.4.1.3.2~~ - ~~Procedure~~ Test Conditions

A voltage as specified in Electrical Measurements ~~at~~ Room Temperature 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 flashover.

8.4.2 Electrical Measurements ~~at~~ High and Low Temperatures

Electrical measurements ~~at~~ High and Low Temperatures shall be ~~made in accordance with Electrical Measurements at High and Low Temperatures~~ 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.

8.4.3 Electrical Measurements ~~at~~ Room Temperature

Electrical measurements ~~at~~ Room Temperature shall be ~~made in accordance with Electrical Measurements at Room Temperature~~ performed as specified in the Detail Specification.

8.4.4 ~~Parameter Measurements~~ Intermediate and End-Point Electrical Measurements

At each of the relevant data points ~~specified for environmental, mechanical and endurance testing~~, ~~measurements shall be made of all parameters listed in Measurements and Inspections~~ 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 ~~required~~ specified.

8.5 EXTERNAL VISUAL INSPECTION

In accordance with ESCC Basic Specification No. 20500. The heater surfaces shall be free of cuts ~~or abrasion~~. The heaters shall not exhibit bubbles or delamination.

Rewritten - see attached

8.6 RAPID CHANGE OF TEMPERATURE

Reformated see attached

~~8.6.1 Initial Measurements~~

~~The resistance shall be measured as specified in Para. 8.4.1.1.~~

Some amendments included

Rewritten Para 8.5:

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.

Reformated and amended Para 8.6, 8.6.1, 8.6.2, 8.6.3

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.

8.6.2 Procedure and Recovery

The flexible heaters shall be suspended by their terminal leads and submitted to Test 'Na' of IEC Publication No. 68-2-14 for the number of cycles specified hereunder. The duration of exposure at each of the storage temperature extremes given in Maximum Ratings in the Detail Specification shall be 15 minutes.

see attached

The flexible heaters shall then remain under standard atmospheric conditions for recovery for not less than 1 hour and not more than 2 hours.

The number of cycles shall be 10. During the 10 exposures to high temperature, electrical continuity shall be checked.

8.6.3 Final Measurements

The resistance shall be measured. ~~The change in resistance compared to the value measured in Para. 8.6.1 shall not exceed the limit prescribed in Measurements and Inspections in the Detail Specification~~.

8.7 CLIMATIC SEQUENCE

8.7.1 Initial Measurements

Intermediate and End-point Electrical Measurements and [redacted]

The resistance shall be measured as specified in ~~Para. 8.4.1.1~~. in the Detail Specification.

8.7.2 Dry Heat

The maximum storage temperature rating as specified in the Detail

The ~~flexible~~ heaters shall be subjected to Test 'Ba' of IEC Publication No. 68-2-2 at the ~~upper category temperature~~ Specification for 2 hours, ~~taking into account the following deviation:~~

On completion of testing the heaters shall be subjected

~~The flexible heaters shall be removed from the chamber and be exposed~~ 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

On completion of testing

The ~~flexible~~ 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. After recovery, the ~~flexible~~ heaters shall be immediately subjected to the Cold Test.

8.7.4 Cold Test

minimum storage temperature rating as specified in the Detail Specification

The ~~flexible~~ heaters shall be subjected to Test 'Ad' of IEC Publication No. 68-2-1 at the ~~lower category temperature~~. After 1 hour of stabilisation at this temperature, the flexible heaters shall be tested with rated power for 45 minutes.

as specified in the Detail Specification

Each layer of Double layer heaters shall be tested ~~one layer after the other~~ successively for the period specified.

Single layer

Resistors of multiple resistor heaters shall be tested simultaneously, ~~unless otherwise specified by the Orderer~~.

On completion of testing

The ~~flexible~~ heaters shall ~~then~~ be removed from the chamber and subjected ~~exposed~~ 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

as specified in the Detail Specification

The ~~flexible~~ heaters, ~~tested~~ operated with rated power, 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 ~~separately~~. successively for the period specified

Resistors of multiple resistor heaters shall be tested simultaneously, ~~unless otherwise specified by the Orderer~~.

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 ~~flexible~~ 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 ~~D.C.~~ DC Load

~~At the end of the conditioning period, the flexible heaters shall be subjected to the standard atmospheric conditions for recovery. The time of transfer shall be as brief as possible and in any case shall not exceed 5 minutes~~.

Suspended and connected by their terminals in still air

as specified in the Detail Specification

~~At 30±5 minutes after removal from the chamber after damp heat cyclic testing~~, The ~~flexible~~ heaters shall be ~~tested~~ operated at rated power for 1 minute. Each layer of double layer heaters shall be tested ~~separately for 1 minute each~~. successively for the period specified.

Resistors of multiple resistor heaters shall be tested simultaneously, ~~unless otherwise specified by the Orderer~~.

On completion of testing

The ~~flexible~~ heaters shall ~~then~~ be subjected to the 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

The resistance and the insulation resistance shall then be measured. The change in resistance compared to the value measured in Para. 8.7.1 shall not exceed the value prescribed in Measurements and Inspections in the Detail Specification. The insulation resistance shall not be less than that prescribed in Measurements and Inspections of the Detail Specification.

A voltage proof test shall be performed in accordance with Para. 8.4.1.3 and there shall be no evidence of breakdown or flash-over.

rewritten - see attached

8.8 ROBUSTNESS OF TERMINATIONS

The ~~flexible~~ heaters shall be subjected to Test 'Ua 1' of IEC Publication No. 68-2-21.

~~8.8.1~~ Initial Measurements

~~The resistance shall be measured as specified in Para. 8.4.~~1.1.

rewritten - see attached

~~8.8.2~~ Procedure

The strength and duration of the pull ~~are given~~ shall be as specified in the Detail Specification.

~~8.8.3~~ Final Measurements

The resistance shall be measured. The change in resistance compared to the value measured in Para. 8.8.1 shall not exceed the value prescribed in Measurements and Inspections in the Detail Specification.

Remitter Para 8.7.8.

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 [redacted] in the Detail Specification. Change in Resistance shall be related to the initial measurements

Remitter Para 8.8, 8.8.1, 8.8.2, 8.8.3

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 ~~and Inspections~~ in the Detail Specification both before and after the test. Change in Resistance shall be related to the initial measurements.

8.9 OPERATING LIFE

The following requirements shall apply:-

(a) **Duration**: 2000 hours.

Each layer of double layer heaters shall be tested successively for 1 000 hours.

(b) **Method of Mounting**

The flexible heaters shall be freely suspended and connected by their terminal leads. They shall be positioned in such a way that the heat from one heater does not unduly influence the temperature of any other heater. ~~There shall be no undue draught over the flexible heaters. Only natural convection resulting from the operating flexible heaters may occur.~~

Para Reformated and amended - see attached

(c) **Test Conditions**

As specified in Operating Life in the Detail Specification.

The voltage (d.c. or full-wave rectified a.c. with ripple less than 5%) shall be increased until the following occurs:

- The rated power density is reached, or
- The temperature of the heaters reaches the maximum operating temperature.

The voltage shall then be applied in cycles of 1.5 hours 'ON' and 0.5 hours 'OFF' throughout the test. The 0.5 hour 'OFF' periods are included in the total test duration.

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

For intermediate and end-point data measurements, the flexible heaters shall be allowed to cool at room temperature for not less than 1 hour and not more than 2 hours. ~~The measurements shall take place at the end of the 0.5 hour "off" period.~~

After intermediate measurements, the flexible heaters shall be returned to the test conditions. The interval between the removal of any heater from the load and its return to the conditions of the test shall not exceed 12 hours.

(d) **Intermediate Data Points**

Measurements at intermediate points in accordance with Measurements and Inspections in the Detail Specification at 0 and 1000 ~~± 48~~ hours.

In the case where Measurements and Inspections specify "changes", the drift shall always be related to the 0-hour measurement.

(e) **End Data Points**

Measurements at end-points in accordance with Measurements and Inspections in the Detail Specification at 0 and 2000 ~~± 48~~ hours.

In the case where Measurements and Inspections specify "changes", the drift shall always be related to the 0-hour measurement.

Reformatted and amended Para 8.9.

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 ±48 ±48
  As specified in Intermediate and End-Point Electrical Measurements [redacted] in the Detail Specification at 0 hours, 1000 hours and 2000 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.

9. DATA DOCUMENTATION

9.1 GENERAL qualification, maintenance and procurement for each lot

For the qualification ~~approval records and with each component delivery~~, 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 Control ~~test~~ data ~~(if specified in the Purchase Order)~~. (Chart F2)

(e) Screening Tests ~~test~~ data (Chart ~~F2~~). F3 including Lot Validation Testing data (when applicable)

(f) Qualification Tests data (Chart ~~F3~~). F4 and Periodic

~~(g) Periodic or Lot Validation test data (when applicable).~~

g (~~h~~) Failed component list ~~(see Paras. 6.3 and 7.5)~~ and failure analysis report ~~(see Para. 7.5)~~. (when applicable)

h (~~i~~) Certificate of Conformity.

Items (a) to (~~i~~) 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 ~~Approval~~ and Qualification Maintenance

In the case of qualification ~~approval~~, the items listed in Para. 9.1 (a) to (~~i~~) h ~~less item (g)~~ are required. or qualification maintenance

9.1.2 Procurement and Component 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 ~~by~~ 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 ~~to the ESCC Executive and the Orderer, if requested, for review~~. 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) ~~Component type and number~~. 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 ~~Process Identification Document (P.I.D.)~~ 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 ~~TEST~~ 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 ~~F2~~ F3)

A test result summary shall be ~~completed~~ compiled, showing the total number of components submitted to, and the total number rejected after each of the tests. ~~The P.D.A. shall be recorded~~.

9.7 QUALIFICATION ~~TEST~~ AND PERIODIC TESTS DATA (CHART F3)

replaced see attached 9.7 9.7.1 9.7.2 9.7.3

All data shall be referenced to the relevant serial numbers. Detailed records shall be provided of the components submitted to each test in each of the subgroups and of those rejected. Detailed data shall be provided of all electrical measurements made in accordance with Measurements and Inspections in the Detail Specification, as and where applicable.

9.8 PERIODIC AND LOT VALIDATION TEST DATA (CHART F3)

9.8.1 Periodic Tests for Maintenance of Qualification

Summary data for the most recent performance of periodic tests for the maintenance of qualification shall be prepared. For each group of periodic tests in Chart F3, the summary shall include a list of the tests performed, when they were last performed, the number of components tested, a statement that the results were satisfactory and a reference identifying the location of the full test data.

Rewritten Para's 9.7, 9.7.1 9.7.2 9.7.3 (9.7, 9.8, 9.8.1, 9.8.2)

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.

9.8.2 Periodic Tests ~~used~~ for Lot Validation

replace see attached

Detailed records shall be prepared of the components submitted to each test in each group of tests and the results obtained.

Detailed data shall be provided of all electrical measurements made in accordance with Measurements and Inspections in the Detail Specification, ~~as~~ and where applicable.

9.9 FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT

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

(a) The reference ~~number~~ 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) → c (b) The failed ~~parameter~~ and the failure mode of the component.

d (c) Detailed failure analysis, ~~if requested~~. (if requested by the ESCC Executive or Orderer).

(b) The serial number (if applicable) of the failed component.

9.10 CERTIFICATE OF CONFORMITY

A Certificate of Conformity shall be established as defined in ESCC Basic Specification No. 20100.

10. DELIVERY

For qualification or qualification maintenance ~~approval~~, the disposition of the ~~qualification~~ 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.

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 ~~(see Para. 7.3)~~.

(c) The relevant documentation in accordance with the requirements of Section 9 ~~of this specification~~.

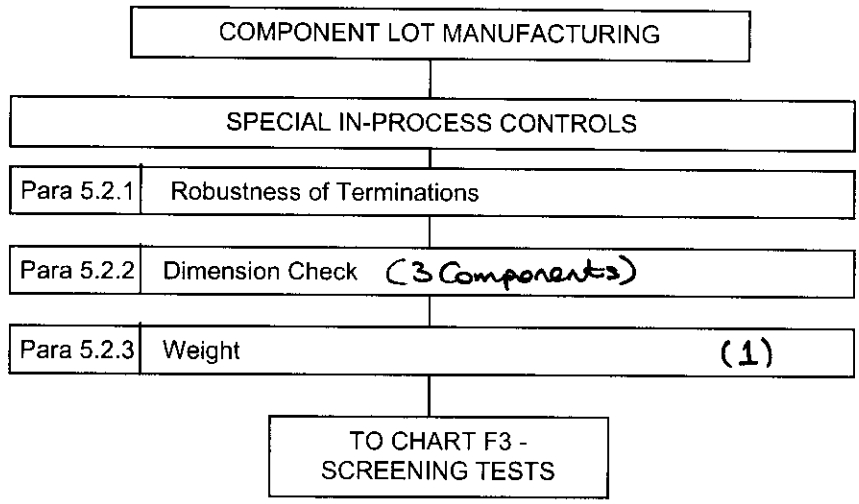
In the case of a component for which a valid qualification ~~approval~~ is in force, all data of all components submitted to Lot Validation Testing shall also be copied, when requested, to the ESCC Executive.

11. PACKAGING AND DESPATCH

The packaging and despatch of components to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 20600.

New Chart F2

12.2 CHART F2 - PRODUCTION CONTROL



NOTES:

1. Guaranteed but not tested.

APPENDIX 1 - Detailed changes to ESCC 4009 issue 1 draft B

This document details all changes proposed by the ESCC Executive Secretariat to specification:

- RESISTORS, HEATERS, FLEXIBLE
  ESCC Generic Specification No. 4009 ISSUE 1, DRAFT 'B', JANUARY 2002.

The proposed changes have been incorporated into the revised specification 4009 issue 2 draft F (See Appendix 3).

Due to the extensive editorial changes made between draft 1B & 2F, only a general description has been given herein by reference to the paragraph affected in 4009 draft 1B and a summary of the extent of the change.

A detailed Mark-up of ESCC 4009 draft 1B (See Appendix 2) shows the details of all changes incorporated into 4009 draft 2F.

The majority of changes detailed herein are considered by the Secretariat to be of an **Editorial** nature. They have been defined and included to serve the purposes of clarification, accuracy, completeness, simplification and consistency. The aim is to simplify and improve the interpretation of the specification and it's requirements whilst maintaining the same overall structure and technical baseline as per the previous ESA/SCC 4009 issue 3B and ESCC 4009 draft 1B specifications. In addition ESCC 4009 draft 2F has been written to closely follow the structure and content of the recently reviewed and accepted ESCC Generic Specification 9000 issue 2 (and recently approved DCR138).

There are some **Technical & Policy** changes included in the revised specification draft 2F for which specific explanations and justifications are also provided herein.

APPENDIX 1 - Detailed changes to ESCC 4009 issue 1 draft B

1) Editorial - Scope
4009 draft 1B is inconsistent, somewhat confusing and in places overly complicated in it's references to:

- Qualification and qualification approval
- Component Type Qualification
- Qualification maintenance & Periodic Testing
- Procurement of qualified components
- Procurement of unqualified components

The Secretariat has tried to simplify, clarify and make consistent the use of these terms throughout 4009 draft 2F.

The terminology related to all these subjects has been changed in the following paragraphs to clarify, simplify and make consistent the specification on this subject.

Para's in 4009 draft 1B affected due to this point:
2.1, 4.1, 4.1.1, 4.1.3, 4.1.4, 4.2, 4.3.1, 5., 6.1, 7., 7.2, 7.3.1, 7.3.3, 7.6, 7.7.1, 7.7.2, 9.1, 9.1.1, 9.1.4,

9.8, 9.8.1, 10.

2) Editorial - Unqualified Components
The Specification has been made applicable and fully usable for procurement of unqualified components as well as for Qualified components. Draft 1B did include some references to procurement of unqualified components but this was generally inconsistent and incomplete.

Para's in 4009 draft 1B affected:
1.2, 2.1, 4.1, 4.1.3, 4.1.4, 4.3.1, Chart F1, 7.3.1, 7.6

3) Editorial - Para 1. Applicability
Delete "lot validation" as a redundant reference from 1st sentence. "Lot Validation Testing" is part of procurement and does not always apply. Therefore it is best not referenced in the Scope para.

4) Editorial - Para 2. Applicability
2nd sentence added to clarify the specification can be used for unqualified components. (See point 2) above).

5) Policy & Editorial - Para 2.1. Definition of Applicable documents replacements & Clarification of the applicable documents for unqualified components.
Delete in the 2nd main sub-para "listed in an appendix to the Detail Specification"

For qualified components, as the Manufacturers' PID will define all applicable documents it is considered unnecessary to list any replacements in the appendix of the Detail Spec. A statement of the requirement of equivalency is considered as sufficient.

For non-qualified Manufacturers and procurements it should be the responsibility of the Orderer to ensure that the Manufacturer meets the quality requirements of the programme prior to procurement including applicable documentation. Sub-para has been added accordingly to cover unqualified components (See point 2) above).

The content of approved DCR138 to ESCC Generic Specification 9000 issue 2 has also been incorporated into this para.

6a) Editorial - Para 2.2. Other (Reference) Documents
Add REP005, ESCC Qualified Parts List.

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6b) Technical - para 2.2 & 6.4.2. Sampling Standard
Delete references to the sampling reference document (IEC Pub. No.410) and the inspection level/AQL.

The given IEC document is only referred to in the generic specification para 6.4.2 (Lot failure during sample testing - during Screening); The only sample test included during screening is Overload with sampling requirements as follows:

- GI level II AQL 2.5%; in the event of a failure a 100% test shall be performed.

Per IEC Publication No. 410 (now designated as IEC Pub. No. 60410) this sample is equal to 5 samples with 0 failures permitted (independent of lot size).
For the purposes of simplification the secretariat proposes to replace the AQL sampling by the equivalent fixed sampling. Reference to the IEC document is thereby not necessary.
If any detail specification did have a requirement for an additional sample test during screening defined by an AQL and sample plan the relevant sampling specification would be included as a reference document in the Detail Specification.

7) Editorial - para 4.1. General
First 3 sub-para's have been amended in order to be complete, accurate, clear and consistent with the actual requirements applicable to component type qualification approval and procurement.

3rd sub-para is deleted due to being covered by the 2nd sub-para.

4th sub-para deleted, as in-process controls may not be eliminated/substituted unless specifically deviated to in the Detail Specification. This sub-para is therefore redundant.

8) Editorial - para 4.1.1. Specifications
Redundant phrase "(including lot validation testing)" deleted

9) Editorial - para 4.1.3. Manufacturer's Responsibility for Performance of Tests and Inspections
Phrase "prior to commencing qualification testing, or procurement" is deleted. This statement is implicit with the word "agreed" and hence redundant in this sentence.

10) Editorial - para 4.1.5. Pre-encapsulation Inspection witnessing
Para is deleted as precap is not applicable to Heaters.

11) Editorial - para 4.1.6. Wires for Terminal Leads
(para 4.5.1 under Materials And Finishes in 4009 draft 2F)
For the purpose of clarification the para is amended to include references to the applicable wire ESCC Detail Specification and the ESCC Qualified Parts List REP005.

12) Editorial - para 4.3. Deliverable components
1st sub-para. Correction - reference to purchase order is deleted. The PO does not specify all the tests, the generic Specification does.

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13) Editorial - para 4.3.1. Lot Failure
1st sub-para. Delete reference to "special in-process controls", as there is no lot failure criteria associated with any of the tests.

2nd to 5th sub-paras rewritten to clarify and make consistent the requirements for both qualified and unqualified components.
ESCC No. 22800 should only apply to qualified manufacturers.
The written notification deadline to the ESCC Executive for qualified manufacturers, though the non-conformance process, is 5 working days as stated (not immediate as implied by the last sub-para of para 4.3.1).

14) Editorial - para 4.4. Marking
Para rewritten to remove the duplicated information already fully specified in ESCC basic Specification 21700.

15) Editorial - para 4.5. Materials & Finishes

Para expanded to include generic information taken out of the Detail Specifications. The Secretariat intends that the generic statements on materials and finishes will be removed from all Detail Specifications during the software conversion process in order to simplify the Detail Specifications.

16) Editorial - para 5. Production Control
Para's rewritten for accuracy, clarification & consistency with the presentation of para 6.1 & 7.1.1. and the actual applicable requirements.

The text in para **5.2** is deleted as a redundant statement.
The generic spec defines the baseline requirements for special in-process controls. Any additional special in-process controls are by definition unique to the detail spec and therefore should not be referenced in the generic spec.

All test methods & procedures have been moved to section 8 (para's 8.5 & 8.6 in 4009 draft 2F)

Para's in 4009 draft 1B affected:
5., 5.1, 5.2, 5.2.1, 5.2.2

17) Editorial - para 5.2.4. Documentation (S.I-P.C.)
Statement "and shall be supplied if specified in the purchase order." is deleted - as this requirement is already covered by para 9.1.3 - Additional documentation.

18) Editorial - CHART F1 - GENERAL FLOW FOR PROCUREMENT
Chart redrawn to clarify the requirements and to reflect the actual procurement flow of components as defined by the specification.

The chart in 4009 draft 1B was unclear and incomplete e.g.
- Lot validation was identified against unqualified components when it can also be applied as an option for qualified components

- Periodic testing was not referenced

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19) Editorial - New chart F2 Production control
New chart F2 was added in 4009 draft 2F to be consistent with the format applied to all other tests within the generic specification.
Both Screening tests and Qualification and Periodic Tests each have a chart that outlines and clarifies as a diagram the test sequence and requirements. This format has been followed for the Production Control section of the generic spec (including Special In-Process Controls). In addition to consistency within the specification it also serves to clarify the requirements and focus the importance of Production controls to the overall requirements, in the same way as charts F3 & F4 do for Screening Tests & Qualification and Periodic Tests.

20) Editorial - para 6.1, 7., Chart F3. Serialisation
The requirement to serialise any qualification or Lot Validation Testing components is deleted from the 2nd sub-para of para 6.1 and moved to para 7. A note about serialisation is added to chart F3 (F4 in 4009 draft 2F). The samples for qualification, qual maintenance and Lot Validation Testing should only be selected after completion of Screening Tests (as there may be failures during screening of any nominated parts).

21) Editorial - para 6.2.2. Other Failures
"Visual Inspection Failure" added for consistency and completeness as the definition had been omitted from 4009 draft 1B.

22) Editorial - para 6.4.1. Lot failure Criteria
Correct and clarify in the 1st sub-para that the reference point for PDA calculation is the "Burn-in" (delete "and electrical measurements section").

23) Editorial - para 6.4.2. Lot Failure during Sample Testing
Add reference "herein" to 1st sentence for number of allowable failures to refer to the generic spec as it does define some sampling requirements.

Correct the incorrectly used term "P.D.A." to be "percent defective" in 2nd sub-para.

24) Editorial - para 6.5. Documentation (Screening)
Delete redundant word "Data" from beginning of sentence.

Correct the reference to be "Screening Tests" (was "burn-in and electrical measurements").

25) Editorial - para 7.1.2. Distribution within the Qualification Test Lot
Para reworded to follow the same wording used in ESCC 9000 issue 2 for consistency. 3rd para is added to clarify the approval required by the ESCC Executive.

26) Editorial - para 7.2 MAINTENANCE OF QUALIFICATION
The 2nd sentence including the word "periodicity" is rewritten for grammar and clarification purposes to be:
"For each subgroup the period between successive subgroup testing shall be as given in chart F4"

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27) Editorial - para 7.3.1 & 7.3.2. - General (Lot validation Testing)
For the purpose of clarification the para is amended with regard to the purchase order requirements for lot validation testing for both qualified and unqualified components.

28) Editorial - para 7.3.3. Lot validation Samples
For the purpose of clarification and consistency the para is rewritten to also include the samples used for Qualification & Qualification maintenance (para 7.7 in 4009 draft 2F).

29) Editorial - para 7.4.2. Electrical Failures
Para rewritten and corrected to simplify the presentation and to be consistent with chart F3 (F4 in 4009 draft 2F) and the detail specifications. Note: The old Table 6 in the detail specifications will be renamed to be "Intermediate and End-Point Electrical Measurements".

30) Editorial - para 7.4.3. Other Failures
Para amended to include all applicable failures and to be consistent with para 6.2.2 (mechanical & handling failures had been omitted from 4009 draft 1B).

31) Editorial - para 7.5. FAILED COMPONENTS
3rd sub-para amended to remove redundant comments "lots" & "of the qualification or procurement lot".

32) Editorial - para 7.6. Lot failure
Delete "of unqualified components" in 3rd sub-para as Lot Validation Testing can apply to both qualified & unqualified components (See point 2) above).

Delete redundant phrase "by the Orderer" in 2nd sub-para.

33) Editorial - para 7.7 Documentation (Qual)
Sub-para's **7.7.1, 7.7.2** reduced to a single statement to cover all Qualification and Periodic tests documentation.

Section 9 already specifies the various requirements to cover the documentation for Qualification and Periodic tests and Lot Validation Testing.

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34) Technical & Editorial - CHART F2 - SCREENING TESTS
(F3 in 4009 draft 2F)

Add note to clarify that the initial Room Temperature electrical is optional at the Manufacturer's discretion.

Add note to check for lot failure after Burn-in at each post-burn-in electrical test to clarify that lot failure can occur after each of the noted tests and hence testing can then be stopped rather than have to wait until the final "check for lot failure" test.

The "check for lot failure" point is moved to be after final electrical as visual failures do not count towards PDA. A note is added to clarify that "check for lot failure" takes into account all post Burn-in electrical parameter failures.

Delete "(100% Go-No-Go)" & "(100%)" from the chart, as these comments are redundant.

35) Technical & Editorial - CHART F3 - QUALIFICATION AND PERIODIC TESTS
(F4 in 4009 draft 2F)

Delete "Parameter Measurements" after Operating Life as final electrical testing is already included as part of Operating Life.

Add External visual inspection after Operating Life to check that no degradation has occurred during the life test. Previously no post life test visual inspection was required.

Amend test titles to be consistent with the tests in the specification.

Correct the word "periodicity" to be " period"

Add note specifying no failures are permitted (as is specified in para 7.6 but omitted from chart F3 in 4009 draft 1B) for the purpose of clarification.

Add note about serialisation for the purposes of clarification (See point 20) above).

36) Editorial - para 8. **TEST METHODS AND PROCEDURES**
Some general changes applicable to various paras in section 8 are as follows:

All the test methods in para 5 are transferred to para 8 resulting in new/amended para's **8.5** (dimension check) & **8.6** in 4009 draft 2F. Some editorial changes are included in the wording of the new para's. This amendment has been incorporated for simplification and clarification purposes. All the various test methods and procedures, called up throughout the generic specification, are consolidated within the single para 8.

The redundant word "flexible" has been deleted from the phrase "flexible heater" throughout the spec.

Any ratings referenced in the various tests are related to "rating as specified in the Detail Specification" for clarification purposes.

The mounting conditions for the various test are made consistent & simplified in Para's **8.1, 8.3, 8.6, 8.7, 8.9**

The content of approved DCR138 to ESCC Generic Specification 9000 issue 2 has also been incorporated into this para.

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37) Editorial - Testing of Resistors of multiple resistor heaters
Delete references to" Unless otherwise specified" & "the orderer" plus add "single layer" to be accurate.

The Detail Spec, not the Orderer, will specify any different test conditions

Para's in 4009 draft 1B affected:
8.1.1, 8.3, 8.7.4, 8.7.5, 8.7.7, 8.9

38) Technical & Editorial - para 8.1 & Chart F2. Overload
This para is rewritten to simplify the para layout including deleting sub-para 8.1.1, 8.1.2 & 8.1.3.

Specific changes to the paras include:

Clarification and simplification on the sampling applied to this test is added (See **6b)** above).
The original sampling:
- General Inspection level II AQL 2.5%

Is rewritten as a fixed, equivalent sample quantity:
- 5 parts with 0 failures allowed, otherwise a 100% inspection applies.

In Para **8.1.1**, 3rd sub-para "times" is amended to "period".

In Para **8.1.2**, references to initial measurements & change in resistance are deleted as without serialisation drift parameter electrical measurements is not applicable. Only resistance after the test will be measured.
As serialisation is not required during screening it is not applicable or possible to measure any drift of parameters during screening. Drift measurements will only apply to the serialised parts during Qualification and Periodic Testing (Chart F4 in 4009 draft 2F)

39) Editorial - para 8.3 BURN-IN
This para is rewritten to simplify the para layout

Specific changes to the paras include:

Detail the mounting and test set-up requirements (same as Operating life)

Clarify the Burn-in period as 168 (+24 -0) hours

Correct "successfully" in 2nd sub-para to be "successively"

Added para clarifying that resistance at room temperature is measured between 1 & 2 hours after completion of burn-in. 4009 draft 1B was unspecific in defining which tests should be performed immediately after burn-in.

40) Editorial - para 8.4.1.1 Resistance Measurement
In 2nd sub-para, 2nd sentence, replace " and cable Generic and Detail Specifications" by "specification".
This clarifies and makes consistent the fact that that the terminal lead resistance is actually found in the applicable wire specification (see point 11) above).

Move last sentence of note 1 to be part of the main sub-para as this sentence refers to the para as a whole not just the measurement of Rn @ 0.1V.

41) Technical & Editorial - para 8.4.1.2.2 & 8.4.1.3.2 Insulation Resistance - Procedure & Voltage Proof - Procedure
Add the requirement " There shall be no evidence of breakdown or flashover" this test which is considered necessary for any high voltage testing. It is included as a requirement for final electrical after Climatic sequence testing.

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42) Editorial - para 8.4. ELECTRICAL MEASUREMENTS
Para's amended to simplify the content and to make terminology consistent.

Para's in 4009 draft 1B affected:
8.4.2, 8.4.3, 8.4.4

43) Editorial - para 8.4.2. Electrical Measurements at high & low Temperatures
Clarification on the sampling acceptance criterion applied to this test is added. i.e. "In the event of any failure a 100% inspection shall be performed".

The acceptance criterion was unclear in 4009 draft 1B.

44) Technical - para 8.6. Rapid Change of Temperature
Initial measurements per para 8.6.1 are deleted.
As drift measurements for this test are not possible without serialisation there is no need to perform initial measurements.

Final measurements per para 8.6.3 are amended to define that only resistance is measured on completion of Rapid Change of Temperature; no drift measurements will be performed.

As serialisation is not required during Screening Tests it is not applicable or possible to measure any drift of parameters during Screening Tests. Drift measurements will only apply to the serialised parts during Qualification and Periodic Testing (Chart F4 in 4009 draft 2F)

45) Editorial - para 8.7 CLIMATIC SEQUENCE
Reference to "upper category" & "lower category" temperatures are replaced by "maximum storage" & "minimum storage" temperatures to reflect the definition in the Detail Specification in para 8.7.2 & 8.7.4

Use "operated with rated power" not "tested with rated power" in para **8.7.7**

Some minor editorial changes have been made for clarification and consistency purposes.

46) Editorial - para 8.8 Robustness of Terminations
Para rewritten to define the different requirement for the Special In-Process Controls test & the Qualification and Periodic Tests test. Pre & post electrical test do not apply to the Special In-Process Controls test.

47) Technical & Editorial - para 8.9. Operating Life
Duration clarified as "2000 +/-48 hours" & "1000+/-48 hours" each layer for double layer heaters.

"intermediate measurement" is replaced by "the 1000 hour measurement" in the 6th sub-para of **8.9(c)**.

The requirement that measurement take place "at the end of the 0.5 hour "OFF" period" is deleted as there is already a recovery period of 1 to 2 hours specified.

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48) Editorial - para 9.1. Documentation - General
Para amended to make the each data item consistent with the content of the specification.

Specific amendments are:
- 1st sentence amended; reference to "each component delivery" is replaced by "each lot"

- (**d**) - Reference to the Purchase Order is deleted, as Special In-Process Controls are mandatory.

- (**f**) & (**g**) - amended to be "Qualification and Periodic Tests data" & "Lot Validation Testing data (when applicable)" for consistency and incorporated in to a single bullet (f).

- (**h**) - "(when applicable)" added for clarification.

49) Editorial - para 9.1.2. Component Delivery
Title amended to be "Component Procurement and Delivery" to be more accurate.

50) Editorial - para 9.1.4. Data Retention/Data Access
Para amended to clarify it applies to the ESCC Executive only for qualified components.

51) Technical & Editorial - para 9.2c. Cover Sheet
For the purposes of clarification and consistency with the ESCC marking requirements, in sub-para (c) replace "Component type and number" with "ESCC Component Number and the Manufacturer's part type number".

In 4009 draft 1B this requirement (c) was unclear. The changed para now clearly defines that the two different identification numbers are required on the cover sheet.

52) Editorial - para 9.6. Screening Test Data
Delete 2nd sentence "The PDA shall be recorded".
The PDA is already defined in the generic spec para 6.4.1 (5%) and therefore does not need to be repeated in the data. The actual percent defective (PD) will be evident from the required screening test result summary.

53) Editorial - para 9.7 & 9.8. QUALIFICATION TEST DATA & PERIODIC AND LOT VALIDATION TEST DATA
Para's incorporated into a single para with title "Qualification and Periodic Tests Data" to cover the data for Qualification Tests, Periodic Tests, and Lot validation Testing each as a sub-para 9.7.1, 9.7.2, 9.7.3 respectively in 4009 draft 2F.

Para **9.8** QUALIFICATION TEST DATA (para 9.8.1 in 4009 draft 2F) is rewritten for clarification purposes to be consistent with the actual tests performed, including the requirement of a test summary and drift calculation.

Para **9.10.1** Periodic Testing for Maintenance of Qualification (1st sub-para of 9.8.2 in 4009 draft 2F) is rewritten for clarification purposes to be consistent with the actual tests performed during qualification maintenance, including the requirement of a test summary and drift calculation.
The periodic summary report (2nd sub-para in 4009 draft 2F) is clarified as being independent from and additional to the full qualification maintenance summary data.

Para **9.10.2** Periodic Tests used for Lot Validation (para 9.8.2 in 4009 draft 2F) is amended to correct the title to be "Lot Validation Testing". Lot Validation Testing is not periodic. Para is also amended for clarification purposes to be consistent with the actual tests performed, including the requirement of a test summary and drift calculation.

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54) Editorial - para 9.9. FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT
Para amended to clarify who defines the need for a detailed failure analysis (i.e. ESCC Executive or the Orderer) and during which tests the failures should be identified.
4009 draft 1B was unclear on these points.

55) Editorial - para 10. DELIVERY
1st sub-para is moved to the bottom to the para for the purposes of presentation & clarification.

56) Editorial - New chart F2 Production control
New chart F2 was added in 4009 draft 2F to be consistent with the format applied to all other tests within the generic specification.
Both Screening and Qualification/Periodic tests each have a chart that outlines and clarifies as a diagram the test sequence and requirements. This format has been followed for the Production Control section of the generic spec (including Special in-process controls). In addition to consistency within the specification it also serves to clarify the requirements and focus the importance of Production controls to the overall requirements, in the same way as charts F3 & F4 do for Screening tests & Qualification and Periodic Tests.

57) Editorial - Other Minor Editorial Changes
Other minor editorial changes have been made throughout the specification to correct grammatical errors and for the purposes of clarification, consistency and removal of redundant phrasing.

For example:
Capitalisation of specific references e.g.
- **P**urchase **O**rder ; **M**anufacturer ; **O**rderer ; etc

Maintain consistency in the use of references e.g.
- "Screening Tests" ; "Lot validation Testing" ; "qualification" ; "qualification maintenance" ; "Qualification Tests" ; "component type qualification" ; "required in the Purchase Order" ; "Room Temperature Electrical Measurements" ; "High and Low Temperatures Electrical Measurements" ; "Intermediate and End-Point Electrical Measurements".

Maintain consistency in use of terminology/phraseology e.g.
- PID (not "P.I.D.") ; etc

Removal of redundant phrasing e.g.
- "of this specification" ; "the requirements of" ; etc

Para's in 4009 draft 1B affected:
2., 2.1, 4.1, 4.1.1, 4.2, 4.3, 4.3.1, 5.1, 5.2.4, 6.1, 6.2.1, 6.3, 6.4, 6.5, 7.1.1, 7.2, 7.3.1, 7.3.2, 7.4, 7.5, 7.6,

Chart F2, Chart F3, 8., 8.2, 8.4.1.1, 8.4.1.2.2, 8.4.1.3.2, 8.4.2, 8.4.3, 8.4.4, 9.1, 9.1.1, 9.1.3, 9.2, 9.3, 9.5,

9.6, 10.

58) Editorial - Internal References
All internal paragraph and Chart references have been amended to be consistent as necessitated by the various changes.