DOCUMENT CHANGE REQUEST

DCR number 229	Changes required for: General	Originator: S Thacker
Date: 2006/01/31	Date sent: 2006/01/31	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Generic Specification for Resistors Heaters Flexible		
Number:	4009	Issue:	2

Other documents affected:

Page:

Page 7 & 8, para 2.2
Page 11 para 6.2.1
15 to 19, para 8.2, 8.3, 8.4, 8.6, 8.7, 8.8
Page 16, para 8.3
Page 21 para 9.7.1, 9.8
Page 26, para 12.4

Paragraph:

Page 7 & 8, para 2.2
Page 11 para 6.2.1
15 to 19, para 8.2, 8.3, 8.4, 8.6, 8.7, 8.8
Page 16, para 8.3
Page 21 para 9.7.1, 9.8
Page 26, para 12.4

Original wording:

Proposed wording:

See attached mark-up for details.

a) Para 12.4 Chart F4 - Endurance Subgroup 2 Period changed to be 24 Months (was 12 Months)

b) Para 8.3 Overload - Add after the test:
"Heaters shall be visually examined and there shall be no evidence of damage."

c) Para 8.2, 8.3, 8.4, 8.7.7, 8.8 - delete the minimum recovery period of 1 hour before electrical testing. Recovery requirements are amended to read:
"... the heaters shall be subjected to standard atmospheric conditions for recovery until thermal equilibrium is reached, up to a maximum of 2 hours, prior to electrical measurements."

d) Para 2.2, 8.2, 8.3, 8.4, 8.6, 8.7
Amend the IEC publication reference to reflect the current issued documents including correcting the publication number

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and test references.

e) Para 6.2.1, 8.5, 9.7.1, 9.8
Minor editorial amendments to bring 4009 in line with the wording used in ESCC 9000 & 5000.

Justification:

a) The 24 month period matches the previous ESA/SCC requalification period, as is still applied for other ESCC QPL listed components (e.g. 4001/022 resistors).

b, d, e) Corrections

c) There is no need to have a minimum recovery period of one hour as the components will reach equilibrium in only a few seconds.

Attachments:

DCR_Attachment_4009.pdf, null

Modifications:

agreed as is
PSWG 22 Meeting

Approval signature:

Date signed:

2006-01-31

MARK-UP FOR DCR
S. Thacker.

European Space Components Coordination

Pages 1 to 26

RESISTORS, HEATERS, FLEXIBLE

ESCC Generic Specification No. 4009

Issue 3	January 2006
Issue ~~2~~	~~February 2005~~

esa

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

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DOCUMENTATION CHANGE NOTICE

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

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

DCR N°.

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.

60068 Part 2

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

60115 Part 1

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.

6.2 FAILURE CRITERIA

Room Temperature Electrical Measurements or High and Low Temperatures Electrical Measurements

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.

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~~ Na of IEC Publication No. ~~68-2-14~~ 60068-2-14 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.

until thermal equilibrium is reached, up to a maximum of 2 hours, prior to electrical measurements.

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. Heaters shall be visually examined and there shall be no evidence of damage.

8.4 BURN-IN

60115-1

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 ~~Ua1~~ Ua1 of IEC Publication No. ~~68-2-21~~ 60068-2-21 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~~ Ba of IEC Publication No. ~~68-2-2~~ 60068-2-2 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~~ First Cycle).

8.7.3 Damp Heat ~~(Accelerated) Five Cycle~~ (First Cycle)

The heaters, suspended by their terminal leads, shall be subjected to Test Db, ~~Severity a~~ Severity a (40°C), Variant 2, of IEC Publication No. ~~68-2-30~~ 60068-2-30, for one cycle of 24 hours. On completion of testing after recovery, the heaters shall be immediately subjected to ~~Ad~~ Ad Cold ~~Test~~.

8.7.4 Cold ~~Test~~

The heaters shall be subjected to Test ~~Ad~~ Ad of IEC Publication No. ~~68-2-1~~ 60068-2-1 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~~ 60068-2-13, 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 ~~Cb~~ Db, ~~Severity a~~ Severity a) (40°C) (6 cycles), Variant 2, of IEC Publication No. ~~68-2-30~~ 60068-2-30 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~~ until thermal equilibrium is reached, up to a maximum of 2 hours, prior to electrical measurements. 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.
  until thermal equilibrium is reached, up to a maximum of 2 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.

9.6 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~~ Testing

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

9.7.2 Periodic Testing for Qualification Maintenance

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

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

9.7.3 Lot Validation Testing

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

9.8 FAILED COMPONENTS LIST AND FAILURE ANALYSIS REPORT

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

(a) The reference and description of the test or measurement performed as defined in this specification and/or the Detail Specification during Special In-Process Controls, Screening Tests and Qualification 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).

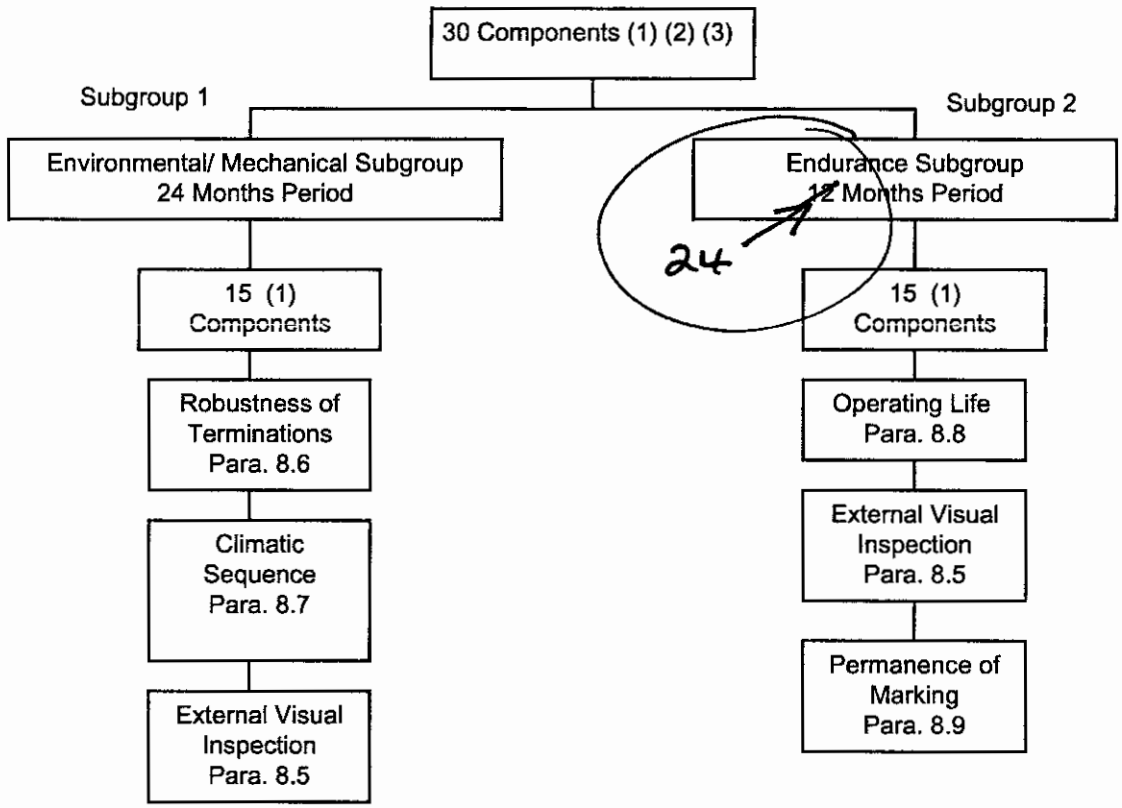
9.9 CERTIFICATE OF CONFORMITY

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:

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.