



Pages 1 to 35

**RELAYS, ELECTROMAGNETIC,
NON-LATCHING**

ESCC Generic Specification No. 3601

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1. **INTRODUCTION**

1.1 **SCOPE**

This specification defines the general requirements for the qualification, qualification maintenance, procurement, and delivery of electromagnetic non-latching relays for space applications. This specification contains the appropriate inspection and test schedules and also specifies the data documentation requirements.

1.2 **APPLICABILITY**

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

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

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

This specification may also be applied to the procurement of unqualified components, recommendations for which are given in ESCC Basic Specification No. 23100.

2. **APPLICABLE DOCUMENTS**

The following documents form part of, and shall be read in conjunction with, this specification. The relevant issues shall be those in effect on the date of starting qualification or placing the Purchase Order.

2.1 **ESCC SPECIFICATIONS**

- No. 20100, Requirements for the Qualification of Standard Electronic Components for Space Application.
- No. 20400, Internal Visual Inspection.
- No. 20500, External Visual Inspection.
- No. 20600, Preservation, Packaging and Dispatch of ESCC Components.
- No. 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. 23100, Recommendations on the use of the ESCC Specification System for the Evaluation and Procurement of Unqualified Components.
- No. 23500, Lead Materials and Finishes for Components for Space Application.
- No. 24600, Minimum Quality System Requirements.
- No. 24800, Resistance to Solvents of Marking, Materials and Finishes.
- No. 25400, Requirements for the Technology Flow Qualification of Electronic Components for Space Application

For qualification and qualification maintenance or procurement of qualified components, with the exception of ESCC Basic Specifications Nos. 20100, 21700, 22800, 24600 and 25400, where Manufacturers' specifications are equivalent to, or more stringent than, the ESCC Basic Specifications listed above, they may be used in place of the latter, subject to the approval of the ESCC Executive.

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

For procurement of unqualified components, where Manufacturers' specifications are equivalent to or more stringent than the ESCC Basic Specifications listed above, they may be used in place of the latter subject to the approval of the Orderer.

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

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

2.2 OTHER (REFERENCE) DOCUMENTS

- ECSS-Q-ST-70-02, Thermal Vacuum Test for the Screening of Space Materials.
- MIL-STD-202, Test Method Standard - Electronic and Electrical Component Parts.

2.3 ORDER OF PRECEDENCE

For the purpose of interpretation and in case of conflict with regard to documentation, the following order of precedence shall apply:

- (a) ESCC Detail Specification.
- (b) ESCC Generic Specification.
- (c) ESCC Basic Specification.
- (d) Other documents, if referenced herein.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply. In addition the following shall apply:

Contact Bounce: Any occurrence of $\geq 90\%$ open circuit voltage between the contacts, with a pulse width of $\geq 10\mu\text{s}$.

4. REQUIREMENTS

4.1 GENERAL

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

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

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

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

4.1.1 Specifications

For qualification, qualification maintenance, procurement and delivery of components in conformity with this specification, the applicable specifications listed in Section 2 of this document shall apply in total unless otherwise specified herein or in the Detail Specification.

4.1.2 Conditions and Methods of Test

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

4.1.3 Manufacturer's Responsibility for Performance of Tests and Inspections

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

4.1.4 Inspection Rights

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

4.1.5 Customer Source Inspection

4.1.5.1 *Pre-Encapsulation Customer Source Inspection*

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

4.1.5.2 *Final Customer Source Inspection*

If stipulated in the Purchase Order, the Orderer may perform a source inspection at the Manufacturer's facility at the end of Screening or during Lot Validation Testing, if applicable, (including, for example, witness of final Room Temperature Electrical Measurements, performance of External Visual Inspection and Dimension Check, review of the data documentation package). Details of the inspections to be performed or witnessed and the required period of notification shall be as stipulated in the Purchase Order.

4.2 QUALIFICATION AND QUALIFICATION MAINTENANCE REQUIREMENTS ON A MANUFACTURER

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

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

4.3 DELIVERABLE COMPONENTS

4.3.1 ESCC Qualified Components

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

4.3.2 ESCC Components

Each component, irrespective of qualification status, identified with an ESCC component number and delivered to this specification shall:

- be traceable to its production lot.
- have satisfactorily completed all the tests required by the relevant issues of the applicable specifications.
- be produced from lots that are considered by the Manufacturer to be capable of passing all applicable tests, and sequences of tests, that are defined in Chart F4. The Manufacturer shall not knowingly supply components that cannot meet this requirement. In the event that, subsequent to delivery and prior to operational use, a component is found to be in a condition such that, demonstrably, it could not have passed these tests at the time of manufacture, this shall be grounds for rejection of the delivered lot.

4.3.3 Lot Failure

Lot failure may occur during Screening Tests (Chart F3) or Qualification 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 or analysis shall be performed on the failed components until so instructed by the ESCC Executive.

Should such failure occur during procurement of unqualified components the Manufacturer shall notify the Orderer by any appropriate written means within 5 working days, giving details of the number and mode of failure and the suspected cause. No further testing or analysis shall be performed on the failed components until so instructed by the Orderer. The Orderer shall inform the Manufacturer within 5 working days of receipt of notification what action shall be taken.

4.4 MARKING

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

4.5 MATERIALS AND FINISHES

Specific requirements for materials and finishes are specified in the Detail Specification. Where a definite material or finish is not specified a material or finish shall be used so as to ensure that the component meets the performance requirements of this specification and the Detail Specification. Acceptance or approval of any constituent material or finish does not guarantee acceptance of the finished product.

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

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

5. PRODUCTION CONTROL

5.1 GENERAL

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

Any components which do not meet these requirements shall be removed from the lot and at no future time be resubmitted to the requirements of this specification.

The applicable test requirements are detailed in the paragraphs referenced in Chart F2.

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

5.2 SPECIAL IN-PROCESS CONTROLS

5.2.1 Internal Visual Inspection

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

5.2.2 Thermal Shock

Thermal Shock shall be performed in accordance with Para. 8.2.1.

5.2.3 Room Temperature Electrical Measurements

Room Temperature Electrical Measurements shall be performed in accordance with Para. 8.3.3.

5.2.4 Seal (Fine and Gross Leak)

Seal (Fine and Gross Leak) may be performed in accordance with Paras. 8.4.1.1 and 8.4.2 at the Manufacturer's discretion.

5.2.5 External Visual Inspection

External Visual Inspection may be performed in accordance with Para. 8.5 at the Manufacturer's discretion.

5.2.6 Dimension Check

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

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

5.2.7 Weight

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

5.2.8 Documentation

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

6. SCREENING TESTS

6.1 GENERAL

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

Any components which do not meet these requirements shall be removed from the lot and at no future time be resubmitted to the requirements of this specification.

The applicable test methods and conditions are specified in the paragraphs referenced in Chart F3.

6.2 FAILURE CRITERIA

6.2.1 Environmental and Mechanical Test Failure

The following shall be counted as component failures:- components which fail during tests for which the pass/fail criteria are inherent in the test method, i.e. Vibration Scan, Seal and External Visual Inspection.

6.2.2 Parameter Drift Failure

Only applicable if specified in the Detail Specification.

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

6.2.3 Parameter Limit Failure

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

6.2.4 Other Failures

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

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

6.3 FAILED COMPONENTS

A component shall be considered as a failed component if it exhibits one or more of the failure modes described in Para. 6.2.

6.4 LOT FAILURE

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

6.4.1 Lot Failure during 100% Testing

If the number of components failed on the basis of the failure criteria specified in Para. 6.2.3 exceeds

10% (rounded upwards to the nearest whole number) of the components submitted to Chart F3, the lot shall be considered as failed.

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

6.4.2 Lot Failure during Sample Testing

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

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

6.5 DOCUMENTATION

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

7. QUALIFICATION, QUALIFICATION MAINTENANCE AND LOT VALIDATION TESTING

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

7.1 QUALIFICATION TESTING

7.1.1 General

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

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

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

7.1.2 Distribution within the Qualification Test Lot

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

The distribution shall be as specified by, or agreed with, the ESCC Executive.

7.2 QUALIFICATION WITHIN A TECHNOLOGY FLOW

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

7.3 QUALIFICATION MAINTENANCE (PERIODIC TESTING)

Qualification is maintained through periodic testing and the test requirements of Para. 7.1 shall apply. For

each subgroup the sample size and the period between successive subgroup testing shall be as specified in Chart F4. The conditions governing qualification maintenance are specified in ESCC Basic Specification No. 20100.

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

7.4 LOT VALIDATION TESTING

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

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

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

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

7.5 FAILURE CRITERIA

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

7.5.1 Environmental and Mechanical Test Failures

The following shall be counted as component failures:-

Components which fail during tests for which the pass/fail criteria are inherent in the test method, e.g. Seal, Terminal Strength, etc.

7.5.2 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.

7.5.3 Other Failures

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

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

7.6 FAILED COMPONENTS

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

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

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

7.7 LOT FAILURE

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

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

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

7.8 QUALIFICATION, QUALIFICATION MAINTENANCE AND LOT VALIDATION TESTING SAMPLES

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

7.9 DOCUMENTATION

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

8. TEST METHODS AND PROCEDURES

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

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

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

8.1 INTERNAL VISUAL INSPECTION

ESCC Basic Specification No. 20400.

8.2 THERMAL SHOCK

8.2.1 Special In-Process Controls

MIL-STD-202, Test Condition 107, Test Condition B.

8.2.2 Qualification and Periodic Tests

MIL-STD-202, Test Condition 107 with the following details:

- Mounting: The relays shall be suspended by any non-heat-conducting material in a plane parallel to the normal air flow in the oven. Test leads may be used for mounting; however they shall not constitute a heat-sink.
- Test Conditions: Test Condition B with the exception that the exposure time at temperature extremes during the 5th cycle shall be 2 hours each.
- Data Points: During the 5th cycle, at the end of the exposure at each temperature extreme, whilst the relays are still in the conditioning chamber, Pick-up Voltage, Drop-out Voltage, Operate Time and Release Time shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.
On completion of testing the relays shall be visually examined and there shall be no cracking, peeling or flaking of the finish. Electrical Measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.3 ELECTRICAL MEASUREMENTS

8.3.1 General

CAUTION : Unless otherwise specified in the Detail Specification, relays to be included in the delivery lot shall not switch a voltage between contacts greater than 6V and a current greater than 10mA, during any testing prior to delivery. Any testing that requires a greater current and/or voltage be applied shall be performed on a destructive sample basis.

Electrical measurements and methods shall be as follows.

Rated Coil Voltage, Rated Resistive Load Contact Current and Rated Inductive Load Contact Current applied during testing shall be as specified in Maximum Ratings in the Detail specification.

8.3.1.1 *Pick-up Voltage*

The Coil Voltage shall be gradually increased from zero until the relay switches, within a period of up to 3 seconds maximum. The Pick-up Voltage shall be read when all contacts have transferred. Suitable means shall be provided for the monitoring of break and make of contacts.

8.3.1.2 *Drop-out Voltage*

Rated Coil Voltage shall be applied to the coil and gradually reduced until the contacts return to their initial position. The Drop-out Voltage shall be read when all contacts have transferred. Suitable means shall be provided for the monitoring of break and make of contacts.

8.3.1.3 *Contact Voltage Drop (Contact Resistance)*

MIL-STD-202, Test Method 307 with the following details using a DC method.

- Method of Connection: For relays with wire lead terminals this measurement shall be made 3mm maximum from the relay body.
- Test Current:
 - for relays with Rated Resistive Load Contact Current less than 5A: As specified in Room Temperature Electrical Measurements in the Detail Specification (100mA maximum).
 - for relays with Rated Resistive Load Contact Current of 5A or greater: As specified in Room Temperature Electrical Measurements in the Detail Specification (between 100mA and Rated Resistive Load Contact Current).
- Maximum Open Circuit Test Voltage: 6V
- Activation prior to Measurement: None; the coil shall be energised with Rated Coil Voltage, if necessary, to close the contacts.

- Number of Measurements per Activation: 1 in each closed contact position.
- Number of Test Activations: 3. No load shall be applied to the contacts during contact transfer.

8.3.1.4 *Operate Time, Release Time, Bounce Time*

Times shall be measured using an oscilloscope or any suitable equipment. Rated Coil Voltage shall be applied to operate the relay. Contacts shall be loaded with 6V maximum at 10mA maximum. Operate Time and Release Time shall be exclusive of Contact Bounce. Times shall be measured on all contact sets.

8.3.1.5 *Coil Resistance*

MIL-STD-202, Test Method 303.

8.3.1.6 *Voltage Proof*

MIL-STD-202, Test Method 301 with the following details.

- Test Voltage: As specified in Room Temperature Electrical Measurements in the Detail Specification.
- Maximum Leakage Current: 1mA.
- Duration of Application: 5s.
- Points of Application:

Between terminals (except coil) and case, coil de-energised.

Between terminals (except coil) and case, coil energised with Rated Coil Voltage.

Between open contacts, coil de-energised.

Between open contacts, coil energised with Rated Coil Voltage.

Between coil and case.

Between coil and other terminals.

Between switching circuits, coil de-energised.

Between switching circuits, coil energised with Rated Coil Voltage.

8.3.1.7 *Insulation Resistance*

MIL-STD-202, Test Method 302 with the following details.

- Test Condition A for relays with coil and contact voltage ratings less than 60V; Test Condition B for all other relays.
- Test Voltage: As specified in Room Temperature Electrical Measurements in the Detail Specification.
- Points of Measurement: as per Voltage Proof.

8.3.2 Parameter Drift Values

Only applicable if specified in the Detail Specification.

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

parameter drift calculated.

8.3.3 Room Temperature Electrical Measurements

Room Temperature Electrical Measurements shall be performed as specified in the Detail Specification. All values obtained shall be recorded against serial numbers.

8.3.4 High and Low Temperatures Electrical Measurements

High and Low Temperatures Electrical Measurements shall be performed as specified in the Detail Specification. High temperature measurements shall be performed after allowing the relay to stabilise with the coil energised. Low temperature measurements shall be performed after allowing the relay to stabilise with the coil de-energised. All values obtained shall be recorded against serial numbers.

8.3.5 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 after allowing the relay to stabilise with the coil de-energised. All values obtained shall be recorded against serial numbers and the parameter drift calculated, if specified.

8.4 SEAL

8.4.1 Seal, Fine Leak

8.4.1.1 *Special In-Process Controls and Screening Tests*

MIL-STD-202, Test Method 112, Test Condition C, Procedure IIIa with the following details.

- Maximum Leak Rate: 1×10^{-8} atm.cm³/s air.
- Duration of Pressurisation: 2 hours minimum at a pressure of 400kPa.
- Recovery Time: 30 minutes minimum at room ambient conditions.

8.4.1.2 *Qualification and Periodic Tests*

MIL-STD-202, Test Method 112, Test Condition C, Procedure IIIa with the following details.

- Maximum Leak Rate: 1×10^{-8} atm.cm³/s air.
- Duration of Pressurisation: 12 hours minimum at a pressure of 400kPa.
- Recovery Time: 2 hours minimum at room ambient conditions.
- The measured leak rate for each component shall be recorded against serial number.

8.4.2 Seal, Gross Leak

MIL-STD-202, Test Method 112, Test Condition B or D with the following details.

- For test condition B, de-ionised water shall be used instead of silicone oil. De-ionised water shall be maintained at 25°C in an absolute pressure of not greater than 8465Pa.
- No bubble shall emanate from the relay case or header.

8.5 EXTERNAL VISUAL INSPECTION AND DIMENSION CHECK

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

Dimension Check (during Special In-Process Controls only) shall be performed in accordance with ESCC Basic Specification No. 20500 and the Detail Specification.

8.6 VIBRATION SCAN

MIL-STD-202, Test Method 204, Test Condition G with the following details.

- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Sweep Time and Duration: The entire frequency range of 10 to 3000Hz and return to 10Hz shall be traversed in 10 minutes. This cycle shall be performed once in the direction of contact motion and once in the direction of the coil axis.
- Coil Load: Coil energised with Rated Coil Voltage during the sweep up. The coil shall be de-energised during sweep down.
- Contact Chatter Monitoring: Closed and open contacts shall be monitored per MIL-STD-202, Test Method 310, Test-circuit B, Test Condition A.

8.7 RUN-IN

MIL-STD-202, Test Method 311 with the following details.

- Test Temperature(s): As specified in the Detail Specification.
- Number of Cycles of Operation: 6000.
- Cycling Rate: 1 to 5 cycles per second. Rated Coil Voltage shall be applied to operate the relay.
- Maximum Contact Resistance Allowed: 100ohm unless otherwise specified in the Detail Specification.
- Number of Misses Allowed: 0
- Monitoring of Contacts for Sticking: Not applicable.

8.8 VIBRATION

8.8.1 Low Level Sine Vibration

MIL-STD-202, Test Method 204 with the following details.

- Test Condition: G (30g peak)
- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Sweep Time, Duration and Coil Load: The entire frequency range of 10 to 3000Hz and return to 10Hz shall be traversed in 20 minutes. This cycle shall be performed 6 times with the coil energised with Rated Coil Voltage, and 6 times with the coil de-energised in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours.
- Contact Chatter Monitoring: Closed and open contacts shall be monitored per MIL-STD-202, Test Method 310, Test-circuit B, Test Condition A.
- Data Points: On completion of testing, relays shall be visually examined and there shall be no evidence of damage or loosening of parts. Electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed. If drift values are specified, the drift shall always be related to the measurement immediately prior to the test.

8.8.2 Random Vibration

Only applicable to relays with Rated Resistive Load Contact Current less than 5A.

MIL-STD-202, Test Method 214 with the following details:

- Test Condition: IG (0.4 G²/Hz, 23.91 Overall rms G)
- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Duration and Coil Load: The relays shall be tested with the coil energised with Rated Coil Voltage for 15 minutes and with the coil de-energised for 15 minutes, in each of three mutually perpendicular directions, so that the motion shall be applied for a total period of approximately 90 minutes.
- Contact Chatter Monitoring: Closed and open contacts shall be monitored per MIL-STD-202, Test Method 310, Test-circuit B, Test Condition A.
- Data Points: On completion of testing, relays shall be visually examined and there shall be no evidence of damage or loosening of parts. Electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed. If drift values are specified, the drift shall always be related to the measurement immediately prior to the test.

8.8.3 High Level Sine Vibration

MIL-STD-202, Test Method 204 with the following details:

- Test Condition: E (50g peak) unless otherwise specified in the Detail Specification.
- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Sweep Time, Duration and Coil Load: The entire frequency range of 10 to 2000Hz and return to 10Hz shall be traversed in 20 minutes. This cycle shall be performed 2 times with the coil energised with Rated Coil Voltage, and 2 times with the coil de-energised, in each of three mutually perpendicular directions (total of 12 times), so that the motion shall be applied for a total period of approximately 4 hours.
- Monitoring: Contact chatter monitoring is not applicable. Contacts shall be monitored for any unintended change in position. Opening or closing of contacts during testing shall not constitute a failure. Permanent change shall constitute a failure.
- Data Points: Immediately on completion of testing, Rated Coil Voltage shall be applied to operate the relay under test. Failure of the relay to switch on application of the first pulse to the coil shall constitute a failure.

After the operating test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed. If drift values are specified, the drift shall always be related to the measurement immediately prior to the test. Relays shall be visually examined and there shall be no evidence of damage or loosening of parts.

8.9 MECHANICAL SHOCK

8.9.1 Low Level Mechanical Shock

MIL-STD-202, Test Method 213 with the following details.

- Test Condition: C.
- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Coil Load: In each of three mutually perpendicular directions, 2 shocks shall be applied with the coil de-energised and 1 shock applied with the coil energised with Rated Coil Voltage.
- Contact Chatter Monitoring: Closed and open contacts shall be monitored per MIL-STD-202, Test Method 310, Test-circuit B, Test Condition A.
- Data Points: On completion of testing, relays shall be visually examined and there shall be no evidence of damage or loosening of parts. Electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed. If drift values are specified, the drift shall always be related to the measurement immediately prior to the test.

8.9.2 High Level Mechanical Shock

MIL-STD-202, Test Method 213 with the following details.

- Test Condition:
 - Peak value: 750g.
 - Duration: 0.5ms
 - Waveform: half-sine.

- Method of Mounting: The relays shall be mounted rigidly by normal mounting means.
- Coil Load: In each of three mutually perpendicular directions, 2 shocks shall be applied with the coil de-energised and 1 shock applied with the coil energised with Rated Coil Voltage.
- Monitoring: Contact chatter monitoring is not applicable. Contacts shall be monitored for any unintended change in position. Opening or closing of contacts during testing shall not constitute a failure. Permanent change shall constitute a failure.
- Data Points: Immediately on completion of testing, Rated Coil Voltage shall be applied to operate the relay under test. Failure of the relay to switch on application of the first pulse to the coil shall constitute a failure.

After the operating test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed. If drift values are specified, the drift shall always be related to the measurement immediately prior to the test. Relays shall be visually examined and there shall be no evidence of damage or loosening of parts.

8.10 RESISTANCE TO SOLDERING HEAT

MIL-STD-202, Test Method 210, Test Condition B with the following details.

- Depth of Immersion: Within 1.5 ± 0.5 mm of the relay header.
- Data Points: On completion of testing, Insulation Resistance, Contact Voltage Drop, Pick-up Voltage, Drop-out Voltage and Coil Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.11 LIFE

8.11.1 Low Level Life

Only applicable to relays with Rated Resistive Load Contact Current less than 5A.

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Room ambient temperature.
- Number of Cycles of Operation: 1000000.
- Cycling rate: The minimum ON/OFF cycle time shall be 10 times the sum of the maximum operate and release times as specified in Room Temperature Electrical Measurements in the Detail Specification, for the relay under test. The coil shall be energised for 50+/- 10% of each cycle. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current shall not exceed 10mA with an open circuit voltage of 10 to 50mV (DC or AC peak). All contacts in each sample unit shall make, carry and break identical loads. The direction of current flow in the contacts of half the quantity of samples shall be in the opposite direction; this requirement does not apply to double make or double break contacts.

All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.
- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect

switching. The Voltage Drop shall be monitored during the first 100000 cycles for 40% minimum of each ON and OFF period during the switching cycle. The remaining cycles need not be monitored. The Voltage Drop across closed contacts shall not be more than 10% of the open circuit voltage for a duration greater than 100 μ s.

The equipment shall automatically shut off when a failure occurs or shall record any failure.

- Data Points: On completion of testing, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.11.2 Inductive Life

Only applicable to relays with Rated Resistive Load Contact Current greater than or equal to 5A.

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification.
- Number of Cycles of Operation: 20000 minimum.
- Cycling rate: The ON time shall be 0.5 \pm 0.05s and the OFF time shall be 3 \pm 0.1s. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: the test current and voltage shall be as specified for Rated Inductive Load Contact Current in Maximum Ratings in the Detail Specification with a time constant L/R of 5.0ms. All contacts in each sample unit shall make, carry and break identical loads. The direction of current flow in the contacts of half the quantity of samples shall be in the opposite direction; this requirement does not apply to double make or double break contacts.
All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.
The equipment shall automatically shut off when a failure occurs or shall record any failure.
- Data Points: On completion of testing, the relay case to ground fuse shall be checked for continuity. Blowing of this fuse shall constitute a failure.
After the fuse continuity test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.11.3 Resistive Life

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification.
- Number of Cycles of Operation: 100000 minimum.
- Cycling rate: 20 \pm 2 ON/OFF cycles per minute and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current and voltage shall be as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification. All contacts in each sample unit shall make, carry and break identical loads. The direction of current flow in the contacts of half the quantity of samples shall be in the opposite direction; this requirement does not apply to double make or double

break contacts.

All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The maximum Voltage Drop across closed contacts shall as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Equipment shall automatically shut off when a failure occurs or shall record any failure.
- Data Points: On completion of testing, the relay case to ground fuse shall be checked for continuity. Blowing of this fuse shall constitute a failure. After the fuse continuity test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.12

COIL LIFE

The relays shall be subjected to temperature cycling in accordance with the following details.

- Mounting: Each relay may be attached by its normal mounting means to a 1.6mm thick minimum, flat aluminium plate heat-sink. The heat-sink shall be designed to position each relay in the centre of its own square space whose total surface area (both sides) is 8 times the outside surface area of the relay, excluding mounting. Relays without mounts shall be held to the heat-sink with a metal strap with a width of 6.35mm and a maximum thickness of 0.3mm. The heat-sink assembly shall be suspended by any non-heat-conducting material in a plane parallel to the normal air flow in the oven. Test leads shall not constitute a heat-sink.
- Temperature Cycling: Each relay assembly shall be subjected to 4 temperature cycles, each with the following steps. At temperature extremes the oven temperature shall be controlled to maintain the specified temperature. The rate of change of ambient temperature between steps shall not exceed 1°C/s.
 - Step 1: Room ambient temperature for a period of 24 (+0 -12) hours.
 - Step 2: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification for a period of 100 (+24 -0) hours.
 - Step 3: Minimum operating temperature (-0 +3°C) as specified in Maximum Ratings in the Detail Specification for a period of 12 (+2 -0) hours.
 - Step 4: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification for a period of 100 (+24 -0) hours.
 - Step 5: Minimum operating temperature (-0 +3°C) as specified in Maximum Ratings in the Detail Specification for a period of 12 (+2 -0) hours.
- Coil and Contact Load Conditions: During steps 2 and 4 at high temperature, the coil shall be energised with Rated Coil Voltage and for at least half of the Normally Open contacts the contact load current and voltage shall be as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification. During the other steps the coil shall be de-energised and the contacts shall not be loaded.
- Data Points: During step 1 of each cycle at room ambient temperature Contact Voltage Drop and Coil Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

During step 3 of the first cycle at low temperature, after allowing the relay to stabilise with the coil

de-energised, Contact Voltage Drop, Operate Time and Release Time shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

During steps 4 and 5 of the fourth cycle at high and low temperatures, after allowing the relay to stabilise with the coil de-energised, Pick-up Voltage and Drop-out Voltage shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

On completion of testing, at room ambient temperature, Voltage Proof, Insulation Resistance, Contact Voltage Drop, Coil Resistance, Operate Time, Release Time and Bounce Time shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Relays shall be visually examined and there shall be no evidence of damage or loosening of parts.

8.13 INTERMEDIATE CURRENT

8.13.1 Relays with Rated Resistive Load Contact Current Less Than 5A

MIL-STD-202, Test Method 312 with the following details.

- Test Temperature: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification.
- Number of Cycles of Operation: 50000.
- Cycling rate: 10 ±2 ON/OFF cycles per minute and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current and voltage shall be 100mA and 28Vdc. All contacts in each sample unit shall make, carry and break identical loads.
- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.
- Data Points: On completion of testing, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.13.2 Relays with Rated Resistive Load Contact Current of 5A to 20A

MIL-STD-202, Test Method 312 with the following details.

- Test Temperature: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification.
- Number of Cycles of Operation: 5000.
- Cycling rate: 10 ±2 ON/OFF cycles per minute and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load:
 - (a) For 1 pole double throw or 2 pole single throw relays:
The Normally Open contact shall make, carry and break a contact load current and voltage as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification while the Normally Closed contact shall make, carry and break 10% of the same contact load.
 - (b) For 2 pole double throw relays:
The relays shall be separated into 3 equal groups.
Both Normally Closed and Normally Open contacts of one pole of each relay shall make, carry and break a contact load current and voltage as specified for Rated Resistive Load Contact

Current in Maximum Ratings in the Detail Specification.

The remaining pole of each relay in the 3 groups shall make, carry and break the following contact load:

- Group 1: 0.5A resistive at 28Vdc
- Group 2: 0.3A inductive at 28Vdc; L/R = 15ms
- Group 3: 0.1A resistive at 28Vdc

(c) For 4 pole double throw relays:

Both Normally Closed and Normally Open contacts of all poles of each relay shall make, carry and break each of the following contact loads:

- Pole 1: Contact load current and voltage as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification.
- Pole 2: 0.5A resistive at 28Vdc
- Pole 3: 0.3A inductive at 28Vdc; L/R = 15ms
- Pole 4: 0.1A resistive at 28Vdc

- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.
- Data Points: On completion of testing, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.13.3 Relays with Rated Resistive Load Contact Current Greater Than 20A

MIL-STD-202, Test Method 312 with the following details.

- Test Temperature: Maximum operating temperature (+0 -3°C) as specified in Maximum Ratings in the Detail Specification.
- Number of Cycles of Operation: 5000.
- Cycling rate: 10 ±2 ON/OFF cycles per minute and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load:
 - (a) For 1 pole double throw or 2 pole single throw relays:

The Normally Open contact shall make, carry and break a contact load current and voltage as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification while the Normally Closed contact shall make, carry and break 10% of the same contact load.
 - (b) For all other relays:

One pole of each relay shall make, carry and break a contact load current and voltage as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification. All other poles shall make, carry and break 10% of the same contact load . Any Auxiliary contacts shall be simultaneously tested in accordance with Para. 8.13.1.
- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.
- Data Points: On completion of testing, electrical measurements as specified in Intermediate and

End-Point Electrical Measurements in the Detail Specification shall be performed.

8.14 MECHANICAL LIFE

Only applicable to relays with Rated Resistive Load Contact Current greater than or equal to 5A.

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Room ambient temperature.
- Number of Cycles of Operation: 350000 minimum.
- Cycling rate: The minimum ON/OFF cycle time shall be 10 times the sum of the maximum operate and release times as specified in Room Temperature Electrical Measurements in the Detail Specification, for the relay under test and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: No load.
- Monitoring: No monitoring.
- Data Points: On completion of testing, Contact Voltage Drop, Pick-up Voltage, Drop-out Voltage, Operate Time, Release Time, Bounce Time and Coil Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification.

8.15 SOLDERABILITY

MIL-STD-202, Test Method 208. All terminals shall be tested.

8.16 OVERLOAD

8.16.1 Relays with Rated Resistive Load Contact Current Less Than 5A

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Room ambient temperature.
- Number of Cycles of Operation: 100.
- Cycling rate: 20 \pm 2 ON/OFF cycles per minute and the ON and OFF times shall be approximately equal. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current and voltage shall be as specified for Overload Current in Maximum Ratings in the Detail Specification. All contacts in each sample unit shall make, carry and break identical loads. All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.
For double throw relays, separate tests may be performed for Normally Open and for Normally Closed contacts. If both Normally Open and Normally Closed contacts of double pole relays are tested simultaneously, a separate load shall be provided for each contact.
The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.
- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Equipment shall automatically shut off when a failure occurs or shall record any failure.
- Data Points: On completion of testing, the relay case to ground fuse shall be checked for continuity. Blowing of this fuse shall constitute a failure.

After the fuse continuity test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.16.2 Relays with Rated Resistive Load Contact Current of 5A to 20A

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Room ambient temperature.
- Number of Cycles of Operation: 50.
- Cycling rate: The ON time shall be 0.2 ± 0.05 s and the OFF time shall be 20 ± 1 s. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current and voltage shall be as specified for Overload Current in Maximum Ratings in the Detail Specification. All contacts in each sample unit shall make, carry and break identical loads.

All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.

For double throw relays, separate tests may be performed for Normally Open and for Normally Closed contacts. If both Normally Open and Normally Closed contacts of double pole relays are tested simultaneously, a separate load shall be provided for each contact.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 10% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Equipment shall automatically shut off when a failure occurs or shall record any failure.
- Data Points: On completion of testing, the relay case to ground fuse shall be checked for continuity. Blowing of this fuse shall constitute a failure.

After the fuse continuity test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.16.3 Relays with Rated Resistive Load Contact Current Greater Than 20A

Relays shall be operated with contacts loaded in accordance with the following conditions.

- Test Temperature: Room ambient temperature.
- Number of Cycles of Operation: 50.
- Cycling rate: The ON time shall be 0.2 ± 0.05 s and the OFF time shall be 20 ± 1 s. Rated Coil Voltage shall be applied to operate the relay under test.
- Contact Load: The test current and voltage shall be as specified for Overload Current in Maximum Ratings in the Detail Specification. All contacts in each sample unit shall make, carry and break identical loads.

All loads shall be connected between the fixed contacts and power supply ground. The moveable contacts shall be connected to the power supply.

For double throw relays, separate tests may be performed for Normally Open and for Normally Closed contacts. If both Normally Open and Normally Closed contacts of double pole relays are tested simultaneously, a separate load shall be provided for each contact.

Any Auxiliary contacts shall be simultaneously tested with a test current and voltage as specified for Rated Resistive Load Contact Current in Maximum Ratings in the Detail Specification.

The relay case shall be connected to the system ground through a normal-blow fuse rated at 100mA or 5.0% of the test current, whichever is greater.

- Monitoring: The opening and closing of the contacts shall be continuously monitored to detect switching. The Voltage Drop shall be monitored for 40% minimum of each ON and OFF period during the switching cycle. The voltage across open contacts shall not be less than 95% of the load voltage. The maximum Voltage Drop across closed contacts shall be as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification. Equipment shall automatically shut off when a failure occurs or shall record any failure.
- Data Points: On completion of testing, the relay case to ground fuse shall be checked for continuity. Blowing of this fuse shall constitute a failure.
After the fuse continuity test, electrical measurements as specified in Intermediate and End-Point Electrical Measurements in the Detail Specification shall be performed.

8.17 PERMANENCE OF MARKING
ESCC Basic Specification No. 24800.

8.18 TERMINAL STRENGTH
Unless otherwise specified, 2 terminals of each discrete design, size and configuration shall be tested. On completion of testing, relays shall be visually examined and there shall be no evidence of loosening or breaking of the terminals or any other damage that could adversely affect their normal operation.

8.18.1 All Relays - Pull Test
MIL-STD-202, Test Method 211, Test Condition A with the following details.

- Applied Force: As specified in the Detail Specification.

8.18.2 Relays with Flat Terminals - Bend Test
MIL-STD-202, Test Method 211, Test Condition B with the following details.

- Number of Bending Operations: 2

8.18.3 Relays with Wire Lead Terminals - Bend Test
MIL-STD-202, Test Method 211, Test Condition C with the following details.

- Load: : As specified in the Detail Specification.

8.18.4 Relays with Wire Lead Terminals - Twist Test
MIL-STD-202, Test Method 211, Test Condition D with the following details.

- Application of Torsion: Each terminal shall be rotated by 45° in one direction, then returned to start; followed by a rotation of 45° in the opposite direction, then returned to start. Each terminal shall be subjected to 2 such sequences of rotations and returns.
Subsequently each terminal shall be held at a point 19mm from the emergence from the relay and, in one plane, be rotated by 20 ±5° in one direction, then return to start; followed by a rotation of 20 ±5° in the opposite direction, then returned to start. This sequence shall then be repeated in the

perpendicular plane.

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 available in electronic format suitable for reading using a compatible PC. The format supplied shall be legible, durable and indexed. The preferred storage medium is CD-ROM and the preferred file format is PDF.

9.1.1 **Qualification and Qualification Maintenance**

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

9.1.2 **Component Procurement and Delivery**

For all deliveries of components procured to this specification, the following documentation shall be supplied:

- (a) Cover sheet (if all of the information is not included on the Certificate of Conformity).
- (b) Certificate of Conformity (including range of delivered serial numbers).

9.1.3 **Additional Documentation**

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

9.1.4 Data Retention/Data Access

If not delivered, all data shall be retained by the Manufacturer for a minimum of 10 years during which time it shall be available for review, if requested, by the Orderer or the ESCC Executive (for qualified components).

9.2 COVER SHEET(S)

The cover sheet(s) of the data documentation package shall include as a minimum:

- (a) Reference to the Detail Specification, including issue and date.
- (b) Reference to the applicable ESCC Generic Specification, including issue and date.
- (c) ESCC Component Number and the Manufacturer's part type number.
- (d) Lot identification.
- (e) Range of delivered serial numbers.
- (f) Number of the Purchase Order.
- (g) Information relative to any additions to this specification and/or the Detail Specification.
- (h) Manufacturer's name and address.
- (i) Location of the manufacturing plant (specify place of assembly and test).
- (j) Signature on behalf of Manufacturer.
- (k) Total number of pages of the data package.

9.3 LIST OF EQUIPMENT USED

A list of equipment used for tests and measurements shall be prepared. Where applicable, this list shall contain inventory number, Manufacturer's type number, serial number, etc. This list shall indicate for which tests such equipment was used.

9.4 LIST OF TEST REFERENCES

This list shall include all Manufacturer's references or codes which are necessary to correlate the test data provided with the applicable tests specified in the tables of the Detail Specification.

9.5 SPECIAL IN-PROCESS CONTROLS DATA (CHART F2)

A test result summary shall be compiled showing the total number of components submitted to, and the total number rejected after each of the tests. For each test requiring electrical measurements the results shall be recorded against component serial number.

9.6 SCREENING TESTS DATA (CHART F3)

A test result summary shall be compiled showing the total number of components submitted to and the total number rejected after each of the tests. For each test requiring electrical measurements the results shall be recorded against component serial number.

9.7 QUALIFICATION AND PERIODIC TESTS DATA (CHART F4)

9.7.1 Qualification Testing

A test result summary shall be compiled showing the components submitted to, and the number rejected after each test in each subgroup. Component serial numbers for each subgroup shall be identified. For each test requiring electrical measurements the results shall be recorded against component serial number. Where a drift value is specified during a test the drift calculation shall be recorded against component serial number. Measurement of leak rate during Seal Fine Leak testing 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. Measurement of leak rate during Seal Fine Leak testing 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. If applicable, measurement of leak rate during Seal Fine Leak testing 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) Traceability information including serial number (if applicable) of the failed component.
- (c) The failed parameter and the failure mode of the component.
- (d) Detailed failure analysis (if requested by the ESCC Executive or Orderer).

9.9 CERTIFICATE OF CONFORMITY

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

10. DELIVERY

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

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

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

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

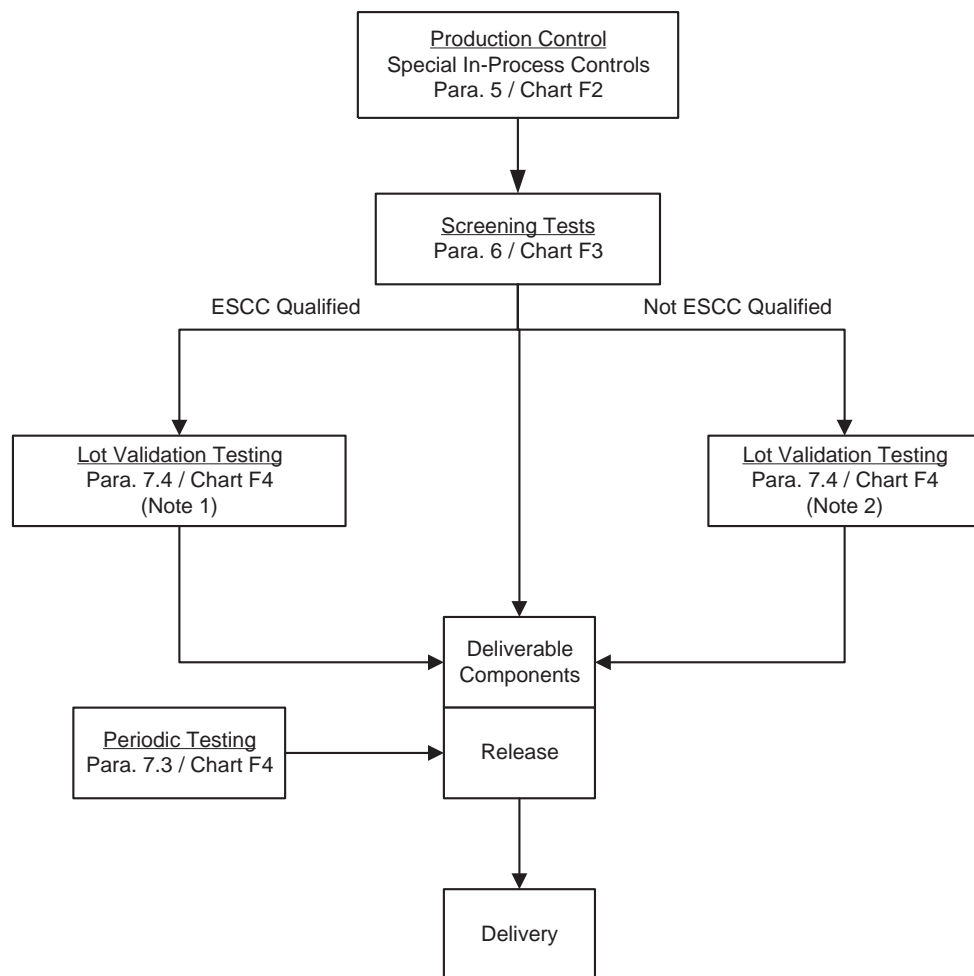
paragraphs of Section 9 of this specification.

11. PACKAGING AND DISPATCH

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

12. CHARTS

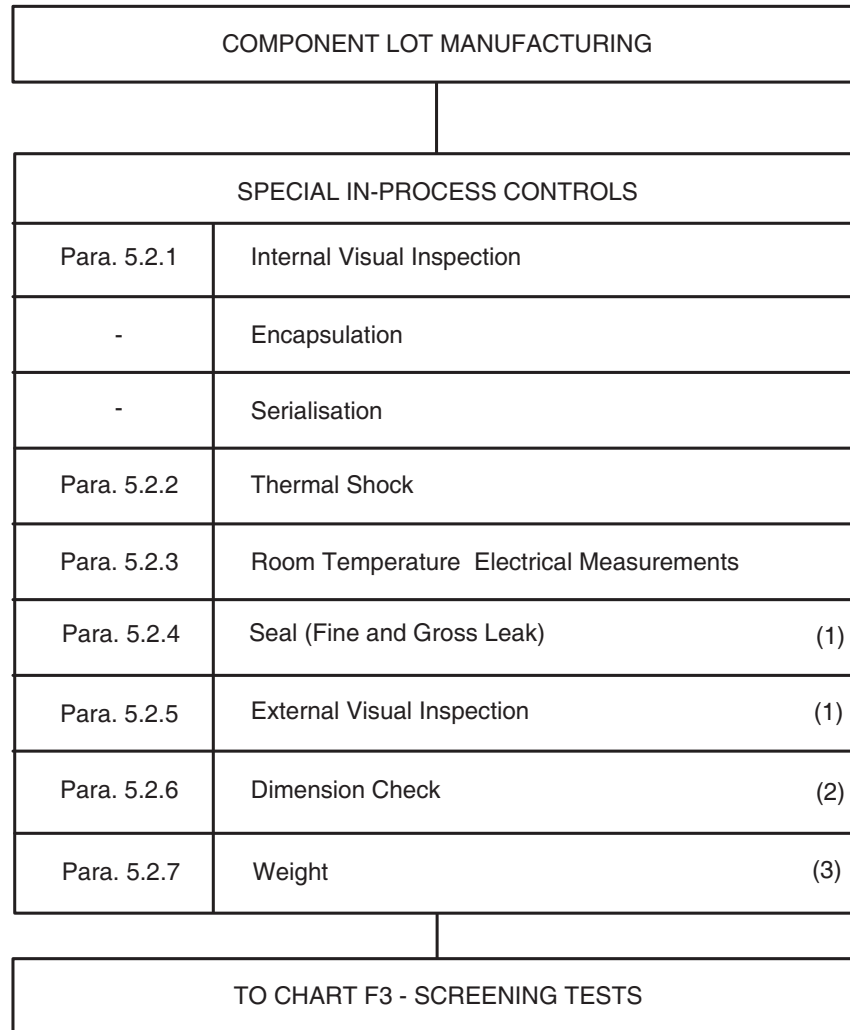
12.1 CHART F1 - GENERAL FLOW FOR PROCUREMENT



NOTES:

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

12.2 CHART F2 - PRODUCTION CONTROL



NOTES:

1. Performed at the Manufacturer's discretion.
2. Performed on a sample basis.
3. Guaranteed but not tested.

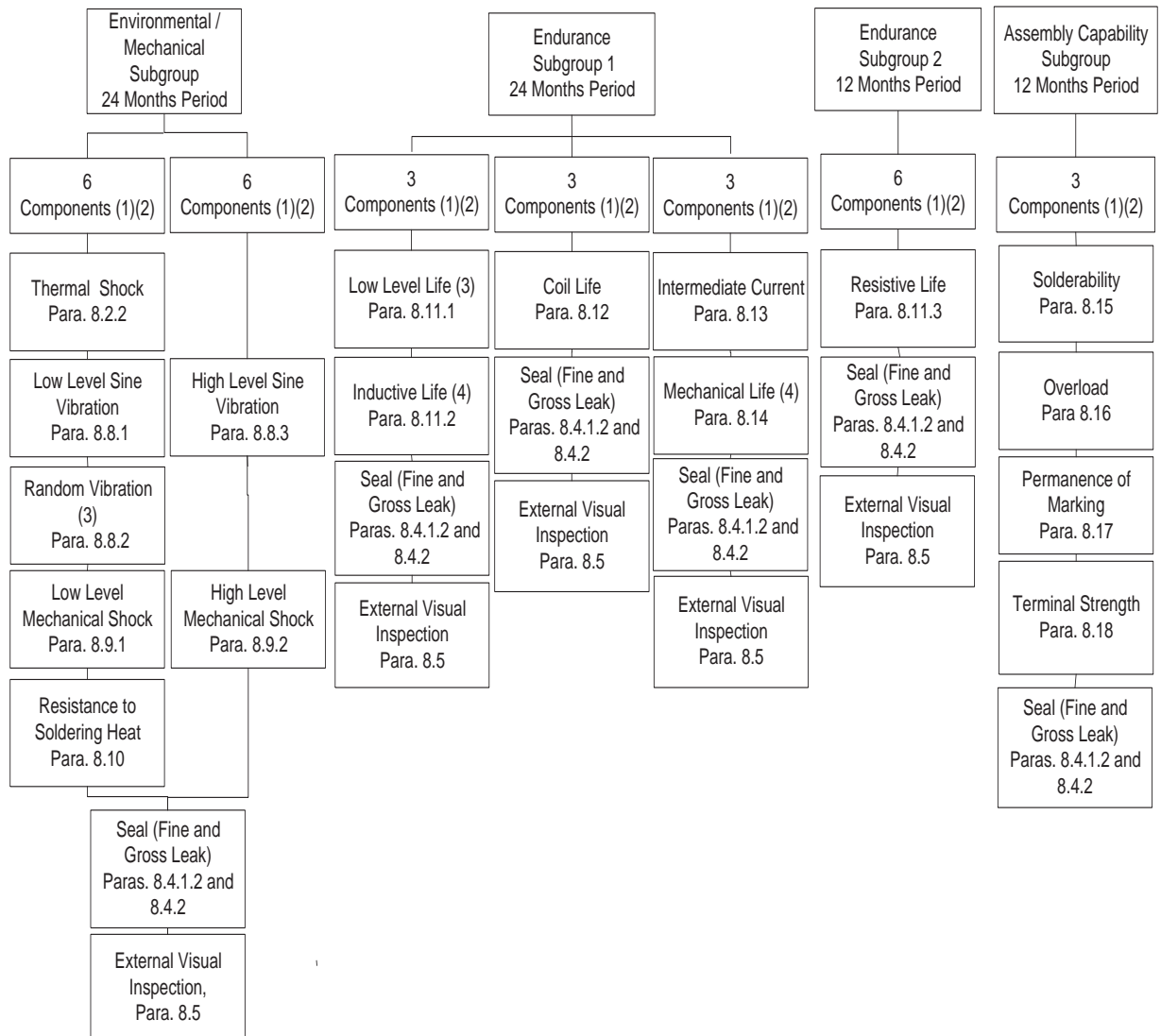
12.3 CHART F3 - SCREENING TESTS

COMPONENTS FROM PRODUCTION CONTROL		
Para. 8.3.2	Parameter Drift Values (Initial Measurements)	(1) (2)
Para. 8.6	Vibration Scan	
Para. 8.7	Run-in	
Para. 8.3.2	Parameter Drift Values (Final Measurements)	(1) (3)
Para. 8.3.4	High and Low Temperatures Electrical Measurements	(4)
Para. 8.3.3	Room Temperature Electrical Measurements	(4)
Para. 8.4.1.1 and 8.4.2	Seal (Fine and Gross Leak)	
Para. 8.5	External Visual Inspection	
Para. 6.4	Check for Lot Failure	(5)
TO CHART F4 WHEN APPLICABLE		

NOTES:

1. If specified in the Detail Specification.
2. Electrical measurements from Special In-Process Controls may be used for the initial measurements.
3. May be performed during Room Temperature Electrical Measurements.
4. The lot failure criteria of Para. 6.4 apply to this test.
5. Check for Lot Failure shall take into account all electrical parameter limit failures that may occur during Screening Tests in accordance with Para. 8.3.3, 8.3.4, with the exception of parameter drift failures during measurement of Parameter Drift Values.

12.4 CHART F4 - QUALIFICATION AND PERIODIC TESTS



NOTES:

1. For distribution within the subgroups see Para. 7.1.2 for qualification and qualification maintenance and Para. 7.4 for Lot Validation Testing.
2. No failures are permitted.
3. Only applicable to relays with Rated Resistive Load Contact Current less than 5A.
4. Only applicable to relays with Rated Resistive Load Contact Current greater than or equal to 5A.