FAILURE RATE LEVEL SAMPLING PLANS AND PROCEDURES

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1 PURPOSE

This specification defines the general requirements for failure rate (FR) level qualification approval and maintenance of qualification approval of components, associated with FR endurance testing, during qualification and qualification maintenance in accordance with ESCC Basic Specification No. 20100 and the applicable ESCC Generic Specification.

It defines:

- Sampling plans for initial FR level qualification approval.
- Requirements for extension of FR level qualification approval to a lower FR level.
- Sampling plans for maintenance of FR level qualification approval.

2 RELATED 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 commencement of the qualification of the component.

2.1 APPLICABLE DOCUMENTS

(a) ESCC Basic Specification No. 20100, Requirements for the Qualification of Standard Electronic Components for Space Application.
(b) ESCC Basic Specification No. 21300, Terms, Definitions, Abbreviations, Symbols and Units.
(c) ESCC Basic Specification No. 21700, General Requirements for the Marking of ESCC Components.
(d) ESCC Basic Specification No. 22800, ESCC Non-Conformance Control System.

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

3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 20100 shall apply. In addition, the following definitions are used:

Confidence Level:	The probability of disqualifying a component when the true failure rate of the component is at the failure rate specified for qualification approval.
Failure Rate Endurance Testing:	Life testing performed, in accordance with a sampling plan, to accumulate data from which a failure rate is calculated.
Failure Rate Level:	Accumulated number of non-conforming units under specified operating conditions and specified accumulated time, evaluated for a given confidence level.
Higher (Lower) FR Level:	This term describes a FR level associated with a higher (lower) number of failures per unit time.

4 REQUIREMENTS

4.1 FAILURE RATE LEVELS

(a) FR levels are related to the operation of the part at the stress level specified by the Generic Specification and the Detail Specification.

(b) Provisions are made for failure rates ranging from 0.1% to 0.001% per 1000 components hours as follows:

Failure Rate Level Letter	Failure Rate
P	0.1% / 1000 hours
R	0.01% / 1000 hours
S	0.001% / 1000 hours

4.1.2 Failure Rate Level Determination

Determination of FR level shall be based upon life test data accumulated on samples subjected to FR endurance testing.

Data shall be accumulated from:

(a) Samples selected for FR endurance testing for initial qualification approval in accordance with the applicable failure rate level qualification sampling plan.

(b) Samples selected for FR endurance testing for maintenance of qualification approval in accordance with the applicable failure rate level maintenance sampling plan.

In addition, subject to agreement by the ESCC Executive, life test data from relevant alternative endurance testing may also be included in the determination of FR level.

4.1.3 Qualification Approval for Higher Failure Rate Levels

Qualification approval granted for one of the lower FR levels shall include approval for the higher FR levels. A Manufacturer may supply to any higher FR level than the one for which qualification has been granted.

4.1.4 Failure Rate Level Marking

All components shall be marked with the FR level letter, for which qualification approval has been granted by the ESCC Executive, in accordance with ESCC Basic Specification No. 21700.

4.1.4.1 Marking for Higher Failure Rate Levels

In the case where a component is supplied to a higher failure rate level than the one to which it is approved, the failure rate level marking shall not be changed.

4.1.4.2 Failure Rate Level Marking Upgrading

Where components have been produced to Manufacturer's stock to a specific failure rate level and qualification approval has subsequently been extended to a lower failure rate level, the existing stock may be remarked to the latest approved failure rate level subject to the formal agreement of the ESCC Executive.

4.2 FAILURE RATE ENDURANCE TESTING

FR endurance testing shall be performed in accordance with the Generic Specification and the Detail Specification. Unless otherwise specified, FR endurance testing samples shall be maintained on life test for a minimum duration of 8000 hours.

4.3 FAILURE CRITERIA

Deviation of one or more parameters during FR endurance testing, beyond the limits specified in the Detail Specification, shall constitute a failure. Failure of more than one parameter on a single component constitutes one failure in determining conformance to the acceptance criteria. The Manufacturer may remove failed components from the test. All failures shall be retained for disposition by the ESCC Executive.

If the number of failures allowed in the selected sampling plan is exceeded, the Manufacturer shall initiate the ESCC non-conformance procedure in accordance with ESCC Basic Specification No. 22800.

4.4 FAILURE RATE ENDURANCE TESTING DOCUMENTATION

All FR endurance testing reports and results shall be made available to the ESCC Executive as part of the qualification test report and periodic testing data, as required in ESCC Basic Specification No. 20100 and the Generic Specification.

Any measurement that indicates failed parts shall be clearly identified as such in the data. A component which fails any given time interval shall be recorded as a failure immediately following the previous measurement and for all subsequent measurements.

All FR endurance testing test records and results shall be maintained in accordance with the data retention requirements specified in the Generic Specification.

5 QUALIFICATION APPROVAL AT THE INITIAL FAILURE RATE LEVEL

Qualification approval at the initial FR level by the ESCC Executive shall be based on accumulation of valid FR endurance testing data to the requirements of this paragraph. Data from components of preceding designs shall not be included.

FR endurance testing shall be conducted for the specified duration with a single sample size, in accordance with the failure rate level qualification sampling plan selected by the Manufacturer, to meet the FR level and confidence level specified in the Generic Specification (see Para. 5.1)

FR endurance testing shall be performed in accordance with the selected sampling plan, on samples from all available lots produced after commencement of the qualification prior to submission of the qualification test report.

Other endurance data for testing performed after commencement of the qualification, prior to submission of the qualification test report, may be considered as applicable for initial FR level qualification approval subject to approval from the ESCC Executive.

The initial FR level and the selected sampling plan shall be agreed with the ESCC Executive prior to commencement of the qualification.

5.1 FAILURE RATE LEVEL QUALIFICATION SAMPLING PLANS

Single sampling plans based on a 60% confidence level are as follows:

FR Level Letter	Failure Rate	Required component Life Test Hours, 60% confidence level, (millions)				
		c = 0	c = 1	c = 2	c = 3	c = 4
P	0.1%/1000 hours	0.916	2.02	3.11	4.18	5.24
R	0.01%/1000 hours	9.16	20.2	31.1	41.8	52.4
S	0.001%/1000 hours	91.6	202	311	418	524

Single sampling plans based on a 90% confidence level are as follows:

FR Level Letter	Failure Rate	Required component Life Test Hours, 90% confidence level, (millions)				
		c = 0	c = 1	c = 2	c = 3	c = 4
P	0.1%/1000 hours	2.3	3.89	5.32	6.68	7.99
R	0.01%/1000 hours	23	38.9	53.2	66.8	79.9
S	0.001%/1000 hours	230	389	532	668	799

NOTES:

1. The maximum allowed FR level and the applicable confidence level shall be as specified in the Generic Specification.
2. c is the number of failures allowed.
3. The duration of individual life tests shall be as specified in Para. 4.2.

6 EXTENSION OF QUALIFICATION APPROVAL TO LOWER FAILURE RATE LEVELS

The Manufacturer may extend the qualification approval to a lower FR level. Extension of qualification approval shall be based on the same sampling plan, confidence level and FR endurance testing requirements as for the initial FR level qualification approval (see Para. 5.1).

Data shall be accumulated from all the FR endurance testing performed during the maintenance of the initial FR level qualification approval. Applicable data for extension of FR level qualification approval shall include:

- Data from the initial FR level qualification.
- All data from FR endurance testing performed since commencement of the qualification.
- Other endurance data subject to approval from the ESCC Executive.

As a minimum data from completed FR endurance testing on the same sample size as that required for initial FR level qualification approval shall be included in the total data submitted.

Unless otherwise approved by the ESCC Executive, the data shall represent a component which has not changed significantly (in terms of process, material, design or construction) during the production period.

7 MAINTENANCE OF FAILURE RATE LEVEL QUALIFICATION APPROVAL

Qualification approval shall be maintained at the applicable FR level periodically, in accordance with this paragraph, for as long as the component remains qualified. Maintenance shall be based on the accumulation of valid FR endurance testing data to the requirements of this paragraph.

FR endurance testing shall be conducted for the specified duration, with a single sample size in accordance with the failure rate level maintenance sampling plan and at a 10% confidence level, for the FR level qualification approval being maintained (see Para. 7.1).

Applicable data for maintenance of FR level qualification approval shall include:

- All data from FR endurance testing performed during the applicable maintenance period.
- Other endurance data for testing performed during the applicable maintenance period, subject to approval from the ESCC Executive.

The data shall be representative of the styles and ranges of values produced over the production period covered by the applicable maintenance period.

Data from FR endurance testing completed during previous qualification maintenance periods shall not be used.

Where the Manufacturer determines that they will not meet the minimum unit hours required during the maintenance period, the ESCC Executive shall be notified immediately.

7.1 FAILURE RATE LEVEL MAINTENANCE SAMPLING PLANS

Single sampling plans based on a 10% confidence level are as follows:

FR Level Letter	Failure Rate	Maintenance Period (months)	Required component Life Test Hours, 10% confidence level, (millions)				
			c = 0	c = 1	c = 2	c = 3	c = 4
P	0.1%/1000 hours	12	NA	0.532	1.10	1.75	2.43
R	0.01%/1000 hours	15	NA	5.32	11.0	17.5	24.3
S	0.001%/1000 hours	24	10.5	53.2	110	175	243

NOTES:

1. c is the number of failures allowed.
2. The duration of individual life tests shall be as specified in Para. 4.2.