

This document and process conversion measures necessary to comply with this revision shall be completed by 1 October 1993

INCH-POUND

MIL-H-38534B
AMENDMENT 1
7 July 1993

MILITARY SPECIFICATION
HYBRID MICROCIRCUITS,
GENERAL SPECIFICATION FOR

This amendment forms a part of MIL-H-38534, dated 26 August 1992, and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 1

Change the following paragraph as shown.

1.1 Scope. This specification establishes the general requirements for hybrid microcircuits and specifies the quality and reliability assurance requirements which shall be met in the acquisition of such devices. The types of devices covered by this specification include but are not limited to hybrid microcircuits, microwave hybrid microcircuits, and multichip modules (MCM's). Detail requirements, specific characteristics, and other provisions which are sensitive to the particular intended use shall be specified in the applicable device acquisition specification. Three quality assurance requirement options directed at, but not limited to, low volume custom devices, medium volume custom or catalog devices, and high volume catalog standard hybrid microcircuits (table I, options 1, 2, and 4, respectively) are provided for in this specification. Two quality assurance levels for hybrid microcircuits, classes K and H, are also provided for in this specification.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Laboratory (ERSS), Griffis AFB, NY 13441-4505, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A

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FSC 5962

Change the following table as shown.

TABLE I. Quality assurance requirements.^{1/}

Requirement	Reference paragraph	Option 1 (In-line)	Option 2 (End-of-line)	Option 4 (Quality Management)
Certification General MIL-STD-1772	3.4.1 3.4.1.1	Required section A	Required section A	Appendix E
Qualification QML-38534	3.4.5 and 4.6	Required	Required	Appendix E
Configuration control	3.4.1.3 and 3.4.8	Required	Required	Required
Traceability	3.4.7	Required	Required	Required
Element evaluation	3.4.2 and 4.3	Required	Required	Appendix E
Process control	3.4.3 and 4.4	Required	Required	Appendix E
Serialization	3.6.7	Class K	Class K	Class K
Screening	3.4.4 and 4.5	Required	Required	Appendix E
QCI Group A	3.4.6 and 4.7	In-line 4.7.2.1	End-of-Line 4.7.3.1	Appendix E
Group B		4.7.2.2	4.7.3.2	
Group C		4.7.2.3	4.7.3.3	
Group D		Not required	4.7.3.4	

^{1/} Option 3 is obsolete and has been removed for clarity.

Delete the reference to the note and the note following paragraph 3.4.1.1, as shown.

3.4.1.1 General. All hybrid microcircuits furnished under this specification shall be devices which are fabricated at a facility certified in accordance with MIL-STD-1772 for options 1 and 2, or validated in accordance with appendix E for option 4 for the applicable device class.

Change the following paragraph as shown.

3.4.1.2 Procedure. The hybrid microcircuit manufacturer shall establish and implement a product assurance program as defined in appendix A and MIL-STD-1772 for options 1 and 2, or appendix E for option 4. The hybrid manufacturer shall arrange for an audit to be performed by the Government qualifying activity in accordance with Section A of MIL-STD-1772 or appendix E, as applicable, for the purpose of certifying the facility. All documentation required therein shall be available for review at the time of the audit. The qualifying activity, on the basis of the successful outcome of the facility audit, shall provide written certification to the manufacturer for production of compliant hybrid microcircuits. The audit and written notification will be the responsibility of the Government since it is the intent of this specification to provide a single qualifying activity to approve the facilities and lines. Following written notification of certification to options 1 and 2 or validation to option 4, the manufacturer shall obtain a QML-38534 listing after successful qualification of certified processes and materials in accordance with 3.4.5 herein.

Delete the last sentence in paragraph 3.4.5.7 as shown.

3.4.5.7 Qualification test requirements. QML qualification shall be accomplished by successful performance of group C testing as specified herein. For options 1 and 2, the group C testing shall be the QML qualification tests and inspections specified in table XIc, under the QML column and 4.6.

Change the following paragraph as shown.

3.4.5.8 Qualification to radiation hardness assurance (RHA) levels. Qualification to an RHA level shall consist of qualification to the appropriate quality and reliability assurance level (class K or H) plus group E tests of MIL-STD-883, method 5005. Special qualification requirements were developed for a number of moderately hard microcircuits which obviated qualification inspection for class H, levels M and D. QPL-38510 provides a footnote for these microcircuits. RHA levels are defined as follows:

RHA Level (see note below)		
RHA level designator	Radiation and total dose	Level neutron fluence
(see 3.6.8.4)	(Rad (Si))	(n/cm ²)
-	No RHA	No RHA
M	3000	2 X 10 ¹²
D	1 X 10 ⁴	2 X 10 ¹²
R	1 X 10 ⁵	2 X 10 ¹²
H	1 X 10 ⁶	2 X 10 ¹²

NOTE: The device acquisition specification may allow for a higher neutron level.

Hybrid microcircuits are considered to meet a specific RHA level if all dice used in the manufacture of the hybrids are acquired from wafers that have passed QCI to that RHA level, or a higher level. Where dice from such wafers are unavailable, a sample of the dice to be used shall be packaged and tested in accordance with the requirements of MIL-STD-883, method 5005, group E for microcircuits or MIL-S-19500, group D for discrete devices. Samples must be taken from the specific wafer lot to be used in the hybrid for class H or from each wafer to be used for class K. The manufacturer may elect to replace the element testing by testing of completed hybrids. The lot definitions, sampling procedures, and test methods of MIL-M-38510 and MIL-STD-883, method 5005, as related to group E, may be applied as an alternate test plan.

Change the following paragraph as shown.

3.5.1 Package. All hybrid microcircuits supplied to this specification shall be hermetically sealed in glass, metal, or ceramic (or combinations of these) packages. The manufacturer must address package design/construction quality and reliability. For class K devices, the sealing atmosphere shall include a minimum of 10 percent helium tracer gas. No adhesive or polymeric materials shall be used for package lid attach (or seal) or repair. Flux shall not be used in the final sealing process. The minimum distance between the glass to metal seals and the package sealing surface for seam welded packages after final seal shall be 0.040 inch (1.02 mm). The internal water vapor content shall be determined in accordance with MIL-STD-883, method 1018 and shall not exceed 5,000 ppm at +100°C for class H or class K devices. Polymer impregnations or secondary seal (backfill, coating, or other uses of organic or polymeric materials to effect, improve, or repair the seal) of the hybrid microcircuit package shall not be permitted. Packages for class K hybrid microcircuits shall have a metal body with hard glass or ceramic seals, a hard glass body, or a ceramic body; and the lid shall be welded, brazed, soldered, or glass frit with a frit sealing temperature greater than +385°C. Glass frit sealed packages shall pass the lid torque test of MIL-STD-883, method 2024. Also for class K, the use of glass frit seal shall have glass on the mating surface only and the inside surface of the cavity shall not be coated with the seal glass. Single layer alumina metallized (SLAM) chip carrier packages are prohibited.

Change the following paragraph as shown.

3.7.1 Environment control. The following are minimum environmental control requirements. The air particle counts for the classifications indicated shall be as described in Federal Standard 209. All fabrication, assembly, and testing of hybrid devices prior to preseal visual shall be in an environment meeting class 100,000 particle count requirements or better, and a relative humidity of 65 percent or less. Devices awaiting preseal visual inspection, devices accepted at preseal visual inspection and awaiting further processing, and noncontinuous production lots (see 3.1.3.19) accumulated after element attach and prior to preseal visual (including parts delidded for rework or repair) shall be stored in a dry nitrogen environment. The preseal visual inspection and the preparation for sealing environment shall be in accordance with MIL-STD-883, methods 2017 and 2032. In addition, for class K devices, all photolithographic operations shall be performed in a class 1000 environment or better, and a relative humidity of 65 percent or less.

Change the following paragraph as shown.

3.7.2.7.2 Welded devices. Only seam sealed, overlapping pulse welded, or laser welded packages designed for delid-relid may be delidded-relidded. Devices may be delidded-relidded N times, with N = 2 maximum for class K.

Change the following table as shown.

TABLE IV. Microcircuit and semiconductor dice evaluation requirements.

Subgroup	Class		Test	MIL-STD-883		Quantity (accept number)	Reference paragraph
	K	H		Method	Condition		
1	x	x	Element electrical			100 percent	4.3.2.1
2	x	x	Element visual	2010 2072 <u>1/</u> 2073 <u>1/</u>		100 percent	4.3.2.2
3	x	x	Internal visual	2010 2072 <u>1/</u> 2073 <u>1/</u>		10 (0)	4.3.2.3 4.3.2.4.2
4	x		Stabilization bake	1008	C	10 (0) <u>2/</u>	4.3.2.3
	x		Temperature cycling	1010	C		
	x		Mechanical shock or Constant acceleration	2002 2001	C, Y1 direction B, Y1 direction		
	x		Interim electrical			4.3.2.4.3	
	x		Burn-in	1015	240 hours minimum at +125°C	4.3.1.7	
	x		Post burn-in electrical			4.3.2.4.3	
	x		Steady-state life	1005		4.3.1.5	
	x	x	Final electrical			4.3.2.4.3	
5	x	x	Wire bond evaluation	2011		10(0) wires or 20(1) wires	4.3.2.3 4.3.2.5
6	x		SEM	2018		See method 2018	4.3.2.6
7	x		Radiation				4.3.2.7
	x		Dose rate and Latch-up	1020		10 (0)	
	x		Total dose	1019		5 (0)	
	x		Neutron irradiation	1017		5 (0)	

1/ MIL-STD-750 methods.

2/ For Class K sample sizes see 4.3.2.4.1.

Change the following subparagraph of paragraph 4.4.1.6.1 as shown.

b. Class K devices: A minimum of 15 wires total shall be tested. As a minimum, wires tested shall include one each from a typical transistor, diode, capacitor, and resistor die, and five wires from the header to the substrate, as applicable.

Delete subparagraph b of paragraph 4.5 and change as shown.

4.5 Device screening. Each hybrid microcircuit shall be subjected to and pass all of the applicable screening tests and inspections in accordance with Table X and 4.5.1 through 4.5.11.

Delete the Option 3 column from Table XI as shown.

TABLE XI. QCI summary. ^{1/}

Requirement	Reference	Option 1 (in-line)	Option 2 (end-of-line)
General	Paragraph	4.7.2	4.7.3
Group A	Paragraph	4.7.2.1	4.7.3.1
	Table	XIa	XIa
Group B	Paragraph	4.7.2.2	4.7.3.2
	Table	N/A	XIb
Group C	Paragraph	4.7.2.3	4.7.3.3
	Table	XIc	XIc
Group D	Paragraph	N/A	4.7.3.4
	Table	N/A	XId

^{1/} For Option 4, this table does not apply.

Change the following paragraph as shown.

4.7.1.1 Sample selection. The number of hybrid microcircuits to be tested shall be chosen (independent of lot size) by the manufacturer in accordance with the applicable requirements of options 1 or 2 herein. Initial samples and resubmitted samples, when applicable, shall be randomly selected from the inspection lot. Lot acceptance is based on an accept number of zero. If a failure occurs, the failed subgroup or test may be performed once using double the sample size or 100 percent with zero failures allowed. For group C inspection, limited sample quantities may be used to meet the requirements of 3.4.6 for production start-up. When limited sampling is used for start-up, a subsequent full sample group C test shall be performed within 6 months of initial group C or prior to exceeding the limited usage requirements of 4.7.2.3.1c, whichever comes first.

Add the following paragraph.

4.7.1.4 Nonfunctional Samples. Electrically rejected devices from the same inspection lot may be used in all subgroups when end point measurements are not required provided that the devices have been subjected to all device screening conditions through burn-in.

Change the following table as shown.

TABLE XIb. Group B testing (option 2 only).

Subgroup	Class		Test	MIL-STD-883		Quantity/ (accept number)	Reference paragraph
	K	H		Method	Condition		
1	x	x	Physical dimensions	2016		2 (0)	
2	x		PIND	2020	A or B	15 (0)	4.7.3.2.1
3	x	x	Resistance to solvents	2015		4 (0)	
4	x	x	Internal visual and mechanical	2014		1 (0)	4.7.3.2.2
5	x	x	Bond strength a. Thermocompression b. Ultrasonic or wedge c. Flip-chip d. Beam lead	2011	C or D C or D F H	2 (0)	4.7.3.2.3
6	x	x	Die shear strength	2019		2 (0)	4.7.3.2.4
7	x	x	Solderability	2003	Solder temperature +245°C ±5°C	1 (0)	4.7.3.2.5
8		x	Seal a. Fine b. Gross	1014	A or B C or D	15 (0)	4.7.3.2.6
9	x	x	ESD a. Electrical parameters b. ESDS c. Electrical parameters	3015	Group A-1 Group A-1	3 (0)	4.7.3.2.7

Delete paragraph 4.7.4

Change the following paragraph as shown.

30.1.2 Records to be maintained. The records required by this section shall be continuously maintained during the manufacture of hybrid microcircuits which are intended to be submitted for shipment as compliant devices in accordance with this specification. The records pertaining to production processes, incoming and in-process inspections shall be retained for a minimum of 3 years (7 years for class K) and those pertaining to screening and QCI shall be retained for a minimum of 5 years (7 years for class K) after performance of the inspections. Records shall be maintained as a minimum for:

- a. Personnel training and testing in accordance with 30.1.2.1 (3-year record retention (7 years for class K)).
- b. Inspection operations in accordance with 30.1.2.2 (3-year record retention (7 years for class K) for production processes, incoming and in-process; 5-year record retention for screening, qualification and QCI).

MIL-H-38534B
AMENDMENT 1

- c. Failure reports and analyses in accordance with 30.1.2.3 (5-year record retention).
- d. Initial documentation and subsequent changes in designs, materials, or processing in accordance with 30.1.2.4 (5-year record retention).
- e. Equipment calibrations in accordance with 30.1.2.5 (see MIL-STD-45662 for records retention).
- f. Process, utility, and material controls in accordance with 30.1.2.6 (3-year record retention (7 years for class K)).
- g. Product lot identification in accordance with 30.1.2.7 (5-year record retention).
- h. Product traceability in accordance with 30.1.2.8 (5-year record retention). Altered records shall not be considered acceptable data unless documented instructions are followed which shall include:
 - i. For changed data:
 - (1) Identification of individual making new entry.
 - (2) Maintain identity of all original data entries ("white out" is not permitted).
 - (3) Justification noted for change and verification by a second party (QA shall verify screening, qualification and QCI records) when change affects lot jeopardy (i.e., lot originally considered to be rejected is changed to pass status).
 - j. For transferred data to new test record:
 - (1) Identification of individual transferring data.
 - (2) All original record entries shall be transferred.
 - (3) New test records entries shall be verified against the original record by a second party.
- k. Computerized records are optional provided they clearly and objectively indicate that all requirements of MIL-H-38534 have been met. The computerized records for traceability, screening and QC inspection shall be readily accessible and available to Government personnel for review and an appropriate electronic or hard copy provided to the qualifying activity as required. The requirements below shall be met.
 - (1) Entry verification.
 - (a) Each individual making entries shall be uniquely identified.
 - (b) All manually entered data shall be verified at the time of entry by the same operator.
 - (c) All accepted transactions (i.e., entered data) shall be identified by time/date of date/entry sequence to protect against "out of sequence" entries. No recorded transactions shall be deleted or changed.
 - (2) Control procedure for lot history records.
 - (a) Lot histories may be modified only by additions (i.e., original entries plus corrective addenda).
 - (b) All corrective addenda shall meet all the requirements of i above.
 - (c) Only limited designated operators shall be able to access lot history computer records for corrective addenda. Documented security procedures shall be followed to assure that limited access is maintained (e.g., restricted terminals, passwords, etc.).
 - (d) A QAR shall verify screening, qualification, and QCI records when corrective addenda affect lot jeopardy.

MIL-H-38534B
AMENDMENT 1

(3) Control of computerized lot history records.

- (a) All computer lot history records shall have an accurate tape or equivalent backup generated prior to lot shipment. Within 3 months of lot shipment, the backup record shall be transferred to a secure location to be archived.
- (b) These archived tapes or equivalent media shall be kept for a minimum of 5 years (7 years for class K).

PAGE 89

Add the following appendix.

APPENDIX E
QUALITY MANAGEMENT PROGRAM (OPTION 4)

10. SCOPE

10.1 Scope. This appendix establishes requirements for a Quality Management (QM) Program for implementation of preventative techniques to assure product quality and reliability. This option allows a manufacturer to migrate from the conventional design and construction requirements and detection tests (e.g., screening, quality conformance, and qualification) of MIL-H-38534 to alternative prevention methods with sufficient documentation. Alternative prevention methods include statistical process control (SPC), periodic process capability certification, design analysis, design robustness, off-line reliability assessment, etc. The documentation must show that the alternative methods ensure product compliance to the minimum quality and reliability requirements of this specification without performing the detection tests or adhering to the specific design and construction requirements. Using this specification as a baseline the manufacturer develops a QM program, which encompasses the entire manufacturing line being validated. This line is controlled by a technology review board (TRB), which can modify, substitute, or delete detection tests as appropriate for the technology or process. Techniques such as statistical process control and design of experiments are employed to ascertain process capabilities. Once alternative techniques are developed, periodic assessment is required to ensure that the processes continue to meet the required capabilities. The QM program also requires a program of continuous improvement to reduce overall product cost and improve quality and reliability. A customer compliance matrix (CCM) is generated for each product as part of the conversion of customer requirements process, and documents the means by which the end-item quality, reliability, and customer requirements will be met.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REQUIREMENTS

30.1 Terms, definitions, methods, and symbols. The terms, definitions, methods and symbols of this specification shall apply.

30.1.1 Cpk. Cpk is a capability index that reflects process centering and variability with respect to specification requirements. The higher the Cpk number, the more capable the process.

30.1.2 Critical control parameters. Critical control parameters are parameters whose variability most affect a design, process, or material.

30.1.3 Customer compliance matrix (CCM). The CCM documents the relationship between each customer requirement for a specific product, and the method used to assure that customer requirements will be achieved. The CCM shall document the correlation between alternative methods of Option 4 and the detection methods of Options 1 or 2 and any changes, and justification for any changes, made to the design requirements.

30.1.4 Design analysis. Design analysis is an evaluation of critical performance parameters and/or design data to determine a design/process/material combination that guarantees compliance to a specific requirement without testing.

30.1.5 Design of experiments (DOE). DOE is a formal plan for conducting experiments which may be used to make achievement of a specific requirement less sensitive to process/material variability. Typical examples include: Taguchi, Central Composite Design, and factorial designs.

30.1.6 Design robustness. Design robustness is insensitivity of a design to uncontrollable variation so that it does not significantly affect the product or process once it is in routine operation.

30.1.7 Off-line reliability assessment. Off-line reliability assessment is the use of statistically based methods to monitor reliability data. This data may be used to control future adjustments to the design/process/material.

30.1.8 Periodic capability certification. Periodic capability certification is the calibration and certification of equipment and/or process steps for an individual parameter(s) such that it can be used as an alternative method to detection testing.

30.1.9 Quality function deployment (QFD). QFD is a technique for analysis of the interrelationships between different requirements. These interrelationships are evaluated in a decision making matrix developed through concurrent engineering.

30.1.10 Standard Evaluation circuit (SEC). An SEC is a test coupon/device that is representative of actual product. The SEC may be actual product or may be specifically designed to evaluate a particular process. The SEC shall be processed using the same processes, equipment, and type of material as the product it represents.

30.1.11 Statistical process control (SPC). SPC utilizes statistical methods to monitor parameters (i.e., process or product) in order to provide early warning of a process fluctuation or shift. Appropriate actions must be taken to maintain a state of statistical control. SPC may be used as a tool to facilitate process improvement.

30.2 Quality Management (QM) Program.

30.2.1 General. A QM program shall be developed and implemented by the manufacturer, documented in the QM Plan, and controlled by the TRB (see 30.2.3). The QM program shall ensure and demonstrate compliance to the minimum quality and reliability requirements of this specification and outline a program for continuous improvement. A device manufactured under Option 4 shall, as a minimum, be equivalent in form, fit, function, quality, and reliability to a device manufactured in accordance with Options 1 or 2.

30.2.2 Implementation. The requirements of this specification shall be used as a baseline for the QM program. From that baseline, Option 4 may be implemented incrementally by process, or by product line. After satisfying the minimum requirements for Option 4 validation, a manufacturer may implement alternative methods for addressing the requirements contained in the baselined Option 1 or 2 flow while performing Option 1 or 2 detection testing on the remainder of the processes. The minimum requirements for the QM program which will be reviewed during validation are as follows:

- a. A Technology review board (30.2.3).
- b. A quality management plan (see 30.2.4).
 1. Process/material confirmation and capability achievement procedures (see 30.2.5).
 2. Conversion of customer requirements procedures (see 30.2.6).
 3. Design center/review procedures (see 30.2.7).
 4. A quality improvement program (see 30.2.8).
 5. A failure analysis/corrective action program (see 30.2.9).
 6. Supplier control procedures (see 30.2.10) (optional).
 7. A self-audit program (see 30.2.11).
 8. A change control plan.
 9. A technology (i.e., typical process, and material) qualification test plan (see 30.3.2.2).

30.2.3 Technology review board (TRB). The manufacturer shall establish a technology review board and develop the necessary procedures to govern its operation. The manufacturer shall be responsible for ensuring that the actions of the TRB result in products that meet all customer requirements. As a minimum, these operating procedures shall address the following:

- a. Record retention.
- b. Minimum organizational membership (see 30.2.3.1).
- c. TRB charter.
- d. Responsibilities (see 30.2.3.2).
- e. System for recovery of data used in TRB decisions.
- f. TRB meeting structure.
- g. Decision making/approval procedures.

h. Distribution of TRB minutes. As a minimum, a copy of the TRB minutes shall be provided to the qualifying activity.

30.2.3.1 TRB organizational structure. The following functions, as a minimum, shall be represented on the manufacturer's TRB: design, material procurement, assembly, test, reliability, and quality assurance. Other personnel with decision making responsibilities affecting the product, its processes, or its production facility shall participate as required. The manufacturer shall identify those organizations that must be represented on the TRB. A responsible technical representative within each of these organizations shall be identified to the qualifying activity. Any changes to either permanent participating organizations or their corresponding technical representatives must be reported, within 30 days, to the qualifying activity.

30.2.3.2 TRB responsibilities. The TRB shall oversee the manufacturer's qualified line, including the processes and materials that continue to be controlled under option 1 or 2 requirements. The TRB shall be responsible for the following:

- a. Developing, monitoring, maintaining and controlling the QM program and QM plan, and all supporting documents and data.
- b. Managing QM plan implementation.
- c. Monitoring and controlling the self audit program. (see App. A, 40.1).
- d. Managing and maintaining the quality improvement programs.
- e. Overseeing the process/material confirmation and change control activities.
- f. Overseeing the initial process/materials certification/qualification and subsequent maintenance thereof.
- g. Reviewing and analyzing data (e.g., Cpk data, defect data, rate of assembly failures, rate of failure returns, and failure analysis results) and taking appropriate action to improve processes. When performance or reliability of shipped microcircuits is called into question, the TRB shall provide quick evaluation, appropriate corrective action, and prompt notification of the problem to the qualifying activity.
- h. Maintaining records of conditions found and actions taken.
- i. Reporting status of the QM program to the qualifying activity (see 30.2.3.4).
- j. Approving alternative methods that modify, substitute, or delete existing methods (e.g., inspection, testing, screening, QCI, or design/construction procedures of this specification).

30.2.3.3 Records. Records of the TRB's membership, deliberations, and decisions shall be maintained; dissenting opinions shall be documented. As a minimum, TRB minutes and associated data shall be maintained for 5 years.

30.2.3.4 Status report. The manufacturer's TRB shall submit a status report to the qualifying activity describing the health of the manufacturer's line including all changes and the criticality of the changes in microcircuit quality, performance, and interchangeability. Support test data shall be retained by the manufacturer. The qualifying activity can request to review the supporting data. The following areas shall be addressed in each status report:

- a. TRB meeting minutes.
- b. Quantity of compliant hybrid microcircuits that were shipped during the reporting period.
- c. Field returns and corrective actions.
- d. Process capability status (see 30.2.5.2).
- e. Changes, additions, and/or improvements in design procedures; fabrication, assembly, or test processes; or in the facility.
- f. Newly qualified processes/materials.

MIL-H-38534B
AMENDMENT 1

Frequency of the status reports to the qualifying activity shall be determined by the TRB, but shall be as a minimum quarterly for the first year following the attainment of validation status and twice annually thereafter. If major problems with the technology are encountered, more frequent reports may be required by the qualifying activity.

30.2.4 Quality management (QM) plan. A plan shall be developed that documents the manufacturer's quality management program. This replaces the quality assurance program plan (Appendix A of this specification). The QM plan shall comprise of the following, as a minimum:

- a. Functional organization chart, including organizational charters.
- b. Flow charts for the product from design through delivery, including those processes that are controlled under Option 1 or 2 requirements.
- c. TRB charter and procedure, including qualifying activity reporting procedure (see 30.2.3).
- d. Alternative method correlation, confirmation, and implementation procedures and change control procedures (see 30.2.5).
- e. Conversion of customer requirements procedures (see 30.2.6).
- f. Design requirements and procedures (see 30.2.7).
- g. Quality improvement plan (see 30.2.8).
- h. Manufacturing process failure analysis program and corrective action plan (see 30.2.9).
- i. Supplier control procedures (see 30.2.10).
- j. Operator/inspector training program.
- k. Cleanliness and atmosphere control program.
- l. Index of certified baseline documents.
- m. Self-audit program and audit results.
- n. A specific plan defining the manufacturer's SPC program within the manufacturing process to the requirements of JEDEC Publication 19.

30.2.5 Alternative method correlation, confirmation, and implementation procedures. This is the approach by which inspection/testing/screening/QCI or design/construction requirements within this specification will be modified, substituted, or deleted. The manufacturer shall develop and document methods for confirmation and maintenance of process and material capability and for verification of design capability under Option 4. Test methods and design/construction requirements of this specification are intended to address worst case application environments for military product. Any alternate method used in lieu of testing, screening, or design/construction requirements shall be approved by the manufacturer's TRB and shall document the specific areas of correlation between the alternative method and the specification requirement it replaces (i.e., how it meets the specific application environments of this specification).

30.2.5.1 Correlation, confirmation, and implementation. The following is a typical flow.

- a. Identify candidate requirements of this specification for alternative method.
- b. Using data, identify any correlations between the candidate requirement and potential alternative method(s).
- c. Where correlations exist, develop and document alternative method(s).
- d. Accumulate data off-line to confirm the capability of the alternative method(s) to assure meeting the requirement.
- e. Submit alternative method(s) for TRB approval.
- f. Implement the alternative method(s) as directed by the TRB.

NOTE: If an alternative method is determined to no longer assure meeting the requirements of this specification, the product shall be inspected/screened/tested in accordance with the previous TRB approved baseline, until the required capability is achieved.

30.2.5.2 Alternative methods. For each candidate process under Option 4, the manufacturer shall specify and implement alternative methods that will be used to maintain each process/material capability such that it continues to meet the minimum quality and reliability requirements of this specification. Examples of alternative methods are design analysis (see 30.1.4), DOE (see 30.1.5), off-line reliability assessment (see 30.1.7), periodic capability certification (see 30.1.8), SPC (see 30.1.11), embedded machine controls, manufacturer derived test methods, automated methods with feedback controls, etc.

30.2.5.2.1 Standard evaluation circuits. A manufacturer may utilize SEC's (see 30.1.10) to evaluate the capability of alternative methods and monitor product quality and reliability. The SEC design shall be approved by the TRB and controlled through the manufacturer's documentation system. SEC documentation shall include construction, dimensions, intended application (i.e., the processes it evaluates), and minimum acceptable limits (e.g., mechanical or electrical values).

30.2.5.2.2 Periodic assessment of alternative methods. Alternative methods shall be periodically assessed, as necessary (determined and documented by the TRB), to assure their continued effectiveness. This periodic assessment is a tool for the TRB to aid in monitoring and maintaining product quality. Methods for periodic assessment may include stress-to-failure tests, failure mode analysis, analytic prediction modeling, etc. If an Option 4 alternative method (substituted for Options 1 or 2) is determined to no longer meet the initial requirement (i.e., Option 1 or 2), the manufacturer shall implement the appropriate previous TRB-approved baselined inspection/screening/testing/step.

30.2.5.3 Change control program. The manufacturer shall develop and document a program that defines how changes are made to Option 4 processes and materials.

30.2.6 Conversion of customer requirements. The manufacturer shall develop and document a system by which customer requirements and all requirements of this specification are converted into working instructions. As part of the conversion of customer requirements process the manufacturer shall generate a CCM (see 30.1.3) for each product that documents the means by which the end-item quality, reliability, and customer/specification requirements will be met. Required process capabilities and specific internal documents used by the manufacturer to control, monitor, or assess processes and materials shall be specified in the CCM. The CCM shall be approved by the TRB and procuring activity. The TRB shall ensure that the CCM is kept current.

30.2.7 Design requirements. The manufacturer shall develop and document an approach for device design. The design approach shall include the following:

a. Design guidelines/handbook. The design guidelines shall define and document the manufacturer's qualified processes and materials as they relate to the design including the interactions between the application environment and affected materials/processes. Any design requirement not in accordance with 3.5 of this specification shall be documented. These guidelines will form the basis for all designs to be manufactured under the QM program.

b. Design models/procedures for worst case temperature and electrical extremes.

c. Rules check procedures, covering the following areas, as applicable:

1. Design rules check (DRC) - geometric and physical.

2. Electrical rules check (ERC) - shorts and connectivity.

3. Reliability rules - Electromigration and current density, IR drops, latchup, single event upset (SEU), hot electrons, ESD, burnout, or backgating, as applicable.

4. RHA rules - applicable radiation environments.

d. Thermal design verification procedures in accordance with 3.5.10.

e. Reliability design verification procedures. Worst case circuit design in accordance with 3.5.11.

f. Package design performance verification procedures.

g. Feedback loop from design/material/process development activities into design guidelines.

30.2.8 Quality improvement program. The manufacturer shall develop, document, and implement a program for continuous quality and reliability improvement of processes.

30.2.9 Failure analysis and corrective action program. The manufacturer shall develop and document the procedures for testing, analyzing, and taking corrective actions on failed parts from all stages of manufacturing, including field returns. The program shall include the specific steps to be followed in order to correct any process that is out of control.

30.2.10 Supplier control program. The capability of supplied material may be validated through a supplier certification system. This system selects and monitors suppliers in order to guarantee that the supplied material will meet and maintain required capability levels (e.g., Cpk, ppm, etc.). Supplier certification is granted based on consistent proof that their product conforms to the specification requirements, through implementation of SPC and quality control systems analogous to those herein. Conventional element evaluation is not required when the elements are purchased from certified suppliers. Material may be procured from vendors who are not certified; such material shall be evaluated in accordance with 4.3 of this specification or alternative methods approved by the TRB. The following are the minimum documentation requirements for each supplier controlled under this program:

- a. A description of the vendor quality assurance plan with status update reports as required by the TRB.
- b. A description of the procedure used by the vendor for notification of changes in materials or processes.
- c. A quality assurance procedure that can be performed by either the vendor or the manufacturer, or a combination of the two.

30.2.11 Self audit program. The manufacturer shall develop, document, and implement a self audit program, in accordance with appendix A, to assess the effectiveness of the QM program. The self audit program shall be approved, monitored, and controlled by the manufacturer's TRB.

30.3 Requirements for approval of qualified manufacturers. Qualification requires validation of the manufacturer's QM program and systems per 30.3.1, and qualification of the manufacturer's processes and materials per 30.3.2. The qualifying activity will verify compliance to the requirements.

30.3.1 Option 4 QM validation requirements. The qualifying activity shall verify adequacy and compliance of the manufacturer's QM program to the requirements specified herein. Each portion of a QML manufacturer's line may be demonstrated independently, but validation will assess a complete technology flow. The validation process requires an on-site visit of the manufacturer's facility.

30.3.1.1 Validation prerequisites. Before a validation review is scheduled, the manufacturer shall submit the following items to the qualifying activity:

- a. A TRB approved QM plan (see 30.2.4).
- b. A technology qualification test plan (see 30.3.2.2).
- c. Results of the manufacturer's self-audit of the QM program.

30.3.1.2 On-site validation. The manufacturer shall make available to the qualifying activity all data needed to support the QM program. Qualifying activity access to manufacturing and testing facilities and operators will be required.

30.3.1.3 Deficiencies and concerns. Deficiencies and concerns shall be noted by the validation team during an exit critique and will be followed up with a written report.

30.3.1.4 Letter of validation approval. After validation and upon correction of all deficiencies and concerns, the qualifying activity shall issue a letter of validation approval to the manufacturer.

30.3.2 Technology QML qualification. This section establishes general requirements applicable to qualification testing. This section is not required if the process/material is already qualified under Options 1 or 2.

30.3.2.1 Technology QML qualification requirements. Technology qualification testing shall be performed in accordance with the approved test plan (see 30.3.2.2) upon devices manufactured in accordance with the manufacturer's QM system. The manufacturer's TRB shall oversee the qualification process.

30.3.2.2 Technology qualification test plan. For the initial qualification of the technology, the manufacturer shall develop a test plan to verify the ability of typical materials and processes to meet the requirements of this specification. An example of such a procedure is outlined in 4.6 of this specification. The test plan shall include such details as milestone charts, the test flow, parametric test limits, test data to be measured, recorded and analyzed, test sampling techniques, traceability records, and accept/reject criteria. The test plan shall define the material types, manufacturing construction, testing, and reporting techniques and shall include a description of the intended qualification vehicle. The test plan shall also include requirements and procedures for adding materials and processes to the QML after initial qualification. The hybrid technology qualification test plan shall be approved by the manufacturer's TRB.

30.3.2.3 Technology qualification test report. Following qualification testing, the TRB shall present a comprehensive analysis of the qualification data to the qualifying activity. The aim of this analysis is to show that all design, process, and material variables are under control and repeatable within the requirements defined by the plan. All improvements resulting from qualification testing shall be presented to the qualifying activity.

30.3.2.4 QML listing. A certificate of qualification to Option 4 will be issued upon successful completion of all qualification tests and acceptance of the qualification documentation by the qualifying activity. Issuance of the certificate of qualification will coincide with listing the manufacturing line on the QML.

30.3.3 QML removal. Requirements for removal of a manufacturer from the QML shall be in accordance with 4.6.7 herein. In addition to the requirements of 4.6.7, the manufacturer may be removed from the QML by the qualifying activity for any of the reasons listed below.

- a. The manufacturer's QML product does not meet the quality, reliability, or performance requirements of this specification and the manufacturer is unable to implement a suitable corrective action plan to return the product to compliance.
- b. The manufacturer has failed to provide status reports to the qualifying activity in accordance with 30.2.3.4.
- c. The manufacturer's TRB fails to adequately manage the QM program.

40. QUALITY ASSURANCE PROVISIONS

40.1 Responsibility for compliance. All items shall meet all requirements of section 30 of this appendix and section 5 of this specification.

40.2 General product requirements. All product manufactured and delivered in compliance with this appendix shall be produced in accordance with the QM plan (see 30.2.4).

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 17
NASA - NA

Review activities:

Army - AR, MI
Navy - MC
Air Force - 19, 85, 99
DLA - ES

User activities:

Army - SM
Navy - AS, CG, OS, SH

Civil agency coordinating activities:

DOT - FAA (RD-650)

Preparing activity:
Air Force - 17

Agent:
DLA - ES

(Project 5962-1341)