This document and process conversion measures necessary to comply with this revision shall be completed by 26 November 1992.

INCH-POUND

MIL-H-38534B
26 August 1992
SUPERSEDING
MIL-H-38534A
22 August 1990

MILITARY SPECIFICATION

HYBRID MICROCIRCUITS, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

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 3, 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.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

MIL-I-23011 - Iron Nickel Alloys for Sealing to Glasses and Ceramics.

MIL-M-38510 - Microcircuits, General Specification for.

MIL-N-46025 - Nickel Bar, Flat Wire (Ribbon) and Strip (For Electronic Use).

MIL-N-46026 - Nickel Rod and Wire (Round) (For Electronic Use).

MIL-I-46058 - Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).

MIL-M-55565 - Microcircuit, Packaging of.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center (RBR-2), Griffis AFB, NY 13441, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5962

STANDARDS

FEDERAL

FED-STD-209 - Clean Room and Work Station Requirements, Controlled Environment.

MILITARY

MIL-STD-100 - Engineering Drawing Practices.

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.

MIL-STD-280 - Definitions of Item Levels, Item Exchangeability, Models and Related Terms.

MIL-STD-750 - Test Methods for Semiconductor Devices.

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

MIL-STD-975 - NASA Standard Electrical, Electronic, and Electromechanical (Eee) Parts List.

MIL-STD-976 - Certification Requirements for Jan Microcircuits.

MIL-STD-977 - Test Methods and Procedures for Microcircuit Line Certification.

MIL-STD-1285 - Marking of Electrical and Electronic Parts.

MIL-STD-1331 - Parameter to be Controlled For the Specification of Microcircuits.

MIL-STD-1520 - Corrective Action and Disposition for Nonconforming Material.

MIL-STD-1772 - Certification Requirements for Hybrid Microcircuit Facilities and Lines.

MIL-STD-1835 - Microcircuit Case Outlines.

MIL-STD-45662 - Calibration Systems Requirements.

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

Handbook H4/H8 - Commercial and Government Entity (CAGE) Handbook.

DLAM 8200.2 - Procurement Quality Assurance Support manual for Defense Contract Administration Service.

NAVSHIPS 0967-190-4010 - Manufacturer's Designating Symbols.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B170 - Standard Specification for Oxygen-Free Electrolytic Copper-Refinery Shapes.

ASTM B487 - Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section.

ASTM B567 - Standard Test Method for Measurement of the Coating Thickness by the Beta Backscatter Method.

ASTM F-15 - Specification for Iron-Nickel-Cobalt Sealing Alloy.

ASTM F-30 - Standard Specification for Iron-Nickel Sealing Alloy.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

JESD19-88 - General Standard for Statistical Process Control.

JEP-108 - Distributor Requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices.

JEP-109 - General Requirements for Distributors of Military Integrated Circuits.

JESD9-A87 - Metal Package Specification for Microelectronic Packages and Covers.

(Application for copies should be addressed to the Electronic Industries Association, 2001 Eye Street, N.W., Washington, DC 20006.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specification, specification sheet, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The manufacturer of hybrid microcircuits, in compliance with this specification, shall have and use production and test facilities and a quality and reliability assurance program adequate to assure successful compliance with the provisions of this specification and the associated device acquisition specification. Adequacy of a hybrid manufacturer to meet the requirements of this specification shall be determined by the Government qualifying activity. The individual item requirements shall be as specified in the associated device acquisition specification and herein. Only hybrid microcircuits which are inspected for and meet all the requirements of this specification and the associated device acquisition specification shall be marked as compliant and delivered. Facilities and programs listed on the Qualified Manufacturer's List (QML) may be used for the manufacture of other than compliant hybrid microcircuits; however, any use or reference to compliant device marking (see 3.6.8.3), class K or H certification status or this specification in such a way as to state or imply equivalency (and thereby Government endorsement) in connection with noncompliant devices is prohibited and may be cause for revocation of certification or QML status (or both).

NOTE: When any manufacturer, contractor, subcontractor, or original equipment manufacturer (OEM) claims a device is compliant with MIL-STD-883, all provisions of MIL-STD-883 shall be met.

3.1.1 Device acquisition specification. Appendix C outlines the requirements recommended for the specification of non-Standardized Military Drawing devices (i.e., source control documents or drawings (SCD), etc.). Appendix D details the format and standard requirements to be submitted for every Standardized Military Drawing (SMD) device acquired under MIL-H-38534. The appendix D format is in accordance with MIL-STD-100. Specification of other requirements for SMD and non-SMD devices may be necessary for a given technology, product, or special condition. The device acquisition specification must be negotiated by the manufacturer and acquiring activity before a product build occurs, especially for custom non-SMD devices.

3.1.2 Conflicting requirements. In the event of conflict between the requirements of this specification and other requirements of the applicable device acquisition specification, the precedence in which documents shall govern, in descending order, is as follows:

a. Applicable SMD or SCD.

b. This specification.

c. Specifications, standards, and other documents referenced in section 2.

NOTE: Ordering data (see 6.2) may be provided in the purchase order or contract; however, any modification or deletion of any of the requirements of this specification will result in the manufactured device being deemed a noncompliant hybrid in accordance with this specification.

3.1.3 Terms, definitions, methods, and symbols. For the purposes of this specification, the terms, definitions, methods, and symbols of MIL-STD-883, MIL-STD-750, MIL-STD-1331, and those contained herein shall apply and shall be used in applicable device acquisition specification wherever they are pertinent. The Government qualifying activity shall interpret the definitions of 6.6 for use wherever pertinent. The item levels of part, subassembly, assembly, unit, group, set, and system, as well as the ancillary terms accessory and attachment, contained in MIL-STD-280, shall be applicable to this specification. To further describe a particular type of hybrid microcircuit, additional modifiers may be prefixed to the type name.

3.1.3.1 Acquiring activity. The organizational element of the Government which contracts for articles, supplies, or services may authorize a contractor or subcontractor to be its agent. When this organizational element of the Government has given specific written authorization to a contractor or subcontractor to serve as agent, the agent shall not have the authority to grant waivers, deviations, or exceptions to this specification unless specific written authorization to do so has also been given by the Government organization which is the preparing activity, or qualifying activity. In the absence of a specific acquiring activity, the acquiring activity shall be an organization within the supplier's company that is independent of the group responsible for device design, process development or screening, or may be an independent organization outside the supplier's company. Qualification, requalifications, or engineering data must be maintained on file and be available for review by the qualifying activity and future acquiring activities.

3.1.3.2 Acquisition documents. Acquisition documents shall consist of the purchase order or contract, device acquisition specification (see appendix C or D) or SCD, SMD, or detail drawings or specifications as applicable.

3.1.3.3 Antistatic materials. Antistatic materials which resist triboelectric charging shall be used as appropriate. Antistatic materials and plastic materials impregnated with antistatic agents (antistats) are antistatic if their surface resistivity is between 1×10^9 and 1×10^{14} ohms/sq.

3.1.3.4 Baseline index of documents. The qualifying activity shall review, approve, and maintain on file the procedures, process specifications, and process qualification reports that are in general, the documents which establish the baseline for a given hybrid manufacturer in satisfying the requirements of certification in accordance with section A of MIL-STD-1772 and qualification in accordance with 3.4.5.

3.1.3.5 Burn-in lot. The burn-in lot used for purposes of percent defective allowable (PDA) or pattern failure accountability (or both), shall be as defined by the manufacturer and approved by the qualifying activity.

3.1.3.6 Compound bond. A bond placed on top of another bond, wire, ribbon, or other conductors not integral to the substrate.

3.1.3.7 Conductive materials. Conductive materials capable of electrostatic field shielding and having a volume resistivity of 1 x 10^3 ohm-cm maximum or a surface resistivity less than 1 x 10^5 ohms/sq shall be used as appropriate.

3.1.3.8 Delta (Δ) limits. Delta limits, maximum changes in specified parameter readings which permit device acceptance on specified tests, shall be based on comparison of present measurements with specified previous measurements.

NOTE: When expressed as a percentage value, they shall be calculated as a proportion of previously measured values.

3.1.3.9 Dissipative materials. Dissipative materials having a surface resistivity between 1 x 10^5 and 1 x 10^9 ohms/sq shall be used as appropriate.

3.1.3.10 Electrostatic discharge sensitivity (ESDS). The level of susceptibility of hybrid microcircuits to damage by static electricity, found by classification testing, shall be used as the basis for assigning an ESDS class.

3.1.3.11 Element. A constituent of a hybrid microcircuit that contributes directly to its operation (e.g., chip resistor, capacitor, diode, transistor, integrated circuit, surface acoustic wave (SAW), substrate, package, etc., incorporated into a hybrid microcircuit), shall be an element of the hybrid microcircuit.

3.1.3.12 Final seal. After manufacturing operations which complete the enclosure of a device following all allowable rework so that further internal processing cannot be performed, and for the purpose of seal date code identification and quality conformance inspection (QCI) testing, the final seal date code shall be used.

3.1.3.13 Compliant hybrid microcircuits. Compliant hybrid microcircuits shall meet, without exception, all of the requirements of this specification.

3.1.3.14 Hybrid microcircuits. Hybrid microcircuits shall consist of a combination of two or more of the following elements:

a. Film microcircuit (see 6.6.7).

b. Monolithic microcircuit (see 6.6.11).

c. Semiconductor element (see 6.6.20).

d. Passive chip or printed or deposited substrate elements (see 6.6.14).

3.1.3.15 Hybrid microcircuit type (device type). The term "hybrid microcircuit type" (device type) refers to a single specific hybrid microcircuit configuration. All samples of a hybrid microcircuit type shall be electrically and functionally interchangeable with each other; have the same electrical and environmental test limits; and use the same package, materials, piece parts, and assembly processes.

3.1.3.16 Inspection lots. Inspection lots shall consist of a quantity of hybrid microcircuits of a single hybrid microcircuit type (required for group A) or several different circuit types (allowed for groups B, C, and D tests only) in a single package type and lead finish submitted at one time for final acceptance. All devices within each inspection lot shall be finally sealed in the same period not exceeding 13 weeks. Inspection lot identification shall be maintained from the time the lot is formed until the lot is accepted. Inspection lot traceability shall be maintained to the production lots from which it was formed.

3.1.3.17 Inspection lot formation. Inspection lot formation is required if the inspection lot is to be formally accepted by the lot related QCI testing of 4.7 or MIL-STD-883, method 5005. If the in-line process verification testing alternative is used, inspection lot formation is not required. For in-line process verification, process traceability must be maintained such that hybrid devices can be clearly identified to specific periods of in-line process testing.

3.1.3.18 Insulating materials. Insulating materials having a volume resistivity of 1 x 10^{12} ohm-cm minimum, or a surface resistivity of 1 x 10^{14} ohms/sq minimum shall be used as required.

3.1.3.19 Noncontinuous production. Noncontinuous production shall occur when devices are held by the manufacturer, with no additional assembly work performed, for more than 30 days.

3.1.3.20 Percent defective allowable (PDA). PDA shall be the maximum observed percent defective which will permit the lot to be accepted after the specified 100 percent test.

3.1.3.21 Production lot. A production lot shall consist of a device type manufactured from the same basic raw materials on the same production line, processed under the same manufacturing techniques and controls using the same type of equipment. The production lot shall be formed at or prior to device kit preparation (i.e., release to manufacturing). In addition for class K devices, all materials shall be from the same incoming inspection lot for each element. If necessary, rework requirements may be satisfied with materials from a different incoming inspection lot.

3.1.3.22 Qualifying activity. The qualifying activity shall be the organizational element of the Government that grants certification and QML status.

3.1.3.23 Similar devices. For the purpose of QCI, one device type is similar to another when it meets all the following conditions:

a. Designed and manufactured identically using the same or fewer fabrication and assembly processes and materials.

b. Assembled with the same or fewer active and passive elements (see 3.1.3.11 for examples of element types).

c. Subjected to the same screening except electrical testing.

d. Designed to generate the same or fewer functions (magnitude of functional attributes such as voltage, current, duty cycle, frequency, etc. may vary) using the same or less functional circuitry (e.g., a 4-bit A/D converter is similar to a 10-bit A/D converter, but not vice versa).

3.1.3.24 Standard evaluation circuit (test coupon or vehicle). Test vehicles or coupons that simulate the assembly process, materials, and construction techniques used on the manufacture of actual hybrid microcircuit types shall be manufactured in an actual production environment by trained personnel using approved test methods and procedures with proper traceability records. Standard evaluation circuits may be used for process qualification purposes in lieu of actual devices.

3.1.3.25 Wafer lots. Wafer lots shall consist of microcircuit and semiconductor wafers formed into lots at the start of wafer fabrication for homogeneous processing as a group. Each lot shall be assigned a unique identifier or code to provide traceability and maintain lot integrity throughout the fabrication process. Wafer lot processing as a homogeneous group shall be accomplished by any of the following procedures, providing process schedules and controls are sufficiently maintained to assure identical processing in accordance with process instructions of all wafers in the lot:

a. Batch processing of all wafers in the wafer lot through the same machine process steps simultaneously.

b. Continuous or sequential processing (wafer by wafer or batch portions of wafer lot) of all wafers through the same machine or process steps.

c. Parallel processing of portions of the wafer lot through multiple machines or process stations on the same certified line, provided statistical quality control (SQC) assures and demonstrates correlation between stations and separately processed portions of the wafer lot.

Rework of a wafer (i.e., the strip and redeposition of a layer in order to correct a nonconformance to a specification limit) shall not be allowed. Additional etch to correct a nonconformance to a specification limit, photoresist strip and recoat, or processing to continue or finish incomplete processing, shall not be considered rework. For class K, additional deposition of oxidation, glassivation, or any interconnect layers (e.g., polysilicon, aluminum, etc.) shall not be allowed.

3.2 Item requirements. The individual item requirements for hybrid microcircuits delivered under this specification shall be documented in the device acquisition specification. Unless otherwise approved by the acquiring activity, all hybrid microcircuits shall have an operating temperature range from -55°C to +125°C and any references to minimum or maximum operating temperatures shall refer to the respective lower and upper limits of this range (i.e., the maximum applicable operating case temperature or ambient temperature shall be specified). Contractor prepared device acquisition specifications in accordance with appendix C or D shall be approved by the acquiring activity as acceptable for the requirements of a specific contract or order.

3.2.1 Country of manufacture. All hybrid microcircuits shall be manufactured, assembled, and tested within the U.S. and its territories, except as provided by international agreement establishing reciprocal and equivalent Government quality system and procedures.

3.3 Classification of requirements. The requirements for hybrid microcircuits are delineated herein as follows:

Title	Paragraph
Quality assurance	3.4
Certification and qualification	3.4.1
Element evaluation	3.4.2
Process control	3.4.3
Screening	3.4.4
QML-38534 Qualification	3.4.5
QCI	3.4.6
Traceability	3.4.7
Configuration control	3.4.8
Design and construction	3.5
Marking of hybrid microcircuits	3.6
Workmanship	3.7

3.3.1 Certification of conformance and acquisition traceability. Manufacturers or suppliers including dealers and distributors who offer the product described by this specification shall provide written certification, signed by the corporate officer who has management responsibility for the production of the product, (1) that the product being supplied has been manufactured and tested in accordance with this specification and conforms to all of its requirements, (2) that all products are as described on the certificate which accompanies the shipment, and (3) that, when applicable, dealers and distributors have handled the product in accordance with the requirements of JEP-108 and JEP-109. The responsible corporate official may, by documented authorization, designate other responsible individuals to sign the certificate, but, the responsibility for conformity with the facts shall rest with the responsible corporate officer. The certification shall be confirmed by documentation to the Government or to users with Government contracts or subcontracts, regardless of whether the products are acquired directly from the manufacturer or from another source such as a distributor. When other sources are involved, their acquisition certification shall be in addition to the certificates of conformance and acquisition traceability provided by the manufacturer and previous distributors. The certificate shall include the following information:

a. Manufacturer documentation:

(1) Manufacturer's name and address.

(2) Customer's or distributor's name and address.

(3) Device type and product assurance level.

(4) Lot date code and latest reinspection date, if applicable.

(5) Quantity of devices in shipment from manufacturer.

(6) Statement certifying product conformance and traceability.

(7) Signature and date of transaction.

b. Distributor documentation for each distributor:

(1) Distributor's name and address.

(2) Name and address of customer.

(3) Quantity of devices in shipment.

(4) Latest reinspection date, if applicable.

(5) Certification that this shipment is a part of the shipment covered by the manufacturer's documentation.

(6) Signature and date of transaction.

3.4 Quality assurance requirements. Two levels of quality assurance (classes K and H) are provided for in this specification. Class K is the highest quality assurance level and is intended for space application. Delivered devices shall pass all applicable requirements, tests, and inspections detailed herein. Devices or lots which have failed to pass any tests or acceptance criterion (e.g., PDA, sample size (accept number)) shall not be downgraded from a class K to a class H quality assurance level even though that test or criterion may not be a requirement of the class H device (i.e., a failed device or lot shall not be accepted). All of the requirements contained in this specification apply to every compliant hybrid microcircuit except where table I specifically provides for an alternative. The quality assurance requirements for a hybrid microcircuit type shall be determined at the time of contract negotiation and acceptance and shall consist of one of the three option flows provided in table I.

TABLE I. Quality assurance requirements.

Requirement	Reference paragraph	Option 1 (In-line)	Option 2 (End-of-line)	Option 3 (QPL/QML)
Certification General MIL-STD-1772	3.4.1 3.4.1.1	Required section A	Required section A	Required
Qualification QML-38534	3.4.5 and 4.6	Required	Required	Reciprocal with QPL-38510
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	MIL-M-38510, appendix A
Process control	3.4.3 and 4.4	Required	Required	Required
Serialization	3.6.7	Class K	Class K	Class K
Screening	3.4.4 and 4.5	Required	Required	MIL-STD-883, test method 5004, (test method 2017)
QCI Group A Group B Group C Group D	3.4.6 and 4.7	In-line 4.7.2.1 4.7.2.2 4.7.2.3 Not required	End-of-line 4.7.3.1 4.7.3.2 4.7.3.3 4.7.3.4	Test method 5005 4.7.4 4.7.4 4.7.4 4.7.4

3.4.1 Certification and qualification.

3.4.1.1 General. All hybrid microcircuits furnished under this specification (except option 3, MIL-M-38510 QPL devices - see note below) shall be devices which are fabricated at a facility certified in accordance with MIL-STD-1772 for the applicable device class.

NOTE: Option 3 hybrid microcircuit manufacturers that have a hybrid microcircuit type listed on the QPL for MIL-M-38510 may also have that device listed on the QML for MIL-M-38534. MIL-STD-1772 certification is not required for the specified QPL/QML listed hybrid microcircuit type; however, the facility at which the device is manufactured must be a MIL-STD-976 certified facility and must be within the U.S. and its territories, except as provided by international agreement establishing reciprocal and equivalent Government quality system and procedures.

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. 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 for the purpose of certifying the facility. All documentation required by appendix A and MIL-STD-1772 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, the manufacturer shall obtain a QML-38534 listing after successful qualification of certified processes and materials in accordance with 3.4.5 herein.

3.4.1.3 Change of the quality assurance (QA) program. A certified manufacturer shall not implement any change in certified material, process, or control without concurrent change to the process control or quality control documents listed in the approved baseline index of documents. The manufacturer shall notify the qualifying activity of any major change to the QA program as defined in 3.4.8.

3.4.1.4 Use of certified lines. When other than compliant product is being manufactured on a certified line, controls shall be maintained such that adverse impact does not occur to compliant product. The controls and procedures for noncompliant products shall be as specified on the manufacturer's flowchart documentation (see 30.1.3.2 of appendix A).

3.4.1.5 Reaudits of certified lines. Following initial certification, the qualifying activity will periodically inspect the manufacturer's facilities and equipment, review his processes and techniques, and audit the implementation of the Product Assurance Program Plan (PAPP) and records. The date, location, time of audit, and extent of participation of manufacturer personnel required to accomplish the task will be established on a schedule which is mutually acceptable to the qualifying activity and the manufacturer. Upon completion of the audit, the manufacturer will be provided an exit critique and will be provided with a written report of the results of such an audit. A schedule for correction of any significant deficiencies will be required and will subsequently be reviewed for completeness, adequacy, and timeliness of completed closure actions.

3.4.2 Element evaluation. Elements shall be evaluated prior to hybrid microcircuit assembly in accordance with 4.3 and element characteristics as specified in the element acquisition documents. Element acquisition documents shall identify element characteristics required to assure device performance and assembly process capability.

NOTE: For class K devices, when approved by the acquiring activity, active elements may be assembled into the device prior to final element lot acceptance. However, the hybrid manufacturer shall have a system, approved by the qualifying activity, to maintain traceability of all such elements for purposes of recall. Element evaluation shall be successfully completed prior to device shipment.

3.4.3 Process control. As a minimum, process control in accordance with 4.4 is required for hybrid microcircuit assembly. If Statistical Process Control (SPC) is utilized, see 4.1 and 4.1.2.2.

3.4.4 Screening. All hybrid microcircuits to be delivered in accordance with this document or for QML/QCI testing shall have passed all of the screening tests detailed in 4.5. Sampling inspections shall not be an acceptable substitute for any specified 100 percent screening test (see 4.5) unless SPC procedures have been approved by the qualifying activity (see 4.1.2.2).

3.4.5 QML-38534 qualification.

3.4.5.1 Initial qualification procedure. Following MIL-STD-1772 certification, the manufacturer shall perform initial qualification testing as required in 4.6 and herein. The qualification test plan shall be approved at the time the certification is granted. Approval of the qualification test results by the qualifying activity shall result in the manufacturer's listing on QML-38534.

3.4.5.1.1 Optional initial qualification procedure. After the qualifying activity has accepted that the manufacturer is prepared for certification audit through review and approval of the baselines, supporting documentation, and self-audit results, the manufacturer may choose to begin the QML qualification process. Qualification by this option shall be at the manufacturer's risk since the testing could occur prior to, or concurrently with the certification audit. If this option is chosen, agreements shall be made with the qualifying activity for selection of the test vehicle, development of a test plan including rework, Government source inspection (GSI) requirements, and the establishment of timeframes. Approval of the qualification test results by the qualifying activity shall always occur following written notification of certification even if testing is completed prior to certification, and shall result in the manufacturer's listing on QML-38534.

3.4.5.2 Qualification by similarity. Upon approval of the qualification test report by the qualifying activity, products that are fabricated with the same qualified baseline processes, package and element types, and within the process parameter and material dimension windows defined in 3.4.8 shall be considered qualified by similarity.

3.4.5.3 Subsequent qualification procedures. Expansion of the QML listing, or the qualification of major changes to the QML listing, shall be accomplished by the manufacturer successfully completing qualification testing as required herein and in accordance with the QML qualification requirements of 4.6 or the QML configuration control requirements of 3.4.8 as applicable or both.

3.4.5.4 Test scheduling procedures. Qualification shall normally be achieved within 9 months after qualification initiation. The qualifying activity may grant an extension to this period if adequate justification exists. The qualifying activity's review of the test report to determine acceptability shall normally be accomplished within 30 days of receipt.

3.4.5.4.1 Test plan. Test plans include DESC Form EQC-19H, Qualification Testing Notification, with section I completed and all items requested in section I. The plan shall include any special assembly, testing, and reporting information that is applicable.

3.4.5.4.2 Testing performed after receiving qualifying activity approval. The manufacturer is eligible to begin the qualification process after an authorization to test (ATT) is granted by the qualifying activity via DESC Form EQC-19H, section II. To receive an ATT from the qualifying activity, the manufacturer shall submit and receive approval of a test plan. Qualification initiation shall be considered to be the date the ATT is issued.

3.4.5.4.3 Additional testing performed before receiving qualifying activity approval. After meeting the requirements of 3.4.1.2 or 3.4.5.1.1 pursuant to certification, the manufacturer is eligible to begin the qualification process after notifying and receiving approval from the qualifying activity of the nature of the initial or subsequent qualification. The manufacturer shall then forward to the qualifying activity a DESC Form EQC-19H, sections I and II, and target dates for completion of the device fabrication, screening, qualification test, and report submission. Qualification initiation shall be considered to be the date that the qualifying activity acknowledges receipt of DESC Form EQC-19H and target dates. The qualification lot shall not be sealed until the authorized government quality organization, such as DCMC (formerly DCAS), has been given an opportunity to perform preseal visual inspection. The remaining test plan documents (see 3.4.5.4.1) shall be submitted with the test report under cover of section III of DESC Form EQC-19H. Start of qualification using alternate test flows (see 3.4.5.7.1) shall not be allowed without qualifying activity approval.

3.4.5.5 Rework qualification. Devices containing any unqualified rework shall not be shipped until the rework has been successfully qualified. The rework and repair provisions of 3.7.2 shall apply.

3.4.5.5.1 Qualification of rework. If any rework is to be qualified, and unless otherwise allowed (see 3.4.5.5.3), the manufacturer shall build a qualification lot of reworked devices in which certified rework processes are performed. Standard evaluation circuits may be used. See 4.6.2.3 for rework sample requirements. Qualification of rework by this method shall require qualifying activity approval of the test plan and ATT prior to assembly of the lot.

3.4.5.5.2 Delid/relid rework qualification procedures. If delid/relid rework is to be qualified, a qualification lot of delidded/relidded devices shall be assembled that includes adequate devices for five qualification samples plus reserve units. Qualification of two or more delid/relid cycles require that the samples be delidded and relidded N+1 times to qualify "N" delid/relid cycles. The N+1 delid/relid rework operations shall be performed on qualification devices that have been fully screened. In addition to the original screen, there shall be N screens performed for N+1 delid/relid operations. The final screen shall occur after the last delid/relid cycle. Note that one delid/relid qualification will require no additional delid/relid operation.

3.4.5.5.3 Alternate qualification procedures for die/wire bond rework. The manufacturer may elect to review the initial production lot(s) from which qualification samples are selected for the occurrence of certified rework processes. The devices containing the rework to be qualified shall be among those selected for qualification. The sampling of 4.6.2.3 shall be required. If the amount of rework that was performed does not meet the sample size requirements of 4.6.2.3, then additional die/bond rework shall be performed on the selected rework samples or more rework samples to meet the minimum sample size requirements. If the initial qualification does not cover all certified rework, then subsequent production lot(s) shall be reviewed for the occurrence of the unqualified rework until all certified rework is qualified. Delid/relid rework shall not be qualified by these procedures.

3.4.5.6 Qualified manufacturer's list (QML) qualification lot. The manufacturer may elect to perform the QML qualification in accordance with 3.4.5.7 on an inspection lot of shippable product; or the manufacturer may choose to build a lot of devices specifically for QML qualification, and test them in accordance with 3.4.5.7. Devices specifically built for QML qualification may either be actual product or standard evaluation circuits (see 3.1.3.24). Any actual products from the qualification lot are shippable as a compliant product after successful completion of qualification tests, subgroups 1, 3, 5, and 7 of table XIb, and table XId tests.

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. Option 3 manufacturers shall receive reciprocal listing on QML-38534 through achieving QPL-38510 listing in accordance with 3.4.1.1.

3.4.5.7.1 Test requirement deviations. Additional or reduced testing, as may be dictated by the uniqueness of a particular process/material or the qualification requirements of 3.4.8, may be authorized by the qualifying activity. Alternate test plans must be specifically authorized by the qualifying activity prior to commencing with the testing.

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 (see 3.6.8.4)	Radiation and total dose (Rad (Si))	Level neutron fluence (n/cm^2)
/	No RHA	No RHA
M	3000	2×10^{12}
D	1×10^4	2×10^{12}
R	1×10^5	2×10^{12}
H	1×10^6	2×10^{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.

3.4.5.9 Qualification to electrostatic discharge sensitivity (ESDS) classes. Initial qualification to an ESDS class or requalification after redesign shall consist of qualification to the appropriate quality and reliability level (class K or H) plus ESDS classification in accordance with method 3015 of MIL-STD-883. ESDS classification levels and associated marking are defined in 3.6.8.2.

NOTE: Manufacturers may, at their option, classify devices as class 1 without performing the ESD sensitivity test based on their own history, judgment, or performance. ESD classification can be determined either by testing the hybrids using method 3015 or marking to the lowest electrostatic voltage class level of the active devices ESDS classified in accordance with MIL-M-38510 that are accessible to the leads of the hybrid devices. Support data (from device tests or ICD manufacturers' ESD results) shall be retained by the hybrid manufacturer for device types compliant with this specification.

3.4.5.10 QML-38534 listing retention procedures. QML-38534 listing shall be retained through yearly retention reports in accordance with 4.6.6.

3.4.6 Quality conformance inspection (QCI). QCI shall consist of the tests and inspections specified in 4.7. Hybrid microcircuits shall not be accepted or approved for delivery until all applicable QCI requirements have been met. The acquiring activity may approve delivery if groups A, B, C1, C3, and D testing have been completed and group C2, steady state life test, has commenced. The hybrid manufacturer shall maintain traceability of all devices delivered to the acquiring activity prior to completion of QCI testing for the purpose of notification/recall in case of test failure. SPC shall not be an acceptable substitute for QCI unless the procedures have been approved by the qualifying activity (see 4.1.2.2).

3.4.7 Traceability.

3.4.7.1 Material and element traceability. Traceability shall be such that for each hybrid microcircuit, all adhesives and coatings shall be traceable to a material production lot, inspection lot, or other specified grouping. All elements and materials used shall be traceable to their incoming inspection lots. For class K, records shall be maintained to provide traceability from the hybrid microcircuit serial number to the specific wafer lot from which each semiconductor and microcircuit element originated.

3.4.7.2 Process traceability. Each hybrid microcircuit, or each group of hybrid microcircuits which have been fabricated as a common batch, shall be identifiable through means of production travelers or similar documentation such that the complete manufacturing history, including rework, shall be recorded. The records should include, as a minimum, the performance date of all identified production process steps, the specification, number of production process steps, and the identification of the operator performing the process steps. The records shall be retained for a minimum of 5 years (7 years for class K) after delivery of the hybrids, and shall be available for review upon request of the acquiring activity.

3.4.7.3 Production lot traceability. The manufacturer shall maintain production lot traceability.

3.4.8 Configuration control. Unless otherwise specified, changes shall be categorized into three classifications.

Class	Description
I	Major changes
II	Minor changes
III	Editorial changes

All changes in design, substitution of materials or processes, or modifications to baselined documentation (i.e., all class I, II, and III changes) for any hybrid microcircuit must be processed in accordance with established change control procedures (see 30.1.2.4 of appendix A).

a. Class I: Class I changes detailed in 3.4.8.1 are those changes that may affect the performance, quality, reliability, or interchangeability of the product. Acquiring activity approval shall be required if specified by contract and/or as specified in 3.4.8.1. The qualifying activity shall be notified of the change by means of the issuance of a request for performing material or process qualification. Where such a change occurs, implementation of the change shall be at the risk of both the acquiring activity and the hybrid manufacturer and not the Government.

b. Class II: Class II changes are all changes except class I and class III changes (e.g., conformance to the military specification revision, vendor metallization mask change, package height change within the envelope tolerances of the detail drawing, etc.). Class II changes do not normally require acquiring or qualifying activity approval except that the cognizant activity shall be notified when there is uncertainty as to a change being major or minor in nature. Control procedures and records shall be in accordance with appendix A product assurance program requirements and shall be available for on-site review. In addition, for class K minor design and process changes, records for each change shall include the rationale, and/or evidence as appropriate that the performance, quality, reliability, or interchangeability of the product were not adversely affected. When the qualifying activity is notified and judges the change class II, the name of the contact and date of the decision may comprise the justification.

c. Class III: Class III, editorial changes, are those changes to documentation necessary to insure the understanding and execution of the affected document (e.g., format changes, spelling, word identity, etc.). Change documentation history for class III type changes shall be available for on-site review.

3.4.8.1 Class I, major changes. Prior to implementation, the manufacturer shall notify the acquiring activity of any major change in product design if required by the contract. The qualifying activity shall be notified of any major changes in the approved baselined index of documents. This notification shall include a thorough description of the proposed change, acceptable engineering data, and a suggested test plan designed to demonstrate that the changed product will continue to meet the acquisition document requirements including performance, quality, reliability, or interchangeability. The acquiring or qualifying activity, as applicable, shall review the proposed change, the engineering data, and test plan as applicable. The manufacturer shall proceed with the change after approval of the test plan. To minimize the need for additional tests due to insufficient details or data regarding the proposed changes, it is recommended that the test plan be discussed with the acquiring or qualifying activity prior to commencing the test program. Test guidelines for each major change listed herein are provided in table II for product design changes (column QCI) and baselined process changes (column QML). For QML by similarity see 3.4.5.2. The subgroup designations in table II correspond with the subgroups designated in tables XIa, XIb, XIc, and XId of this specification. Tests shall be performed on samples of the first hybrid microcircuits or subassemblies manufactured incorporating the changes. Upon completion of the prescribed test program, the results shall be provided to the acquiring activity for review and approval or disapproval. At the manufacturer's option, hybrid microcircuits incorporating the change may be manufactured and tested prior to approval; however, all shipments of these changed devices shall be withheld until formal documented approval is granted by the acquiring or qualifying activity. Changes representative of those which are subject to the requirement are:

a. Substitution of substrate material (e.g., alumina versus BeO).

b. Substitution of materials or inks deposited on hybrid substrate (e.g., (1) conductor: gold versus copper; (2) resistor: ruthenium base versus carbon) or deposit method: (e.g., thinfilm versus thickfilm).

c. Cumulative change of nominal process time of deposited materials exceeding 25 percent or nominal process temperature exceeding +50°C or 10 percent, whichever is greater, since the last qualification or major change notification.

d. Cumulative changes to hybrid substrate mask design that reduce nominal design dimensions, spacing or isolation more than ±25 percent, or changes to electrical parameters of the deposited elements beyond the design limits since the last qualification or major change notification.

e. Substitution of trimming method (e.g., abrasive versus laser).

f. Increase in substrate fabrication multi-layer conductor levels more than one conductor level from QML Listing.

g. Substitution of attach material (e.g., epoxy A versus epoxy B) or of attachment method (e.g., epoxy versus eutectic) for hybrid microcircuit elements.

h. Change in the baselined process temperature for element or substrate attachment which exceeds +25°C or 10 percent, whichever is greater.

i. Substitution of die type (e.g., 2N2484 versus 2N2905) or other element types (e.g., tantalum versus ceramic capacitors or thinfilm versus thickfilm resistors) mounted on the hybrid substrate.

j. Increase in element attach area more than 50 percent from QML listing.

k. Substitution of baselined wire bond method (e.g., ultrasonic versus thermal compression) or wire size changes greater than 1.0 mil.

l. Any change in specified material composition or purity of the wire.

m. Increase in substrate attach perimeter more than 50 percent of QML listing.

n. Substitution of package configuration (e.g., platform versus bathtub), lid or covers (e.g., step lid versus drawn cover) or plating material.

o. Substitution of package or lid base material (e.g., nickel versus stainless steel).

p. Changes to finished hybrid dimensions exceeding SCD, or SMD envelope tolerances.

q. Substitution of seal method (e.g., seam weld versus laser weld), or seal material (e.g., SnAg versus AuSn).

r. Change in the baselined seal process time, temperature, or vacuum of more than 10 percent, or sealing atmosphere except for the addition of helium.

s. Increase in package seal perimeter more than 50 percent from QML listing.

t. Increase in lead count for QML listing per package type.

u. Changes to the baselined product flowchart in which element evaluation, screening, QCI options, and any operations are added or deleted, except for additional inspections and SPC operations.

v. Addition of new processes or materials to QML.

w. Assembly operation or test facility move.

x. Class I changes as defined in MIL-STD-480.

TABLE II. Testing guidelines for major product/process changes. 1/ 2/ 3/ 4/ 5/ 6/ 7/

Major changes or substitutions (see 3.4.8.1)	Recommended test subgroups of tables XIa, XIb, XIc, and XId (unless otherwise noted)		Variable data required (subgroups)	
	QCI	QML	QCI	QML
a. Substitution of substrate material	C1	C1 -> C4	N/A	C4
b. Substitution of material deposited on substrate				
(1) conductor	A, B5, B6	A, C1 -> C4	B5, B6	C4
(2) resistor	A	A		
(3) deposit method	A, B5, B6,C2	A, C1 -> C4	B5, B6 C2	C4
c. Process/time/temp changes	A, B5	Same as QCI	B5	B5
d. Substrate mask design	A1, B4, C2	N/A	C2	N/A
e. Substitution of trim method	A, C2	Same as QCI	C2	C2
f. Increase in multi-layer conductor levels, more than one level	B5, B6	C1 -> C4	B5, B6	C4
g,h Substitution of attach material or process temperature	C1 -> C3	C1 -> C4 (no wirebond)	C3	C4
i. Substitution of die type	A, C2	N/A	C2	N/A
j. Increase in element area from QML listing	N/A	C1 -> C4 (no wirebond)	N/A	C4
k(1) Substitution of baselined wirebond method	N/A	C1 -> C4 (no die shear)	N/A	C4
k(2) Wire size change	C1, -> B5	C1 -> C4 (no die shear)	B5	C4
l. Substitution of wirebond material	C1, -> B5	C1 -> C4 (no die shear)	B5	C4
m. Increase in substrate perimeter from QML listing	N/A	C1 -> C3	N/A	C3
n. Substitution of package configuration, etc.	B1, C1 -> C3	C1 -> C3	C3	C3
o. Substitution of package, lid base material	B1, C1 -> C3	C1 -> C3	C3	C3

See footnotes at end of table.

TABLE II. Testing guidelines for major product/process changes - Continued.
1/ 2/ 3/ 4/ 5/ 6/ 7/

Major changes or substitutions (see 3.4.8.1)	Recommended test subgroups of tables XIa, XIb, XIc, and XId (unless otherwise noted)		Variable data required (subgroups)	
	QCI	QML	QCI	QML
p. Change to finished hybrid dimensions	Notify acquiring activity	N/A	N/A	N/A
q, r Substitution of seal method, profile or seal material	C1 -> C3	C1 -> C3	C3	C3
s. Increase in package seal perimeter from QML listing	N/A	C1 -> C3	N/A	C3
t. Increase in lead count per package type	See table VIII C3 8/	See table VIII C3 8/	C3	C3
u. Change to baselined product flowchart	N/A	Notify qualifying activity	N/A	N/A
v. Addition of new process or material	N/A	Notify qualifying activity	N/A	N/A
w. Assembly operation or test facility move	N/A	Notify qualifying activity	N/A	N/A
x. Class I change, MIL-STD-480	Notify acquiring activity	Notify acquiring activity	N/A	N/A

1/ Sampling shall be in accordance with table XIa, XIb, XIc, and XId of this specification.
2/ All electrical parameter testing shall be in accordance with the device acquisition specification or drawing or SMD.
3/ Data histograms providing a parametric data summary may be submitted in place of variables data.
4/ The acquiring or qualifying activity (or both) may add or reduce testing as warranted by detail specification requirements, unique design, or process circumstances after notification by the manufacturer.
5/ The acquiring activity shall determine testing requirements for design changes affecting class K devices.
6/ Notification is required at the time of acceptance of new order or delivery on existing order when changes are made to devices acquired to Specification Control Drawings.
7/ -> implies specified subgroups testing shall be sequential.
8/ Excluding subgroups 5 and 6.

3.5 Design and construction. Hybrid microcircuit design and construction shall be in accordance with all the requirements specified herein and the device acquisition specification or SMD.

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. 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.

NOTE: Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

3.5.2 Polymeric materials. The cure temperature of polymeric materials shall not be exceeded after completion of final seal.

3.5.2.1 Polymeric adhesives. All adhesive polymeric materials shall meet the requirements of MIL-STD-883, method 5011, and shall be approved by the qualifying activity.

3.5.2.2 Other polymeric materials. Any other use of polymeric materials shall be approved by both the acquiring and qualifying activities for the specific application for which it is intended.

3.5.3 Metals. External metal surfaces, other than seal weld areas, shall be corrosion resistant or shall be plated or treated to resist corrosion and shall meet the requirements specified in 3.5.8.

3.5.4 Other materials. External parts, elements, or coatings including markings shall be non-nutrient to fungus and shall not blister, crack, outgas, soften, flow, or exhibit defects that adversely affect storage, operation, or environmental capabilities of hybrid microcircuits delivered to this specification under the specified test conditions.

3.5.5 Design and manufacturing documentation. Design, topography, schematic circuit information, manufacturing flowcharts, and process control documents for all hybrid microcircuits supplied under this specification shall be available in-plant for review by the acquiring activity and the process certification audit team. This documentation shall be sufficient to depict completely the physical and electrical construction of the hybrid microcircuits supplied under this specification. Each hybrid microcircuit shall be traceable to a specific part, drawing, or type number, and to the production lot and inspection lot codes under which hybrid microcircuits are manufactured and tested so that revisions can be identified. Changes to product shall be controlled in accordance with 3.4.8.

3.5.5.1 Device topography. Color photomicrographs (8 x 10 inches) or 35 mm color slides capable of being enlarged to 8 x 10 inch shall be required for initial design verification and after a design change. These photomicrographs or transparencies shall show the specific interconnection pattern used to connect the elements. They shall apply to the substrate and all conductor patterns and active or passive elements deposited thereon, as well as to semiconductor die, as applicable. This requirement can be satisfied by the manufacturer's assembly drawing having a minimum scale of 10X.

3.5.5.2 Schematic diagrams. For hybrid microcircuits supplied under this specification, the actual schematic diagram, logic diagram, or combination thereof, shall be available with sufficient detail to represent all electrical elements functionally designed into the hybrid microcircuit together with their values (when applicable). For complex devices or those with redundant detail, the overall hybrid microcircuit may be represented by a logic diagram in combination with schematic details. Where parasitic elements are important to the proper functioning of any hybrid microcircuit, they shall be included in the schematic diagram.

3.5.6 Internal conductors. Internal thin film conductors on elements (metallization stripes, contact areas, bonding interfaces, etc.) shall be designed so that no properly fabricated conductor shall experience in normal operation (at worst case specified operating conditions), a current density in excess of the maximum allowable value shown below for the applicable conductor material:

Conductor material	Maximum allowable current density
Aluminum (99.99 percent pure or doped) without glassivation	2×10^5 A/cm^2
Aluminum (99.99 percent pure or doped) glassivated	5×10^5 A/cm^2
Gold	6×10^5 A/cm^2
All other (unless otherwise specified)	2×10^5 A/cm^2

The current density shall be calculated at the point of maximum current density (i.e., greatest current per unit cross section; see 3.5.6a) for the specified device type and schematic or configuration.

a. Use a current value equal to the maximum continuous current (at full fanout for digitals or at maximum load for linears) or equal to the simple time-averaged current obtained at maximum rated frequency and duty cycle with maximum load, whichever results in the greater current value at the point of maximum current density. This current value shall be determined at the maximum recommended supply voltage and with the current assumed to be uniform over the entire conductor cross-sectional area.

b. Use the minimum allowed metal thickness in accordance with manufacturing specifications and controls including appropriate allowance for thinning experienced in the metallization step (via). The thinning factor over a metallization step is not required unless the point of maximum current density is located at the step.

c. Use the minimum actual design conductor widths (not mask widths) including appropriate allowance for narrowing or undercutting experienced in metal etching.

d. Areas of barrier metals and nonconducting material shall not be included in the calculation of conductor cross section.

Unless otherwise approved by the qualifying activity, thick film conductors on hybrid microcircuits or multichip substrates (metallization strips, bonding interfaces, etc.) shall be designed so that no properly fabricated conductor shall dissipate more than 4 watts/cm^2 when carrying maximum design current (except for conductors on BeO which shall dissipate no more than 80 watts/cm^2).

3.5.7 Internal lead wires. Internal lead wires or other conductors which are not in thermal contact with a substrate along their entire length (such as wire or ribbon conductors) shall be designed to experience, at maximum rated current, a continuous current for direct current, or an rms current, for alternating or pulsed current, not to exceed the values established by the following relationship:

$$I = Kd^{3/2}$$

Where: I = Maximum allowed current in amperes.

d = Diameter in inches for round wire (or equivalent round wire diameter which would provide the same cross-sectional area for other than round wire internal conductor).

K = A constant taken from below for the applicable wire or conductor length and composition used in the device.

"K" values for bond-to-bond total conductor length		
Composition	Length ≤ 0.040 inch (0.10 cm)	Length > 0.040 inch (0.10 cm)
Aluminum	22,000	15,200
Gold	30,000	20,500
Copper	30,000	20,500
Silver	15,000	10,500
All other	9,000	6,300

3.5.8 Package element material and finish.

3.5.8.1 Package body material. Package body material shall be metal or ceramic or a combination of these materials and shall conform to MIL-STD-883, method 2009. In addition, metal packages shall conform to JESD9-A87. In case of conflict, method 2009 shall take precedence.

3.5.8.2 Lead or terminal material. Unless otherwise specified, the lead or terminal material shall conform to one of the following compositions:

a. Type A: Iron-Nickel-Cobalt alloy: MIL-I-23011, class I, ASTM F-15.

b. Type B: Iron-Nickel alloy (41 percent Ni): MIL-I-23011, class 5, ASTM F-30.

c. Type C: Co-fired metallization such as nominally pure tungsten. The composition and application processing of these materials shall be subject to qualifying activity approval.

d. Type D: Copper core-iron nickel ASTM F-30 alloy (50.5 percent Ni). The core material shall consist of copper (oxygen-free) ASTM B170, grade 2.

e. Type E: Copper core ASTM F-15 alloy. The core material shall consist of copper (oxygen-free) ASTM B170, grade 2.

f. Type F: Copper (oxygen-free) ASTM B170, grade 2. This material shall not be used as an element of any glass-to-metal seal structure.

g. Type G: Iron-Nickel alloy (50.5 percent Ni): MIL-I-23011, class 2 ASTM F-30.

h. Type H: Nickel: MIL-N-46025 (for ribbon leads) and MIL-N-46026 (for round wire leads).

3.5.8.3 Hybrid microcircuit finishes. Finishes of all external leads or terminals and all external metallic package elements shall conform to either 3.5.8.3.2 or 3.5.8.3.3 as applicable. The leads or terminals shall meet the applicable solderability and corrosion resistance requirements. The other metallic package elements (including metallized ceramic elements) shall meet the applicable corrosion resistance requirements. Finishes on interior elements (e.g., bonding pads, posts, tabs) shall be such that they meet lead bonding requirements and any applicable design and construction requirements. The use of strike plates is permissible to a maximum thickness of 10 microinches (0.25 µm). All plating of finishes and undercoats shall be deposited on clean, nonoxidized metal surfaces. Suitable deoxidation or cleaning operations shall be performed before or between plating processes. All hybrids and packages (cases and covers) shall be capable of meeting the following requirements:

a. Table VIII, package evaluation.

b. MIL-STD-883, method 2025, adhesion of lead finishes.

c. ASTM B487, Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross-section.

d. ASTM B567, Measurement of Coating Thickness by the Beta Backscatter Method, X-ray Fluorescence, or Equivalent.

Compliance to the above requirements shall be demonstrated when and as specified. The aforementioned ASTM methods are provided as reference methods to be used when the failure to pass other finish requirements suggests deficiencies in plating thickness.

3.5.8.3.1 Finish thickness measurements. Lead finish thickness measurements shall be taken halfway between the seating plane and the tip of the lead. This requirement is to avoid having the inspector select a non-typical portion of the lead on which to perform the measurement. Measurements taken on the shorting bar shall be correlated by direct measurement on the lead. Finish thickness measurements for package elements other than leads shall be taken at the center of major flats.

3.5.8.3.2 Lead finish. The finish system on all external leads or terminals shall conform to one of the following:

a. Hot solder dip. The hot solder dip shall be homogeneous with a minimum thickness of 60 microinches (1.52 µm) for round leads and, for other shapes, a minimum thickness at the crest of the major flats of 200 microinches (5.08 µm) solder (SN60 or Sn63). In all cases, the solder dip shall extend up to and beyond the effective seating plane for packages with standoffs or within .030 inch (0.76 mm) of the lead or package interface for leaded flush mounted devices. For leadless chip carrier devices, the hot solder dip shall cover a minimum of 95 percent of the metallized side castellation or notch and metallized areas above and below the notch except the index feature if not connected to the castellation. Terminal area intended for device mounting shall be completely covered. The hot solder dip is applicable:

(1) Over a finish in accordance with entry b or c below, or

(2) Over electroplated nickel or electroless nickel phosphorous in accordance with 3.5.8.3.4, or

(3) Over the basis metal. When applied over the basis metal, underplate that is nonconforming, or other finishes that are nonconforming (e.g., fused tin less than 200 microinches), hot solder dip shall cover the entire lead to the glass seal or point of emergence of the lead or metallized contact through the package wall.

b. Tin plate. As plated tin shall be a minimum of 300 microinches thick and shall be dense, homogeneous, and continuous. As plated tin shall contain no more than 0.05 percent by weight co-deposited organic material measured as elemental carbon. Tin plate shall be fused after plating before or after burn-in by heating above its liquidus temperature. Fused tin plate shall be visually inspected after fusing and shall exhibit a dense, homogeneous, and continuous coating. Fused tin plate shall be a minimum of 200 microinches thick when measured at the crest of major flats. Fused tin plate is applicable:

(1) Over electroplated nickel or electroless nickel phosphorous in accordance with 3.5.8.3.4 or

(2) Over the basis metal.

As plated tin need not be fused if the leads are subsequently hot solder dipped in complete accordance with 3.5.8.3.2a. Tin-lead plating may be used as an alternative to tin plate and shall have in the plated deposit 2 percent to 50 percent by weight lead (balance nominally tin) homogeneously co-deposited. As plated tin-lead shall be a minimum of 300 microinches thick. As plated tin-lead shall contain no more than 0.05 percent by weight co-deposited organic material measured as elemental carbon.

Tin-lead plate is applicable:

(1) Over as-plated tin.

(2) Over electroplated nickel or electroless nickel phosphorous in accordance with 3.5.8.3.4.

(3) Over the basis metal.

Tin-lead plating may be fused after plating before or after burn-in by heating above its liquidus temperature. Fused tin-lead shall be visually inspected after fusing, and shall exhibit a dense, homogeneous, and continuous coating. Fused tin-lead shall be a minimum of 200 microinches thick. The maximum carbon content for both tin and tin-lead plate (and minimum lead content in the tin-lead plate) on the as-plated finish shall be determined by the manufacturer on at least a weekly basis. The visual inspection after fusing shall be conducted on a sampling basis by the manufacturer as an in-process control. Visual inspection of the fusing shall be performed at a frequency sufficient to assure uniform compliance with these requirements on the finished product. The determination of carbon and lead content may be made by any accepted analytical technique (e.g., for carbon: pyrolysis, infrared detection using an IR212, IR244 infrared detector, or equivalent; for lead: X-ray florescence, emission spectroscopy) so long as the assay reflects the actual content in the deposited finish.

c. Gold plate. Gold plating shall be a minimum of 99.7 percent gold, and only cobalt shall be used as the hardener. Gold plating shall be a minimum of 50 microinches (1.27 µm) and a maximum of 225 microinches (5.72 µm) thick. Gold plating shall be permitted only over nickel plate or undercoating in accordance with 3.5.8.3.4.

3.5.8.3.3 Package body finish. External metallic package elements other than leads, terminals, and seal weld (e.g., lids, covers, bases, seal rings, etc.) shall meet the applicable corrosion resistance and environmental requirements or shall be finished so that they meet those requirements using finishes conforming to one or more of the following as applicable:

a. Solder in accordance with 3.5.8.3.2a.

b. Tin plate in accordance with 3.5.8.3.2b.

c. Gold plate shall be a minimum of 99.7 percent gold and only cobalt shall be used as a hardener. Gold plating shall be a minimum of 10 microinches (0.25 µm) and a maximum of 225 microinches (5.72 µm) thick. The gold plate shall be applied over electroless or electroplated nickel or undercoating in accordance with 3.5.8.3.4. Multilayered finish structures are acceptable provided the outer gold layer meets the minimum thickness of 10 microinches (0.25 µm) and each of the nickel undercoats meets the thickness requirements of 3.5.8.3.4 with the total nickel thickness not to exceed 600 microinches (15.24 µm).

d. Nickel plate in accordance with 3.5.8.3.4.

3.5.8.3.4 Nickel plate or undercoating. Electroplated nickel undercoating or finishes from a sulfamate nickel bath is preferred and shall be 50 to 350 microinches (1.27 µm to 8.89 µm) thick measured on major flats or diameters. Electroless nickel undercoating or finishes, when allowed, shall be 50 to 350 microinches (1.27 µm to 8.89 µm) thick measured on major flats or diameters. The addition of organic "wetting agents" is prohibited for either sulfamate or phosphorous nickel baths. Electroplate or electroless nickel plate (or combinations thereof) as well as nickel cladding may be used as the finish for package elements other than flexible leads or terminals provided the corrosion resistance and environmental requirements are met. In all cases, electroplated nickel undercoating from a nickel sulfamate bath is preferred for lead finishes. Electroless nickel shall not be used as the undercoating on flexible or semiflexible leads (see 3.3.1 and 3.3.2 of method 2004 of MIL-STD-883) and shall be permitted only on rigid leads or package elements other than leads.

3.5.9 Device elements. All active and passive elements utilized in the manufacture of hybrid microcircuits shall conform to the applicable requirements of 3.4.2. In addition for class K devices, active elements shall be from certified space level lines when available and passive elements shall be from established reliability lots when available.

3.5.10 Thermal design. Thermal design analysis shall be performed and shall establish as a minimum that functional hybrid microcircuit elements are operating within their design temperature ratings when the hybrid microcircuit is operated at the specified maximum operating case temperature. Finite element analysis is an acceptable thermal design analysis technique. All active and passive elements shall be derated (see 3.5.11a).

3.5.11 Electrical circuit design. Worst case circuit design analysis shall be performed and include the following evaluations as a minimum (applicable to the design):

a. Electrical element stress over the specified operating temperature range shall be within the specified derating criteria. For class K devices, all active and passive elements as a minimum shall be derated to the requirements of MIL-STD-975, unless otherwise specified.

b. Voltage and timing margins under worst case temperature conditions. Margins should be assessed at external device terminals.

3.6 Marking of hybrid microcircuits. Marking shall be in accordance with the requirements of this specification, and the identification and marking provisions of the device acquisition specification. The marking shall be legible and complete, and shall meet the resistance to solvents requirements of MIL-STD-883, method 2015. When mechanical or laser marking is performed it shall be clearly visible through those conformal coatings approved for use in MIL-I-46058 (see method 2015 of MIL-STD-883 if contrasting material or ink is used to highlight the trace). Mechanical or laser marked metal surfaces shall meet all applicable microcircuit finish and group D test requirements. Mechanical or laser marking shall be approved by the qualifying activity. If any special marking is used, it shall in no way interfere with the marking required herein, and shall be visibly separated therefrom. The following marking shall be included on each microcircuit unless otherwise specified.

a. Index point (see 3.6.1).

b. Part or Identifying Number (PIN) (see 3.6.2).

c. Lot identification code or date code (see 3.6.3).

d. Hybrid manufacturer's identification (see 3.6.4).

e. Hybrid manufacturer's designating symbol (see 3.6.5).

f. Country of origin (see 3.6.6).

g. Serialization, when applicable (see 3.6.7).

h. Special marking (see 3.6.8 and 3.6.8.1).

i. Certification mark (see 3.6.8.3).

j. ESD sensitivity identifier (see 3.6.8.2).

Unless otherwise specified, the certification mark, the PIN, the inspection lot identification code, and the ESD identifier shall be located on the top surface of flat packages or dual-in-line configurations and on either the top or the side of cylindrical packages (TO configurations and similar configurations).

3.6.1 Index point. The index point, tab, or other marking indicating the starting point for numbering of leads or for mechanical orientation shall be as specified and shall be applied so that it is visible from above when the microcircuit is installed in its normal mounting configuration. The outline of an equilateral triangle (i.e., Δ), which may be used as an electrostatic identifier (see 3.6.8.2), may also be used as the pin 1 identifier.

3.6.2 Part or Identifying Number (PIN). Each SMD microcircuit shall be marked with the complete PIN. The number sequence for MIL-H-38534B is 5962-XXXXXZZHYY, where:

5962	-	XXXXX	ZZ	H	Y	Y
Federal stock class designator	RHA designator (see 3.6.8.4)		Device type no. (see 3.6.2.1)	QML device class designator (see 3.6.2.2)	Case outline (see 3.6.2.3)	Lead finish designator (see 3.6.2.4)
\ Drawing number /						

NOTE: Non-SMD microcircuits shall be marked with the pin number in accordance with the device acquisition specification, appendix C.

3.6.2.1 Device type. The device type shall identify the circuit function as indicated in the device acquisition specification.

3.6.2.2 Device class designator. This device class designator shall be a single letter identifying the product assurance level in accordance with the device acquisition specification.

3.6.2.3 Case outline. The case outline shall be designated by a single letter assigned to each outline within each device acquisition specification.

3.6.2.4 Lead finish. Lead frame or terminal material and finish shall be as specified in 3.5.8.2. The lead finish shall be designated by a single letter as follows:

Finish letter	Lead frame or terminal material and finish (see note)
A	Types A, B, C, D, E, F, G, and H with hot solder dip
B	Types A, B, C, D, E, F, G, and H with tin plate or lead-tin plate
C	Types A, B, C, D, E, F, G, and H with gold plate
X	Types A, B, C, D, E, F, G, and H with finishes A, B, and C (see note)

NOTE: Finish letter "X" shall not be marked on the microcircuit or its packaging. This designation is provided for use in drawings, part lists, purchase orders, or other documentation where lead finishes A, B, and C are all considered acceptable and interchangeable without preference. For Government logistic support, the A lead finish will be acquired and supplied to the end user when the X is included in the PIN for lead finish. If the PIN is not available with the A lead finish, the same PIN will be acquired except with the C or B lead finish designator as determined by availability. Type C terminal material is a fired on metallization used with leadless chip carriers.

3.6.3 Lot identification code (date code). Hybrid microcircuits shall be marked by a unique code to identify the week of final seal. The first two numbers in the code shall be the last two digits of the number of the year, and third and fourth numbers shall be two digits indicating the calendar week of the year. When the number of the week is a single digit, it shall be preceded by a zero. Reading from left to right or from top to bottom, the code number shall designate the year and week, in that order (e.g., 8806 equals week 6 of 1988). If QCI is performed on an inspection lot basis and two or more different inspection lots (or class K sublots), each having the same PIN, are to be marked with the same identification code, a unique suffix letter immediately following the identification code shall be added.

3.6.4 Manufacturer's identification. Hybrid microcircuits shall be marked with the name or trade mark of the manufacturer. The identification of the equipment manufacturer may appear on the hybrid microcircuit only if the equipment manufacturer is also the hybrid microcircuit manufacturer.

3.6.5 Manufacturer's designating symbol. The manufacturer's designating symbol or CAGE code number shall be as listed on NAVSHIPS 0967-190-4010 or cataloging Handbook H4/H8. The designating symbol shall be used only by the manufacturer to whom it has been assigned and only on those devices manufactured at the manufacturer's plant. In the case of small hybrid microcircuits, the manufacturer's designating symbol may be abbreviated by omitting the first "C" in the series of letters.

3.6.6 Country of origin. The phrase "Made in the U.S.A." shall be marked in small characters below or adjacent to the other marking specified, except that for hybrid microcircuits made in a foreign country, the phrase shall be changed accordingly. If there is limited space, the marking may be shortened to "U.S.A" or to the appropriate accepted abbreviation for the country of origin. At the option of the manufacturer, for QML hybrid microcircuits only, the country of origin marking may be omitted from the body of the hybrid microcircuit but shall be retained on the initial container.

3.6.7 Serialization. Serialization allows traceability of electrical tests results (variables data) to an individual hybrid microcircuit.

3.6.7.1 Class K serialization. Prior to the first recorded electrical measurement in screening, each class K hybrid microcircuit shall be marked with a unique serial number assigned consecutively. Lot records shall be maintained to provide traceability from the serial number to the specific incoming inspection lots from which the elements originated.

3.6.7.2 Class H serialization. Serialization of class H hybrid microcircuits shall only be required when specified in the device acquisition specification.

3.6.8 Special marking. When the size of a package is insufficient to allow marking of special process identifiers on the top surface, the back side of the package may be used for these markings except the ESD identifier shall be marked on the top. Button cap flat packs with less than or equal to 16 leads may have the identifier marked on the ceramic. Back side marking with conductive or resistive ink shall be prohibited on nonconductive surfaces.

3.6.8.1 Beryllium oxide package identifier. If a hybrid microcircuit package contains beryllium oxide, the device shall be marked with this designation: BeO.

3.6.8.2 Electrostatic discharge (ESD) sensitivity identifier. ESD classification levels are defined as follows when tested in accordance with MIL-STD-883, method 3015.

ESD class designator	Prior designation category	Part marking	Electrostatic voltage
1	A	Δ	0-1,999 V
2	B	Δ Δ	2,000-3,999 V
3	---	---	4,000 V

Devices not yet ESD classification tested shall be marked as class 1 until testing determines the appropriate class. Devices previously classed by test as category A shall be marked as class 1. Devices previously classified as category B shall be marked as class 2.

3.6.8.3 *Certification mark*. All hybrid microcircuits acquired to and meeting the requirements of this specification and the applicable associated device acquisition specification, and which are approved for listing on QML-38534 shall bear the "QML" certification mark for SMD controlled hybrid microcircuits and the "CH" (compliant hybrid) certification mark for non-SMD controlled hybrid microcircuits. The certification mark shall be located preceding the date code. The certification mark abbreviation "Q" or "C" may be used for small devices. The "QML" or "CH" certification mark or the abbreviation "Q" or "C" shall not be used for any hybrid microcircuit acquired under contracts or orders which permit or require any changes to this specification. The "QML" or "CH" certification mark and its application shall constitute certification by the manufacturer that all tests of the applicable device acquisition specification and this specification have been satisfactorily completed; that verifiable test data will be retained in files for not less than 5 years; and that within the specified time period, test data will be made available for on-site review by Government representatives upon request. In the event that a lot fails to pass inspection, the manufacturer shall remove or obliterate the "QML" or "Q" or "CH" or "C" certification mark from the sample tested and also from the devices represented by the sample.

3.6.8.4 Radiation hardness assurance (RHA) designator. RHA designators M, D, R, and H defined in 3.4.5.8 shall be marked on the part as indicated in the device acquisition specification.

3.6.9 Marking option for controlled storage of class H. Where hybrid microcircuits are subjected to testing and screening in accordance with some portion of the quality assurance requirements and stored in controlled storage areas pending receipt of orders requiring conformance to the same or a different level, the inspection lot identification code shall be placed on the hybrid microcircuit package along with the other markings specified in 3.6 sufficient to assure identification of the material. As an alternative, if the microcircuits are stored together with sufficient data to assure traceability to processing and inspection records, all markings may be applied after completion of all inspection to the specified level.

3.6.10 Marking option for quality conformance inspection (QCI). The manufacturer has the option of marking the entire lot or only the sample devices to be submitted to groups B, C, and D QCI. If the manufacturer exercises the option to mark only the sample devices, the procedures shall be as follows:

a. The sample devices shall be marked prior to performance of groups B, C, and D qualification or QCIs, as applicable.

b. At the completion of QCI, the marking of the sample devices shall be inspected for conformance with the requirements of 3.6.

c. The inspection lot represented by the quality conformance sample shall then be marked and any specified visual and mechanical inspection performed.

d. The marking materials and processing procedures applied to the inspection lot shall be the same as those used for the inspection sample.

3.6.11 Remarking. If sealed devices are remarked (to change or correct the marking as specified in 3.6), the reason for remarking shall be recorded. The remarking procedure and its qualification test plan shall be approved by the qualifying activity. Approval shall be required once only for each package material composition (marking surface base material and plating).

3.7 Workmanship. Hybrid microcircuits shall be manufactured, processed, and tested in a careful and workmanlike manner in accordance with good engineering practice, with the requirements of this specification, and with the production practices, workmanship instructions, inspection and test procedures, and training aids prepared by the manufacturer in fulfillment of the product assurance program (see appendix A). For contamination and foreign material identification, see internal visual inspection requirements of MIL-STD-883, methods 2017 and 2032.

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. 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 100 environment.

3.7.2 Rework and repair provisions. All rework and repair permitted on devices shall be accomplished in accordance with procedures and safeguards documented in accordance with MIL-STD-1772 and 30.1.1.6 of appendix A. This documentation shall reflect the processes, procedures, and materials to be used including verification or test data, and be approved by the qualifying activity. Each process or procedure shall be designated as rework or repair. This documentation shall indicate that a decision to rework is made solely by the manufacturer while a repair decision shall be made with the concurrence of the qualifying activity except for repairs permitted by this specification. When required, the Government shall participate in repair decisions (see MIL-STD-1520). A typical example of rework is the removal of a defective element and replacement with a new element. An example of repair is the use of an organically attached molytab to replace a previously alloy attached semiconductor element.

3.7.2.1 General rework and repair provisions.

a. All temperature excursions during any rework or repair shall not exceed the baselined rework or repair limitations. Time and temperature limits shall be specified.

b. Touch-up of package sealing surface plating on delidded packages is not permitted.

c. The minimum distance between the glass to metal seals and the package sealing surface shall be at least .040 inch (1.02 mm) after final seal to prevent damage to lead seals by welding adjacent to them. (Applies to seam welding only.)

d. For class H devices, any device that is reworked or repaired after preseal visual inspection shall be subjected to full screening or rescreening as applicable. If a device has not been subjected to a given required screen prior to rework or repair, then that device must be subjected to that screen after repair or rework. If a device has been subjected to a given screen prior to rework or repair, then rescreening applies as follows:

(1) Preseal visual inspection. Inspect for general damage (low magnification in accordance with MIL-STD-883, method 2017 and method 2032) which might have been caused by the rework or repair and perform a complete method 2017 or method 2032 inspection of the reworked or repaired element or area (e.g., replaced die, wirebonds, etc.).

(2) Temperature cycle or shock, mechanical shock or centrifuge, seal, and external visual. Rescreen all rework or repair devices 100 percent.

(3) Burn-in. Devices delidded to rework package seal failures do not require burn-in rescreen. Devices which have had elements replaced or have been wirebonded or rewirebonded require 100 percent burn-in rescreen.

e. For class K devices, any device which is reworked or repaired after 100 percent nondestructive bond pull (or preseal burn-in, when applicable) shall be subjected to full screening or rescreening as applicable. If a device has not been subjected to a given required screen prior to rework or repair, then that device must be subjected to that screen after repair or rework. Full screening is required after any rework or repair operation involving unlidded (includes delidded) devices with clarification as follows:

(1) Preseal burn-in (when applicable) shall be repeated if the rework or repair involves any active element replacement or wire bonding (or wire rebonding) of any active element.

(2) Nondestructive bond pull is only required on wires that were replaced or rebonded provided the device has already been subjected to the 100 percent bond pull screen.

(3) Devices delidded for rework or repair after post seal burn-in.

When preseal burn-in option is included in the baseline, the subsequent post seal burn-in rescreen may be reduced to 240 hours minimum. When preseal burn-in option is not included in the baseline the subsequent post seal burn-in rescreen may be reduced to 240 hours minimum provided that the rework or repair does not involve any active element replacement or wire bonding (or wire rebonding) of any active element.

f. When flux is required for rework or repair, the specific flux and detailed procedures for its use and subsequent special cleaning operations shall be documented and approved in accordance with 30.1.1.6 of appendix A.

g. Replacement elements shall not be bonded onto the chip element they are to replace.

3.7.2.2 Element wire rebonding. Wire rebonding of elements other than substrates shall be permitted with the following limitations:

a. No scratched, voided, or discontinuous paths or conductor patterns on an element shall be repaired by bridging with or addition of bonding wire or ribbon.

b. All rebonds shall be placed on at least 50 percent undisturbed metal (excluding probe marks that do not expose underlying oxide). No more than one rebond attempt at any design bond location shall be permitted. No rebonds shall touch an area of exposed oxide caused by lifted or blistered metal. A bond shall be defined as a wire to post or wire to pad bond. Bond-offs required to clear the bonder after an unsuccessful bond attempt need not be visible, shall not be cause for reject and shall not be counted as a rebond. For class K, the total number of rebond attempts (exclusive of element replacement or tuning wire replacement) shall be limited to a maximum of 10 percent of the total number of bonds in the hybrid microcircuit. The 10 percent limit on rebond attempts may be interpreted to the nearest whole number to the 10 percent value.

3.7.2.3 Substrate wire rebonding or repair. Wire rebonding on substrates shall be permitted with the following limitations:

a. Scratched, open, or discontinuous substrate metallization paths or conductor pattern on a substrate, not caused by poor adhesion, may be repaired by bridging with or by addition of bonded conductors having current carrying capacity at least 3.5 times the maximum calculated operating load current for the conductor or 3.5 times the current capacity of the wire bond connection terminating on the damaged conductor path. The quantity of repairs shall be limited to one for each one-half square inch or fraction thereof of substrate area.

b. No rebonds shall be made over intended bonding areas in which the top layer metallization has lifted, peeled, or has been damaged such that underlying metallization or substrate is exposed at the immediate bond site.

3.7.2.4 Compound bonding. Compound bonding is permitted only as follows:

a. When required for design, rework, or repair, gold bonds shall be limited to one bond over the original bond, wire, or ribbon.

b. Only monometallic compound bonds of the same size wire or ribbon are permitted (i.e., the original bond wire and that used for compound bonding must be the same material).

c. For rework or repair, the maximum number of compound bonds shall not exceed 10 percent of the total number of wires.

d. For rework or repair, a corrective action system must be utilized in order to reduce the number of compound bonds.

e. For rework or repair, all compound bonds shall be 100 percent nondestructive pull tested in accordance with MIL-STD-883, method 2023.

f. A compound bond shall not be used to connect two wires.

g. All compound bonds shall meet the visual criteria in MIL-STD-883, method 2017.

3.7.2.5 Element replacement. Element replacement shall be permitted with the following limitations:

a. Any polymer attached element may be replaced two times at a given location on any device. Any element attached with polymer to metal other than substrate metallization (e.g., pedestals, ribs, carriers, etc.) may be replaced four times at a given location. Polymer attached tuning element replacements may be replaced four times at a given location.

b. Any metallic attached element may be replaced one time at a given location.

c. Any metallic attached element onto a plated tab where the tab is attached to a substrate with a higher temperature metallic attach process may be replaced two times.

d. Substrates may be removed, replaced, or put into a new package one time. This restriction does not apply to substrates attached into a package using mechanical fasteners.

3.7.2.6 Seal rework. The use of polymers to effect, improve, or repair any package seal shall not be permitted.

3.7.2.6.1 Lid seal rework. It shall be permissible to perform seal rework without delidding on hybrid microcircuits that fail fine leak testing one time, only if tracer gas is included during the original sealing operation and under all of the following conditions:

a. Fine leak testing, without pressurization (bomb), must be performed immediately after sealing prior to any other test.

b. Devices shall be stored in a nitrogen environment for a maximum of 4 hours between initial seal and reseal without replacing the cover.

c. Devices shall be submitted to a predetermined vacuum bake prior to reseal.

d. Solder sealed packages may not be reworked in accordance with this procedure.

NOTE: The above leak testing shall not be used as a substitute for the fine leak testing required in 4.5.10.

3.7.2.6.2 Other seal rework. It shall be permissible to rework other seals (e.g., feedthroughs, connectors, seal plugs, windows, etc.) at metal-to-metal interfaces on unlidded devices.

3.7.2.7 Delidding of devices. Hybrid microcircuits may be delidded and relidded for rework or repair provided the delid-relid procedures, controls, qualification plan, and resulting data are baselined and approved by the qualifying activity. Qualification of the delid-relid process shall be in accordance with 3.4.5.5.2. The number of delid-relid cycles allowed shall be in accordance with 3.7.2.7.1 or 3.7.2.7.2. Delid-relid history (i.e., traceability by lot number or serial numbers) shall be maintained by the hybrid manufacturer and shall be made available for acquiring or qualifying activity review upon request.

3.7.2.7.1 Solder sealed devices. Class H solder sealed devices may be delidded-relidded one time. Class K solder sealed devices may not be delidded-relidded.

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 two times, N = 2, maximum for class K.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to insure supplies and services conform to prescribed requirements. The Government also reserves the right to witness any of the tests and inspections set forth herein or in the device acquisition specification and to audit the data resulting from the manufacturer's performance of these examinations and tests. The responsible Government inspection agency shall be given adequate notification prior to the initiation of all tests and inspections. If a manufacturer elects to eliminate a QCI step or 100 percent screen step by substituting a SPC program (see 4.1.2.2), the manufacturer is only relieved of the responsibility of performing the QCI or 100 percent screen step.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of insuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.1.1 Quality assurance program. A quality assurance program shall be established in accordance with appendix A.

4.1.2 Inspection during manufacture. The manufacturer shall establish and maintain in-process production controls, quality controls, and inspections at appropriately located points in the manufacturing process in accordance with the procedures described in 30.1.1 of appendix A to assure continuous control of quality of materials, subunits, and parts during manufacture and testing. These controls and inspections shall be adequate to assure compliance with the applicable device acquisition specification and quality standards of hybrid microcircuits manufactured to this specification.

4.1.2.1 Control of critical processes and procedures. Critical processes and procedures shall be monitored in accordance with 4.4.

4.1.2.2 Statistical Process Control (SPC). The use of SPC is strongly encouraged. As a minimum, the SPC program should include training, definition of controlled critical processes, installation of statistical control techniques, and a control action system as defined by JESD19-88. Process control is recommended for (but not limited to) wirebonding, lid seal, lead trim, and final lead finishing (solder dip, etc.). When implemented as allowed by manufacturer's option in 4.1, the program shall be documented and approved by the qualifying activity. The implementing procedures shall provide for frequency, sample size, reject criteria, allowable rework, and disposition of failed product or lot. Also, a procedure is required for the traceability, recovery, and disposition of all devices manufactured since the last successful test in case of process failure. Records of process control shall be available for review. The use of SPC control charts is recommended.

4.1.2.3 Inspection verification for class K devices. Following each 100 percent visual inspection during assembly, trained quality control inspectors shall reinspect a sample of the materials, assemblies, or devices to the same criteria used for the 100 percent inspection. This requirement is waived if trained quality control inspectors perform 100 percent inspection at mandatory inspection points. Sampling will be to a sample size (accept number) of 22(0). Lots failing to meet the sample size (accept number) requirement shall be 100 percent reinspected and resampled to a sample size (accept number) of 32(0). This reinspection requirement shall not be applied to the 100 percent nondestructive bond pull test.

4.1.3 Control and inspection records. The manufacturer shall maintain objective evidence documenting that each lot has been subjected to all processing controls, inspections, and tests accomplished in accordance with sections 3 and 4 herein. Records shall be retained as specified in 30.1.1 of appendix A.

4.1.4 Configuration documents. The supplier shall upon request furnish device acquisition specification documentation to the acquiring activity. The documentation submitted for review, upon the request of the acquiring activity, shall include the current design, topography, schematic circuit, and related information.

4.1.5 Control and inspection of acquisition sources. The manufacturer shall be responsible for assuring that all supplies and services used in the manufacture and test of hybrid microcircuits conform to all the requirements of this specification, the device acquisition specification, and other provisions of the applicable device acquisition specification.

4.1.6 Test equipment and inspection facilities. All measurements for process control or product acceptance shall be made with instruments whose accuracy has been certified. Calibration shall be traceable to the National Institute of Standards and Technology (NIST). Calibration of measurement and test equipment and test standards which control the accuracy of inspection and test equipment and facilities shall be in accordance with MIL-STD-45662.

4.1.7 Manufacturer control over its distributors. The manufacturer shall be responsible for assuring that its distributors maintain adequate controls to assure that products sold are of the same quality as products acquired directly from the manufacturer.

4.1.8 Distributor inventory, traceability, and handling control. Distributors shall, as a minimum, maintain an adequate inventory control system, traceability documentation required by this specification and their appropriate certification, adequate handling, storage, ESD controls (see JEP-108), and repackaging methods to protect quality and prevent damage and degradation of products.

4.1.9 Government source inspection (GSI) for class K devices. When required by contract or purchase order, Government personnel and/or other Government designated representatives shall perform surveillance and monitoring functions related to inspection, assembly, and substrate fabrication from substrate lot acceptance through acceptance of the completed product. The mandatory inspection requirements will be performed or witnessed by the Government representative at designated manufacturing and test steps as depicted in the manufacturing or inspection flowchart. Adequate inspection stations shall be provided to the Government representative. These designated mandatory manufacturing and test steps are reflected in the procedures of section III, part 5 of DLAM 8200.2, and as a minimum shall include the following:

a. Review of substrate lot acceptance results.

b. Right to witness and analyze scanning electron microscope (SEM) photography, if applicable.

c. Perform visual inspection at preseal (at each power specified) on a sample basis unless 100 percent inspection is required by the applicable contract.

d. Surveillance of in-process bond strength test.

e. Surveillance of burn-in board checkout for circuit continuity.

f. Surveillance of group B tests.

g. Audit of documentation.

h. Surveillance of failure analysis, DPA activities, and the results and corrective actions related thereto, if applicable.

i. Surveillance of RHA tests, if applicable.

j. Surveillance of ESDS classification tests.

4.1.10 Procedure for lots held more than 36 months. Hybrid microcircuits held by manufacturers or authorized distributors for a period exceeding 36 months following the date of the inspection lot identification code, shall be reinspected by the manufacturer for all specified group A inspection requirements, prior to shipment. In case of lot failure during reinspection, the lot shall be subjected to 100 percent inspection for all tests in the subgroup failed and all hybrid microcircuits which fail any of these tests shall be removed from the lots and rejected. All reinspection lots with date codes of 8601 or later shall also be resubjected to and pass the solderability subgroup B-7 of table XIb (B-3 for method 5005 of MIL-STD-883.) The devices shall retain the original inspection lot identification code (see 3.6.3). Records of reinspection shall be maintained as specified in 30.1.2 of appendix A.

4.2 General inspection conditions. The general requirements of MIL-STD-883 shall apply.

4.2.1 Classification of examinations and tests. The examinations and tests required to assure conformance to the specified product assurance levels of hybrid microcircuits or lots thereof are classified as follows:

Title	Paragraph
Element evaluation	4.3 (see 3.4.2)
Screening	4.5 (see 3.4.4)
Qualification (QML-38534)	4.6 (see 3.4.5)
QCI	4.7 (see 3.4.6)
Data recording	4.7

4.2.2 Sampling. Statistical sampling for QCIs shall be in accordance with the sampling procedures of appendix B of this specification, and as specified in the acquisition document, device acquisition specification or drawing, as applicable. Reserve sample devices may be tested with the subgroups to provide replacements in the case of test equipment failure or operator error (see 4.2.5). These devices shall be used in predesignated order. Initial samples and samples used for resubmission shall be randomly selected from the inspection lot or sublot, as applicable.

4.2.2.1 Disposal of samples. Hybrid microcircuits subjected to destructive tests or which fail any test shall not be shipped on the contract or purchase order as acceptable product. They may, however, be delivered at the request of the acquiring activity if they are isolated from acceptable product, and clearly identified so as to prevent their being mistaken for acceptable product. Sample hybrid microcircuits from inspection lots which have passed product assurance inspection or tests and which have been subjected to mechanical or environmental tests classified non-destructive (see 4.2.2.3) or found to be nondestructive by repetitive testing (see 4.2.2.2), may be shipped as acceptable product provided they pass 100 percent external visual inspection in accordance with MIL-STD-883, method 2009, and 100 percent group A electrical tests in accordance with the applicable device acquisition specification.

4.2.2.2 Destructive tests. All mechanical or environmental tests (other than those listed in 4.2.2.3), shall be considered destructive initially, but may subsequently be considered nondestructive upon accumulation of sufficient data to indicate that the test is nondestructive. The accumulation of data from five repetitions of the specified tests on the same sample of product, without evidence of cumulative degradation or failure to pass the specified test requirements in any hybrid microcircuit in the sample, is considered sufficient evidence that the test is nondestructive. Any test specified as a 100 percent screen shall be considered nondestructive for the stress level and duration or number of cycles applied as a screen. Unless otherwise specified or subsequently determined to be otherwise, the following MIL-STD-883 tests shall be initially classified as destructive.

Internal visual and mechanical (method 2014) 1/
Bond strength (method 2011)
Solderability (except for lead finish A)
Moisture resistance
Lead integrity (method 2004)
Salt atmosphere
SEM inspection for metallization
Steady state life test (accelerated)
Die shear strength test
Total dose radiation hardness test
ESDS test
Lid torque test
Adhesion of lead finish
Vibration, variable frequency
Internal water vapor test 2/
Pin grid package lead pull (method 2028)

4.2.2.3 Nondestructive tests. Unless otherwise specified, the following tests are classified as nondestructive:

Barometric pressure
Steady state life (see note)
Intermittent life (see note)
Hermeticity
External visual
Internal visual (preseal)
Burn-in screen (see note)
Radiography
Particle impact noise detection (PIND)
Physical dimensions
Nondestructive bond pull test (method 2023)
Resistance to solvents
Solderability (for lead finish A only)

NOTE: When the test temperature exceeds the maximum specified junction temperature for the device (including maximum specified for operation or test), these tests shall be considered destructive unless otherwise specified.

4.2.3 Formation of lots. Hybrid microcircuits shall be segregated into identifiable production lots as defined in 3.1.3.21 as required to meet the production control and inspection requirements of appendix A. Hybrid microcircuits shall be formed into inspection lots as defined in 3.1.3.17 as required to meet the quality assurance inspection and test requirements of this specification.

1/ This inspection is nondestructive when performed at preseal visual.
2/ Test samples may be delidded and relidded in accordance with the rework provisions of 3.7.2 thereby making these devices eligible for shipment. The hybrid manufacturer shall assure that proper precautions for handling, testing, and shipping have been taken by the applicable Residual Gas Analysis (RGA) test laboratory.

4.2.3.1 Resubmission of failed lots. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. When any lot submitted for QCI fails any subgroup requirement of groups A, B, C, and D tests, it may be resubmitted once for that particular subgroup at double the sample size with zero failures allowed. A second resubmission using double the initial sample size with zero failures allowed is permitted only if failure analysis is performed to determine the mechanism of failure for each failed hybrid microcircuit from the prior submissions and it is determined that failure is due to:

a. A defect that can be effectively removed by rescreening the entire lot, or

b. Random type defects which do not reflect poor basic device design or poor basic processing procedures.

In all instances where analysis of the failed devices indicates that the failure mechanism is due to poor basic processing procedures, a basic design fault, or nonscreenable defects, the lot shall not be resubmitted.

4.2.4 Test method alternatives. Alternate test methods are allowed provided that it is demonstrated to the qualifying activity that such alternatives in no way relax the requirements of this specification and that they are approved before testing is performed. For proposed electrical test alternatives, schematic wiring diagrams of the test equipment shall be made available for checking by the acquiring activity. Electrical test and burn-in circuits shall be approved by the acquiring activity.

4.2.5 Procedure in case of test equipment failure or operator error. Whenever a hybrid microcircuit is believed to have failed as a result of faulty test equipment or operator error, the failure shall be entered in the test record which shall be retained for review along with a complete explanation verifying why the failure is believed to be invalid. When GSI is required, the Government quality assurance representative (QAR) shall be notified within one working day and given details from the test record and the opportunity to challenge the validity of the error claimed. If no challenge is made within the next working day, the error will be considered valid as recorded.

NOTE: ESD failures shall be counted as rejects and not attributed to equipment or operator error for screening, group A and end-point electrical tests of 4.5, 4.6, or 4.7 and MIL-STD-883, method 5005.

4.2.5.1 Procedure for sample tests. When it has been established that a failure is due to test equipment failure or operator error and it has been established that the sample device has been damaged or degraded, a replacement hybrid microcircuit from the same inspection lot may be added to the sample. The replacement hybrid microcircuit shall be subjected to all those tests to which the discarded hybrid microcircuit was subjected prior to its failure and to any remaining specified tests to which the discarded hybrid microcircuit was not subjected prior to its failure. The manufacturer, at his own risk, has the option of replacing the failed hybrid microcircuit and continuing with the tests before the validity of the test equipment failure or operator error has been established.

4.2.5.2 Procedure for screening tests. When it has been established that a lot failure during screening test is due to operator or equipment error and it has been established that the remaining product has not been damaged or degraded, the lot or surviving portion of the lot, as the case may be, may be resubmitted to the corrected screening test in which the error occurred. Failures verified as having been caused by test equipment failure or operator error shall not be counted in the PDA calculation (when applicable).

4.2.5.3 Failure and corrective action reports. When the procedures of 4.6.4.1 and 4.6.4.2 are utilized in continuing sample tests or resubmitting lots for screening tests, the manufacturer shall document the results of his failure investigations and corrective actions and shall make this information available to the Government QAR, the acquiring activity, or the qualifying activity, as applicable.

4.2.6 Failure analysis, class H. Failure analysis that is required by the device acquisition specification shall be in accordance with test method 5003, test condition A, of MIL-STD-883.

4.2.7 Failure analysis, class K. Class K devices shall be analyzed in accordance with test method 5003, test condition B, of MIL-STD-883 to identify the failure cause. The documented results shall be reported to the qualifying or acquiring activity, when requested.

4.2.8 Test equipment verification. The manufacturer shall define and utilize a method (e.g., correlation samples; diagnostic routines, etc.) to verify the measurement or operation characteristics of the electrical test equipment. When in use, electrical test equipment shall be verified at the start of a test run and after any physical changes to the test system (i.e., replacement of test equipment, etc.). When a test run exceeds one day, verification shall be accomplished at the end of the test run.

4.2.9 Manufacturer imposed tests. For class H, any manufacturer imposed tests (e.g., gross and fine leak) conducted after any screening tests, but prior to any qualification or quality conformance testing, are to be reported in both the qualification and quality conformance reports. The number of devices tested and the number of devices failed shall be included in the report. If any manufacturer imposed tests detect a problem, the manufacturer shall submit all devices in the lot to those tests to eliminate rejects and shall take steps to determine and eliminate the cause of failure (e.g., rough handling which has produced gross leaks).

4.3 Element evaluation. Table III provides a summary and guide to the tests and procedures for evaluating hybrid microcircuit elements.

4.3.1 General.

4.3.1.1 Sequence of testing. Subgroups within a group (table) of tests may be performed in any sequence, but individual tests within a subgroup shall be performed in the sequence indicated.

4.3.1.2 Sample selection. Samples shall be randomly drawn from inspection lots or in-line production samples as applicable. The sample size columns in the evaluation tables give minimum quantities to be evaluated with applicable accept number enclosed in parentheses.

4.3.1.3 Class requirements. Class K and class H element evaluation requirements are identified by X's in the appropriate column locations of evaluation tables.

4.3.1.4 Location of element evaluation. Element evaluation may be performed at the element supplier facility (or other facility approved by the hybrid device manufacturer) or at the hybrid device manufacturing facility.

TABLE III. Element evaluation summary.

Element	Paragraph	Table or MIL-STD-883, method
Microcircuit and semiconductor dice	4.3.2	See table IV
Passive elements	4.3.3	See table V
Saw elements	4.3.4	See table VI
Alternate ICD evaluation	4.3.5	N/A
Substrates	4.3.6	See table VII
Packages	4.3.7	See table VIII
Adhesives	4.3.8	Method 5011

4.3.1.5 Characteristics. Characteristics to be verified shall be those necessary for compatibility with the element acquisition documents and assembly procedures and at least those which cannot be verified after assembly, but could cause functional failure.

4.3.1.6 Protection from electrostatic discharge. Suitable handling precautions and grounding procedures shall be taken to protect ESDS elements from accidental damage.

4.3.1.7 Electrical test specifications. Electrical test parameters, values, limits (including deltas when applicable), and conditions shall be specified in the element acquisition documents.

4.3.2 Microcircuit and semiconductor dice. Microcircuit and semiconductor dice from each wafer lot shall be evaluated in accordance with table IV and 4.3.2.1 through 4.3.2.7.2. For class H devices, element evaluation testing is not required for JANC discrete semiconductors which have been tested in accordance with MIL-S-19500, appendix H.

4.3.2.1 Subgroup 1, 100 percent electrical test of dice. Each die shall be electrically tested, which may be done at the wafer level provided all failures are identified and removed from the lot when the dice are separated from the wafer. Electrical testing shall as a minimum include static testing at +25°C (see group A, table XI, subgroup 1 for microcircuits and MIL-S-19500, group A, subgroup 2 for semiconductors).

4.3.2.2 Subgroup 2, 100 percent visual inspection of dice. Each die shall be visually inspected to assure conformance with the applicable die related requirements of MIL-STD-883, method 2010; MIL-STD-750, methods 2072 and 2073; and the element acquisition documents.

4.3.2.3 Sample evaluation of assembled dice.

4.3.2.3.1 Test samples. A sample of dice from each wafer lot shall be evaluated in accordance with table IV, subgroups 3 through 7 as applicable, and 4.3.2.3.2 through 4.3.2.7.2.

4.3.2.3.2 Test sample preparation. Test samples shall be assembled into suitable packages such that the assembly methods and conditions the element will see during normal production assembly will be simulated.

4.3.2.4 Subgroups 3 and 4.

4.3.2.4.1 Sample size. The class K sample shall consist of 3 die from each wafer and a total of at least 10 die from each wafer lot. The class H sample shall consist of at least 10 die from each wafer lot.

4.3.2.4.2 Internal visual. Each sample shall be visually inspected after assembly to assure conformance with the applicable requirements of MIL-STD-883, method 2010; MIL-STD-750, methods 2072 and 2073; and the element acquisition documents.

4.3.2.4.3 Electrical test. For interim, post burn-in, and final electrical tests, the minimum requirements for microcircuits and semiconductor dice shall include static tests at each of the following:

a. +25°C.

b. Maximum rated operating temperature.

c. Minimum rated operating temperature.

NOTE: Final electrical tests satisfy end point electrical test requirements specified in preceding test methods and need not be repeated.

4.3.2.5 Subgroup 5.

4.3.2.5.1 Sample size. From each wafer lot, a sample of at least 5 die requiring 10 bond wires minimum shall be selected.

4.3.2.5.2 Wire bond strength testing. For wire bond strength testing:

a. A minimum of 10 wires consisting of die-to-package, die-to-die, or die-to-substrate bonds shall be destructively pull tested. An equal number of bonds shall be tested on each sample die.

b. For beam lead and flip-chips, five dice shall be tested.

c. The die metallization shall be acceptable if no failure occurs. If only one wire bond fails, another sample shall be selected in accordance with 4.3.2.5.1 and subjected to subgroup 5 evaluation. If the second sample contains no failures, the bonding test results are acceptable and the lot of dice is acceptable. If the second sample contains one or more failures, or if more than one failure occurs in the first sample, the lot of dice shall be rejected.

d. The rejected wafer lot may be resubmitted to subgroup 5 evaluation if the failure was not due to defective die metallization.

4.3.2.6 Subgroup 6, scanning electron microscope (SEM).

4.3.2.6.1 Sample selection and reject criteria. Sample selection and reject criteria shall be in accordance with MIL-STD-883, method 2018. Alternatively, SEM testing may be performed on a sample of eight randomly selected dice from each wafer. In cases when dice are very large and comprise a large area of the wafer, the qualifying activity may approve other alternate sample selection plans.

4.3.2.7 Subgroup 7, radiation testing.

4.3.2.7.1 Class K sample size. The class K sample requires 3 dice from each wafer and a minimum of 10 dice from each wafer lot.

4.3.2.7.2 Radiation testing requirement. Radiation testing is required when applicable to the microcircuit device.

a. For dose rate and latchup, photo current and latch-up effects are functions of circuit configurations and thus should be simulated during tests.

b. The sample shall be equally divided between MIL-STD-883, methods 1017 and 1019.

4.3.3 Passive elements. Passive elements from each inspection lot shall be evaluated in accordance with table V and 4.3.3.1 through 4.3.3.6. This evaluation is not required when the elements are acquired from the Established Reliability series of military specifications and the element meets or exceeds the evaluation requirements of this specification and is listed on the QPL.

4.3.3.1 Subgroup 1, 100 percent electrical test of passive elements. Each passive element shall be electrically tested at +25°C as specified in the element acquisition documents.

4.3.3.2 Subgroup 2, visual inspection of passive elements. Passive elements shall be visually inspected to assure conformance with the applicable passive element related requirements of MIL-STD-883, method 2032, and the passive element acquisition documents.

a. Each class K passive element shall be visually inspected.

b. Class H elements shall be sample inspected using a sample size and (accept number) of 22 (0).

4.3.3.3 Test sample preparation for subgroups 3 and 4.

a. For class H and K passive elements, when assembly is required to perform electrical tests, test samples shall be assembled into suitable packages such that the assembly methods and conditions the element will see during normal assembly will be simulated.

b. The total test sample shall contain at least 20 wire bonds (an equal number on each element) if wire bonding assembly is applicable.

TABLE IV. Microcircuit and semiconductor dice evaluation requirements.

Subgroup	Class K	Class H	Test	MIL-STD-883 Method	MIL-STD-883 Condition	Quantity (accept number)	Reference paragraph
1	x	x	Element electrical			100 percent	4.3.2.1
2	x	x	Element visual	2010 2072 1/ 2073 1/		100 percent	4.3.2.2
3	x	x	Internal visual	2010 2072 1/ 2073 1/		10 (0)	4.3.2.3 4.3.2.4.2
4	x		Stabilization bake	1008	C	10 (0)	4.3.2.3
	x		Temperature cycling	1010	C		
	x		Mechanical shock or Constant acceleration	2002 2001	B, Y1 direction A, 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.

4.3.3.4 Sample electrical test of passive elements. Sample passive elements shall be electrically tested at +25°C for the following characteristics (minimum):

a. Resistors: DC resistance.

b. Capacitors:

(1) Ceramic type: Dielectric withstanding voltage, insulation resistance, capacitance, and dissipation factor.

(2) Tantalum type: DC leakage current, capacitance, and dissipation factor.

(3) Metal insulation semiconductor type (MIS): DC leakage current, capacitance, dielectric withstanding voltage.

c. Inductors: DC resistance, inductance, and Q.

4.3.3.5 Visual examination. Elements shall be visually examined for evidence of corrosion or damage attributable to the test and conditioning sequence.

4.3.3.6 Wire bond strength testing. Wire bond strength testing applies to elements which are wire bonded during the hybrid microcircuit device assembly operation. The sample shall include at least 5 elements and 10 bond wires minimum.

a. At least 10 wires, consisting of element-to-substrate, element-to-package, or element-to-element bonds shall be destructively pull tested. An equal number of bonds shall be tested on each sample element.

b. The element metallization shall be acceptable if no failure occurs. If only one wire bond fails, a second sample shall be selected and subjected to the test in accordance with 4.3.3.6a. If the second sample contains no failures, the bonding test results and the element lot are acceptable. If the second sample contains one or more failures, or if more than one failure occurs in the first sample, the element lot shall be rejected.

c. The element inspection lot may be resubmitted to evaluation if the failure was not due to defective element metallization.

4.3.4 Surface acoustic wave (SAW) element evaluation. SAW elements shall be evaluated in accordance with table VI and 4.3.4.1 through 4.3.4.3.

4.3.4.1 RF probe test. Each SAW element shall be RF probe tested as specified in the detail/acquisition specification. This RF probe test may be done at the wafer level provided all failures are identified and removed from the lot when the elements are separated from the wafer. RF probe testing shall be performed at +25°C unless otherwise specified by the detail/acquisition specification.

4.3.4.2 Visual inspection. Each SAW element shall be visually inspected to assure conformance with the requirements of MIL-STD-883, method 2032, 3.4.

4.3.4.3 Wire bond evaluation. From each inspection lot of SAW elements, a randomly selected sample of at least two elements shall be evaluated for wire bond pull strength. A minimum of 10 wires shall be destructively pull tested in accordance with MIL-STD-883, method 2011. The SAW element metallization shall be acceptable if no failure occurs. If only one wire fails, another sample shall be selected and a minimum of 10 wires shall be destructively pull tested in accordance with method 2011. If the second sample contains one or more failures, or if more than one failure occurs in the first sample, the lot of SAW elements shall be rejected. The rejected lot may be resubmitted to wire bond evaluation if the failure was not due to defective metallization. With acquiring activity approval, destructive bond pull tests may be performed on test coupons which provide the specified test requirements. Test coupons must be processed with the same element production lot.

TABLE V. Passive element evaluation requirements.

Subgroup	Class		Test	MIL-STD-883		Quantity (accept number)	Reference paragraph
	K	H		Method	Condition		
1	x	x	Element electrical			100 percent	4.3.3.1
2	x		Visual inspection	2032		100 percent	4.4.3.2
		x		2032		22(0)	4.4.3.2
3	x		Stabilization bake	1008	C	10 (0)	4.3.3.3
	x		Temperature cycling	1010	C		
	x		Mechanical shock	2002	B, Y1 direction		
			or				
	x		constant acceleration	2001	A, Y1 direction		
	x		voltage conditioning				4.3.1.7
			or				
	x		aging (capacitors)				
	x		Visual inspection	2017			4.3.3.5
	x	x	Electrical				4.3.3.4
4	x	x	Wirebond evaluation	2011		10(0) wires or 20(1) wires	4.3.3.3 4.3.3.6

4.3.5 Alternate Integrated Circuit Die (ICD) Evaluation. Alternate ICD evaluation shall be used only in cases where complex ICD testing is impractical outside the actual end item (i.e., hybrid microcircuit). The ICD sample built into hybrids must successfully complete evaluation prior to release of the balance of the incoming lot. Acquiring activity approval must be obtained prior to implementation of this alternate procedure. In lieu of packaged element evaluation tests in accordance with 4.3.2, 4.3.3, and 4.3.4 ICD's may be assembled into hybrid microcircuits and acceptance of these elements shall be based on the ability of the hybrid microcircuit to meet all group A, subgroups 1, 2, and 3 (plus 4, 7, and 9 as applicable) electrical tests required for the hybrid microcircuit. A minimum of 10 ICD's (0 defects) shall be assembled into at least 3 hybrid microcircuit devices. Hybrid microcircuit devices assembled for the purpose of element evaluation are deliverable provided all of the provisions of this specification are met. Element wire bond evaluation for ICD's may be accomplished using a second or additional sample of elements wire bonded for that purpose only. When the hybrid microcircuit build option for ICD evaluation is selected, the manufacturer shall establish and maintain a sample plan or procedure to identify the sample prior to electrical test. In case of lot failure when alternative ICD evaluation is used, all of the hybrid samples and the ICD inspection lot shall be rejected. When the manufacturer chooses to analyze the failed hybrids to isolate the cause of failure and this analysis determines that the cause of failure is not related to the ICD being tested and that the ICD has been correctly stressed during the required screening and testing, then the ICD inspection lot may be accepted. If the ICD has not been correctly stressed, the failed hybrid device may be reworked or new sample replacement hybrids may be assembled.

TABLE VI. SAW element evaluation requirements.

Subgroup	Class K	Class H	Test	MIL-STD-883 Method	MIL-STD-883 Condition	Quantity	Reference paragraph
1	x	x	RF electrical probe			100 percent	4.3.4.1
2	x	x	Visual inspection	2032		100 percent	4.3.4.2
3	x	x	Wire bond evaluation	2011		10 (0) wires or 20 (1) wires	4.3.4.3

4.3.6 Substrate evaluation. Substrates shall be evaluated in accordance with table VII and 4.3.6.1 through 4.3.6.5.3.3.

NOTE: Substrates fabricated by the hybrid device manufacturer using a MIL-STD-1772 qualified process, shall be exempt from this evaluation.

4.3.6.1 Definition. For the purpose of substrate evaluation, a substrate inspection lot shall consist of homogeneous substrates having the same number of layers, manufactured using the same facilities, processes, materials, and vacuum deposited, plated or printed as one lot.

4.3.6.2 Electrical test parameters. Electrical test parameters, values, limits, and conditions shall be as specified in the applicable detail/acquisition specification.

4.3.6.3 Subgroup 1, 100 percent electrical testing. Each substrate shall be electrically tested at +25°C, if and as specified in the applicable detail/acquisition specification.

4.3.6.4 Subgroup 2, 100 percent visual inspection. Each substrate shall be visually inspected to assure conformance with the applicable requirements of MIL-STD-883, method 2032, and the applicable detail/acquisition specification.

4.3.6.5 Subgroups 3, 4, and 5 general requirements. From each inspection lot of substrates, a randomly selected sample shall be evaluated. With acquiring activity approval, destructive tests may be performed on test coupons which provide the required test data. The test coupons must be made with the same materials that were used in the manufacturing of the inspection lot and processed at the same time as the inspection lot.

4.3.6.5.1 Subgroup 3. A minimum of five samples shall be submitted to subgroup 3 testing.

4.3.6.5.1.1 Physical dimension. Inspect in accordance with MIL-STD-883, method 2016, and the applicable detail/acquisition specification.

4.3.6.5.1.2 Visual inspection. Inspect in accordance with MIL-STD-883, method 2032, and the applicable detail/acquisition specification.

4.3.6.5.1.3 Electrical. Substrates shall be electrically tested at +25°C for the following characteristics (minimum). Requirements shall be as specified in the applicable detail/acquisition specification.

a. Resistors: DC resistance.

b. Capacitors: Capacitance. If specified in the applicable detail/acquisition specification, test for dielectric withstanding voltage, insulation resistance, and dissipation factor.

c. For multilayered substrates, continuity and isolation testing shall be performed to verify the interconnection of conductors as specified in the applicable detail/acquisition specification.

4.3.6.5.2 Subgroup 4. A minimum of three samples that have been subjected to, and passed, subgroup 3 testing shall be submitted to subgroup 4 testing.

4.3.6.5.2.1 Conductor thickness. Measure conductor thickness in accordance with the applicable detail/acquisition specification. Conductor thickness shall meet the requirements specified in the applicable detail/acquisition specification.

4.3.6.5.2.2 Conductor resistivity. Measure conductor resistivity in accordance with the applicable detail/acquisition specification. Conductor resistivity shall meet the requirements specified in the applicable detail/acquisition specification.

4.3.6.5.2.3 Film adhesion. Perform film adhesion testing in accordance with MIL-STD-977, method 4500. The substrate and tape shall show no evidence of peeling or flaking of metallization.

4.3.6.5.2.4 Solderability. For solderable substrates only, perform solderability testing if specified in the applicable detail/acquisition specification in accordance with the applicable detail/acquisition specification.

4.3.6.5.3 Subgroup 5. A minimum of two samples that have been subjected to, and passed, subgroup 3 testing shall be submitted to subgroup 5 testing.

4.3.6.5.3.1 Temperature coefficient of resistance (TCR): When specified in the applicable detail/acquisition specification, perform TCR testing for resistors in accordance with MIL-STD-202, method 304. TCR shall meet the requirements specified in the applicable detail/acquisition specification.

a. Thick film type: Test as a minimum, two resistors from each resistor paste sheet resistance value. One from the smallest and one from the largest area resistors at -55°C using a reference reading at +25°C, or temperatures as specified in the detail/acquisition specification.

b. Thin film type: Test as a minimum, the highest value resistor at +125°C using a reference reading at +25°C or temperatures as specified in the detail/acquisition specification.

c. If specified in the applicable detail/acquisition specification, TCR tracking testing shall be performed. TCR tracking shall meet the requirements specified in the applicable detail/acquisition specification.

4.3.6.5.3.2 Wire bond strength testing. For wire bondable substrates, perform wire bond strength testing in accordance with MIL-STD-883, method 2011. The sample shall include at least 2 substrates and 10 bond wires minimum. For gold metallized class K substrates that at the hybrid level are intended to contain aluminum wire bonds, aluminum wires shall be placed as specified in the detail/acquisition specification and these wire bond samples shall be baked for 1 hour at +300°C in either an air or an inert atmosphere prior to the performance of wire bond strength testing.

a. At least 10 wires, consisting of substrate to substrate bonds, shall be destructively pull tested. An equal number of bonds shall be tested on each sample substrate.

b. The substrate metallization shall be acceptable if no failure occurs. If only 1 wire bond fails, a second sample of a minimum of 20 wires shall be prepared using the same wire type/size and the same type equipment as the failed bond(s). If the second sample contains one or more failures, or if more than one failure occurs in the first sample, then the substrate inspection lot shall be rejected.

c. The substrate inspection lot may be resubmitted to evaluation if the failure(s) was not due to defective substrate metallization.

TABLE VII. Substrate evaluation requirements.

Subgroup	Class K	Class H	Test	MIL-STD-883 Method	MIL-STD-883 Condition	Quantity (accept number)	Reference paragraph
1	x	x	Electrical testing			100 percent	4.3.6.3
2	x	x	Visual inspection	2032		100 percent	4.3.6.4
3	x	x	Physical dimensions	2016		5 (0)	4.3.6.5.1.1
	x	x	Visual inspection	2032			4.3.6.5.1.2
	x	x	Electrical				4.3.6.5.1.3
4	x	x	Conductor thickness or conductor resistivity			3 (0)	4.3.6.5.2.1 or 4.3.6.5.2.2
	x	x	Film adhesion test				4.3.6.5.2.3
	x	x	Solderability				4.3.6.5.2.4
5	x	x	TCR			2 (0)	4.3.6.5.3.1
	x	x	Wire bond evaluation	2011		10 wires (0) 30 wires (1)	4.3.6.5.3.2
	x	x	Die shear evaluation	2019		2 (0)	4.3.6.5.3.3

4.3.6.5.3.3 Die shear strength testing. Perform shear strength testing in accordance with MIL-STD-883, method 2019. At least two die per substrate shall be attached and tested for each die attachment method, as specified in applicable detail/acquisition specification. If a failure occurs at less than the specified force and is not due to defective substrate materials, the lot shall be resubmitted to die shear evaluation and the failure mode documented.

4.3.7 Package evaluation. Package cases or covers shall be evaluated in accordance with table VIII and 4.3.7.1 through 4.3.7.5. In addition, laser marked surfaces shall be subjected to and pass subgroups 3, 5, and 6.

4.3.7.1 Definition. For the purpose of package evaluation, a package inspection lot shall consist of homogeneous cases or covers of the same package type and outline dimensions (may differ only in lead length and lead count); manufactured using the same facilities and processes; and plated as one lot (if plating is applicable).

4.3.7.2 General.

a. From the initial package inspection lot, a randomly selected sample shall be subjected to package evaluation.

b. Subgroups 1, 2, and 3 of table VIII shall be accomplished for each lot. The remainder of table VIII shall be accomplished periodically at intervals not exceeding 6 months for additional package inspection lots, except as noted in 4.3.7.5 herein.

c. Subgroups 2, 3, and 4 of table VIII apply to cases only. A quantity (accept number) of 15 (0) shall apply to the number of terminals or leads to be tested. The leads shall be randomly selected from three packages minimum.

4.3.7.3 Subgroup 1. Separately verify case and cover dimensional compliance with the element acquisition documents.

4.3.7.4 Subgroup 4. For metal cases with leads separated by an insulator, measure insulation resistance between the metal body of the case and the leads that are isolated from the case. This test does not apply to non-metallic cases. This test shall be performed at 6-month intervals unless a change in insulator material is made for class H devices and on every incoming lot for class K devices.

4.3.7.5 Subgroups 5 and 6. Separately verify case and cover for compliance with subgroups 5 and 6. Corrosion in the internal cavity area shall not be cause for rejection. This test shall be performed one time only for class H and at 6-month intervals for class K unless a change in material or plating is made.

TABLE VIII. Package evaluation requirements.

Subgroup	Class K	Class H	Test	MIL-STD-883 Method	MIL-STD-883 Condition	Quantity (accept number)	Reference paragraph
1	x	x	Physical dimensions	2016		3 (0)	4.3.7.3
2	x	x	Solderability	2003	Soldering temperature +245°C ±5°C	3 (0)	4.3.7.2c
3	x	x	Thermal shock	1011	C	3 (0)	4.3.7.2
	x	x	High temperature bake	1008	1 hour at +150°C		
	x	x	Lead integrity	2004	B2 (lead fatigue)		
					D (leadless chip carriers)		
				2028	(Pin grid array leads and rigid leads)		
	x	x	Seal	1014	A4 Unlidded cases		
4	x	x	Metal package isolation	1003	600 V dc 100 nA maximum	3 (0)	4.3.7.4
5	x	x	Moisture resistance	1004		5 (0)	4.3.7.5
6	x	x	Salt atmosphere	1009	A	5 (0)	4.3.7.5

4.3.8 Adhesive evaluation. The polymeric adhesives used in hybrid microcircuit applications shall be subjected to and pass the evaluation procedures detailed in MIL-STD-883, method 5011.

4.4 Process control. The indicated processes shall be controlled in accordance with table IX and 4.4.1 through 4.4.2.

TABLE IX. Process control summary.

Operation	Class		MIL-STD-883		Paragraph
	K	H	Method	Condition	
Wire bonding	x x	x x	2011 2023		4.4.1
Seal	x		1014	A, 1×10^{-8} atm/cc He	4.4.2

4.4.1 Wire bonding.

4.4.1.1 General. A process machine operator evaluation shall be performed:

a. When a machine is put into operation.

b. Periodically while in operation, not to exceed 4 hours.

c. When the operator is changed. Change of certified auto wirebond operators is allowed if all other machine conditions for evaluation are maintained.

d. When any machine part has been changed.

e. When any machine adjustment of the process parameters has been made.

f. When the spool of wire is changed.

g. When a new device type is started (unless the machine was evaluated using test samples that also simulate the new device type, see 4.4.1.2).

4.4.1.2 Standard evaluation circuit (test coupon or test vehicle). Standard evaluation circuits (test coupons or test vehicles) that simulate the production device may be destructively evaluated in lieu of the product.

4.4.1.3 Process machines. Process machines not meeting the evaluation requirements shall not be used.

4.4.1.4 Corrective action of process machine. A process machine may be returned to operation only after appropriate corrective action has been implemented and the machine has been evaluated and passed testing in accordance with table IX as required.

4.4.1.5 Data record. A data record shall be maintained and identifiable to each machine, operator, shift, and date of test.

4.4.1.6 Wire bonding.

4.4.1.6.1 Process machine/operator evaluation. Sample wires from three devices shall be destructively pull tested in accordance with MIL-STD-883, method 2011 and as follows:

a. Class H devices: A minimum of 10 wires total consisting of wire bonds to elements typical of device assembly operation shall be tested.

b. Class K devices: A minimum of 15 wires from each device 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.

c. Requirements classes H and K: Evaluation results are acceptable if no failure occurs at less than the value given in table I of MIL-STD-883, method 2011. If any of the sample wires fail, the machine/operator shall be deactivated and corrective action taken. When a new sample has been prepared, tested, and has passed this procedure, the machine/operator has been certified or recertified, it can be returned to service.

4.4.1.6.2 Lot sample bond strength. From each wire bonding lot, a sample of at least two devices shall be nondestructively tested in accordance with MIL-STD-883, method 2023. This requirement does not apply to devices that are 100 percent nondestructively tested. Alternately, destructive pull testing in accordance with method 2011 may be performed. Devices with known visual wire bonding rejects shall not be excluded from this sample.

a. A wire bonding lot consists of devices that are consecutively bonded using the same setup and wire, by one machine/operator (operator changes are allowed for autobonders) during the same period not to exceed 4 hours.

b. In each sample device, at least 15 wires shall be tested, including 1 wire from each type of transistor, diode, capacitor, and resistor chips, 3 wires from each type of integrated circuit, and 5 wires connecting package leads, as applicable. If there are less than 15 wires in the device, all wires shall be tested. Sample devices shall be inspected for lifted wires. Lifted wires resulting from bond pull testing shall be counted as nondestruct pull test failures.

c. The wire bonding lot shall be acceptable if no failure occurs. If one wire/bond fails, another sample of two devices shall be selected and 100 percent nondestructively tested. If the second sample contains no failures, the wire bonding lot is acceptable. If the second sample also contains failure(s), or more than one wire/bond fails in the first sample, the bonding machine/operator shall be removed from the operation.

d. The failures shall be investigated and appropriate corrective action shall be implemented. The machine/operator shall be recertified in accordance with 4.4.1.6.1 before being returned to operation. All devices bonded since the previous certification (lot sample bond strength test) shall be subjected to 100 percent nondestructive bond strength testing (class H).

e. For RF/microwave devices, test sample circuits that simulate the production device may be destructively evaluated in lieu of the product (see 4.4.1.2). When test sample circuits are used, the data from this test shall be used for SPC monitoring of the process/product.

4.4.2 Seal testing. All class K devices shall receive fine leak testing, without pressurization (bomb) immediately after sealing and prior to any other test. Class K devices are sealed with a minimum 10 percent helium tracer gas atmosphere (see 3.5.1). If a failure occurs, the lid seal rework requirements of 3.7.2.6.1 shall be followed.

4.5 Device screening. Each hybrid microcircuit shall be subjected to and pass all of the applicable screening tests and inspections in accordance with the following:

a. Option 1 and 2 devices: Table X and 4.5.1 through 4.5.11.

b. Option 3 devices: MIL-STD-883, method 5004 except methods 2017 and 2032 shall replace method 2010.

4.5.1 General.

a. Additional tests and inspections may be performed where experience indicates justifiable concern for specific quality characteristics.

b. Electrical test parameters, values, limits (including deltas), and conditions shall be as specified on the acquisition document.

c. All devices that fail any test criterion in the screening sequence shall be removed from the lot at the time of observation or immediately at the conclusion of the test in which the failure was observed.

d. When PDA, pattern failure, or delta limits have been specified or other conditions for lot acceptance have been imposed, the required data shall be recorded and maintained as a basis for lot acceptance.

e. Once rejected and verified as a device failure, rework and subsequent rescreening in accordance with the limitations of 3.7.2 may be performed.

4.5.2 Preseal burn-in test Preseal burn-in is optional, and performance requires the approval of the acquiring activity.

4.5.3 Nondestructive bond pull test for class K Devices. Nondestructive 100 percent bond pull test shall be performed for class K devices. The total number of failed wires and the total number of devices failed shall be recorded. The lot shall have a PDA of 2 percent or one wire, whichever is greater based on the number of wires pulled in the wire bond lot or production lot. Failed lots may be resubmitted one time to 100 percent nondestructive bond pull test with a tightened PDA of 1.5 percent. The test shall be performed in accordance with MIL-STD-883, method 2023. Devices from lots which have been subjected to the nondestructive 100 percent bond pull test and have failed the specified class K PDA requirement shall not be delivered as class H product.

4.5.4 Internal visual inspection. Devices awaiting preseal inspection and accepted devices awaiting further processing shall be stored in a dry, controlled environment until sealed as specified in MIL-STD-883, method 2017.

4.5.5 Visual inspection for damage. The manufacturer may inspect for damage after each thermal or mechanical screening step, or at any subsequent time in the screening sequence.

4.5.6 Particle impact noise detection (PIND) test. When approved by the acquiring activity, PIND testing shall not apply to devices with internal conformal coating. PIND shall be performed in accordance with test method 2020 of MIL-STD-883, condition A or B. The lot may be accepted on any of the five runs if the percentage of defective devices is less than 1 percent (or one device, whichever is greater). All defective devices shall be removed after each run. Lots which do not meet the 1 percent PDA on the fifth run, or exceed 25 percent defectives cumulative, shall be rejected.

4.5.7 Preburn-in electrical test.

a. Preburn-in electrical testing is optional except when delta limit measurements are required. However, devices may be tested to remove defects prior to further screening and to form a basis for application of PDA criteria.

b. This test need not include all device parameters, but shall include those measurements most sensitive to and effective in removing electrically defective devices.

c. When delta limits are specified in the device acquisition specification, the measurements shall be recorded, and traceability shall be maintained from the device to the corresponding electrical test data.

4.5.8 Burn-in. Burn-in shall be performed on each device.

4.5.8.1 General.

a. Preburn-in (interim burn-in for class K) and post burn-in electrical parameters as specified in the device acquisition specification shall be measured.

b. Burn-in electrical conditions shall be as specified in the device acquisition specification.

c. Delta measurements shall be made on parameters specified in the device acquisition specification.

4.5.8.2 Burn-in period.

a. Class K devices shall be burned-in in accordance with the time-temperature regressions specified in MIL-STD-883, method 1015. The burn-in time shall be equally divided into two successive burn-ins. Interim electrical tests in accordance with the device acquisition specification shall be performed after the first burn-in to determine acceptable devices for the second burn-in.

b. Class H devices shall be burned-in in accordance with the time-temperature regressions specified in MIL-STD-883, method 1015.

4.5.8.3 Failure analysis of burn-in screen failures for class K devices. Catastrophic failures (e.g., shorts or opens measurable or detectable at +25°C) after burn-in shall be analyzed. Analysis of catastrophic failures may be limited to a quantity and degree sufficient to establish failure mode and cause. Failure analysis results shall be documented and available to the Government representatives.

4.5.8.4 Lots resubmitted for burn-in. Burn-in lots that do not exceed twice the allowable PDA may be resubmitted for burn-in one time only. Resubmitted lots shall be kept separate from new lots and shall be inspected for all specified characteristics using a tightened inspection PDA equal to the next lower number in the PDA series (see appendix B). The number of pattern failures allowed shall be the same as required for the original burn-in.

4.5.8.5 Burn-in acceptance criteria. At the option of the manufacturer, burn-in acceptance shall be based on PDA or pattern failures. Either option or both may be applied to a burn-in lot as acceptance criteria (i.e., if a lot exceeds PDA requirements, then pattern failure analysis may be used to determine if the lot is acceptable).

TABLE X. Device screening.

Test inspection	MIL-STD-883		Requirements		Reference paragraph
	Method	Condition	Class K	Class H	
Preseal burn-in	1030		Optional	Optional	4.5.2
Nondestructive bond pull	2023		100 percent	N/A	4.5.3
Internal visual	2017		100 percent	100 percent	4.5.4
Temperature cycling or thermal shock	1010 1011	C A, minimum	100 percent N/A	100 percent or 100 percent	4.5.5
Mechanical shock or constant acceleration	2002 2001	B, (Y1 direction only) A, (Y1 direction only)	100 percent or 100 percent	100 percent or 100 percent	4.5.5
PIND	2020	A or B	100 percent	N/A	4.5.6
Electrical	In accordance with applicable device specification		100 percent	Optional	4.5.7
Burn-in	1015		100 percent	100 percent	4.5.8
Final electrical test	In accordance with applicable device specification		100 percent	100 percent	4.5.9
Seal a. Fine b. Gross	1014		100 percent	100 percent	4.5.10
Radiographic	2012		100 percent	N/A	
External visual	2009		100 percent	100 percent	4.5.11

4.5.8.5.1 General. Pattern failures are multiple device failures within a device burn-in lot with the same root cause of failure. The manufacturer shall determine and document, prior to beginning burn-in, the criteria for the formation of burn-in lots (e.g., devices submitted to burn-in at one time, a production lot, or an inspection lot) for the purposes of PDA calculation. The burn-in lot shall be ≥ 41 devices or all devices submitted to burn-in during a 1-week period, whichever is less. The manufacturer shall not conduct burn-in in addition to that specified. Delta limits shall be defined in the device acquisition specification when required. When the PDA or pattern failures applies to delta limits, the delta parameter values measured after burn-in (100 percent screening test) shall be compared with the delta parameter values measured prior to that burn-in. Unless otherwise specified in the device acquisition specification, PDA, and pattern failure analysis shall be applicable only to +25°C static tests (group A, subgroup 1).

4.5.8.5.2 PDA option.

4.5.8.5.2.1 PDA class H. For class H, the PDA shall be 10 percent or one device, whichever is greater, regardless of burn-in lot size.

4.5.8.5.2.2 PDA class K. For class K, the PDA shall be 2 percent or one device, whichever is greater, regardless of burn-in lot size. Class K PDA shall be calculated on failures occurring during the second half of burn-in only.

4.5.8.5.3 Pattern failure option.

4.5.8.5.3.1 Pattern failure option, class H. For class H devices, when acceptance is based on pattern failures, all multiple device static failures at +25°C must be analyzed to determine root cause. Multiple device failures with the same root cause (three or more depending on lot size) shall be considered a "failure pattern". If a failure pattern is established, the lot shall be rejected; otherwise, the lot shall be accepted regardless of PDA. In all cases, lots with device failures that do not exceed the PDA are acceptable and do not require pattern failure analysis. The number of device failures with the same root cause that establish a failure pattern shall be based on lot size, as follows:

Lot size (x)	Number of failures that establish a pattern
$x \leq 20$	3
$21 \leq x \leq 40$	4
$40 < x \leq 100$	5
$100 < x \leq 300$	6
$300 < x \leq 500$	11
$500 < x$	16

Example 1: Lot size is 25 with 4 device static failures at +25°C.

- o If all 4 device failures do not have the same root cause of failure (i.e., 3 or less failures with the same root cause), then no "failure pattern" exists and the passing 21 devices are acceptable.
- o If all 4 failures have the same root cause of failure, then a "failure pattern" exists and the lot should be rejected.

Example 2: Lot size is 400 with 15 device static failures at +25°C.

- o The lot is acceptable (i.e., 10 percent PDA allows 40 device failures).

Example 3: Lot size 400 with 41 device static failures at +25°C.

- o If 10 or less of the device failures are due to the same root cause, then a "failure pattern "does not exist and the lot is acceptable.
- o If 11 or more of the device failures are due to the same root cause, then a "failure pattern" has been established and the lot is unacceptable.

4.5.8.5.3.2 Pattern failure option, class K. For class K, when acceptance is based on pattern failures, all multiple device static failures at +25°C must be analyzed to determine root cause. The lot shall be stopped and placed on hold if:

a. any two device failures within the burn-in lot have the same root cause of failure (i.e., pattern failure established), or

b. the total number of device failures in the burn-in lot exceeds 5 percent.

The lots may be reworked and recovered if the failure is due to:

a. a defect that can be effectively removed by rescreening the entire burn-in lot or,

b. random type defects which do not reflect poor basic device design or poor basic processing procedures.

In all instances where analysis of the failed devices indicates that the failure mechanism is due to poor basic processing procedures, a basic design fault, or nonscreenable defects, the lot shall be rejected.

4.5.9 Final electrical test.

a. Final electrical testing shall include all parameters, limits, and conditions of test which are specifically identified in the device acquisition specification as final electrical test requirements. As a minimum, final electrical testing shall include group A, table XIa, subgroups 1, 2, and 3 (plus 4, 7, and 9 as applicable).

b. Final electrical testing satisfies end-point electrical test requirements specified in the preceding test methods, and need not be duplicated.

4.5.10 Seal (fine and gross leak).

a. For class K devices, the seal test may be performed in any sequence between the final electrical test and external visual, but it shall be performed after all shearing and forming operations on the terminals.

b. For class H devices, the seal test shall be performed in any sequence between the constant acceleration test and external visual, but it shall be performed after all shearing and forming operations on the terminals.

c. For class K and H devices, all device lots (sublots) having any physical processing steps (e.g., solder dipping to the glass seal, etc.) performed following seal or external visual shall be retested for hermeticity and visual defects. This shall be accomplished by performing, and passing, as a minimum, a sample seal test (MIL-STD-883, method 1014) using an acceptance criteria of a quantity (accept number) of 45(0), and an external visual inspection (MIL-STD-883, method 2009) on the entire inspection lot (sublot). For devices with leads that are not glass sealed and that have a lead pitch less than or equal to 1.27 mm (0.050 inch), the sample seal test shall be performed using an acceptance criteria of a quantity (accept number) of 15(0). If the sample fails the acceptance criteria specified, all devices in the inspection lot represented by the sample shall be subjected to the fine and gross seal tests and all devices that fail shall be removed from the lot for final acceptance.

4.5.11 External visual screen. The final external visual screen shall be conducted in accordance with MIL-STD-883, method 2009 after all other 100 percent screens have been performed to determine that no damage to, or contamination of the package exterior has occurred.

4.6 QML-38534 qualification. All tests, test methods, test conditions, and limits shall be in accordance with MIL-STD-883 and as specified herein. If a qualification lot is withdrawn due to (1) failing to meet qualification requirements or (2) lack of failure analysis, corrective action, and (3) no retesting is performed, the certification of the process or material (or both) to be covered by that qualification shall be removed by the qualifying activity.

NOTE: The hybrid manufacturer has the right to select not to use any solution or solvent identified within this specification or related specifications that has also been identified by the American Congress of Government Industrial Hygienists as being a potential or suspect carcinogen. Where the hybrid manufacturer elects not to use a material, he must notify the acquiring or qualifying activities and the customer in writing in clear, unambiguous language not subject to misinterpretation that this right has been exercised.

4.6.1 Qualification eligibility. All processes to be qualified and which are to be included on QML-38534 must have been certified by the qualifying activity in accordance with 3.4.1.

4.6.2 Test samples. Devices used for qualification shall have been assembled using MIL-STD-1772 certified process (or as allowed by 3.4.5.1.1) and screened in accordance with the applicable sections of 4.5 herein. Qualification tests shall be performed at facilities which have laboratory suitability granted by the qualifying activity. DESC Form EQC-42H, Hybrid Product Baseline, or its equivalent, shall be used to baseline the specific processes and materials utilized in the qualification device.

4.6.2.1 Standard evaluation circuits. The manufacturer may elect to design and build a functional standard evaluation circuit (device) in accordance with 3.1.3.24 in lieu of utilizing actual product. If qualification is to be performed on a lot of devices built specifically for QML qualification (see 3.4.5.6), the device shall be representative of the physical complexity of the product that will be covered by its testing. Standard evaluation circuits shall not be used for group C QCI product qualifications.

4.6.2.2 Sample selection. The sample size for each test is listed in the corresponding subgroups of the group C table XIc. In addition for group C, subgroup 3, a minimum of three electrical rejects or representative mechanical samples shall be reserved (see 4.6.5.8). Except for designated rework and nonfunctional devices, test samples shall be randomly selected from the inspection lot. The manufacturer shall retain a sufficient number of test devices from the lot to designate reserve samples.

4.6.2.3 Rework samples. For approval of rework qualification, the rework sample shall be prepared in accordance with the manufacturer's baselined rework procedure. Three out of five devices tested in group C, subgroup 1 shall have undergone the rework to be qualified. Two out of the three (3(0)) devices tested in group C, subgroup 3 shall contain the rework to be qualified. One of the two devices tested in group C, subgroup 4 shall contain the rework to be qualified. The die and wire sample size requirements of 4.6.5.10 and 4.6.5.11 shall be applied to reworked wirebonds and replaced die. Each rework method shall be considered a different process.

4.6.2.4 Nonfunctional samples. Electrical rejects from final electrical testing in screening can be used in any subgroup of qualification tests where electrical testing is not required.

4.6.2.5 Disposition of samples. Samples destructively tested (see 4.2.2.2) during qualification testing shall be submitted to the qualifying activity with the qualification test report. Other hybrid microcircuits in the qualification inspection lot shall be disposed of in accordance with 4.2.2.1.

4.6.3 Test report. The manufacturer shall submit the test report under cover of DESC form EQC-19H with sections I and III completed.

4.6.3.1 Test data. Test data shall be submitted to the qualifying activity. This data shall include a summary of attributes for all required tests and measurements including device screening and QCI/qualification tests. In addition, variables data shall be provided for the following tests when applicable:

a. Group A data and group C end point electrical test data.

b. Group C internal water vapor and RGA readings.

c. Group C die shear strength test results, the force at the time of failure and the failure category or the die shear force if no separation occurs.

d. Group C wire bond strength test results, the forces at the time of failure and the failure category or readings for the devices tested if no failure occurs.

e. Other data is required by the qualifying activity for alternate test plans.

4.6.3.2 Documents submitted to qualifying activity. Original fabrication, assembly, screening, and QCI/qualification travelers and variables data shall be submitted with the test report. Alternatively, copies of the original documents that have been verified by the government source inspector are acceptable. Any changes to records shall meet the requirements of 30.1.2 of appendix A.

4.6.3.2.1 Testing location diagrams. Diagrams shall be supplied with the test report detailing and labeling the elements and wirebond test locations on the test vehicle or sample (e.g., die placement and orientation, wire bonding, resistor location, etc.).

4.6.4 Test failures.

4.6.4.1 Resubmission of failed samples or lots (or both). Unless otherwise specified (4.6.5.8.1), resubmission of failed samples or additional samples from the same production lot are not allowed unless such failures are due to equipment or operator errors in accordance with 4.2.5. Notification of the qualifying activity is required.

4.6.4.2 Failures. All test failures shall be reported to the qualifying activity, along with (if applicable) the resulting failure analysis and corrective actions needed to assess qualification status or alternatives.

4.6.5 Detailed test requirements. Table XIc under the QML column and 4.6.5.1 through 4.6.5.11 detail the testing requirements for qualification for both class H and class K devices.

4.6.5.1 PIND. The hybrid microcircuits shall show no evidence of loose particles. Any hybrid microcircuit showing loose particles when tested as specified herein shall be analyzed. Failure of PIND shall not jeopardize qualification provided the manufacturer demonstrates that the loose particle control is established and random samples, from product fabricated using the baselined process, are PIND tested after corrective action implementation. These random samples shall have been screened (see 4.5). The retest requirements shall be determined based on the nature of the changes made as a result of the corrective action. Compliant class H shall receive 100 percent PIND screening until the manufacturer demonstrates to the qualifying activity that the requirements of 4.6.5.1 are met.

4.6.5.1.1 Loose particle recovery. The loose particles that caused the failures shall be recovered and analyzed for the cause and source. If the analysis fails to locate the particles causing failure, the device shall be carefully delidded and examined in an attempt to locate the particles. Captured particles shall be evaluated at 30X minimum and the offending portion of the process shall be identified and corrected.

4.6.5.2 Temperature cycling. Thermal shock, MIL-STD-883, method 1011, shall not be used as a substitute for temperature cycling for QML qualification.

4.6.5.3 Mechanical shock. When QML qualification is being performed, constant acceleration is not an option in place of mechanical shock. Both tests are required for qualification.

4.6.5.4 Constant acceleration. For QML qualification, a stiffener plate (e.g., .125 inch (3.18 mm) aluminum) may be attached to the base of the package to prevent damage due to "oil canning" of the package. If conflicting design/process constraints warrant stress levels lower than the specified 10,000 g level, qualifying activity approval is required on a case-by-case basis. In this event the "g" level shall be no lower than 7500 g and the "g" level that the manufacturer actually qualifies shall be reflected on QML-38534.

4.6.5.5 Visual examination. The visual examination shall be in accordance with the procedure given within MIL-STD-883, method 1010 or 1011.

4.6.5.6 Electrical requirements. Electrical end points shall be measured (and recorded when required) before starting and after completion of all tests in subgroups 1 and 2 of group C tests. Electrical end-point limits, life test conditions, and intermediate measurement requirements shall be specified as required by the applicable device acquisition specification. Test samples which require variable data shall be serialized prior to tests.

4.6.5.7 Steady-state life test. Steady-state life testing shall be performed on each initial lot of each hybrid microcircuit type. If group C, subgroup 2 testing is being performed for QML qualification only (see 3.4.5.6), the sample size shall be five with zero failures allowed. In addition, if group C2 testing is being performed for QML qualification only, a 1000-hour bake at +150°C followed by end-point electrical testing may be performed in lieu of steady-state life testing.

4.6.5.8 Internal water vapor. An internal water vapor content sample of three devices (zero failures) or five devices (one failure) shall be selected from the subgroup 1 sample. The use of electrical rejects or representative mechanical samples is permissible provided these samples have seen, as a minimum, the environmental exposures required in subgroup 1 (i.e., temperature cycle or thermal shock, mechanical shock or constant acceleration and seal tests as applicable). If the internal water vapor content exceeds 5000 ppmv at +100°C on more than one device, an additional 3(0) or 5(1) fully screened samples shall be subjected to 10 cycles (20 cycles for class K) of MIL-STD-883, method 1010 temperature cycling, condition C, (or the optional 15 cycles of thermal shock, condition A for class H). Following temperature cycling (or thermal shock), the samples shall be tested for internal water vapor content. The RGA data from both sets of testing shall be submitted to the qualifying activity. Other gas species present in quantities greater than 100 parts per million volume (0.01 percent) shall be reported. Different circuits in the same package and with an equal quantity (or fewer) elements and the same materials may be qualified by similarity to a qualified test sample that was processed and sealed in the same period.

4.6.5.8.1 Correlation testing for internal water vapor. At the manufacturer's option, if the initial test samples (three or five devices) fail internal water vapor, a second complete sample (see 4.6.2.2) may be tested at an alternate laboratory that has been issued suitability by the qualifying activity. An additional three samples shall be held by the manufacturer until final disposition of the test report. If this test passes, the devices and data from both test submissions shall be submitted to the qualifying activity for approval of internal water vapor criteria.

4.6.5.9 Internal visual and mechanical. In addition to the criteria of MIL-STD-883, method 2014, this inspection shall verify that no damage has occurred to and no contamination is present on the elements and substrate.

4.6.5.10 Wire bond strength for QML qualification. Two devices minimum shall be tested to assure the post seal bond strength requirements of MIL-STD-883, method 2011. The bond strength test shall be performed on a sample size (accept number) of 15(0) bond wires for each wirebond process (including each rework method outlined in 4.6.5.10.1 as a separate process) and material (wire metallization) present in the device. Each 15 piece sample of wires shall contain an even distribution of all wire sizes that can be qualified by that sample. No failures shall be allowed. Additional devices shall be added, if necessary, to meet the required wire sample size. The test wires shall be predesignated.

4.6.5.10.1 Wire bond strength for QML rework qualification. Each of the following wirebond rework methods shall be considered as separate methods requiring QML qualification:

a. Gold ball bonds on substrate wires (see 3.7.2.4).

b. Gold ball bonds on crescent bonds (see 3.7.2.4).

c. Gold ball bonds on top of gold ball bonds (see 3.7.2.4).

4.6.5.11 Element shear for QML qualification. Two devices minimum shall be tested to assure the die shear strength requirements of MIL-STD-883, method 2019. The die shear test shall be performed to a quantity (accept number) of 22(0) minimum of the elements in the hybrids or a quantity (accept number) of 5(0) elements for each element attach process (including element replacement as a separate process) and material present in the device. The materials considered shall include the attach medium, element backing, and substrate/package attach area surface. Each five-piece sample of elements shall contain an even distribution of all element sizes that can be qualified by that sample. No failures shall be allowed. Additional devices shall be added if necessary to meet the required element sample size. The test elements shall be predesignated.

4.6.6 QML retention report. To retain QML status, the manufacturer shall forward a report to the qualifying activity at 12 month intervals summarizing activities associated with QML processes and materials. The qualifying activity shall establish the initial reporting date. The report shall include the following:

a. Identification by PIN, date code, and quantity of lots that have completed groups A, B, C, and D inspections. Information should be formatted such that the periodic QCI tests and lots represented by them are clearly presented. When option 1 (in-line inspection) is performed, information shall be organized to demonstrate in-line inspection coverage for all compliant product.

b. A list of all QML processes and materials for which there has been no QCI. The manufacturer shall certify that they still have the capabilities and facilities to produce these items to the qualified level.

c. A summary of failure analysis results and corrective action of failures which result in changes to the manufacturer's QML listing.

d. Certification that the design and construction of all compliant product was verified and found to be identical to QML requirements and that the QCI requirements have been satisfactorily met.

e. Self-audit results (see appendix A, 40.3.6).

If the summary results indicate nonconformance with the requirements of this specification, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing processes and materials from the QML. Failure to submit the summary report within 30 days for the 12 month period may result in loss of the manufacturer's QML listing and certification. If during two consecutive reporting periods, there has been no QCI of product utilizing QML processes and materials on a certified line, the manufacturer may, at the discretion of the qualifying activity, be required to perform supplemental process qualification testing in accordance with 4.6.

4.6.7 Removal of a manufacturer from the QML.

4.6.7.1 Reasons for removal. A manufacturer may be removed from the QML by the preparing activity for any of the reasons listed below. Removal for any other reason must be approved in advance by the Departmental Standardization Office of the preparing activity.

a. The product or material offered under contract does not meet the requirements of the device acquisition specification or SMD.

b. The manufacturer has terminated manufacturing the product or material represented by the sample test specimen for which a QML listing was granted.

c. The manufacturer requests that his company's name be removed from the list.

d. One or more of the conditions under which certification and qualification were granted have been violated.

e. The manufacturer has failed to notify the qualifying activity of a change in design, material, manufacturing facility, process, or fabrication line.

f. An audit of manufacturing facilities and fabrication lines indicates nonconformance to the applicable specification.

g. The manufacturer's name appears on the "Consolidated List of Debarred, Ineligible, and Suspended Contractors."

h. The manufacturer has failed to comply with the requirements for retention of qualification, as stated in the specification.

4.6.7.2 Notification of proposed removal. Excepting cases of immediate removal for reasons c, g, and h of 4.6.7.1, the manufacturer will be notified of the proposed removal of his company from the list and the reasons for removal and be granted at least 14 days from the date of the notifying letter in which to respond. If removal is for reasons 4.6.7.1a, 4.6.7.1b, 4.6.7.1d, 4.6.7.1e, or 4.6.7.1f, the manufacturer will be invited to furnish comment.

4.6.7.3 Notification of removal. After determination has been made to remove a company from the list, the manufacturer will be sent a notification of removal and his company will be deleted from the QML without delay.

4.7 QCI.

4.7.1 General. QCI for a given hybrid microcircuit type is determined by selection of a requirements option flow (see tables I and XI) at the time of contract negotiation and acceptance. The requirements option flow selected shall determine the QCI requirements for the specific hybrid microcircuit manufactured. Where applicable, inspection lot sampling shall be in accordance with appendix B of this specification. Except where the use of final electrical test rejects or simulation samples (i.e., test coupons or test vehicles) is allowed, all hybrid microcircuits shall have been previously screened (see 3.4.4 and 4.5) and subjected to and passed all final electrical tests. Successful completion of QCI for a given product assurance level shall satisfy the quality conformance requirements for any lower level hybrid microcircuit manufactured on the same certified line. If a lot is withdrawn in a state of failing to meet quality conformance requirements and is not resubmitted, it shall be considered a failed lot and reported as such. Lots submitted for QCI shall meet the requirements of 3.4.6 for all device classes.

NOTE: The hybrid manufacturer has the right to elect not to use any solution or solvent identified within this specification or related specifications that has also been identified by the American Congress of Government Industrial Hygienists as being a potential or suspect carcinogen. Where the hybrid manufacturer elects not to use a material, he must notify the acquiring or qualifying activities and the customer in writing in clear, unambiguous language not subject to misinterpretation that this right has been exercised.

TABLE XI. QCI summary.

Requirement	Reference	Option 1 (in-line)	Option 2 (end-of-line)	Option 3 (QPL/QML)
General	Paragraph	4.7.2	4.7.3	4.7.4
Group A	Paragraph	4.7.2.1	4.7.3.1	4.7.4
	Table	XIa	XIa	
Group B	Paragraph	4.7.2.2	4.7.3.2	4.7.4
	Table	N/A	XIb	
Group C	Paragraph	4.7.2.3	4.7.3.3	4.7.4
	Table	XIc	XIc	
Group D	Paragraph	N/A	4.7.3.4	4.7.4
	Table	N/A	XId	

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, 2, or 3 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.

4.7.1.2 End point. Electrical end points shall be measured in accordance with 4.6.5.6.

4.7.1.3 Data. Test results shall be recorded by inspection lot identification code (see 3.6.3) for each inspection lot, when applicable. For in-line group B inspections where inspection lots are not applicable, data records or logs shall be maintained and available for review by the qualifying and acquiring activities. A summary of attributes results for all tests and measurements shall be part of the test report. Variable data shall be provided when required by the device acquisition specification.

4.7.2 Option 1 (in-line inspection). Option 1 QCI shall be satisfied by in-line inspections and tests in accordance with 4.7.2.1 through 4.7.2.4.

4.7.2.1 Group A electrical testing. Group A electrical testing shall be performed in accordance with table XIa, 4.7.2.1.1 through 4.7.2.1.4 and the applicable device acquisition specification.

TABLE XIa. Group A electrical test.

Subgroup	Parameters	Quantity (accept number)
1	Static test at +25°C	116(0)
2	Static tests at maximum rated operating temperature	76(0)
3	Static tests at minimum rated operating temperature	45(0)
4	Dynamic test at +25°C	116(0)
5	Dynamic tests at maximum rated operating temperature	76(0)
6	Dynamic tests at minimum rated operating temperature	45(0)
7	Functional tests at +25°C	116(0)
8	Functional tests at maximum and minimum rated operating temperatures	76(0)
9	Switching tests at +25°C	116(0)
10	Switching tests at maximum rated operating temperature	76(0)
11	Switching tests at minimum rated operating temperature	45(0)

4.7.2.1.1 Group A general requirements. Group A subgroups shall as a minimum, include the final electrical testing subgroups 1, 2, and 3 (plus 4, 7, and 9 as applicable) and any other subgroups required by the device acquisition specification. Each inspection lot or sublot shall be tested. A procedure for performing group A inspection in accordance with one or more of the following methods shall be approved by the qualifying activity.

a. Sampling: A single sample may be used for all subgroup testing. Where the required size exceeds the lot size, 100 percent inspection shall be allowed.

b. Sequence of test: Group A testing by subgroup or within subgroups may be performed in any sequence after subgroup 1 or alternate subgroups (see MIL-STD-883, method 1015) are performed.

4.7.2.1.2 End-of-line sample testing.

a. Production performs all required final electrical screening tests.

b. Quality assurance or quality designate randomly pulls samples to the required quantity (accept number) and performs acceptance testing.

4.7.2.1.3 In-line sample testing. Test samples for each individual group A subgroup shall be randomly selected from the inspection lot after 100 percent screening of that subgroup (or subgroups, in the event that multiple subgroups are tested at the same temperature in sequence with the same test program). All devices in the inspection lot or sublot shall be available for selection as a test sample and a fully random sample shall be selected from the total population of devices. In addition, a different operator shall check the entire test setup and verify the use of the correct test program prior to testing the group sample.

4.7.2.1.4 In-line verification testing. This method may be used only when the inspection lot is less than 500 units.

a. For each test setup (and operator for manual testing) production shall test a correlation unit to assure that the accuracy requirements of 4.5.2 of MIL-STD-883 are being met.

b. Testing shall be performed using the verified setup.

c. At the completion of testing (or at least once each week) or following a change of operators for manual testing, QA or a QA designate verifies the production testing by:

(1) Visually inspecting to confirm that the correct test fixture, equipment, software, and procedures were used.

(2) Actual testing of a controlled, known good, device of the device type being tested, utilizing the fixtures, equipment, software, and procedure(s) that were used by production. Variables data for all applicable group A tests at +25°C shall be read and recorded for the controlled unit. This data shall be maintained with the lot.

(3) Failure of the verification test shall, as a minimum, require engineering to perform a detailed review of hardware, software, setup, and parts. If the engineering review does not locate the problem, the verification unit shall undergo failure analysis. The appropriate corrective action must then be taken based on the failure analysis results. The entire group of devices being considered for acceptance at the time of the failure may then be retested for the appropriate subgroup(s) acceptance one time only by repeating in-line verification testing. If the failure analysis does not specifically locate the problem, the lot may be reconsidered for acceptance one time only for 100 percent retesting of all of the devices to all of group A requirements and by repeating in-line verification testing.

4.7.2.2 Group B inspection. Group B inspection shall be satisfied by performing in-line inspection sample monitoring as follows. Electrically rejected devices or test vehicles or coupons may be used in all subgroup tests in lieu of actual product.

a. Physical dimensions: Randomly select hybrid microcircuits from devices at final inspection such that as a minimum two devices of each package configuration presented for inspection are inspected each month. Confirm that all critical dimensions affected by the assembly process (e.g., package length, width, height, pin length, etc.) meet the requirements of the device acquisition specification. Critical dimensions unaffected by assembly processes may be inspected at final visual inspection or as a part of incoming (receiving) inspection.

b. Resistance to solvents: Each inspection lot of marking ink shall be tested prior to acceptance in accordance with MIL-STD-883, method 2015. This series of tests shall be performed on each type of surface which is used as the marking surface on completed hybrids (e.g., silver plate, abraded nickel plate, non-abraded nickel plate, etc.). One piece of each surface type shall be tested in each solvent. Each week one device or element (lid or package) representative of each of the marking surfaces of each device marked during the week shall be tested in accordance with MIL-STD-883, method 2015 except that only "solvent D" is required.

c. PIND: PIND testing is not required for class H devices. PIND testing for class K devices shall be performed in accordance with MIL-STD-883, method 2020, condition A or B as specified in the device acquisition specification.

d. Internal visual and mechanical: Internal visual and mechanical inspection shall be performed at preseal visual inspection in accordance with the requirements of MIL-STD-883, method 2014. As a minimum, one device of each hybrid microcircuit type received at preseal visual inspection each month shall be inspected.

e. Bond strength: Wire bond strength in-line inspection shall be performed as a part of wire bond certification (see 4.4.1.6.) and in accordance with MIL-STD-883, method 2011. Each wire bond process (i.e., thermosonic gold, ultrasonic aluminum, thermal compressions gold, etc.) shall be tested weekly. Where more than one machine exists for a specific process, the test sample shall be rotated between machines such that all machines are tested at least once during each 13 week period when in operation. At the time of certification, an additional minimum 10 wires total (15 wires for class K) shall be bonded in the certification sample part(s). After completion of certification bond pulls, the parts with the additional 10 wires (15 wires for class K) intact shall be preconditioned for 1 hour at +300°C minimum in either air or an inert atmosphere followed by destructive pull tests. Bond strength requirements (i.e., minimum pull forces) shall be as specified in table XIb-1. No failures are allowed.

f. Die shear: Die shear testing shall be performed on two devices as a part of group C inspection (i.e., first lot and any element attach changes). Die shear testing during group C shall be performed in accordance with MIL-STD-883, method 2019.

g. Solderability: Solderability testing shall be performed as a part of incoming inspection (i.e., package evaluation, see 4.3.7) as follows:

Packages shall be temperature aged to one of the following conditions prior to performing the solderability test.

6 ±0.5 hours at T_A = +250°C, ±10°C
22 ±1 hours at T_A = +200°C, ±8°C
160 ±8 hours at T_A = +150°C, ±6°C

When the hybrid process flow includes an operation in which the package lead finish is changed prior to delivery of the hybrid (i.e., a solder coating is applied), this operation shall be performed on the package evaluation sample packages subsequent to the temperature aging. Following the temperature aging (and the lead finish application, if applicable), the sample packages shall be solderability tested in accordance with method 2003 including a 7- to 8-hour steam aging.

h. Seal: Seal tests shall be performed in accordance with MIL-STD-883, method 1014. One-hundred percent testing shall be performed on all devices between final electrical test and external visual.

4.7.2.3 Group C inspection. Group C inspection shall be performed only on the first inspection lot submitted for inspection and as required to evaluate or qualify changes listed in 3.4.8. For QML qualification, refer to 3.4.5.7. Group C inspection shall be performed in accordance with table XIc under the QCI column, 4.6.5.1 through 4.6.5.11 and as outlined herein.

NOTE: The qualifying activity may approve alternate test plans for small lots of devices for group C inspection.

4.7.2.3.1 General.

a. Group C sample selection: Samples for group C shall be drawn from the first inspection lot submitted.

b. Subgroup sampling: Subgroup 1 samples (or electrical rejects or mechanical samples, see 4.6.5.8) shall be used for the subgroup 3 and subgroup 4 tests.

c. Limited usage samples: (See 4.7.1.1 for group C production start-up). A minimum of five devices shall be subjected to subgroups 1 and 2 when all of the following are met:

(1) A maximum of 500 devices in a single order against a contractor-prepared document.

(2) A maximum of 2000 devices acquired against a contractor-prepared document on a given equipment-acquisition contract or program.

(3) A maximum of 2000 devices acquired against a contractor-prepared document during a 12 month period for a given hybrid microcircuit and manufacturer.

4.7.2.3.2 Wire bond strength for option 1 QCI product qualification. Two devices minimum shall be tested to assure conformance to the applicable requirements of MIL-STD-883, method 2011. Sample criteria shall be based on the number of wires pulled using a sample size (accept number) of 22(0) for class H and a sample size (accept number) of 45(0) for class K devices. If the 45(0) requirement for class K cannot be met with two devices then all wires in two devices shall be pulled with a minimum of 22 wires being pulled with zero failures. Sample wires shall include one wire from each type transistor, diode, capacitor, and resistor chip; 3 wires from each type of integrated circuit; and 5 wires from package leads as applicable. For test conditions F and H, test 3 dice for each method of interconnection, or all flip chips and beam lead dice, if less. The minimum allowable bond strength shall be the post seal bond strength requirements of method 2011.

4.7.2.3.3. Element shear for option 1 QCI product qualification. The element (die/chip) shear test shall be performed to a quantity (accept number) 22(0) of the elements in the hybrids or all elements in the two sample devices, whichever is less. The shear sample shall be uniformly divided among all element types (or all elements, if less) in the hybrid and shall be performed in a minimum of two hybrid microcircuits. The sample shall include typical resistor, capacitor, integrated circuit, and discrete semiconductor elements.

4.7.2.4 Nonconformance. Should failure occur in any of the above in-line inspections, an analysis to determine cause shall be performed and corrective action, as necessary, shall be imposed. The cause of failure, applicable corrective action, and disposition of product affected by the failure shall be documented. This documentation shall be available for qualifying and acquiring activity review.

4.7.3 Option 2 (end-of-line). Option 2 QCI shall be satisfied by end-of-line inspections and tests in accordance with 4.7.3.1 through 4.7.3.5.

4.7.3.1 Group A electrical testing. Group A testing shall be performed in accordance with table XIa, 4.7.2.1 through 4.7.2.1.4 and the applicable device acquisition specification.

4.7.3.2 Group B inspection. Group B inspection shall be performed on each inspection lot for each package type and lead finish in accordance with table XIb and 4.7.3.2.1 through 4.7.3.2.7.

4.7.3.2.1 PIND test. Lots failing to pass this test shall be subjected to 100 percent PIND testing. Corrective action shall be initiated to determine the cause for the rejects.

4.7.3.2.2 Internal visual and mechanical. The criteria for internal visual and mechanical examination shall be the general requirements for design and construction (see 3.5), the requirements of the device acquisition specification and confirmation that the actual device construction is in accordance with the design documentation on file in accordance with 3.5.5.

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

Subgroup	Class K	Class H	Test	MIL-STD-883 Method	MIL-STD-883 Condition	Quantity/ (accept number)	Reference paragraph
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	2 (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

4.7.3.2.3 Bond strength. Destructive wirebond pull tests shall be performed in accordance with MIL-STD-883, method 2011 and as follows. Testing may be accomplished in-line anytime after device wire bonding.

a. Two devices shall be preconditioned and tested.

b. Sample devices shall be preconditioned for one hour minimum at +300°C minimum in either air or an inert atmosphere.

c. Sampling criteria shall be based on the number of wires pull tested using a sample size (accept number) as follows:

(1) Class H: 22(0) wires, 11 wires each device (or all wires if less).

(2) Class K: 44(0) wires, 22 wires each device (or all wires if less).

d. Sample wire locations shall include wires from the following device locations as applicable:

(1) One wire from each type transistor, diode, capacitor, and resistor chip/die.

(2) Three wires from each type integrated circuit.

(3) Five wires connecting to package leads.

e. The minimum allowable bond strength shall be in accordance with table XIb-1.

TABLE XIb-1. Bond strength requirements.

Gold or aluminum wire diameter, X (inches)	Minimum bond strength (grams)
X < 0.001	0.5
X = 0.001	1.0
0.001 < X ≤ 0.003	MIL-STD-883 method 2011, table I, post seal requirement minus 1 gram
0.003 < X	MIL-STD-883 method 2011, figure 2011-1, post seal requirement minus 10 percent

4.7.3.2.4 Die shear strength. The element (die/chip) shear test shall be performed to a quantity (accept number) of 22(0) of the elements in the hybrids or all elements in the two sample devices, whichever is less. The shear sample shall be uniformly divided among all element types (or all elements, if less) in the hybrid and shall be performed in a minimum of two hybrid microcircuits. The sample shall include typical resistor, capacitor, integrated circuit, and discrete semiconductor elements.

4.7.3.2.5 Solderability. At least 15 leads (or all leads, if less) shall be randomly selected, identified and tested.

4.7.3.2.6 Seal (fine and gross). This test is not required if the 100 percent seal test screening is performed between the final electrical test and external visual (see 4.5.10).

4.7.3.2.7 Electrostatic discharge (ESD). This test shall be performed for initial qualification and product redesign as a minimum, or the device shall be treated in accordance with 3.4.5.9.

4.7.3.3 Group C inspection. Group C inspection shall be in accordance with 4.7.2.3 except table XIc, subgroup 4 tests are not required.

TABLE XIc. Group C testing.

Subgroup	Class K	Class H	Test	MIL-STD-883 conditions Method	QCI	QML	Quantity (accept number)	Reference paragraph
1	x	x	External visual	2009			5(0)	
	x	x 1/	PIND	2020	N/A	A or B, 5 passes		4.6.5.1
	x		Temperature cycling	1010	C, 20 cycles	C, 100 cycles		4.6.5.2
		x	Temperature cycling or	1010 or	C, minimum or	C, 100 cycles		4.6.5.2
		x	Thermal shock	1011	A, minimum	N/A		4.6.5.2
	x	x	Mechanical shock or	2002 or	B, Y1 direction,	B, Y1 direction,		4.6.5.3
	x	x	Constant acceleration	2001	or A1, Y1 direction	and B, Y1 direction		4.6.5.4
	x	x	Seal (fine and gross)	1014				
	x	x	PIND	2020	N/A	A or B, 1 pass		4.6.5.1
	x		Radiographic	2012	Y axis	Y axis		
	x	x	Visual examination	1010				4.6.5.5
	x	x	End-point electrical	2/				4.6.5.6
2	x	x	Steady-state life test	1005	1000 hours at +125°C or equivalent in accordance with table I	1000 hours at +125°C or equivalent in accordance with table I	22(0) or 5(0) 3/	4.6.5.7
	x	x	End point electrical	2/				4.6.5.6
3	x	x	Internal water vapor content	1018 at +100°C			3(0) or 4/ 5(1) 4/	4.6.5.8
4	x	x	Internal visual and mechanical	2014	Option 1 only		2(0) 4/	4.6.5.9
	x	x	Wirebond strength	2011	Option 1 only			4.6.5.10 4.7.2.3.2
	x	x	Element shear	2019	Option 1 only		2(0)4/	4.6.5.11 4.7.2.3.3

1/ Manufacturer's option.
2/ In accordance with the applicable device specification.
3/ When group C, subgroup 2 is being performed for QML qualification or limited QCI or class I changes only, a sample size (accept number) of 5(0) may be used.
4/ Subgroups 3 and 4 samples shall have received subgroup 1 environmental exposure (see 4.6.5.8). Subgroup 3 samples may be used to perform subgroup 4 tests.

4.7.3.4 Group D inspection. Group D inspection shall be performed on the first inspection lot submitted and at intervals not exceeding 26 weeks for additional inspection lots. Group D inspection shall be performed in accordance with table XId and 4.7.3.4.1 through 4.7.3.4.3.

NOTE: This testing may be accomplished during package evaluation at incoming inspection and need not be repeated.

4.7.3.4.1 Samples. Sealed empty packages that have been subjected to the handling and stress conditions of screening may be used for group D testing.

4.7.3.4.2 End point electrical measurements. End point electrical measurements are not required.

4.7.3.4.3 Lead integrity. Lead integrity testing shall be performed on 15 leads minimum or all leads if there are fewer than 15 leads per device package.

TABLE XId. Group D package related tests.

Test	MIL-STD-883		Quantity (accept number)	Reference paragraph
	Method	Condition		
Thermal shock	1011	C	5(0)	4.7.3.4.2
Stabilization bake	1008	+150°C, 1 hour	5(0)	4.7.3.4
Lead integrity	2004	B2 (lead fatigue) D (leadless chip carrier)	1(0)	4.7.3.4.3
	2028	(pin grid array leads and rigid leads)		
Seal a. Fine b. Gross	1014	 A or B C or D	5(0)	

4.7.3.5 Nonconformance. Lots which fail subgroup requirements of groups A, B, C, and D may be resubmitted in accordance with the provisions of 4.2.3.1. A failed lot which is reworked (see 3.7.2) or is rescreened (resubmittal to inadvertently missed process steps is not considered a rescreen) may not be resubmitted to the failed subgroups (and must be counted as a failure) for periodic groups B, C, and D QCI coverages. The lot may be resubmitted only to the failed subgroup to determine its own acceptance. If a lot is not resubmitted or fails the resubmission, the lot shall not be shipped and the compliant marking and all references to MIL-H-38534 shall be removed. Lots that are not resubmitted, fail the resubmission, are withdrawn from compliant hybrid microcircuit consideration, reworked, or rescreened (excluding resubmittal to final electrical test when test conditions or limits are not changed) due to the failure of a PDA or QCI requirement of this specification must be reported to the qualifying activity within 30 days of such action. Confirmed lot failures on returned materials shall be reported to the qualifying activity within 30 days of such action. The reporting of these lots shall be in written format and shall include the following as applicable:

a. PIN.

b. Inspection lot identification code.

c. Quantity of lot.

d. Point of scrap in manufacturer's flow.

e. Test results and date of failure (including all rescreening, reworks, and resubmissions).

f. Reason for failure or scrapping including applicable test results.

g. Date of scrapping or withdrawal from compliant hybrid microcircuit.

h. Disposition action of affected lots.

NOTE: The qualifying activity reserves the right to request and receive information concerning implementation of corrective actions and justification for rework and rescreening.

4.7.4 Option 3. Option 3 QCI shall be conducted in accordance with the applicable requirements of MIL-M-38510, 4.5 and groups A, B, C, D, and E of method 5005 of MIL-STD-883 for the specified device class. QML-38534 qualification shall be accomplished in accordance with the note in 3.4.1.1 and 3.4.5.7.

4.8 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-M-55565.

4.9 Data recording. The results of all screening and quality conformance tests and inspections and the results of all required failure analyses shall be recorded and maintained in the manufacturer's facility in accordance with appendix A.

4.9.1 Screening test data for class K hybrid microcircuits. When specified in the device acquisition specification, a copy of the attributes test data, a copy of the variables data and the delta calculations resulting from the applicable delta parameter tests before and after each burn-in, and a copy of the X-rays required by the device acquisition specification shall accompany each lot of class K hybrid microcircuits shipped. Unless otherwise specified in the device acquisition specification, the manufacturer shall maintain one complete copy of all screening data for 7 years after delivery of the parts. This data shall be legible and shall be correlatable to the applicable PIN, the lot date code, and the individual serial number. The data shall be verified by the manufacturer's quality assurance organization and must bear evidence of such verification.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-55565.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Hybrid microcircuits conforming to this specification are intended for use for Government hybrid microcircuit application and logistic purposes. For maximum cost effectiveness while maintaining essential quality and reliability requirements, it is recommended that, for initial acquisitions for original equipment complements, the device class appropriate to the need of the application (see 3.4) be acquired. For acquisition of spare parts for logistic support, it is recommended that, unless otherwise specified, all hybrid microcircuits be acquired to class H requirements.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. PIN.

d. Title, number, and date of applicable device acquisition specification or drawing and identification of the originating design activity.

e. Hybrid microcircuit finishes (see 3.5.8.3).

f. Product assurance level (see 1.1).

g. Change notification (i.e., who to contact).

6.2.1 Optional acquisition data. The following items are optional and are only applicable when specified in the acquisition documents.

a. Requirements for failure analysis.

b. Special requirements (see 30.4 of appendix C).

c. Disposition of samples (from groups B, C, and D tests).

d. Requirement for qualification or QCI plan.

6.3 Preparation of device acquisition specifications. The items for the preparation of device acquisition specifications are listed in appendix C and D of this specification.

6.4 Reevaluation of lot quality. When deemed necessary, the purchase order may specify detailed criteria for lot reevaluation and disposition. GSI procedures or resubmissions of failed lots shall not be considered as reevaluation of lot quality but rather as a part of the initial quality conformance procedure.

6.5 Subject term (key word) listing.

Audit
Burn-in
Class H
Class K
Classification
Construction
Custom
Design
Deviation
ESD
Element
Inspection lot
Lead finish
Metallization
PDA
PIND
QML
Qualification
Repair
Rework
SPC
Screen(ing)
Seal
Substrate
Traceability
Workmanship

6.6 Definitions.

6.6.1 Catalog standard hybrid microcircuit. A hybrid microcircuit, the design and right to the design (i.e., ownership, control, or proprietary rights), of which are completely in the control of the device manufacturer, and is advertised and made available to any acquiring activity through the publication and distribution of product catalogs or product data sheets.

6.6.2 Custom hybrid microcircuit. A hybrid microcircuit built in accordance with this specification but for which the design is under the specification or control of the purchaser or user of the hybrid microcircuit.

6.6.3 Case outline. The device configuration including dimensions and dimensional tolerances.

6.6.4 Device. A hybrid microcircuit.

6.6.5 Device type. A single specific hybrid microcircuit.

6.6.6 Die family. All elements manufactured by the same basic process (e.g., low power schottky, HCMOS, FAST).

6.6.7 Film microcircuit (or film integrated circuit). A microcircuit consisting exclusively of elements which are films formed in-situ upon or within an insulating substrate.

6.6.8 Microwave or RF hybrid. A hybrid microcircuit that requires one or more of the following:

a. Input and output terminals or connectors with matched impedance.

b. Use of specific impedance transmission lines on an insulating substrate.

c. Device whose RF performance characteristics are affected by conductor length, width, or topology.

6.6.9 Microelectronics. That area of electronic technology associated with or applied to the realization of electronic systems from extremely small electronic parts or elements.

6.6.10 Microcircuit. A small circuit having a high equivalent circuit element density, which is considered as a single part composed of interconnected elements on one or more substrates to perform an electronic circuit function. (This excludes printed wiring boards, circuit cards assemblies, and modules composed exclusively of discrete electronic parts mounted on a non-ceramic substrate or board.)

6.6.11 Monolithic microcircuit (or integrated circuit). A microcircuit consisting exclusively of elements formed in-situ on or within a single semiconductor substrate with at least one of the elements formed within the substrate.

6.6.12 Multichip microcircuit. A microcircuit consisting of elements formed on or within two or more semiconductor chips which are separately attached to a substrate or package.

6.6.13 Package type. Packages which have the same case outline, configuration, materials (including bonding wire and die attach), piece parts (excluding preforms which differ only in size) and assembly processes.

6.6.14 Passive element. Planar resistors, capacitors, inductors and patterned substrates (single and multilayer) and nonplanar chip resistors, capacitors, inductors, and transformers.

6.6.15 Pattern failure. Multiple hybrid microcircuit failures with the same root cause.

6.6.16 QML. A list of manufacturers, by name and plant address, who have met the certification and qualification requirements stated herein. The listing includes identification of the certified quality control level (classes K and H), qualified materials, and qualified manufacturing construction techniques. QML is the accepted abbreviation for the term qualified manufacturers list.

6.6.17 RHA. The portion of product assurance which insures that parts continue to perform as specified or degrade in a specified manner when subjected to a specified radiation environmental stress.

6.6.18 Repair. Repair is an operation performed on a nonconforming hybrid to make it functionally usable but does not completely eliminate the nonconformance.

6.6.19 Rework. Rework is an operation performed on a nonconforming hybrid that restores all nonconforming characteristics to the requirements in the contract, device acquisition specification, or other approved product description.

6.6.20 Semiconductor element. Transistor or diode.

6.6.21 Source control documents or drawings (SCD). The device acquisition specification prepared by the contractor and approved by the acquiring activity which contains the detailed performance and test requirements specific to a hybrid microcircuit type (see appendix C).

6.6.22 Substrate. The supporting material upon or within which the elements of a hybrid microcircuit are fabricated or attached. Substrates may not have conductor patterns or printed or deposited components.

6.6.23 Traceability. The ability to retrieve records as required herein (see 3.4.7).

6.6.24 Tuning. The adjustment of signals from an RF/microwave circuit by altering lines or pads, adding, deleting, or manipulating wires/ribbons, or changing resistance, inductance, or capacitance values or a combination of these changes to meet specific electrical specifications.

6.6.25 Tuning element. A passive element or mechanical constituent (e.g., wire, ribbon, tab, etc.) used for circuit tuning.

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

APPENDIX A

QUALITY ASSURANCE PROGRAM

10. SCOPE

10.1 Scope. This appendix contains details of the quality assurance program requirements which serve as the basis for manufacturer certification and constitute a precondition for hybrid microcircuit qualification. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. QUALITY ASSURANCE PROGRAM

30.1 Manufacturer certification. The manufacturer shall establish, implement, and maintain a product assurance program in accordance with 30.1 through 30.1.3.9 (summarized in table XII) in order to become a certified manufacturer of hybrid microcircuits. The manufacturer's quality assurance program shall demonstrate and assure that design, manufacture, inspection, and testing of hybrid microcircuits are adequate to assure compliance with the applicable requirements and quality standards of this specification and the device acquisition specifications. Where the manufacture or any portion of the manufacturing and testing operation is other than the manufacturer's facility, it shall be the responsibility of the manufacturer to secure and prove the documentation and control of the quality assurance program as described herein. The program shall be documented in these ways:

a. Design, processing, manufacturing, and testing instructions (see 30.1.1).

b. Records to be maintained (see 30.1.2).

c. PAPP (see 30.1.3).

All required documentation shall be available at, and continually effective in the manufacturer's plant while producing hybrid microcircuits which are intended to be offered for shipment as compliant devices. All required program documentation and records shall be available for review by the qualifying or acquiring activity upon request. The acquiring activity shall have access to nonproprietary areas of the manufacturer's plant for the purpose of verifying its implementation, and the qualifying activity shall have access to all areas of the manufacturer's plant for the purpose of verifying its implementation. Personnel performing quality functions shall have sufficient well defined responsibility, authority, and the organizational freedom to identify and evaluate quality problems and to initiate, recommend, and provide solutions.

30.1.1 Design, processing, manufacturing, and testing instructions. The manufacturer shall have in effect documented instructions covering, as a minimum, these areas:

a. Conversion of customer requirements into manufacturer's internal instructions (see 30.1.1.1).

b. Personnel training and testing (see 30.1.1.2).

c. Inspection of incoming materials, utilities, and work in-process (see 30.1.1.3).

d. Quality control operations (see 30.1.1.4).

e. Quality assurance operations (see 30.1.1.5).

f. Design, processing, rework, tool and materials standards, and instructions (see 30.1.1.6).

g. Cleanliness and atmosphere control in work areas (see 30.1.1.7).

h. Design, material, and process change control (see 30.1.1.8).

i. Tool, gauge, and test equipment maintenance and calibration (see 30.1.1.9).

j. Failure and defect analysis and data feedback (see 30.1.1.10).

k. Corrective action and evaluation (see 30.1.1.11).

l. Incoming, in-process, and outgoing inventory control (see 30.1.1.12).

m. Schematics (see 30.1.1.13).

n. ESD handling control program (see 30.1.1.14).

Detailed requirements for coverage of these items are stated in 30.1.1.1 through 30.1.1.14. These requirements will normally be expected to be met by the manufacturer's standard drawings, specifications, process instructions, and other established manufacturing practices. If particular requirements are not covered by the manufacturer's established practices, suitable documentation shall be added to satisfy those requirements.

30.1.1.1 Conversion of customer requirements into manufacturer's internal instructions. The procedure by which customer requirements, as expressed in specifications, purchase orders, etc., are converted into working instructions for the manufacturer's personnel shall be documented.

30.1.1.2 Personnel training and testing. The motivational and work training and testing practices, employed to establish, evaluate, and maintain the skills of personnel engaged in reliability critical work shall be documented as to form, content, and frequency of use.

30.1.1.3 Inspection of incoming materials, utilities, and work in-process. Inspection operations shall be documented as to type of inspection, sampling and test procedures, acceptance rejection criteria, and frequency of use.

30.1.1.4 Quality control operations. Quality control operations shall be documented as to type, procedures, rating criteria, action criteria, records, and frequency of use. The use of SQC and SPC is strongly encouraged.

30.1.1.5 Quality assurance operations. Quality assurance operations shall be documented as to type, procedures, equipment, judgment, and action criteria, records, and frequency of use. The use of SQC and SPC is strongly encouraged.

30.1.1.6 Design, processing, manufacturing equipment, and materials instructions. Device design, processing, manufacturing equipment, and materials shall be documented in drawings, standards, specifications, or other appropriate media which shall cover the requirements and tolerances for all aspects of design and manufacturing including equipment test and prove-in, materials acquisition and handling, design verification testing and processing steps. As a minimum requirement, detailed documentation must exist for the following items and must be adequate to assure that quantitative controls are exercised, that tolerances or limits of control are sufficiently tight to assure a reproducible high quality product, and that process and inspection records reflect the results actually achieved:

a. Incoming materials control (substrates, packages, active and passive chips or elements, wire, water purification, etc.).

b. Masking, photoresist, and mask registration.

c. Glassivation or passivation.

d. Metallization and film deposition.

e. Die, element, or substrate attachment.

f. Wire bonding.

g. Rework.

h. Sealing.

30.1.1.7 Cleanliness and atmosphere control in work areas. The requirements for cleanliness and atmosphere control in each work area in which unsealed devices, or parts thereof, are processed or assembled shall be documented. Air particle counts shall be in accordance with Federal Standard 209. The manufacturer shall establish action and absolute control limits (at which point work stops until corrective action is completed) based on historical data and criticalness of the process in each particular area. For foreign material identification and control, see internal visual inspection requirements of MIL-STD-883, method 2017.

30.1.1.8 Design, material, and process change control. The methods and procedures for implementation and control of changes in device design, material and processing, and for making change information available to the acquiring activity, when applicable, shall be documented.

30.1.1.9 Tool and test equipment maintenance and calibration. The maintenance and calibration procedures, and the frequency of scheduled actions, for tools, gauges, and test equipment shall be documented and in accordance with the requirements of MIL-STD-45662.

NOTE: Corrective action specified in MIL-STD-45662 shall not require a manufacturer to recall those hybrid microcircuit devices tested or inspected on equipment found to be out of tolerance during calibration. These corrective actions shall not be required provided the Government QAR has verified the acceptability of the manufacturer's calibration and corrective action procedures for equipment found to be out of calibration and the periodic checking procedures for assuring acceptability of product between calibration intervals. For major discrepancies, as determined by the QAR, a written report shall be prepared and a copy submitted to the qualifying activity detailing the circumstances and corrective action.

30.1.1.10 Failure and defect analysis and data feedback. The procedures for identification, handling, and analysis of failed or defective devices and for dissemination of analysis data shall be documented, including the procedure for informing the qualifying activity of analysis results, when applicable.

30.1.1.11 Corrective action and evaluation. The procedure and responsibility for decisions regarding the necessity for corrective action as a result of failure or defect analysis, and for evaluation and approval of proposed corrective actions, shall be documented. If the procedure for evaluation and approval of changes proposed for other reasons, such as cost reduction or product improvement, differs from the above, it shall also be documented.

30.1.1.12 Incoming, in-process, and outgoing inventory control. The methods and procedures shall be documented which are used to control storage and handling of incoming materials, work in-process, and warehoused and outgoing product in order to achieve such factors as age control of limited-life materials, and prevent inadvertent mixing of conforming and nonconforming materials, work, or finished product. Each area shall maintain identity of work in process to facilitate access by Government source inspectors. In addition, for class K devices, tests and inspections performed by the manufacturers on acquired raw materials and supplies shall include verification of chemical, physical, and functional characteristics required by manufacturer drawings and specifications. Procedures shall be prepared and maintained for controlling the receipt of acquired materials and supplies. The procedures shall provide the following:

a. Withholding received materials or supplies from use pending completion of the required inspection or tests, or the receipt of necessary reports.

b. Segregation and identification of nonconforming material and supplies from conforming materials and supplies and removal of nonconforming subassemblies and parts.

c. Identification and control of limited-life materials and supplies.

d. Identification and control of raw materials.

e. Assurance that the required test reports, certification, etc., have been received.

f. Clear identification of materials released from receiving inspection and test to clearly indicate acceptance or rejection status of material pending review action.

30.1.1.13 Schematics. Schematics pertaining to the testing of hybrid microcircuits shall be under document control. This includes device schematics, burn-in schematics in accordance with the applicable device acquisition specification for qualified product or those for which qualification test authorization has been requested.

30.1.1.14 ESD handling control program. The ESD handling control program documentation shall be under document control. This includes methods, equipment and materials, training, packaging, handling, and procedures for handling ESD sensitive devices.

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 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 (1-year record retention).

b. Inspection operations in accordance with 30.1.2.2 (1-year record retention for production processes, incoming and in-process; 5-year record retention for screening, qualification and QCI).

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 (1-year record retention).

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.

(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.

30.1.2.1 Personnel training and testing. Records shall cover the nature of training or testing given, the date thereof by week and length in hours, and the group of personnel given work training and testing. Records are required only for product related training and testing as distinguished from safety, first aid, etc.

30.1.2.1.1 Training of operators and inspectors. All critical processes and production inspection shall be performed by personnel who have been trained by the manufacturer to perform their assignment task in accordance with manufacturer's in-house standards, including a formal training (e.g., classroom or on the job training supervised by a certified trainer) and test procedure to assure the proficiency of each individual. Each individual shall be retested or retrained at the end of a designated period or when personnel performance indicates poor proficiency. Personnel shall not be used in critical processes or inspections until the required level of proficiency has been demonstrated.

30.1.2.2 Inspection operations. Records of inspection operations shall cover the tests or inspections made, the materials group (lot, batch, etc.) inspected, the controlling documentation, the date of completion of inspection, the amount of material tested, and acceptance, rejection, or other final disposition of the material.

30.1.2.3 Reports and analyses of defective devices and failures. Records of defective devices shall cover the source from which each device was received, the test or operation during which failure occurred or defects were observed, and prior testing or screening history of the device, the date of receipt, and the disposition of the device. Records of failure and defect analyses shall cover the nature of the reported failure or defect (failure or defect mode), verification of the failure or defect, the nature of any device discrepancies which were found during analysis (failure or defect mechanism), assignment of the failure-activating cause if possible, the date of completion of the analysis, identification of the group performing the analysis, disposition of the device after analysis, and the distribution of the record. The record shall also treat the relationship of observed failure or defect modes in related lots or devices and, where applicable, corrective action taken as a result of the findings.

30.1.2.4 Changes in design, materials, or processing. Records shall cover the initial documentation and all changes, with the date upon which each change in design, materials, or processing becomes effective for devices intended to be submitted for QCI under this specification. The documents authorizing and implementing the change, and identification of the first production, or QCI lot (as applicable) within which product incorporating the change is included shall be maintained when the change requires approval of the qualifying activity (see 3.4.1.3 and 3.4.7). For class K minor design and process changes, records shall include the documents that justify the change as minor (see 3.4.7).

30.1.2.5 Equipment calibrations. Records shall cover the scheduled calibration intervals for each equipment item, the dates of completion of actual calibration, identification of the group performing the calibration, and certification of the compliance of the equipment with documented requirements after calibration, in accordance with MIL-STD-45662.

30.1.2.6 Process, utility, and materials controls. Records shall cover the implementation of devices such as control charts (e.g., X and R charts) or other means of indication of the degree of control achieved at the points in the material, utility, and assembly process flow documented in the manufacturing instructions. Records shall also indicate the action taken when each out-of-control condition is observed, and the disposition of product processed during the period of out-of-control operation.

30.1.2.7 Production lot identification. Records shall be maintained to identify when each production or inspection lot was processed through each area. Records shall be capable of identifying for each production or acceptance-inspection lot (as applicable) of finished product, these items as a minimum:

a. The acceptance-inspection tests performed on the lot, and their results.

b. The serial numbers (when applicable) of all devices in the lot.

c. The date of completion of acceptance inspection of the lot.

d. Identification of the lot.

e. The pertinent associated device acquisition specification under which inspection was performed.

f. Final disposition of the lot (withdrawn, not accepted, accepted).

g. Acquiring activity source inspection consideration of the lot.

h. The number of devices, by device type, in each lot at the time of seal.

i. Independently identify, by device type, the number of devices shipped and the number of devices in stock inventory.

30.1.2.8 Product traceability. The traceability system shall be maintained such that the qualifying activity can trace and determine that the hybrid microcircuits passed the applicable screening, qualifications and QCIs and that the hybrid microcircuits were assembled on the proper certified assembly line.

30.1.3 Program assurance program plan (PAPP). The PAPP shall be established and maintained by the manufacturer, and shall be delivered to the qualifying activity for review (prior to survey, when applicable) as a basis for manufacturer certification in accordance with 3.4.1. The PAPP shall consist of a volume or portfolio, or series of same, which will serve to demonstrate to the qualifying activity that the manufacturer's understanding of a complete quality assurance program, as exemplified by his documentation system, is adequate to assure compliance of his product with the applicable specifications and quality-standards. If the quality assurance program exemplified is applied consistently to all product lines intended to be submitted for acceptance inspection under this specification, only one PAPP is required for each manufacturing plant; any difference in treatment of different product lines within a plant shall be stated and explained in the PAPP, or separate PAPP's prepared for such different lines. The PAPP shall contain, as a minimum, these items (see table XII):

a. Functional block organization chart (see 30.1.3.1).

b. Example of manufacturing flowchart (see 30.1.3.2).

c. Proprietary document identification (see 30.1.3.3).

d. Examples of design, material, equipment, visual standard, and process instructions (see 30.1.3.4).

e. Examples of records (see 30.1.3.5).

f. Examples of design, material, and process change control documents (see 30.1.1.8) and as required in 3.4.1.3 and 3.4.7.

g. Examples of failure and defect analysis and feedback documents (see 30.1.1.10).

h. Examples of corrective action and evaluation documents (see 30.1.1.11).

i. Manufacturer's internal instructions for internal visual inspection (see 30.1.3.6).

j. Examples of test travelers (see 30.1.3.7).

k. Examples of design and construction baseline (see 30.1.3.8).

l. Manufacturer's self-audit (see 30.1.3.9).

Detail requirements for these items are described in 30.1.3.1 through 30.1.3.6, 30.1.1.2, 30.1.1.8, 3.4.1.3, 3.4.7, 30.1.1.10, and 30.1.1.11.

30.1.3.1 Functional block organization chart. This chart shall show, in functional block-diagram form, the lines of authority and responsibility (both line and staff) for origination, approval, and implementation of the several aspects of the product assurance program. Names of the incumbents are not required in this chart.

30.1.3.2 Examples of manufacturing flowchart. The flowchart for all devices shall reflect the complete manufacturing processes being used at the time and shall show all manufacturing, inspection, testing and quality verification points, and the point where all materials or subassemblies enter the flow. The chart will identify all major documents pertaining to the inspection of materials, the production processes, the production environments, and production controls which were used. The documents will be identified by name and number. Changes approved thereafter will be treated in accordance with the approved document change control procedures in 3.4.7. For class K, the manufacturers shall maintain a file or book of all referenced documents noted on the flowchart, including in-house documents referenced there for use by the qualification or certification teams and the designated Government representative.

30.1.3.3 Proprietary document identification. A listing of proprietary documents and areas shall be included in the program plan and maintained on a current basis (see 30.1).

30.1.3.4 Examples of design, material, equipment, and process instructions. An example of each type of design, material, equipment, visual standard, and process instruction used in the manufacture of microcircuits intended to be submitted for acceptance inspection under this specification shall be included in the program plan. These may be either dummies or actual working documents, but shall in either event show the form of the pertinent document; blank forms shall not be included.

30.1.3.5 Examples of records. Examples of records, complying with the requirements of 30.1.3.4 for instructions, shall be included in the program plan.

30.1.3.6 Manufacturer's internal instructions for internal visual inspection. The manufacturer's internal instructions for internal visual inspection in accordance with method 2017 and method 2032 of MIL-STD-883 for the applicable device class, shall be included in the program plan.

30.1.3.7 Examples of test travelers. Screening and groups A, B, C, and D test travelers shall be included in the program plan and maintained on current basis. The test traveler utilized for QCI lots may be the same traveler as used for qualification lots. When in-line inspections are allowed (i.e., alternate group A or B) the traveler shall include documentation of required inspections. The test travelers shall include all manufacturer imposed tests. Alternative methods of meeting these requirements may be approved by the qualifying activity. The test traveler shall include all the following minimum information:

a. Identification as to whether the lot is qualification or QCI.

b. Name or title of operation and specification number of each process or test.

c. Identify PIN, date code, and manufacturer internal lot identification number.

d. Date of test and operator identification.

e. Calibration control number or equipment identification of all major equipment components used for test.

f. Quantity tested and rejected for each process or test and actual quantity tested if sampled.

g. Serial numbers of passing and failing devices when applicable.

h. Time in and out of process or test if critical to process or test results (i.e., burn-in and 96-hour window).

i. Specific major conditions of test that are verifiable by operator including times, temperature, rpm, etc. (required for MIL-STD-1772, section B only).

j. The percent defective calculated and the pattern failure analysis for burn-in.

k. Burn-in or life test board serial number or test circuit identification number and revision.

l. All required variables data (see 4.6) except for electrical tests (attachments permitted). Not required for QCI traveler.

m. For electrical tests, test program number and revision, and identify when variables data is required.

30.1.3.8 Examples of design and construction baseline. The design and construction baseline form (i.e., a listing of the process specifications to be qualified through MIL-STD-1772, section B testing) shall be included in the manufacturer's program plan and maintained under document control.

30.1.3.9 Manufacturer's self-audit. The manufacturer's self-audit which identifies key review areas, their frequency of audit, and the corrective action system to be employed when variations from approved procedures or specification requirements are identified shall be included in the program plan.

APPENDIX A

40. SELF-AUDIT REQUIREMENTS

40.1 Self-audit requirements. This portion of appendix A contains, details for implementation of the minimum requirements to be used in the manufacturer's self-audit program. The intent of this self-audit program is to assure continued conformance to military specification requirements.

40.2 Definitions.

40.2.1 Self-audit. The performance of periodic surveys and reviews by the device manufacturer's designated personnel to evaluate compliance to military specifications.

40.2.2 Audit checklist. A form listing specific items which are to be audited.

40.3 General.

40.3.1 Self-audit program. The manufacturer shall establish an independent self-audit program under the direction of the quality organization to assess the effectiveness of the manufacturer's quality assurance system. The self-audit shall identify any deficiencies for resolution in the processing, testing, or deviations from specification requirements. The self-audit shall also review any differences from the qualifying activity approved baseline, flowchart, test facility list, etc.

40.3.2 Self-audit representatives. The QAR's or their designated appointees shall perform all self-audits. The designated auditors shall be independent from the area being audited. If the use of an independent auditor is not practical, then as a minimum another individual should be assigned to participate in the audit or review the results with the auditor from the area. The auditors shall be trained in the area to be audited, in the applicable military specification requirement, and provided with an appropriate checklist for annotating deficiencies. Prior to the audit, the assigned auditor shall review the previous audit checklist to assure corrective actions have been implemented and are sufficient to correct the deficiencies.

40.3.3 Audit deficiencies. All audit deficiencies shall be documented on the appropriate checklist and a copy submitted to the department head for corrective action. All corrective actions shall be agreed to by the quality organization or Material Review Board.

40.3.4 Audit follow-up. All audit reports will be filed and maintained by the quality organization. The quality organization shall establish a procedure to follow up on all audit deficiencies to assure that the corrective actions have been implemented in a timely manner. A system (e.g., management review) shall also be established to review the acceptability and timeliness of all corrective actions and to determine if any deficiencies have repeated since the last required self-audit. If any deficiencies have occurred two or more times in the predetermined time period, additional corrective actions shall be taken to assure immediate correction of the problem and the qualifying activity shall be notified.

40.3.5 Audit schedules. The original audit frequency shall be established by the quality organization but in no case exceed 1 year for each area, unless authorized by the qualifying activity. A self-audit shall be conducted and corrective actions completed prior to the initial qualifying activity audit. Changes to the frequency of audit due to being consistently above or below average performance on the self-audit shall require approval of the quality organization.

40.3.6 Self-audit report. The self-audit report shall be submitted along with any deficiencies and corrective action to the qualifying activity for review on an annual basis as part of the retention report. The self-audit report shall be signed by the QAR responsible for its overall success or failure. The manufacturer shall keep the self-audit report on file for a minimum of 4 years. The manufacturer shall make available to the qualifying activity, during reaudits, the self-audit report, deficiencies, and corrective actions taken. The qualifying activity may modify the frequency of the self-audit or require additional testing based on the self-audit report. A successful self-audit program can be used by the qualifying activity to extend the reaudit interval or reduce the audit time duration. If the qualifying activity determines the self-audit program is ineffective and unacceptable, certification approval will be withheld.

40.3.7 Self-audit areas. The self-audit will be performed to assure conformance to the checklist and military specification in at least the following areas:

Areas

Calibration	Training
Fabrication	Failure analysis
DI water controls	Qualification/QCI system
Assembly operations	Document control
Electrical test	Design change control
Test methods	Incoming inspection
Environmental control	Inventory control and traceability

40.3.8 Self-audit checklist. The audit checklist shall be approved by the quality organization and maintained under document control. The checklist shall be provided to the auditor prior to initiation of each self-audit. The checklist shall assure that the quality assurance system is adequate and followed by all personnel in each area.

40.3.9 Deficiency review. The manufacturer shall submit to the qualifying activity for review, any deficiencies that are considered major, any deficiency that has repeated within the specified time period, and all corrective actions. The qualifying activity may modify the frequency of the self-audit or require additional testing based on the data from the self-audit.

TABLE XII. Product assurance program requirements.

In-house documentation covering these areas (see 30.1.1)	In-house records covering these areas (see 30.1.2)	A program plan covering these areas (see 30.1.3)	Self-audit plan covering these areas (see 40.3)
a. Conversion of customer requirements into manufacturer's internal instructions (see 30.1.1.1)	a. Personnel training and testing (see 30.1.2.1)	a. Functional block organization chart (see 30.1.3.1)	a. Self-audit program (see 40.3.1)
b. Personnel training and testing (see 30.1.1.2)	b. Inspection operations (see 30.1.2.2)	b. Examples of manufacturing flowchart (see 30.1.3.2)	b. Self-audit representatives (see 40.3.2)
c. Inspection of incoming materials and utilities and of work in-process (see 30.1.1.3)	c. Failure and defect reports and analyses (see 30.1.2.3)	c. Proprietary-document identification (see 30.1.3.3)	c. Audit deficiencies (see 40.3.3)
d. Quality-control operations (see 30.1.1.4)	d. Change in design, materials, or processing (see 30.1.2.4)	d. Examples of design, material, equipment, and process instructions (see 30.1.3.4)	d. Audit follow-up (see 40.3.4)
e. Quality assurance operations (see 30.1.1.5)	e. Equipment calibrations (see 30.1.2.5)	e. Examples of records (see 30.1.3.5)	e. Audit schedules (see 40.3.5)

TABLE XII. Product assurance program requirements - Continued.

In-house documentation covering these areas (see 30.1.1)	In-house records covering these areas (see 30.1.2)	A program plan covering these areas (see 30.1.3)	Self-audit plan covering these areas (see 40.3)
f. Design, processing, manufacturing equipment and materials instructions (see 30.1.1.6)	f. Process utility and material controls (see 30.1.2.6)	f. Examples of design, material and process change control documents (see 30.1.1.8) and as required in 3.4.1.3	f. Self-audit report (see 40.3.6)
g. Cleanliness and atmosphere control in work areas (see 30.1.1.7)	g. Product lot identification (see 30.1.2.7)	g. Examples of failure and defect analysis and data feedback documents (see 30.1.1.10)	g. Self-audit areas (see 40.3.7)
h. Design, material, and process change control (see 30.1.1.8)	h. Product traceability (see 30.1.2.8)	h. Examples of corrective action and evaluation documents (see 30.1.1.11)	h. Self-audit checklist (see 40.3.8)
i. Tool and test equipment maintenance and calibration (see 30.1.1.9)		i. Manufacturer's internal instructions for internal visual inspection (see 30.1.3.6)	i. Deficiency review (see 40.3.9)
j. Failure and defect analysis and data feedback (see 30.1.1.10)		j. Examples of test travelers (see 30.1.3.7)	
k. Corrective action and evaluation (see 30.1.1.11)		k. Examples of design and construction baseline (see 30.1.3.8)	
l. Incoming, in-process, and outgoing inventory control (see 30.1.1.12)		l. Manufacturer's self-audit (see 30.1.3.9)	
m. Schematics (see 30.1.1.13)			
n. ESD handling control program (see 30.1.1.14)			

APPENDIX B

STATISTICAL SAMPLING, TEST AND INSPECTION PROCEDURES

10. SCOPE

10.1 Scope. This appendix contains statistical sampling qualification procedures used with hybrid microcircuits. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this document.

30. GENERAL

30.1 Definitions. The following definitions shall apply for all statistical sampling procedures:

a. PDA series: The PDA series is defined as the following decreasing series of PDA values: 50, 30, 20, 15, 10, 7, 5, 3, 2, 1.5, 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1.

b. Tightened PDA inspection: Tightened PDA inspection is defined as inspection performed using the next PDA value in the PDA series which is lower than that specified.

c. Acceptance number (c): The acceptance number is defined as zero.

d. Rejection number (r): Rejection number is defined as one or more.

30.2 Symbols. The following symbols shall apply for all statistical sampling procedures:

a. c: Acceptance number.

b. r: Rejection number.

40. STATISTICAL SAMPLING PROCEDURES AND TABLE

40.1 General. Statistical sampling shall be conducted using a sample size (accept number) method as specified in table XIII herein. The procedures specified herein are suitable for all quality conformance requirements. For reevaluation purposes, see 6.4.

40.1.1 Selection of samples. Samples shall be randomly selected from the inspection lot or inspection sublots. For continuous production, the manufacturer, at his option, may select the sample in a regular periodic manner during manufacture provided the lot meets the formation of lots requirement.

40.1.2 Failures. Failure of a unit for one or more tests of a subgroup shall be charged as a single failure.

40.2 Single-lot sampling method. QCI information (sample sizes and number of observed defectives) shall be accumulated from a single inspection lot to demonstrate conformance to the individual subgroup criteria.

40.2.1 Sample size. The sample size for each subgroup shall be determined from table XIII and shall meet the specified sample size (accept number).

40.2.2 Acceptance procedure. If zero failures are found in the initial sample of the required sample size, the lot shall be accepted. If the observed number of defectives from the initial sample is greater than zero, a second sample of double the initial sample size may be selected from the original sub(lot). The sub(lot) may be accepted if zero defectives are observed in this double-size sample.

40.2.3 One-hundred percent inspection. Inspection of 100 percent of the lot shall be allowed, at the option of the manufacturer, for any or all subgroups other than those which are called "destructive". If the observed percent defective for the inspection lot exceeds the specified PDA series value for the sample size specified, the lot shall be considered to have failed the appropriate subgroup. One-hundred percent sampling is required where lot size is smaller than the required sample size with zero defectives allowed. Resubmission of lots tested on a 100 percent inspection bases shall also be on a 100 percent inspection basis and in accordance with the tightened PDA inspection criteria (see 30.1b).

TABLE XIII. Sample size (accept number) sampling plan. 1/ 2/ 3/

PDA series	50	30	20	15	10	7	5	3	2
	Minimum sample size (accept number)								
Accept number c = 0, r ≥ 1	5(0)	8(0)	11(0)	15(0)	22(0)	32(0)	45(0)	76(0)	116(0)

PDA series	1.5	1	0.7	0.5	0.3	0.2	.15	0.1
	Minimum sample sizes (accept number)							
Accept number c = 0, r ≥ 1	153(0)	231(0)	328(0)	461(0)	767(0)	1152(0)	1534(0)	2303(0)

1/ Sample sizes are based upon the Poisson exponential binomial limit.
2/ In this specification lot tolerance percent defective (LTPD) has been replaced with sample size (accept number) where the accept number is zero. Where reference is made by unrevised test methods of MIL-STD-883 to an LTPD value, that value shall be found in the PDA series and the sample size shall be the value immediately below the PDA series value. The accept number shall always be zero.
3/ Minimum size of sample to be tested to assure, with a 90 percent confidence, that a lot having percent defective equal to the specified sample size (accept number) will not be accepted (single sample).

APPENDIX C

DEVICE ACQUISITION SPECIFICATION REQUIREMENTS
FOR
SOURCE CONTROL DOCUMENTS OR DRAWINGS (SCD)

10. SCOPE

10.1 Scope. This appendix contains the details of SCD and detail element specifications or drawing requirements needed to define individual hybrid microcircuit types, families, or elements for acquisition. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. GENERAL

30.1 Contractor-prepared hybrid microcircuit SCD's. Contractor prepared SCD's for hybrid microcircuits shall be prepared in military format and shall utilize relevant portions of this specification. Contractor-prepared hybrid microcircuit SCD's shall be approved by the acquiring activity as acceptable for the requirements of a specific contractor order at the time of the acquisition.

30.2 Applicable documents. Hybrid microcircuits SCD's shall comply with the requirements of MIL-STD-883, MIL-STD-1331, and this specification.

30.3 Content and format. The hybrid microcircuit SCD shall be prepared in a format and contain details so as to clearly identify which parameters, limits, and conditions of test shall be applied in response to any given requirement of this specification (i.e., qualification, QCI, screening, etc.). All parameters, limits, and conditions of test which reflect the intended functions of the hybrid microcircuit and which are characteristic of the hybrid microcircuit shall be specified.

30.4 Special requirements. Any special requirements (e.g., extended or accelerated reliability demonstration tests) shall be stated in the hybrid microcircuit SCD or acquisition document. The hybrid microcircuit SCD shall specify the basis for sample selection, sample size, test conditions, accept or reject criteria, failure analysis, or reporting and inspection status (qualification, quality conformance groups A, B, C, D, or screening) as applicable.

30.5 Contractor-prepared detail element specifications or drawings. Contractor-prepared specifications for the elements (substrates, semiconductor chips, packages, etc.) used in the manufacture of hybrid microcircuits shall be prepared in military format and shall be approved by the acquiring activity as acceptable for the requirements of a specific contractor order at the time of acquisition.

40. SPECIFIC REQUIREMENTS

40.1 Individual item requirements. The hybrid microcircuit SCD or element drawings shall cover the items listed in "a" through "n" below:

a. PIN of the applicable detail specification (including date and revision letter, if applicable).

b. Design, construction, and physical dimensions (see 3.5).

c. Special marking provisions (see 3.6).

d. Acceptance numbers as applicable.

e. Identification of the following electrical test parameters;

(1) Preburn-in (if applicable).

(2) Final electrical.

(3) Group A.

f. Specify whether the case is conductive or nonconductive.

g. For metal cases, specify whether the case is connected to the ground lead or to any part of the device.

h. Delta limits.

i. Burn-in and life test circuits.

j. Schematic diagram.

k. Lead designations and internal connections.

l. Test circuits.

m. ESDS.

n. RHA (as applicable).

o. Test data (variables or attributes).

p. Pre/post burn-in test parameters.

40.2 MIL-STD-883 details. In addition to the items listed in 40.1, the applicable details required by MIL-STD-883 shall be listed in the SCD.

APPENDIX D

DEVICE ACQUISITION SPECIFICATION REQUIREMENTS
FOR
STANDARDIZED MILITARY DRAWING (SMD) HYBRID MICROCIRCUITS

10. SCOPE

10.1 Scope. This appendix contains the details of the device acquisition specification requirements needed to define individual SMD hybrid microcircuit types for acquisition. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

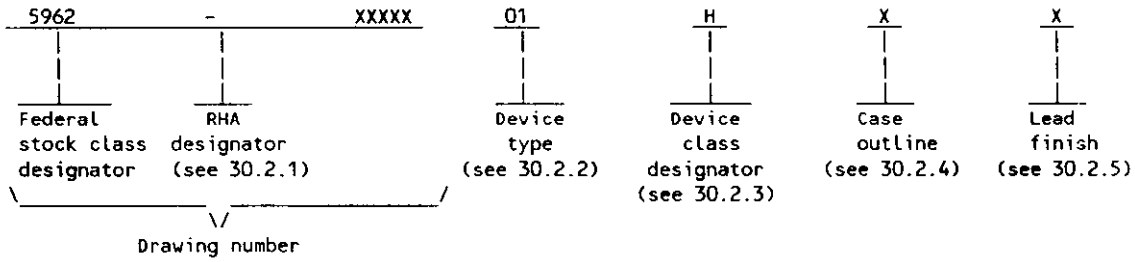
20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DEVICE ACQUISITION SPECIFICATION

30.1 Scope. This drawing forms a part of a one part - one part number documentation system (see 80.6 herein). This drawing describes device requirements for hybrid microcircuits to be processed in accordance with MIL-H-38534. Two product assurance classes, military high reliability (device class H) and space application (device class K) and a choice of case outlines and lead finishes are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

30.2 PIN. The PIN shall be as shown in the following example:



30.2.1 Radiation hardness assurance (RHA) designator. Device classes H and K RHA marked devices shall meet the MIL-H-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

30.2.2 Device type(s). The device type(s) shall identify the circuit function as follows:

Device type	Generic number	Circuit function

30.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level as follows:

Device class	Device requirements documentation
H or K	Certification and qualification to MIL-H-38534

30.2.4 Case outline(s). The case outline(s) shall be as designated in MIL-STD-1835, and as follows:

Outline letter	Descriptive designator	Terminals	Package style

30.2.5 Lead finish. The lead finish shall be as specified in MIL-H-38534 for classes H and K. Finish letter "X" shall not be marked on the microcircuit or its packaging. The "X" designation is for use in specifications when lead finishes A, B, and C are considered acceptable and interchangeable without preference.

30.3 Absolute maximum ratings. 1/

Operating temperature range
Positive supply voltage
Negative supply voltage
Input voltage
Power dissipation (P_D)
Storage temperature range
Lead temperature (soldering, 10 seconds)
Thermal resistance, junction-to-case (Θ_{JC})
Electrostatic discharge sensitivity (ESDS)
G-force
Other parameters (device specific)

30.4 Recommended operating conditions.

Operating temperature range (case (T_C) or ambient (T_A) as appropriate)
Supply voltages
Other parameters (device specific)

40. APPLICABLE DOCUMENTS

40.1 Government specification, standards, and handbook. Unless otherwise specified, the following specification, standards, and handbook of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this drawing to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-H-38534 - Hybrid Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-480 - Configuration Control-Engineering Changes, Deviations and Waivers.
MIL-STD-883 - Test Methods and Procedures for Microelectronics.
MIL-STD-1835 - Microcircuit Case Outlines.

HANDBOOK

MILITARY

MIL-HDBK-780 - Standardized Military Drawings.

(Copies of the specification, standards, and handbook required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

40.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing shall take precedence.

1/ Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.

APPENDIX D

50. REQUIREMENTS

50.1 Item requirements. The individual item requirements shall be in accordance with MIL-H-38534 and as specified herein.

50.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-H-38534 and herein.

50.2.1 Case outline(s). The case outline(s) shall be in accordance with 30.2.4 herein and figure

50.2.2 Terminal connection(s). The terminal connection(s) shall be as specified on figure

50.2.3 Truth table(s). The truth table(s) shall be as specified on figure

50.2.4 Logic diagram(s). The logic diagram(s) shall be as specified on figure

50.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table XIV and shall apply over the full specified operating temperature range.

50.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table XV. The electrical tests for each subgroup are described in table XIV.

50.5 Marking. Marking shall be in accordance with MIL-H-38534. The part shall be marked with the PIN listed in 30.2 herein. In addition, the manufacturer's PIN may also be marked as listed in QML-38534.

50.6 Manufacturer eligibility. In addition to the general requirements of MIL-H-38534, the manufacturer of the part described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, produced on the certified line, for each device type listed herein. The data should also include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DESC-EC) upon request.

50.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance submitted to DESC-EC shall affirm that the manufacturer's product meets the requirements of MIL-H-38534 and the requirements herein.

50.8 Certificate of conformance. A certificate of conformance as required in MIL-H-38534 shall be provided with each lot of microcircuits delivered to this drawing.

60. QUALITY ASSURANCE PROVISIONS

60.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-H-38534.

60.2 Screening. Screening shall be in accordance with MIL-H-38534. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DESC-EC or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I in test method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table XV herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

APPENDIX D

TABLE XIV. Electrical performance characteristics.

Test	Symbol	Condition $-55°C \le T_C \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	

List specific tests with parameters.

FIGURES Including case outlines, terminal connections, truth tables, switching test circuits, logic diagrams, and waveforms as required.

TABLE XV. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (in accordance with method 5008, group A test table)
Interim electrical parameters	
Final electrical test parameters	
Group A test requirements	
Group C end-point electrical parameters	
Group E end-point electrical parameters for RHA devices	Subgroups ** (in accordance with method 5005, group A test table)

* PDA applies to subgroup 1.
** When applicable to this standardized military drawing, the subgroups shall be defined.

60.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-H-38534 and as specified herein.

60.3.1 Group A inspection. Group A inspection shall be in accordance with MIL-H-38534 and as follows:

a. Tests shall be as specified in table XV herein.

b. Subgroups , , and shall be omitted.

c. Subgroups 7 and 8 shall include verification of the truth table.

60.3.2 Group B inspection. Group B inspection shall be in accordance with MIL-H-38534.

60.3.3 Group C inspection. Group C inspection shall be in accordance with MIL-H-38534 and as follows:

a. End-point electrical parameters shall be as specified in table XV herein.

b. Steady-state life test, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DESC-EC or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

60.3.4 Group D inspection. Group D inspection shall be in accordance with MIL-H-38534.

60.3.5 Group E inspection. Group E inspection is required only for parts intended to be marked as radiation hardness assured (see 50.5 herein). RHA levels for device classes H and K shall be M, D, R, and H. RHA quality conformance inspection sample tests shall be performed at the RHA level specified in the acquisition document.

a. RHA tests for device classes H and K for levels M, D, R, and H shall be performed through each level to determine at what levels the devices meet the RHA requirements. These RHA tests shall be performed for initial qualification and after design or process changes which may affect the RHA performance of the device.

b. End-point electrical parameters shall be as specified in table XV herein.

c. Prior to total dose irradiation, each selected sample shall be assembled in its qualified package. It shall pass the specified group A electrical parameters in table XIV for subgroups specified in table XV herein.

d. For device classes H and K, the devices shall be subjected to radiation hardness assured tests as specified in MIL-H-38534 for RHA level being tested, and meet the postirradiation end-point electrical parameter limits as defined in table XIV at T_A = +25°C ±5°C, after exposure.

e. Prior to and during total dose irradiation testing, the devices shall be biased to establish a worst case condition as specified in the radiation exposure circuit.

f. For device classes H and K, subgroups 1 and 2 in table V, method 5005 of MIL-STD-883 shall be tested as appropriate for device construction.

g. When specified in the purchase order or contract, a copy of the RHA delta limits shall be supplied.

70. PACKAGING

70.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-H-38534.

80. NOTES

80.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

80.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

80.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-481 using DD Form 1693, Engineering Change Proposal (Short Form).

APPENDIX D

80.4 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and the applicable SMD. DESC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DESC-EC, telephone (513) 296-6047.

80.5 Comments. Comments on this drawing should be directed to DESC-EC, Dayton, Ohio 45444, or telephone (513) 296-5373.

80.6 One part - one part number system. The one part - one part number system described below has been developed to allow for transitions between identical generic devices covered by the four major microcircuit requirements documents (MIL-M-38510, MIL-H-38534, MIL-I-38535, and 1.2.1 of MIL-STD-883) without the necessity for the generation of unique PIN's. The four military requirements documents represent different class levels, and previously when a device manufacturer upgraded military product from one class level to another, the benefits of the upgraded product were unavailable to the Original Equipment Manufacturer (OEM), that was contractually locked into the original unique PIN. By establishing a one part number system covering all four documents, the OEM can acquire to the highest class level available for a given generic device to meet system needs without modifying the original contract parts selection criteria.

Military documentation format	Example PIN under new system	Manufacturing source listing	Document listing
New MIL-M-38510 Military Detail Specifications (in the SMD format)	5962-XXXXXZZ(B or S)YY	QPL-38510 (Part 1 or 2)	MIL-BUL-103
New MIL-H-38534 Standardized Military Drawings	5962-XXXXXZZ(H or K)YY	QML-38534	MIL-BUL-103
New MIL-I-38535 Standardized Military Drawings	5962-XXXXXZZ(Q or V)YY	QML-38535	MIL-BUL-103
New 1.2.1 of MIL-STD-883 Standardized Military Drawings	5962-XXXXXZZ(M)YY	MIL-BUL-103	MIL-BUL-103

80.7 Sources of supply for device classes H and K. Sources of supply for device classes H and K are listed in QML-38534. The vendors listed in QML-38534 have submitted a certificate of compliance (see 50.7 herein) to DESC-EC and have agreed to this drawing.

90. GENERAL

90.1 Contractor-prepared hybrid microcircuit device acquisition specifications. Contractor-prepared device acquisition specifications for hybrid microcircuits shall be prepared in SMD format and shall utilize relevant portions of this specification. Contractor-prepared hybrid microcircuit device acquisition specifications shall be approved by the acquiring activity as acceptable for the requirements of a specific contractor order at the time of acquisition.

90.2 Applicable documents. Hybrid microcircuit device acquisition specifications shall comply with the requirements of MIL-STD-883, MIL-STD-1331, and this specification.

90.3 Content and format. The hybrid microcircuit device acquisition specification shall be prepared in a format and contain details so as to clearly identify which parameters, limits, and conditions of test shall be applied in response to any given requirement of this specification (i.e., qualification, quality conformance inspection, screening, etc.). All parameters, limits, and conditions of test which reflect the intended functions of the hybrid microcircuit and which are characteristic of the hybrid microcircuit shall be specified.

90.4 Special requirements. Any special requirements (e.g., extended or accelerated reliability demonstration tests) shall be stated in the hybrid microcircuit device acquisition specification. The hybrid microcircuit device acquisition specification shall specify the basis for sample selection, sample size, test conditions, accept or reject criteria, failure analysis or reporting and inspection status (qualification, quality conformance groups A, B, C, D or screening) as applicable.

90.5 Contractor-prepared detail element specifications or drawings. Contractor-prepared specifications for the elements (substrates, semiconductor chips, packages, etc.) used in the manufacture of hybrid microcircuits shall be prepared in military format and shall be approved by the acquiring activity as acceptable for the requirements of a specific contractor order at the time of acquisition.

100. SPECIFIC REQUIREMENTS

100.1 Individual item requirements. The hybrid microcircuit device acquisition specification or element drawings shall cover the items listed in a through n below:

a. PIN of the applicable detail specification (including date and revision letter, if applicable).

b. Design, construction, and physical dimensions (see 3.5).

c. Special marking provisions (see 3.6).

d. Acceptance numbers as applicable.

e. Identification of the following electrical test parameters:

(1) Preburn-in (if applicable).

(2) Final electrical.

(3) Group A.

(4) End points for groups C and D (if applicable).

f. Specify whether the case is conductive or nonconductive.

g. For metal cases, specify whether the case is connected to the ground lead or to any part of the device.

h. Delta limits.

i. Burn-in and life test circuits.

j. Schematic diagram.

k. Lead designations and internal connections.

l. Test circuits.

m. ESDS.

n. RHA (as applicable).

o. Test data (variables or attributes).

p. Pre/post burn-in test parameters.

100.2 MIL-STD-883 details. In addition to the items listed in 100.1, the applicable details required by MIL-STD-883 shall be listed in the device acquisition specification.

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DLA - ES

(Project 5962-1248)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-H-38534B	2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE
MIlitary Specification Hybrid Microcircuits, General Specification for

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON
c. ADDRESS (Include Zip Code)	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

DD Form 1426, OCT 89 *Previous editions are obsolete.* 198 290