The document and process conversion measures necessary to comply with this revision shall be completed by 15 May 1992.

INCH-POUND

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SUPERSEDING
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# MILITARY SPECIFICATION
# MICROCIRCUITS,
# GENERAL SPECIFICATION FOR

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

This specification is intended to support Government microcircuit application and logistic programs. Detailed characteristics of microcircuits needed for a program are to be defined by detail drawings or specifications.

## 1. SCOPE

1.1 Scope. This specification establishes the general requirements for monolithic, multichip, and hybrid microcircuits and the quality and reliability assurance requirements which must be met in the acquisition of microcircuits. Detail requirements, specific characteristics of microcircuits, and other provisions which are sensitive to the particular use intended shall be specified in the applicable device specification. Multiple levels of product assurance requirements and control for monolithic and multichip microcircuits and two levels for hybrid microcircuits are 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 issues of these documents shall be 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-I-23011 | - | Iron-Nickel Alloys for Sealing to Glass and Ceramics. |
| MIL-N-46025 | - | Nickel Bar, Flatwire (Ribbon) and Strip (for Electronic Use). |
| MIL-N-46026 | - | Nickel, Rod and Wire (Round) (for Electronic Use). |
| MIL-M-46058 | - | Insulating Compound, Electrical (For Coating Printed Circuit Assemblies). |
| MIL-M-55565 | - | Microcircuits, Packaging of. |

(See supplement 1 for list of associated detail specifications.)

STANDARDS

MILITARY

| | | |
|---|---|---|
| MIL-STD-129 | - | Marking for Shipment and Storage. |
| MIL-STD-280 | - | Definitions of Item Levels, Item Exchangeability, Models and Related Terms. |
| MIL-STD-883 | - | Test Methods and Procedures for Microelectronics. |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Laboratory (RL/ERSS), Griffiss AFB, NY 13441-5700, 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

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

| | | |
|---|---|---|
| MIL-STD-976 | - | Certification Requirements for Microcircuits. |
| MIL-STD-1285 | - | Marking of Electrical and Electronic Parts. |
| MIL-STD-1331 | - | Parameters to be Controlled for the Specification of Microcircuits. |
| MIL-STD-1772 | - | Certification Requirements for Hybrid Microcircuits Facilities and Lines. |
| MIL-STD-1835 | - | Microcircuit Case Outlines. |

(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. Not more than five items may be ordered on a single request; the invitation for bid or contract number should be cited where applicable. Only latest revisions (complete with latest amendments) are available; slash sheets must be individually requested. Request all items by document number. For information on subscription service, direct inquiries to the above address or telephone (215) 697-3321, inquiry desk.

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 shall be those cited in the solicitation.

| | | |
|---|---|---|
| Handbook H4/H8 | - | Commercial and Government Entity (CAGE) Handbook. |
| MIL-BUL-103 | - | List of Standardized Military Drawings (SMD's). |
| DLAM 8200.2 | - | Procurement Quality Assurance Support Manual for Defense Contract Administration Service. |
| NAVSHIPS 0967-190-4010 | - | Manufacturer's Designating Symbols. |

(Copies of specifications, standards, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Non-Government publications. The following document(s) 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 F15 | - | Iron-Nickel-Cobalt Sealing Alloy, Specification for. |
| ASTM F30 | - | Iron-Nickel Sealing Alloy, Specification for. |
| ASTM B170 | - | Oxygen-Free Electrolytic Copper, Refinery Shapes. |
| ASTM B487-79 | - | Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section. |
| ASTM B567-79A | - | Measurement of Coating Thickness by the Beta Backscatter Method. |
| ASTM B568 | - | Measurement of Coating Thickness by X-Ray Spectrometry. |

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

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

| | | |
|---|---|---|
| EIA-STD-RS-471 | - | Symbol and Label for Electrostatic Sensitive Devices. |
| EIA-STD-5 | - | Packaging Materials Standard for Protection of Electrostatic Discharge Sensitive Devices. |
| JEDEC Publication 19 | - | General Standard for Statistical Process Control. |
| JEDEC Publication 108 | - | Distributor Requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices. |
| JEDEC Publication 109 | - | General Requirements For Distributors of Military Integrated Circuits. |

(Application for copies should be addressed to the Electronic Industries Association, 2001 Pennsylvania Avenue N.W., Washington, DC 20006-1813.)

(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 specifications), 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 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 detail specification. While these facilities and program may be used for the manufacture of other than JAN microcircuits (under the provisions and limitations stated herein), any reference to the "JAN" or "J" certification mark (see 3.6.7), class S or B certification status, MIL-M-38510, or the military Part or Identifying Number (PIN) (or portion thereof) in such a way as to state or imply equivalency (and thereby Government endorsement) in connection with non-JAN product is prohibited and may be a cause for revocation of certification or product qualification or both. The individual item requirements shall be as specified herein, and in accordance with the associated detail specification or drawing. In addition, when the manufacturer's absolute process or DESC-EQM form 42, "Baseline Sheet for JAN Microcircuits", limits are exceeded the lot shall be dispositioned as non-JAN and documented in accordance with appendix A, 30.1.1.6. Only qualified (QPL-38510) microcircuits which are inspected for, and meet all the requirements of the military detail specification shall be marked and delivered as JAN microcircuits. Government source inspection shall be required (see section 4).

3.1.1 Reference to associated detail specification. For purposes of this specification, when the term "as specified" is used without additional reference to a specific location or document, the intended reference shall be to the associated detail specification or drawing number which constitutes the applicable individual device specification.

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

a. Applicable device specification (associated detail specification or drawing).

b. This specification.

c. Specifications, standards, and other documents referenced in 2.1.

3.1.3 Terms, definitions, and symbols. For the purpose of this specification, the terms, definitions, and symbols of MIL-STD-883 and MIL-STD-1331, and those contained herein shall apply and shall be used in the applicable associated detail specifications or drawings wherever they are pertinent. The definitions of part, subassembly, assembly, unit, group, set, and system, as well as the ancillary terms accessory and attachment are contained in MIL-STD-280. To further define a particular type of microcircuit, additional modifiers may be prefixed. This is particularly desirable in the case of the hybrid microcircuit.

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

3.1.3.2 Element (of a microcircuit or integrated circuit). A constituent of the microcircuit or integrated circuit that contributes directly to its operation. (A discrete part incorporated into a microcircuit becomes an element of the microcircuit.)

3.1.3.3 Substrate (of a microcircuit or integrated circuit). The supporting material upon or within which the elements of a microcircuit or integrated circuit are fabricated or attached.

3.1.3.4 Microcircuit. A small circuit having a high equivalent circuit element density, which is considered as a single part composed of interconnected elements on or within a single substrate to perform an electronic circuit function. (This excludes printed wiring boards, circuit card assemblies, and modules composed exclusively of discrete electronic parts.)

3.1.3.4.1 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.

3.1.3.4.2 Hybrid microcircuit. A microcircuit consisting of elements which are a combination of the film microcircuit type (see 3.1.3.4.4) and the semiconductor types (see 3.1.3.4.1 and 3.1.3.4.3) or a combination of one or both of the types with discrete parts.

3.1.3.4.3 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.

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

3.1.3.5 Microcircuit module. An assembly of microcircuits or an assembly of microcircuits and discrete parts, designed to perform one or more electronic circuit functions, and constructed such that for the purposes of specification testing, commerce, and maintenance, it is considered indivisible.

3.1.3.6 Production lot. A production lot shall consist of devices manufactured on the same production line(s) by means of the same production technique, materials, controls, and design. For hybrids, a production lot shall consist of a group of devices manufactured from the same basic raw materials, processed under the same manufacturing specifications and procedures, and manufactured with the same type equipment. Where a production lot identification is terminated upon completion of wafer or substrate processing, or at any later point prior to device sealing, it shall be permissible to process more than a single device type in a single production lot provided traceability is maintained by assembling devices into inspection lots, as defined herein, at the point where production lot identification is terminated.

3.1.3.7 Inspection lot - class S. An inspection lot for class S microcircuits shall consist of a single device type from a maximum of four wafer lots in a single package type and lead finish. All devices shall be sealed within a single week. All assembly operations from die mounting through package sealing shall be completed within the same 6-week period. Each inspection sublot shall be uniquely identified to maintain traceability of that sublot from the wafer lot to the inspection lot (see 3.4.6 and 4.3.3).

3.1.3.8 Inspection lot - class B. A quantity of microcircuits submitted at one time for inspection to determine compliance with the requirements and acceptance criteria of the applicable device specification. Each inspection lot shall consist of microcircuits of a single device type, in a single package type and lead finish. Each inspection lot shall be manufactured on the same production lines through final seal by the same production techniques and sealed within the same period not exceeding 6 weeks. Inspection lot identification shall be maintained from the time the inspection lot is formed through the time the lot is accepted, and shall be traceable to the production lot(s) from which the inspection lot was formed (see 3.4.6 and 4.3.3).

3.1.3.9 Inspection sublot - class S. An inspection sublot for class S microcircuits shall be a division (one wafer lot maximum) of parts in an inspection lot into smaller quantities of parts (see 4.5.2).

3.1.3.10 Inspection lot split - class B. A class B inspection lot split shall be a further division of the number of parts in an inspection lot into smaller quantities of parts (see 4.5.2).

3.1.3.11 Wafer lot. A wafer lot consists of microcircuit wafers formed into a lot at the start of wafer fabrication for homogeneous processing as a group, and assigned a unique identifier or code to provide traceability, and maintain lot integrity throughout the fabrication process (see 4.3.3).

* 3.1.3.12 Package type. A package with a unique case outline (see MIL-STD-1835), configuration, materials (including bonding wire and die attach), piece parts (excluding preforms which differ only in size), and assembly processes.

3.1.3.13 Microcircuit group. Microcircuits which are designed to perform the same type of basic circuit function (e.g., for linear: Amplifier, comparator, sense amplifier, regulator, etc.; for digital: Logic gate buffer, flip-flop, combinational gate, sequential register/counter) within a given circuit technology (e.g., DTL, Non-Schottky TTL, ECL, Schottky TTL, Linear, Hybrid, MOS) which are designed for the same supply, bias and signal voltages and for input-output compatibility and which are fabricated by use of the same basic die construction and metallization; the same die attach method; and by use of bonding interconnects of the same size, material and attachment method.

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

3.1.3.15 Delta (Δ) limit. The maximum change in a specified parameter reading which will permit a device to be accepted on the specified test, based on a comparison of the present measurement with a specified previous measurement. Note: When expressed as a percentage value, it shall be calculated as a proportion of the previous measured value.

3.1.3.16 Rework. Any processing or reprocessing operation documented in accordance with appendix A, 30.1.1.6h, other than testing, applied to an individual device, or part thereof, and performed subsequent to the prescribed nonrepairing manufacturing operations which are applicable to all devices of that type at that stage.

3.1.3.17 Final seal. That manufacturing operation which completes the enclosure of a device so that further internal processing cannot be performed without disassembling the device.

3.1.3.18 Acquiring activity. The organizational element of the Government which contracts for articles, supplies, or services; or it may be a contractor or subcontractor when the organizational element of the Government has given specific written authorization to such contractor or subcontractor to serve as agent of the acquiring activity. A contractor or subcontractor serving as agent of the acquiring activity 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 (i.e., preparing activity, qualifying activity).

3.1.3.19 Qualifying activity. The organizational element of the Government that grants certification and qualification for the specific associated end-product in accordance with this specification and the applicable detail specification.

3.1.3.20 Device type. The term device type refers to a single specific microcircuit configuration. Samples of the same device type will be electrically and functionally interchangeable with each other at the die or substrate level even though made by different manufacturers using different mechanical layouts and possibly different materials. The electrical and environmental limits will be the same (but not necessarily the inherent reliability) for a given device type even though the device class, the case outline, the lead finish, the lot identification code, and the manufacturer may be different (see 3.6.2). A given type shall appear on only one device specification but that detail specification may also specify other similar devices.

3.1.3.21 Die type. A microcircuit manufactured using the same physical size, materials, topology, mask set, and process flow, on a single fabrication line.

3.1.3.22 Antistatic. An antistatic material resists triboelectric charging upon contact and separation with another material. Plastic materials impregnated with antistatic agents (antistats) are antistatic if their surface resistivity is between $10^{9}$ and $10^{14}$ ohms/square.

3.1.3.23 Conductive. A conductive material is one capable of electrostatic field shielding and having a volume resistivity of $10^{3}$ ohm-cm maximum or a surface resistivity less than $10^{5}$ ohms/square.

3.1.3.24 Insulating. An insulating material is defined as having a volume resistivity of $10^{12}$ ohm-cm minimum, or a surface resistivity of $10^{14}$ ohms/square minimum.

3.1.3.25 Dissipative. A dissipative material is defined as having a surface resistivity between $10^{5}$ and $10^{9}$ ohms/square.

3.1.3.26 Radiation hardness assurance (RHA). The portion of product assurance which insures that parts continue to perform as specified or degrade in a specified manner when subjected to the specified radiation environmental stress.

3.1.3.27 Electrostatic discharge sensitivity (ESDS). Electrostatic discharge sensitivity is defined as the level of susceptibility of a device to damage by static electricity. The level of susceptibility of a device is found by ESDS classification testing and is used as the basis for assigning an ESDS class (see 3.4.1.4).

3.1.3.28 Custom microcircuits. A nonstandard microcircuit, the design, and right(s) to the design (for example, ownership, control, or proprietary rights) of which are under the control of the purchaser-user of the microcircuit.

3.1.3.29 Die family. All devices manufactured by the same basic process (e.g., low power Schottky, HCMOS, FAST) as specified in appendix E.

* 3.1.3.30 Package family. A set of package types with the same package configuration (e.g., side brazed, bottom brazed) material type (e.g., alumina, beryllium oxide (BeO)) package construction techniques (e.g., single layer, multilayer) terminal pitch, lead shape (e.g., gullwing, J-hook), and row-spacing (i.e., dual-in-line packages only) and with identical package assembly techniques (e.g., material and type of seal, wire bond method and wire size, die attach method and material).

3.1.3.31 Military operating temperature range. The military temperature range or military operating temperature range is defined as -55°C to +125°C.

3.1.3.32 Process monitor. The regularly scheduled periodic sample measuring of a parameter during normal performance of production operations in accordance with the manufacturer's approved program plan. The parameter to be measured, the frequency of measurement, the number of sample measurements, the conditions of measurement, the analysis of measurement data will vary as a function of the requirements, capability and criticality of the operation being measured.

3.1.3.33 Military detail specification. The term military detail specification shall be used exclusively to reference or describe Government published documents with the combined purposes of standardization and procurement which detail the specific requirements for JAN or non-JAN microcircuits. The term associated detail specification or associated military detail specification shall be used to exclusively reference or describe Government published documents detailing the specific requirements for JAN microcircuits.

3.2 Item requirements. The individual item requirements for microcircuits delivered under this specification shall be documented in the associated detail specification or drawing prepared in accordance with appendix F herein, unless otherwise specified in the military associated detail specification. All microcircuits shall have an operating ambient 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. Contractor-prepared detail specifications or drawings shall be approved by the acquiring activity as acceptable for the requirements of a specific contract or order, at the time of acquisition.

3.2.1 Country of manufacture. All JAN microcircuits shall be manufactured, assembled, and tested within the United States and its territories except as provided by international agreement establishing reciprocal and equivalent Government quality control systems and procedures. Microcircuits manufactured in other countries to either MIL-M-38510 or equivalent national specifications may be reciprocally listed on QPL-38510 using United States or other national PINs depending upon the degree of verification of equivalence to MIL-M-38510. However, the JAN certification mark (see 3.6.7) shall be used only on products manufactured and tested completely under the control of the United States qualifying activity. Equivalent national symbols, certification marks, or quality marks may be used by nations other than the United States in accordance with their own national rules and requirements for products made in those nations.

3.3 Classification of requirements. The requirements of the microcircuits are classified herein as follows:

| Requirement | Paragraph |
|---|---|
| Quality assurance | 3.4 |
| Qualification | 3.4.1 |
| General | 3.4.1.1 |
| Class B certification | 3.4.1.2 and 3.4.1.2.1 |
| Class S certification | 3.4.1.2 and 3.4.1.2.2 |
| Radiation hardness assurance | 3.4.1.3 |

| Requirement | Paragraph |
|---|---|
| Electrostatic discharge sensitivity class | 3.4.1.4 |
| Change of qualified product | 3.4.2 |
| Screening | 3.4.3 |
| Quality conformance inspection | 3.4.4 |
| Wafer lot acceptance | 3.4.5 |
| Traceability | 3.4.6 |
| Government source inspection | 3.4.7 |
| Design and construction | 3.5 |
| Marking | 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 and assurance of the quality and reliability 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, and can be reasonably expected to remain in conformance indefinitely unless destructively mishandled, (2) that all products are as described on the certificate which accompanies the shipment, and (3) that dealers and distributors have handled the product in accordance with the requirements of JEDEC Publication 108, and JEDEC Publication 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 contractors or subcontractors, 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 hybrid and two levels of monolithic and multichip microcircuit quality assurance (quality and reliability assurance) are provided for in this specification. Classes S and B devices shall be those which have been subjected to, and passed all applicable requirements, tests, and inspections detailed herein, including screening, qualification and quality conformance inspection requirements for the specified class. Class S is the highest quality assurance level of this specification and is intended for space applications. Quality assurance related to microcircuit sensitivity to electrostatic discharge (ESD) damage is provided for in this specification by categorizing microcircuits into three ESDS classes (classes 1, 2, and 3). Classes 1, 2, and 3 devices shall be those which have been subjected to and passed applicable classification testing requirements for the assigned ESDS class. In addition, four RHA levels (M, D, R, and H) are provided for those microcircuits qualified to radiation hardness levels specified in 3.4.1.3. Except for limitations stated in 4.5.6, devices which pass the requirements of a higher quality assurance level shall be considered to meet the requirements of all lower quality assurance levels. Devices or lots which have failed to pass any tests applied or acceptance criterion (PDA) shall not be downgraded to any lower quality assurance level even though that test or criterion may not be a requirement of the lower level (a failed device or lot shall not be accepted). Where shown, method references are in accordance with MIL-STD-883. For general guidance, the following summary states these requirements for the respective device classes.

| Requirements | Reference paragraph | Monolithic and multichip | | Hybrid | |
|---|---|---|---|---|---|
| | | Class S | Class B | Class S | Class B |
| Qualification | | | | | |
| a. General | 3.4.1.1 | Required | Required | Required | Required |
| b. Certification | 3.4.1.2 | Required | Required | Required | Required |
| Qualification (groups A, B, C, D, and E of method 5005, 5010, or 5008 for applicable device class) 1/ | 3.4.2, 4.4 and 4.4.4 | Required | Required | Required | Required |
| Wafer lot acceptance (per method 5007 or 5010) | 3.4.5 | Required | --- | --- | --- |
| Traceability | 3.4.6 and 30.4.4 of appendix G | Required | Required | Required | Required |
| Government source inspection | 3.4.7 | Required | Required | Required | Required |
| Inspection during manufacture | 4.1.1 | Required | Required | Required | Required |
| Process monitors | 3.4.1.2.7 | Required | Required | Required | Required |
| Screening (per method 5004, 5008, or 5010) | 3.4.3, 4.4.4 and 4.6 | | | | |
| a. Internal visual (precap) | | Method 2010 Test cond. A | Method 2010 Test cond. B | Method 2017 | Method 2017 |
| b. Stabilization bake | | --- | --- | Required | Required |

See footnotes at end of summary.

| Requirements | Reference paragraph | Monolithic and multichip | | Hybrid | |
|---|---|---|---|---|---|
| | | Class S | Class B | Class S | Class B |
| c. Temp. cycling and/or thermal shock | | Required | Required | Required | Required |
| d. Constant acceleration | | Required | Required | Required 2/ | Required 2/ |
| e. Particle impact noise detection | 4.6.3 | Required | --- | Required 3/ | --- |
| f. Serialization | | Required | --- | Required | --- |
| g. Interim electrical | | Required | --- | Required | --- |
| h. Burn-in | | 240 hours | 160 hours | 320 hours | 160 hours |
| i. Interim electrical | | Required when reverse bias burn-in spec. | --- | --- | --- |
| j. Reverse bias burn-in | | 72 hours | --- | 72 hours | --- |
| k. Interim electrical | | Required | Required | Required | Required |
| l. Seal (fine and gross) | | Required | Required | Required | Required |
| m. Final electrical | | Required | Required | Required | Required |
| n. Radiographic | | Required | --- | Required | --- |
| o. External visual | | Required | Required | Required | Required |
| p. Nondestructive 100% bond pull test | 4.6.5 | Required | --- | Required | --- |
| Quality conformance inspection (per method 5005, 5008, or 5010) | 3.4.4, 4.4.4 and 4.5 | Required | Required | Required | Required |
| a. Group A (each lot and sublot) | 4.5.2 | Required | Required | Required 4/ | Required 4/ |
| b. Group B (each lot) | 4.5.3 | Required | Required | Required 4/ | Required 4/ |
| c. Group C (periodic, each quarter) (die related) | 4.5.4 | --- | Required | Required 4/ | Required 4/ |
| d. Group D (periodic, every 6 months) (package related) | 4.5.5 | Required | Required | Required 4/ | Required 4/ |
| e. Group E (each lot or sublot) 1/ | 4.5.6 | Required for RHA | Required for RHA | --- | --- |

1/ Group E inspections are for RHA qualification and quality conformance inspection (QCI) of class B or S monolithic or multichip devices only.

2/ Mechanical shock is optional as a substitute for centrifuge on hybrids only.

3/ For hybrids, see method 5008 of MIL-STD-883.

4/ See appendix G.

3.4.1 Qualification.

* 3.4.1.1 General. Microcircuits furnished under this specification and associated military detail specifications shall be products which are qualified for listing on the applicable qualified products list (see 4.4.2 and 6.3.1). As a precondition to performing qualification inspection, the microcircuit manufacturer shall establish certification (see 3.4.1.2) and submit a notification of a qualification lot initiation (see appendix D) to the qualifying activity prior to or concurrently with starting the assembly process. The qualified product shall be produced only on the line certified for the concerned product and from which the product qualification was attained. Devices which have met the radiation hardness assurance requirement and the quality assurance provisions herein shall be annotated in the QPL with the appropriate

identifier (see 3.6.2.2). Devices that have been classified for ESDS, either by test (see 3.4.1.4) or default, shall be handled in accordance with 4.4.2.7 and marked in accordance with 3.6.9.2. Devices having undergone ESDS classification testing shall have the applicable ESDS class designator and highest electrostatic voltage level successfully passed listed in QPL-38510. MIL-BUL-103 for SMD devices shall have the applicable ESDS class designator listed.

3.4.1.1.1 Qualification of class S microcircuits. Qualification of product to class S shall consist of class S certification, and qualification inspection in accordance with method 5005, 5008, or 5010 of MIL-STD-883 and the requirements of this specification.

3.4.1.2 Certification. Certification shall be in accordance with the requirements of MIL-STD-976 for monolithic devices, MIL-STD-1772 for hybrid devices, and this specification. As a precondition to certification inspection, the microcircuit manufacturer shall establish and implement a quality assurance program as defined in appendix A, submit the quality assurance program plan in accordance with 30.1.3 of appendix A to the qualifying activity, provide for a manufacturer survey by the qualifying activity and submit a qualification plan (milestone chart) signed by manufacturer's management officials ultimately responsible for the qualification program's success or failure (marketing, production, and QA) covering the die/package combinations that will be qualified from the certified line. When the qualifying activity determines on the basis of their manufacturer survey that the manufacturer is eligible to qualify the product, the manufacturer shall receive written notification of such eligibility (see 3.4.1.2.1 and 3.4.1.2.2). This written notification constitutes certification. Revocation or suspension of either class B or class S certification shall automatically revoke or suspend both certifications except when the qualifying activity allows retention of the class B certification when the difficulties involved are limited to the class S certification requirements.

3.4.1.2.1 Class B certification. Manufacturers of class B microcircuits shall meet the class B certification requirements of MIL-STD-976 for the specific technology(ies) (or specified products thereof) and the associated facility(ies) within the manufacturing location(s) that is (are) certified. Class B certification shall expire if the manufacturer does not initiate qualification inspection within 3 months and obtain part I QPL listing within 12 months after receiving certification unless extended by the qualifying activity. A semiannual report shall be submitted to the qualifying activity updating the progress of qualifying the devices on the milestone chart and signed by the same manufacturer's management officials.

3.4.1.2.2 Class S certification. Manufacturers of class S microcircuits shall meet the class S certification requirements of MIL-STD-976 for the specific production line or manufacturing and testing facility (or specified portions thereof). Parallel processing paths in a production line are acceptable if both are certified and the baseline shows only processes normally and regularly used in the production flow. Manufacturers shall initiate class S qualification inspection within 12 months and obtain part I QPL listing within 2 years after receiving certification or the certification may be canceled.

3.4.1.2.3 Change of the quality assurance program. After a manufacturer receives certification he shall not implement any change in product design, material, process, or control without concurrent change in the quality assurance program documentation. When other than major changes (see 3.4.2) are made to the process control or quality control documents listed in the approved quality assurance program plan, the manufacturer need not notify the qualifying activity, except when there is uncertainty as to a change being major or minor in nature (see 3.4.2).

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

3.4.1.2.5 Reaudits of certified lines. Following initial certification, a certification audit team will periodically inspect the manufacturer's facilities and equipment, review his processes and techniques, and audit the implementation of the Product Assurance Program Plan 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. The manufacturer must also receive certification within 90 days after any recertification audit or authority to ship JAN devices will be suspended unless extended by the qualifying activity. The manufacturer is encouraged to correct all audit deficiencies during the audit.

* 3.4.1.2.6 Statistical process control (SPC) program. The manufacturer shall be actively developing an SPC program. A minimum program shall include training, definition of critical operations, installation of statistical control techniques, and a control action system. JEDEC Publication 19, may be used as a guideline. This program shall be implemented by 31 December 1990.

The following applies to JAN microcircuits only:

Upon approval of the qualifying activity, tests in MIL-STD-883, method 5004 (except temperature cycling and seal) may be optimized for JAN product only, provided the manufacturer has demonstrated a defined capability on the manufacturing line, which is controllable and in control (via statistical process control), through appropriate sampling. Readings shall be recorded and tracked on a suitable process control medium. Any verified reading that exceeds the statistical process control limits will require the affected lot(s) to be subjected to and pass 100 percent screening for the applicable test reduced or eliminated in favor of SPC. The manufacturer is still responsible for providing product which meets all of the performance, quality, and reliability requirements herein. Any product returned from the field, which has been produced utilizing SPC for screening reduction or elimination, shall be analyzed to establish failure mode and cause and the results shall be reported to the qualifying activity.

3.4.1.2.7 Process monitor programs. Process monitor programs in accordance with MIL-STD-976 for processes performed by the manufacturer shall be established as a minimum, as follows: SEM, wire bonding, die attachment, lid seal, particle detection, lead trimming, and application of final lead finish. These programs shall be documented and made available to the certification team for review. The implementing procedures shall provide for frequency, sample size, reject criteria, allowable rework, and disposition of failed product/lot(s). With the exception of the particle detection monitor, a procedure is required for the traceability, recovery, and disposition of all units monitored since the last successful test. As with all monitors, the particle detection procedure shall provide for continual process improvement. Records of these monitors shall be available to the certification team for review.

3.4.1.3 Qualification to RHA levels. Qualification to an RHA level shall consist of qualification to the appropriate quality and reliability assurance level (class S or B) plus group E tests in accordance with, method 5005 of MIL-STD-883. RHA levels are defined as follows:

Radiation hardness assurance (RHA) level (see note below)

| RHA level designator (see 3.6.2) | Radiation and total dose (Rad (Si)) | Level Neutron fluence ($n/cm^2$) |
|---|---|---|
| / | No RHA | No RHA |
| M | 3000 | $2 \times 10^{12}$ |
| D | $10^4$ | $2 \times 10^{12}$ |
| R | $10^5$ | $2 \times 10^{12}$ |
| H | $10^6$ | $2 \times 10^{12}$ |

NOTE: The detail specification or drawing may allow for a higher neutron level.

3.4.1.4 Qualification to ESDS classes. Initial qualification to an ESDS class or requalification after redesign shall consist of qualification to the appropriate quality and reliability level (class S or B) plus ESDS classification in accordance with method 3015 of MIL-STD-883.

ESDS classification levels are defined as follows:

| ESDS class designator | Prior designation category | Marking | Electrostatic voltage |
|---|---|---|---|
| 1 | A | Δ | 0 to 1999 V |
| 2 | B | Δ Δ | 2000 V to 3999 V |
| 3 | --- | --- | ≥ 4000 V |

a. Devices existing prior to 30 September 1989 that were not ESDS classification tested shall be marked as class 1 until classified. Devices previously classified by test as category A shall be marked class 1. Devices previously classified by test as category B shall be marked as class 2. If it can be shown that test results obtained using method 3015.3 correlate with results using method 3015.6 (or later versions) and give correct ESDS classification, retesting of previously tested devices is not required except where redesign has occurred. Completed (sealed and date coded) devices in inventory or distribution prior to 30 September 1989 need not be remarked for ESDS.

b. Beginning no later than 31 December 1988, all newly designed or redesigned device types shall be classified as ESDS class 1, 2, or 3 in accordance with method 3015 of MIL-STD-883.

c. After 30 September 1989, in order to be compliant with this specification or 1.2.1 of MIL-STD-883, all other device types for use in new system or equipment designs or system or equipment redesigns shall have completed classification in accordance with test method 3015 of MIL-STD-883. All devices of existing design (i.e. not subject to 3.4.1.4b above) shall be marked class 1 except when known by test to be, in fact, class 2 or better, in which case they shall be correctly identified for ESDS.

d. Although little variation due to case outline is expected, if a device type is available in more than one package type or case outline, ESDS testing and classification shall be applied to at least that one package type shown by experience to be worst case for ESDS. ESDS classification test results (or class 1 marking assigned without test) shall be submitted to DESC-EQM for all JAN device types, DESC-ECS for all SMD device types, and retained by the manufacturer (to be made available to the acquiring activity upon request) for device types compliant with 1.2.1 of MIL-STD-883 which are neither JAN nor SMD devices.

* 3.4.2 Change to qualified product or quality assurance program. The manufacturer shall notify the qualifying activity prior to the implementation of any major change(s) of the product or quality assurance program which may affect performance, quality, reliability, radiation hardness assurance (when specified), ESDS class, or interchangeability. Such notification shall include a thorough description of the proposed change(s). The manufacturer shall submit acceptable engineering data, quality conformance inspection data, or a suggested test plan (authorization to test), as agreed upon by the manufacturer and qualifying activity, sufficient to demonstrate that the change(s) will not adversely affect performance, quality, reliability, interchangeability, radiation hardness, or electrostatic discharge sensitivity and that the product will continue to meet the specification requirements. Based upon the review, the qualifying activity will approve or disapprove the change(s) and notify the manufacturer. At the manufacturer's option, devices incorporating the change(s) may be manufactured and tested prior to approval; however, all shipments of these changed devices, shall be withheld until approval is granted by the qualifying activity. The qualifying activity shall be notified of the first lot incorporating the change(s). Changes representative of those which are subject to this requirement are any basic design changes in the manufacturing process such as:

a. Doping material source and concentration changes or process technique changes (e.g., ion implantation versus diffusion).

b. Cross section diffusion profile changes.

c. Die structure topography changes (e.g., double-diffused, epitaxial, isolation).

d. Mask changes or redesign which alter die size or active element dimensions, spacing, or isolation.

e. Change in passivation or glassivation material, thickness, or technique (including addition or deletion of passivation).

f. Metallization change (pattern, material, number of layers, deposition technique, line width or thickness and thick film drying and firing environments and temperature profiles).

g. Change in die or substrate or element attach material, method, or location.

h. Significant change in die or element attach process temperature.

i. Wire bond method changes (ultrasonic versus thermal compression).

j. Changes in wire material composition and dimensions.

k. Package or lid structure and material changes or changes to the internal cavity geometry, or lead frame design change.

l. Seal technique changes (materials or sealing process). This includes lid, lead seals, frame attach and cleaning of frame.

m. Implementation procedures for internal visual and other test methods.

n. Critical documents (see appendix A, 30.1.3b).

o. Hybrid or multichip substrate material and surface finish quality.

p. Conductor, resistor or dielectric materials.

q. Change or substitution of die or other elements mounted on the hybrid or multichip substrate.

r. Hybrid screen or mask design changes that alter dimensions, electrical parameters, spacing, or isolation.

s. Element trimming methods and processes.

t. Methods and materials used to clean hybrids.

u. Wafer fabrication move from one line or building to another.

v. Assembly operation move from one line or building to another.

w. Test facility (with laboratory suitability) move from one facility or building to another.

x. Scribing and die separation method.

y. Qualification or quality conformance inspection procedures including manufacturer imposed tests (see 4.3.7).

z. Change in passivation process temperature/time for RHA products.

aa. Change in diffusion process temperature/time for RHA products.

bb. Change in sintering or annealing temperature/time for RHA products.

* 3.4.3 Screening. All microcircuits to be delivered or submitted for part I qualification or submitted for quality conformance in accordance with this specification shall have been subjected to, and passed, all the screening tests detailed in method 5004, 5008, or 5010 of MIL-STD-883 for the type of microcircuit and quality assurance level (device class) specified. Sampling inspections shall not be an acceptable substitute for any specified screening test except when the approved SPC program utilized for JAN microcircuits (see 3.4.1.2.6) indicates sampling is an acceptable substitute. All tests, preconditioning and screening operations which were performed on microcircuits submitted for qualification inspection, in

accordance with method 5005 of MIL-STD-883, shall be performed on all devices subsequently submitted for quality conformance inspection (see 4.5).

3.4.4 Quality conformance inspection. Microcircuits shall not be accepted or approved for delivery until the inspection lot has passed quality conformance inspection (see 4.5).

* TABLE I. Testing guidelines for changes identified as major.

| Changes in accordance with 3.4.2 herein | | Testing, MIL-STD-883, method 5005 (All electrical parameters in accordance with the detail specification) 1/ 2/ 3/ 4/ 5/ | (Samples) To be submitted to qualifying activity |
|---|---|---|---|
| a. | Doping material source Concentration | Group A and C-1 deltas (variables only when deltas are required) | C-1 (2) |
| | Process Technique | | |
| b. | Diffusion profile | Group A and C-1 deltas (variables only when deltas are required) | C-1 (2) |
| c. | Die structure | Group A and C-1 deltas (variables only when deltas are required) | C-1 (2) |
| d. | Mask changes affecting die size or active element | Variable group A, C-1 prior to shipment, and notify qualifying activity if new area is smaller/larger in applicable package than previously qualified. | C-1 (2) |
| | Wafer diameter | Group A, C-1 prior to shipment | C-1 (2) |
| | Final die thickness | Group D-3 | D-3 (2) |
| e. | Passivation/ glassivation | Group A, C-1 and glass integrity test if current density over $2X10^5$ | C-1 (2) |
| f. | Metallization changes | Group A, C-1, and B-5 | C-1 (2) |
| g. | Die attach method | D-3 and D-4 | D-3 (2), D-4 (2) |
| h. | Die attach process | D-3 and D-4 | D-3 (2), D-4 (2) |
| i. | Bond process | B-5 and D-3 | D-3 (2) |
| j. | Bond wire material/ dimension | B-5 and D-3 | D-3 (2) |
| k. | Package or lid structure | D-1 (variables), D-3, D-4, D-8 (lid torque) (variables) | D-3 (2), D-4 (2) |
| | Package or lid material | D-3, D-4, D-5, and D-6 (variables), and D-8 (lid torque)(variables) | D-3 (2), D-4 (2) |
| | Package or lid dimension | D-1 (variables), D-2, and D-8 (lid) (variables) | D-1 (2), D-2 (2) |
| | Lead frame material | See 4.4.2.6.6 | D-3 (2), D-5 (2) |
| | Lead frame dimension | D-1 (variables) and D-2 | D-1 (2), D-2 (2) |
| | Cavity dimension | B-5, D-2, and D-6 (variables), and D-8 (lid torque) (variables) | D-2 (2) |

See footnotes at end of table.

TABLE I. Testing guidelines for changes identified as major -Continued.

| | Changes in accordance with 3.4.2 herein | | Testing, MIL-STD-883, method 5005 (All electrical parameters in accordance with the detail specification) 1/ 2/ 3/ 4/ 5/ | (Samples) To be submitted to qualifying activity |
|---|---|---|---|---|
| | l. | Sealing profile | D-3, D-4, and D-6 (variables) and D-8 (lid torque) (variables) | D-3 (2), D-4 (2) |
| | | Sealing material | D-3, D-4, and D-6 (variables) and D-8 (lid torque) (variables) | D-3 (2), D-4 (2) |
| | | Frame attach | B-3, D-3, D-4, D-6 (variables), and D-7 (adhesion of lead finish) (variables) | B-3 (2), D-3 (2) |
| | | Frame cleaning | B-3, D-3, D-2, and D-7 (adhesion of lead finish) | B-3 (2), D-3 (2) |
| | m. | Implementation of test methods | Notify qualifying activity (may involve test demonstration) | As required |
| | n. | Critical documents (see appendix A 30.1.3b) | Notify qualifying activity (may involve test demonstration) | As required |
| * | 6/ u. | Fab move | Group A and group C | C-1 (2) |
| * | v. | Assembly move | Group D per each package family (see 3.1.3.30) prior to ship (see 4.4.2.6) | As required |
| | w. | Test facility move | Notify qualifying activity | As required |
| | x. | Scribe/die separation | Five SEM photographs of randomly selected die showing one full edge of die front and back | 5 samples |
| | y. | Qualification/QCI procedures | Notify qualifying activity | As required |
| * | z. | Passivation for RHA | Group A, E, C-1, and glass integrity test if current density is over 2 X $10^5$ | C-1 (2) |
| * | aa. | Diffusion profile for RHA | Group A, E, and C-1, deltas (variables only when deltas are required) | C-1 (2) |
| * | bb. | Sinter/anneal for RHA | Group A, E, C-1, and B-5 | C-1 (2) |

1/ Acceptable supporting data may be submitted to reduce or eliminate required testing.
2/ When variable data is required for applicable groups A and C testing, data histograms providing an acceptable parameter data summary may be submitted in place of variables.
3/ If changes involve more than one device type from the same certified line, contact the qualifying activity to determine appropriate selection of device type(s) to be selected for testing.
4/ The qualifying activity may add or reduce testing if warranted by detail specification requirements or unique design or process circumstances after notification of the manufacturer.
5/ This table is for class B subgroups only. For class S, use the equivalent class S subgroups.
6/ o through t relate to hybrid microcircuits and are intentionally omitted from this table (see appendix G).

3.4.5 Wafer lot acceptance. Class S microcircuits furnished under this specification shall be products from wafer lots that are subjected to and successfully meet the wafer lot acceptance inspections and tests specified in method 5007 of MIL-STD-883.

3.4.6 Traceability. Traceability shall be provided for all microcircuit quality assurance levels. Each delivered microcircuit shall be traceable to the inspection and wafer lot(s) (see appendix A, 30.1.2). For hybrids, see appendix G, 30.1.3a and 30.4.4.

3.4.6.1 Lot travelers. The manufacturer shall maintain lot travelers to document the completion of each required processing step from wafer diffusion for class S (and class B radiation hardened devices) and beginning with assembly for class B with wafer lot identification through microcircuit assembly and screening test. Travelers shall provide space for those items specified in 30.1.3.7 of appendix A. The lot travelers shall provide traceability to all prior processing steps and shall be identifiable through assembly and acceptance testing and shall be monitored by the manufacturer's quality control organization.

3.4.7 Government source inspection. Government source inspection and acceptance in accordance with DLAM 8200.2 is required on all "JAN" branded microcircuits delivered to this specification. The inspection shall be performed by the designated Government agency (see 4.1.4).

3.5 Design and construction. Microcircuit design and construction shall be in accordance with all the requirements specified herein and in the associated detail specification drawing.

* 3.5.1 Package. All devices supplied under this specification shall be hermetically sealed in glass, metal, or ceramic (or combinations of these) packages. No organic or polymeric materials (lacquers, varnishes, coatings, adhesives, greases, etc.) shall be used inside the microcircuit package unless specifically detailed in the device specification or drawing (e.g., polyimide interlayer dielectric or alpha particle die coating). Desiccants may be used in the microcircuit package (except for class S devices where they are prohibited) only if each lot is subjected to and passes an internal water vapor test, test method 1018 of MIL-STD-883, with a limit of 1000 ppm at +100°C for a sample of 3(0) or 5(1). The internal moisture content for class S devices after completion of all screening shall not exceed 5,000 ppm at +100°C. Polymer impregnations (backfill, docking, coating, or other uses of organic or polymeric materials to effect, improve, or repair the seal) of the microcircuit packages shall not be permitted. Polymer coating used to effect or improve marking adhesion shall not be applied over lid seal area. In addition, packages for class S microcircuits shall have metal body with hard glass seals, hard glass body, or ceramic body and the lids shall be welded, brazed, preform soldered, or glass frit sealed with a frit sealing temperature in excess of +385°C. In addition, glass frit sealed packages shall pass the Lid Torque Test (method 2024 of MIL-STD-883) and Internal Water-vapor Content (method 1018 of MIL-STD-883) specified in the class S, group B tests. The lids of the packages sealed with a glass frit shall have the glass on the mating surfaces only. Single layer alumina metallized (SLAM) chip carrier packages are prohibited. Bottom brazed flat packages (i.e., F-2 configuration 2, F-4 configuration 2, F-5 configuration 2, F-6 configuration 2, F-9 configuration 2) with "Q" dimension less than .026 inch (0.66 mm) but not less than .010 inch (0.25 mm) and "spider" packages (i.e., F-1, F-3, F-6, F-8, configurations 3 and 4, and F-9, configuration 4) shall be acceptable only for use in equipment designed or redesigned on or before 29 November 1986 (see MIL-STD-1835 and the designated flat package outline configurations).

NOTE: Packages containing beryllia shall not be ground, sand-blasted, 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 Metals. External metal surfaces shall be corrosion-resistant or shall be plated or treated to resist corrosion. External leads shall meet the requirements specified in 3.5.6.

3.5.3 Other materials. External parts, elements or coatings including markings shall be inherently nonnutrient to fungus and shall not blister, crack, outgas, soften, flow or exhibit defects that adversely affect storage, operation, board assembly (e.g., permanently attached organic bumpers), or environmental capabilities of microcircuits delivered to this specification under the specified test conditions.

3.5.4 Design documentation. Design, topography, and schematic circuit information for all microcircuits supplied under this specification shall be submitted to the qualifying activity and shall be available in-plant for review by the acquiring activity and the qualifying activity upon request. This design documentation shall be sufficient to depict completely the physical and electrical construction of the microcircuits supplied under this specification, and shall be traceable to the specific part, drawing, or type numbers to which it applies, and to the production lot(s) and inspection lot codes under which microcircuits are manufactured and tested so that revisions can be identified.

3.5.4.1 Die topography. For semiconductor die (monolithic die or dice for inclusion in multichip or hybrid microcircuits), there shall be a photograph, drawing(s), mask list with revisions or other representation defining the topography of the elements of the die without the intraconnection pattern, in sufficient magnification or detail to document the die being qualified.

3.5.4.2 Die intraconnection pattern. There shall be an enlarged photograph(s) or transparency of diazotypes of the mask set to the same scale as the die topography (see 3.5.4.1) showing the specific intraconnection pattern used to connect the elements on the die so that elements used and those not used can be easily determined. For film hybrid or multichip microcircuits, this requirement shall apply to the substrate and all conductor pattern and active or passive circuit elements deposited thereon, as well as to semiconductor die, as applicable.

3.5.4.3 Die to terminal interconnection. There shall be an enlarged photograph(s), transparency, or drawing(s) to scale and of sufficient magnification to clearly depict the interconnection pattern for all connections made by wire or ribbon bonding, beam leads or other methods between the semiconductor die, other elements of the microcircuit, substrate(s) and package terminals or lands as applicable to the specific type of microcircuit supplied. If these interconnections show clearly on the die intraconnection pattern photograph, an additional photograph or drawing is not required.

3.5.4.4 Schematic diagrams. For microcircuits supplied under this specification, the actual schematic diagram(s), logic diagram(s), or combination thereof shall be provided, sufficient to represent all electrical elements functionally designed into the microcircuit together with their values (when applicable). For simple devices, this shall be a complete detailed schematic circuit showing all functional elements and values. For complex devices or those with redundant detail, the overall microcircuit may be represented by a logic diagram in combination with schematic details. As a minimum, details which must be included are: A schematic presentation of input/output stages and protection network details identified by appropriate pin numbers. Sufficient details to depict addressing or other device elements where the test parameters, conditions, or limits are sensitive to the specific device schematics. Where parasitic elements are important to the proper functioning of any microcircuit, they shall be included in the schematic diagram.

3.5.5 Internal conductors. Internal thin film conductors on silicon die or substrate (metallization stripes, contact areas, bonding interfaces, etc.) shall be designed so that properly fabricated conductor shall not 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 or without glassivation layer integrity test | $2 \times 10^5$ A/cm$^2$ |
| Aluminum (99.99 percent pure or doped) glassivated (see 3.5.5.4) | $5 \times 10^5$ A/cm$^2$ |
| Gold | $6 \times 10^5$ A/cm$^2$ |
| All other | $2 \times 10^5$ A/cm$^2$ |

The current density shall be calculated at the point(s) of maximum current density (i.e., greatest current (see 3.5.5a) per unit cross section) for the specific 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(s) of maximum current density. This current value shall be determined at the maximum recommended supply voltage(s) 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. 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, not intended by design to contribute to current carrying capacity, and nonconducting material shall not be included in the calculation of conductor cross section.

Thick film conductors on hybrid microcircuits or multichip substrates (metallization strips, bonding interfaces, etc.) shall be designated so that no properly fabricated conductor shall dissipate more than 4 watts/cm$^2$ when carrying, maximum design current.

3.5.5.1 Metallization thickness. For class S microcircuits, the minimum metallization thickness shall be 8,000 Å (800 nm) for single level metal and for the top level of multi-level metal, and 5,000 Å (500 nm) for the lower level(s) of multi-level metal. In all cases, the current density requirements of 3.5.5 shall also be satisfied.

3.5.5.2 Internal wire size and material. For class S microcircuits, the internal wire diameter shall be 0.001 inch minimum (0.03 mm) and, except for hybrid microcircuits, the internal lead wire shall be of the same metal as the die metallization.

3.5.5.3 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 (peak current divided by $\sqrt{2}$), 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 the table below for the applicable wire or conductor length and composition used in the device.

| Composition | "K" values for bond-to-bond total conductor length | |
|---|---|---|
| | Length ≤ 0.040" (0.10 cm) | Length > 0.040" (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 |

3.5.5.4 Verification of glassivation layer integrity. Where the current density of aluminum metallization for a device type to be qualified exceeds the allowable current density for unglassivated aluminum, the device type shall be subjected to and pass the requirements of MIL-STD-883, method 2021 prior to part I or part II qualification (whichever comes first) and the glassivation layer integrity sample used along with and a photograph of the etched die shall be submitted with the qualification test report. One resubmission is permitted at twice the sample size. Unless otherwise specified by the qualifying activity, the device type shall be tested after sealing (or after exposure to the time/temperature sealing profile) in the package type that receives the highest temperature range during sealing for which the device type is to be qualified. Changes in design, materials, or process which affect current density or glassivation shall also be evaluated using MIL-STD-883, method 2021. This evaluation applies only when the current density requirements for unglassivated aluminum are exceeded.

3.5.6 Package element material and finish.

3.5.6.1 Package material. *Package body material shall be metal, glass, or ceramic in accordance with* 3.5.1.

3.5.6.2 Lead or terminal material. 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 F15.

b. Type B: Iron-nickel alloy (41 percent nickel): MIL-I-23011, class 5, ASTM F30.

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 and submitted with application to test and as otherwise requested by the qualifying activity.

d. Type D: Copper-core, iron-nickel ASTM F30 alloy (50.5 percent nickel). The core material shall consist of copper (oxygen-free), ASTM B-170, grade 2.

e. Type E: Copper-core ASTM F15 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 nickel): MIL-I-23011, class 2, ASTM F30.

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

3.5.6.3 Microcircuit finishes. Finishes of all external leads or terminals and all external metal package elements shall conform to either 3.5.6.3.2 or 3.5.6.3.3, as applicable. The lead finish designator (see 3.6.2.7) shall apply to the finish of the leads or terminals. The leads or terminals shall meet the applicable solderability and corrosion resistance requirements. The other external 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 the lead bonding requirements and applicable design and construction requirements. The use of strike plates is permissible to the maximum thickness of 10 microinches (0.25 micrometer). 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 parts shall be capable of meeting the following requirements of MIL-STD-883:

a. Method 2004, lead integrity, test condition B1, B2, or D, or method 2028, pin-grid package destructive lead pull test, as applicable.

b. Method 1009, salt atmosphere.

c. Method 2003 or method 2022, solderability (plus time/temperature exposure of burn-in except for devices which have been hot solder dipped or have undergone tin fusing after burn-in).

d. Method 2025, adhesion of lead finish.

Compliance to the above requirements shall be demonstrated when and as specified.

3.5.6.3.1 Finish thickness measurements. Lead finish thickness measurements shall be taken at the seating plane on surface mount leads (such as J-bend and gull-wing type leads) and approximately halfway between the seating plane and the tip of the lead on all other lead types. (This requirement is to avoid having the inspector select a nontypical portion of the lead on which to perform the measurement.) On all lead shapes other than round, the finish thickness measurement shall be taken at the crest of major flats. 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. Finish thickness measurements shall be performed in accordance with one of the following procedures:

a. ASTM B487-79.

b. ASTM B567-79A.

c. ASTM B568.

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. Compliance to the finish thickness requirements shall be demonstrated when and as specified.

3.5.6.3.2 Lead finish. The finish system on all external leads or terminals shall conform to one of the combinations listed in table II, and to the thickness and composition requirements of table III. The finish system shall also conform to the requirements of 3.5.6.3.4 and 3.5.6.3.5, where applicable.

3.5.6.3.3 Package element (other than lead or terminal) finish. External metallic package elements other than leads and terminals (e.g., lids, covers, bases, and seal rings) shall meet the applicable environmental requirements without additional finishing of the base materials or else they shall be finished so they meet those requirements using a finish system conforming to one of the combinations listed in table IV, and conforming to the thickness and composition requirements of table III. The finish system shall also conform to the requirements of 3.5.6.3.4 and 3.5.6.3.5, where applicable.

3.5.6.3.4 Hot solder dip. The hot solder dip shall be homogeneous and shall be applied as follows:

a. All outlines with hot solder dip over compliant coating. The hot solder dip shall extend beyond the effective seating plane. If the seating plane is not defined, the hot solder dip shall extend to within .030 inch (0.76 mm) of the lead/package interface. 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.

b. All outlines with hot solder dip over base metal or noncompliant coating. The solder shall extend to the glass seal or point of emergence of the metallized contact or lead through the package wall. If solder is applied up to the seal, a hermeticity test (method 1014, LTPD 2(1)) shall subsequently be performed and passed. For leadless chip carrier devices, the hot solder dip shall completely cover the metallized side castellation or notch and metallized areas above and below the notch, except the index feature if not connected to the castellation.

3.5.6.3.5 Tin and tin-lead plate. Tin plate shall be fused after plating before or after burn-in by heating above its liquidus temperature. Fusing of tin plate on leads is not required under either of the following conditions:

a. The tin plate meets 300-microinch thickness requirement of table III and the leads are subsequently hot solder dipped in accordance with 3.5.6.3.4a.

b. The leads are subsequently hot solder dipped in accordance with 3.5.6.3.4b.

Tin-lead plate may be fused after plating before or after burn-in by heating above its liquidus temperature. Tin and lead-tin plate shall be visually inspected after fusing and shall exhibit a dense, homogeneous, and continuous coating. The visual inspection after fusing shall be conducted on a sample basis by the manufacturer as an in-process control. Visual inspection of the fusing shall be performed at a frequency sufficient to assure continuous compliance with these requirements on the finished product.

TABLE II. Lead finish systems.

| Finish | Applied over | | Required underplate | | |
|---|---|---|---|---|---|
| | Gold plate | Tin plate | Electroplated nickel | Electroless nickel 1/ | None |
| Hot solder dip 2/ | | | | | X |
| Hot solder dip 2/ | | | X | | |
| Hot solder dip 2/ | | | | X | |
| Hot solder dip 2/ | | X | | | X |
| Hot solder dip 2/ | | X | X | | |
| Hot solder dip 2/ | | X | | X | |
| Hot solder dip 2/ | X | | X | | |
| Hot solder dip 2/ | X | | | X | |
| Tin plate 3/ | | | | | X |
| Tin plate 3/ | | | X | | |
| Tin plate 3/ | | | | X | |
| Tin-lead plate 3/ | | | | | X |
| Tin-lead plate 3/ | | | X | | |
| Tin-lead plate 3/ | | | | X | |
| Tin-lead plate 3/ | | X | | | X |
| Tin-lead plate 3/ | | X | X | | |
| Tin-lead plate 3/ | | X | | X | |
| Gold plate | | | X | | |
| Gold plate | | | | X | |

1/ Electroless nickel shall not be used as the undercoat on flexible or semi-flexible 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.

2/ Hot solder dip shall be applied in accordance with 3.5.6.3.4.

3/ Tin plate shall be fused in accordance with 3.5.6.3.5. Fusing of tin-lead plating is permitted in accordance with 3.5.6.3.5.

TABLE III. Coating thickness and composition requirements.

| Coating | Thickness (microinch/micrometer) | | Coating composition requirements |
|---|---|---|---|
| | Minimum 1/ | Maximum 2/ | |
| Hot solder dip (for round leads) 3/ | 60/1.52 | NS | The solder bath shall have a nominal composition of Sn60 or Sn63. |
| Hot solder dip (for all shapes other than round leads) 3/ | 200/5.08 | NS | The solder bath shall have a nominal composition of Sn60 or Sn63. |
| Tin plate (as plated) 4/ | 300/7.62 | NS | Shall contain no more than 0.05 percent by weight co-deposited organic material measured as elemental carbon. 5/ |
| Tin plate (fused) 4/ | 200/5.08 | NS | |
| Tin-lead plate (as plated) 4/ | 300/7.62 | NS | Shall consist of 2 to 50 percent by weight lead (balance nominally tin) homogeneously co-deposited. Shall contain no more than 0.05 percent by weight co-deposited organic material measured as elemental carbon. 5/ |
| Tin-lead plate (fused) 4/ | 200/5.08 | NS | |
| Gold plate | 50/1.27 | 225/5.72 | Shall contain a minimum of 99.7 percent gold. Only cobalt shall be used as the hardener. |
| Nickel plate (electroplate) | 50/1.27 | 350/8.89 | The introduction of organic addition agents to nickel bath is prohibited. Up to 40 percent by weight cobalt is permitted as a co-deposit. |
| Nickel plate (electroless) | 50/1.27 | 250/6.35 | The introduction of organic addition agents to nickel bath is prohibited. |
| Nickel cladding | 50/1.27 | 350/8.89 | |

1/ Package elements having noncompliant coatings are permitted provided they are subsequently hot solder dipped in accordance with 3.5.6.3.4b.

2/ NS = not specified.

3/ See 3.5.6.3.4.

4/ See 3.5.6.3.5.

5/ The maximum carbon content (and minimum lead content in tin-lead plate) shall be determined by the manufacturer on at least a weekly basis. 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 fluorescence, emission spectroscopy) so long as the assay reflects the actual content in the deposited finish.

TABLE IV. Package element (other than leads/terminals) finish systems.

| Finish | Applied over | | Required underplate | | | |
|---|---|---|---|---|---|---|
| | Gold plate | Tin plate | Electroplated nickel 1/ | Electroless nickel 1/ | Nickel cladding 1/ | None |
| Hot solder dip | | | | | | X |
| Hot solder dip | | | X | | | |
| Hot solder dip | | | | X | | |
| Hot solder dip | | | | | X | |
| Hot solder dip | | X | | | | X |
| Hot solder dip | | X | X | | | |
| Hot solder dip | | X | | X | | |
| Hot solder dip | | X | | | X | |
| Hot solder dip | X | | X | | | |
| Hot solder dip | X | | | X | | |
| Hot solder dip | X | | | | X | |
| Tin plate 2/ | | | | | | X |
| Tin plate 2/ | | | X | | | |
| Tin plate 2/ | | | | X | | |
| Tin plate 2/ | | | | | X | |
| Tin-lead plate 2/ | | | | | | X |
| Tin-lead plate 2/ | | | X | | | |
| Tin-lead plate 2/ | | | | X | | |
| Tin-lead plate 2/ | | | | | X | |
| Tin-lead plate 2/ | | X | | | | X |
| Tin-lead plate 2/ | | X | X | | | |
| Tin-lead plate 2/ | | X | | X | | |
| Tin-lead plate 2/ | | X | | | X | |
| Gold plate 3/ | | | X | | | |
| Gold plate 3/ | | | | X | | |
| Gold plate 3/ | | | | | X | |
| Electroplated nickel 1/ | | | | | | X |
| Electroless nickel 1/ | | | | | | X |
| Nickel cladding 1/ | | | | | | X |

1/ Combinations of electroplated nickel and electroless nickel and nickel cladding are permitted.

2/ Tin plate shall be fused on all surfaces exposed to the package/case cavity in accordance with 3.5.6.3.5. Fusing of tin-lead plate is permitted in accordance with 3.5.6.3.5.

3/ Multilayer gold and nickel finish structures are acceptable provided the outer gold layer meets a minimum thickness of 25 microinches (0.635 micrometer), the total of the gold layers meet a minimum thickness of 50 microinches (1.27 micrometers), and each of the nickel undercoats meet the thickness requirements of table III with the total nickel thickness not to exceed 450 microinches (11.43 micrometers). For multilayer finish structures, nickel plate, nickel cladding, or gold plate are permitted on the base metal.

3.5.7 Die plating and mounting. Pure glass shall not be used for microcircuit die mounting. Metal glass die mounting is acceptable with qualifying activity approval. Electroplated and electroless plated gold backing on dice shall not be used, with the exception of GaAs dice which may use electroplated gold backing.

* 3.5.8 Glassivation. All microcircuits shall be coated with a transparent glass or other approved coating. Integrated circuits used in hybrid microcircuits shall be glassivated unless otherwise specified. The minimum glassivation thickness shall be 6000 Å (600 nm) for $SiO_2$, 2,000 Å (200 nm) for $Si_3N_4$, or approved thicknesses for approved coatings. The composition and minimum thickness of other approved coatings are subject to approval by the qualifying activity. The glassivation/nitridation shall cover all electrical conductors except the bonding or test pads. NOTE: For GaAs microwave microcircuits, the glassivation or nitride dielectric shall cover the semiconductor regions (e.g., FET) of the device and planar thin film resistors as a minimum. Furthermore; for class S devices, the glassivation or nitride dielectric shall cover regions where conductors are separated by less than the minimum particle size detectable by a PIND test. For RF/microwave GaAs microcircuits, the manufacturer shall define appropriate glassivation thickness requirements for the technology in the internal baseline documentation.

3.5.9 Die thickness. The minimum die thickness for all microcircuits shall be 0.006 inch (0.15 mm). For GaAs microcircuits, the minimum die thickness shall be 0.003 inch (0.076 mm).

3.5.10 Laser scribing. For class S microcircuits, laser scribing shall not be used for die separation except for backside scribing of silicon on sapphire (SOS) wafers.

3.5.11 Internal lead separation for class S devices. For class S devices, the minimum separation of the internal leads (excluding conductors which are at the die or substrate potential) from the unglassivated surface of the die shall be a minimum of 1.0 mil. This design requirement shall be verified during qualification and during group B internal visual and mechanical test in accordance with MIL-STD-883, method 5005.

* 3.6 Marking of microcircuits. Marking shall be in accordance with the requirements of this specification, and the identification and marking provisions of the detail specification or drawing. The marking shall be legible and complete, and shall meet the resistance to solvents requirements of MIL-STD-883, method 2015. When laser marking is performed, it shall be clearly visible through those conformal coatings approved for use in MIL-M-46058, (see method 2015 of MIL-STD-883 if contrasting material or ink is used to highlight the trace). Laser marked metal surfaces shall have been submitted to and passed all group D test requirements. 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 placed on each microcircuit. If any special marking (e.g., altered item drawing number) is used by the device supplier or user/equipment contractor, it shall be in addition to the existing/original marking as required herein and shall be visibly separate from and in no way interfere with the marking required herein. The device manufacturer alone is authorized to apply or remove the JAN brand on microcircuits built in accordance with this specification. The following shall be placed on each microcircuit:

a. Index point (see 3.6.1).

b. PIN (see 3.6.2).

c. Identification codes (see 3.6.3).

d. Manufacturer's identification (see 3.6.4).

e. Manufacturer's designating symbol (see 3.6.5).

f. Country of origin (see 3.6.6).

g. "JAN" certification mark (see 3.6.7).

h. Serialization, when applicable (see 3.6.8).

i. Special marking (see 3.6.9, 3.6.9.1).

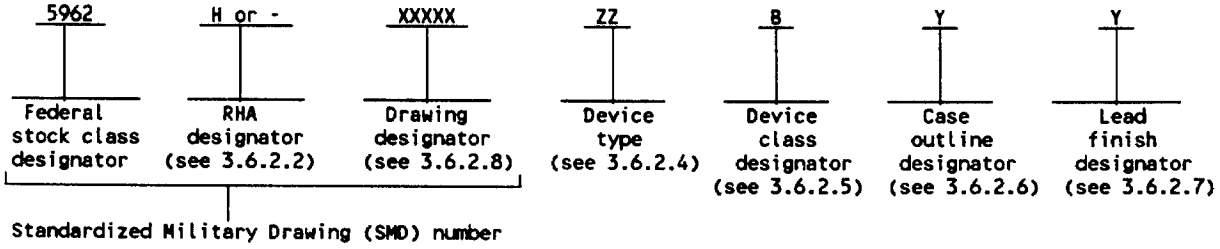
j. Electrostatic discharge sensitivity identifier (see 3.6.9.2).

NOTE: All devices shall be marked by the manufacturer in such a manner as to leave space for additional unique marking (assigned and applied by the user or called out in the purchase order or contract).

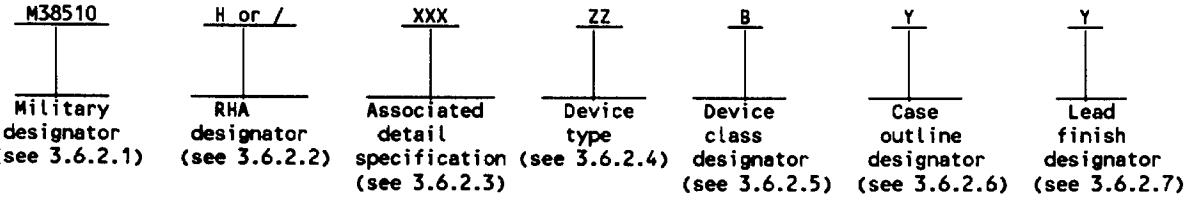
3.6.1 Index point. The index point, tab, or other marking indicating the starting point for numbering of leads or for mechanical orientation shall be as specified (see MIL-STD-1835) and shall be designed so that it is visible from above when the microcircuit is installed in its normal mounting configuration. The outline of equilateral triangle(s) (Δ) which may be used as an electrostatic identifier (see 3.6.9.2), may also be used as the pin 1 identifier.

* 3.6.2 PIN. Each microcircuit shall be marked with the complete PIN. The PIN may be marked on more than one line provided the PIN is continuous except where it "breaks" from one line to another. The PIN system shall be as follows:

The PIN for the new one part-one part number system shall be as follows:




The PIN for the associated military detail specification documents, dated prior to 27 July 1990, shall be as follows:




All new PINs specified by new documents, dated after 27 July 1990, shall be in accordance with the one part-one part number system.

All PINs specified by existing associated military detail specifications with the number assigned prior to 27 July 1990, may use either the original assigned PIN or the one-part one-part number system with the first two digits in the drawing designator being "38" and the last three being the associated detail specification number (see 3.6.2.8).

3.6.2.1 Military designator. The M38510 military designator for microcircuits means a "MIL" specification item produced in full compliance with MIL-M-38510 including qualification, and the referenced military detail specification (see 3.6.2.3). Any device which does not meet all the requirements of this specification and the applicable military detail specification shall not be marked M38510 and shall not make reference to MIL-M-38510, except when QPL listing for that device does not exist and qualification is waived by the preparing activity. When qualification has been waived, the devices shall not be marked "JAN" or "J" (see 3.6.7) and shall be subjected to and pass all the specified screening and quality conformance tests in accordance with the applicable military detail specification. After completion of the quality conformance tests, the manufacturer shall notify the qualifying activity and shall be prepared to submit to the qualifying activity and/or acquiring activity, upon request, certification that the devices were subjected to and passed all the screening and quality conformance tests as stated above. Violation of requirements of this paragraph and the requirements of 3.1 and 3.6.7 may be cause for removal of the manufacturer's product from the Qualified Products List, QPL-38510.

NOTE: The military designator is optional for leadless chip carrier outlines which have a surface area smaller than the C-10 package provided the full certification mark "JAN" is used rather than the abbreviation "J".

3.6.2.2 RHA designator. A "/" or "-" indicates no radiation hardness assurance. Letters M, D, R, or H designator levels are defined in 3.4.1.3.

NOTE: The letter designator for hardness assured hybrid microcircuits shall reflect no greater hardness level than the lowest level of any active device chip used in that hybrid (i.e., if a hybrid uses only M and D chips, the hybrid shall be designated no better than M. If any undesignated chips are employed, the hybrid microcircuit shall not have any hardness assurance designator.).

3.6.2.3 Associated detail specification. The associated detail specification shall consist of three digits from 001 to 999 as applicable.

3.6.2.4 Device type. The device type number shall be as specified in the associated detail specification or SMD. The numbers shall consist of two digits assigned sequentially, from 01 to 99 within each associated detail specification or SMD.

3.6.2.5 Device class. The device class shall be designated by a single letter identifying the quality assurance level.

3.6.2.6 Case outline. The case outline shall be designated by a single letter assigned to each outline.

3.6.2.7 Lead finish. Lead frame or terminal material and finish shall be as specified in 3.5.6. The lead finish shall be designated by a single letter as follows:

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

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, or 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 B or C lead finish designator as determined by availability. Type C terminal material is a fired on metallization used with leadless chip carriers.

3.6.2.8 Drawing designator. For new one part-one part number drawings without existing associated detail specifications the first two characters of the drawing designator will consist of the last two digits of the year and the last three characters will consist of unique characters assigned to the drawing by DESC. When an existing MIL-M-38510 associated detail specification PIN is converted to a one part-one part number PIN via a substitution statement, the first two characters of the drawing designator of the one part-one part number will be replaced with the first two digits of MIL-M-38510 (i.e., 38), and the last three characters of the one part-one part number will be replaced with the three digit identifier assigned to the associated detail specification (e.g., M38510/00101BAC will become 5962-3800101BAC).

3.6.3 Identification codes. Identification codes shall be as follows.

3.6.3.1 Class B die fabrication date code. Class B microcircuits shall be marked with a unique code to identify the year and quarter in which the die fabrication was started (or completed at the manufacturer's predesignated option). The first character of the code shall be the last digit of the year in which die fabrication started (or completed at the manufacturer's predesignated option). The second character of the code shall be a letter (A, B, C, or D) respectively designating the first quarter (weeks 1 - 13), the second quarter (weeks 14 - 26), third quarter (weeks 27 - 39), or fourth quarter (weeks 40 - 52 or 53) of the calendar year of die fabrication.

3.6.3.2 Inspection lot identification code for class S and B. Microcircuits shall be marked with a unique code to identify the inspection lot (see 3.1.3.7 and 3.1.3.8) and identify the first or the last week of the period (6 weeks maximum) during which devices in that inspection lot were sealed. At the option of the manufacturer, the actual week of seal may be used. The first two numbers in the code shall be the last two digits of the number of the year, and the 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. When two or more different inspection lots (or class S sublots), each having the same part number, are to be marked with the same identification code, a unique suffix letter representing each additional inspection lot (or class S sublot) shall appear immediately following the identification code. Once assigned, the inspection lot identification code shall not be changed.

NOTE: These die fabrication date codes may be combined with the inspection lot identification code as shown:

| FAB YR | FAB QTR | ASSY YR | ASSY WK | Unique suffix |
|---|---|---|---|---|
| 6 | B | 87 | 10 | A |
| 1986 | 2nd qtr | 1987 | 10 | First lot |

3.6.4 Manufacturer's identification. Microcircuits shall be marked with the name or trademark of the manufacturer. The identification of the equipment manufacturer may appear on the microcircuit only if the equipment manufacturer is also the 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 that manufacturer's plant(s). In the case of small 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 U.S.A." shall be marked in small characters below or adjacent to the other marking specified, except that for 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 JAN microcircuits only, the country of origin marking may be omitted from the body of the microcircuit but shall be retained on the initial container.

3.6.7 "JAN" certification mark. All microcircuits acquired to and meeting the requirements of this specification and the applicable associated detail specification, and which are approved for listing on QPL-38510 shall bear the "JAN" certification mark (if manufactured in the U.S.) preceding the PIN except for small devices, where the abbreviation "J" may be used. For product manufactured outside the U.S., the quality conformance certification mark of the country in which the product was manufactured shall be used in place of the JAN brand. The "JAN" certification mark or the abbreviation "J" shall not be used for any microcircuit acquired under contracts or orders which permit or require any changes to this specification or in the applicable detail specification which affect the form, fit, or function of the microcircuit or adversely affect quality or reliability. The "JAN" certification mark is registered as a U.S. Government certification mark as number 504860 by the U.S. Patent Office, and its application shall constitute certification by the manufacturer that all tests of the applicable detail 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 "JAN" or "J" certification mark, the M38510 military designator (as defined in 3.6.2.1) and all reference to MIL-M-38510 from the sample tested and also from all devices represented by the sample. The "JAN" or "J" certification mark shall not be used on product acquired to contractor-prepared drawings or specifications.

* 3.6.7.1 Extra tests and screens. If contractually required by the customer, the use of nondestructive tests or screens (including environmental test screens, rescreening, or acceptance testing which does not affect form, fit, or function) to assess or verify the quality or reliability of microcircuits when used within their specified operating performance envelope shall be permitted and shall not result in the deletion of the JAN brand or PIN. Devices which have had extra tests or screens performed on them in response to a specific contractor order cannot be restocked and sold as virgin JAN product. These additional tests or screens shall not necessitate preparation of an additional or substitute specification or drawing (i.e., nothing shall be done to change the true identity of the actual part) provided such tests or screens that do not effect form, fit, or function, are performed by the QPL manufacturer or an authorized distributor (i.e., authorized by the JAN manufacturer to perform the specific tests required) under the device manufacturer's control, to minimize the risk of damage due to improper handling or testing. It is recommended that such tests or screens be performed by a laboratory that has DESC laboratory suitability. Because these tests obviously contribute to increase cost and risk of damage due to handling, it is strongly

recommended that any such tests believed to be necessary should be incorporated in the original device specification rather than become the subject of additional requirements composed after normal device processing (e.g., PIND test, radiography, additional temperature cycling, or burn-in).

3.6.8 Serialization. Prior to the first recorded electrical measurement in screening each class S microcircuit and, when specified, each class B microcircuit shall be marked with a unique serial number assigned consecutively within the inspection lot. This serial number allows traceability of test results down to the level of the individual microcircuit within that inspection lot (see 4.4.2.1.1). For class S, inspection lot records shall be maintained to provide traceability from the serial number to the specific wafer lot from which the devices originated.

3.6.9 Marking location and sequence. The "JAN" or "J" certification mark, the PIN, identification codes and ESDS identifier shall be located on the top surface of leadless or leaded chip carriers, pin grid array packages, flat packages, or dual-in-line configurations and on either the top or the side of cylindrical packages (TO configurations and similar configurations). When the size of a package is insufficient to allow marking of special process identifiers on the top surface, the backside of the package may be used for these markings except the ESDS 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. Backside marking with conductive or resistive ink shall be prohibited.

NOTE: C01 marking previously used for optional nondestructive bond pull (NDBP) test is no longer active since NDBP is now mandatory for all class S devices. Also, C02 and C03 total dose radiation hardness identifiers have been replaced by the "R" and "H" designators respectively.

3.6.9.1 Beryllium oxide package identifier. If a microcircuit package contains beryllium oxide (see 3.5.1 note), the part shall be marked with the designation "BeO".

3.6.9.2 Electrostatic discharge sensitivity identifier. Microcircuits shall be ESDS classified in accordance with 3.4.1.4 and marked with the applicable ESDS identifier.

a. Class 1 - 1999 V and below - Δ - single equilateral triangle in outline or solid form (still acceptable as pin one designator).

b. Class 2 - 2000 V - 3999 V - Δ Δ - double equilateral triangle in outline or solid form (still acceptable as pin one designator).

c. Class 3 - 4000 V and above - no designator.

3.6.10 Marking on container. See 5.1.2 for additional marking requirements.

3.6.11 Marking option for controlled storage of class B. Where 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 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 inspections to the specified level.

3.6.12 Marking option for qualification or quality conformance inspection. The manufacturer has the option of marking the entire lot or only the sample devices to be submitted to qualification or groups B, C, and D (and E if applicable) quality conformance inspection, as applicable. 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 (and E if applicable) qualification or quality conformance inspections, as applicable.

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

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

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

3.6.13 Remarking. If sealed devices are remarked (to change or correct the marking as specified in 3.6), the reason for remarking and a description of the process shall be recorded in the qualification test report and quality conformance test record. In addition to the tests described below for qualification of the remarking procedure, subgroup B-2 and internal visual and mechanical tests (method 2014 with sample size/(accept no.) of 1(0) for class B devices and subgroups B-2a and B-2b (method 2014 only) for class S devices shall be performed on each remarked lot to assure marking permanency and that markings and device type coincide. For class B only, in lieu of internal visual and mechanical tests, a group A tests at elevated temperature (i.e., +125°C) with sample size/(accept no.) of 116(0) may be performed. Remarking procedures shall be approved by the qualifying activity. Approval shall be required once only for each package material (i.e., lid, base) composition (regardless of package configuration), or at change of remarking procedures or materials. For qualification of the remarking procedure, a sample of remarked devices shall be tested to the following test methods according to method 5005 of MIL-STD-883:

a. Method 2015, resistance to solvents (4 devices).

b. Method 1011, thermal shock (test condition B, 15 cycles minimum).

c. Method 1004, moisture resistance.

d. Method 1009, salt atmosphere.

NOTE: Electrical tests are not required. Visual inspection, after each test in accordance with applicable failure criteria, shall be conducted.

3.7 Workmanship. 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 quality assurance program (see appendix A).

* 3.7.1 Rework provisions. All rework (see 3.1.3.16) permitted on microcircuits acquired under this specification shall be accomplished in accordance with procedures and safeguards documented in accordance with 30.1.1.6 of appendix A and available for review by the qualifying and acquiring activity. In addition, all rework operations shall be clearly identified on each process flowchart. Allowable rework of sealed packages includes recleaning of any microcircuit or portion thereof, any rebranding (see 3.6.13) to correct defective marking and lead straightening (provided the reworked devices meet the requirements of 4.6.2 for conditions of leads). In the event of equipment failure beyond manufacturer control, continuation of processing is permitted and is considered allowable rework provided material is not removed from equipment prior to completion of the process cycles. Additional etch to correct a nonconformance to a specification limit, photoresist strip and redeposition, and strip and redeposition of layer(s) used exclusively as a masking function (e.g., nitride, nitride glass) which are removed prior to the next processing operation, is not considered rework. The strip and redeposition of backside metalization is considered allowable rework. No delidding or package opening for rework shall be permitted for microcircuits of any class. For monolithic microcircuit wafers of any class, the strip and redeposition of a layer or additional processing to correct a nonconformance to a specification limit is not allowed, except as specified above. For class S any assembly rework operation prior to package seal is not allowed, except as specified in 3.7.1.1.

* 3.7.1.1 Rebonding of monolithic devices. Visual criteria for rebonding and rebonding limitations for class S and class B monolithic microcircuits shall be in accordance with test method 2010, Internal Visual (Monolithic), of MIL-STD-883, (see 3.2.1.4i and 3.2.1.5). For class S devices the manufacturer's rebonding operation and rebonding procedure shall be documented in accordance with 30.1.1.6 of Appendix A, and will be audited during the periodic class S audits. Rebonding shall be limited to the bonding operation only.

3.7.1.2 Rebonding and element replacement for hybrid and multichip microcircuits. Rework provisions of 3.7.1.1 shall apply to all semiconductor die used in hybrid and multichip microcircuits. In addition and unless otherwise specified, rebonding and replacement of attached elements in hybrid and multichip microcircuits shall be permitted with the following limitations:

a. One scratched, open, or discontinuous substrate metallization path or conductor pattern may be repaired by bridging with or by addition of a minimum of two bonding wires or a ribbon having equivalent current carrying capacity.

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 the underlying metallization or substrate is exposed.

c. The total number of rebond attempts (exclusive of total element replacement) shall be limited to a maximum of 10 percent of the total number of bonds in the microcircuit. The 10 percent limit on rebond attempts may be interpreted as the nearest whole number to the 10 percent value. A bond shall be defined as a wire to post or wire to pad bond (i.e., for a 14 lead wire-bonded package there are 28 bonds). Bond-offs required to clear the bonder after an unsuccessful first bond attempt need not be considered as rebond attempts provided they can be identified as bond-offs by being made physically off the plated post or if they contain a nontypical number of wedge marks. The initial bond attempt need not be visible. A replacement of one wire bonded at one end or an unsuccessful bond attempt at one end of the wire counts as one rebond attempt; a replacement of a wire bonded at both ends, or an unsuccessful bond attempt of a wire already bonded at the other end counts as two rebond attempts. Compound bonds shall not be allowed, except as specified in method *2017 of MIL-STD-883*.

d. The total number of times a hybrid or multichip microcircuit may be subjected to interconnection bonding or element placement is limited to three cycles (i.e., after the completion of the first bonding or element placement cycle, the microcircuits cannot be exposed to these conditions more than two additional times). Rebonding to substrate pad or package post when performed to effect element replacement shall not be counted against the rebond limitation of 3.7.1.2c.

e. Regardless of the number of allowable rebonds or element replacement in the microcircuit, the rework shall be accomplished in no more than two recycles of any single microcircuit.

## 4. QUALITY AND RELIABILITY 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 as specified herein and in the associated detail specification. Except as otherwise specified in the contract or purchase order, the contractor may use his own or other suitable facilities (which for JAN microcircuits have been approved and granted laboratory suitability by the qualifying activity for the performance of the tests and inspection requirements specified herein). The Government or acquiring activity reserves the right to witness or perform any of these tests and inspections set forth herein or in the associated detail specification and to audit the data resulting from the manufacturer's performance of these tests and inspections. 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 quality conformance inspection step or 100 percent screen operation by substituting a process monitor or statistical process control procedure (when allowed in Methods 5004 and 5005 of MIL-STD-883), the manufacturer is only relieved of the responsibility of performing the QCI or 100 percent screen operation. However, the manufacturer is still responsible for providing product which meets all of the performance, quality, and reliability requirements herein.

4.1.1 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 acquisition documentation and quality standards of microcircuits manufactured to this specification and the applicable associated detail specification.

4.1.1.1 Metal package isolation test for class S devices. Prior to die mount, each metal-bodied package with leads glass-isolated within .005 inch (0.13 mm) of the metal body shall have 600 V dc applied between the case and leads not connected to the case. Packages which exhibit leakage greater than 100 nA shall be rejected.

4.1.1.2 Control of processes and procedures. When applicable, die attachment, wire bonding, lid sealing, lead trimming, and final lead finish thickness operations shall be monitored in accordance with MIL-STD-976.

4.1.1.3 Inspection verification for class S 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. Sampling shall be to an LTPD of 10. Lots failing to meet the LTPD requirement shall be 100 percent reinspected and resampled to an LTPD of seven.

4.1.2 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 microcircuits conform to all the requirements of this specification, the detail specification, and other provisions of the applicable acquisition documentation.

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 30.1.2 of appendix A.

4.1.4 Government source inspection. Government source inspection shall be required as a condition for the use of a "JAN" brand on all microcircuit devices acquired to the requirements of this specification and the applicable military detail specification. Government source inspection shall apply to qualification, quality conformance inspection, screening, and all records required by 30.1.2.7 of appendix A. In the event of limited inspection resources, the Government Source Inspector shall arrange the schedule for the performance of inspections, surveillance, audit, or reviews so as to maximize the effectiveness of the inspection function.

4.1.4.1 Government source inspection for class S devices. For each class S inspection lot, Government personnel and other Government designated representatives (when required by contract or order) shall perform surveillance and monitoring functions related to inspections, assembly, and wafer fabrication from wafer 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/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 wafer lot acceptance results.

b. Right to witness and analyze SEM photography of applicable wafers.

c. Perform visual inspection at pre-seal (at each power specified) on a sample basis unless 100 percent inspection is required.

d. Surveillance of in-process die shear test.

e. Surveillance of in-process bond strength test(s).

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

g. Surveillance of group B tests required by (b), (c), and (d) of subgroup 2 of table IIa, method 5005 of MIL-STD-883.

h. Audit of documentation of each lot.

i. Surveillance of failure analysis, Destructive Physical Analysis (DPA) activities and the results and corrective actions related thereto.

j. Surveillance of radiation hardness assurance tests.

k. Surveillance of ESDS classification tests.

4.1.4.2 Government source inspection for class B devices. For class B inspection lots, Government personnel and other Government designated representatives will perform surveillance and monitoring functions related to screening and quality conformance inspections, assembly and processing steps back to the wafer fabrication line. These surveillance and monitoring functions are reflected in the procedures of section III, part 5 of DLAM 8200.2

4.1.4.3 Government source inspection for suppliers. The supplier (whether manufacturer, distributor, dealer, stocker, etc.) shall have an inventory control system for JAN branded or other QPL-38510 devices which documents and maintains traceability by quantity accumulated and distributed on each device lot or partial lot (i.e., as identified by common PIN, inspection lot identification code and manufacturer) to the original manufacturer or (where intermediate transaction(s) is involved) to the previous supplier(s).

All suppliers of JAN or other QPL-38510 microcircuits shall be prepared to provide to any customer, when required by purchase order or contract, copies of the actual records of processing or a certification as to the origin and their own transactions and handling of microcircuits ordered from them including copies of the actual records of processing or certification(s) from their supplier(s).

Any supplier of JAN or other QPL-38510 microcircuits shall make details of their inventory control system and traceability documentation available to an authorized Government representative for inspection (acceptance) upon request.

4.1.5 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.

4.1.6 Distributor inventory, traceability and handling control. Distributors shall, as a minimum, maintain adequate inventory control system, traceability documentation required by this specification and their appropriate certification, adequate handling, storage, and repackaging methods to protect quality and prevent damage and degradation of products.

* 4.2 Procedures for lots held by manufacturers for more than 36 months. Microcircuits held by manufacturers or distributors for a period exceeding 36 months from the date of the inspection lot identification code shall be demonstrated to be solderable in accordance with subgroup B-3 of test method 5005 of MIL-STD-883 prior to shipment. The devices shall retain the original inspection lot identification code (see 3.6.3), and an updated certificate shall accompany all shipments of devices to the Government or its contractors or subcontractors. Records of reinspection shall be maintained as specified in 30.1.2 of appendix A. The requirements for group A reinspection have been deleted. However, it is recommended that devices with inspection lot identification codes in excess of 36 months be demonstrated to be functional prior to next level assembly (i.e., that the devices have not been damaged or degraded by storage or handling).

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

4.3.1 Classification of inspections and tests. The inspections and tests required to assure conformance to the specified quality assurance levels of microcircuits or lots thereof are classified as follows:

| Requirement | Paragraph |
|---|---|
| Qualification procedures | 4.4 |
| Quality conformance inspection | 4.5 |
| Inspection of packaging | 4.5.9 |
| Screening | 4.6 |
| Individual photomicrographs | 4.7 |
| Data recording | 4.8 |

4.3.2 Sampling. Statistical sampling for qualification and quality conformance inspections shall be in accordance with the sampling procedures of appendix B of this specification, and as specified in the associated detail 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 4.3.5, 4.4.2.1.1, 4.4.2.1.3). These devices shall be used in predesignated order. Initial samples (and added samples, when applicable) shall be randomly selected from the inspection lot or sublot, as applicable. After a test has started, the manufacturer may add an additional quantity to the initial sample, but this

may be done only once for any subgroup with a specified LTPD. Add-on samples are not allowed for fixed sample size subgroups nor for resubmitted lots. The added samples shall be subjected to all the tests within the subgroup. The total samples (initial and added samples) shall determine the new acceptance number. The total defectives of the initial and second sample shall be additive and shall comply with the specified LTPD. The manufacturer shall retain sufficient microcircuits from the lot to provide for additional samples.

4.3.2.1 Disposal of samples. Devices 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, and clearly identified so as to prevent their being mistaken for acceptable product. As a minimum, the "JAN" or "J" certification mark and the M38510 military designator shall be removed or obliterated prior to delivery. Sample microcircuits, from lots which have passed quality assurance inspections or tests and which have been subjected to mechanical or environmental tests specified in groups B, C, and D inspection and not classified as destructive, may be shipped on the contract or purchase order provided the test has been proved to be nondestructive (see 4.3.2.2) and each of the microcircuits subsequently passes final electrical tests in accordance with the applicable device specification.

4.3.2.2 Destructive tests. The following MIL-STD-883 tests shall be classified as destructive:

Internal visual and mechanical (method 2014).
Bond strength.
Solderability (except for lead finish A).
Moisture resistance.
Lead integrity.
Salt atmosphere.
SEM inspection for metallization.
Steady-state life test (accelerated).
Die shear strength test.
Total dose radiation hardness test.
Neutron irradiation.
Electrostatic discharge sensitivity classification test.
Lid torque test.
Adhesion of lead finish.
Vibration, variable frequency.
Internal water vapor test.

All other mechanical or environmental tests (other than those listed in 4.3.2.3), 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 test on the same sample of product, without evidence of cumulative degradation or failure to pass the specified test requirements in any 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.

4.3.2.3 Nondestructive tests. The following tests are classified as nondestructive:

Barometric pressure
**Steady state life
**Intermittent life
Seal
External visual
Internal visual (pre-cap)
**Burn-in screen
Radiography
Particle impact noise detection
Physical dimensions
Nondestructive 100 percent bond pull test where stress does not exceed the specified pull force and positive tolerance
Resistance to solvents
Solderability (for lead finish A only)

**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.

4.3.3 Formation of lots. Microcircuits shall be segregated into identifiable production lots as defined in 3.1.3.6 as required to meet the production control and inspection requirements of appendix A. Microcircuits shall be formed into inspection lots as defined in 3.1.3.7 and 3.1.3.8 as required to meet the quality assurance inspection and test requirements of this specification.

Wafer lot processing as a homogeneous group (see 3.1.3.11) 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 step(s) simultaneously.

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

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

* 4.3.3.1 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 qualification or quality conformance inspection fails any subgroup requirement of group B, C, or D tests, it may be resubmitted once for that particular subgroup using tightened inspection criteria (as defined in 40.2.6 of appendix B). Resubmission for group A inspection failure is not permitted. In case of group B, subgroup B-2a failure, the entire lot may be remarked as defined in 3.6.13. The remarked lot shall not be acceptable for alternate group B (class B only) coverage of a standard lot (see 4.5.8.2 for recovery). For fixed sample size subgroups, lots may be resubmitted one time only at double the sample size with zero failures allowed. All submissions shall be subject to the sampling requirements of 4.3.2. A second resubmission (class S lots shall be resubmitted one time only) using a second tightened inspection criteria is permitted only if failure analysis is performed to determine the mechanism of failure for each failed microcircuit from the prior submissions and it is determined that failure(s) is (are) due to:

a. A defect that can be effectively removed by rescreening or reworking the entire lot (see 3.7.1).

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.

4.3.4 Test method deviation. Deviations from test methods or test circuits specified are allowed provided that it is demonstrated to the qualifying activity and specifying activity that such deviations in no way relax the requirements of this specification and that they are approved before testing is performed. The specifying activity shall be notified by the device manufacturer of any test method deviation approved/implemented by the qualifying activity. For proposed electrical test deviations, schematic wiring diagrams of the test equipment shall be made available for checking by the qualifying activity.

4.3.5 Procedure in case of test equipment failure or operator error. Whenever a microcircuit is believed to have failed as a result of faulty test equipment or operator error, unless otherwise specified in the test method, 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 lot jeopardy is involved and failure occurs during the processing of JAN microcircuits or Government Source Inspection (GSI) is required for other than JAN microcircuits, the Government Quality Assurance Representative (QAR) shall be notified within 1 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 be attributed to equipment/operator error for screening, group A, and end-point electrical tests of method 5005 of MIL-STD-883.

4.3.5.1 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 product has not been damaged or degraded, a replacement microcircuit from the same inspection lot may be added to the sample. The replacement

microcircuit shall be subjected to all those tests to which the discarded microcircuit was subjected prior to its failure and to any remaining specified tests to which the discarded microcircuit was not subjected prior to its failure. The manufacturer, at his own risk, has the option of replacing the failed microcircuit and continuing with the tests before the validity of the test equipment failure or operator error has been established.

4.3.5.2 Procedure for screening tests. When it has been established that lot failure(s) during screening test(s) are 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 tests(s) 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).

4.3.5.3 Failure and corrective action reports. When the procedures of 4.3.5.1 and 4.3.5.2 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.

4.3.6 Test equipment verification. The manufacturer shall define and utilize a method (e.g., correlation samples, diagnostic routines, etc.) to verify the measurement/operation characteristics of the electrical test equipment at least daily when in use.

4.3.7 Manufacturer imposed tests. For class B, any manufacturer imposed test(s) (i.e., gross and fine leak) conducted after any screening tests, but prior to any qualification or quality conformance testing, is (are) to be reported in both the qualification and quality conformance reports. If these tests are performed, the test data shall be recorded and submitted to the qualifying activity. 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).

4.4 Qualification procedures.

4.4.1 General. Qualification inspection shall be performed at a laboratory acceptable to the qualifying activity. Qualification inspection shall be conducted in accordance with the procedures described in this section and appendix B of this specification. Qualification to a given quality assurance level qualifies the product for all lower quality assurance levels provided the product for all levels is manufactured on the same certified line and meets all the requirements of the lower level. Products used for part I qualification shall have been fabricated and assembled on a certified manufacturing line and screened in full accordance with the requirements of 3.4.3. For part II qualification procedures, see appendix D.

4.4.2 Qualification. A certified manufacturer shall qualify individual devices by subjecting them to, and demonstrating that, they satisfy all the groups A, B, C, and D (and E if applicable) requirements of method 5005, method 5008, or method 5010 as applicable (see 4.4.4) of MIL-STD-883 for the specified device class and type of microcircuits. The manufacturer shall prepare and submit qualification test evidence to the qualifying activity, as required in accordance with appendix D, for the specific PIN(s) and level(s) to be qualified. For retention of qualification, see 4.4.3.

4.4.2.1 Inspection routine. Except where the use of electrical rejects is allowed, all microcircuits subjected to groups B, C, and D (and E if applicable) tests shall have previously been subjected to and passed all tests of group A inspection specified as end-point electrical parameters. The microcircuits shall then be divided into the subgroups for groups B, C, and D (and E if applicable) inspection. When necessary to meet subsequent sample requirements, all failures found in the course of group A inspection shall be replaced by microcircuits which have passed group A tests prior to subjection to group B, C, or D (and E if applicable) tests. All tests shall be applied to and all acceptance criteria referenced to the entire lot or sublot as applicable, not to an arbitrary quantity of devices tested.

4.4.2.1.1 Sample. The number of microcircuits to be tested shall be chosen (independent of lot size) by the manufacturer and shall be adequate to demonstrate conformance to the inspection criteria for each subgroup of groups A, B, C, and D (and E if applicable) inspection. All qualification test samples for subgroups which require variables data shall be serialized prior to qualification tests.

4.4.2.1.2 Lot size. The qualification inspection lot shall be chosen by the manufacturer, and the lot and each sublot shall initially contain (except for class S) at least twice the number of microcircuits required for qualification.

4.4.2.1.3 Selection of samples. Sample selection for group A, B, C, or D (and E if applicable) testing shall be in accordance with MIL-STD-883.

4.4.2.1.4 Acceptance criteria. The number of failures allowed in any group A, B, C, or D (and E if applicable) inspection shall be determined by the applicable inspection requirements.

4.4.2.1.5 End-points. Electrical end-points shall be measured (and recorded when required) before starting and after completion of all tests in the subgroups of groups B, C, and D (and E if applicable) for which electrical end-point measurements are specified and intermediate measurements shall be made as required by the applicable associated detail specification.

* 4.4.2.1.6 Data. A summary of attributes results for all tests and measurements shall be made available to the qualifying activity. Variables data shall be provided when the following tests are required:

a. Where delta limits are specified, variables data, identified to the device serial number, shall be provided for initial and final measurements.

b. For bond strength testing, the forces at the time of failure and the failure category or the minimum and maximum reading for the devices tested if no failure occurs.

c. For die shear strength testing, the forces at the time of the failure and the failure category or the die shear force if no separation occurs.

d. For class S, wafer lot acceptance, method 5007 of MIL-STD-883 (including SEM photographs) and a copy of the test data on nondestructive bond pull testing as required by method 2023 of MIL-STD-883.

e. For total dose and neutron radiation, pre- and post-test end-point electrical parameters.

f. For lid torque strength testing, the forces at the time of failure or the actual applied torque if no separation occurs.

g. For internal water vapor content readings.

h. For ESDS class and voltage level (see 3.4.1.1).

4.4.2.1.7 Lot release. The lot from which the qualification samples are selected may be offered for delivery under contract after qualification approval has been granted, provided all applicable quality conformance requirements have been successfully completed.

4.4.2.2 Group A electrical testing. The parameters, conditions of test and limits for group A testing shall be as specified in method 5005 of MIL-STD-883 and the applicable associated detail specification or drawing. Group A testing may be performed in any order. If an inspection lot is made up of a collection of splits or class S inspection sublot, each split or class S inspection sublot, shall pass group A inspection as specified.

4.4.2.3 Group B testing. Group B tests shall be as specified in method 5005 of MIL-STD-883.

4.4.2.4 Groups C and D testing. Groups C and D tests shall be as specified in method 5005 of MIL-STD-883.

4.4.2.5 Group E testing. Group E tests shall be conducted as specified in method 5005 of MIL-STD-883. Group E is required for initial qualification and after process or design changes which may effect radiation hardness (see 3.4.2). Qualification for RHA shall be for a specific microcircuit die and package type, except as authorized by the qualifying activity. Microcircuits which pass the quality assurance and RHA requirements to a higher reliability or RHA level shall be acceptable to a lower level or as non-RHA parts if all other applicable requirements and pre- and postirradiation electrical parametric and timing limits are met.

4.4.2.6 Qualification testing requirements. The following paragraphs apply to each technology group (see appendix E and table V).

Table V. Qualification within a technology group for classes B and S.

| | New die family | Eligible die family |
|---|---|---|
| New package family | Groups A, B, C (class B only), and D for initial qualification<br>(Use any die type and package type, from the allotted package family)<br>Use block 4 to continue<br>See 4.4.2.6.1 \| 1 | Groups B and D for initial qualification for class B<br>Groups B-2, B-3 and D for initial qualification for class S<br>(Must use qualified die type)<br>Use block 4 to continue<br>See 4.4.2.6.3 \| 3 |
| Eligible package family | Groups A and C for initial qualification for class B<br>Groups A and B for initial qualification for class S<br>(Must use qualified package type)<br>Use block 4 to continue<br>See 4.4.2.6.2 \| 2 | Group A on each unqualified die type<br>(Must use package type from the eligible package family)<br>See 4.4.2.6.4 \| 4 |

* 4.4.2.6.1 New die family and new package family.

a. Qualification testing shall consist of groups A, B, C (for class B), D, and group E as applicable. Any die type in the die family and worst case package type (see 4.5.5.1a), from the allotted package family, shall be used. The die family and package family of the tested part are then eligible for qualification by extension (see 4.4.2.6.4).

b. If testing is failed, the qualifying activity shall be notified within 10 working days of the test results. The PIN using the failed die type or failed package type shall be removed from QPL-38510. Relisting shall occur only after additional qualification, to be determined by the qualifying activity, has successfully been completed and the results submitted to the qualifying activity for the PIN that failed.

* 4.4.2.6.2 New die family and eligible package family.

a. Qualification testing shall consist of groups A and C for class B product, groups A and B for class S product, and group E as applicable. Any die type in the die family (see 3.1.3.29) and a qualified package type shall be used for each certified fabrication line. The die family of the tested part is then eligible for qualification by extension (see 4.4.2.6.4).

b. In the event of failure, 4.4.2.6.1b applies.

* 4.4.2.6.3 New package family and eligible die family.

a. Qualification testing shall consist of groups B (for class S product, subgroups B-2 and B-3 only) and D. A qualified die type and a worst case package type (see 4.5.5.1a), from the allotted package family from each certified assembly line, shall be used. The package family of the tested part is then eligible for qualification by extension (see 4.4.2.6.4).

b. Qualification testing shall also include group C for class B product or subgroup B-5 for class S product if the calculated operating junction temperature of the tested part (at maximum operating power and maximum operating temperature) exceeds $T_J$ maximum (as specified in the detail specification) -10°C for the die/package type combination being tested.

c. In the event of failure, 4.4.2.6.1b applies.

* 4.4.2.6.4 Qualification extension.

a. Qualification testing shall consist of group A, acceptable engineering data for life test, and group E (if applicable) for each die type. The die type tested shall be selected from an eligible die family using a qualified or unqualified package type from an eligible package family. In the event of failure 4.4.2.6.1b applies.

b. Each die type from a certified wafer fabrication line and each package type from a certified assembly line qualified under 4.4.2.6.4a shall not be shipped until the quality conformance inspection (QCI) requirements of 4.5 have been satisfied. These test records shall be retained by the manufacturer and the results submitted to the qualifying activity as part of qualification retention. In the event of failure, 4.4.2.6.1b applies.

c. The qualification by extension of a qualified die type in a given package type may be extended to other qualified package types. For class B, qualification testing is not required unless group C (see 4.4.2.6.3b) or group E are applicable. For class S, qualification testing is not required unless groups B-5 (see 4.4.2.6.3b) or group E are applicable.

* 4.4.2.6.5 Approval of other lead finishes. After qualification of one package type with a single lead finish, other lead finishes may be approved by submitting a single device type for each additional lead finish in the previously approved package family to group B, subgroup 3 and group D, subgroups 1, 3, 5, and 7 tests. Subgroup D-7 testing shall not be required for hot solder dip over lead finishes B or C (tin, gold plate) which have been qualified on the same package family. Lead finishes qualified for a given package family for class B devices (part I of QPL-38510) may be approved for the same package family for class S, (part I of QPL-38510) without additional testing. Once a lead finish is approved for one associated detail specification within a technology group, approval for the same lead finish may be extended to other package types in the given package family on other associated detail specifications, within the technology group, upon request to and approval by the qualifying activity.

* 4.4.2.6.6 Approval of other lead material. After the first lead material is qualified with a particular package family, the unqualified lead material can be approved by the qualifying activity for the particular package family provided the required lead finish tests specified (see 4.4.2.6.5) with the addition of subgroup D-2, are successfully performed. Subgroup D-6 shall be completed when the lead frame extends into the die cavity.

4.4.2.7 Electrostatic discharge sensitivity. Electrostatic discharge sensitivity classification testing shall be done in accordance with method 3015 of MIL-STD-883, and the applicable associated detail specification (see 3.6.9.2). Devices shall be handled in accordance with the manufacturer's in-house control documentation. Handling shall begin at lead clip or wire bond (i.e., for packages which do not have a lead shorting bar or do not have leads shorted together). Handling documentation shall be submitted for approval to the qualifying activity. A model ESD control program is available upon request from the qualifying activity and may be used as a guideline document. Further guidance for device handling is available in the Electronics Industry Association (EIA) JEDEC Publication 108 document.

* 4.4.3 Retention of qualification. To retain qualification, the contractor shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall include the following (items a and b can be combined in a matrix):

a. Identification by PIN and identification code(s) the number of devices that passed screening in each lot. If a manufacturer has additional package types or lead finishes qualified for a given PIN, each must be indicated (i.e., by manufacturer internal package identification number).

b. Identification by PIN and identification code(s) the lots that completed groups A, B, C, and D (and E if applicable) inspections and formatted such that the periodic QCI tests and lots represented by them are clearly presented. If all lots (identified in item 4.4.3a) received a given inspection (i.e., group A), the manufacturer need only certify that all lots received that inspection.

c. List of all qualified device types, package types, and lead finishes for which there has been no quality conformance inspection. The manufacturer shall certify that they still have the capabilities and facilities to produce these items to the qualified level.

d. Certification that the design and construction of all product was verified and found to be identical to that which qualification approval was valid, and that the quality conformance inspection requirements have been satisfactorily met.

If the summary of test results indicates nonconformance with the requirements of the specification, and corrective action acceptable to the qualifying activity has not been taken, action shall be taken to remove the failing product from the qualified products list. Failure to submit the summary report within 30 days after the end of 12-month period may result in loss of qualification for products within that microcircuit group. If during two consecutive reporting periods, there has been no quality conformance inspection of qualified product on a certified line, the manufacturer may, at the discretion of the qualifying activity, be required to submit representative product(s) qualified on the certified line for the specified device class to complete testing in accordance with the qualification inspection requirements (see 4.4.2).

4.4.4 Provisions for hybrid microcircuits and multichip microcircuits that utilize an interconnect pattern to contractor-prepared documents. Acquisition of hybrid microcircuits and multichip microcircuits that utilize an interconnect pattern, to contractor-prepared documents, shall be in accordance with appendix G.

4.5 Quality conformance inspection.

* 4.5.1 General. Quality conformance inspection shall be conducted in accordance with the applicable requirements of groups A, B, C, and D (and E if applicable) of method 5005 (or method 5008 when applicable (see 4.4.4) or method 5010 when applicable), MIL-STD-883, for the specified device class and method 5007 of MIL-STD-883, when applicable. Inspection lot sampling shall be in accordance with appendix B of this specification. Test results shall be recorded by inspection lot identification code (see 3.6.3) for each inspection lot. 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 reported as such. Lots submitted for quality conformance inspection shall meet the requirements of 3.4.3 and 4.6 for all device classes. If a manufacturer elects to eliminate a quality conformance inspection step or 100 percent screen operation substituting either a process monitor or statistical process control procedures, the manufacturer is only relieved of the responsibility of performing the QCI or 100 percent screen operation. The manufacturer still bears full liability for any failure that may result if these tests are performed at a later time.

4.5.2 Group A inspection. Group A inspection shall be performed on each inspection lot in accordance with MIL-STD-883 and shall consist of electrical parameter tests specified for the specified device class. Group A inspection may be performed in any order. If an inspection lot is made up of a collection of splits or class S inspection sublots, it shall be recombined into an inspection lot before the group A inspection sample is taken or a group A inspection sample shall be taken from each split or class S inspection sublot.

* 4.5.3 Group B inspection. Group B inspection shall be performed in accordance with MIL-STD-883 on each inspection lot for each qualified package type and lead finish. As an alternate, except for class S (at the manufacturer's option) group B inspection may be performed on each qualified package type and lead finish in accordance with 3.5.2 of method 5005 or 3.4.2.1 of method 5010 of MIL-STD-883. For class S, group B, subgroups 1A, 2, 3, and 4 inspections shall be performed on each sublot (split) when the manufacturer elects to keep the sublots (splits) separate from each other after screen tests are completed. Except as otherwise specified in method 5005 of MIL-STD-883, samples for this inspection shall be completed and fully marked devices from lots which have been subjected to and passed the post burn-in +25°C final electrical static tests (subgroup 1). Class S steady-state life test, subgroup B-5, results shall not be used to support class B shipments.

4.5.3.1 Group B sample selection. Samples for group B subgroups shall be chosen in accordance with MIL-STD-883 at random from any inspection lot which has completed the screening requirements of 4.6 and has been submitted to quality conformance inspection (see appendix B).

4.5.3.2 Acceptance number exceeded. Sampling of the inspection lot may continue using 4.3.2 and 4.3.3 (including subparagraphs), but only production lots which have passed may be combined.

4.5.3.3 Failure. Failed production lots shall not be designated as JAN product.

4.5.4 Group C inspection for class B only. Group C inspection (die-related tests) shall be in accordance with MIL-STD-883 and shall include those tests specified which are performed periodically. Group C tests are required for each microcircuit group (see 3.1.3.13) in which a manufacturer has qualified device types. Group C tests for each microcircuit group shall be performed on one inspection lot of the most complex device type available at the time of selection from production devices produced on each certified die fabrication line in each quarter of a year as defined in 3.6.3.1.

4.5.4.1 Group C sample selection. Samples selected for group C inspection shall meet all of the following requirements:

a. Must be chosen at random from any inspection lot comprised only of die from the quarter of the year (see 3.6.3.1) for which quality conformance inspection is being established in a particular microcircuit group (see 3.1.3.13) for each certified die fabrication line.

b. Must be chosen from an inspection lot that has been submitted to and passed group A quality conformance inspection (regardless of whether that inspection lot has been submitted and passed group B quality conformance inspection).

c. The inspection lot from which the samples are selected shall be the one with the most complex device type available at the time of selection.

4.5.4.1.1 Product acceptable for delivery. Product shall be acceptable for delivery only after the successful completion of all group C testing and shall be comprised of die meeting the following requirements:

a. Manufactured on the same certified die fabrication line as the sample selected for 4.5.4.1.

b. In the same microcircuit grouping as the sample selected in 4.5.4.1.

c. Which was started (or completed, at the manufacturer's predesignated option) within the same quarter of the year sample selected in 4.5.4.1.

d. Product meeting the requirements of a and b above but comprised of die which were started (or completed at the manufacturer's option) in the immediately succeeding quarter may also be accepted for delivery prior to completion of the group C testing for the immediately subsequent quarter if all of the following requirements are met:

(1) Samples meeting the requirements of 4.5.4.1 have been submitted to group C quality conformance inspection for the new quarter.

(2) The group C inspection from the immediately prior quarter has been successfully completed.

(3) This provision shall not negate the requirement to perform group C inspection on die produced in each quarter of production (see 4.5.4).

* e. Group C coverage is required for each quarter of material production on each microcircuit group.

NOTE: The above group C inspection and corresponding marking system shall be implemented on all devices with an inspection lot date code (seal week) of 8840 and later. Inspection lots formed using die fabricated prior to 1988 shall be grandfathered according to the previous group C QCI requirements and marked with "GF" for the die fab symbolization (see 3.6.3.1).

4.5.4.2 Acceptance number exceeded. Sampling of the wafer lot may continue using 4.3.2 and 4.3.3 (including subparagraphs), but the group C lot (finished goods) being sampled shall not be reprocessed until a pass/fail decision has been made.

* 4.5.5 Group D inspection. Group D inspection (package related tests) shall be in accordance with test method 5005 of MIL-STD-883 and shall include those package or case-related tests which are performed periodically. Group D tests on each package family shall be performed on devices from each 26 weeks production of devices (based on inspection lot identification codes) for each assembly line. Group D results can be used to support any class provided all of the Group D sampling criteria are met. Each additional lead finish for each package family shall be subjected to subgroups 3, 5, and 7 of group D. Subgroup D-7 testing is not required for hot solder dip over lead finishes B or C (tin, gold plate) which

have been periodically tested for quality conformance inspection on the same package family. For hot solder dipped leadless chip carriers, the B3 and L3 dimensions may be measured prior to solder dip. In addition, laser marked devices for each package family, which do not have group D coverage for laser marking, shall be subjected to subgroups 3 and 5 of group D.

* 4.5.5.1 Group D sample selection. Sample selection for group D shall be as follows:

a. The package types selected for Group D inspection shall be either rotated among the package types available at the time of sample selection from the allotted package family or worst case available from the allotted package family. Worst case shall be determined by the manufacturer based on an incoming vendor material control program (see 4.5.5.2). For glass-sealed packages (e.g., cerdips, cerpaks), worst case is based on the minimum seal area and the maximum cavity size (in most cases this will be two packages). Under the rotation option, if a package type has not been tested for 3 years, then the next assembled lot of that package type shall receive group D inspection.

b. The product accepted for delivery shall be the inspection lot identification codes of the 36 successive weeks beginning with the inspection lot identification code of the successful group D sample for the package family.

c. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup for all the associated detail specifications within a technology group utilizing the qualified package family and lead finish. Different device types may be used for each subgroup. For nonconformance see 4.5.8.

* 4.5.5.2 Incoming vendor material control program. The manufacturer who utilizes the worst case group D option shall have in place an incoming vendor material control program for the piece parts used in packaging (e.g., vendor SPC program). The methods and procedures used to control inspection, storage, and handling of incoming materials shall be documented.

4.5.6 Group E inspection. Group E inspection shall be in accordance with method 5005 of MIL-STD-883 and, at the contractors option, is allowed anytime following completion of wafer fabrication. A device type which fails group E inspection may not be certified as an RHA microcircuit at the failed or higher level, but may be used as a non-RHA microcircuit or certified at another (lower) level if the microcircuit meets the lower level requirements and all other applicable requirements including pre- and postirradiation electrical and timing parametric limits.

4.5.6.1 Group E sample selection. Sample selection shall be in accordance with method 5005 of MIL-STD-883 and shall be from each wafer prior to assembly or from each inspection or wafer lot. QCI requirements for class B wafer lots shall be satisfied if all wafers used in that lot have been tested individually in accordance with class S requirements. For traceability, see 3.4.6.

4.5.7 End-point tests for groups B, C, and D (and E if applicable) inspections. End-point measurements and other specified post-test measurements shall be made for each microcircuit of the sample after completion of all other specified tests in the subgroup. The test limits for the end-point measurements shall be the same as the test limits for the respective group A subgroup inspections. Different end-points may be specified for group E tests in the detail specifications. Any additional end-point electrical measurements which may be performed at the discretion of the manufacturer, shall be accomplished in accordance with 3.4.3 (i.e., tests performed on sample devices subjected to groups B, C, and D (and E if applicable) tests shall be performed as a 100-percent screen on all production devices represented by the sample).

4.5.8 Nonconformance. Lots which fail subgroup requirements of groups A, B, C, and D (and E if applicable) may be resubmitted in accordance with the provisions of 4.3.3.1. A failed lot which is reworked (see 3.7.1) 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 group B, C, or D (or E if applicable) quality conformance inspection 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 JAN marking and all references to MIL-M-38510 shall be removed. For RHA microcircuits where group E tests are performed, and a sample plan of 18(1) and 38(1) is utilized for two successive lots of the same device type or for more than 10 percent of the lots during the preceding 18 months, data as specified herein shall be provided. Resubmission for RHA qualification inspection, in this case, may be required. Lots that are not resubmitted, fail the resubmission, are withdrawn from JAN consideration, reworked, or rescreened (excluding resubmittal to final electricals 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 JAN consideration.

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.

4.5.8.1 Group B failure. When a lot failure occurs for a group B subgroup, then all other sublots within the inspection lots must be submitted to the failed subgroup.

4.5.8.2 Alternate group B failure. When a failure has occurred in group B using the alternate group B procedure, samples from three additional inspection lots of the same package type, lead finish and week of seal as the failed package shall be tested to the failed subgroups. If all three inspection lots pass, then all devices manufactured on the same assembly line using the same package type and lead finish and sealed in the same week may be accepted for group B inspection. If one or more of the three additional inspection lots fails, then no inspection lot containing devices manufactured on the same assembly line using the same package type and lead finish sealed in the same week shall be accepted for group B inspection until each inspection lot has been subjected to and passed the failed subgroups.

4.5.8.3 Group C failure. When a group C failure occurs, samples from subsequent wafer lots submitted for acceptance in the same microcircuit group, produced on the same certified die fabrication line, and started (or completed at the manufacturer's option) die fabrication during the same quarter of the year shall be subjected to group C. The testing shall be performed on a wafer-lot-by-wafer-lot basis until three consecutively tested wafer lots from the same microcircuit group and quarter of fabrication pass group C; the testing may then return to periodic testing. A device type which fails a group C inspection shall not be accepted until the device type which failed successfully completes group C. In addition, any other inspection lots using die from the same failed wafer lot must successfully complete group C prior to shipment until three successive inspection lots from the same wafer lot have passed group C using a tightened LTPD.

* 4.5.8.4 Group D failure. When a failure occurs for a group D subgroup(s), samples from subsequent lots submitted for acceptance of the same package family and lead finish shall be subjected to all the tests in the failed subgroup(s). The testing shall be performed on a lot-by-lot basis until three successive lots of the same package family pass the failed subgroup(s). Testing of the package family may then return to periodic testing. The package type that failed the Group D subgroup(s) shall be tested on a lot-by-lot basis until 3 successive lots pass the failed subgroup(s) at which time it may return to periodic inspection coverage. Under the worst case conditions option, when a glass sealed package fails, every package type in the package family must pass the failed group D subgroup, prior to shipping the device. Failed package types shall be tested on a lot-by-lot basis until 3 successive lots of the same package type pass the failed subgroup(s) at which time it may return to periodic inspection.

4.5.9 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.

4.6 Screening. Each microcircuit shall have been subjected to and passed all the screening tests detailed in method 5004, method 5008, or method 5010, as applicable, of MIL-STD-883 for the specified quality assurance level and type of microcircuit in order to be acceptable for delivery. When a PDA (see 3.1.3.14 herein and methods 5004, 5008, or 5010 of MIL-STD-883) or delta limits (see 3.1.3.15) has 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. Devices which fail any test criteria 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. Once rejected and verified as a device failure, no device may be retested for acceptance.

4.6.1 Burn-in. Burn-in shall be performed on all microcircuits where specified and the specified pre- and post-burn-in electrical parameters shall be measured.

4.6.1.1 Lots and sublots resubmitted for burn-in. Inspection lots, lot splits, and class S sublots may be resubmitted for burn-in one time only and may be resubmitted only when the observed percent defective does not exceed twice the specified PDA, or 20 percent whichever is greater. Resubmitted inspection lots, lot-splits, and class S sublots shall contain only parts which were in the original lot or sublot. Resubmitted inspection lots, lot splits, and class S sublots shall be kept separate from new lots and sublots and shall be inspected for all specified characteristics using a tightened inspection PDA equal to the next lower number in the LTPD series (see appendix B), or one device, whichever is greater.

4.6.1.2 Burn-in acceptance criteria. The PDA for each inspection lot or class S sublot submitted to burn-in and interim (post burn-in) electrical parameters (see method 5004 of MIL-STD-883) shall be 5 percent (or one device, whichever is greater) on all failures. In addition, for class S, the PDA shall be 3 percent (or one device, whichever is greater) on functional failures. A manufacturer may elect to divide inspection lots into splits for burn-in and interim electrical parameter measurement and calculate a PDA for each split, or the manufacturer may elect to add all failures from the constituent splits together to calculate a PDA for the original inspection lot. If a PDA is calculated for each split it shall be used as accept/reject criteria for that split only and shall not be combined with the PDA from any other lot or split for any reason related to lot or split acceptance. If a PDA is calculated for an inspection lot by adding the failures found in the various constituent splits, this PDA shall be used as accept/reject criteria for the entire lot and shall, in no way, be used as accept/reject criteria for any grouping of devices other than the entire lot. The supplier shall not conduct burn-in in addition to that specified. Delta limits shall be defined in the associated detail specification. When the PDA 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. Lots may be resubmitted only when the observed percent defective does not exceed twice the specified PDA or 20 percent, whichever is greater. The delta criteria applying to such resubmissions shall be in accordance with the following procedure:

a. Devices having delta drift values in excess of the detail specification limits shall be rejected.

b. The remaining devices shall then be submitted to the balance of inspections and tests as specified herein.

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

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

4.6.3 Particle impact noise detection (PIND) test for class S devices. The inspection lot (or sublots) shall be submitted to 100 percent PIND testing a maximum of five times in accordance with method 2020 of MIL-STD-883, condition A. PIND prescreening shall not be performed. The lot may be accepted on any of the five runs if the percentage of defective devices is less than 1 percent (zero failures allowed for lots of less than 100 devices). 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 and resubmission is not allowed.

4.6.4 Lead forming. When lead forming (bending) is specified for any device class, the fine and gross seal test shall be performed in accordance with method 5004 of MIL-STD-883 after the lead forming operations and prior to final visual inspection of these devices, and devices which fail any test shall be removed from the lot.

4.6.5 Nondestructive bond pull test for class S devices. Nondestructive 100 percent bond pull test shall be performed for class S 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 less based on the number of wires pulled in specified lot. The test shall be performed in accordance with method 2023 of MIL-STD-883. Devices from lots which have been subjected to the nondestructive 100 percent bond pull test and have failed the specified class S, PDA requirement shall not be delivered as class B product.

4.7 Individual photomicrographs. When specified in the applicable acquisition document and only when individual device serialization is also required, each microcircuit which passes internal visual inspection shall be photographed in color prior to final seal. The photomicrograph shall be a positive transparency and shall include the entire die or substrate. The die or substrate shall be illuminated to produce specular reflection. The resulting transparency shall have adequate resolution and grain size to permit viewing under 80X minimum magnification (or projection) enabling satisfactory performance of the specified internal visual inspections delineated in MIL-STD-883, method 2010. Each photomicrograph transparency shall be identified with the serial number of the specific device it represents. Any glassivation coating added to the device after metallization shall be sufficiently transparent to permit fulfillment of the internal visual inspection and photomicrograph requirements. The photomicrographs of each device processed shall be placed in protective containers, properly identified with the inspection lot code, and either shipped with the devices or placed on file, as specified.

4.8 Data recording. The results of all qualification and quality conformance tests and inspections and the results of all required failure analysis shall be recorded and maintained in the manufacturer's facility in accordance with appendix A. The Quality Assurance Program Plan, qualification test reports, periodic summary report (see 4.4.3), and any other data reports required by the applicable acquisition document shall be submitted to the qualifying activity (or acquiring activity when specified in the purchase agreement). The disposition of all lots or samples submitted for wafer lot acceptance, screening (when PDA is specified), quality conformance inspection or qualification shall be fully documented and lots which fail any specified requirement shall be recorded as failed lots whether resubmitted or withdrawn. Disposition of resubmitted lots shall likewise be recorded so that a complete history is available for every lot tested from initial submission to final disposition including all failures, resubmissions, and withdrawals.

4.8.1 Screening test data for class S microcircuits. When specified in the acquisition document, 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 associated detail specification shall accompany each lot of class S microcircuits shipped. The manufacturer shall maintain one complete copy of all screening data for 5 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. In addition, microcircuits which have been determined to require electrostatic discharge protection, category A or class 1 or 2 by test method 3015 of MIL-STD-883, shall be packaged in conductive material or packaged in accordance with one of the following:

Category A.

(1) Unit container suitable for ESD protection in accordance with MIL-M-55565.

or

(2) Conductive noncorrosive rail with noncorrosive and conductive or antistatic foam plugs at both ends of each rail which prevents movement.

or

(3) Antistatic noncorrosive rail with noncorrosive and conductive or antistatic foam plugs at both ends of each rail which prevents movement. Antistatic rails shall be packaged in conductive, electrostatic field shielding material.

(Other packaging methods shall require the approval of the qualifying activity.)

NOTE: Rails (i.e., multiple carriers) coated but not impregnated with antistats shall be used only if the antistatic properties are proven to be intact on the surface. These measurements shall conform to 3.1.3.22 and EIA-STD-5.

5.1.1 Carrier and container. When specified on the associated detail specification or purchase order, microcircuits shall be supplied mounted in the carrier (unit or multiple) and carrier container, or carrier and unit container. Marking on the carrier or unit container shall be as specified in 5.1.2.

5.1.2 Marking of container. All of the markings specified in 3.6, except the index point and serialization, shall appear on the carrier, unit pack (e.g., individual foil bag), unit container, or multiple carriers (e.g., tubes, rails, magazines) for delivery and this marking shall be in accordance with MIL-STD-129 and MIL-M-55565 for ESDS microcircuits. In addition, the EIA-STD-RS-471 symbol for ESDS devices may also be marked on the carrier or container. However, if all the marking specified above is clearly visible on the devices and legible through the unit carrier or multiple carrier, or both, then the ESD marking only (in accordance with MIL-STD-1285) shall be required on the multiple carrier. These requirements apply to the original or repackaged product by the manufacturer or distributor. In addition, for lots held by manufacturers and their authorized distributors for more than 36 months (see 4.2) following the inspection lot identification code date, a similar code identifying subsequent reinspection dates shall be applied to the lowest level of packaging which contains a single inspection lot date code of unit carriers, unit packs, unit containers, or multiple carriers.

6. NOTES

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

6.1 Intended use. Microcircuits conforming to this specification are intended for use for Government 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 microcircuits be acquired to class B requirements. (Cross reference information can be found in the supplement to MIL-M-38510.)

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the 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 and JAN identification (if applicable).

d. Test data to be furnished.

e. Selection of applicable level of packaging required (see 5.1), specification of carrier and container, as applicable (see 5.1.1) and special marking, when applicable (see 5.1.2).

f. Requirement for radiation hardness assurance testing (see 4.4.2.5 and 4.5.6).

6.2.1 Lead finish designator. For Government logistic support, the A lead finish will be ordered and supplied to the end user when X is used in place of the A, B, or C lead finish designators. If the device type is not available with lead finish A, the same PIN will be ordered except that C or B will be used as the lead finish designator depending upon which is available.

6.3 Preparation of associated detail specifications. The items for the preparation of detail specifications are listed in appendix F of this specification.

6.4 Qualification and first article.

6.4.1 Qualification. With respect to products requiring qualification (and except for zero source QPL items), awards for purchase orders or contracts specifically for microcircuit acquisition will be made only for products which are, at the time of award of contract, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. For zero

source QPL and part II QPL items, it shall be permissible, and in fact is encouraged for orders to be placed with manufacturers willing to pursue part I qualification during the processing of the order so that the delivered product is part I qualified. The attention of the manufacturer is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the Department of the Air Force, Rome Laboratory, ATTN: ERD, Griffiss Air Force Base, New York, 13441; however, information pertaining to the qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45444-5294.

6.4.1.1 Part II, Qualified Products List. Products listed in part II, Qualified Products List (QPL) 38510 are considered qualified products. Therefore, manufacturers are eligible to accept orders on JAN parts that are listed on QPL-38510 part II. The shipment of parts to fill these orders is not permissible until quality conformance inspection required of part I listed products has been successfully completed, and at least one QPL-38510 part I listing has been approved for that product assurance level, and group C tests on each device type are performed and passed prior to the first shipment of each device type.

6.4.2 Qualification removal. A manufacturer whose PIN is removed from the QPL 38510 shall not manufacture, JAN mark, or accept orders for the removed PIN except the manufacturer may fulfill contracts signed during the timeframe that the part numbered device was qualified for listing of the QPL. The contract shall be for a defined quantity of product to be delivered within a specified timeframe. The contract(s) shall not be open ended nor contain any add-on provisions. All screening and groups A, B, C, and D (and E if applicable) quality conformance inspections and all other requirements of MIL-M-38510, must be performed and passed as specified in 4.5 before any JAN lots are shipped. A manufacturer who is discontinuing production of a PIN listed on the QPL part I, will continue to be listed until zero inventory is reached or the manufacturer requests removal. Distributors holding inventory of PINs removed from the QPL may deliver the product except when the product was removed for cause (i.e., identified quality or reliability problems).

6.5 Reevaluation of lot quality. The specified LTPD method is designed for source inspection and provides a high degree of assurance that a lot has a proportion defective no greater than the specified LTPD value. Reevaluation of any given lot to the same LTPD and acceptance number has the net effect of increasing the probability of rejection or the manufacturer's risk. This is especially true when the initial sampling plan is based on a low acceptance number or when lot reevaluation is done using a lower acceptance number than was used in the initial sampling plan. Table B-I of appendix B herein provides examples of the approximate quality levels required to satisfy any selected sampling plan. To minimize the effect of reevaluation on the manufacturer's risk, whenever the quality of a lot is reevaluated by sampling inspection subsequent to the manufacturer's demonstration of compliance with the quality requirements, the sampling plan shall be based on the next higher acceptance number (for the same LTPD) above that used in the initial lot evaluation. If the initial acceptance number is not known, or if the original inspection was conducted as a screening or 100 percent inspection, then the lot being reevaluated shall not be rejected using an acceptance number of less than three. Lots may, however, be accepted on reevaluation using an acceptance number as low as zero. When deemed necessary, the purchase order may specify detailed criteria for lot reevaluation and disposition other than the above. Government Source Inspection 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.

6.6 Subject term (key word) listing.

Acceptance
Attach
Attribute
Audit
Bond(ing)
Burn-in
Case
Case and package material
Cerquad
Class B
Class S
Classification
Construction
Custom
DIP
Data
Deposition
Design
Detail specification
Deviation
Die
Dimension
Distributor
Documentation
ESD
Extension
FP
Failure
GSI
General specification
Glassivation
Hybrid
Index
Inspection
Inspection lot
Interconnect
JAN
LCC
LTPD
Laser marking
Lead finish
Lead material
Marking
Measurement
Metallization
Monolithic
Network
(Non)conformance
Oxide
PDA
PGA
PIND
Package
Packaging
Part or Identifying Number (PIN)
Plating
Production lot
QAR
QPL-38510
Qualification
RHA
Records
Retention
Rework
SCD
SPC
SQC
Sample
Sampling
Schematic
Screen(ing)
Seal
Serialization
Sublot
Substrate
Surveillance
Symbols
Test
Topography
Traceability
Verification
Wafer
Wafer lot
Workmanship

6.7 Changes from previous issue. The margins of this document are marked with asterisks (or vertical lines) to indicate where changes (additions, deletions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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 microcircuit qualification. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

* 20. APPLICABLE DOCUMENTS

* 20.1 Government documents.

* 20.1.1 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 issues 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.

STANDARD

FEDERAL

| | | |
|---|---|---|
| FED-STD-209 | - | Clean Room and Work Station Requirements, Controlled Environments. |
| MIL-STD-45662 | - | Calibration Systems Requirements. |

* 20.2 Order of precedence. In the event of a conflict between the text of this appendix and the references cited herein (except for associated detail specifications), the text of this appendix shall take precedence. Nothing in this appendix, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

30. QUALITY ASSURANCE PROGRAM

30.1 Manufacturer certification. The manufacturer shall establish, implement, and maintain a quality assurance program in accordance with 30.1 through 30.1.3.8 (summarized in table A-I) in order to become a certified manufacturer of microcircuits. The manufacturer's quality assurance program shall demonstrate and assure that design, manufacture, inspection and testing of microcircuits are adequate to assure compliance with the applicable requirements and quality standards of this specification and the associated detail specification. 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. Quality assurance program plan (see 30.1.3).

All required documentation shall be available at, and continually effective in the manufacturer's plant while it is producing microcircuits which are intended to be offered for qualification and quality conformance inspections under this specification.

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, manufacturing equipment, and materials 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 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 and utilities, and of 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.

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.

APPENDIX A

TABLE A-I. Quality 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 analyses (see 30.1.2.3) | c. Proprietary-documents (see 30.1.3.3) | c. Audit deficiencies (see 40.3.3) |
| d. Quality-control operations (see 30.1.1.4) | d. Initial documentation and subsequent changes 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 30.1.1.6) | e. Equipment calibrations (see 30.1.2.5) | e. Examples of records (see 30.1.3.5) | e. Audit schedules (see 40.3.5) |
| 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 3.4.1.2.3 and 3.4.2) | 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 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, gauge, and test equipment maintenance, and calibration (see 30.1.1.9) | i. Self-audit report (see 40.3.6) | i. Manufacturer's internal instructions for internal visual inspection (see 30.1.3.6) | |

TABLE A-I. Quality 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 (30.1.3) | Self-audit plan covering these areas (see 40.3) |
|---|---|---|---|
| j. Failure and defect analysis and feedback (see 30.1.1.10)<br><br>k. Corrective action and evaluation (see 30.1.1.11)<br><br>l. Incoming, in-process, and out-going inventory control (see 30.1.1.12)<br><br>m. Schematics (see 30.1.1.13)<br><br>n. ESD handling control program (see 30.1.1.14) | | j. Examples of test travelers (see 30.1.3.7)<br><br>k. Examples of design and construction baselines (see 30.1.3.8)<br><br>l. Manufacturer's self-audit (see 40.1) | |

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 manufacture 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 (absolute limits shall be established for baselined and other critical wafer fabrication process monitors used for acceptance of JAN product) 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 (wafers, substrates, packages, active and passive chips or elements for hybrid or multichip microcircuits, wire, water purification, etc.).

b. Masking, photoresist, and mask registration.

c. Epitaxy and diffusion.

d. Oxidation and passivation.

e. Metallization and film deposition.

f. Die, element, and substrate attachment.

g. Bonding.

h. Rework.

i. 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. During manufacture, transit, and storage, prior to seal, microcircuit die/wafers shall be protected from human contamination, machine overspray, or other sources of contamination which may occur due to human error or machine design which does not totally eliminate the possibility of overspray or other forms of contamination. 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 criticality of the process in each particular area. For foreign material identification and control, see internal visual inspection requirements of MIL-STD-976 and method 2010 of MIL-STD-883.

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, gauge, and test equipment maintenance and calibration. The maintenance and calibration procedures, and the frequency of scheduled actions, for tools, gauges, manufacturing and test equipment shall be documented and in accordance with the requirements of MIL-STD-45662. Failure to perform scheduled maintenance, repair and recalibration requirements critical to a process (as defined by the manufacturer) shall require corrective action. Deviations from the schedule shall require approval of the quality organization.

NOTE: Corrective action specified in MIL-STD-45662 shall not require a manufacturer to recall those microcircuit devices tested or inspected on equipment found to be out of tolerance during calibration provided the government quality assurance representative 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 quality assurance representative, 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 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 (a) achieve such factors as age control of limited-life materials; and (b) 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, tests and inspections performed by the manufacturers on acquired 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 materials 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 microcircuits shall be under document control. This includes device schematics, burn-in schematics in accordance with the applicable detail military 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 microcircuits which are intended to be submitted for quality conformance inspection under this specification. The records pertaining to production processes, incoming and in-process inspections shall be retained as detailed in item b below. Those pertaining to screening and quality conformance inspection shall be retained for a minimum of 5 years after performance of the inspections. Records shall be maintained as a minimum for:

* a. Personnel training and testing (see 30.1.2.1) (1-year active file retention; 5-year total record retention).

b. Inspection operations (see 30.1.2.2) (1-year record retention for production processes, incoming and in-process; 5-year record retention for screening, qualification, and quality conformance inspection).

c. Failure and defect reports and analyses (see 30.1.2.3) (5-year record retention).

d. Initial documentation and subsequent changes in design, materials, or processing (see 30.1.2.4) (5-year record retention).

e. Equipment calibrations (see 30.1.2.5) (see MIL-STD-45662 for records).

f. Process, utility, and material controls (see 30.1.2.6) (1-year record retention).

g. Product lot identification (see 30.1.2.7) (5-year record retention).

h. Product traceability (see 30.1.2.8) (5-year record retention).

* i. Self-audit report (see 40.3.6) (4-year retention).

Altered records shall not be considered acceptable data unless documented instructions are followed which shall include:

j. 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 and date noted for change and verification by a second party (QA shall verify screening, qualification and quality conformance inspection records) when change affects lot jeopardy (i.e., lot originally considered to be rejected is changed to pass status).

k. For transferred data to new test record:

(1) Identification of individual transferring data.

(2) All original record entries shall be transferred.

(3) New test record entries shall be verified against the original record by a second party.

l. Computerized records are optional provided they clearly and objectively indicate that all requirements of MIL-M-38510 have been met. The computerized records for traceability, screening and quality control inspection shall be readily accessible and available to government personnel for review and an appropriate electronic/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 or date/entry sequence to protect against "out of sequence" entries. No recorded transactions shall be deleted or changed.

(2) Control procedures 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 30.1.2i.

(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 quality assurance representative shall verify screening, qualification and quality conformance inspection 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(s) 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 Failure and defect reports and analyses. Records of failed or 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 Initial documentation and subsequent 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 quality conformance inspection under this specification, the documents authorizing and implementing the change, and identification of the first production and quality conformance inspection lot(s) (as applicable) within which product incorporating the change is included shall be maintained when the change requires notification of the qualifying activity (see 3.4.1.2.3 and 3.4.2).

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 material controls. Records shall cover the implementation of devices such as control charts (e.g., X bar 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 Product lot identification. Records shall be maintained to identify when each production or inspection lot or both was processed through each area. Records shall be capable of identifying for each production and 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 detail 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 JAN microcircuits passed the applicable screening, qualification and quality conformance inspections; that the microcircuits were assembled on the proper certified assembly line, and processed on the correct certified wafer process line.

30.1.3 Quality assurance program plan. The quality assurance program plan 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. It 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 program plan is required for each manufacturing plant; any difference in treatment of different product lines within a plant shall be stated and explained in the program plan, or separate program plans prepared for such different lines. The program plan shall contain, as a minimum, these items:

a. Documents representing the manufacturer's quality organization:

(1) Functional block organization chart (see 30.1.3.1).

(2) Example of manufacturing flowchart (see 30.1.3.2).

(3) Proprietary-document identification (see 30.1.3.3).

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

(5) Examples of records (see 30.1.3.5).

(6) Examples of design, material and process change control documents (see 30.1.1.8 and as required in 3.4.1.2.3 and 3.4.2).

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

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

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

(10) Examples of test travelers (see 30.1.3.7).

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

(12) Manufacturer's self-audit program (see section 40).

*

Detail requirements for these items are described in 30.1.3.1 through 30.1.3.8, 3.4.1.2.3, 3.4.2, 30.1.1.10, and 30.1.1.11.

NOTE: Where a manufacturer's lot/test traveler (see 3.4.6.1 and 30.1.3.7) contains all the information required for a flowchart (see 30.1.3.2), it may be used to satisfy the requirement for the flowchart.

* b. Critical documents which are to be kept current and on file at the qualifying activity:

(1) SPC program plans/milestones.

(2) Process flowcharts and baselines (wafer fabrication and assembly).

(3) General QCI procedures.

(4) Major change notification procedure.

(5) Internal visual inspection procedure.

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 quality assurance program. Names of 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 flowchart shall clearly show any utilization of third party activities. 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 3.4.2. For class S, 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-certification teams and the designated Government representative(s).

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, visual standard, 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 2010 or method 2017, as applicable, of MIL-STD-883 for the applicable device class, shall be included in the program plan.

30.1.3.7 Examples of travelers. Wafer fab, assembly, screening, and groups A, B, C, D (and E, if applicable) travelers shall be included in the program plan and maintained on current basis. The traveler utilized for quality conformance inspection 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 travelers shall include all manufacturer imposed tests. Alternate methods of meeting these requirements may be approved by the qualifying activity. The test traveler shall include all the following minimum information (if applicable):

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. PIN, date code, and manufacturer internal lot identification number(s).

d. Date(s) 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, temperatures, RPMs, etc. (Not required for screening and QCI traveler.)

j. The percent defective calculated for burn-in.

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

l. All required variables data (see 4.4.2.1.6) 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 information (e.g., DESC-EQM form 42, DESC Microcircuit Materials and Construction Baseline Sheet, or equivalent) shall be included in the manufacturer's program plan and maintained under document control. The baseline form shall clearly show any utilization of third party activities.

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 survey 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 compliance to all applicable specifications. The manufacturer's self-audit program which identifies key review areas, their frequency of audit, and the corrective action system to be employed when variations from the approved procedures or specification requirements are identified shall be included in the program plan. The self-audit program shall, as a minimum, incorporate the following requirements.

40.3.1.1 Correction of deficiencies. A system to identify and correct any deficiencies (e.g., processing and testing) or deviations from the specification requirements.

40.3.1.2 Deviation from critical documents. Provide for review of all deviations from critical documents, such as, baseline(s), flowchart(s), traveler(s), QCI procedures, etc.

40.3.1.3 Training and retention of auditors. Specify the selection and training/retraining requirements for auditors.

40.3.1.4 Self-audit schedule and frequency. Specify the self-audit frequencies and require that a schedule be established and adhered to.

40.3.2 Self-audit representatives. The quality assurance representatives or the 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(s) 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 form and a copy submitted to the department head for corrective action(s). 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. The self-audit team shall perform a 6-month follow-up verification of corrective actions covering all deficiencies found during the qualifying activity audit and annual self-audit to assure corrective actions are adequate and maintained.

40.3.5 Audit schedules and frequencies. The original audit frequency shall be established with a schedule 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 qualifying activity.

* 40.3.6 Self-audit report. The self-audit report shall be signed by the quality assurance representative responsible for the quality assurance program's overall success or failure. The manufacturer shall make available to the qualifying activity, during reaudits, the self-audit report, deficiencies, and corrective actions taken. This report shall include a summary report of self-audit results categorized by deficiency type (i.e., nonconformance to military specification requirement(s), occurrences affecting product reliability, recurring deficiencies). 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:

Calibration and preventive maintenance
Fabrication
Assembly operations
Electrical test
Test methods
Environmental control
Incoming inspection
Inventory control and traceability
DI water controls
Training
Failure analysis
Qualification/QCI system
Document control
Design change control
Statistical process control
Third party subcontractors 1/

1/ The self-audit shall include any activities performed by a third party, and shall ensure full compliance by the third party to MIL-M-38510 and its associated detail specification or drawing. Any deviations or questionable areas shall be brought to the attention of the qualifying activity.

40.3.8 Self-audit checklist. The audit checklist shall be prepared by the quality organization and maintained under document control. The checklist shall assure that the quality assurance system is adequate and followed by all personnel in each area.

APPENDIX B

STATISTICAL SAMPLING, TEST AND INSPECTION PROCEDURES

10. SCOPE

10.1 Scope. This appendix contains statistical sampling, life test and qualification procedures used with 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 appendix.

30. GENERAL

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

a. LTPD series: The lot tolerance percent defective (LTPD) series is defined as the following decreasing series of LTPD or Lambda ($\lambda$) 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 inspection: Tightened inspection is defined as inspection performed using the next LTPD or lambda value in the LTPD series lower than that specified.

c. Acceptance number (c): The acceptance number is defined as an integral number associated with the selected sample size which determines the maximum number of defectives permitted for that sample size.

d. Rejection number (r): Rejection number is defined as one plus the acceptance number.

e. Lambda ($\lambda$): Lambda is defined as LTPD per 1,000 hours.

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

a. LTPD: Lot tolerance percent defective.

b. $\lambda$: Lambda.

c. c: Acceptance number.

d. r: Rejection number.

40. STATISTICAL SAMPLING PROCEDURES AND TABLE - LTPD METHOD

40.1 General. Statistical sampling shall be conducted using the LTPD method. The LTPD method as specified herein is a sampling plan which provides a high degree of assurance that a lot having a percent defective greater than or equal to the specified LTPD value will not be accepted. The procedures specified herein are suitable for all quality conformance requirements. For reevaluation purposes see 6.5.

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. Quality conformance inspection 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 B-I or B-II and shall meet the specified LTPD or lambda. The manufacturer may, at his option, select a sample size greater than that required; however, the number of failures permitted shall not exceed the acceptance number associated with the chosen sample size in table B-I or B-II. In table B-II, the LTPD column to be used for sample size determination shall be that given in the lot size column which is nearest in value of the actual size of the submitted lot, except that if the actual lot size is midway between two of the lot sizes given in the table, either of the bounding lot size columns may be used at the manufacturer's option. If, in table B-II, the appropriate lot size column does not contain an LTPD value equal to or less than the specified LTPD value, 100 percent inspection shall be used. In table B-II, the LTPD value in the appropriate lot size column which is numerically closest to the specified LTPD value shall be used to determine the sample size.

40.2.2 Acceptance procedure. For the first sampling, an acceptance number shall be chosen and the associated number of sample devices for the specified LTPD selected and tested (see 40.2.1). If the observed number of defectives from the first sample is less than or equal to the preselected acceptance number, the lot shall be accepted. If the observed number of defectives exceeds the preselected acceptance number, an additional sample may be chosen such that the total sample complies with 40.2.3. The table (B-I or B-II), which is used for the first sampling of a given inspection lot for a given subgroup shall be used for any and all subsequent samplings for the same lot and subgroup for each lot submission.

40.2.3 Additional sample. The manufacturer may add an additional quantity to the initial sample, but this may be done only once for any subgroup and is limited to the initial sample (i.e., does not apply to resubmitted lots after initial failure). The added samples shall be subjected to all the tests within the subgroup. The total sample size (initial and added samples) shall be determined by a new acceptance number selected from table B-I or B-II.

40.2.4 Multiple criteria. When one sample is used for more than one acceptance criterion, the entire sample for a subgroup shall be used for all criteria within the subgroup. In table B-I, the acceptance number shall be that one associated with the largest sample size in the appropriate LTPD column which is less than or equal to the sample size used. In table B-II, the acceptance number shall be that one associated with the specified LTPD, in the appropriate lot size column, for the sample size used.

40.2.5 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 LTPD value, the lot shall be considered to have failed the appropriate subgroup(s). Resubmission of lots tested on a 100 percent inspection basis shall also be on a 100 percent inspection basis only and in accordance with the tightened inspection LTPD and other requirements of 4.3.3.1.

40.2.6 Tightened inspection. Tightened inspection shall be performed by testing to the criteria of the next LTPD or $\lambda$ value lower than that specified in the series 1, 1.5, 2, 3, 5, 7 times $10^n$, where n is an integral number.

TABLE B-I. LTPD sampling plan. 1/ 2/

Minimum size of sample to be tested to assure, with a 90 percent confidence, that a lot having percent-defective equal to the specified LTPD will not be accepted (single sample).

| Maximum percent defective (LTPD) or A | 50 | 30 | 20 | 15 | 10 | 7 | 5 | 3 | 2 | 1.5 | 1 | 0.7 | 0.5 | 0.3 | 0.2 | 0.15 | 0.1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acceptance number (C) (r = c + 1) | Minimum sample sizes (For device-hours required for life test, multiply by 1000) | | | | | | | | | | | | | | | | |
| 0 | 5 (1.03) | 8 (0.64) | 11 (0.46) | 15 (0.34) | 22 (0.23) | 32 (0.16) | 45 (0.11) | 76 (0.07) | 116 (0.04) | 153 (0.03) | 231 (0.02) | 328 (0.02) | 461 (0.01) | 767 (0.007) | 1152 (0.005) | 1534 (0.003) | 2303 (0.002) |
| 1 | 8 (4.4) | 13 (2.7) | 18 (2.0) | 25 (1.4) | 38 (0.94) | 55 (0.65) | 77 (0.46) | 129 (0.28) | 195 (0.18) | 258 (0.14) | 390 (0.09) | 555 (0.06) | 778 (0.45) | 1296 (0.027) | 1946 (0.018) | 2592 (0.013) | 3891 (0.009) |
| 2 | 11 (7.4) | 18 (4.5) | 25 (3.4) | 34 (2.24) | 52 (1.6) | 75 (1.1) | 105 (0.78) | 176 (0.47) | 266 (0.31) | 354 (0.23) | 533 (0.15) | 759 (0.11) | 1065 (0.080) | 1773 (0.045) | 2662 (0.031) | 3547 (0.022) | 5323 (0.015) |
| 3 | 13 (10.5) | 22 (6.2) | 32 (4.4) | 43 (3.2) | 65 (2.1) | 94 (1.5) | 132 (1.0) | 221 (0.62) | 333 (0.41) | 444 (0.31) | 668 (0.20) | 953 (0.14) | 1337 (0.10) | 2226 (0.062) | 3341 (0.041) | 4452 (0.031) | 6681 (0.018) |
| 4 | 16 (12.3) | 27 (7.3) | 38 (5.3) | 52 (3.9) | 78 (2.6) | 113 (1.8) | 158 (1.3) | 265 (0.75) | 398 (0.50) | 531 (0.37) | 798 (0.25) | 1140 (0.17) | 1599 (0.12) | 2663 (0.074) | 3997 (0.049) | 5327 (0.037) | 7994 (0.025) |
| 5 | 19 (13.6) | 31 (8.4) | 45 (6.0) | 60 (4.4) | 91 (2.9) | 131 (2.0) | 184 (1.4) | 308 (0.85) | 462 (0.57) | 617 (0.42) | 927 (0.28) | 1323 (0.20) | 1855 (0.14) | 3090 (0.085) | 4638 (0.056) | 6181 (0.042) | 9275 (0.028) |
| 6 | 21 (15.6) | 35 (9.4) | 51 (6.6) | 68 (4.9) | 104 (3.2) | 149 (2.2) | 209 (1.6) | 349 (0.94) | 528 (0.62) | 700 (0.47) | 1054 (0.31) | 1503 (0.22) | 2107 (0.155) | 3509 (0.093) | 5267 (0.062) | 7019 (0.047) | 10533 (0.031) |
| 7 | 24 (16.6) | 39 (10.2) | 51 (7.2) | 77 (5.3) | 116 (3.5) | 166 (2.4) | 234 (1.7) | 390 (1.0) | 589 (0.67) | 783 (0.51) | 1178 (0.34) | 1680 (0.24) | 2355 (0.17) | 3922 (0.101) | 5886 (0.067) | 7845 (0.051) | 11771 (0.034) |
| 8 | 26 (18.1) | 43 (10.9) | 63 (7.7) | 85 (5.6) | 128 (3.7) | 184 (2.6) | 258 (1.8) | 431 (1.1) | 648 (0.72) | 864 (0.54) | 1300 (0.36) | 1854 (0.25) | 2599 (0.18) | 4329 (0.108) | 6498 (0.072) | 8660 (0.054) | 12995 (0.036) |
| 9 | 28 (19.4) | 47 (11.5) | 69 (8.1) | 93 (6.0) | 140 (3.9) | 201 (2.7) | 282 (1.9) | 471 (1.2) | 709 (0.77) | 945 (0.58) | 1421 (0.38) | 2027 (0.27) | 2842 (0.19) | 4733 (0.114) | 7103 (0.077) | 9468 (0.057) | 14206 (0.038) |
| 10 | 31 (19.9) | 51 (12.1) | 75 (8.4) | 100 (6.3) | 152 (4.1) | 218 (2.9) | 306 (2.0) | 511 (1.2) | 770 (0.80) | 1025 (0.60) | 1541 (0.40) | 2199 (0.28) | 3082 (0.20) | 5133 (0.120) | 7704 (0.080) | 10268 (0.060) | 15407 (0.040) |
| 11 | 33 (21.0) | 54 (12.8) | 83 (8.3) | 111 (6.2) | 166 (4.2) | 238 (2.9) | 332 (2.1) | 555 (1.2) | 832 (0.83) | 1109 (0.62) | 1664 (0.42) | 2378 (0.29) | 3323 (0.21) | 5546 (0.12) | 8319 (0.083) | 11092 (0.062) | 16638 (0.042) |
| 12 | 36 (21.4) | 59 (13.0) | 89 (8.6) | 119 (6.5) | 178 (4.3) | 254 (3.0) | 356 (2.2) | 594 (1.3) | 890 (0.86) | 1187 (0.65) | 1781 (0.43) | 2544 (0.3) | 3562 (0.22) | 5936 (0.13) | 8904 (0.086) | 11872 (0.065) | 17808 (0.043) |
| 13 | 38 (22.3) | 63 (13.4) | 95 (8.9) | 126 (6.7) | 190 (4.5) | 271 (3.1) | 379 (2.26) | 632 (1.3) | 948 (0.89) | 1264 (0.67) | 1896 (0.44) | 2709 (0.31) | 3793 (0.22) | 6321 (0.134) | 9482 (0.089) | 12643 (0.067) | 18964 (0.045) |
| 14 | 40 (23.1) | 67 (13.8) | 101 (9.2) | 134 (6.9) | 201 (4.6) | 288 (3.2) | 403 (2.3) | 672 (1.4) | 1007 (0.92) | 1343 (0.69) | 2015 (0.46) | 2878 (0.32) | 4029 (0.23) | 6716 (0.138) | 10073 (0.092) | 13431 (0.069) | 20146 (0.046) |
| 15 | 43 (23.3) | 71 (14.1) | 107 (9.4) | 142 (7.1) | 213 (4.7) | 305 (3.3) | 426 (2.36) | 711 (1.41) | 1086 (0.94) | 1422 (0.71) | 2133 (0.47) | 3046 (0.33) | 4265 (0.235) | 7108 (0.141) | 10662 (0.094) | 14216 (0.070) | 21324 (0.047) |
| 16 | 45 (24.1) | 74 (14.6) | 112 (9.7) | 150 (7.2) | 225 (4.8) | 321 (3.37) | 450 (2.41) | 750 (1.44) | 1124 (0.96) | 1499 (0.72) | 2249 (0.48) | 3212 (0.337) | 4497 (0.241) | 7496 (0.144) | 11244 (0.096) | 14992 (0.072) | 22487 (0.048) |
| 17 | 47 (24.7) | 79 (14.7) | 118 (9.86) | 158 (7.36) | 236 (4.93) | 338 (3.44) | 473 (2.46) | 788 (1.48) | 1182 (0.98) | 1576 (0.74) | 2364 (0.49) | 3377 (0.344) | 4728 (0.246) | 7880 (0.148) | 11819 (0.098) | 15759 (0.074) | 23639 (0.049) |
| 18 | 50 (24.9) | 83 (15.0) | 124 (10.0) | 165 (7.54) | 248 (5.02) | 354 (3.51) | 496 (2.51) | 826 (1.51) | 1239 (1.0) | 1652 (0.75) | 2478 (0.50) | 3540 (0.351) | 4956 (0.251) | 8260 (0.151) | 12390 (0.100) | 16520 (0.075) | 24780 (0.050) |
| 19 | 52 (25.5) | 86 (15.4) | 130 (10.2) | 173 (7.76) | 259 (5.12) | 370 (3.58) | 518 (2.56) | 864 (1.53) | 1296 (1.02) | 1728 (0.77) | 2591 (0.52) | 3702 (0.358) | 5183 (0.256) | 8638 (0.153) | 12957 (0.102) | 17276 (0.077) | 25914 (0.051) |
| 20 | 54 (26.1) | 90 (15.6) | 135 (10.4) | 180 (7.82) | 271 (5.19) | 386 (3.65) | 541 (2.60) | 902 (1.56) | 1353 (1.04) | 1803 (0.78) | 2705 (0.52) | 3864 (0.364) | 5410 (0.260) | 9017 (0.156) | 13526 (0.104) | 18034 (0.078) | 27051 (0.052) |
| 25 | 65 (27.0) | 109 (16.1) | 163 (10.8) | 217 (8.08) | 326 (5.38) | 466 (3.76) | 652 (2.69) | 1086 (1.61) | 1629 (1.08) | 2173 (0.807) | 3259 (0.538) | 4656 (0.376) | 6518 (0.269) | 10863 (0.161) | 16295 (0.108) | 21726 (0.081) | 32589 (0.054) |

1/ Sample sizes are based upon the Poisson exponential binomial limit.

2/ The minimum quality (approximate AQL) required to accept (on the average) 19 of 20 lots is shown in parenthesis for information only.

TABLE B-II. Hypergeometric sampling plans for small lot sizes of 200 or less
(N = lot size, n = sample size, c = acceptance number)

C - 0

| N | 10 | | 20 | | 30 | | 40 | | 50 | | 60 | | 80 | | 100 | | 120 | | 150 | | 160 | | 200 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD |
| 2 | 2.2 | 85 | 2.5 | 86 | 2.5 | 67 | 2.5 | 67 | 2.5 | 67 | 2.5 | 68 | 2.5 | 68 | 2.5 | 68 | 2.5 | 68 | 2.5 | 68 | 2.5 | 68 | 2.5 | 68 |
| 4 | 1.2 | 36 | 1.2 | 40 | 1.2 | 42 | 1.2 | 42 | 1.3 | 42 | 1.3 | 43 | 1.3 | 43 | 1.3 | 43 | 1.3 | 43 | 1.3 | 43 | 1.3 | 44 | 1.3 | 44 |
| 5 | 1.0 | 29 | 1.0 | 43 | 1.0 | 34 | 1.0 | 35 | 1.0 | 35 | 1.0 | 35 | 1.0 | 36 | 1.0 | 36 | 1.0 | 37 | 1.0 | 37 | 1.0 | 37 | 1.0 | 37 |
| 8 | 0.5 | 15 | 0.6 | 20 | 0.6 | 22 | 0.6 | 23 | 0.6 | 23 | 0.6 | 23 | 0.6 | 24 | 0.7 | 24 | 0.7 | 24 | 0.7 | 24 | 0.7 | 24 | 0.7 | 25 |
| 10 | | | 0.4 | 15 | 0.5 | 17 | 0.5 | 19 | 0.5 | 19 | 0.5 | 19 | 0.5 | 20 | 0.5 | 20 | 0.5 | 20 | 0.5 | 20 | 0.5 | 20 | 0.5 | 20 |
| 16 | | | 0.2 | 6.9 | 0.25 | 10 | 0.25 | 11 | 0.3 | 11 | 0.3 | 12 | 0.3 | 12 | 0.3 | 13 | 0.3 | 13 | 0.3 | 13 | 0.3 | 13 | 0.3 | 13 |
| 20 | | | | | 0.2 | 6.8 | 0.2 | 8.0 | 0.25 | 8.7 | 0.25 | 9.0 | 0.25 | 9.4 | 0.25 | 10 | 0.25 | 10 | 0.25 | 10 | 0.25 | 10 | 0.25 | 11 |
| 25 | | | | | 0.15 | 4.3 | 0.15 | 3.7 | 0.2 | 6.4 | 0.2 | 6.9 | 0.2 | 7.4 | 0.2 | 7.5 | 0.2 | 7.6 | 0.2 | 7.7 | 0.2 | 7.8 | 0.2 | 7.9 |
| 32 | | | | | | | 0.1 | 3.7 | 0.1 | 4.4 | 0.1 | 5.0 | 0.1 | 5.5 | 0.1 | 5.9 | 0.15 | 6.0 | 0.15 | 6.2 | 0.15 | 6.3 | 0.15 | 6.3 |
| 40 | | | | | | | | | 0.1 | 3.0 | 0.1 | 3.4 | 0.1 | 4.0 | 0.1 | 4.5 | 0.1 | 4.6 | 0.1 | 4.9 | 0.1 | 5.0 | 0.15 | 5.0 |
| 50 | | | | | | | | | | | 0.1 | 2.3 | 0.1 | 2.9 | 0.10 | 3.3 | 0.1 | 3.5 | 0.10 | 3.7 | 0.1 | 3.7 | 0.10 | 3.9 |
| 64 | | | | | | | | | | | | | 0.08 | 1.7 | 0.08 | 2.2 | 0.06 | 2.5 | 0.06 | 2.7 | 0.06 | 2.8 | 0.06 | 2.9 |
| 80 | | | | | | | | | | | | | | | 0.07 | 1.5 | 0.07 | 1.7 | 0.07 | 2.0 | 0.07 | 2.1 | 0.07 | 2.2 |
| 100 | | | | | | | | | | | | | | | | | 0.05 | 1.1 | 0.05 | 1.5 | 0.05 | 1.5 | 0.05 | 1.7 |
| 125 | | | | | | | | | | | | | | | | | | | 0.04 | 0.8 | 0.04 | 0.9 | 0.04 | 1.2 |
| 128 | | | | | | | | | | | | | | | | | | | 0.04 | 0.8 | 0.04 | 0.9 | 0.04 | 1.1 |
| 160 | | | | | | | | | | | | | | | | | | | | | | | 0.03 | 0.7 |

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| N | 10 | | 20 | | 30 | | 40 | | 50 | | 60 | | 80 | | 100 | | 120 | | 150 | | 160 | | 200 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD |
| 2 | 27 | 95 | 24 | 95 | 24 | 95 | 23 | 95 | 23 | 95 | 23 | 95 | 23 | 95 | 23 | 95 | 23 | 95 | 22 | 95 | 22 | 95 | 22 | 95 |
| 4 | 15 | 62 | 12 | 66 | 12 | 66 | 11 | 67 | 11 | 67 | 10 | 67 | 10 | 67 | 10 | 67 | 10 | 67 | 9.8 | 67 | 9.7 | 67 | 9.7 | 68 |
| 5 | 13 | 51 | 10 | 55 | 8.8 | 56 | 8.5 | 57 | 8.4 | 57 | 8.1 | 58 | 7.9 | 58 | 7.6 | 58 | 7.5 | 58 | 7.5 | 58 | 7.5 | 58 | 7.5 | 58 |
| 8 | 11 | 28 | 7.2 | 35 | 6.2 | 38 | 5.8 | 38 | 5.4 | 39 | 5.0 | 39 | 4.7 | 39 | 4.5 | 39 | 4.3 | 39 | 4.3 | 40 | 4.2 | 40 | 4.2 | 40 |
| 10 | | | 6.2 | 30 | 5.0 | 30 | 4.6 | 31 | 4.2 | 32 | 4.2 | 22 | 4.2 | 32 | 3.9 | 33 | 3.5 | 33 | 3.3 | 33 | 3.3 | 33 | 3.3 | 33 |
| 16 | | | 5.6 | 15 | 4.2 | 18 | 3.8 | 18 | 3.4 | 20 | 3.0 | 20 | 2.9 | 21 | 2.6 | 21 | 2.5 | 21 | 2.3 | 21 | 2.3 | 22 | 2.2 | 22 |
| 20 | | | | | 4.0 | 13 | 3.2 | 15 | 2.8 | 16 | 2.5 | 16 | 2.4 | 16 | 2.3 | 16 | 2.1 | 17 | 2.0 | 17 | 2.0 | 17 | 2.0 | 18 |
| 25 | | | | | 3.8 | 9.2 | 3.1 | 11 | 2.5 | 12 | 2.2 | 13 | 2.0 | 13 | 1.8 | 13 | 1.7 | 13 | 1.6 | 14 | 1.6 | 14 | 1.6 | 14 |
| 32 | | | | | | | 3.1 | 7.4 | 2.4 | 8.2 | 2.1 | 9.0 | 1.8 | 9.9 | 1.6 | 10 | 1.5 | 10.5 | 1.4 | 11 | 1.3 | 11 | 1.3 | 11 |
| 40 | | | | | | | | | 2.4 | 5.9 | 2.1 | 6.8 | 1.6 | 7.8 | 1.4 | 7.8 | 1.3 | 8.2 | 1.2 | 8.3 | 1.2 | 8.4 | 1.1 | 8.6 |
| 50 | | | | | | | | | | | 1.7 | 4.6 | 1.4 | 5.6 | 1.2 | 6.1 | 1.2 | 6.4 | 1.0 | 6.5 | 0.9 | 6.7 | 0.9 | 6.7 |
| 64 | | | | | | | | | | | | | 1.3 | 3.8 | 1.1 | 4.4 | 1.0 | 4.7 | 0.8 | 5.0 | 0.8 | 5.0 | 0.7 | 5.2 |
| 80 | | | | | | | | | | | | | | | 1.1 | 3.0 | 1.0 | 3.4 | 0.8 | 3.7 | 0.7 | 3.8 | 0.6 | 4.0 |
| 100 | | | | | | | | | | | | | | | | | 0.9 | 2.5 | 0.7 | 2.8 | 0.7 | 2.8 | 0.6 | 3.0 |
| 125 | | | | | | | | | | | | | | | | | | | 0.7 | 1.9 | 0.7 | 2.0 | 0.5 | 2.2 |
| 128 | | | | | | | | | | | | | | | | | | | 0.7 | 1.7 | 0.7 | 1.9 | 0.5 | 2.2 |
| 160 | | | | | | | | | | | | | | | | | | | | | | | 0.5 | 1.5 |

C - 2

| N | 10 | | 20 | | 30 | | 40 | | 50 | | 60 | | 80 | | 100 | | 120 | | 150 | | 160 | | 200 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD | AQL | LTPD |
| 4 | 33 | 82 | 28 | 83 | 27 | 84 | 27 | 85 | 27 | 85 | 26 | 85 | 26 | 85 | 26 | 86 | 26 | 86 | 25 | 86 | 25 | 86 | 25 | 86 |
| 5 | 27 | 69 | 23 | 73 | 21 | 74 | 20 | 74 | 20 | 74 | 20 | 75 | 20 | 75 | 19 | 75 | 19 | 75 | 19 | 75 | 19 | 75 | 19 | 75 |
| 8 | 22 | 42 | 15 | 49 | 14 | 49 | 13 | 52 | 13 | 52 | 13 | 52 | 12 | 53 | 12 | 53 | 12 | 53 | 11 | 53 | 11 | 53 | 11 | 53 |
| 10 | | | 13 | 39 | 11 | 42 | 11 | 42 | 10 | 43 | 10 | 43 | 9.6 | 43 | 9.2 | 44 | 9.1 | 44 | 8.9 | 44 | 8.9 | 44 | 8.7 | 44 |
| 16 | | | 11 | 22 | 8.6 | 25 | 6.9 | 27 | 6.8 | 27 | 6.4 | 27 | 6.0 | 28 | 6.0 | 29 | 5.9 | 29 | 5.9 | 29 | 5.7 | 29 | 5.5 | 30 |
| 20 | | | | | 7.7 | 19 | 6.2 | 21 | 5.9 | 22 | 5.6 | 22 | 5.1 | 23 | 4.8 | 23 | 4.8 | 23 | 4.6 | 23 | 4.5 | 24 | 4.5 | 24 |
| 25 | | | | | 7.4 | 13 | 6.0 | 16 | 4.9 | 17 | 4.5 | 17 | 4.3 | 18 | 4.1 | 18 | 3.9 | 18 | 3.7 | 18 | 3.7 | 19 | 3.7 | 19 |
| 32 | | | | | | | 5.5 | 11 | 4.8 | 12 | 4.3 | 13 | 3.6 | 14 | 3.4 | 14 | 3.2 | 14 | 3.0 | 14.5 | 3.0 | 15 | 2.9 | 15 |
| 40 | | | | | | | | | 4.6 | 8.9 | 3.9 | 9.8 | 3.1 | 11 | 2.8 | 12 | 2.6 | 12 | 2.4 | 12 | 2.4 | 12 | 2.3 | 12 |
| 50 | | | | | | | | | | | 3.5 | 6.9 | 2.8 | 8.1 | 2.4 | 8.4 | 2.3 | 8.6 | 2.1 | 9.0 | 2.1 | 9.3 | 2.0 | 9.5 |
| 64 | | | | | | | | | | | | | 2.6 | 5.7 | 2.2 | 6.2 | 2.0 | 6.6 | 1.8 | 7.1 | 1.7 | 7.1 | 1.6 | 7.4 |
| 80 | | | | | | | | | | | | | | | 2.1 | 4.5 | 1.8 | 4.9 | 1.6 | 5.4 | 1.5 | 5.4 | 1.4 | 5.6 |
| 100 | | | | | | | | | | | | | | | | | 1.8 | 3.5 | 1.4 | 3.9 | 1.4 | 4.0 | 1.2 | 4.4 |
| 125 | | | | | | | | | | | | | | | | | | | 1.4 | 2.8 | 1.3 | 2.9 | 1.1 | 3.3 |
| 128 | | | | | | | | | | | | | | | | | | | 1.4 | 2.6 | 1.3 | 2.9 | 1.1 | 2.2 |
| 160 | | | | | | | | | | | | | | | | | | | | | | | 1.1 | 2.3 |

Table B-II gives the AQL and LTPD values associated with certain single sampling plans (acceptance number, sample size, and lot size). The table has the following features:

(a) Calculations are based upon the hypergeometric distribution (exact theory) for lot sizes 200 or less.

(b) The AQL of a sampling plan is defined as the interpolated percent defective for which there is a 0.95 probability of acceptance under the plan. The AQL so defined need not be a realizable lot percent defective for the lot size involved (e.g., 12 percent is not a realizable percent defective for a lot size of 20).

(c) The LTPD of a sampling plan is defined as the interpolated percent defective for which there is a 0.10 probability of lot acceptance under the plan. The LTPD so defined need not be a realizable lot percent defective for the lot size involved.

(d) The sequence of sample sizes and lot sizes are generated by taking products of preceding numbers in the respective sequences and the numbers two and five.

# APPENDIX C

## CASE OUTLINES

* THE REQUIREMENTS OF THIS APPENDIX HAVE BEEN SUPERSEDED BY MIL-STD-1835 AS OF THE DATE OF REVISION J OF MIL-M-38510.

APPENDIX D

MATERIAL AND TEST DATA REQUIRED FOR LISTING OF MICROCIRCUITS IN THE QUALIFIED PRODUCTS LIST AND TO RECEIVE AUTHORIZATION TO TEST

10. SCOPE

10.1 Scope. This appendix contains details of the material and test data requirements for listing of microcircuits in Qualified Products List QPL-38510, part I and part II, and to initiate qualification testing. 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 Qualified products list QPL-38510, part I and part II. Qualified products list QPL-38510 consists of two segments titled part I and part II. The microcircuits listed in part I have been subjected to and passed all the qualification requirements of this document and the applicable detail military specification. The microcircuits listed in part II have not been subjected to all the tests required for listing in part I; however, the microcircuits have been subjected to sufficient tests to demonstrate that they meet the electrical test requirements of this document and the applicable detail military specification.

30.1.1 Expiration of part II listing. The listing in part II of QPL-38510 is temporary. In the case of no part I listing for an identically part numbered device, a part II listing is normally valid until a manufacturer is listed on part I for the same PIN. When a manufacturer qualifies a device for a part I listing, manufacturers with a part II listing for an identically part numbered device will be notified of the part I listing. From that date of notification, the manufacturers with said part II listing will be retained on part II for no more than 90 days for class B and 180 days for class S. At this point, the qualifying activity will remove said part II listing from the QPL-38510.

a. Once a manufacturer is removed for cause from QPL-38510, part II, for a particular device type, he will not be relisted on part II for that device type.

b. If a manufacturer is removed from part II for a particular device type and this device type is listed on part I for that manufacturer this device type may be relisted on part II for different PINs if the manufacturer has submitted acceptable information for the part numbered device and:

(1) The PIN is not listed on part I.

(2) The manufacturer was not listed on part II previously for the PIN.

c. If a manufacturer fails a part I device type qualification test, that manufacturer's QPL-38510, part II, listing for that device type will be removed.

d. If a manufacturer fails a part I qualification test, that manufacturer's QPL-38510, part II, listings for that device type and package will be removed, if the failure is package related. If the failure is not package related, only that manufacturer's device type will be removed from QPL-38510, part II.

30.2 Material and test data requirements. To obtain listing of microcircuits in part I or part II of QPL-38510, the manufacturer must meet the requirements of 3.4.1.1 and 3.4.1.2. The procedure to obtain qualification listing is shown on figure D-1. The manufacturer must submit to the qualifying activity the material and test data specified in table D-I. To receive class B, part I or part II, listing, the manufacturer must submit a part I or part II test report (see 30.2.1 and table D-I). To receive class S, part I, listing, the manufacturer must use the procedures listed in a or b below. To receive class S, part II, listing, the manufacturer must use the procedure listed in c below.

a. If a manufacturer has qualified for class B, part I, listing for the die/package type combination to be qualified for class S listing, the class S qualification inspection lot shall be subjected to the tests specified in tables I and IIa of method 5005 of MIL-STD-883. Successful completion of this inspection lot will qualify the die/package type combination for class S, part I, listing.

b. If the manufacturer has not qualified for class B, part I, listing for the die/package type combination to be qualified for class S listing, the class S inspection lot shall be subjected to the tests specified in tables I, IIa, and IV of method 5005 of MIL-STD-883. Successful completion for class S will also achieve a class B, part I, listing.

c. The manufacturer is listed for class B, part I, for the same die/package type combination; receives class S certification; submit(s) a request for class S, part II, listing to the qualifying activity.

(1) The manufacturer is listed for class B, QPL part I, for the same die/package type combination to be qualified; receives class S certification; submit(s) notification of test initiation for class S qualification testing.

(2) The manufacturer is not listed for class B, QPL; receives class B and S certification; submits part A of class S, part II, test report; submit(s) notification of test initiation for class S qualification testing and submits part B of the class S, part II, test report (see table D-I).

* 30.2.1 Information required to initiate qualification testing and test report approval. The information listed in the following subparagraphs (a through n) is required, as applicable (see table D-I), when initiating qualification testing or submitting a qualification test report.

a. A completed section I of DESC Form 19C.

b. A test plan for the concerned test program.

c. All pertinent information and test samples as specified in the applicable DESC Form 19C.

d. A wafer lot acceptance report for class S.

e. The actual test traveler (or a copy) shall be submitted for screening and designated groups A, B, C, and D (and E if applicable) inspections and any additional required inspections.

* f. Variables and attribute data for all the tests and measurements (see 4.4.2.1.6) not included on the test traveler and all data for failed tests and failed devices.

* g. The photographs, and other material required by 3.5.4 through 3.5.4.4 inclusive.

* h. The burn-in and life test schematic.

* i. A copy of the manufacturer's controlled forcing function and test limits tables (all electrical screening and sampling subgroups and, if applicable, deltas and end-points) in the format of pin to pin conditions (e.g., group A inspection for device type table (table III, or equivalent) of the detail specification) and certification (DESC Form 67, Certificate of Compliance, or equivalent) that the test programs used for qualification have been verified against the test tables submitted. The copy is to include any tests used by the manufacturer that are not required by group A inspection for device type table (table III) of the associated detail specification. If the same revision of the test tables was previously approved, it need not be resubmitted.

* NOTE: The manufacturer may, at the discretion of the qualifying activity, be required to submit variables data or a printout of the actual test program used for qualification.

* j. A completed DESC Microcircuit Materials and Construction Baseline Sheet, section III, (DESC-EQM-42), or equivalent.

* k. A completed section III of the Qualification Testing Notification, DESC Form 19C.

* l. The group A subgroup tests including those tests specified as additional electrical subgroups in table II of the applicable associated detail specification shall be performed. The tests must be performed in strict compliance with the parameters and requirements of this specification and the applicable associated detail military specification.

* m. A glass integrity test photograph prior to part I or part II qualification whichever comes first (see 3.5.5.4).

* n. A copy of the test data on nondestructive bond pull testing (for class S only) as required by method 2023 of MIL-STD-883.

30.2.2 To receive part 1 package extension (see 4.4.2.6). The following information shall be submitted to the qualifying activity:

a. The manufacturer must certify that the die for the device in the additional packages is identical in all respects to the die for the device type qualified with a given package.

b. Mounting and bonding diagrams for each die in each different package.

c. A complete DESC Microcircuit Materials and Construction Baseline Sheet (DESC-EQM-42), or equivalent.

d. Terminal connections for the die in each different package.

e. Burn-in/life test schematic if different for the package used to qualify the die.

f. The manufacturer's $T_J$ calculation shall be submitted for each new die/package combination.

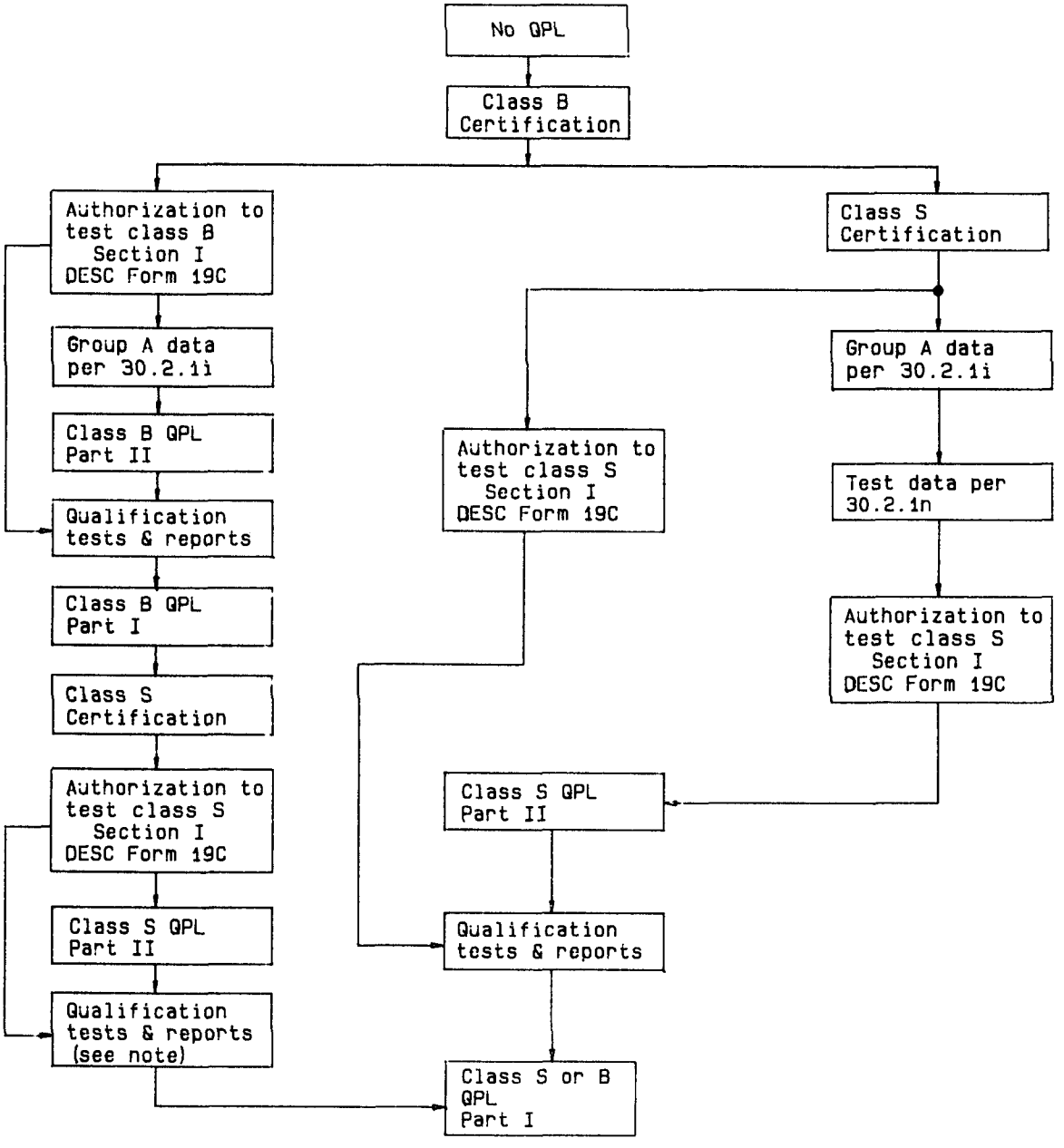
* TABLE D-I. Information required to receive authorization to conduct test and test report approval.

| Information in accordance with 30.2.1 | Part I qualification testing notification | | Part II test report 1/ | | | Part I test report 2/ | Die extension report |
|---|---|---|---|---|---|---|---|
| | Class B | Class S | Class B | Class S | | Complete report 2/ | |
| | | | | Part A | Part B | | |
| a | X | X | | | | | |
| b | X | X | | | | X | |
| c | | | | | | X | X |
| d | | X | | | | | |
| e | | | | | X | X | X |
| f | | | | | | X | |
| g | | | | X | | X | X |
| h | X 3/ | X 3/ | | X | | X | X |
| i | | | X | X | | X | X |
| j | X | X | X | X | | X | X |
| k | | | | | | X | |
| l | | | | | | X | X |
| m | | | X | X | | X | X |
| n | | | | | | X | |

1/ Information from the part I qualification testing notification column above shall be submitted for each new die family qualification. Information for part II test report need not be included if it is identical to the information previously submitted with the notification of qualification testing. If the notification of qualification testing for a particular PIN is canceled or testing is not completed within 9 months, the qualifying activity must be notified. The class S, part II, test report is not required if the manufacturer receives class B, QPL, part I, listing prior to submitting notification of qualification testing for class S.

2/ Information for part I test report need not be included if it is identical to the information submitted with the request for notification of qualification testing or the part II test report or both; however, if the information submitted with the part II test report is over 3 years old (from the date of receipt at the qualifying activity), all the information described by 30.2.1a through n, as applicable, of this appendix shall be submitted with the part I test report.

3/ At the manufacturer's option, the burn-in/life test schematic may be submitted for qualifying activity approval prior to DESC Form 19C notification.




NOTE: No additional group D testing required.

FIGURE D-1. Procedure to receive QPL-38510 listing.

APPENDIX E

MICROCIRCUIT GROUP ASSIGNMENTS FOR QUALITY CONFORMANCE INSPECTION
AND TECHNOLOGY GROUP/DIE FAMILY ASSIGNMENTS FOR QUALIFICATION

10. SCOPE

10.1 Scope. This appendix contains the microcircuit group assignments used in performing quality conformance inspections (see 3.1.3.13 and 4.5) and technology group/die family assignments for use in qualification (see 4.4.2.6). 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. *MICROCIRCUIT GROUP ASSIGNMENTS*

30.1 Microcircuit group assignments. Microcircuits group assignments and technologies/die family assignments shall be as specified in the following tables. The group assignments in tables E-I, E-II, and E-IV shall apply to monolithic microcircuits only. Microcircuit group assignment for hybrid and multichip microcircuits shall be determined in the individual associated detail specification, see table E-III. Each number represents a different microcircuit group. Each letter in the top row of the table represents a different technology group. Each table entry in the line below the technologies (e.g., Standard TTL, Schottky TTL, CMOS, etc.) represent a separate die family (e.g., 93, 93H, LS, etc). For the listing of detail specifications and devices within microcircuits groups, see supplement 1 of MIL-M-38510.

TABLE E-I. Digital microcircuits.

| Technology group | A | | | | B | C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Technologies | Standard TTL | Schottky TTL | Low power TTL | DTL | ECL | CMOS | PNMOS | NMOS | Combination bipolar and CMOS | Integrated |
| Die family | 93,93H, 54,54H | S,LS, F,ALS | 93L,54L | | | 54HC,54A, 4xxx | | | 54BCT,54ABT | Injection logic |
| Function | | | | | | | | | | |
| Gates | 1 | 8 | 15 | 22 | 29 | 36 | NA | NA | 125 | NA |
| Buffers | 2 | 9 | 16 | 23 | 30 | 37 | NA | NA | 126 | NA |
| Flip-Flops | 3 | 10 | 17 | 24 | 31 | 38 | NA | NA | 127 | NA |
| Combinational gates | 4 | 11 | 18 | 25 | 32 | 39 | NA | NA | 128 | NA |
| Sequential registers/ counters | 5 | 12 | 19 | 26 | 33 | 40 | 45 | 48 | 129 | 97 |
| RAM | 6 | 13 | 20 | 27 | 34 | 41 | 43 | 46 | 130 | 98 |
| ROM/PROM/PLA | 7 | 14 | 21 | 28 | 35 | 42 | 44 | 47 | 131 | 99 |
| Microprocessors interface peripherals FIFO | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 132 | 108 |

NA - None assigned, to be assigned at a later date as necessary.

APPENDIX E

TABLE E-II. Linear microcircuits. 1/

| Technology group | D | E | F | G |
|---|---|---|---|---|
| Technologies | Bipolar | J-FET | CMOS | Combinational |
| Functions | | | | |
| Operational amplifiers | 49 | 61 | 73 | 85 |
| Comparators | 50 | 62 | 74 | 86 |
| Sense Amplifiers | 51 | 63 | 75 | 87 |
| Regulators | 52 | 64 | 76 | 88 |
| Line drivers/ receivers | 53 | 65 | 77 | 89 |
| Timers | 54 | 66 | 78 | 90 |
| Core drivers | 55 | 67 | 79 | 91 |
| D/A converters | 56 | 68 | 80 | 92 |
| A/D converters | 57 | 69 | 81 | 93 |
| Analog switches/ multiplexers | 58 | 70 | 82 | 94 |
| Voltage reference | 59 | 71 | 83 | 95 |
| Sample and hold | 60 | 72 | 84 | 96 |
| Active filters | 109 | 112 | 115 | 118 |
| Telecommunication | 110 | 113 | 116 | 119 |
| Electro-optics | 111 | 114 | 117 | 120 |

1/ Die families are defined as microcircuit groups shown.

APPENDIX E

TABLE E-III. Other microcircuits.

| Technology group | Function |
|---|---|
| H<br>I | Multichip<br>Hybrid |

TABLE E-IV. Application specific microcircuits. 1/

| Technology group | K | |
|---|---|---|
| Technologies | Bipolar | CMOS |
| Function | | |
| Gate array | 121 | 123 |
| Linear array | 122 | 124 |

1/ Die families are defined as microcircuit groups shown.

APPENDIX F

REQUIREMENTS FOR THE PREPARATION OF
DEVICE SPECIFICATIONS OR DRAWINGS

10. SCOPE

10.1 Scope. This appendix contains the details of device specification or drawing requirements needed to define individual microcircuit types or families for acquisition. These requirements may be tailored depending on technology. 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 Applicable documents. Device specifications and drawings shall comply with the requirements of MIL-STD-883, MIL-STD-1331, and this specification. Any exceptions to the minimum requirements as stated herein shall be approved by the acquiring activity in accordance with MIL-STD-480. The manufacturer shall not advertise or sell product with such exceptions as compliant to MIL-M-38510, appendix G, or MIL-STD-883.

30.2 Content and format. The detail specification or drawing shall be prepared in such a content or format as to clearly identify which parameters, limits, and conditions of test shall be applied in response to any given requirement of this specification (e.g., qualification, quality conformance inspection, screening, etc.). All parameters, limits, and conditions of test which reflect the intended functions of the microcircuit are critical to assure proper application design and which are characteristic of the microcircuit shall be specified across the operating temperature and power supply ranges.

30.3 Interchangeability. The individual requirements shall be documented in the device specification or drawing to an extent sufficient to assure functional interchangeability and pin-for-pin replaceability among any microcircuits supplied in conformance with a specific device specification and a specific PIN. Any change which effects the degree of interchangeability and replaceability shall require assignment of a new part or type number and preparation of a new or revised device specification or drawing.

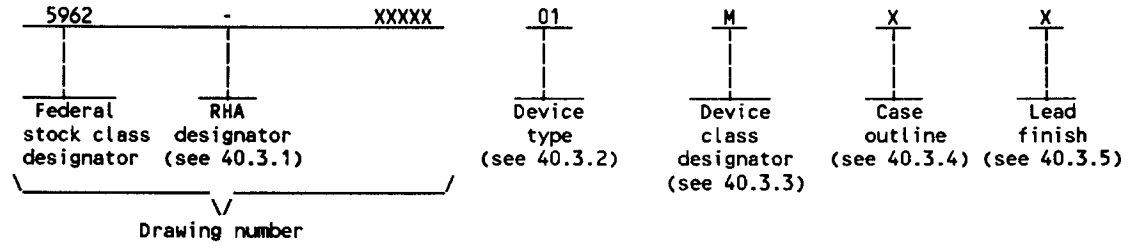
30.4 Special requirements. Any special requirements (e.g., for extended or accelerated reliability demonstration tests) shall be stated in the device specification or drawing. The device specification or drawing shall specify the basis for sample selection, sample size, test conditions, accept or reject criteria, failure analysis or reporting and inspection status (qualification, quality conformance groups B, C, or screening) as applicable.

40. DEVICE PROCUREMENT SPECIFICATION

40.1 SCOPE

40.2 Scope. This drawing forms a part of a one part - one part number documentation system (see 90.6 herein). Two product assurance classes consisting of military high reliability (device classes B, Q, and M) and space application (device classes S and V) and a choice of case outlines and lead finishes are available and are reflected in the PIN. Device class M microcircuits represent non-JAN class B microcircuits in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices". When available, a choice of radiation hardness assurance (RHA) levels are reflected in the PIN.

40.3 PIN. The PIN shall be as shown in the following example:



40.3.1 Radiation hardness assurance (RHA) designator. Device classes M, B, and S RHA marked devices shall meet the MIL-M-38510 specified RHA levels and shall be marked with the appropriate RHA designator. Device classes Q and V devices shall meet or exceed the electrical performance characteristics specified in table I herein after exposure to the specified irradiation levels specified in the absolute maximum ratings herein and the RHA marked device shall be marked in accordance with MIL-I-38535. A dash (-) indicates a non RHA device.

40.3.2 Device type(s). The device type(s) shall identify the circuit function as follows:

| Device type | Generic number | Circuit function |
|---|---|---|

40.3.3 Device class designator. The device class designator shall be a single letter identifying the product assurance level as follows:

| Device class | Device requirements documentation |
|---|---|
| M | Vendor self-certification to the requirements for non-JAN class B microcircuits in accordance with 1.2.1 of MIL-STD-883 |
| B or S | Certification and qualification to MIL-M-38510 |
| Q or V | Certification and qualification to MIL-I-38535 |

40.3.4 Case outline(s). For device classes M, B, and S, case outline(s) shall meet the requirements in appendix C of MIL-M-38510 and as listed below. For device classes Q and V, case outline(s) shall meet the requirements of MIL-I-38535, appendix C of MIL-M-38510, and as listed below.

| Outline letter | Case outline |
|---|---|

40.3.5 Lead finish. The lead finish shall be as specified in MIL-M-38510 for classes M, B, and S or MIL-I-38535 for classes Q and V. 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.

40.4 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 ($\theta_{JC}$)
Electrostatic discharge sensitivity (ESDS)
G-force
Other parameters (device specific)

40.5 Recommended operating conditions.

Operating temperature range (case ($T_C$) or ambient ($T_A$) as appropriate)
Supply voltages
Other parameters (device specific)

40.6 Digital logic testing for device classes Q and V.

Fault coverage measurement of manufacturing
logic tests (MIL-STD-883, test method 5012) - - - - - - - XX percent

50. APPLICABLE DOCUMENTS

50.1 Government specifications, standards, bulletin, and handbook. Unless otherwise specified, the following specifications, standards, bulletin, 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-M-38510 | - | Microcircuits, General Specification for. |
| MIL-I-38535 | - | Integrated Circuits, Manufacturing, General Specification for. |

STANDARDS

MILITARY

| | | |
|---|---|---|
| MIL-STD-480 | - | Configuration Control-Engineering Changes, Deviations and Waivers. |
| MIL-STD-883 | - | Test Methods and Procedures for Microelectronics. |

BULLETIN

MILITARY

| | | |
|---|---|---|
| MIL-BUL-103 | - | List of Standardized Military Drawings (SMD's). |

HANDBOOK

MILITARY

| | | |
|---|---|---|
| MIL-HDBK-780 | - | Standardized Military Drawings. |

(Copies of the specifications, standards, bulletin, 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.)

50.2 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.

60. REQUIREMENTS

60.1 Item requirements. The individual item requirements for device class M shall be in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant NON-JAN devices" and as specified herein. The individual item requirements for device classes B and S shall be in accordance with MIL-M-38510 and as specified herein. For device classes B and S a full electrical characterization table for each device type shall be included in this SMD. The individual item requirements for device classes Q and V shall be in accordance with MIL-I-38535, the device manufacturer's Quality Management (QM) plan, and as specified herein.

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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.

60.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 for device classes M, B, and S and MIL-I-38535 for device classes Q and V and herein.

60.2.1 Case outline(s). The case outline(s) shall be in accordance with 40.3.4 herein and figure

60.2.2 Terminal connections. The terminal connections shall be as specified on figure

60.2.3 Truth table. The truth table shall be as specified on figure

60.2.4 Block or logic diagram. The block or logic diagram shall be as specified on figure .

60.2.5 Radiation exposure circuit. The radiation exposure circuit shall be as specified on figure

60.3 Electrical performance characteristics and postirradiation parameter limits. Unless otherwise specified herein, the electrical performance characteristics and postirradiation parameter limits are as specified in table I and shall apply over the full case operating temperature range.

60.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table IIA. The electrical tests for each subgroup are defined in table I.

60.5 Marking. The part shall be marked with the PIN listed in 40.3 herein. Marking for device class M shall be in accordance with MIL-STD-883 (see 60.1 herein). In addition, the manufacturer's PIN may also be marked as listed in MIL-BUL-103. Marking for device classes B and S shall be in accordance with MIL-M-38510. Marking for device classes Q and V shall be in accordance with MIL-I-38535.

60.5.1 Certification/compliance mark. The compliance mark for device class M shall be a "C" as required in MIL-STD-883 (see 60.1 herein). The certification mark for device classes B and S shall be a "J" or "JAN" as required in MIL-M-38510. The certification mark for device classes Q and V shall be a "QML" as required in MIL-I-38535.

60.6 Certificate of compliance. For device class M, a certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-BUL-103 (see 90.7 herein). For device classes Q and V, a certificate of compliance shall be required from a QML-38535 listed manufacturer in order to supply to the requirements of this drawing (see 90.7 herein). The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply for this drawing shall affirm that the manufacturer's product meets, for device class M the requirements of MIL-STD-883 (see 60.1 herein), or for device classes Q and V, the requirements of MIL-I-38535 and the requirements herein.

60.7 Certificate of conformance. A certificate of conformance as required for device class M in MIL-STD-883 (see 60.1 herein) or device classes B and S in MIL-M-38510 or for device classes Q and V in MIL-I-38535 shall be provided with each lot of microcircuits delivered to this drawing.

60.8 Notification of change for device class M. For device class M notification to DESC-ECS of change of product (see 90.2 herein) involving devices acquired to this drawing is required for any change as defined in MIL-STD-480.

60.9 Verification and review for device class M. For device class M, DESC, DESC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

60.10 Microcircuit group assignment for device classes M, B, and S. Device classes M, B, and S devices covered by this drawing shall be in microcircuit group number xxx (see MIL-M-38510, appendix E).

60.11 Serialization for device class S. All device class S devices shall be serialized in accordance with MIL-M-38510.

70. QUALITY ASSURANCE PROVISIONS

APPENDIX F

70.1 Sampling and inspection. For device class M, sampling and inspection procedures shall be in accordance with section 4 of MIL-M-38510 to the extent specified in MIL-STD-883 (see 60.1 herein). For device classes B and S, sampling and inspection procedures shall be in accordance with MIL-M-38510 and method 5005 of MIL-STD-883, except as modified herein. For device classes Q and V sampling and inspection procedures shall be in accordance with MIL-I-38535, and the device manufacturer's QM plan.

TABLE I. Electrical performance characteristics.

| Test | Symbol | Conditions<br>$-55°C \le T_C \le +125°C$<br>$4.5\ V \le V_{CC} \le 5.5\ V$<br>unless otherwise specified | Group A subgroups | Device type | Limit | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| | | see figure 6 | | | | | |

FIGURE 1. Case outline.
FIGURE 2. Terminal connections.
FIGURE 3. Truth table.
FIGURE 4. Block diagram.
FIGURE 5. Radiation exposure circuit.
FIGURE 6. Timing waveforms.

70.2 Screening. For device class M, screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection. For device classes B and S, screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. For device classes Q and V, screening shall be in accordance with MIL-I-38535, and shall be conducted on all devices prior to qualification and technology conformance inspection. The following additional criteria shall apply.

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition or . For device class M, the test circuit shall be submitted to DESC-ECS for review with the certificate of compliance. For device classes B and S, the test circuit shall be submitted to the qualifying activity. For device classes Q and V, the test circuit shall be submitted to DESC-ECS with the certificate of compliance and under the control of the device manufacturer's technical review board (TRB) in accordance with MIL-I-38535.

(2) $T_A$ = +125°C, minimum.

b. Interim and final electrical test parameters shall be as specified in table IIA herein.

70.2.1 Additional screening for device class V. Additional screening for device class V beyond the requirements of device class Q shall be as specified in appendix B of MIL-I-38535 and as detailed in table IIB herein. These additional screens may be used to satisfy space system requirements and shall be reflected in the PIN.

70.3 Qualification inspection.

70.3.1 Qualification inspection for device classes B and S. Qualification inspection for device classes B and S shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, D, and E inspections (see 70.4.1 through 70.4.5).

70.3.2 Qualification inspection for device classes Q and V. Qualification inspection for device classes Q and V shall be in accordance with MIL-I-38535. Inspections to be performed shall be those specified in MIL-I-38535 and herein for groups A, B, C, D, and E inspections (see 70.4.1 through 70.4.5).

70.4 Conformance inspection. Quality conformance inspection for device class M shall be in accordance with MIL-STD-883 (see 60.1 herein) and as specified herein. Quality conformance inspection for device classes B and S shall be in accordance with MIL-M-38510 and as specified herein. Inspections to be performed for device classes M, B, and S shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, D, and E inspections (see 70.4.1 through 70.4.5). Technology conformance inspection for classes Q and V shall be in accordance with MIL-I-38535 including groups A, B, C, D, and E inspections and as specified herein, except where option 2 of MIL-I-38535 permits alternate in-line control testing.

70.4.1 Group A inspection.

a. Tests shall be as specified in table IIA herein.

b. For device class M, subgroups 7 and 8 tests shall be sufficient to verify the truth table. For device classes B and S, subgroups 7 and 8 tests shall be sufficient to verify the truth table as approved by the qualifying activity. For device classes Q and V, subgroups 7 and 8 shall include verifying the functionality of the device, these tests shall have been fault graded in accordance with MIL-STD-883, test method 5012 (see 40.6 herein).

70.4.2 Group B inspection. The group B inspection end-point electrical parameters shall be as specified in table IIA herein.

70.4.3 Group C inspection.

a. End-point electrical parameters shall be as specified in table IIA herein.

b. Steady-state life test conditions, method 1005 of MIL-STD-883:

(1) Test condition or . For device class M, the test circuit shall be submitted to DESC-ECS for review with the certificate of compliance. For device classes B and S, the test circuit shall be submitted to the qualifying activity. For device classes Q and V, the test circuit shall be submitted to DESC-ECS with the certificate of compliance and under the control of the device manufacturer's TRB in accordance with MIL-I-38535.

(2) $T_A$ = +125°C, minimum.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

70.4.4 Group D inspection. For group D inspection end-point electrical parameters shall be as specified in table IIA herein.

70.4.5 Group E inspection. Group E inspection is required only for parts intended to be marked as radiation hardness assured (see 60.5 herein). RHA levels for device classes B, S, Q, and V shall be M, D, R, and H and for device class M shall be M and D. RHA quality conformance inspection sample tests shall be performed at the level specified in the acquisition document.

a. RHA tests for device classes B and S for levels M, D, R, and H or for device class M for levels M and D 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 IIA 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 I for subgroups specified in table IIA herein.

d. For device classes M, B, and S the devices shall be subjected to radiation hardness assured tests as specified in MIL-M-38510 for RHA level being tested, and meet the postirradiation end-point electrical parameter limits as defined in table I at $T_A$ = 25°C ±5 percent, 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 M, B, and S, 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.

TABLE IIA. Electrical test requirements.

| Test requirements | Subgroups (per method 5005, table I) | | | Subgroups (per MIL-I-38535, table III) | |
|---|---|---|---|---|---|
| | Device class M | Device class B | Device class S | Device class Q | Device class V |
| Interim electrical parameters (see 70.2) | | | | | |
| Final electrical parameters (see 70.2) | 1/ | 2/ | 2/ | 1/ | 1/ |
| Group A test requirements (see 70.4) | | | | | |
| Group B end-point electrical parameters (see 70.4) | | | | | |
| Group C end-point electrical parameters (see 70.4) | | | | | |
| Group D end-point electrical parameters (see 70.4) | | | | | |
| Group E end-point electrical parameters (see 70.4) | | | | | |

1/ PDA applies to subgroup 1.
2/ PDA applies to subgroups 1 and 7.

80. PACKAGING

80.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510 for device classes M, B, and S and MIL-I-38535 for device classes Q and V.

90. NOTES

90.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

90.1.1 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

90.1.2 Substitutability. Device classes B and Q devices will replace device class M devices.

90.2 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).

TABLE IIB. Additional screening for device class V.

| Test | MIL-STD-883, test method | Lot requirement |
|---|---|---|
| Particle impact noise detection | 2020 | 100% |
| Internal visual | 2010, condition A or approved alternate | 100% |
| Nondestructive bond pull | 2023 or approved alternate | 100% |
| Reverse bias burn-in | 1015 | 100% |
| Burn-in | 1015, total of 240 hours at +125°C | 100% |
| Radiographic | 2012 | 100% |

90.3 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and which SMD's are applicable to that system. 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 microelectronic devices (FSC 5962) should contact DESC-ECS, telephone (513) 296-6022.

90.4 Comments. Comments on this drawing should be directed to DESC-ECS, Dayton, Ohio 45444, or telephone (513) 296-5375.

90.5 Symbols, definitions, and functional descriptions.

90.6 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 |

90.7 Sources of supply.

90.7.1 Sources of supply for device classes B and S. Sources of supply for device classes B and S are listed in QPL-38510.

90.7.2 Sources of supply for device classes Q and V. Sources of supply for device classes Q and V are listed in QML-38535. The vendors listed in QML-38535 have submitted a certificate of compliance (see 60.6 herein) to DESC-ECS and have agreed to this drawing.

90.7.3 Approved sources of supply for device class M. Approved sources of supply for class M are listed in MIL-BUL-103. The vendors listed in MIL-BUL-103 have agreed to this drawing and a certificate of compliance (see 60.6 herein) has been submitted to and accepted by DESC-ECS.

100. SPECIFIC REQUIREMENTS

100.1 Individual item requirements. The device specification or drawing shall cover the items listed in a through p below, and shall be in the one part-one part number documentation format:

a. PIN and number of the applicable associated detail specification (including date and revision letter, if applicable).

b. Design, construction and physical dimensions (see 3.5 and appendix C).

c. Special marking provisions (see 3.6).

d. Acceptance numbers as applicable.

e. Identification of electrical parameters, limits and conditions of test which are to be used for group A electrical test, interim and final electrical measurements and end-point parameters for groups B, C, D, and E (if applicable) for screening and qualification or quality conformance purposes (see 3.2).

f. Package thermal requirements.

g. Specify whether the case is conductive or nonconductive.

h. For metal packages, specify whether the case is connected to the ground lead or to any other part of the device.

i. Delta limits.

j. Burn-in and life test circuits.

k. Schematic diagram.

l. Lead designations and internal connections (see 30.1 of appendix C).

m. Test circuits.

n. Microcircuit group assignment (see 3.1.3.13).

o. Electrostatic sensitivity classification.

p. Radiation hardness assurance (as applicable).

100.1.1 MIL-STD-883 compliant device detail specifications. The detail specifications for non-JAN, MIL-STD-883 compliant devices shall specify all electrical, frequency or bandwidth, and timing parameters appropriate to the technology and device type which are critical to assuring proper design application across full military operating temperature range (see 3.1.3.31) and power supply range. These critical design parameters shall be included in the testing requirements of the detail specification. The subgroups to be tested, and the parameters that constitute a subgroup shall, as a minimum, be equivalent to those of the most similar Government published military detail specification. Deviations or omissions specifically granted in the Government published military detail specification for the same generic device type may also be applied to devices manufactured in the same process, to the same design criteria, and using elements of the same microcircuit group as those used for devices covered by the Government published military detail specification.

100.2 MIL-STD-883. In addition to the items listed in 100.1 the applicable details required by MIL-STD-883 shall be listed in the device specification or drawing.

APPENDIX G

GENERAL REQUIREMENTS
FOR
CUSTOM HYBRID AND MULTICHIP MICROCIRCUITS

THE REQUIREMENTS OF THIS APPENDIX HAVE BEEN SUPERSEDED BY MIL-H-38534 AS OF 30 JUN 89.

APPENDIX H

PIN SUBSTITUTION INFORMATION

10. SCOPE

10.1 Scope. This appendix contains the PIN substitution information to support the one part-one part number system. For devices specified in existing associated military detail specifications dated prior to 27 July 1990, the new PIN's can be used in lieu of the old PIN's. (For example; 5962-3800101BAX can be used in lieu of M38510/00101BAX, see 3.6.2.) This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

* 20.1 Government documents.

* 20.1.1 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 issues 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.

STANDARD

MIL-STD-983 - Substitution List for Microcircuits.

* 20.2 Order of precedence. In the event of a conflict between the text of this appendix and the references cited herein (except for associated detail specifications), the text of this appendix shall take precedence. Nothing in this appendix, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

30. GENERAL

30.1 PIN conversion. When an existing MIL-M-38510 associated detail specification PIN is converted to a one part-one part number PIN via a substitution statement, the first two characters of the drawing designator of the one part-one part number will be replaced with the first two digits of MIL-M-38510 (i.e., 38), and the last three characters of the one part-one part number will be replaced with the three digit identifier assigned to the associated detail specification (e.g., M38510/00101BAC will become 5962-3800101BAC, see 3.6.2).

30.2 Data. PIN substitution information can be found in MIL-STD-983.

30.3 Lead finish designator. The lead finish designator does not appear in the PIN's in MIL-STD-983. The lead finish designator shall be included as part of the PIN and marked on the device as specified in 3.6.

30.4 Case outlines. The case outline column in MIL-STD-983, consists of all packages available on the applicable military detail specification (i.e., not all of the packages are qualified).

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(Project 5962-1234)