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MIL-STD-1772B
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SUPERSEDING
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15 MAY 1987

MILITARY STANDARD

CERTIFICATION REQUIREMENTS FOR HYBRID MICROCIRCUIT FACILITIES AND LINES



AMSC N/A

FSC 5962

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FOREWORD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

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

3. The purpose of this standard is to establish criteria for certification and qualification as required by MIL-M-38534. Definite criteria will assure that hybrid microcircuits are manufactured under conditions which have been demonstrated to be capable of continuously producing highly reliable products. This is accomplished by evaluating the manufacturer's capability for holding critical processes within established limits at specified critical points and continuously maintaining this capability during production. Certification, qualification and the maintenance is performed in advance of delivery of product and independent of acquisition.

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1. SCOPE

1.1 Purpose. This document establishes minimum requirements governing certification and qualification of manufacturing construction techniques and materials for hybrid microcircuits. It is intended to standardize the documentation and testing for hybrid microcircuits for use in military and aerospace applications. It covers the interface between user and manufacturer and it is not intended to be a complete set of documentation required to build hybrid microcircuits.

1.2 Classification. Hybrid microcircuits covered by this document include all package sizes, class M and class K devices, microwave integrated circuits, switches, relays, oscillators, timers, etc.

1.3 Areas of concern.

- a. All manufacturing construction techniques are documented.
- b. All manufacturing construction techniques are under control.
- c. Conformance to this document and MIL-N-38534.
- d. Supplier control acquisition documents for parts and materials.

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2. REFERENCED 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 are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

MILITARY

MIL-H-38534 - Hybrid Microcircuits, General Specification for.

STANDARDS

MILITARY

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

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

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

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. DEFINITIONS

3.1 Terms and definitions. The following terms and definitions shall be as specified in MIL-N-38534, MIL-STD-883, and herein.

3.1.1 Qualifying activity. The organizational element of the Government that grants certification and qualification for the manufacturing construction techniques and materials in accordance with this specification and the applicable detail specification.

3.1.2 Certification. The process by which a manufacturer's facilities are audited and approved for compliance with the requirements of section A of this document and MIL-N-38534.

3.1.3 Qualification. The process by which a manufacturer's manufacturing construction techniques and materials are tested and approved for compliance with the requirements of section B of this document.

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4. GENERAL REQUIREMENTS

4.1 Certification requirements. The following requirements are applicable for the general line certification.

4.1.1 Documentation. The manufacturer shall have available for on-site review by the certifying activity documentation that demonstrates process control and test capability as defined in MIL-R-38534.

4.1.2 Quality assurance verification. Quality assurance verification shall be in accordance with appendix A of MIL-R-38534.

4.1.3 Audit. The certifying activity reserves the right to audit the facility in accordance with section A of this document and MIL-R-38534. The audit plan of section A herein shall be used for keeping the line certification current.

4.1.4 Audit level. The qualification activity will conduct a class K audit of a facility only if the facility has class M certification.

4.2 Qualification requirements. The requirements of section B herein are applicable for qualifying and maintaining manufacturing construction techniques and materials used in the production of hybrid microcircuits.

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5. DETAILED REQUIREMENTS

5.1 Responsibilities.

5.1.1 Certifying activity. The certifying and qualifying activity shall be responsible for the following:

- a. Scheduling and conducting the audit in accordance with section A of this document and MIL-N-38534.
- b. Reporting the audit results as specified in 5.2.1.1.
- c. Maintaining audit results for review by acquiring activities.
- d. Approving section B testing.
- e. Preparing and maintaining a qualified manufacturers list (QML).

5.1.2 Manufacturer. The manufacturer shall notify the certifying activity of any major change, as defined in MIL-N-38534, in a certified facility. The certifying activity may choose to:

- a. Approve the change without further testing.
- b. Require specific testing.
- c. Require complete recertification.

5.1.3 Acquiring activity. The acquiring activity shall review audit results (maintained by the certifying activity) to verify that the manufacturing construction techniques and materials used at the time of the audit adequately represent those to be used in the impending procurement.

5.2 Audit plan in accordance with section A. The purpose of the audit plan is to provide a systematic method for determining a manufacturer's conformance to the product assurance requirements of MIL-N-38534 and MIL-STD-883. The plan contains audit requirements that serve as the basis for initial and continuing certification for manufacturers of custom hybrid microcircuits.

5.2.1 Method. This procedure details the following:

5.2.1.1 Analysis of results. The representative of the certifying activity shall provide an exit debriefing immediately following the audit, and a summary report within 30 days to the manufacturer's quality management. The written summary report shall include specific details of any condition less than full compliance.

5.2.1.2 Corrective action. Corrective action or justification is required whenever any condition less than full compliance exists. The certifying activity shall review and approve the corrective action.

5.2.1.3 Frequency of auditing. Audits in accordance with section A of this document shall be performed once every two years.

5.2.2 Manufacturing construction techniques. This document is not intended to direct or select the use of any particular manufacturing construction techniques but only to standardize on the minimum auditing required to assure that the manufacturing construction techniques will continue to generate satisfactory products.

5.3 Qualification of manufacturing construction techniques and materials in accordance with section B. The purpose of this section is to document a systematic and uniform method of qualifying various manufacturers' construction techniques. This section provides the methods to establish a baseline and evaluate proposed changes in construction techniques, materials, or design to assure that such changes will maintain or enhance instead of degrading the quality or reliability of the hybrid.

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5.3.1 Qualified manufacturing construction techniques and materials. This section is not intended to direct or select the use of any particular construction or handling process, but provides a minimum standardized method of qualification to assure that the manufacturing construction techniques will generate hybrids that will satisfy the requirements of MIL-H-38534.

5.3.2 Analysis of results. The detailed results of section B testing must be submitted for review by the qualifying activity.

5.3.2.1 Corrective action. Corrective action or justification is required whenever any condition less than full compliance exists and shall be approved by the qualifying activity.

5.3.3 Frequency of testing. Testing in accordance with section B of this document shall be performed for initial certification and shall be updated when new manufacturing construction techniques and materials to be covered by certification and qualification are introduced.

6. NOTES

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

6.1 Subject term (key word) listing.

Audit
Hybrid microcircuit
Requirements, certification
Requirements, qualification.

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

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SECTION A

AUDIT PLAN FOR FACILITIES AND LINE CERTIFICATION

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A-6	Incoming material control
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A-17	Failure analysis
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AUDIT
SECTION
NUMBER
A-1

QUALITY ASSURANCE PROGRAM

Requirement: The manufacturer shall have established, implemented, and shall be maintaining a quality assurance program in accordance with MIL-N-38534.

Reference: Appendix A of MIL-N-38534.

DETAILS: Verify conformance to the following as applicable:

	<u>APPROVAL</u>	<u>N/A</u> ^{1/}	<u>COMMENTS</u>
a. Manufacturer documentation:			
(1) Conversion of customer requirements into manufacturer's internal instructions.			
(a) Travelers(s) or a mandatory detailed checklist demonstrating full compliance to test method 5008 of MIL-STD-883. This includes requirements for incoming inspection (element evaluation), process control, screening, and quality conformance evaluation.			
(b) Review of SCD for specification of test conditions, electrical parameters (at temperature), and to compliance of appendix C of MIL-N-38534.			
(c) Materials and processes as listed on the QML.			
(d) Design requirements of MIL-N-38534.			
(e) Marking requirements of MIL-N-38534.			
(f) Documents utilized are on approved baseline listing.			
(g) Travelers in accordance with section C(10).			
(h) Test methods per laboratory suitability letter or DESC approved laboratory.			
(i) Rework allowed per MIL-N-38534.			
(2) Quality control operations.			
(3) Quality assurance operations.			
(4) Tool and test equipment maintenance and calibration.			
(5) Corrective action and evaluation.			
(6) Schematics, testing, burn-in.			
b. Manufacturer records:			
(1) Equipment calibrations.			
(2) Product lot identification.			

^{1/} Not applicable.

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QUALITY ASSURANCE PROGRAM

APPROVAL N/A COMMENTS

c. Manufacturer program plan:

- | | |
|---|--|
| (1) Functional block organizational chart. | |
| (2) Manufacturing flow chart: Generic flow chart(s) detailing receipt of material through shipment of completed hybrid. | |
| (3) Proprietary-document listing. | |
| (4) Examples of design, material, equipment, and processing instructions. | |
| (5) Examples of records. | |
| (6) Examples of design, material and process change control documents: | |
| (a) A change control system. | |
| (b) The change control system is implemented and enforced. | |
| (7) Examples of failure and defect analysis and feedback documents. | |
| (8) Examples of corrective action and evaluation documents. | |
| (9) Manufacturer's internal instructions for internal visual inspection. | |
| (10) Examples of test travelers. | |
| Incoming evaluation, screening, assembly, and QCI travelers shall include the following as a minimum: | |
| (a) Identification as to whether the lot is qualification or QCI. | |
| (b) Name and title of operation and specification number and revision of each process or test. | |
| (c) Identify part number, date code, and manufacturer internal lot identification number(s). | |
| (d) Date(s) of test or process 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. (Actual quantity tested, if sampled.) | |
| (g) Serial numbers of passing and failing devices, when applicable. | |

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QUALITY ASSURANCE PROGRAM

APPROVAL N/A COMMENTS

(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) The percent defective calculated for burn-in.

(j) Burn-in life test board serial number or test circuit identification number and revision.

(k) Identification and disposition of any parts removed from the lot.

Note: Alternate means of meeting these requirements may be approved by the qualifying activity. Only items b, c, d, f, h, and k shall apply to fabrication and assembly travelers.

(11) Examples of design and construction baseline.

(12) Manufacturer's self audit.

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-3

QUALITY CONFORMANCE EVALUATION

Requirement: The manufacturer's quality conformance procedures shall be in accordance with MIL-N-38534 and herein.

Reference: MIL-N-38534.

DETAILS: Verify conformance to the following as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Group A on each inspection lot in accordance with MIL-N-38534.			
b. Group B on each inspection lot in accordance with MIL-N-38534.			
c. Group C inspection in accordance with MIL-N-38534. A system to insure group C performed on first lot submitted is needed.			
d. Group D inspection in accordance with MIL-N-38534. A system to track group D coverage is needed.			
e. Definition and control of inspection lot(s). Inspection lot identification shall be maintained from the time of lot assembly through acceptance of that lot. Date code system.			
f. Must define add-on and resubmittal procedures.			
g. QCI failure disposition and notification of customer and/or certifying activity.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-4

WORKMANSHIP

Requirement: The manufacturer's documents shall be in accordance with MIL-N-38534.

Reference: MIL-N-38534.

DETAILS: Verify existence of the procedures and conformance to the process as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Rework/repair:			
(1) Temperature controls.			
(2) Package rework limitations.			
(3) Provision for complete rescreening.			
(4) Element replacement limitations.			
(5) Time/temperature limits specified and documented.			
b. Wire rebonding:			
(1) Limitations documented for circuit elements.			
(2) Limitation documented for substrate.			
c. Delid and reseal:			
(1) Process documented and qualified.			
(2) Process sheets at work station.			
(3) Meets delid limitation.			
d. Other.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

MIL-STD-1772B

AUDIT
SECTION
NUMBER
A-5

CLEANLINESS AND ATMOSPHERIC CONTROL

Requirement: Cleanliness and atmospheric control shall have documented requirements for each area in which unsealed units and component parts are stored, processed, or assembled.

Reference: Appendix A of MIL-N-38534, cleanliness and atmosphere control in work areas.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Specified facility cleaning.	_____	_____	_____
b. Particle count.	_____	_____	_____
c. Temperature and humidity.	_____	_____	_____
d. General housekeeping.	_____	_____	_____
e. Documentation.	_____	_____	_____
f. Human contamination.	_____	_____	_____

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-6

INCOMING MATERIAL CONTROL

Requirement: Inspection operations shall be documented as to type of inspection, sampling and test procedures, acceptance-rejection criteria, and frequency of use.

References: Method 5008 of MIL-STD-883, test procedures.
MIL-W-38534, inspection of incoming materials.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>M/A</u>	<u>COMMENTS</u>
Chip components:			
a. Chip topology conforms to that specified on manufacturer's acquisition document.			
b. Incoming visual inspection.			
c. Incoming electrical testing.			
d. Storage in controlled environment.			
e. Electrical test verification. Use of electrical test program or correlation units to verify electrical test setup within applicable device specification limits. Correlation units may be generic types that include tested parameter ranges for a group or family of devices.			
f. Test equipment calibration.			
Case, package, and cover (lid):			
a. Case and cover type conforms to type specified on manufacturer's acquisition document.			
b. Compliance with tables V and VI, method 5008 of MIL-STD-883.			
c. Plating thickness.			
Other:			
a. Incoming parts and materials are inspected.			
b. Documented procedure for incoming inspection to include sampling procedures lot accept and reject criteria and frequency of testing.			
c. Documented procedure for handling discrepant parts and materials.			
d. Rework.			
e. Verification of element evaluation performed at the element supplier in lieu of incoming inspection.			

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AUDIT
SECTION
NUMBER

A-6

INCOMING MATERIAL CONTROL

COMPANY AUDITED: _____

PERFORMED BY: _____

DATE: _____

COMMENTS: _____

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AUDIT
SECTION
NUMBER
A-8

POLYMERIC MATERIALS

Requirement: All polymeric materials have their own unique requirements for handling, storage, and application/usage.

References: Method 5011 of MIL-STD-883
MIL-N-38534.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>M/A</u>	<u>COMMENTS</u>
a. Materials tested to method 5011 of MIL-STD-883.	_____	_____	_____
b. Storage.	_____	_____	_____
c. Shelf life identified and followed.	_____	_____	_____
d. Pot life identified and followed.	_____	_____	_____
e. Cure conditions specified and followed.	_____	_____	_____

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-9

SUBSTRATE AND CIRCUIT ELEMENT ATTACHMENT

Requirement: The documentation and performance of the process steps by which circuit elements are incorporated into the assembly of a hybrid microcircuit shall be evaluated.

References: Methods 2017 and 5008 of MIL-STD-883.
MIL-M-38534.

DETAILS: Verify conformance to the following, as applicable:

	APPROVAL	N/A	COMMENTS
Substrate and circuit elements are attached:			
a. In accordance with layout.			
b. In accordance with method 2017.			
c. Rework.			
Process controls:			
a. Conformance to documentation.			
b. Applicable revision.			
Polymer adhesives for attachment:			
a. Shelf life control.			
b. Process conforms to documentation in terms of time, temperature, and effectiveness.			
Metallic material attachment:			
a. Material is in accordance with documentation.			
b. Process conforms to documentation in terms of time, temperature, and effectiveness.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-10

INTERNAL VISUAL

Requirement: Internal visual inspection procedures shall be evaluated for conformance to method 2017.

References: Methods 2017 and 2010 of MIL-STD-883, and method 2073 of MIL-STD-750. MIL-N-38534.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Methods 2010, 2017, 2072, and 2073.	_____	_____	_____
b. Proper inspection equipment.	_____	_____	_____
c. Workmanship standards.	_____	_____	_____
d. Visual aids.	_____	_____	_____
e. Rejections are documented.	_____	_____	_____
f. Provisions of reinspecting rework.	_____	_____	_____
g. Contamination control documentation during handling, transportation, and storage.	_____	_____	_____
h. Damage prevention documentation.	_____	_____	_____

Confirm:

a. Monitors rework history.	_____	_____	_____
b. Initiates corrective action.	_____	_____	_____
c. Monitors corrective action.	_____	_____	_____

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-11

WIRE BOND

Requirement: Wire bonding documentation and operations shall be evaluated to ascertain adequate process control.

References: Methods 2011, 2023, and 500B of MIL-STD-883.
MIL-R-38534.

DETAILS: Verify conformance to the following, as applicable:

	APPROVAL	N/A	COMMENTS
a. For each bonding station:			
(1) Operating records to indicate conformance to bond strength requirements.			
(2) Evaluation and process control in accordance with method 500B.			
(3) Control settings range:			
(a) Time.			
(b) Temperature.			
(c) Pressure.			
(d) Power.			
(4) Documentation for process operation.			
(5) Visual aids.			
(6) Rework.			
(7) Equipment maintenance.			
b. For the pull test equipment:			
(1) Calibration procedure.			
(2) Frequency of calibration.			
c. Corrective action:			
(1) Implementation of corrective action.			
(2) Control of corrective action.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-12

CLEANING

Requirement: The various cleaning processes shall have documented requirements for each method along with handling and storage requirements after the cleaning-operation prior to the next operation or assembly step.

Reference: MIL-H-38534.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>M/A</u>	<u>COMMENTS</u>
a. Documentation:			
(1) Exposure times and techniques.			
(2) Storage environment.			
b. Mechanical.			
c. Gas blow off.			
d. Vapor degreaser:			
(1) Solids contamination control.			
(2) Liquid contamination control (acidity).			
e. Liquid wash:			
(1) Solids contamination control.			
(2) Liquid contamination control (acidity).			
f. Plasmas.			
g. High temperature vacuum bake.			
h. Inspection/test.			
i. All cleans prior to final visual.			
j. Precautions for wire bonds.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-13

PACKAGE SEAL

Requirement: Sealing documentation and operations shall be evaluated to ascertain adequate process control.

References: Method 1014 of MIL-STD-883.
MIL-N-38534.

DETAILS: Verify conformance to manufacturing process documentation:

APPROVAL N/A COMMENTS

a. Preseal bake cycle:

- (1) Time.
- (2) Temperature.
- (3) Atmosphere.

b. Sealing:

- (1) Process documentation in work area.
- (2) Sealing schedules are recorded and maintained.
- (3) Monitor moisture.
- (4) Rework.

c. Conformance to method 1014:

- (1) Fine leak.
- (2) Gross leak.

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-14

SCREENING

Requirement: Screening documentation and operations shall be evaluated to ascertain adequate process control.

Reference: MIL-STD-883.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Preseal burn-in, method 1030:			
(1) Environmental control.			
(2) Device protection.			
(3) Proper burn-in circuit.			
(4) Proper voltages and signals.			
(5) Temperature control.			
(6) Preburn-in log.			
b. Nondestructive bond pull, method 2023, frequency of calibration.			
c. Internal visual, precap, method 2017.			
d. Stabilization bake, method 1008.			
e. Temperature cycling, method 1010.			
f. Constant acceleration, method 2001 or mechanical shock, method 2002.			
g. Particle impact noise detection (PIND), method 2020:			
(1) System calibration.			
(2) Mounting methods.			
h. Preburn-in electrical test:			
(1) Test procedure, applicable revision.			
(2) Calibrated electrical instruments.			
(3) Calibrated temperature probes.			
(4) Verification of test procedure by means of testing a correlation unit.			
(5) Data recording.			
i. Burn-in, method 1015:			
(1) Proper burn-in circuit.			
(2) Proper voltages and signals.			

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AUDIT
SECTION
NUMBER
A-14

SCREENING

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
(3) Temperature control.	_____	_____	_____
(4) Burn-in log.	_____	_____	_____
(5) Control of burn-in board and socket testing.	_____	_____	_____
j. Electrical test:			
(1) Test procedure, applicable revision.	_____	_____	_____
(2) Calibrated electrical instruments.	_____	_____	_____
(3) Calibrated temperature probes.	_____	_____	_____
(4) Verification of test procedure by means of testing a correlation unit.	_____	_____	_____
(5) Data recording.	_____	_____	_____
k. Seal, method 1014:			
(1) Fine.	_____	_____	_____
(2) Gross.	_____	_____	_____
l. Radiographic, method 2012.	_____	_____	_____
m. External visual, method 2009.	_____	_____	_____

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

MIL-STD-1772B

AUDIT
SECTION
NUMBER
A-15

ACCEPTANCE FOR SHIPMENT

Requirement: The traveler record shall be evaluated for completeness, and the units shall be examined for external package requirements.

References: Method 2009 of MIL-STD-883.
MIL-H-38534.

DETAILS: Verify conformance to the following, as applicable:

	APPROVAL	N/A	COMMENTS
Review records for the following:			
a. Maximum allowed rework.			
b. Reinspection of rework.			
c. Evidence of inspection.			
d. PDA review.			
e. Verification of QCI coverage.			
f. Verification of QML coverage.			
Verify conformance to method 2009 and SCD requirements.			
Review microcircuit marking:			
a. Legibility.			
b. Serialization.			
c. Resistance to solvents, method 2015.			
Verify special customer requirements.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

MIL-STD-1772B

AUDIT
SECTION
NUMBER
A-16

HANDLING AND STORAGE

Requirement: The handling and storage of materials from component parts through the completed and sealed hybrid.

References: Method 5008 of MIL-STD-883
MIL-R-38534.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Documentation utilized to identify critical handling and storage requirements.			
b. ESD practices defined and followed.			
c. Packaging/protection:			
d. Environmental/atmospheric.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

MIL-STD-1772B

AUDIT
SECTION
NUMBER
A-17

FAILURE ANALYSIS

Requirement: To have the capability of analyzing problems on hybrids so that corrective action can be effected.

References: Method 5003 of MIL-STD-883
MIL-N-38534.

DETAILS: Verify conformance to the following, as applicable:

	<u>APPROVAL</u>	<u>N/A</u>	<u>COMMENTS</u>
a. Manufacturer has minimum capability to perform analysis to test condition A of method 5003.			
b. Documentation of results.			
c. Defs. feedback/corrective action.			
d. Handling of customer returns.			

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

MIL-STD-1772B

AUDIT
SECTION
NUMBER
A-18

TRAINING

Requirement: The training program and documentation shall meet the referenced document.

Reference: MIL-N-38534.

DETAILS: Verify conformance to training in the critical hybrid manufacturing processes, as applicable:

- a. Cleaning.
- b. Element attachment.
- c. Substrate attachment.
- d. Bonding.
- e. Sealing.
- f. Rework/repair.
- g. ESD practices.
- h. Inspection.
- i. Clean room practices.
- j. Substrate fabrication.

APPROVAL N/A COMMENTS

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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AUDIT
SECTION
NUMBER
A-19

CERTIFICATION/QUALIFICATION PROGRAM

Requirement: The test methods shall meet the referenced documents.

Reference: MIL-STD-883.

DETAILS: Verify conformance of specified documents to applicable test methods of MIL-STD-883.

<u>Test method</u>	<u>Number</u>	<u>Condition</u>	<u>Document number/ comments</u>
Stabilization bake	1008	C, F	
Temperature cycle	1010	B, C (50 cycles max)	
Thermal shock	1011	C	
Internal visual	2017		
Internal visual	2010	A*, B	
Internal visual	2072		
Internal visual	2073		
Physical dimensions	2016		
Solderability	2003		
Bond strength	2011	Per bond type	
Lead integrity	2004	B ₁ , B ₂ , D	
Seal	1014	A or B, and C or D and A ₄	
Moisture resistance	1004		
Steady state life	1005	125°C/1000 hours	
Salt atmosphere	1009		
Pre-seal burn-in	1030		
External visual	2009		
Resistance to solvents	2015		
Internal visual mechanical	2014		
Internal water vapor	1018		
Vibration	2007	B	
ESD	3015	A-1	
Dye penetrant	1772	(4.3.2) 2/	
Loose particle detection	1772	(4.3.1)	
Insulation resistance	1003	600 V dc, 100 nA	
Non-destruct bond pull	2023		
Mechanical shock	2002	C, B, (Y ₁ axis)	
Constant acceleration	2001	A, B, C, D (Y ₁ axis)	
PIND	2020	A* or B	
Burn-in	1015		
Radiation latch*	1020		
Steady state total dose*	1019*		
Neutron irradiation*	1017*		
Die shear	2019		
Radiography	2012	Y axis	
Failure analysis	5003	A, B*	
Forward voltage	3071		
Saturation V-B	4011		
Voltage conditioning on aging*	5008	Table IV	
SEM	2018*		
Polymeric material	5011		

* Required for class S. May be approved during class B certification.

1/ MIL-STD-750 methods

2/ Optional.

3/ Metallic attach only.

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AUDIT
SECTION
NUMBER
A-19

CERTIFICATION/QUALIFICATION PROGRAM

<u>Test method</u>	<u>Number</u>	<u>Condition</u>	<u>Document number/ Comments</u>
Electrical			
(1) General requirements		A1, A2, A3, and A4, or A7 (3.2.3.5)	
(2) Passive elements	5008		
(3) MIL-S-19500		A2, A3, and A4	
Adhesion	1772	B	
Conductivity resistivity (four point probe)	1772	B	

Company audited: _____

Performed by: _____

Date: _____

Comments: _____

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SECTION B

QUALIFICATION OF MATERIALS AND MANUFACTURING CONSTRUCTION TECHNIQUES

TABLE OF CONTENTS

TITLE

Subsection B-1	Thick and thin film fabrication
Subsection B-2	Substrate and element attachment
Subsection B-3	Bonding, internal
Subsection B-4	Sealing, delidding, and resealing
Subsection B-5	Qualification option
Tables B-1 through B-5	Qualification testing tables

1. SCOPE

1.1 Purpose. This section establishes general requirements applicable to initial qualification testing and qualification of additions and changes to materials and manufacturing construction techniques for both classes K and M quality levels. Qualification shall be performed to subsections B-1, B-2, B-3 and B-4 if special test vehicles are to be used for qualification; or, at the manufacturers' option, to subsection B-5 if actual functioning hybrid microcircuit devices or special test vehicles are used for qualification.

1.2 Frequency of testing. The manufacturer is eligible to begin qualification testing after certification is granted. However, qualification shall be achieved no later than six months after certification. After completion and approval of initial qualification testing, the applicable subsection of MIL-STD-1772, section B testing shall be repeated annually for those materials and manufacturing construction techniques which, during the certification year, were not subjected to quality conformance evaluation of MIL-N-38534. Repeating section B qualification testing annually shall not be acceptable in lieu of quality conformance inspection. Certain subsections of MIL-STD-1772, section B, may be required, as determined by the qualifying activity, to be repeated for changes or additions to materials and manufacturing construction techniques.

1.3 Areas of concern. (See subsections.)

2. GENERAL REQUIREMENTS

2.1 General qualification requirements. The general inspection conditions of MIL-N-38534 apply. The tests, test methods, test conditions, and testing limits shall be in accordance with MIL-N-38534, MIL-STD-883, and as specified herein.

2.2 Test plan.

2.2.1 Test flow. A test plan detailing all materials, manufacturing construction techniques, and testing and reporting requirements shall be submitted to the qualifying activity with application for a MIL-STD-1772, section A, certification audit and shall be approved prior to implementation. This test plan shall include test travelers meeting the requirements for travelers in MIL-N-38534, appendix A. The revision level of all documents shall be included.

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2.2.2 Testing location. Diagrams shall be supplied with the test plan detailing and labeling the location on the individual sample of the actual testing (i.e., die placement, wire bonding, resistor location, etc.).

2.2.3 Test limits. All test limits shall be in accordance with MIL-N-38534, MIL-STD-883, and the requirements specified herein. Delta limits for selected electrical parameters such as VCE (SAT) and VF or other electrical tests shall be specified and in accordance with applicable or most similar military detail specification.

2.3 Test data. Test data shall be submitted to the qualifying activity. This data shall include a summary of attributes results for all required tests and measurements including preconditioning. A traveler containing all the specified details of MIL-N-38534, appendix A, is sufficient to meet this requirement. Variables data shall also be provided for the following tests:

- a. Bond strength testing. The forces at the time of failure and the failure category or the minimum and maximum readings for the devices if no failure occurs.
- b. Die shear strength testing. The force at the time of failure and failure category or the die shear force if no separation occurs.
- c. Conductivity/resistivity testing. The "ohm per square" readings shall be recorded.
- d. Internal water-vapor testing. Actual water-vapor content readings shall be provided.
- e. VCE (SAT), VF or other electrical testing. Measured parameter values shall be recorded and submitted.
- f. Fabricated resistors. Design, printed, and trimmed values shall be recorded and submitted.
- g. Other data as required by the qualifying activity.

2.3.1 Submitted data. Original travelers and data sheets shall be submitted; or travelers and data sheets which have been verified by the Government source inspector as being copied from the original. Altered records shall not be considered acceptable unless the requirement of MIL-N-38534 for changes or transfers of records are met.

2.4 Test samples.

2.4.1 Sample construction. The test samples shall be fabricated, assembled and tested in a facility certified to MIL-N-38534 and MIL-STD-1772 using representative materials, manufacturing construction techniques and approved testing procedures in a actual production environment by trained personnel who perform these operations on production devices. Appropriate production and test travelers shall be submitted to demonstrate compliance to this requirement. Materials and manufacturing construction techniques used in the fabrication and assembly of test samples shall be clearly documented, as this information will be required for subsequent qualification listings.

2.4.2 Traceability. All samples shall be serialized and identified as qualification samples before testing begins. This step shall be contained on all qualification test travelers. The test travelers shall indicate all, and only, certified steps and processes needed to conduct and control testing (i.e., serialization).

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2.4.3 Sample size. The sample size shall be as specified in the individual subsection. Sample sizes may be exceeded at the manufacturer's own risk.

2.4.4 Sample submission. All test samples shall be submitted to the qualifying activity with the testing results.

2.5 Documentation.

2.5.1 Materials and manufacturing construction technique documentation. Materials and manufacturing construction technique documentation shall relate to the following. (This is a minimal requirement, complex situations may require additional documentation.)

- a. Acquisition of semiconductor and other active devices, passive devices, substrates, packages, wire and related processing materials such as gases, chemicals, metals, polymers, etc.
- b. Incoming inspection and methodologies.
- c. Storage and handling, requirements and conditions.
- d. Critical parameter/procedure, process, and cleanliness control.
- e. Environmental requirements and control.

2.5.2 Test documentation. Test plan documentation shall be submitted to the qualifying activity and shall list all required tests. Detailed limits and conditions for each required test shall be clearly specified in the documentation.

2.6 Failures. All failed tests, resulting failure analysis, and corrective actions shall be submitted to the qualifying activity. This section is intended to provide the manufacturer with a vehicle to demonstrate capability to make hybrid microcircuits using specific materials and manufacturing construction techniques. Therefore, if any particular testing results are not successful, the manufacturer shall perform failure analysis, take necessary corrective action, and adjust the process until all tests can be successfully performed. The manufacturer must notify the qualifying activity of any decision not to pursue qualification of any material or manufacturing construction technique previously approved by the authorization to test letter. Detailed supporting documentation must be kept and submitted to the qualifying activity when qualifying to section B of MIL-STD-1772.

2.6.1 Operator and equipment failure. The procedure in MIL-B-38534 for verifying operator and equipment failure shall apply.

2.7 Polymeric materials. All polymeric materials used in this testing shall be approved by the acquiring activity.

2.8 Test deviation. Additional or reduced testing, as may be dictated by the uniqueness of particular material and manufacturing construction techniques can be required or authorized by the qualifying activity. Alternate test plans must be specifically authorized by the qualifying activity.

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SUBSECTION B-1

THICK AND THIN FILM FABRICATION

1. SCOPE

1.1 Purpose. This subsection provides for the evaluation of thick and thin film fabrication materials and techniques to assure that satisfactory electrical and mechanical performance will be obtained.

1.2 Areas of concern. Areas of concern include the following:

1.2.1 Substrate material.

- a. Visual.
- b. Mechanical.

1.2.2 Metallization.

- a. Corrosion/oxidation.
- b. Adhesion.
- c. Solderability/leach resistance.
- d. Bondability (wire).
- e. Weldability.
- f. Materials compatibility.
- g. Age control/storage.
- h. Thickness (wet/dry/fired).
- i. Porosity/cracks.
- j. Conductivity/resistivity.

1.2.3 Insulating layers/passivation.

- a. Adhesion.
- b. Materials compatibility.
- c. Age control/storage.
- d. Thickness (wet/dry/fired).
- e. Porosity/cracks/voids.
- f. Dielectric strength.

1.2.4 Resistors.

- a. Stability (time, temperature, and voltage).
- b. Materials compatibility.
- c. Age control/storage.
- d. Thickness (wet/dry/fired).
- e. Cracks.

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- f. Trim method compatibility
- g. Back lit porosity.

1.2.5 Overglaze/glassivation.

- a. Materials compatibility
- b. Age control/storage
- c. Thickness (wet/dry/fired)
- d. Porosity/cracks/voids/bubbles
- e. Trim method compatibility

1.2.6 Rework.

2. DETAILED REQUIREMENTS (See section B for general requirements)

2.1 Test sample fabrication. For each substrate material/fabrication technique combination to be qualified, 15 substrate assemblies shall be fabricated. The maximum number of layers for each substrate material/fabrication technique shall be demonstrated using appropriate workmanship standards.

2.2 Test flow. The test flow shall be in accordance with table B-1.

2.2.1 Test sample preconditioning. The substrates shall be preconditioned before component assembly as follows:

- a. Stabilization bake, method 1008, test condition C, 150°C for 24 hours.
- b. Temperature cycling, method 1010, test condition C, 15 cycles.

2.2.2 Test sample evaluation.

2.2.2.1 Conductivity/resistivity. This test to be performed prior to semiconductor die attach test and wire bond adhesion test. Films shall not exceed the maximum ohms per square limit that was referenced in the approved test plan after processing as determined by means of a four-point probe.

2.2.2.2 File adhesion. A minimum of three substrates from subgroup 1 shall be subjected to an adhesive tape test for film adhesion. The substrates shall show no evidence of film peeling or flaking.

2.2.2.3 Die attach and wire bonding. A minimum of 12 samples that have been subjected to, and passed, subgroup 1 testing shall be submitted to subgroup 3.

2.2.2.4 Internal visual. Each sample shall be inspected in accordance with method 2017 of MIL-STD-883.

2.2.2.5 Wire bonds. Each wire bond shall be tested in accordance with method 2011 of MIL-STD-883.

2.2.2.6 Die attach. Each die attach shall be tested in accordance with method 2019 of MIL-STD-883.

2.2.2.7 Printed resistor. As applicable, control of resistor fabrication and trimming shall be demonstrated by comparing design values to fired and trimmed values.

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TABLE B-1. Substrate fabrication qualification.

Subgroup	Test	MIL-STD-883		Quantity (accept no.)	Reference paragraph
		Method	Condition		
Precondi- tioning	stabilization bake Temperature cycling	1008	C (24 hours, 150°C)	15 (0)	2.2.1a
		1010	C, 15 cycles		2.2.1b
1	Conductivity/ resistivity test Printed resistor.			15 (0)	2.2.2.1 2.2.2.7
2	Film adhesion test			3 (0)	2.2.2.2
3	Die attach and wire bonding Internal visual Wire bonds Die shear	 2017 2011 2019		12 (0)	2.2.2.3 2.2.2.4 2.2.2.5 2.2.2.6

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SUBSECTION B-2

SUBSTRATE AND ELEMENT ATTACHMENT

1. SCOPE

1.1 Purpose. This procedure provides for the evaluation of die and substrate attach to assure that satisfactory mechanical strength, heat transfer, and electrical performance will be obtained.

1.2 Areas of concern. Areas of concern include the following.

1.2.1 Mechanical and material characteristics.

- a. Strength of the element and substrate attach initially and throughout the life in accordance with method 500B.
- b. Loose particles generated with the particular materials or method of attachment.
- c. Materials outgassing causing surface problems with subsequent process steps.

1.2.2 Thermal characteristics.

- a. Thermal coefficients of expansion of constituent materials.
- b. Heat transfer characteristics of substrate and die attachment materials.

1.2.3 Electrical characteristics.

- a. Interelement contact resistance initially and throughout the life of the hybrid.
- b. Electrical surface leakage currents due to outgassing contamination or moisture content of the package.
- c. Optimization of microwave hybrid device characteristics that use the substrate as a ground plane by selection of attachment materials.

2. DETAILED REQUIREMENTS (See section B for general requirements.)

2.1 Test sample construction. A minimum of 12 identical test sample hybrid devices shall be constructed for each type of substrate and element attach to be qualified. They shall be representative of the substrate and element attach systems (methods and materials) used in regular production. A minimum of two elements of each configuration to be qualified shall be attached per sample.

2.2 Test flow. Test flow shall be in accordance with table B-2. Twelve samples shall be subjected to preconditioning. Six samples from preconditioning shall be subjected to each subgroups 1 and 2. Three samples (2 reworks, 1 nonrework) from each of subgroups 1 and 2 shall be subjected to subgroup 3. Three samples (2 reworks, 1 nonrework) from each of subgroups 1 and 2 shall be subjected to subgroup 4. Substrate and element attach may be tested separately. If these are tested separately, substrate attach testing need not include the tests or elements for VCE (SAT) or Vf, and die shear testing. Element attach testing shall always include all the tests of table B-2.

2.2.1 Test sample preconditioning. Test samples shall be preconditioned using the operations identified in table B-2, and shall include element and substrate rework to be qualified.

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2.2.1.1 Rework. Qualification of rework permitted in MIL-N-38534 shall be accomplished by replacing elements and the substrate. If rework is to be qualified, all but four samples shall be reworked. Two elements per each reworked sample shall not be reworked. These nonreworked elements and samples shall be clearly identified in order to provide rework versus nonreworked data. The rework cycle starting with the first step in preconditioning shall be performed two times for polymer attached elements and one time for metallic attached elements. If this type of rework will not be performed in production, this sequence will not be applicable, and no rework will be qualified.

2.2.2 Test sample evaluation. Test samples shall be evaluated in accordance with the applicable test flow.

2.2.2.1 Electrical tests. Twelve samples (six from each subgroup 1 and 2) shall be subjected to VCE (SAT) or VF. Each test sample shall measure VCE (SAT) using method 3071 (transistor) of MIL-STD-750, or VF shall be VCE (SAT) measured using method 4011 (diode) of MIL-STD-750. This test is used to evaluate the attach interface.

2.2.2.2 Loose particles. The parts shall show no evidence of loose particles as a result of the element and substrate attachment processes. Any parts evidencing loose particles (PMD test rejects) shall be investigated after completion of the internal water vapor test. This shall be accomplished by fastening a piece of transparent tape over a 0.025 to 0.040 inch hole (the hole made during the water vapor test may be used). The part is then placed on the loose particle tester to capture the particles on the tape. The captured particles shall be examined at 30X minimum and evaluated. The cause of the loose particles shall be determined and corrected.

2.2.2.3 Radiography. For metallic attachment only. The parts shall show evidence of good wetting, with no part having less than 50 percent coverage. For subgroup 2, radiography may be done in process to enhance x-ray.

2.2.2.4 Internal water vapor.

2.2.2.4.1 Subgroup 1. Three samples with zero reject or five samples with one reject shall have a maximum internal water vapor content of 5000 parts per million. Other gas species presenting quantities greater than 1000 parts per million (0.01 percent) shall be reported.

2.2.2.4.2 Subgroup 2. Internal water vapor content testing is for information only. All constituents shall be reported.

2.2.2.5 Internal visual. Particular attention shall be focused on the quality of attachment material. Cracking, peeling, and recrystallization (for metallic attachment) shall not be present. Only rejects resulting from the attachment procedure shall be considered for this evaluation.

2.2.2.6 Constant acceleration. The parts shall withstand a minimum of 15 kp. If a part would be stressed to a higher constant acceleration level in MIL-STD-883, test method 5008 screening, then the part shall be tested as a minimum to this higher level. A stiffener plate (e.g., .125 inch aluminum) may be attached to the base-plate of the package to prevent damage due to "oilcanning" of the package.

2.2.2.7 Internal visual and mechanical. In addition to the criteria of MIL-STD-883, method 2014, this inspection shall verify that no damage has occurred to element and substrate attach.

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TABLE B-2. Substrate and element attach qualification.

Subgroup	Test	MIL-STD-883		Quantity (except no.)	Reference paragraph (see 2.2)				
		Method	Conditions						
Precondi- tioning	Internal visual	2017	C (100 hours at 150°C)	12 (0)	2.2.2.5				
	Stabilization bake	1008							
	Temperature cycling	1010							
	Constant acceleration	2001	A, Y ₁ axis only		2.2.2.6				
	Internal visual	2017	2.2.2.5 2.2.1.1						
	Rework								
	Seal	1014							
External visual	2009								
1	VCE (SAT) or VF	3071 4011	C (100 cycles) A, Y ₁ axis only B	6 (0)	2.2.2.1				
	Temperature cycling	1010							
	Constant acceleration	2001							
	PIND test	2020							
	VCE (SAT) or VF	3071 4011							
	Radiography	2012							
	Internal water- vapor	1018				3(0) or 5(1)			
	Loose particle recovery					2.2.2.2			
	2	VCE (SAT) or VF				3071 4011	C (1000 hours at 150°C) A, Y ₁ axis only B	6 (0)	2.2.2.1
		Stabilization bake				1008			
Constant acceleration		2001							
PIND test		2020							
VCE (SAT) or VF		3071 4011							
Radiography		2012							
Internal water- vapor		1018	3(0) or 5(1)						
Loose particle recovery			2.2.2.2						
3		Mechanical shock	2002	C	6 (0)	2.2.2.1			
		VCE (SAT) or VF	3071 4011						
	Internal visual	2017							
	Die shear	2019							
4	Constant acceleration	2001	C (minimum) Y ₁ axis only	6 (0)	2.2.2.6				
	External visual	2009							
	Internal visual and mechanical	2017							

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SUBSECTION B-3

BONDING, INTERNAL

1. SCOPE

1.1 Purpose. This subsection provides for the evaluation of hybrid microcircuit internal bonding techniques to assure that the manufacturing construction technique being evaluated will result in satisfactory mechanical strength and electrical performance.

1.2 Areas of concern. Areas of concern include the following.

1.2.1 Mechanical characteristics.

- a. Strength of the wire/bond attachment initially and throughout life in accordance with method 5008 of MIL-STD-883.
- b. Bonding schedules considering the following in the development of the schedules.
 - (1) Element technology.
 - (2) Package technology.
 - (3) Thick and thin film substrate technology.
 - (4) Attachment materials.
 - (5) Heat spreaders.
 - (6) Bonding pad size.
 - (7) Bonding surface characteristics.
 - (8) Aluminum wire, various sizes used.
 - (9) Gold wire, various sizes used.
 - (10) Bonding machine technique, (wedge-wedge, gold ball, thermosonic, ultrasonic, thermocompression, etc.).

1.2.2 Chemical characteristics. Hybrid microcircuit bonding surface cleanliness.

2. DETAILED REQUIREMENTS

2.1 Test sample construction. A minimum of four hybrid device test samples with a minimum of 120 bond wires (30 wires per sample) shall be fabricated for this evaluation. Evaluation of wire bonding to table B-3 shall be performed for each combination of the following materials and techniques to be qualified.

- a. Bonding technique.
- b. Manual bonding.
- c. Automatic bonding.
- d. Wire composition.
- e. Smallest wire/ribbon diameter.
- f. Largest wire/ribbon diameter.
- g. Conductor material.

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2.1.1 Test sample content. Each test sample device shall contain elements typical of device assembly and shall include, as a minimum, an integrated circuit, transistor, diode, capacitor and resistor chip. Thick and thin film capacitor and resistor chips shall be used. Wire bonds shall include one wire from each type of transistor, diode, capacitor and resistor chip, three wires from each type of integrated circuit and five wires connecting package leads per sample, as applicable.

NOTE: Only those chips actually used in the manufacture of hybrids are required. For example, if thin film resistor chips are not used in manufactured devices, this type of chip would not have to be included in the sample devices.

2.2 Test flow. Tests and test flow shall be as specified in table B-3. Two units each shall be subjected to subgroups 1 and 2 testing. Only sealed devices shall be subjected to subgroup 1.

2.2.1 Wire bonds. Wire bonds shall have a minimum post-bake strength of at least half the value specified for bonds evaluated at post sealing in accordance with method 2011 of MIL-STD-883.

2.2.2 Simulated rework. Simulated rework shall consist of a one-hour bake at 165°C minimum or actual rework.

2.2.3 Wire bond rework. All wire bonds for subgroup 2 shall be replaced. If no wire bond rework is to be qualified, all units shall be subjected to subgroup 1 testing.

2.2.4 Constant acceleration. As an alternate, mechanical shock (method 2002) may be used. The level of stress to be applied shall be that used in screening as a minimum.

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TABLE B-3. Bonding, internal qualification.

Subgroup	Test	MIL-STD-883		Quantity (accept no.)	Reference paragraph
		Method	Conditions		
Precondi- tioning	Internal visual	2017		4 (0)	2.2.2
	Simulated rework				
	Nondestructive bond pull	2023			
	Internal visual	2017			
	Package seal				
	Stabilization bake	1008	C (24 hours at 150°C)		
	Temperature cycling	1010	C		
1	Mechanical shock	2001	B (Y ₁ only)		
	Seal	1014			
	Temperature cycling	1010	C (100 Cycles)		
	Stabilization bake	1008	F (1 hour)	2 (0)	
2	Package delid	2017			2.2.1
	Internal visual	2011			
	Destructive bond pull				
2	Delid			2 (0)	2.2.3
	Wire bond rework				
	Internal visual	2017			
	Package reseal				
	Seal	1014			
	Stabilization bake	1008	F (1 hour)		
2.2.1	Package delid	2017			2.2.1
	Internal visual	2011			
	Wire bonds				

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SUBSECTION B-4

SEALING, DELIDDING, AND RELIDDING

1. SCOPE

1.1 Purpose. This subsection provides for the evaluation of techniques for sealing, delidding, and relidding hybrid microcircuit packages to assure hermeticity and to assure that loose particles are not introduced into the hybrid microcircuit as a result of these operations.

1.2 Areas of concern. Areas of concern include the following:

1.2.1 Processes.

- a. Precap cleaning procedure, lid and cover cleaning operations, and sealing (dry) box cleanliness control methods.
- b. Sealing environment: Moisture continually monitored, temperature, moisture and H_2 atmosphere specified, plus tracer gas, if used, and method of control identified.

1.2.2 Mechanical.

- a. Ability to meet seal integrity and external visual in accordance with methods 1014 and 2009 of MIL-STD-883.
- b. Control of temperature, time, and other parameters that affect the sealing process.
- c. Control of loose particles generated by the initial seal, seal rework, delidding, and relidding techniques.
- d. Records of weld or eutectic schedules and seal parameters for each size package used, for each package supplier.

1.2.3 Electrical. Ability to prevent pin-to-case or pin-to-pin shorts from solder, loose particles or other conductive material.

1.2.4 Internal water vapor content. Ability to monitor moisture within the sealing chamber and to evaluate the moisture and gas content of the sealed package in accordance with method 1018 of MIL-STD-883.

2. DETAILED REQUIREMENTS (See section B for general requirements.)

2.1 Test sample construction. A minimum of 22 electrically functional hybrid device test samples shall be fabricated for this evaluation. Additional groups of similar test samples shall be fabricated for each different package type and sealing technique used. The test samples shall be representative of devices in or to be in regular production, in the largest 11 and smallest 11 package sizes. If the smallest and largest seal perimeter packages are not available for testing, consideration shall be given by the qualifying activity for the use of the next available perimeter size.

2.2 Test flow. Tests and test flow shall be as specified in table B-4.

2.2.1 Seal rework. Rework of fine leak rejects shall be permitted only if requirements of MIL-N-38534 are met, and have been approved during the section A audit.

2.2.2 Electrical testing. Electrical testing shall, as a minimum, include all 25°C group A subgroups required for final electrical in screening and group A testing in quality conformance evaluation.

2.2.3 Radiography. For solder seal only.

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2.2.4 PIND and loose particle detection. The parts shall show no evidence of loose particles resulting from the seal, delid or reseal process. Any parts showing loose particles shall be investigated. The investigation shall consist of fastening a piece of transparent tape over a small hole (.025 to .040 inch) punched in the lid. The part is then placed on the loose particle tester to capture the particles on the tape. The captured particles shall be examined at 30X minimum. The cause of the loose particles shall be determined and corrected.

NOTE: Loose particle recovery is only required for PIND rejects.

NOTE: Since very small metallic particles could be generated during the process of delidding and preparing the sealing surface for resealing, a careful inspection is required to detect latent defects, particles which could, in time, find their way across the glass beads. Any evidence, either visual or electrical, of these particles shall require corrective action.

2.2.5 Internal water vapor. Three samples (0 failures) or 5 samples (1 failure) shall have a minimum internal water vapor content of 5000 ppm for class B or 3000 ppm for class S. If possible, PIND rejects shall not be used for internal water vapor testing.

2.2.6 Delidding and relidding evaluation. This sequence shall be performed only for those packages for which the one delid is to be qualified. If delid is not to be qualified, then subgroup 2 is not applicable.

2.2.6.1 Delidding and relidding procedure. After completion of all tests and if delidding is to be qualified, the parts shall then be delidded one time and the sealing surface prepared for relidding using documented procedures. In order to assure that no loose conductive particles are still in the package, the following tests shall be performed:

- a. Internal visual inspection: Method 2017 of MIL-STD-883.
- b. Utilization of appropriate cleaning methods to achieve the required level of cleanliness.
- c. The parts shall be visually examined for loose particles which have been introduced during the delidding operation. Burrs on seal areas must be removed. Preseal visual inspection in accordance with method 2017 of MIL-STD-883.
- d. The parts shall be resealed using documented procedures.
- e. Subgroup 1 is repeated.

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TABLE B-4. Sealing, delidding, and relidding qualification.

Subgroup	Test	MIL-STD-883		Quantity (accept no.)	Reference paragraph
		Method	Conditions		
1	Seal	1014		22 (0)	2.2.1
	Seal rework	2009			
	External visual		25°C only		
	Electrical	2012			
	Radiography	1010	C, (50 cycles)		
	Temperature cycling	2007	B		
	Vibration, variable frequency				
	Seal	1014			
	PIND test	2020	B 25°C only		
	Electrical	1018			
Internal water- vapor content				2.2.5	
Loose particle recovery				2.2.4	
2	Delid			22 (0)	2.2.6 2.2.6.1

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SUBSECTION B-5

QUALIFICATION OPTION

1. SCOPE

1.1 Purpose. This subsection establishes the requirements particular to qualification option. Materials and manufacturing construction techniques listed on the QML shall be for those materials and manufacturing construction techniques which are actually tested.

1.2 Areas of concern. Areas of concern include all those listed in subsections B-1, B-2, B-3, and B-4.

2. DETAILED REQUIREMENTS (See section B for general requirements.)

2.1 Test vehicle.

2.1.1 Test sample construction. A list of materials and manufacturing construction techniques to be qualified by the manufacturer shall be submitted to the qualifying activity. A test vehicle shall be defined based on the manufacturer's assessment of the most critical fabrication, assembly, and material technologies; and can be actual production devices or devices specifically designed for this purpose.

2.1.2 Preconditioning. The test vehicle shall be fully screened to method 5008 of MIL-STD-883 before qualification testing is commenced. Additionally, all rework to be qualified shall be demonstrated as part of preconditioning. Two test devices and two elements per each reworked test device shall not be reworked. These nonreworked elements and test vehicles shall be clearly identified in order to provide reworked versus nonreworked data. Evidence of these preconditioning steps shall be presented to the qualifying activity as part of the test traveler.

2.1.3 Inspection of package. The devices shall be checked for evidence of damage. Special fixturing may be used to prevent damage to the package if the force used in the test is greater than that which would be used in normal MIL-STD-883, test method 5008, testing.

2.1.4 Wire bond testing. The bond strength test shall be performed to a lot tolerance percent defective (LTPD) of 7 for the number of bonds. The sample wires shall be predesignated, representative of the bonds to the various elements, and evenly distributed among the sample parts.

2.2 Tests and test flow. For initial qualification, the test and test flow as a minimum, shall be in accordance with table B-5A. For qualification of new or additional processes or materials, the tests and test flow, as a minimum, shall meet the requirements of table B-5B.

2.2.1 Electrical testing. Electrical testing shall be at 25°C only.

2.2.2 Nonfunctional samples. Electrical rejects from final electrical testing in screening can be used for subgroups 4, 5, and 6 testing. Only sealed units shall be subjected to subgroup 4.

2.2.3 Sampling. The same sample parts may be used for subgroups 1, 2, and 3 testing; and those tests identified in MIL-N-38534 as destructive can be performed only in subgroup 3.

2.3 Test limits. All test limits, as a minimum, except as noted herein, shall meet the requirements noted in MIL-N-38534 and MIL-STD-883.

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2.3.1 PIND and loose particle detection. The parts shall show no evidence of loose particles. Any parts showing loose particles shall be investigated. The investigation shall consist of fastening a piece of transparent tape over a small hole (.025 to .040 inch) punched in the lid. The part is then placed on the loose particle tester to capture the particles on the tape. The captured particles shall be evaluated at 30X minimum and the offending portion of the process identified and corrected.

NOTE: Loose particle recovery is only required for PIND rejects.

2.3.2 Internal visual and mechanical. Loose particle recovery and internal water vapor testing shall be performed carefully to minimize damage to the areas to be inspected.

2.3.3 Internal water vapor.

2.3.3.1 Subgroup 3. Internal water vapor content testing is for information only. All constituents shall be reported.

2.3.3.2 Subgroup 6. Three samples (0 failures) or five samples (1 failure) shall have a maximum internal water vapor content of 5000 parts per million. Other gas species present in quantities greater than 100 parts per million (0.01 percent) shall be reported.

2.3.4 Constant acceleration. The parts shall withstand a minimum of 15 kg. If a part would be stressed to a higher constant acceleration level in MIL-STD-883, test method 5008 screening, then the part shall be tested as a minimum to this higher level. A stiffener plate (e.g., .125 inch aluminum) may be attached to the base-plate of the package to prevent damage due to "oilcanning" of the package.

2.3.5 Die shear. Die shear shall be performed on all elements in five devices with zero failures allowed.

2.3.6 Internal visual and mechanical. In addition to the criteria of MIL-STD-883, method 2014, this inspection shall verify that no damage has occurred to the element and substrate attach.

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TABLE B-5A. Qualification subgroups.

Subgroup	Test	MIL-STD-883		Quantity (accept no.)	Reference paragraph
		Method	Conditions		
1	Thermal shock	1011	C, 15 cycles	5 (0)	2.3.4
	Temperature cycling	1010	C, 100 cycles		
	Constant acceleration	2001	A, Y ₁ axis only		
	or Mechanical shock	2002	B, Y ₁ axis only		
	Seal	1014	B		
	PIND	2020	B 25°C only		
	Electrical Loose particle recovery				
Internal visual and mechanical	2014	B	2.3.6		
Die shear	2019		2.3.5		
2	Mechanical shock	2002	B, Y ₁ only	5 (0)	2.1.3
	Variable frequency vibration	2007	Y only		
	Constant acceleration	2001	A, Y ₁ only		
	External visual	2009			
	Seal	1014	B		
	PIND	2020	B 25°C only		
	Electrical Loose particle recovery				
Internal visual and mechanical	2014		2.3.1, 2.3.2 2.2.5, 2.3.2		
3	Stabilization bake	1008	150°C, 1000 hours	5 (0)	2.3.4
	Constant acceleration	2001	Y ₁ only		
	Seal	1014	B		
	Electrical		25°C only		
	Internal water vapor	1018			
Internal visual and mechanical	2014		2.2.1 2.3.2, 2.3.3.1 2.3.6		
4	Stabilization bake	1008	F, 1 hour	5 (0)	2.1.4
	Bond strength	2011			
5	Constant acceleration	2001	C minimum	5 (0)	2.3.4 2.3.6
	Internal visual and mechanical	2014	(Y ₁ axis only)		
6	Internal water vapor	1018		3 (0) or 5 (1)	2.3.3.2

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TABLE B-58. Testing guidelines for process and material changes or additions.

	Qualification test subgroups (from table B-5A)
Substrate material	1, 2, 3, 4, 5
Conductor material or process temperature	1, 2, 3, 4, 5
Die or element attach materials	1, 2, 3, 4, 5, 6
Substrate attach material or process temperature	1, 2, 3, 4, 5, 6
Package/lid structure or plating material	1, 2, 3, 4, 5
Package lid/base material	1, 2, 3, 5
Wire bond method, materials or dimensions	1, 4
Seal method, process, material or atmosphere	1, 2, 3, 6

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CONCLUDING MATERIAL

Custodians:

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

Review activities:

Army - AR, MI
Navy - SH
Air Force - 11, 19, 85, 99
DLA - ES

User activities:

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

Preparing activity:
Air Force - 17

Agent:
DLA - ES

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