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MILITARY STANDARD

CERTIFICATION REQUIREMENTS
FOR
JAN MICROCIRCUITS

AMSC N/A

FSC 5962

DEPARTMENT OF DEFENSE
Washington, DC 20301

Certification Requirements for JAN Microcircuits

MIL-STD-976

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: NASA, Parts Project Office, NASA/Goddard Space Flight Center, ATTN: Code 311.A, Greenbelt, MD 20771, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

The purpose of this standard is to establish requirements and criteria for certification (as required by MIL-M-38510). Definite criteria will assure that 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 attaining statistical control of critical parameters and continuous improvement of process capability. Certification and the maintenance thereof is a prerequisite to microcircuit qualification and is performed in advance and independent of procurement.

CONTENTS

NOTE: Appendix B has been deleted. The remaining appendices have not been reidentified.

1. SCOPE

* 1.1 Scope. This standard establishes the minimum requirements for the certification of manufacturing facilities/lines(s) used in fabricating, assembling, and testing high reliability JAN microcircuits in accordance with MIL-M-38510. This includes plant facilities, equipment, materials, personnel training, process controls, testing, and documentation.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-M-38510	-	Microcircuits, General Specification for

STANDARDS

FEDERAL

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

MILITARY

* DOD-STD-1686	-	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices
MIL-STD-883	-	Test Methods and Procedures for Microelectronics
MIL-STD-977	-	Test Methods and Procedures for Microcircuit Line Certification
MIL-STD-45662		Calibration Systems Requirements

HANDBOOKS

MILITARY

* DOD-HDBK-263	-	Electrostatic Discharge Control Program for Electrical and Electronic Parts, Assemblies and Equipment
* MIL-HDBK-279	-	Total Dose Hardness Assurance Guidelines for Semiconductor Devices and Microcircuits
* MIL-HDBK-280		Neutron Hardness Assurance Guidelines for Semiconductor Devices and Microcircuits
* MIL-HDBK-339 (USAF)	-	Custom Large Scale Integrated Circuit Development and Acquisition for Space Vehicles

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this standard to the extent specified herein.

Defense Nuclear Agency (DNA) Document

* DNA-TR-86-38 - Hardness Assurance Guidelines for MIL-HDBK-339 (USAF)

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

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Definitions. In addition to the definitions specified in MIL-M-38510, the following definitions apply:

* 3.1.1 Certification. The process by which a qualifying activity or certification team determines on the basis of a survey that a manufacturer's facility(ies)/lines are in compliance with the applicable requirements so that the manufacturer is eligible to qualify product manufactured on those facilities/lines. The written notification of such eligibility constitutes certification.

3.1.2 Certification team. The Government qualifying activity's designated representative(s) charged with the responsibility of auditing a manufacturer's facility/line.

* 3.1.3 Facility. Equipment, documentation, and services used to support the manufacture, assembly, testing, and shipping of microcircuits.

3.1.4 Microcircuit technology. A group of microcircuits which are manufactured on the same line using the same materials, procedures, and similar equipment, such as TTL, CMOS, NMOS, etc. (see MIL-M-38510, appendix E).

* 3.1.5 Line. A collection of designated wafer fabrication, assembly, and test equipment, and organizational structure used to manufacture microcircuits in accordance with specific process flow.

4. GENERAL REQUIREMENTS

* 4.1 Requirements. The following requirements are applicable for the certification of product assurance levels for JAN microcircuits as specified in MIL-M-38510. The qualifying activity shall determine the adequacy and compliance to the requirements and shall report their findings and recommendations to the manufacturer.

* 4.1.1 Pre-audit information submission. The manufacturer may be required to submit to the qualifying activity the information required in 4.1.1.1 through 4.1.1.13 for review and approval prior to the initial audit. At least one JAN product, which is intended for manufacture on each line to be certified for each particular process, shall be identified. A milestone chart for qualification per MIL-M-38510 shall be supplied. A pre-audit information letter shall be issued by the qualifying activity to the manufacturer under consideration for certification. Additional items may be requested by the qualifying activity, however, the primary pre-audit information is listed below:

* 4.1.1.1 Quality assurance program plan. The plan shall be in accordance with and cross-referenceed to the applicable paragraphs of MIL-M-38510, appendix A. The manufacturer's flow chart for the line must be complete, current, and accurate and shall contain, as a minimum, the type of information as shown in the example on figure 1 for all processes to be certified.

* 4.1.1.1.1 Process flow charts and lot travelers. Process flow charts (e.g., see figure 1) and lot travelers, as required by the qualifying activity, shall be submitted for wafer fabrication, assembly, screening (in accordance with MIL-STD-883, method 5004 or 5010 as applicable), and groups A, B, C, D and E (if applicable) tests (in accordance with MIL-STD-883, method 5005 or 5010 as applicable). The manufacturer's flow chart for each line to be certified must comply with the requirements of MIL-M-38510, appendix A, 30.1.3.2. Lot travelers may be used in lieu of flow charts if the lot travelers contain the required flow chart information.

4.1.1.2 Calibration information.

* 4.1.1.2.1 Calibration system description. The system description shall be in accordance with and cross-referenced to MIL-STD-45662 requirements using appendix A herein or equivalent.

* 4.1.1.2.2 Calibration laboratories list. The list shall include names and addresses of all calibration laboratories utilized. The test laboratory must verify that the calibration laboratories utilized are, in fact, capable of performing the required services (see 5.7.1 of MIL-STD-45662).

* 4.1.1.3 Test procedures. All test procedures for which laboratory suitability is to be issued by the qualifying activity shall be cross-referenced to the applicable MIL-STD-883 test methods and submitted. If the quality control personnel use a different document(s) than the manufacturing personnel, both sets of documents shall be cross-referenced to the applicable MIL-STD-883 test methods.

4.1.1.4 Testing information. The following test information shall be made available to the qualifying activity:

4.1.1.4.1 Device type information. The manufacturer's part number and military part number(s) (if available) of the device type(s) to be qualified are to be listed (in accordance with the detail Military Specification). If the detail military specification is not in final form, this information shall be supplied as called out in the proposed or initial draft of the detail military specification.

* 4.1.1.4.2 Test equipment suitability. The manufacturer shall have a documented system in operation which assures the suitability of equipment and associated calibration standards used for the screening qualification and quality conformance inspections.

* 4.1.1.5 Verification procedure documentation. The manufacturer shall supply, as required by the qualifying activity, the procedures which are used internally to verify that the electrical test programs, switching and special schematics, and burn-in schematics are in accordance with the specification requirements.

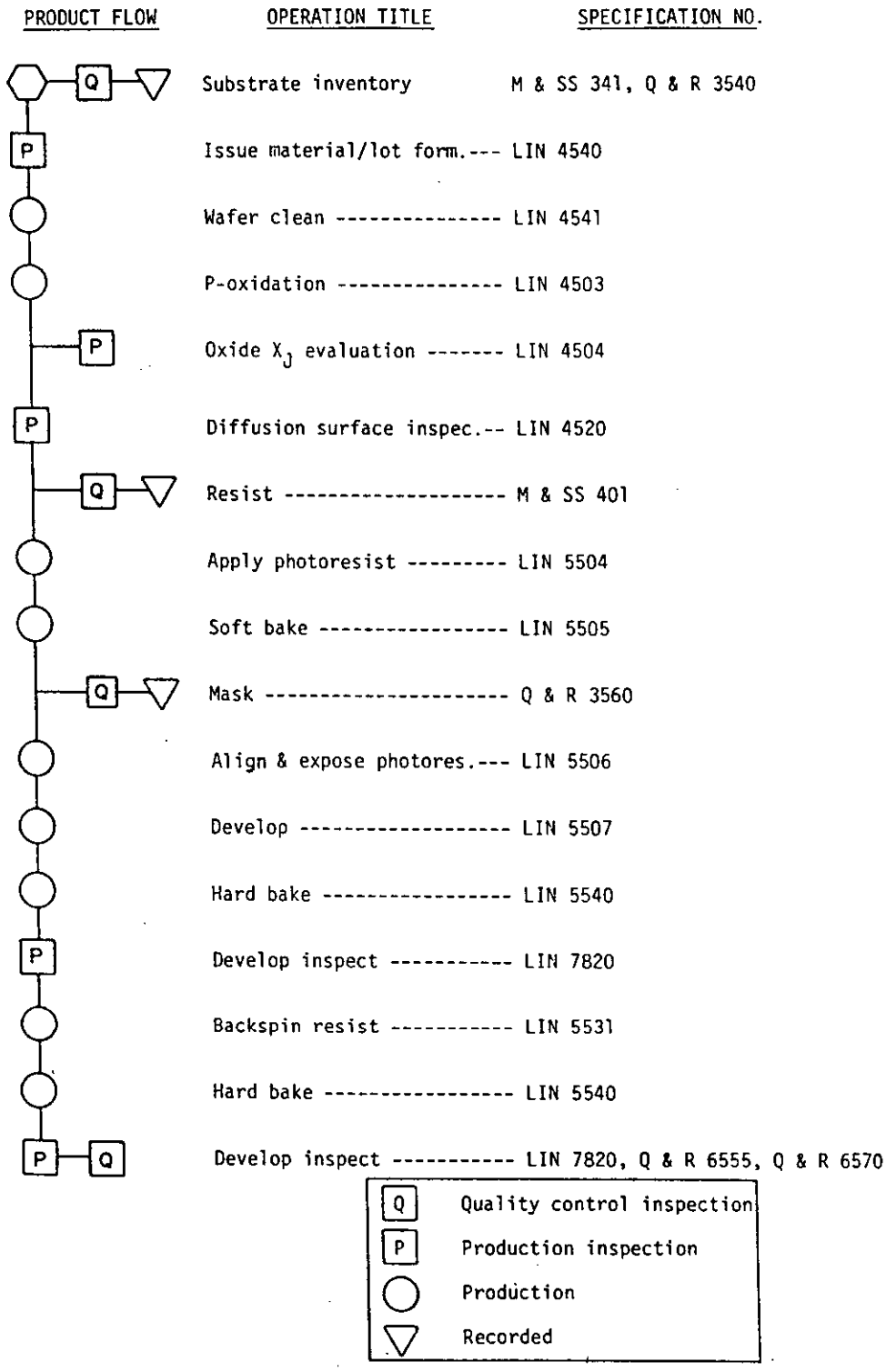
* 4.1.1.6 Samples. The manufacturer shall supply representative samples of the package types and device types, including drawings and material specifications, which are intended for production on the line to be certified.

* 4.1.1.7 Audit baseline sheet. Form DESC-EQM-42 (appendix C), sections I and II, shall be current and complete for each line and technology for which the manufacturer is seeking certification. This shall be verified prior to the certification audit.

* 4.1.1.8 Quality conformance inspection (QCI). A documented QCI procedure shall be submitted which includes a sample selection process and notification of lot failure.

* 4.1.1.9 Electrostatic discharge (ESD) control. A documented ESD handling and control procedure in accordance with 5.1.11 shall be submitted.

* 4.1.1.10 Self-audit. A documented self-audit procedure in accordance with MIL-M-38510, appendix A shall be submitted. A guide for a self-audit checklist may be obtained from the qualifying activity.



NOTES:
1. Specification revisions and dates must be current at the time of audit. This information shall not be placed on the flow chart. However, this information must be made available to the certification team during the audit.
2. This flow chart is not complete and is used as an example to show the type of information which shall be included.

FIGURE 1. Typical process flow chart.

* 4.1.1.11 Distributor audits. When applicable a documented distributor audit procedure in accordance with MIL-M-38510, 3.3.1, 4.1.5, 4.1.6, and appendix A, 30.1.1 shall be submitted. The procedure shall contain provisions for ESD handling, repackaging, storage and product retest. The results of the last two distributor audits performed shall be available at the manufacturer's facility for review.

* 4.1.1.12 Current density. For each different product line, facility, or technology to be certified, a current density calculation procedure in accordance with MIL-M-38510, 3.5.5 shall be submitted.

* 4.1.1.13 Radiation hardness assurance (RHA) program. When applicable, a documented RHA program plan in accordance with 5.2.18 shall be submitted.

* 4.1.2 Manufacturer audit. The qualifying activity shall audit the manufacturer's facility(ies) and line(s). The purpose of the audit is to determine that the controls imposed on manufacturing, inspection, and testing of JAN microcircuits are sufficient to assure conformance with the requirements of MIL-M-38510 and this standard.

* 4.1.2.1 Capability demonstration. Evidence shall be shown to the qualifying activity during the audit that the certification requirements herein are being regularly met in production. The manufacturer shall provide (or make available for review during the audit of each line) representative sample(s), data, and documentation as required.

4.1.2.2 Audit report. The qualifying activity will report the results of the audit to the manufacturer.

* 4.1.3 Certification. Certification is valid until terminated by written notification from the qualifying activity. Throughout the duration of the certification, the manufacturer is subject to a periodic reaudit approximately every two years and a more frequent review by the qualifying activity or its representatives.

4.1.3.1 Loss of certification. The manufacturer may lose certification for failing to comply with the requirements of MIL-M-38510 or this standard.

4.1.3.2 Reinstatement of certification. Manufacturers may have certification reinstated by successfully completing all the requirements referred to in MIL-M-38510 and this standard, or such portions thereof as the qualifying activity may direct in order to remedy the deficiencies leading to the loss.

5. DETAIL REQUIREMENTS

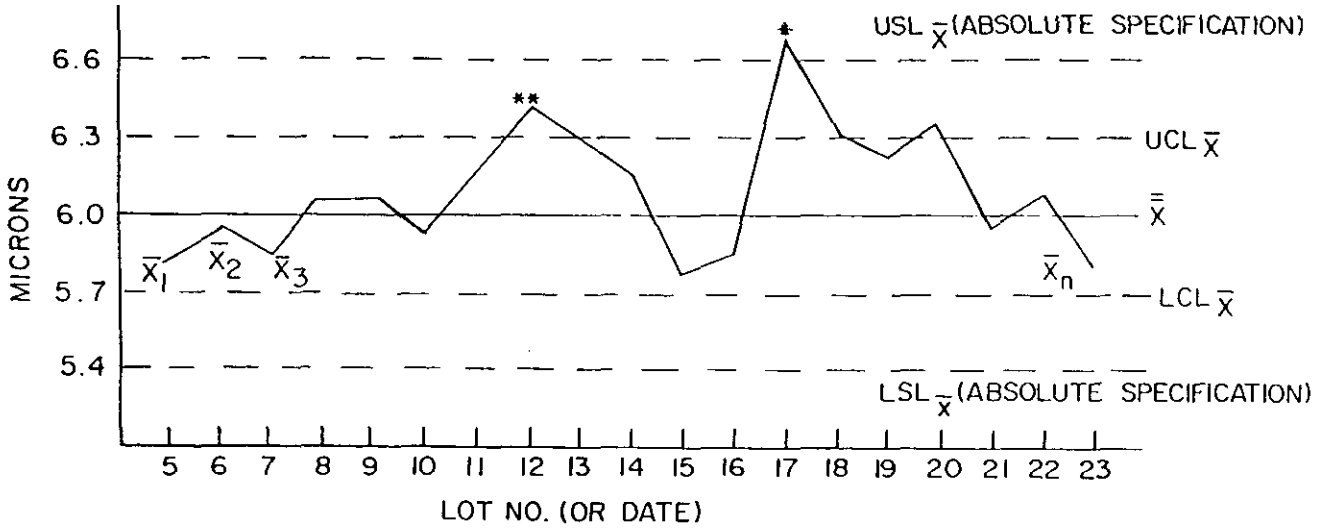
5.1 System requirements. In addition to section 4., the manufacturer shall document, control, and meet the following:

* 5.1.1 Documentation. Documents which specify materials, calibration techniques, processing, tests and measurements, controls, and procedures shall be maintained in accordance with appendix A of MIL-M-38510. These documents shall cover all process steps to be certified. The documentation shall be readily available to the operating personnel at all times. It shall be made available to the qualifying activity for the purpose of verifying its existence, coverage, implementation, and adequacy.

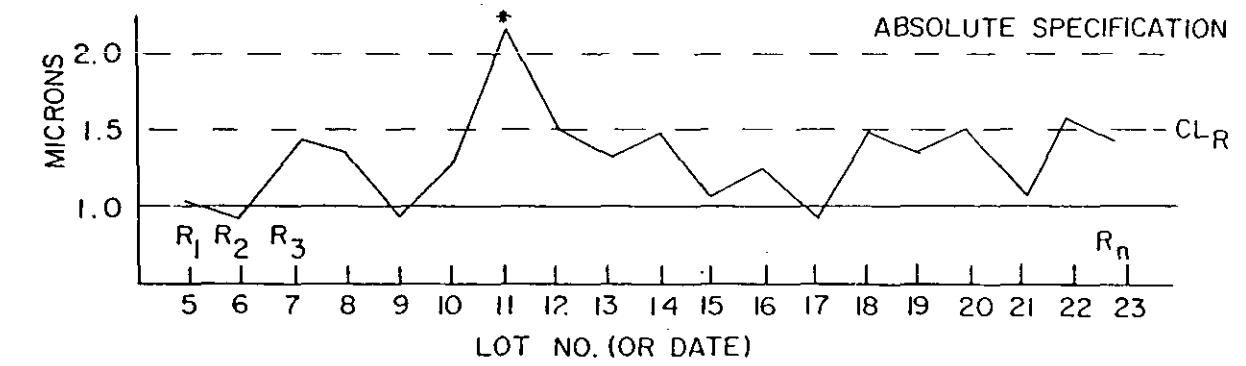
* 5.1.1.1 Lot traveler. A lot traveler shall be used for each lot, sublot, or split. The lot travelers shall include as the minimum: lot identification, operation, identification of critical equipment when an equipment option is available (class S only), quantity in and out , date of operation, PDA (when applicable), and unique operator identification. In addition, the test lot traveler shall be in accordance with MIL-M-38510, appendix A, 30.1.3.7.

* 5.1.1.1.1 Wafer lot acceptance for class S. A form which contains the data required by method 5007, MIL-STD-883 shall be utilized for each wafer lot.

* 5.1.1.2 Statistical process control (SPC) program. The manufacturer's SPC program per MIL-M-38510, 3.4.1.2.6 shall be documented and available for review by the qualifying activity during the audit. A planned SPC milestone schedule and progress reporting system shall be developed and made available for review.



a. Mean ($\bar{\bar{X}}$) Epitaxy thickness (acceptance criteria 6 ±0.6 microns)



b. Range, epitaxy thickness

*Corrective action report filed and disposition of product documented

**Corrective action required

FIGURE 2. Example $\bar{X}$, R charts.

* 5.1.1.2.1 SPC tools. SPC tools, which are used to summarize data and to aid in the SPC analysis of a given manufacturing process, shall be maintained at operations where inspections or measurements are performed (e.g. dimensions, strengths, thicknesses, resistivity). Examples of SPC tools shall include, but are not limited to, the following: histograms, pareto analyses, scatter plots, check sheets, control charts, cumsum charts, and cause and effect diagrams. Where control limits (trends), absolute specification or baselined limits are exceeded, the manufacturer shall document the product disposition and corrective action taken. If absolute specification or baselined limits (appendix C) are exceeded, (other than rework allowed by MIL-M-38510), the product must be dispositioned as non-JAN. The records of SPC tools shall be readily available during the audit.

* 5.1.1.3 Equipment maintenance and calibration. The procedures, records, and calibration facility location for the performance of preventative maintenance and recalibration (including recall cycle) and repairs shall be specified in accordance with MIL-M-38510, appendix A, 30.1.1.9 and 30.1.2.5.

* 5.1.2 Control of incoming materials. Control of incoming materials shall be accomplished using one of the following:

* 5.1.2.1 Incoming inspection. Methods and procedures used to control inspection, storage, and handling of incoming materials shall be documented. Records shall be provided which verify that materials used in production meet the requirements of the manufacturer's specifications and of the general and detail MIL-M-38510 specifications. As an example the following items shall be covered:

* 5.1.2.1.1 Substrate. Thickness, flatness, surface orientation, conductivity type, resistivity, visual examination, surface quality after defect etch, and oxygen and carbon content.

* 5.1.2.1.2 Bond wire. Composition, uniformity, hardness, diameter, elongation, tensile strength, and purity.

* 5.1.2.1.3 Metal. Composition, and purity.

* 5.1.2.1.4 Package material and lead frames. Dimensions, composition, lead integrity test, material purity, plating, underplating, and tolerances where applicable.

* 5.1.2.1.5 Chemicals, photoresists, and gases. Composition, purity, and grades.

* 5.1.2.1.6 Masks. Geometry (lines, gaps, tolerances), pinholes (density, size, distribution), scratches, edge raggedness, and level overlay.

* 5.1.2.2 Vendor quality system certification. As an alternative to the requirements of 5.1.2.1, the vendor quality system certification may be used to ensure the quality of incoming supplies. This system requires validation of the vendor's quality system, staff capabilities, equipment controls, facilities, and record procedures. This method may replace the microcircuit manufacturer's incoming inspection. It shall consist of, as a minimum, the evaluation of the vendor's inspection data, process control statistics, and calibration records, including a correlation of the vendor's measurements to the microcircuit manufacturer's incoming inspection procedures. Microcircuit manufacturers shall periodically verify the vendors quality system. This shall include random measurements to verify correlation, periodic vendor facility audits, and receipt of C of A or C of C.

All aspects of the program shall be documented, including methods, criteria, and evaluation or audit procedures. Both parties shall maintain records to verify that the incoming material consistently meets the requirements of the microcircuit manufacturer's specifications.

The vendor is defined as all suppliers or manufacturers of incoming supplies to the microcircuit manufacturer. In the case of more than one vendor, for example, a manufacturer and a packager, both must be certified. Supplies include, but are not limited to, package piece parts including bonding wires and preforms, chemicals, masks, gases, and silicon.

If, in the course of audits or monitors, inadequacies are found that jeopardize the efficiency of the program, the microcircuit manufacturer shall revert to incoming inspections until corrective actions are implemented.

5.1.3 Calibration. Calibration shall be in accordance with MIL-STD-45662. Certificates showing traceability to the National Bureau of Standards (NBS) are to be maintained current at the manufacturer's plant and available at the time of audit.

5.1.4 Environmental control. Specify, control, and record the relative humidity, temperature, and particle count for each critical process step (e.g. wafer fabrication, assembly). The procedures and techniques for measuring these environmental parameters and limits shall be documented. The procedures shall contain corrective actions for out-of-tolerance environmental conditions. Particle counts shall be in accordance with Federal Standard 209.

* 5.1.5 Deionized water control. Specify, measure, control, and record the purity of water in terms of: minimum resistivity (control and absolute specifications limits) at 25°C, maximum total organic carbon (TOC), maximum bacteria count, maximum total dissolved silica, maximum particulates, and maximum residue.

5.1.6 Electrical testing for JAN microcircuits.

* 5.1.6.1 Hardware. All electrical test equipment and fixtures used for testing JAN microcircuits shall be suitable to meet applicable test conditions. Setup, operation, and verification procedures for each operation/equipment shall be made available during the audit. Test equipment shall be verified in accordance with MIL-M-38510, paragraph 4.3.6. In addition all test equipment without self-test capability shall be verified for each device type to be tested prior to and after testing. In the event of a verification failure, a procedure for traceability, recovery, and retesting of all units tested since the last successful verification is required. This procedure shall also provide for the detailed disposition of failed device(s) or lots(s).

5.1.6.2 Programs and tapes. Test programs and corresponding tapes shall meet the requirements of the detail microcircuit specifications. A system shall be documented which ensures that, if a specification is revised, the corresponding program(s) and tape(s) are also changed, and that the correct program is used.

5.1.7 Environmental testing for JAN microcircuits. All environmental test equipment and fixtures used for testing JAN microcircuits shall be suitable to meet applicable test conditions. Setup and operation procedures for each operation/equipment shall be made available for determination of adequacy.

5.1.8 Failure analysis. Failure analysis and corrective actions shall be performed and documented in accordance with MIL-M-38510.

5.1.9 Handling of wafers, substrates, and tools. Provisions shall be made for the careful handling of wafers, substrates, tools, fixtures, etc. used in the production cycle to prevent damage and contamination.

* 5.1.10 Training. Procedures and records of training for operators and inspectors shall be made available for review by the qualifying activity and shall be in accordance with MIL-M-38510, appendix A, 30.1.1.2 and 30.1.2.1.

* 5.1.11 Electrostatic discharge (ESD) control program. The ESD control program procedure shall be documented and implemented in accordance with MIL-M-38510, 4.4.2.7 and appendix A, 30.1.1.14. The ESD control program shall be made available to the qualifying activity.

The ESD control program shall incorporate failure analysis feedback. The manufacturer shall be responsible for assuring that it's distributors implement and maintain ESD controls.

Definitions specified in the ESD control program shall be in accordance with MIL-M-38510 and DOD-HDBK-263 as applicable. DOD-HDBK-263 and DOD-STD-1686 are recommended as guides in establishing the ESD control program.

* 5.2 Class B line requirements. The following processes shall be documented and controlled, including accept/reject criteria, and are applicable to the certification of a line on which the manufacturer intends to produce class B JAN microcircuits. Additionally, the manufacturer must meet the requirements of sections 4 and 5.1 of this standard.

5.2.1 Oxidation and deposition. Each combination of materials (SiO_2, Si_3N_4, Al_2O_3) formed on the substrate or wafer shall be identified and the methods of formation (thermal oxidation, sputtering) shall be specified. Equipment, thickness, and tolerances shall be specified and controlled.

5.2.2 Patterning. Techniques (photolithography, beam) and materials used to form patterns shall be specified.

5.2.2.1 Photoresist. The following shall be specified: preparation and evaluation (specific gravity, viscosity, solids residue, definition of line width, pinhole count), storage conditions (temperature, time, type of container), application (humidity control, rpm of spinner, acceleration, spin time), pre-bake and bake (time, temperature, environment), development (cycle times, temperature, chemicals), and removal. If the photoresist thickness is measured, rpm of spinner, acceleration, and spin time need not be specified.

* 5.2.2.2 Etching. The controls and tolerances on each patterning process shall be specified for each technique (wet chemical etch, dry plasma etch, etc.). For wet etch methods the etchant information shall include: composition, grade, concentration, frequency of etchant replacement, temperature, etch rate and uniformity and time of each oxide or metal layer agitation, and method of drying. For dry etch methods the etchant information shall include: gas composition, chamber pressure, forward RF power, limit on reflection power, electrode temperature, and a procedure for monitoring etch rate uniformity.

* 5.2.2.3 Alignment and exposure. Contact print parameters shall be specified as: exposure (uniformity, contact pressure, wavelength, light intensity, time, environment), and visual inspection (magnification, lighting, visual aids). Projection print parameters shall include: scan, aperture, focus (microns from center allowable), distortion, intensity, uniformity, and wavelength.

5.2.3 Epitaxy. Techniques, controls, materials, and equipment used in forming an epitaxial layer on a substrate shall be specified. This shall include temperature, cycle times, sheet resistivity of epitaxial layer, thickness of epitaxial layer, gas flow rates, loading and unloading of wafers (dust removal, wafer placement on susceptor), wafer precleaning, and susceptor and tube cleaning. Instruments used for temperature measurement shall be calibrated.

* 5.2.4 Structure formation. Techniques and materials used in forming junctions and MOS gates shall be identified.

* 5.2.4.1. Diffusion. Diffusion temperature measurements including tolerances, profiling techniques, diffusion tube and associated handling hardware cleaning frequency and techniques, flow rate of gases, wafer loading and unloading, storage, calibration of thermocouples, and dopant source (grade, type, etc.) shall be specified when applicable.

5.2.4.2 Ion implantation. Dopant source (grade, type, etc.), calibration frequency of integrated dose rate measuring equipment, power supplies and vacuum equipment, frequency and cleaning techniques of the entire system, wafer loading and unloading, and maintenance records shall be specified.

* 5.2.4.3 Test structures. Test results shall be made available on critical parameters: Beta, breakdown voltages, threshold voltages, leakage current, or others as applicable. These results shall show the control or specification limits, frequency of test, and type of record.

* 5.2.5 Metallization. Equipment for depositing metal, composition of each metal layer (Al, Ti-W-Au, Pt-Ti-W-Au, etc.), method (vacuum chamber electroplating, sputtering, etc.), heat source (E-beam, filament, etc.), temperature of substrate during deposition, metal thickness and tolerance, deposition rate of metal, motion (stationary, rotary, or planetary), cleaning of chamber, thickness control, weight of melt, and sintering (time, temperature, ambient gas) shall be specified.

* 5.2.6 CV plotting. The techniques, equipment, frequency of test, test conditions (time, temperature, bias, etc.), and control or specification limits shall be specified. CV plotting is required on bipolar lines producing product which operates above ten volts and all MOS lines.

* 5.2.7 Glassivation. The method of formation (oxidation of silicon, quartz sputtering, etc.), and the materials used shall be identified. The controls for the glassivation layer(s) shall be documented and include temperature, time, thickness, flow rate of gases, motion of wafer during deposition, control of power and frequency, and dopant concentration.

* 5.2.8 Final wafer thinning. Techniques, methods of removal (lapping, etching, etc.), and materials used in reducing wafer thickness shall be specified. Pressure, grit size, speed of rotation, removal of coating, cleaning, front side protection, taper, final thickness, tolerances, and other pertinent parameters shall also be specified.

* 5.2.9 Scribing. Each method (diamond, laser, sawing, etc.) of scribing shall be specified.

5.2.9.1 Diamond. The type of machine, scribing tool, tool point (e.g. heel), tool angle, tool pressure, speed and direction of tool travel, depth of scribe line, orientation of die pattern, use of oxide and metal free channels, and debris removal shall be specified.

5.2.9.2 Laser. The type of equipment, power, beam resolution, depth of scribe line, cleaning, protective overcoat, and pulse rate shall be specified.

* 5.2.9.3 Sawing. The wafer feed rate limits, wheel thickness, slurry, washing, and kerf depth shall be specified.

* 5.2.10 Die separation. Each method of die separation to be certified shall be specified. Additionally, the method of storing sorted die shall be specified.

* 5.2.10.1 Roller. Wafer protection, roller diameter, composition, and cleanliness shall be specified.

* 5.2.10.2 Sawing. The wafer feed rate limits, wheel thickness, slurry, and washing shall be specified.

* 5.2.10.3 Anvil. Wafer protection, anvil, pressure, etc., shall be specified as applicable.

* 5.2.11 Die attach. For each type of device, the die attach material (eutectic, metal/glass, epoxy, etc.), package type (TO-5, multilayer ceramic, dual-in-line, flatpacks, etc.), and die orientation shall be specified. Additional requirements such as time, temperature, pressure, scrub, die attach environment, or others as applicable shall be specified.

* 5.2.12 Interconnect bonding. Techniques (ultrasonic, thermocompression, tape automated bonding, etc.), material (Al, Au, etc.), material size (diameter, width, thickness), and type of interconnect (wire, beam lead, etc.) used in connecting die to package shall be identified. The following shall also be specified, if applicable: temperature, pressure dwell time, condition of capillary or electrode control, power, loop height, size and thickness/width of bond, and environment.

* 5.2.13 Internal visual inspection. The procedures for internal visual inspection of microcircuits shall be documented and shall be in accordance with the applicable requirements of method 2010 or method 5004 (or 5010 if applicable) of MIL-STD-883.

* 5.2.14 Sealing. Type of material and seals (solder, vitrious glass) used in production of package (TO-5, flatpack, cerdip, LCC, etc.), and the method (beam welding, resistance welding, belt furnace, etc.) shall be specified. The following shall also be specified: pre-seal bake (time, temperature, atmospheric conditions), temperature or power, moisture content of sealing environment in ppm, flow rate of gases, profile and welding controls (pressure, power, time), cleaning, and package orientation.

* 5.2.15 Marking. The techniques, procedures, and materials used for marking shall be specified.

* 5.2.16 Foreign material contamination (FMC). Procedures for a FMC control program shall be documented in accordance with MIL-STD-883, method 2010, paragraph 3. The procedures and the results of the required audits and subsequent corrective action(s) shall be made available for the qualifying activity's review. Records shall cover at least the previous three-month period except where not possible (e.g. new certification).

* 5.2.17 Process monitor programs. Process monitor programs required by MIL-M-38510, paragraph 3.4.1.2.7 shall have provisions for the following:

* 5.2.17.1 Wire bonding. The manufacturer shall monitor the wire bond strength in accordance with the manufacturer's documented procedure. The frequency of this procedure shall be performed at machine setup as a minimum. At the manufacturer's option, this procedure shall consider shift start and stop, change of operators, spools, packages, wire size, lot size, and other related factors.

* 5.2.17.2 Die attachment. The manufacturer shall monitor the die attachment integrity in accordance with the manufacturer's documented procedure. This procedure shall be performed at each equipment setup as a minimum. At the manufacturer's option, this procedure shall consider other related factors.

* 5.2.17.3 Lid sealing. The manufacturer shall monitor, as a minimum, glass frit packages for seal integrity in accordance with the manufacturer's documented procedure. A sample and test plan shall be available for review by the qualifying activity.

* 5.2.17.4 Lead trimming and final lead finish thickness. The manufacturer shall monitor the package lead lengths to assure meeting the applicable military detail specification for proper lead length and the final lead finish thickness in accordance with MIL-M-38510. The frequency of the lead length monitor shall be performed at each equipment setup as a minimum. A sample and test plan shall be available for review by the qualifying activity.

* 5.2.17.5 Inspection by scanning electron microscope (SEM). A continuing SEM program shall be established to ensure adequate process control and coverage of metallization at oxide steps, contact openings, and general metallization. A monthly (minimum frequency) SEM evaluation shall be performed on product which is in the manufacturing process. The SEM program shall establish routine control over metallization processes by process families or inspection of products.

* 5.2.18 Radiation hardness assurrance (RHA) program. The manufacturer of RHA devices shall have documentation defining the critical factors and the procedures for design, manufacture, inspection, and testing of RHA devices (including RHA test structures). The manufacturer shall consult MIL-HDBK-279, MIL-HDBK-290, MIL-HDBK-339, and DNA-TR-86-38 for guidance regarding development of this documentation. This documentation shall be available for review by the qualifying activity.

* 5.2.18.1 RHA responsibility. The manufacturer shall identify a person or persons whose responsibility is to act as the interface with the qualifying activity regarding RHA activities.

* 5.2.18.2 Test structures. The manufacturer's documentation shall define test structures (devices, patterns, or coupons) used to monitor radiation response or processes affecting radiation response. The applications of these structures (sample plan, frequency, type of testing, and acceptance testing) shall be detailed. The correlation in radiation response between the test structures and the microcircuit shall be documented.

5.3 Class S line requirements. In addition to sections 4, 5.1, and 5.2, the manufacturer shall document and demonstrate capability to control the following:

* 5.3.1. Substrate measurements. Using documented techniques and capable equipment, the manufacturer shall have performed and continue to be capable of performing the measurements specified in table I. If the qualifying activity has reason to doubt the capability of the manufacturer to correctly make these measurements, the qualifying activity may request that additional measurements be made in their presence. The qualifying activity may also request that the substrates, including the recorded measurements, be submitted to the qualifying activity for performance testing in accordance with some or all of the measurements specified in MIL-STD-977 and referenced in table I. An adequate vendor quality system may also be implemented to meet any or all of these measurements.

* 5.3.2 Pinhole and crack measurements. Demonstrate the method used during production for detecting and measuring the densities and size of pinholes and cracks in a typical oxide layer. Test methods 3040 and 3050 of MIL-STD-977 or an equivalent test shall be used. The qualifying activity may request samples of oxides that have these imperfections identified and measured be submitted for verification in accordance with the aforementioned test methods. The wafer lot reject limits, disposition of reject wafers, and corrective actions shall be specified.

* 5.3.3 Stability of devices. To assure the stability of each process step in producing devices, the manufacturer shall have documented procedures to show that they have developed and are using tests such as high temperature reverse bias, BV_{CEO}, BV_{DSS}, BV_{GO}, h_{FE}, I_{CBO}, I_{EBO}, V_T, sheet resistivity, or others. The manufacturer may be required to demonstrate these tests to the qualifying activity. Records, such as X-bar, R charts (see figure 2), shall be available with parameter limits that show control of the process used for producing devices.

* 5.3.4 CV plotting. Current CV plots or equivalent in accordance with method 5007 of MIL-STD-883 shall be made available to the qualifying activity. CV plotting may be required to be performed during the audit.

* 5.3.5 Induced wafer defects. When requested by the qualifying activity, the manufacturer shall demonstrate that the quantity of induced dislocations and other defects are not sufficient to be deleterious to the characteristics of the junctions, oxide layers or other structures built in or on the substrate.

5.3.6 Photoresist pinholes. The test method and the maximum density of pinholes shall be specified for each photoresist type.

* 5.3.7 Masks. The defect density (size, hard and soft, etc.) allowable on working masks, and cleaning and inspection frequencies shall be specified.

5.3.8. Epitaxy. The stacking fault count allowable of the epi-layer shall be specified and recorded.

* 5.3.9 Stability of conductors. The tests specified in 5.3.9.1 and 5.3.9.2 are applicable, as a minimum, to manufacturing lines on which devices having any of the following are manufactured:

a. Conductor line widths narrower than 2 miorons

b. Multilevel structures

c. Conductors other than doped aluminum, gold, titanium tungsten, polysilicon, or nichrome.

TABLE I. Substrate measurements.

Test	MIL-STD-977 Test method (or equivalent) 2/	Max tolerance 1/
1. Diameter	1590 (F613)	3 inch wafers: ±20 mil 100 mm wafers: ±0.50 mm 125 mm wafers: ±0.50 mm 150 mm wafers: ±0.50 mm
2. Thickness	1580 (F533)	3 inch wafers: ±25 µm 100 mm wafers: ±25 µm 125 mm wafers: ±25 µm 150 mm wafers: ±25 µm
Thickness var.	1580 (F657)	3 inch wafers: 25 µm 100 mm wafers: 50 µm 125 mm wafers: 50 µm 150 mm wafers: 50 µm
3. Warp	1580 (F657)	3 inch wafers: 40 µm 100 mm wafers: 40 µm 125 mm wafers: 60 µm 150 mm wafers: 75 µm
4. Surface roughness 3/ 4/	1600	
a. Front side		
(1) Scratches		3, length radius/2
(2) Pits		None
(3) Haze		None
(4) Contamination and particulate		3 inch wafers: 6 100 mm wafers: 10 125 mm wafers: 15 150 mm wafers: 15
(5) Contamination area		None
(6) Edge chips 5/		None
(7) Cracks, crowsfeet 5/		None
(8) Craters		None
(9) Dimples		None
(10) Grooves		None
(11) Mounds		None
(12) Orange peel		None
(13) Saw mark		None
(14) Resistivity striation		6/
b. Back side		
(1) Edge chips 5/	1600	None
(2) Cracks, crowsfeet 5/		None
(3) Contamination area		None
(4) Saw marks		None

TABLE I. Substrate measurements - Continued.

Test	MIL-STD-977 Test method (or equivalent) 2/	Max tolerance 1/
5. Crystal perfection	1550, 1560	
a. Dislocation count	(F47)	500 pits/cm^2
b. Lineage	(F80)	None
c. Slip	(F416)	None
6. Surface orientation	1530	±1°
7. Primary flat	(F671)	3 inches 0.750-1.000 inches
a. Length		100 mm 30.0-35.0 mm
		125 mm 40.0-45.0 mm
		150 mm 55.0-60.0 mm
b. Orientation	(F847)	±1°
8. Secondary flat 7/		
a. Length	(F671)	3 inches 0.380-0.500 inches
		100 mm 16.0-20.0 mm
		125 mm 25.0-30.0 mm
		150 mm 35.0-40.0 mm
b. Location		<100> n-type 180° ±5° from primary
		<111> n-type 45° ±5° CLW from primary
		<100> p-type 90° ±5° CLW from primary
		<111> p-type none
9. Conductivity type	1570 (F42)	n or p
10. Resistivity	1510 (F43, F34, F673)	In accordance with specification
Resistivity gradient	1510 (F81)	
11. Oxygen content	1550 (F120, F121)	In accordance with specification
12. Carbon content	(F120, F123)	1 ppm
13. Crystal growth method		In accordance with specification

1/ Tolerances defined within this table are to be used unless other tolerances are approved by the qualifying activity.

2/ ASTM test methods are listed in parentheses to provide a means of establishing equivalency.

3/ Performed on finished polished wafers to an AQL of 1%.

4/ All listed characteristics ≤ 2.5%.

5/ Cummulative AQL for both frontside and backside is 1%.

6/ Striations may be visible on low resistivity wafers. (≤ 0.020 ohm-cm)

7/ Secondary flat is vendor dependent.

As an alternative to the requirements of 5.3.9.1 and 5.3.9.2, data may be presented to the qualifying activity which demonstrates the stability of the metallization and contacts of actual devices from the lines to be certified under temperature and high current density stresses. The qualifying activity shall evaluate the manufacturer's test procedures and results for acceptability.

* 5.3.9.1 Effect of time and temperature. Data shall be presented to the qualifying activity for each metallization type used on the line(s) to be certified and to demonstrate the stability of contact resistance under accelerated time and temperature conditions. If more than one conductor-contact type is used (e.g., metal-polysilicon, metal-multilayer, polysilicon-silicon, etc.), data shall be presented for each conductor-contact type.

An acceptable test would consist of subjecting the conductor-contact test patterns to a storage temperature of 200° for 2000 hours. Each test pattern should contain at least 60 conductor-contacts of each type, unless otherwise specified.

Five test patterns or actual devices from each of five different deposition runs shall be used for the test. The contact resistance shall be measured before and after the temperature stress test and the data shall be recorded. The manufacturer's test plan, procedures, failure criteria, and test results shall be reviewed for acceptability by the qualifying activity.

Equivalent time and temperature tests are allowed when approved by the qualifying activity.

* 5.3.9.2 Effect of current. Data shall be presented to the qualifying activity for each conductor type and type of deposition system to be certified in order to demonstrate absence of electromigration under current and temperature accelerated test conditions.

Test patterns may be used which contain metallization crossovers, contacts, etc. These test patterns are laid out using design rules (layouts, dimensions, etc.) representative of the worst case design rules used in the production line to be certified.

Five test patterns or actual devices containing each conductor type from five different deposition runs for each metallization equipment type (E-beam, filament, etc.) on the line to be certified shall be tested and the data recorded for review by the qualifying activity. The manufacturer's test plan, procedures, failure criteria, and test results shall be reviewed for acceptability by the qualifying activity.

Equivalent time and temperature tests are allowed when approved by the qualifying activity.

* 5.3.10 Inspection by scanning electron microscope (SEM). A continuing SEM program shall be established to ensure control over metallization at oxide window edges. This program shall consist of the SEM process monitor in accordance with 5.2.17.5 except that the SEM criteria shall be in accordance with method 2018 of MIL-STD-883. SEM wafer lot acceptance data, when available, may be used instead of this monitor.

SEM photographs shall be presented demonstrating capability of meeting the requirements of method 2018, of MIL-STD-883. The angles from which the photographs were taken shall be varying and they shall be from a minimum of four lots per month manufactured over a period of at least the preceding six months. These photographs should include, as a minimum, views of the deepest oxide step covered by metallization lines. These photographs should confirm that the metallization process meets the SEM requirements of method 2018, of MIL-STD-883.

The manufacturer's SEM operator(s), who make assessments in accordance with method 2018 of MIL-STD-883, shall satisfy the following criteria: (1) demonstrate the ability to attain the required resolution as specified in paragraph 2 of method 2018, of MIL-STD-883; (2) clearly identify all defects in accordance with the documented library of defects; and (3) receive training and retraining on a yearly (minimum) basis.

* 5.3.11 Current density verification. Assumptions for thinning or narrowing shall be verified at initial qualification and upon any major change in design or process that affects worst case current density or upon the request of the qualifying activity.

5.3.12 Control of materials for assembly area. The criteria, sampling requirements, acceptable control limits, and handling which reflect the higher reliability requirements of Class S shall be identified. As a minimum, these requirements shall include:

a. Formation of special inspection lots for critical materials and for packages.

b. Sample assembly of critical items into packages and their acceptability.

* 5.3.13 Effect of time and temperature on electrical resistance and strength of bonds. Evidence shall be presented to demonstrate the mechanical and electrical integrity of the bonds with respect to such factors as: (1) flexing of bond wire due to thermal expansion; and (2) microcracks or microvoids at the wafer interface.

* 5.3.14 Die attachment. The die strength test shall be performed for both eutectic and adhesive (epoxy, metal-glass) die attach. For eutectic die attach, the die shear strength test shall be performed at the start and finish of operator change, package type change, die size change, and after every two hours of production. This die shear strength test shall be in accordance with method 2019 of MIL-STD-883. Alternatively, for adhesive die attach techniques (e.g. silverglass and epoxy), each lot or sublot die attached on a single machine and processed as a single group through final adhesive cure shall be tested to the die strength test method 2027 of MIL-STD-883 on a randomly selected sample of 0.5 percent of the lot size, or two devices, whichever is greater. In the event that the die shear is less than the value of figure 4, method 2019 of MIL-STD-883, the die attach station and process shall be closed down until tests show that satisfactory operation has been re-established. A procedure for the traceability, recovery, and disposition of all units die attached since the last successful die shear test shall be required. This procedure shall provide for sample size, reject criteria, and disposition of failed lots. This test may be conducted on the same samples used for the wire bond strength test.

* 5.3.15 Wire bond strength test. The manufacturer's wire bond strength test shall be conducted on each sample in accordance with the requirements of MIL-STD-883, method 2011, test condition D. The manufacturer shall submit the sampling plan to the qualifying activity for approval, which shall include start and completion of shifts, frequency of sampling during the shift, change of operators, spools, packages, wire size, lot size, and other related factors (e.g. bond pull testing two devices approximately every two hours of production). Pull strength data shall be read, recorded, and maintained in accordance with the specified requirements. Data shall include the force (grams) required for failure, the physical location of the point of failure, and the nature of the failure. In the event that any bond strength is less than the pre-seal value given in table I, method 2011 of MIL-STD-883, the bonder shall be inactivated immediately and not returned to production until tests show that satisfactory operation has been re-established. A procedure for the traceability, recovery, and disposition of all units bonded since the last successful bond strength test shall be required. This procedure shall provide for sample size, number of bonds and device to be tested, reject criteria, and disposition of failed lots.

* 5.3.16 Internal visual inspection. The circuits shall be visually inspected using adequate visual aids, inspection criteria, storage, and equipment. Handling and storage shall be documented in accordance with method 2010 (condition A) of MIL-STD-883.

* 5.3.17 Internal water vapor levels. Documentation from a test laboratory that has been granted suitability from DESC shall be provided at the time of the audit showing the actual internal water vapor level of devices for a package type for which qualification is desired. These devices shall have been processed and screened on the same line which is being evaluated for class S certification.

* 5.3.18 Lid torque test. For glass frit sealed packages, the manufacturer shall document the testing and sampling procedure for lid torque testing in accordance with Method 2024 of MIL-STD-883. This procedure shall be available to the qualifying activity for their review.

* 5.4 Changes from previous issue. The margins of this standard are marked with asterisks to indicate where changes (additions, 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.

CROSS INDEX OF CALIBRATION SYSTEM REQUIREMENTS (MIL-STD-45662 VS. COMPANY DOCUMENTATION)

COMPANY NAME _____

ADDRESS _____

PREPARED BY _____

TITLE _____ DATE _____

Please indicate where each program element is covered in the company documentation. If documentation does not exist because a specific program element does not apply, so state and explain. If additional space is required, us a separate sheet. (May be handscribed.)

PROGRAM ELEMENT AND MIL-STD-45662 PARAGRAPH	PLEASE LIST COMPANY DOCUMENT TITLE, NUMBER REVISION, SECTION, PARAGRAPH, PAGE, ETC. (AS APPLICABLE)
CALIBRATION	
a. Description of Calibration System	
(1) Controls for segregation of obsolete, damaged or otherwise inaccurate equipment	
(2) Controls for verification of production tooling (jigs, fixtures, etc.) when used	
(3) List of Measurement Standards (reference and transfer) DESC Form 36	
(4) Availability of system description, procedures, and calibration reports	
b. Adequacy of Standards Measurement standards established for calibration of test and measuring equipment have the capabilities for the intended use (5.2)	
(1) Accuracy	
(2) Stability	
(3) Range	
c. Environment Controls (5.3)	
(1) Environmental conditions controlled to the extent necessary to assure continued measurements of the required accuracy. Consideration given to:	
Temperature	
Humidity	
Vibration	
Cleanliness	
Other controllable factors affecting precise measurement	
(2) Controls for the application of compensating corrections to calibration results obtained in environments other than standard	
d. Calibration Intervals (5.4) Procedures provide control for:	
(1) The calibration of measuring and test equipment and measurement standards at periodic intervals	
(2) The establishment of an interval period based upon stability, purpose, and degree of usage	

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Previous Edition can be used until exhausted

Page 1 of 3

PROGRAM ELEMENT AND MIL-STD-45662 PARAGRAPH	PLEASE LIST COMPANY DOCUMENT TITLE, NUMBER, REVISION, SECTION, PARAGRAPH, PAGE, ETC (As Applicable)
(3) The adjustment of interval periods when evidenced by the results of previous calibrations	
e. Calibration Procedures (5.5)	
(1) Preparation, provision, and utilization of written procedures for the calibration of measuring and test equipment and measurement standards	
(2) Requirement for calibration to be performed by comparison with higher accuracy level standards	
(3) Utilization of published standard practices or manufacturers instructions	
(4) Surveillance or checks that procedures are being followed	
(5) Availability of procedures to calibration personnel	
f. Out of tolerance evaluators (5.6)	
(1) Evaluation of suspect products (5.6.1)	
(a) Procedures to determine impact of out of tolerance equipment on product quality	
(b) Corrective action procedure for out of tolerance equipment	
(c) Records of results of analysis and corrective action	
(d) Records are available to Government representative	
(2) Evaluation of Calibration system accuracy (5.6.2)	
(a) Procedures evaluate the calibration system based on results of generated calibration test data	
(b) Calibration system includes: Adjustment of calibration frequency, adequacy of measuring or test instrument, review of calibration procedure; Identification of unsatisfactory or inaccurate equipment	
g. Calibration Sources (5.7)[1] Procedures provide control for:	
(1) The calibration of test and measuring equipment by a source whose standards are traceable to the National Bureau of Standards	
(2) The calibration of reference standards by a capable commercial facility, a Government laboratory or the National Bureau of Standards	
(3) A report, certificate, or data sheet attesting to the data, accuracy, and conditions under which the calibration results of reference standards were obtained	
(4) The provision of reports, record cards, etc., for subordinate standards, measuring and test equipment when such information is deemed essential	
(5) Assuring that calibration sources other than the National Bureau of Standards or a Government laboratory are in fact capable of performing the required service	
(6) Producing such reports for review by the Government representative	
h. Application and Records (5.8)[1] (5.2.5(c))[2] Procedures provide control for:	
(1) Supporting records to show that established schedules and procedures are applied to maintain the accuracy of measuring and test equipment and measurement standards	
(2) An individual record of calibration for each item of measuring and test equipment and measurement standard providing calibration interval, date of certification and result of last calibration	

PROGRAM ELEMENT AND MIL-STD-45662 PARAGRAPH	PLEASE LIST COMPANY DOCUMENT TITLE, NUMBER REVISION, SECTION, PARAGRAPH, PAGE, ETC (As Applicable).
(3) Noting the report of certificate number on the individual record of these items whose accuracy is reported by calibration report or certificate	
i. Calibration status (5.9) Procedure provides control for:	
(1) The labeling or other means shall be established to assure adherence to calibration schedules. The system shall indicate the date of last calibration, by whom calibrated, and when the next calibration is due.	
(2) An identifying code to reflect the status of serviceability for those items whose size or functional characteristics prohibit the application of a label	
(3) The monitoring of recall records is assure adherence to calibration schedules	
(4) Labels, codes, or recall records indicating the applicable condition of those items which are not required to be used to their full capabilities or which require a functional check only	
j. Control of subcontractor calibration to this standard is assured by the contractor to the degree necessary to assure compliance with contractor requirements (5.10)	
k. All measuring and test equipment handling procedures provide assurance that transportation shall not adversely affect the equipment (5.11)	
l. Amendment and revisions (5.12)	
(1) The contractor may allow or authorize his subcontractor to follow the amended or revised standard subsequent to contractually effective date, where no increase in fee or price is involved	
(2) The contractor shall not be required to follow the amended or revised standard except as a change in the contract	
(3) Procedures provide for notification of the contracting officer	

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APR 81

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Baseline Sheet
JAN microcircuits

Form: DESC-EQM-42
Revision D
Date: 12 Feb 88

ATTENTION: For any given process, additional information may be required.

I. Wafer process

Revision_____ Date_____

MANUFACTURER:	
WAFER FAB LINE IDENTIFICATION:	WAFER FAB FLOWCHART NUMBER:
APPLICABLE MILITARY DETAIL SPECIFICATION(S):	

A. Process Baseline

1. FAB particle count limits (control/absolute):
   Room_____ Hood_____
2. Construction technique (ECL, NMOS, CMOS, etc.): _____
3. Substrate (include tolerances):
   a. Material:_____
   b. Crystal orientation:_____
   c. Resistivity range:_____
   d. Original thickness:_____
   e. Final thickness:_____
   f. Wafer diameter:_____
   g. N or P doped:_____
   h. Gold doping (life time): Yes_____ No_____
      MIN/MAX thickness:_____
   i. Backside metallization (for die attach) material:_____
      MIN/MAX thickness:_____

4. Substrate isolation techniques (SOS, diffused junction, implanted oxide isolation, etc.):

5. Diffusion and ION implant profiles (list sequentially):

Diffusion number or name	Diffusion purpose (junction, resistor, etc.)	Impurity source ($POCl_3$, BN, etc.)	States (e.g., liquid)	Process verification Absolute limits (e.g., V/I)	
				MIN	MAX

Implant number or name	Implant purpose (Well, resistor, etc.)	Impurity source (BF_3, PH_3, etc.)	States (e.g., gas)	Isotope identification	Process verification absolute limits (e.g., V/I)	
					MIN	MAX

6. Epi layer: Yes_____ No_____

   a. Reactor type:_____

   b. Silicon source:_____

   c. Impurity source:_____

   Epi thickness: MIN_____ MAX_____

   Epi resistivity limits: MIN_____ MAX_____

   Epi spike count: MAX_____

7. MAX CV shifts (see paragraph 5.2.6 of MIL-STD-976):

   V_{FB}_____ MAX V_{FB}_____

8. Capacitors: Yes_____ No_____

   a. Material type(s):_____

   b. Dielectric thickness: MIN_____ MAX_____

9. MOS gates:

Gate type(s) (e.g., polysilicon)	Dielectric composition	Dielectric thickness MIN	MAX

10. PROM fuses:

    a. Fuse material and composition (include tolerances):_____

    b. Fuse dimensions and tolerances:_____

    c. Resistivity range:_____

11. Passivation 1/, conduction, and glassivation 2/ system

Passivation/glassivation type: Oxide_____ Nitride_____

If oxide:

a. Impurity source:_____

b. Impurity concentration and tolerance:_____

c. Percent by weight of phosphorous concentration in glassivation:

_____

d. Process temperature: MIN_____ MAX_____

If nitride:

a. Process temperature: MIN_____ MAX_____

Level/layer number and identification 3/	Material composition (purity if applicable)	Deposition process	Final thickness	
			MIN	MAX

NOTES:

1/ Passivation is the silicon oxide, nitride or other insulating material that is grown or deposited directly on the die prior to the deposition of metal.

2/ Glassivation is the top layer(s) of transparent insulating material that covers the active circuit area including metallization, except bonding pads and beam leads.

3/ List all passivation, conduction, glassivation and any other levels deposited in the actual order deposited, level number 1 being the one closest to the substrate; use each level number only once.

B. Wafer processing location(s):

Operation	Plant or building	Address: Street, City, State

II. Assembly process (this section is required for each package type.):

Revision_____ Date_____

MANUFACTURER:	
ASSEMBLY FACILITY IDENTIFICATION:	ASSEMBLY FLOWCHART NUMBER:
JAN PACKAGES PRODUCED UNDER THIS FLOWCART:	

A. Process Baseline

1. Assembly particle count limits (control/absolute):
Room_____ Hood_____

2. Package type identification:

a. Product technologies used in this package type (CMOS, linear, etc.):_____

b. Military case outline number and configuration (per MIL-M-38510, appendix C):_____

c. Military case outline letter (per MIL-M-38510 part number):
_____

d. Manufacturer package identification number:_____

e. Nominal cavity volumn (cubic cm):_____

f. Package base cavity (mils): Width_____ Length_____

g. Lead attachment (side braze, through glass, etc.):_____
_____

h. Design glass seal area (square cm), (reference method 2024, MIL-STD-883):_____

3. Scribing/dicing (diamond, laser, saw, etc.):_____
_____

4. Die mounting

a. Eutectic mounting (if applicable)

(1) Scrub: Manual_____ Automatic_____

(2) Preform composition (%) (if applicable)_____

	MIN	MAX	Monitor point (e.g., block, package)
(3) Temperature	_____	_____	_____

b. Other mounting (e.g., glass, epoxy)_____

(1) Material type_____

(2) Composition_____

(3) Viscosity_____

(4) Specific gravity_____

(5) Mount profile_____

	Ramp up	Flat zone	Ramp down
Time			
Temperature			

5. Substrate mounting (multichip/hybrid)
(Ceramic substrate)

a. Type mounting (eutectic, glass, epoxy):_____

b. Temperature:
(Where applicable)

	MIN	MAX
Oven	_____	_____
Block	_____	_____
Package	_____	_____

c. Time (dwell/bake)

d. Preform composition (%)"_____

6. Internal wire bonding

	Type bond	Forward or reverse	Manual or automatic	Bond wire material (% composition)	Bond wire diameter
Die wire bonding					
Post wire bonding					

7. Package sealing technique

a. Sealing method and atmosphere: _____

b. Sealing material: _____ Type number: _____

Solder seal composition (%): _____

c. Sealing profile:

	Ramp up	Flat zone	Ramp down
Time			
Temperature			

8. Package materials

	Base material	Underplationg and finish plating material	Plating thickness	
			MIN	MAX
Die attach area				
Bonding posts				
Case				
Lid				
External leads		1/		
Dessicant		Cavity location:		
Substrate (multichip/hybrid)				
Other				

1/ If nickel underplating is used, indicate whether it is electrolytic or electroless: _____

If gold plate lead finish is used, indicate minimum purity (%)

_____

9. Package piece part identification

Package (cerdip, cerpack, metal cans, etc.):_____

	Drawing number	Piece part number or drawing
Lid/cap		
Base/header		
Lead frame		
Bond wire		
Die attach preform		
Lid/cap preform		
Substrate (multichip/hybrid)		
Other		

10. Marking

a. Ink manufacturer:_____

b. Ink type number and color:_____

B. Scribe, break, and assembly location(s):

Operation	Plant or building	Address: Street, City, State

III. Product baseline

Revision_____ Date_____

If sections I and II are in a controlled document and on file at DESC-EQM, then only this section is required for applications and qualification test reports.

Section I. Document number_____ Revision_____

Section II. Document number_____ Revision_____

Military P/N:	Manufacturer:
Manufacturer P/N:	Test report number:

A. Die baseline

1. Company die identification number:_____
   Revision:_____

2. Die size (Mils):_____ X (Mils)_____

3. Bond pad size (Mils):_____ X (Mils)_____
   (Minimum)

4. Calculated maximum metallization current density (A/cm^2):_____
   (Refer to paragraph 3.5.5, MIL-M-38510)

   a. Circuit location (metal mask location):_____

   b. Minimum metallization width:_____
      Thickness:_____

   c. Maximum current (mA):_____

   d. Design rule for metallization (mA/µm):_____
      (Maximum)

5. Glassivation layer integrity test required: Yes_____ No____
   (Refer to paragraph 3.5.5.4, MIL-M-38510)

B. Package baseline

1. Company package identification number:_____

2. Die attach preform size (Mils):_____ X (Mils):_____

3. Internal lead wire calculation (this calculation is required only if a lead wire's maximum operating current exceeds 480 mA)

   a. Lead number:_____

   b. Operating maximum lead wire current (amps):_____

   c. Maximum bond-to-bond wire length (Mils):_____

   d. Wire size (Mils):_____

   e. Calculated maximum lead wire current allowed (amps):____
      (Refer to paragraph 3.5.5.3, MIL-M-38510)

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

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:
NASA - NA

Agent:
DLA - ES

(Project 5962-1048)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988 — 548-063/60112

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-976B	CERTIFICATION REQUIREMENTS FOR JAN MICROCIRCUIT

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)