



Langley Research Center

LPR 5320.1 A-1

Effective Date: November 18, 2014

Revised: August 14, 2015

Expiration Date: October 31, 2019

NASA LaRC Counterfeit Electrical, Electronic, and Electromechanical (EEE) Parts Plan

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RESPONSIBLE OFFICE: Safety and Mission Assurance Office

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PREFACE

P.1 Purpose

- a. This National Aeronautics and Space Administration (NASA) Langley Research Center (LaRC) Procedural Requirement (LPR) provides uniform requirements, practices, and methods to mitigate the risks of receiving and installing counterfeit Electrical, Electronic, and Electromechanical (EEE) parts in flight products developed at NASA LaRC and by its contractors as delineated in their contracts and grants.
- b. This NASA LaRC Counterfeit EEE Parts Plan provides structure and guidance to:
 - 1) Maximize availability of authentic EEE parts.
 - 2) Procure EEE parts from reliable sources.
 - 3) Ensure authenticity and conformance of procured EEE parts.
 - 4) Control EEE parts identified as counterfeit.
 - 5) Report counterfeit EEE parts to other potential users and Government investigative authorities.

P.2 Applicability

- a. This plan is applicable to NASA LaRC in its development of all flight products for space flight hardware, critical ground support equipment (GSE), and critical ground test systems used in Category 1 and Category 2 projects as defined by NPR 7120.5, NASA Space Flight Program and Project Management Requirements, and/or Class A, B, or C payloads as defined by NPR 8705.4, Risk Classification for NASA Payloads, Appendix A or other flight projects as determined in the Product Assurance Plan or Product EEE Parts Plan.
- b. The requirements of this plan apply to all NASA LaRC contracting organizations, to the extent delineated in their contracts or grants that procure EEE parts, whether such parts are procured directly or integrated into EEE assemblies or equipment.
- c. The requirements of this LPR/Plan apply to each NASA LaRC organization's procurement of EEE parts as specified in P.2.a, regardless of type, size, and flight product provided.
- d. As specified in this LPR/Plan, each applied flight project that entails the use of EEE parts shall have an assigned EEE parts engineer who shall develop and implement a project specific EEE parts plan per LMS-CP-5515 that complies with the requirements of this LPR/Plan.

P.3 Authority

The Counterfeit EEE Parts Plan authority is derived from NPD 8730.2C, NASA Parts Policy requirement and the authorities cited within. It states that the Program, Project, and Government Furnished Equipment (GFE) managers shall develop, document, and implement a counterfeit EEE parts control plan for the avoidance, detection, mitigation, disposition, control, and reporting of counterfeit EEE parts.

- a. The EEE control plans may be unique to a single project or apply to multiple Center projects.
- b. This Counterfeit EEE Parts Plan satisfies this requirement for all Center flight projects.

P.4 Applicable Documents

- a. NASA Policy Directive (NPD) 8730.2, "NASA Parts Policy"
- b. NASA Procedural Requirements (NPR) 8735.1, "Procedures for Exchanging Parts, Materials, Software, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program (GIDEP) and NASA Advisories"
- c. Langley Management System (LMS) Center Procedure (CP) 5507, "Reporting and Disposition of Nonconforming Aerospace Hardware Items and Products"
- d. Military Performance Specifications (MIL-PRF) -19500, "General Specification for Semiconductor Devices"
- e. MIL-PRF-38535, "General Specification for Integrated Circuits (Microcircuits) Manufacturing"
- f. Military Standard (MIL-STD) -202, "Test Method for Electronic and Electrical Component Parts"
- g. MIL-STD-750, "Test Methods for Semiconductor Devices"
- h. MIL-STD-883, "Test Method Standard Microcircuits"
- i. MIL-STD-1580, "Destructive Physical Analysis for Electronic, Electromagnetic, and Electromechanical Parts"
- j. Aerospace Recommended Practice (ARP) 9009, "Aerospace Contract Clauses"
- k. Aerospace Standard (AS) 5553, "Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition"

- l. AS9003, "Inspection and Test Quality System"
- m. AS9100C, "Quality Management Systems - Requirements for Aviation, Space and Defense Organizations"
- n. AS9120, "Quality Management Systems, Aerospace Requirements for Stock list Distributors"
- o. International Electrotechnical Commission (IEC) TS 62239, "Process Management for Avionics – Preparation of an Electronic Components Management Plan"
- p. Electronic Industries Alliance (EIA)-4899, "Standard for Preparing an Electronic Components Management Plan"
- q. Government Electronics and Information Technology Association (GEIA)-GEB1, "Diminishing Manufacturing Sources and Material Shortages (DMSMS) Management Practices"
- r. Joint Electron Device Engineering Council (JEDEC)-JESD31, "General Requirements for Distributors of Commercial and Military Semiconductor Devices"
- s. Independent Distributors of Electronics Association (IDEA)-STD-1010, "Acceptability of Electronic Components Distributed in the Open Market"
- t. International Organization for Standardization, (ISO) 9000, "Quality Management Systems – Fundamentals and Vocabulary"
- u. ISO 9001, "Quality Management Systems – Requirements"
- v. Standards Document (SD)-22, "Department of Defense (DOD) Diminishing Manufacturing Sources and Material Shortages (DMSMS) Guidebook"

P.5 Measurement/Verification

Compliance with this LPR will be tracked by product assurance plans.

P.6 Cancellation

None.

Original signed on file

Virginia C. Wycoff
Associate Director

Chapter 1

1. Requirements

1.1 Counterfeit Electrical, Electronic, and Electromechanical (EEE) Parts Control Plan

The NASA LaRC counterfeit EEE parts control plan documents the process used for selection (use, availability and source), risk assessment and mitigation, purchasing, verification (including testing), disposition, control, and reporting of counterfeit EEE parts. The risk-based process flow is presented in the Figure 1 below. Counterfeit EEE part control is an element of every NASA LaRC project EEE Parts Control Plan and shall be documented in each plan by the assigned project EEE parts engineer. Original Component Manufacturers (OCM) are the preferred source for EEE part procurement.

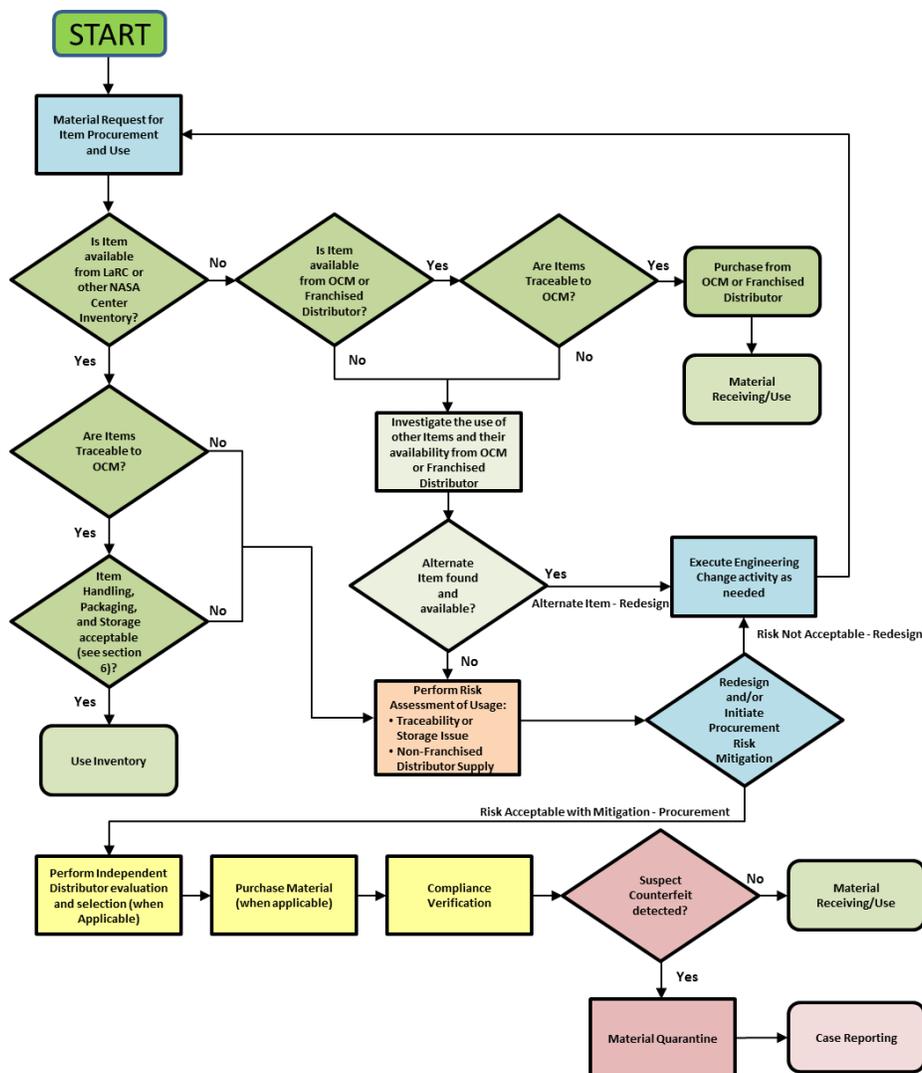


Figure 1-1: Acquisition Risk Assessment Process

Chapter 2

2. Parts Availability

The NASA LaRC Counterfeit EEE Parts Plan maximizes use and availability of authentic, originally designed, and/or qualified parts throughout the product's life cycle, including management of EEE parts obsolescence.

2.1 Design, Proposal, and Program Planning

2.1.1 During design, proposal, and program planning efforts, organizations shall assess the long-term availability of authentic EEE parts and part sources for production and support of systems.

2.1.2 When assessments indicate availability risks, exposure to counterfeit EEE parts shall be reduced by considering the following:

- a. Lifetime buy.
- b. System redesign.
- c. Alternate/multiple sources.
- d. Substitutions.
- e. Planning for adequate procurement lead times.

2.2 Obsolescence Management

2.2.1 Obsolescence can increase the risk of acquiring counterfeit EEE parts. To reduce the likelihood of purchasing counterfeit EEE parts, projects shall proactively manage the life cycle of their products through the use of DMSMS information and processes.

2.2.2 The following Government and Industry sources provide guidance with regard to managing DMSMS:

- a. NPR 8735.2, "Procedures for Exchanging Parts, Materials, Software, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program (GIDEP) and NASA Advisories" (Local Center Representative or www.hq.nasa.gov/office/codeq/GIDEP/).
- b. SD-22, "Department of Defense (DOD) Diminishing Manufacturing Sources and Material Shortages (DMSMS) Guidebook" (http://www.dmea.osd.mil/docs/sd22dmsms_Guidebook.pdf).

- c. GEIA GEB1, “Diminishing Manufacturing Sources and Material Shortages (DMSMS) Management Practices.”
- d. Government Electronics and Information Technology Association.
- e. EIA-4899, “Standard for Preparing an Electronic Components Management Plan.”
- f. IEC TS 62239, “Process Management for Avionics – Preparation of an Electronic Components Management Plan.”

Chapter 3

3. Purchasing

Counterfeit EEE Parts avoidance requires a purchasing effort specifying contract/purchase order quality requirements to minimize the risk of being provided counterfeit EEE parts. The activity, program or project requiring the procurement shall adhere to the following requirements:

3.1 Assessment of Suppliers

3.1.1 Project engineers shall assess potential sources of supply (including EEE parts, assembly, and equipment suppliers) to determine the risk of receiving counterfeit EEE parts.

3.1.2 Assessment actions may include surveys, audits, review of product alerts (e.g., GIDEP, Electronic Resellers Association International (ERAI)), and review of supplier quality data to determine past performance.

3.1.3 Supplier approval and source selection considerations shall include:

- a. NASA LaRC's/NASA's/Other Government Agencies historical experience with the source.
- b. Previously documented problems noted by external sources (e.g., GIDEP, ERAI, IDEA-STD-1010, EEE Parts).
- c. How long the source has been in business.
- d. Source's demonstrated adherence and/or certification to higher-level quality standards, such as the following:
 - (1) Assembly/equipment/system providers: AS9100
 - (2) Original Component Manufacturers (OCMs), aftermarket manufacturers: AS9100, ISO 9001, AS9003
 - (3) Distributors: AS9120
 - (4) Test facilities: ISO 9001
- e. The source's demonstrated adherence to applicable provisions of AS5553.
- f. Results of audits previously performed in a manner consistent with the following guidance:
 - (1) Audits demonstrating that the supplier's quality management system incorporates adequate documented processes to prevent the purchase, acceptance, use, and delivery of counterfeit parts should be performed

before purchasing product, and periodically thereafter (note: typical audit certifications apply to specific facilities, so multiple sites may require multiple audits). These audits should occur at intervals sufficient to determine that the supplier's quality management system incorporates a program compliant with AS5553 (for equipment/system providers, where invoked), and/or other invoked contract requirements related to counterfeit parts risk mitigation. Audits may be performed by a qualified independent third party.

- (2) Using the results of audits performed by other private sector or Government organizations is an acceptable alternative to second- or third-party auditing, provided the auditing process, attributes, and auditor qualifications are evaluated and deemed adequate to ensure compliance with this document and/or other invoked requirements.
 - (3) Audit scope and frequency shall be commensurate with the assessed risk of the source. Audit requirements may range from completion of a survey assessment of the source's processes and controls (procurement, quality, handling, test, etc.), to a full facility audit of these processes.
- g. Documented purchasing and product acceptance processes and practices for verifying the authenticity of Parts supplied.
- h. Use of outsourced or in-house laboratory testing.
- i. Use of quality inspectors who have been trained and qualified concerning types and means of electronic parts counterfeiting and how to conduct effective product authentication.
- j. Membership in associations with rigorous business, ethical, and quality standards intended to avoid acquiring and reselling counterfeit goods (e.g., IDEA).
- k. Terms of the supplier warranty, return policy and product liability.
- l. OCM franchise agreement provisions as specified in section 3.3.2.

3.2. Approved Supplier List

The NASA LaRC Office of Procurement shall maintain a register of approved suppliers, including the scope of the approval, to minimize the risk of counterfeit parts supply while maintaining purchasing efficiency.

3.3. Integrity Assurance

3.3.1 The NASA LaRC Engineering Directorate shall specify a preference to procure directly from OCMs or authorized suppliers who are on the approved supplier register.

3.3.1.1 Electronic parts shall be purchased, whenever possible, directly from OCMs or from authorized suppliers.

3.3.1.2 Independent distributors shall be used only after consideration of alternate parts, redesign, schedule adjustments, and a reasonable search for material from franchised/authorized sources has been conducted and approval has been obtained from the EEE parts engineer.

3.3.2 The NASA Engineering Directorate shall be cognizant that OCM franchise agreements (see section 3.1.3) typically include provisions that protect the user by ensuring product integrity and traceability, such as:

- a. Original manufacturer warranty.
- b. Proper handling, storage, and shipping procedures.
- c. Failure analysis and corrective action support.
- d. Certificates of conformance and acquisition traceability.

Note: Independent distributors have no warranty or product support agreements with the OCM, and therefore have limited means to ensure product integrity and traceability.

3.3.3 The NASA LaRC Engineering Directorate shall require Broker distributors to adhere to the following requirements:

- a. Act only as scouting agencies for hard-to-find parts, and not maintain quality-assured inventories.
- b. Ensure that independent distributors have established documented processes and the financial means to support any contractual guarantees expected.

(1) Purchase agreements shall include product certifications and contractual remedies such as financial penalties if inaccuracies are found.

- c. Investigate independent distributors through reporting sources such as GIDEP and ERAI in advance of procurement activity to ensure suspect counterfeiting incidents have not occurred.

Note: An industry standard that can be used to help evaluate the suitability of an independent distributor is JEDEC Standard JESD31, General Requirements for Distributors of Commercial and Military Semiconductor Devices. JESD31 includes a number of provisions that protect the user by ensuring product integrity and traceability.

3.3.4 The cost of product inspections, tests, and supplier assurance actions (e.g., audits/surveys) shall be factored into a determination of total procurement costs in order to fully evaluate and compare costs to be incurred by offerer proposals.

3.4 Source Diligence

The EEE parts engineer shall assure that approved/ongoing sources of supply are maintaining effective processes for mitigating the risks of supplying counterfeit electronic parts. Assurance actions may include surveys, audits, review of product alerts, and review of supplier quality data to determine past performance.

3.5 Procurement Risks

3.5.1 The EEE parts engineer shall assess and mitigate risks of procuring counterfeit parts from sources other than OCMs or authorized suppliers.

3.5.1.1 The assigned project EEE parts engineer shall document the assessment and mitigation of risks for every application when it is necessary to procure from other than the OCM or an authorized supplier.

3.5.1.2 Risk shall be assessed from lowest to highest, using Table 3-1 as a guideline.

LOWEST COUNTERFEIT RISK and GREATEST CONFIDENCE in AUTHENTICITY		
CONFIDENCE IN AUTHENTICITY THROUGH SOURCE OF SUPPLY	VERIFY PEDIGREE FROM ALL SOURCE S	PRODUCT AND APPLICATION
<ul style="list-style-type: none"> Original Component Manufacturer or Certified Manufacturer 		<ul style="list-style-type: none"> Non-Critical Applications
<ul style="list-style-type: none"> Franchised Distributor 		<ul style="list-style-type: none"> Short Product Life
<ul style="list-style-type: none"> Original Equipment Manufacturer / Contract Manufacturer 		<ul style="list-style-type: none"> Product Accessible in Field
<ul style="list-style-type: none"> Independent Distributor with good quality, reputation, and procedures 		<ul style="list-style-type: none"> Application Critical
<ul style="list-style-type: none"> Independent Distributor with unknown quality, reputation, and procedures 		<ul style="list-style-type: none"> Refurbished or Reclaimed Parts
<ul style="list-style-type: none"> Unknown Source 		<ul style="list-style-type: none"> ERAI & GIDEP Alert on Items
<ul style="list-style-type: none"> ERAI & GIDEP Advisories / Alerts issued on Vendor or Vendor Debarred 		<ul style="list-style-type: none"> Field work or repair impossible (i.e., Satellites, etc.)
		<ul style="list-style-type: none"> Mission Critical
	<ul style="list-style-type: none"> Safety Critical 	
	<ul style="list-style-type: none"> Life Dependent Applications 	
HIGHEST COUNTERFEIT RISK and LOWEST CONFIDENCE in AUTHENTICITY		

Table 3-1: Risk Hierarchy

3.5.1.3 Franchised distributors shall provide products acquired through franchise agreements with OCMs. When a distributor does not provide products in this manner, then for the purpose of this document, the distributor is considered an independent distributor for those products.

3.5.1.4 Procurement assurance processes for avoiding counterfeit EEE product shall begin upon requirements determination.

3.5.2 The extent of these processes shall be commensurate with risks related to the source of supply and product criticality. Table 4-1 depicts overall supplier risk as a function of supplier reliability and product criticality. Table 4-2 identifies factors for assessing and mitigating supplier risk.

3.5.2.1 Key Supplier Risk Assessment Factors :

- a. Customer audited and approved with site visit
- b. Recently audited and approved by third-party accreditation
- c. AS-9100 / AS-9120 Certification
- d. ISO 9001 Certification
- e. ANSI ESD S20.20 Certification
- f. Recognized quality management system established
- g. Established track record and quality recognition
- h. Sustained level of business maturity

3.6 Supply Chain Traceability

3.6.1 Engineering shall require supply chain traceability from the OCM or aftermarket manufacturer that identifies the name and location of all supply chain intermediaries from the part manufacturer to the direct source of the product for the seller.

3.6.1.1 OCMs and distributors (franchised and independent) shall provide certificates of conformance and acquisition traceability; otherwise the purchaser assumes unknown risks.

Note: such documentation has the potential to be forged or falsified.

3.6.1.2 Acquisition traceability consists of the name and location of all supply chain intermediaries from the part manufacturer to the direct source of the product.

3.6.1.3 The requiring organization shall ensure that these requirements are clearly stated as deliverable data within the procurement documents, regardless of which level of the supply chain provides the parts.

3.6.1.4 Upon receipt of delivery of EEE product, the activity or project engineers shall review and assess received deliverables for proper traceability and documentation.

3.6.1.5 If traceability is unknown or documentation is suspect, engineers shall perform a documented risk assessment as specified in sections 4.1 and 4.2.

3.6.1.6 The assessing engineer shall coordinate with the Center Acquisition Integrity Coordinator in the Office of Chief Council.

3.6.1.7 MIL-PRF-38535, General Specification for Integrated Circuits (Microcircuits) Manufacturing, includes requirements for certification of conformance and acquisition traceability provided by the original manufacturer and the manufacturer's franchised distributors. The certificate shall include the following information:

a. Manufacturer documentation:

- (1) Manufacturer's name and address
- (2) Customers or distributor's name and address
- (3) Device type
- (4) Date code and latest re-inspection date, if applicable
- (5) Quantity of devices in shipment from manufacturer
- (6) Statement certifying QML microcircuit conformance and traceability
- (7) Solderability re-inspection date, if applicable
- (8) Signature and date of transaction
- (9) Statement indicating that alternate die/fab requirements are being used ("QD" certification mark) when applicable

b. Distributor documentation for each distributor:

- (1) Distributor's name and address
- (2) Customer's name and address
- (3) Quantity of devices in shipment
- (4) Latest re-inspection date, if applicable
- (5) Certification that this shipment is a part of the shipment covered by the manufacturer's documentation
- (6) Solderability re-inspection date, if applicable
- (7) Signature and date of transaction

Note: Similar requirements are included in MIL-PRF-19500, General Specification for Semiconductor Devices. There is a distinction regarding the level of documentation to be supplied when buying parts manufactured to U.S.

military standards and aerospace specifications versus parts made to commercial or industrial standards.

3.6.1.8 To assure supply chain traceability when parts are purchased through franchised distribution, the documentation in the following paragraphs shall be required.

3.6.1.8.1 For procurement of a product for commercial or industrial use, a product delivered by the manufacturer to the franchised distributor is not normally required to contain a formal certificate of conformance. In such cases, the accompanying documentation is a commercially acceptable packing list. This document normally identifies the manufacturer, the distributor to whom the parts were supplied, distributor purchase order number, part number, and quantity. Additional information, such as date code or statement of compliance, may be provided but is not normally required. This document is maintained on file by the distributor and not supplied to the end customer. Shipments of commercial and industrial parts are typically accompanied by a distributor packing list and/or certificate of conformance. Purchase orders shall require that material purchased through franchised distribution be acquired directly from OCMs or authorized suppliers.

3.6.1.8.2 For procurement of product for military or U.S. Government use, a manufacturer certification to a specified military or aerospace specification or standard is required. This documentation shall contain the following information at a minimum for each quantity supplied:

- a. Manufacturer
- b. Distributor
- c. Distributor purchase order number
- d. Part number
- e. Quantity
- f. Date code
- g. Additional information, as required by governing specifications, may also be provided

3.6.1.8.2.1 A copy of this document shall:

- a. Accompany shipment of parts to the end customer.
- b. Be accompanied by a certificate of conformance showing proper supply chain traceability for parts procured through franchised distributors.

3.6.1.8.3 While it is prudent to request independent distributors to provide these certificates of conformance and acquisition traceability, independent distributors often lack this documentation. Traceability to the OCM may not have been maintained, may have been lost, or may be unavailable. An independent distributor's inability to provide certificates of conformance and acquisition traceability does not indicate wrongdoing or noncompliance; however, in these circumstances the procuring organization assumes unknown levels of risk regarding product authenticity and shall take appropriate risk mitigation actions.

3.6.1.8.4 Examples of procurement clauses requiring certificates of conformance and supply chain traceability (e.g., Certificate of Conformance, Certificate of Conformance and Traceability, Guarantee of Product Sources, tests and inspections, Quality Management System, Acceptance of Financial Responsibility, Length of Obligation, and Penalties associated with fraud) are provided in Aerospace Standard AS5553, Appendix D.

3.7 Requirement Flow Down

The assigned project EEE parts engineer shall specify flow down of applicable requirements of this document for inclusion within contracts and sub-contracts. In the event that one or more supply chain intermediaries lack a counterfeit part control plan compliant to this document, the project EEE parts engineer shall perform a risk analysis for each application of the EEE part.

Chapter 4

4. Verification of Purchased Product

The verification processes employed by quality assurance, inspection personnel, and the assigned project EEE parts engineer shall assure detection of counterfeit EEE parts prior to formal product acceptance by applying verification rigor commensurate with product risk.

4.1 Determination of Risk

Risk shall be determined by the criticality of the EEE part and the assessed likelihood of receiving a counterfeit part using Table 4-1, below.

Total Risk Assessment $R_T = R_P * R_C * R_S$ Where: total risk (R _T) score will be calculated using the following parameters: product risk (R _P), component risk (R _C), and supplier risk (R _S). Critical: RT ≥ 200 High: 130 ≤ RT < 200 Medium: 75 ≤ RT < 130 Low: RT < 75		Supplier Risk - Non-Franchised Distributor (see notes 1/ and 2/)			
		Low (R _S =4)	Moderate/Low (R _S =6)	Moderate/High (R _S =10)	High (R _S =14)
		Used successfully in the last 6 months by purchasing and has been audited by NASA within the last year. The following additional criteria will also be met: a. No part-corrective actions within the last 24 months. b. No GIDEP/ERAI alerts issued in the last 24 months. c. No quality notices related to suspect counterfeit parts (see note).	Used successfully in the last 12 months by purchasing and AS9120 certified. The following criteria will also be met: a. No part-corrective actions within the last 12 months. b. No GIDEP/ERAI alerts issued in the last 24 months. c. No quality notices related to suspect counterfeit parts (see note).	Used successfully in the last 24 months by purchasing. The following additional criteria will also be met: a. They are AS9120 certified. b. No suspect counterfeit part corrective actions within the last 24 months. c. No GIDEP/ERAI alerts issued in the last 24 months. d. No quality notices related to suspect counterfeit parts (see note).	No or minimal previous experience using, or has not been used by purchasing, or is not AS9120 certified. The following additional criteria will also be met: a. No suspect counterfeit part corrective actions within the last 12 months, or b. No GIDEP or ERAI alerts within the last 24 months, or c. No quality notices related to suspect counterfeit parts (see note).
Product and Component Risk	Catastrophic Failure (R_P=R_C=7) A failure of the component may result in death.	Critical	Critical	Critical	Critical
	Critical Failure (R_P=R_C=5) A failure of the component may cause severe injury, major property damage, and/or loss of the product's function.	Medium	High	Critical	Critical
	Marginal Failure (R_P=R_C=3) A failure of the component may cause minor injury, minor property damage, or minor product damage which will result in delay or loss of availability or degraded operation.	Low	Low	Medium	Medium
	Minor Failure (R_P=R_C=2) A failure of the component is not serious enough to cause injury, property damage, or system damage but will result in unscheduled maintenance or repair.	Low	Low	Low	Low
1/ Define the risk level for the supplier based on past experience 2/ This includes no defects in the Procurement Tracking Data System.					

Table 4-1: Total Risk

4.2 Risk Mitigation Testing

Total Risk, developed using product, component, and supplier risk, drives the verification action process based on categorization of the risk (i.e., Low, Medium, High, or Critical).

4.2.1 Verification actions for passive and active components shall include:

- a. Review of data deliverables
- b. Visual inspection
- c. Measurements
- d. Non-destructive evaluation
- e. Destructive testing (e.g., marking permanency, x-ray, destructive physical analysis, thermal cycling, hermeticity, and burn-in)

Note: Examples of active devices include but are not limited to monolithic microcircuits, hybrid microcircuits, semiconductor devices, solid state relays, and crystal oscillators. Examples of passive devices include but are not limited to capacitors, circuit breakers, crystals, passive filters, fuses, inductors/coils, passive networks, relays, resistors, thermistors, transformers, and connectors.

4.2.2 Guidelines concerning the performance of risk-based product assurance are provided in Table 4-2. All testing shall be performed on components identified as critical. Testing is defined in Appendix C.

Steps	Tests	Active Devices Risk Mitigation Flow				Passive Devices Risk Mitigation Flow			
		Critical Risk	High Risk	Medium Risk	Low Risk	Critical Risk	High Risk	Medium Risk	Low Risk
1	Data Review and Verification	Y (LOT)	Y	Y	Y	Y	Y	Y	Y
2	External Visual Inspection	Y	Y	Y	Y	Y	Y	Y	Y
3	Remarking test (resistance to solvents)	Y	Y	Y	Y	Y	Y	Y	Y
4	Radiography	Y	Y	Y	Y	Y	Y	Y	Y
5	Lead Finish Evaluation	Y	Y	Y	Y	Y	Y	Y	Y
6	Resurfacing test (acetone, 1-Methyl 2-Pyrrolidinone, Dynasolve 750)	Y	Y	Y	Y	Y	Y	Y	Y
7	Resurfacing (Mechanical tests)	This test is necessary only if the chemical test methods failed or if deemed necessary.							
8	Temperature Cycling Seal Test	Y	-	-	-	Y	-	-	-
9	Key Parametric Electrical Tests (i.e., Group A) at 25°C (read and record)	Y	Y	Y	Y	Y	Y	Y	Y
10	Full Functional over Temp	N/A	N/A	N/A	N/A	Y	Y	-	-
11	Pre-Electricals at 25°C (read and record) Burn-In Post-Electricals with Delta Limits	Y	Y	-	-	Y	-	-	-
12	Key Parametric Electrical Tests (i.e., Group A) at Temperature (min and max operating temperature) (read and record)	Y	Y	Y	-	Y	Y	Y	-
13	Destructive Physical Analysis	Y	Y	Y	-	Y	Y	Y	-
14	Additional Tests	The responsible Project-assigned engineers (i.e., design, parts, etc...) will review the need for additional tests based upon risk, samples per lot, and findings from tests listed herein.							

Key:
 Y- Yes the test is performed, **green** means low chance of sample damage, **yellow** means possible chance of sample damage, **red** means sample is damaged
 N/A - Test not-applicable;

*NASA LaRC Evaluation of in-house vs outsource testing: **Green Text** indicates in-house capability, **Blue Text** indicates equipment needs to be purchased to achieve in-house capability, **Red Text** Indicated outsource, and **Black** indicates – depends upon additional testing type (evaluated later).

Table 4-2: Risk Mitigation Tests

4.3 Training

4.3.1 All personnel performing an inspection or test procedure shall be trained in, and familiar with, that part of the operation relevant to their function.

4.3.2 Personnel, including incoming inspection and quality control, Office of Procurement, and Center Acquisition Integrity Coordinator shall be trained regarding the avoidance and detection of counterfeit EEE parts. Counterfeit EEE Parts Avoidance training is available from The Defense Acquisition University (<http://www.dau.mil>), course CLL032, and from Jet Propulsion Laboratory (JPL), a Federally Funded Research and Development Center.

4.3.3 Personnel conducting tests and examinations at the testing shall be trained in the use of specialized equipment.

4.3.4 Personnel coming in direct contact with ESD-sensitive parts shall be trained and certified for handling of ESD-sensitive parts.

4.3.5 Some additional inspection and test requirements may be performed by an outside test laboratory.

Chapter 5

5. In-Process Nonconformance Investigation

5.1 Determining Conformance/Non-conformance

5.1.1 After observation and documentation of a discrepancy, the project engineer shall perform an assessment/analysis in accordance with LMS-CP-5507, "Reporting and Disposition of Nonconforming Aerospace Hardware Items and Products," to determine if it is due to nonconformance of item or product being inspected or tested or some "other cause,"(e.g., operator or procedural error or misinterpretation).

5.1.2 Segregation of the nonconforming item shall be performed in accordance with LMS-CP-5507, "Reporting and Disposition of Nonconforming Aerospace Hardware Items and Products."

5.1.3 When a nonconforming item is suspected counterfeit, further analysis shall be performed to verify that it is suspect counterfeit.

5.1.4 In all cases, including "other causes," analysis shall include the consideration of part or product damage or stress from propagated failure or abnormal conditions.

5.1.5 When identification of a suspect counterfeit part occurs after hardware acceptance and/or while in-service, an assessment based on risk shall be performed by the project engineer as stated in sections 4.1 and 4.2 and reported on per section 7. This assessment guides management on how to proceed with controls or actions to remove the suspect item.

Chapter 6

6. Material Control

NASA LaRC has center processes for both bonded stores (LMS-CP-4892) and controlled stores (LMS-CP-5514). The processes cover the receiving of parts from engineering for storage, inspecting for acceptance and use, and logging out parts for use. In either case, if it is determined that a nonconforming (e.g., suspect counterfeit EEE part) part has been identified, the segregation of the nonconforming item shall be performed in accordance with LMS-CP-5507, "Reporting and Disposition of Nonconforming Aerospace Hardware Items and Products." In addition, the requirements in section 5 shall be followed.

The LMS-OP-5515, "*EEE Parts Assurance*," outlines the process for developing a EEE Parts Plan. It addresses electrostatic discharge (ESD) sensitive items protection including packaging and shipping in a project-approved electrostatic discharge protective material and marking as ESD sensitive. Shipping, marking, and handling requirements, CP-4756, "*Handling, Preservation, Storage, and Shipping of Space Flight Hardware*," also addressed in the EEE Parts Plan.

Product assurance plans developed specifically for activities' and projects shall contain specific requirements for storage and operating requirements (e.g., contamination, temperature, humidity, and radiation exposure).

Chapter 7

7. Reporting to Others

All occurrences of suspect counterfeit EEE parts shall be reported by anyone at NASA LaRC who has evidence of a counterfeit EEE part, as appropriate, to internal organizations, customers, government reporting organizations (e.g., GIDEP), industry-supported reporting programs (e.g., ERAI), and criminal investigative authorities (e.g., OIG), and Center Acquisition Integrity Coordinator.

Chapter 8

8. Inspection and Reporting

The EEE parts engineer shall establish a receipt inspection process for the activity or project as part of the EEE Parts Plan. The following receiving inspection plan and reporting requirements (Tables 8-1 and 8-2) are performed during the Center receipt inspection process by project personnel (e.g., assigned project personnel or EEE parts engineer). They are used for documenting inspections as part of the counterfeit EEE part mitigation process. As a minimum, the visual inspections shall be performed as applicable or as defined in the EEE Parts Plan (e.g., instances where OCMs are not used shall implement more diligent inspections based on the risk defined in sections 3 and 4).

Receiving Inspection Plan (RIP): RIP-1000 Additional Inspections for Counterfeit Parts Prevention			
1.0	Scope:		
1.1	This document is NOT a standalone document.		
1.2	This document is to be used in addition to the applicable RIP to invoke additional inspections for the detection of counterfeit parts.		
Step#	Inspection Steps	Reference Criteria	STAMP
		IDEA STD- 1010A/ AS5553	
2.1	Packaging	A.3	
	General		
	<ul style="list-style-type: none"> Inspect shipping boxes for authenticity and possible prior use. Inspect parts packaging for any evidence of tampering and/or seals are intact Lot and/or date codes on the packaging do not match the Lot and/or date codes on the parts. Manufacturer's logo or label is absent, or does not match that shown on their website or on previous shipments. Poor use of English, misspelled words, alterations, or changes to the documentation. Bar coding does not match the printed part number. Verify that part packaging complies with applicable ESD and humidity control requirements. 	E.1.1.a E.1.1.b E.1.1.c E.1.1.d	
	Trays/Chip Carrier:		
	<ul style="list-style-type: none"> Verify labeling information matches with supplier documentation (e.g. part number, single date code/Lot number, quantity). Verify carrier is not damaged. Verify carrier matches lid (e.g. discoloration differences, over or undersized lid compared to carrier). 	E.1.1.h	
	Reels:		
	<ul style="list-style-type: none"> Verify that tape is consistent and appropriate in type and color and conforms to the norm for the manufacturer (including "single" Lot Date Code per reel). Inspect for missing parts within the tape. Verify that parts are facing the same direction within the carrier tape. 	E.1.1.h E.1.1.n	
	Packaging-Tubes:		
	<ul style="list-style-type: none"> Verify parts are facing the same direction inside the tubes. Verify that tube size and configuration is appropriate for the part. 		
2.2	Part Traceability:		
	<ul style="list-style-type: none"> Inspect for inconsistencies in date code(s)/lot code(s) (i.e. dates that are not possible, mixed date codes within a shipment, etc.). Inspect for multiple countries of origin with the same Lot code. Inspect labels (parts and packaging material), for authenticity of logos and manufacturing markings. 	E.1.1.h	
2.3	Visual Inspection:	A.4	
	<ul style="list-style-type: none"> Determine sample size, per Verify Supplier Quality Requirements Process No 2.1.3. Verify the following: <ol style="list-style-type: none"> Proper pin arrangement and pin count Inspect part markings to verify they match information on the datasheet or C of C Inspect date code(s)/lot code(s) marked on parts for inconsistencies (i.e. dates that are not possible) Inspect part markings for multiple countries of origin with the same lot code Inspect part markings for authenticity of logos and manufacturing markings Inspect part markings for inconsistencies in font style, thickness, print color, and marking/identification placement Inspect part markings that are smeared, illegible, or poor quality in general Verify that markings on top of the parts are consistent with bottom markings as applicable Inspect leads for possible prior use – bend and co-planarity outside allowable limits, oxidized or contaminated, tinning or solder, consistency of gloss/shine, color and texture Inspect for signs of previous programming (i.e. colored dots or ink marks) Inspect the surfaces of the parts for evidence of re-surfacing (for example: terminal finish, blacktopping, directional scratches, indents that are no longer clean and flat, chipouts, rough surface texture on normally smooth Pin 1 indicator area) or traces of glue or adhesive Inspect for stickers, underlying etching on the part's casing or any evidence of re-identification Inspect for cracks on the surface of the parts and suspect laser burn marks Inspect surface of parts for burn marks indicating exposure to excessive heat Inspect for evidence of tool / pull marks or heat-sink witness markings indicating prior use Inspect for color or shading discrepancies on the top vs. bottom of part 	E.1.1.e E.1.2.i&m E.1.2.k E.1.2.l E.1.1.l E.1.2.c E.1.2.b E.1.1.d, e, f, j, &o E.1.2.g E.1.2.g E.1.2.a	

Table 8-1: RIP-1000, Additional Inspections for Counterfeit Parts Prevention

Receiving Inspection Plan (RIP): RIP-0014 Integrated Circuits			
Step #	Inspection Steps	Reference Criteria	STAMP
1.0	Prepare for Receiving Inspection:		
1.1	Obtain supporting documents to perform part verification and traceability. Documents may include Contract/Purchase Order (PO), drawings or statements of work, vendor supplied documents.		
1.2	The Contract/PO dictates the revision of all supporting documents. If the Contract/Purchase Order does not indicate a revision, use the latest revision at the time the PO was placed.		
2.1	Environmental Review:	ESD Control, D-1348	
	<ul style="list-style-type: none"> Verify room temperature is within 70 F ± 2 degrees. Verify relative room humidity is between 30% thru 70%. 		
	Electrostatic Discharge (ESD) Review:		
	<ul style="list-style-type: none"> Verify that workstation ESD certification is current and ESD precautions are in place. 		
	NOTE: If the hardware's ESD sensitivity level is under 50 volts, use air ionizers at work bench.		
2.2	Contract Requirements and Approved Supplier List (ASL) Verification:	See LaRC Counterfeit Parts Plan, Section 4.1.2	
	<ul style="list-style-type: none"> Verify all procurement vehicle (i.e. P-card Order, PO, etc.) requirements have been met by the supplier. Verify that the supplier is approved on the ASL (for flight parts) or requirements met (see above). 		
2.3	Configuration Management and Document Review:	See LaRC Counterfeit Parts Plan	
	<ul style="list-style-type: none"> Verify that all documents and labeling provided by the supplier are consistent with each other and the procurement vehicle. (Via part numbers, lot date codes and serial numbers, if applicable). Inspect CoC and supplier documentation for misspelling and inconsistencies. Verify documentation provided by the supplier includes traceability to OCM (flight parts). 		
2.4	Visual Inspection:	Drawing, MIL-STD-883, TM2010.10 and 2032.1	
	Warning: If packaging requires special tooling to open, notify Receiving Inspection (RI) Lead for instruction before opening.		
	Verify all tools/gages that are to be used for the inspection are calibrated.		
	<ul style="list-style-type: none"> Determine sample size per A.1 and A.2. Verify the traceability of part to manufacturer's documentation, to drawing and procurement vehicle. Verify visual requirements have been met, using visual inspection criteria per drawing and appropriate standard. At a minimum, the following key points should be inspected: 		
	a) Legible and permanent marking		
	b) Body finish, pin holes, and cracks in insulation		
	c) Lead plating, finish and damage		
	d) Excessive body material		
	e) General damage		
	f) Proper pin arrangement and pin count		
g) Contamination			
h) Signs of counterfeiting			
	NOTE: If unable to open packaging to perform visual inspection, look through available windows in the packaging and inspect for the above as completely as possible.		
2.5	Count Parts (excluding weight counted parts or parts on reels):	Procurement Vehicle	
	Verify quantity stated on the packaging slip and part label is the correct amount. For weight counted parts use quantity provided by Flight Stores Rep. For parts on reels use quantity identified by supplier.		
3.0	Additional Inspections		
	For suspected counterfeit parts or parts not from the OCM or authorized distributor, perform additional inspections on Risk Mitigation Tests (e.g., X-Ray Inspection, X-Ray Fluorescence, Scanning Acoustic Microscopy – used to detect original laser-etched part numbers under a resurface or remarked part, Hermeticity Verification - Fine and Gross Leak, Destructive Physical Analysis, Thermal Test Cycling, and Electrical Testing) delineated by the requestor (see LaRC Counterfeit Parts Plan, Section 4.1.4.2)		

Table 8-2: RIP-0014, Integrated Circuits

RIP0014 Integrated Circuits (continued)	
Generation of Inspection Report	
4.0	Document Inspection
	The following information MUST be included in the Inspection Report (IR):
	a) Part Number and Revision (as applicable)
	b) Serial Numbers (as applicable)
	c) Quantity
	d) Date Codes and/or Lot Number (as applicable)
	e) Nomenclature
	f) Project
	g) Cognizant Engineer and Quality Assurance Engineer Name (s)
	h) Type of Inspection : "Receiving"
	i) Location of inspection (e.g. building and room number)
	j) Manufacturer Name
	k) Supplier Name with CAGE Code in parenthesis (http://www.dlis.dla.mil/cage_welcome.asp)
	l) Parts Received By and Received Date
	m) Quantity Accepted and Rejected
4.1	n) Supplier Responsibility (Yes/No)
	o) Quantity Rejected supplier at fault
	p) Inspection Standard
	q) Work Order Number
	r) Receipt Number
	s) Purchase Order and Line Item
	t) Observations (as applicable, document under "Inspection Report Notes")
	u) Nonconformance (as applicable, document under "Discrepant Items")
	v) LaRC Organization Code for Test Area
	NOTE 1: When testing data is provided , document as nonconformance "REQUIREMENT: Acceptance of parts as flight hardware is contingent upon review and acceptance of all required test data by part specialist. CONDITION: Part specialist had not reviewed test data." Transfer test data to part specialist.
	NOTE 2: For suspected counterfeit parts , inspecting personnel document as follows, "REQUIREMENT: Only parts of acceptable quality shall be selected for use per the Institutional Parts Program. CONDITION: Parts are suspect counterfeit because of the following reason(s) _____ and therefore acceptability of quality is in question."
	Attach the following documentation to the IR:
4.2	<ul style="list-style-type: none"> • Stamped Receiving Inspection Plan. • All vendor supplied documentation. • Picture(s) of the inspected part(s).
4.3	Complete Inspection. Take one of the following actions:
	<ul style="list-style-type: none"> • If part(s) are acceptable, transfer to appropriate stores (i.e., Bonded or Controlled). • If part(s) are rejected, proceed per LMS-CP-5507 (Reporting and Disposition of Nonconforming Aerospace Hardware Items and Products).
	Apply proper identification per Langley Procedural Requirements 5300.1 , "Product Assurance Plan"

Receiving Inspection (RI) Completion:				
Inspection Report (IR) No.				
Contract Number (P-Card, PO or Sub-Contract)		Stamp		Date (MM/DD/YY)

Appendix A. Definitions

A.1 AFTERMARKET MANUFACTURER: A manufacturer that meets one or more of the following criteria:

- a. The manufacturer is authorized by the OCM to produce and sell replacement parts, usually due to an OCM decision to discontinue production of a part. Parts supplied are produced from dice that have been:
 - (1) Transferred from the OCM to the aftermarket manufacturer, or
 - (2) Produced by the aftermarket manufacturer using OCM tooling and intellectual property (IP).
- b. The manufacturer produces parts using semiconductor dice or wafers, manufactured by and traceable to an OCM, that have been properly stored until use and are subsequently assembled, tested, and qualified using processes that meet technical specifications without violating the OCM's intellectual property rights, patents, or copyrights.
- c. The manufacturer produces parts through emulation, reverse-engineering, or redesign, that match the OCM's specifications and satisfy customer needs without violating the OCM's intellectual property rights (IPR), patents, or copyrights.

In any case, the aftermarket manufacturer must label or otherwise identify its parts to ensure that the "as shipped" aftermarket manufactured part should not be mistaken for the part made by the OCM.

A.2 APPROVED SUPPLIER: Suppliers that are formally assessed, determined to provide low risk of providing counterfeit parts, and entered on a register of approved suppliers are defined as Approved Suppliers.

A.3 AUTHORITY HAVING JURISDICTION: A statutory authority can differ between countries, the term is used to refer to the governmental organization at the federal, national, state, or local entity having statutory authority to respond to, enforce, or prosecute anti-counterfeiting laws. Examples are Customs and Judicial bodies.

A.4 AUTHORIZED DISTRIBUTION: Transactions conducted by an OCM-authorized distributor, distributing products that are within the terms of an OCM contractual agreement. Contractual agreement terms include, but are not limited to, distribution region, distribution products or lines, and warranty flow down from the OCM. Under this distribution, the distributor would be known as an Authorized Distributor. For the

purposes in this Standard, Franchised Distribution is considered synonymous with Authorized Distribution.

A.5 AUTHORIZED (FRANCHISED) DISTRIBUTOR: Distributor, when performing Authorized Distribution.

A.6 AUTHORIZED SUPPLIER: Aftermarket manufacturers and OCM-authorized sources of supply for a part (i.e., franchised distributors).

A.7 BROKER: In the independent distribution market, brokers are professionally referred to as independent distributors. See definitions for “broker distributor” and “independent distributor.”

A.8 BROKER DISTRIBUTOR: A type of independent distributor that works in a “Just in Time” (JIT) environment. Customers contact the broker distributor with requirements identifying the part number, quantity, target price, and date required. The broker distributor searches the industry and locates parts that meet the target price and other customer requirements.

A.9 CERTIFICATE OF CONFORMANCE (C of C, CoC): A document provided by a supplier formally declaring that all buyer purchase order requirements have been met. The document may include information such as manufacturer, distributor, quantity, lot and/or date code, inspection date, etc., and is signed by a responsible party for the supplier.

A.10 CERTIFICATE OF CONFORMANCE AND TRACEABILITY (CoCT): A certificate of conformance required by certain military specifications which requires documented traceability from the QPL/QML manufacturer through delivery to the Government if the material is not procured directly from the approved manufacturer.

A.11 COUNTERFEIT EEE PART: Counterfeit EEE parts are defined as a suspect part that is a copy or substitute without legal right or authority to do so or one whose material, performance, or characteristics are knowingly misrepresented by a supplier in the supply chain. Examples of counterfeit parts include, but are not limited to:

- a. Parts which do not contain the proper internal construction (die, manufacturer, wire bonding, etc.) consistent with the ordered part.
- b. Parts which have been used, refurbished or reclaimed, but represented as a new product.
- c. Parts that have different package style or surface plating/finish than the ordered parts.

- d. Parts that have not successfully completed the OCM's full production and test flow, but are represented as completed product.
- e. Parts sold as upscreened parts, which have not successfully completed upscreening.
- f. Parts sold with modified labeling or markings intended to misrepresent the part's form, fit, function, or grade.

Parts which have been refinished, upscreened, or uprated, and have been identified as such, are not considered counterfeit.

A.12 DESTRUCTIVE PHYSICAL ANALYSIS (DPA): A systematic, logical, detailed examination of parts during various stages of physical disassembly, conducted on a sample of completed parts from a given lot, wherein parts are examined for a wide variety of design, workmanship, and/or processing problems. Information derived from DPA may be used to:

- a. Preclude installation of inauthentic parts or parts having patent or latent defects.
- b. Aid in disposition of parts that exhibit anomalies.
- c. Aid in defining improvements or changes in design, materials, or processes.
- d. Evaluate supplier production trends.

A.13 DISPOSITION: Decisions made by authorized representatives within an organization concerning future treatment of nonconforming material. Examples of dispositions are to scrap, use as-is (normally accompanied by an approved variance/waiver), retest, rework, repair, or return to supplier.

A.14 ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PARTS: EEE parts are designed to perform specific functions and are not subject to disassembly without destruction or impairment of design use. Examples of electrical parts include resistors, capacitors, inductors, transformers, and connectors. Electronic parts include active devices, such as monolithic microcircuits, hybrid microcircuits, diodes, and transistors. Electromechanical parts are devices that have electrical inputs with mechanical outputs, or mechanical inputs with electrical outputs, or combinations of each. Examples of electromechanical parts are motors, synchros, servos, and some relays.

A.15 ELECTRONIC RESELLERS ASSOCIATION INTERNATIONAL (ERAI): A privately held global trade association that monitors, investigates, reports, and mediates

issues affecting the global supply chain of electronics, including supply of counterfeit and substandard parts.

A.16 FRANCHISED DISTRIBUTOR: Contractual agreements to buy, stock, re-package, sell and distribute OCM product lines may be contractually arranged by the OCM with this special type distributor. When a distributor does not provide products in this manner, then for the purpose of this document, the distributor is considered an independent distributor for those products. Franchised distributors normally offer the product for sale with full manufacturer flow-through warranty. Franchising contracts may include clauses that provide for the OCM's marketing and technical support inclusive of, but not limited to, failure analysis and corrective action, exclusivity of inventory, and competitive limiters.

A.17 GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM (GIDEP):

A cooperative activity between government and industry participants seeking to reduce or eliminate expenditures of resources by sharing technical information essential during research, design, development, production and operational phases of the life cycle of systems, facilities and equipment.

A.18 INDEPENDENT DISTRIBUTOR: A distributor that purchases new parts with the intention to sell and redistribute them into the market. Purchased parts may be obtained from original equipment manufacturers (OEMs) or contract manufacturers (typically from excess inventories), or from other independent distributors. Re-sale of the purchased parts (re-distribution) may be to OEMs, contract manufacturers, or other independent distributors. Independent distributors do not have contractual agreements or obligations with OCMs.

A.19 INDEPENDENT DISTRIBUTORS OF ELECTRONICS ASSOCIATION (IDEA):

IDEA, a non-profit trade association representing independent distributors that have formally committed to adhere to prescribed quality and ethical standards. The stated purpose of IDEA is to promote the independent distribution industry through media advocacy; to improve the quality of products and services through a quality certification program, educational seminars and conferences; and to promote the study, development, and implementation of techniques and methods to improve the business of independent distributors.

A.20 LOT: A group of parts received in a given shipment that are of the same part type and have the same manufacturer, part number, and lot date code.

A.21 LOT DATE CODE: A marking, usually inscribed on an EEE part and required by the applicable specification, to identify parts that have been processed as a batch.

A.22 MILITARY OFF-THE-SHELF (MOTS): An off-the-shelf product developed or customized by a commercial vendor to respond to specific military requirements. The source code and design of a military off-the-shelf product may have been changed from a commercially available version to address military requirements. Because a MOTS product is adapted for a specific purpose, it can be purchased and used immediately. However, since MOTS specifications are controlled by external non-government sources, changes to the product will not be in the government's control. For a MOTS product that contains software, the source code may not be in the government's control.

A.23 OPEN MARKET: The trading market that buys or consigns primarily OEM and contract manufacturer's excess inventories of new electronic parts and subsequently utilizes these inventories to fulfill supply needs of other OEMs and contract manufacturers, often due to urgent or obsolete part demands.

A.24 ORGANIZATION: In the context of this document, it refers to procurement entities (government and contractor), and sub tier equipment suppliers and producers.

A.25 ORIGINAL COMPONENT MANUFACTURER (OCM): An organization that designs and/or engineers a part and is pursuing or has obtained the intellectual property rights to that part.

Notes:

- a. The part and/or its packaging are typically identified with the OCM's trademark.
- b. OCMs may contract out manufacturing and/or distribution of their products.
- c. Different OCMs may supply products for the same application or to a common specification.

A.26 ORIGINAL EQUIPMENT MANUFACTURER (OEM): A company that manufactures products it has designed and manufactured (directly or by a third party) from purchased components and sells those products under the company's brand name.

A.27 PACKAGING (COMPONENT): Component packaging refers to the manner in which electronic parts are packaged in preparation of use by electronic assemblers. The determination of packaging types is determined by product sensitivities such as moisture, physical (lead pitch, co-planarity), electrostatic discharge (ESD), as well as the method (manually, or by use of automated equipment) to be used to place parts on the printed circuit board. There are four main types of packaging: bulk, trays, tubes, and tape and reel.

A.28 PART(S): One or more pieces joined together, which are not normally subject to disassembly without destruction or impairment of intended design use.

A.29 REFINISHED: Using post-manufacture plating methods (such as solder dipping) to alter the plating composition on a part's leads.

A.30 REFURBISHED: Parts that have been brightened, polished, or renovated in an effort to restore them to a "like new" condition. Refurbished parts may have had their leads realigned and re-tinned.

A.31 STOCKING DISTRIBUTOR: A type of independent distributor that typically stocks large inventories that are purchased from both original equipment manufacturers (OEMs) and contract manufacturers. The handling, chain of custody, and environmental conditions for parts procured from stocking distributors are generally better known than for product bought and supplied by broker distributors.

A.32 SUPPLIER: Within the context of this document, a blanket description of all sources of supply for a part (e.g., OCM, franchised distributor, independent distributor, broker distributor, stocking distributor, aftermarket manufacturer, Government Supply Depot).

A.33 SUPPLY CHAIN TRACEABILITY: Documented evidence of a part's supply chain history. This refers to documentation of all supply chain intermediaries and significant handling transactions, such as from OCM to distributor, or from excess inventory to broker to distributor.

A.34 SUPPLY CHANNEL: The general category of Supplier, such as Open Market, OCM, Aftermarket Manufacturers, Authorized (Franchised) Distributor, 3PL Provider, Independent Distributor, Broker Distributor, OEM Surplus, etc.

A.35 UNUSED (NEW SURPLUS): Electronic parts that have not been previously used (i.e., attached to a board or powered up since leaving the supply chain). A shipment of unused material can contain mixed date codes, lot codes, or countries of origin, and should be received in unused factory or third party packaging. The material may have minor scratches or other physical defects as a result of handling, but the leads should be in good condition and should not be refurbished. The material should be guaranteed to meet the manufacturer's full specifications. Unused programmable parts should be un-programmed.

A.36 UPRATED: Assessment that results in the extension of a part's ratings to meet the performance requirements of an application in which the part is used outside the manufacturer's specification range.

A.37 UPSCREENED: Additional part testing performed to produce parts verified to specifications beyond the part manufacturer's operating parameters. Examples are Particle Impact Noise Detection (PIND) testing, temperature screening, Radiation Hardness Assurance testing, etc.

A.38 USED (REFURBISHED OR PULLED): Product that has been electrically charged and subsequently pulled or removed from a socket or other electronic application is designated "used." Used products may be received in non-standard packaging (i.e., bulk), and may contain mixed lots, date codes, be from different facilities, etc. Parts may have physical defects such as scratches, slightly bent leads, test dots, faded markings, chemical residue, or other signs of use, but the leads should be intact. Used product may be sold with a limited warranty, and programmable parts may still contain partial or complete programming that could impact the part's functionality. Used parts marketed as refurbished should be declared as such.

A.39 SUSPECT PART:

A part in which there is an indication by visual inspection, testing, or other information that it may have been misrepresented by the supplier or manufacturer and may meet the definition of counterfeit part provided below.

Appendix B. Acronyms

B.1 Acronyms

For the purposes of this document, the acronyms, terms, and definitions stated in ISO 9000 and the following apply:

ACORD	Association for Cooperative Operations Research and Development
AS	Aerospace Standard
ASSIST	Articulation System Stimulating Inter-institutional Student Transfer
BGA	Ball Grid Array
C	Celsius
CGA	Column Grid Array
CM	Contract Manufacturer
CMOS	Complementary Metal Oxide Semiconductor
CoC	Certificate of Conformance
CoCT	Certificate of Conformance and Traceability
COTS	Commercial Off-the-Shelf
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DPA	Destructive Physical Analysis
EDS	Energy Dispersive Spectroscopy
EEE	Electrical, Electronic, and Electromechanical
ERAI	Electronic Resellers Association International
ESD	Electrostatic Discharge
EVI	External Visual Inspection
FIB	Focused Ion Beam
FTIR	Fourier Transform Infrared Spectrometry
GEIA	Government Electronics and Information Technology Association
GIDEP	Government Industry Data Exchange Program
ID	Identification
IDEA	Independent Distributors of Electronics Association
IMC	Intermetallic Compound

IP	Intellectual Property
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
JEDEC	Joint Electron Device Engineering Council
JIT	Just in Time
LaRC	Langley Research Center
LDC	Lot Date Code
MOTS	Military Off-the-Shelf
NASA	National Aeronautics and Space Administration
OCM	Original Component Manufacturer
OEM	Original Equipment Manufacturers
OIG	Office of Inspector General
OMB	Office of Management and Budget
PIND	Particle Impact Noise Detection
QML	Qualified Manufacturing Line
QPL	Qualified Parts List
PPE	Personal Protective Equipment
RC	Component Risk
RF	Radio Frequency
RP	Product Risk
RS	Supplier Risk
RT	Total Risk
SAE	Society of Automotive Engineers
SEM	Scanning Electron Microscope
STD	Standard
STI	Shallow Trench Isolation
TL	Test Laboratory
XRF	X-ray Fluorescence

Appendix C. Testing

C.1 Lot Requirements

An EEE parts lot is defined as the total number of devices that are received in a given shipment and have the same manufacturer, part number and lot date code (LDC). A future shipment of devices of the same LDC will be considered a new lot. A lot will consist of a minimum of 10 and a maximum of 1000 EEE parts. A lot will contain enough parts to meet the sampling plan described below and to provide the project with the proper number of test and flight parts. A lot containing more than 1000 parts will be divided into sub-lots having equal number of devices, totaling less than 1000 devices per sub-lot. Each sub-lot will be treated as a unique lot for testing and inspection. Generally, a procurement lot is a lot consisting of parts having the same LDC; however, for procurement lots with mixed LDCs, the devices will be separated into separate sub-lots. The sub-lots will meet the lot size requirements stated above.

C.2 Lot Sampling Plan Requirements

The project EEE parts engineer shall ensure each lot will be tested in accordance with the sampling plan given in Table C-1. Samples will be selected at random from the lot. The same samples can be used for multiple test steps as indicated in the table. For example, the samples used for remarking can be used for destructive physical analysis.

Inspection or Test	Paragraph	Sample Size 1/	
		10 ≤ Lot ≤ 125	125 < Lot ≤ 1000
Lot Data Review and Verification	A.3	Each lot	Each lot
External Visual Inspection	A.4	100%	100%
Remarking test (resistance to solvents)	A.5	5% or 2 minimum up to 5	5% or 2 minimum up to 5
Radiographic Inspection	A.6	100%	100%
XRF/Lead Finish	A.7	100% up to 45 maximum	100% up to 45 maximum
Resurfacing test (Chemical or Mechanical)	A.8	2/	2/
Temperature Cycling	A.9	100% up to 45 maximum	45
Seal Test		3/	3/
Key Parametric Electrical Tests (i.e., Group A) at 25°C with recording	A.10	100% 3/, 4/	125 3/, 4/
Pre-Electricals at 25°C (read and record)	A.10.1	100% up to 45 maximum	45
Burn-In Post-Electricals at 25°C (read and record)		3/, 5/	3/, 5/
Key Parametric Electrical Tests (i.e., Group A) at Temperature (min and max operating temperature) (read and record)	A.10	100% up to 45 maximum 3/, 6/	45 3/, 6/
Destructive Physical Analysis	A.11	2/	2/
Additional Tests	A.12	7/	7/

1/ If the sample size is less than 100% of the lot, samples will be randomly selected. If the parts are received in tape and reel, select parts randomly throughout the entire tape and reel.
2/ Remarking test samples may be used. Samples used for the remarking test and resurfacing test will not be used for production hardware.
3/ Samples used for remarking test, resurfacing test, or DPA will not be used.
4/ Samples that pass Temperature cycling/Seal Test may be used.
5/ Samples that pass Key Electrical Tests at 25°C may be used. Pre-Electrical Tests do not need to be repeated.
6/ Samples that pass Post-Electrical Testing at 25°C may be used.
7/ Responsible Project engineers (i.e., design, parts ...) will determine if additional tests are necessary and sample size for each additional test performed.

Table C-1: Lot Sampling

C.3 Data Review and Verification

The data package that arrives with the parts, their associated package types, and shipping containers will be reviewed and verified prior to conducting tests. This activity must be conducted to catch suspect counterfeit parts before costly testing begins. The following will be verified for part authentication:

- a. Parts are received in a single shipment.
- b. Parts and shipping materials are marked or otherwise identified with identical lot, batch, run, and identification information (e.g., dates codes, lot codes, and serial numbers). If multiple date codes are observed, follow the criteria defined in Section A.1 for handling of multiple date codes.
- c. Parts and shipping materials appear to have been subjected to the same handling, packaging, and/or storage conditions.
- d. Parts have maintained their physical placement relative to each other (i.e., have never been separated based on evidence such as source, packaging, labeling).

C.4 External Visual Inspection (EVI)

External visual inspection will be conducted. Independent Distributors of Electronics Association (IDEA) specification IDEA-STD-1010 can be used as a guideline to understand external visual inspection techniques. Findings from EVI, including photographs of anomalies, will be reported. When examining electrical connectors, the test lab will ensure connector pairs are mateable and that the mating and demating forces are within specified limits.

C.4.1 Inspection Criteria

All devices in a lot will undergo the inspection process defined below. Adequate lighting and a typical magnification range of 3X – 100X will be used to distinguish points of interest. Whenever possible, compare the sample(s) being inspected to a part received from the OCM or OCM approved franchised distributor. When this is not possible, the parts should be compared to others within the lot for evidence of inconsistencies.

- a. Part Specifications
 - (1) Package type
 - (2) Dimensions
 - (3) Pin number
 - (4) Pin 1 position
 - (5) Device orientation and consistency if tape and reel
- b. Part Markings
 - (1) Visible evidence of previous markings

- (2) Marking style consistency (front and back) of sample set having same LDC
- (3) Same country of origin designation of sample set having same LDC
- c. Package Surface
 - (1) Significant package variation from part to part having same LDC
 - (2) Color uniformity throughout sample set having same LDC
 - (3) Color discrepancies between the top and bottom of same part
 - (4) Surface Contamination (i.e. glue/adhesives, corrosion, solder, paint)
 - (5) Visible damage (i.e. cracks, burn marks, tooling marks, unidirectional abrasions)
 - (6) Uneven package thickness
 - (7) Consistency of dimple pattern depth
 - (8) Corner Radius differences between top and bottom surfaces
- d. Leaded Parts
 - (1) Non-uniform color
 - (2) Tooling marks
 - (3) Evidence of straightening or re-tinning of leads
 - (4) Exposed copper on lead ends
 - (5) Bent or non-planar leads
 - (6) Excessive or uneven plating
 - (7) Gross oxidation, discoloration, dirt, or residue on surface
 - (8) Scratches or insertion marks on the inside and outside of lead faces
 - (9) Excessive solder
- e. Column Grid Array/Ball Grid Array (CGA/BGA) Parts
 - (1) Discoloration, dirt, debris, or residue on or between solder spheres/columns
 - (2) Crushed/flattened solder spheres or misaligned/damaged columns
 - (3) Non-uniform size and shape of solder spheres or columns
 - (4) Solder mask damage or scratches in mask underneath solder sphere or column
 - (5) Excessive Intermetallic Compound (IMC) thickness
 - (6) Constituents present in the IMC that are not consistent with the plating method used
 - (7) Solder dross on the solder mask
 - (8) Evidence of solder mask touchup or repair

C.5 Test for Remarking

This first test focuses on the part marking and is a resistance- to-solvents test. To perform this test, mix a solution of three parts mineral spirits with one part ethyl alcohol. Dip a cotton swab into the solution, and wipe the swab across the markings on the part. The markings should not smear or be removed by the solution.

C.6 Radiographic Inspection

Radiographic inspection is considered non-destructive if the radiation exposure to the parts does not exceed the manufacturer's specification. Acceptable radiation levels should be validated in the manufacturer's specification prior to performing radiographic inspection. If this data cannot be provided, the test lab will provide tube voltage, current, and exposure times as part of the test report. Parts that are exposed to radiation levels that do exceed the manufacturer's specification may be used for subsequent destructive tests. Parts should be inspected for homogeneity, consistency, and uniformity. Comparison of die size, general shape, lead frame construction, wire bond gauge, and routing will be performed. Normally there is some variation across different LDCs, but not in parts with the same LDC. Radiographic film (or real time images) should be inspected using the appropriate military standard requirements: MIL-STD-883 for microcircuits and hybrids, MIL-STD-750 for semiconductors, and MIL-STD-202 for electrical and electronic parts not covered by the previous specifications.

Radiographic films or digital images will be retained and provided with the lot.

C.7 Lead Finish Evaluation

A lead finish evaluation will be performed using XRF or scanning electron microscopy/energy dispersive spectroscopy (SEM/EDS) to verify that the lead finish/solder ball and column composition matches the device specification or the data sheet. If a pure tin finish is found and called out in the specification, verify the tin thickness and presence of barrier metals using XRF.

C.8 Test for Resurfacing

Chemical or mechanical methods will be used to test for resurfacing.

C.8.1 Chemical Method

This test focuses on the parts surfaces and is a sequence of three separate tests: 1) an Acetone Test, 2) a 1-Methyl 2-Pyrrolidinone Test, and 3) a Dynasolve 750 Test. These tests expose plastic part resurfacing attempts. Upon performing each test, examine the texture on the sides at a minimum 30 X magnification and compare it to the top and bottom surfaces. They should be the same. The dimples should also be inspected for surface uniformity. Typically, dimples are smooth and highly reflective.

When exposing parts to chemicals, the soak times are not fixed. The part should be monitored often during the timed soak. If the coating is reacting quickly, shorten the soak time. Controlling the total exposure time should prevent any issues concerning damage to mold compound on authentic parts. For all of these solvents, make sure proper safety precautions are used including a ventilated fume hood and elimination of any sources of ignition. Also, use the proper personal protective equipment (PPE). Acetone, 1-Methyl 2-Pyrrolidinone, and Dynasolve 750 attack different types of coatings. These three solvents cover a wide range of potential coatings. These tests can also be used on ceramic parts to check for coatings on the part surface. The same samples can be used for all resurfacing tests.

C.8.1.1 Acetone Test

To perform this test, dip a cotton swab into Acetone. Wipe the swab across the surface of the part avoiding printed markings. If the surface is coated, a black or grayish substance will show on the cotton swab. If the wiped section exhibits a permanent color change, the part may have been resurfaced, which is indicative of a suspect counterfeit part.

C.8.1.2 1-Methyl 2-Pyrrolidinone (1M2P) Test

To perform this test, completely immerse the part in the solution that is preheated to 115 to 120 degrees Celsius. The part should be immersed for two to five minutes maximum (the time and temperature may be adjusted to compensate for the sample). Carefully remove the part from the solution and use a cotton swab to wipe the surface while avoiding printed markings. If the surface is coated, a black or grayish substance will show on the cotton swab, which is indicative of a suspect counterfeit part.

C.8.1.3 DYNASOLVE 750 Test

Using a preheated solution of Dynasolve 750 at 105 degrees Celsius, completely immerse the part in the solution for 45 minutes. Carefully remove the part from the solution and use a cotton swab to wipe the surface while avoiding printed markings. If the surface is coated, a black or grayish substance will show on the cotton swab. If the coating is removed, look for scratch marks on the remaining surface. Either condition is indicative of a suspect counterfeit part.

C.8.2 Mechanical Method

Mechanical removal of coatings can be used if coatings are not removed by chemical means and additional resurfacing tests are warranted. This method involves lightly rubbing an X-ACTO blade, in one direction only, over the surface of the part where the blade is maintained perpendicular to the part surface. Using this technique ensures that some of the part surface will be removed. Make a video recording or document part orientation and direction of blade movement to provide confirmation that any anomalies (such as sanding marks) revealed were not caused by the coating removal process.

C.9 Temperature Cycling and Seal Test

C.9.1 Temperature cycling tests will be performed a minimum of 10 cycles in accordance with MIL-STD-883 for microcircuits, MIL-STD-750 for semiconductor devices, and MIL-STD-202 for passives. Test conditions will be per the manufacturer's specification. Following completion of testing, parts will be examined for evidence of marking deterioration or other physical damage.

C.9.2 Seal (Hermeticity) testing will be performed on cavity devices. Hermeticity tests will consist of both fine and gross leak tests in accordance with MIL-STD-883 for microcircuits, MIL-STD-750 for semiconductor devices, and MIL-STD-202 for other EEE parts as applicable.

C.10 Electrical Testing

All electrical tests and test data will be documented. Figure 4 shows the required level of electrical testing based on total risk score. The extent of electrical testing will be determined by selecting the pertinent key electrical parameters from the applicable specifications. Commercial off-the-shelf parts will be tested per the manufacturer's datasheet for the key electrical parameters.

C.10.1 Pre-Electrical, Burn-In, Post Electrical
Burn-in test conditions and the pre- and post-burn-in electrical parameter limits and delta electrical limits will be specified. Burn-in will be a minimum of 80 hours, and the delta electrical limits will not exceed the percent deviation of the pre-burn-in electrical readings specified in the applicable specification or datasheet.

C.10.2 Full Functional over Temperature
Full Functional electrical testing over temperature includes DC/AC functional and parametric testing at the recommended manufacturers or specific industry extreme operating temperatures to verify component quality and performance.

C.11 Destructive Physical Analysis

C.11.1 The DPA technique and process will be performed per MIL-STD-1580 or equivalent method except internal water vapor, bond strength, and die shear are not necessarily required. A more detailed analysis of the die is necessary. This detailed analysis should include visual inspection, passivation layer analysis, and metallization characteristics analysis. Review and confirm that the die is acceptable by the OCM. If die information is not available from the OCM, compare die between samples selected from the population.

C.11.2 If internal construction anomalies are discovered during radiographic inspection, the samples required for DPA should be selected by utilizing the variant

configurations discovered during radiographic screening and should include one sample that represents the majority of the population. In addition, if there are more variations discovered during radiography than required for the DPA sampling plan, the test laboratory will notify the Responsible Project engineers (i.e., design, parts ...) to determine if a larger sampling size is necessary to identify construction anomalies found during radiographic inspection.

C.11.3 The data collected will be compared against the expected characteristics for the manufacturer's product. Characteristics should include but not be limited to bond wire location, composition and number of bond wires, die characteristics, lead frame size and shape, double ball bonds (where one ball bond is stacked on another) and internal cavity dimensions (where applicable). Many of these characteristics require a known good part, a database containing information of known good parts to compare against, or it may require support from the OCM.

C.11.4 The analysis may require some of the following analytical techniques and tools:

- a. Cross-section analysis.
- b. Chemical de-potting and de-capsulation.
- c. Mechanical disassembly.
- d. Optical examination and photo-documentation.
- e. Scanning electron microscope examination.
- f. Elemental analysis tools such as EDS, Auger, Fourier transform infrared spectrometry (FTIR), XRF, etc.
- g. Focused ion beam (FIB).

C.11.5 All anomalies will be documented and the Responsible Project engineers (i.e., design, parts, etc.) notified. Anomalies between samples within the population will be recorded and included in a DPA report. The following items should be included in the DPA report:

- a. Number of parts inspected.
- b. All of the information required from previous testing and inspection.
- c. Key findings.
- d. Defect characterization.
- e. Key differences between the parts analyzed and the expected findings.
- f. A summary statement regarding if any conditions were observed that would indicate that the device was potentially a counterfeit part.
- g. Photo-documentation as specified in the previously part procedure sections including high magnification photos showing any relevant anomalous condition.

- h. A detailed list of the chemicals and techniques used to de-capsulated and/or disassemble the part.

C.11.6 Procedures for Device DPA

C.11.6.1 External Optical Examination

Utilize the data obtained from EVI to evaluate any anomalous conditions that may affect the de-capsulation process (cracks in the case, uneven surfaces, etc.). Photo-document the side of the device through which the die will be exposed.

C.11.6.2 Radiographic Inspection

To minimize unnecessary de-capsulation damage, obtain x-ray images through the top and sides of the devices. Information of interest includes internal structure, die attach extent and alignment. For plastic encapsulated parts, determine the side of the part that needs to be chemically etched in order to expose the die face. Although the die is not x-ray dense, the die attach provides clues to the area taken up by the die because the die imprint is visible in the die attach. Obtaining a radiographic image that is a 1:1 ratio will help in the location of the die within the case and will also help with the gasket selection when using an automated de-capsular.

C.11.6.3 De-capsulation of Plastic Parts and De-lidding of Cavity Devices.

De-capsulation of plastic parts and de-lidding of components will follow MIL-STD-1580 procedures where applicable. Procedures developed by the testing lab that are outside MIL-STD-1580 will be approved by the Risk Assessment and Mitigation Team.

C.11.7 Procedure for Inspection of Active Devices

The test lab will record all de-capsulation parameters for each device to determine repeatability or aberrations in the process. The test lab will photograph the de-capsulated devices to document the overall condition of the part after de-capsulation. The test lab will photograph the die at a higher magnification. The die will be examined at a minimum magnification of 500X. This magnification includes the objective lens magnification times the eyepiece magnification. Inspect the die for and photo-document the following information:

- a. Manufacturer markings
- b. Name
- c. Logo
- d. Unique image (iconic image used by the die manufacturer such as a flag, a space shuttle, a cartoon man, a tree, etc.)
- e. Die part numbers
- f. Die mask identification (ID) numbers
- g. Year of design
- h. Number of metal layers

- i. Pin 1 bond pad outline
- j. Presence of double ball bond (inspect by tilting the device)
- k. Bond wire diameter
- l. Bond types
- m. Thermal sonic
- n. Crescent with or without safety bonds
- o. Ultrasonic bonds
- p. Compound bonds
- q. Any other markings or features that may help in identifying the origins of the die

A more comprehensive analysis may be performed as required by the Risk Assessment and Mitigation team. This may include de-processing of the die, focused ion beam (FIB) analysis, or a cross-section analysis of the part to determine characteristics of the die and internal part structures. Some types of analysis and part-type characteristics are:

- a. Passivation layer type analysis (silicon nitride, oxide types, polyimide, etc.)
- b. Metallization characterization
- c. Elemental analysis
- d. Three or five layers per metal line
- e. Etch profile
- f. Lead frame characteristics
- g. Die attach
- h. Lead frame material
- i. Die passivation layer thicknesses
- j. Passivation types
- k. Isolation types (shallow trench isolation (STI), field-ox, deep trench, etc.)
- l. Transistor types (complementary metal oxide semiconductor (CMOS), bipolar, radio frequency (RF), etc.)
- m. Metallization characteristics

C.11.8 Procedure for Inspection of Passive Devices

Passive devices will not have the detail typically found with microcircuits. However, the data collected on characteristics of the internal structures will be documented in sufficient detail and resolution to enable a comparison against a known good part from the same lot. If a known good part is unavailable, then the original OCM should be asked to provide the data and photos.

The following items will be inspected and documented:

- a. Internal dimensions
- b. Elemental composition of the part materials

- c. Construction and interconnection techniques
- d. Overall photos showing the internal structures and alignment
- e. Interconnections and interfaces
- f. Plating thicknesses and optical characteristics
- g. Photomicrographs with calibrated measuring bars for critical dimensional measurements
- h. Data and spectra from elemental analysis
- i. Internal alignment characteristics

C.12 Additional Tests

Additional tests may be used in detecting suspect counterfeit parts when further clarification is necessary. For example, scanning acoustic microscopy may be used to detect original laser-etched part number under a resurface and remarked part. The Responsible Project engineers (i.e., design, parts, etc.) will work with the test lab to determine if additional tests are necessary.