IEC/PAS 62239

Edition 1.0
2001-04

PRE-STANDARD

Electronic component management plans

PUBLICLY AVAILABLE SPECIFICATION

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

Reference number
IEC/PAS 62239

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ELECTRONIC COMPONENT MANAGEMENT PLANS

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

This PAS Pre-Standard has been published using a rapid procedure as a result of technical consensus at the level of experts working on the subject within the IEC. The normal IEC procedure for the preparation of an International Standard is pursued in parallel and this Pre-Standard will be withdrawn upon publication of the corresponding International Standard.

IEC-PAS 62239 has been processed by IEC technical committee 107: Process management for avionics.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document:
Draft PAS	**Report on voting**
107/2/PAS	107/7/RVD

Full information on the voting for the approval of this PAS Pre-Standard can be found in the report on voting indicated in the above table.

ELECTRONIC COMPONENT MANAGEMENT PLANS

Purpose

This document is intended to help aerospace equipment manufacturers, subcontractors, maintenance facilities, and other aerospace component users develop their own Electronic Component Management Plans (ECMPs), hereinafter also called the Plan. This document states objectives to be accomplished; it does not require specific tasks to be performed, specific data to be collected or reports to be issued. Those who prepare Plans in compliance with this document are encouraged to document processes that are the most effective and efficient for them in accomplishing the objectives of this document. In order to allow flexibility in implementing and updating the documented processes, Plan preparers are encouraged to refer to their own internal process documents instead of including detailed process documentation within their Plans.

This component management document is intended for aerospace users of electronic components. It is not intended for use by the manufacturers of electronic components. Components selected and managed according to the requirements of a Plan compliant to this document may be approved by the concerned parties for the proposed application, and for other applications with equal or less severe requirements.

Organizations that prepare such Plans may prepare a single Plan, and use it for all relevant products supplied by the organization, or may prepare a separate Plan for each relevant product or customer.

1 Scope

This document defines the requirements to assure customers and regulatory agencies that all of the electronic components in the equipment of Electronic Component Management Plan owners are selected and applied in controlled processes; and that the following objectives are accomplished:

- Components are applied properly in the design
- Components are qualified for the intended application
- The quality of every individual component
- Component integrity and compatibility with manufacturing processes
- A process is in place to collect, store, retrieve, analyse, and act upon data related to the component itself, and also relevant component data from equipment design, equipment manufacturing, and component use in service
- Components are selected, substituted, and managed systematically by the equipment supplier to maintain a traceable path to the qualified equipment through the operation of an effective configuration control system
- Component availability, obsolescence and reliability are understood, and their impacts on the application are understood and managed

2 References

2.1 Normative References

2.2 Informative References

AS 9000	Aerospace Basic Quality System Standard, Appendix 1 Revised 1998, Society of Automotive Engineers
BSI PD6503	(1990) Toxicity of Combustion Products
BSI BS EN 190000	Harmonised System of Quality Assurance for Electronic Components, Generic Specification Monolithic Integrated Circuits
CDF-AEC Q100	Stress Test Qualification for Automotive-Grade Integrated Circuits, Chrysler-Delco-Ford Automotive Electronics Council
CDF-AEC Q101	Stress Test Qualification for Automotive-Grade Discrete Semiconductors, Chrysler-Delco-Ford Automotive Electronics Council
CDF-AEC Q200	Stress Test Qualification for Automotive-Grade Passive Components, Chrysler-Delco-Ford Automotive Electronics Council
CECC EN 190000	Harmonised System of Quality Assurance for Electronic Components General Specification Monolithic Integrated Circuits
CECC 00114	Rules of Procedure Quality Assessment Procedures
EIA JESD22-A112-A	JEDEC Standard –Test Method A112-A, Moisture Induced Stress Sensitivity for Plastic Surface Mount Devices
EIA JESD22-A113-B	(1999) Test Method A113-B Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
EN 100015-1	(1992) Basic Specification: Protection of Electrostatic Sensitive Devices - Part 1: General Requirements
EN 100015-2	(1993) Basic Specification: Protection of Electrostatic Sensitive Devices - Part 2: Requirements for Low Humidity Conditions
EN 100015-3	(1993) Basic Specification: Protection of Electrostatic Sensitive Devices - Part 3: Requirements for Clean Room Areas
EN 100015-4	(1993) Basic Specification: Protection of Electrostatic Sensitive Devices - Part 4: Requirements for High-Voltage Environments
EN 100114-1	(1996) Rules of Procedure 14: Quality Assessment Procedures – Part 1: CECC Requirements for the Approval of an Organisation
EN 100114-6	(1996) Rules of Procedure 14: Quality Assessment Procedures – Part 6: Technology Approval of Electronic Component Manufacturers
EN ISO 9000-1	(1994) Quality Management and Quality Assurance Standards – Part 1: Guidelines for Selection and Use

EN ISO 9000-2	(1997) Quality Management and Quality Assurance Standards – Part 2: Generic Guidelines for the Application of ISO 9001, ISO 9002 and ISO 9003
EN ISO 9000-3	(1997) Quality Management and Quality Assurance Standards – Part 3: Guidelines for the Application of ISO 9001:1994 to the Development, Supply, Installation and Maintenance of Computer Software
EN ISO 9000-4	(1993) Quality Management and Quality Assurance Standards – Part 4: Guide to Dependability Program Management. IEC/CEI 300-1
IEC 107/3/PAS	IEC PAS Pre-Standard 62240 Avionics Industry: Use of Semiconductor Devices Outside Manufacturers' Specified Temperature Ranges
IEC 107/4/PAS	Avionics Industry: Reliability Assessment of Electronic Equipment
IEC QC 001002-3	Rules of Procedure, Part 3: Approval procedures
IEC QC001004	Specification List
IEC 47A/532/CD	(1998) [Draft] Integrated Circuits, Measurement of Electromagnetic Emissions, 150 KHz to 1 GHz (IEC Project No 61967)
IEC 61340-5-1	(1998) Electrostatics – Part 5-1: Protection of Electronic Devices from Electrostatic Phenomena – General Requirements
IEC 61340-5-2	(1999) Electrostatics – Part 5-1: Protection of Electronic Devices from Electrostatic Phenomena – User Guide
IPC/JEDEC J-STD-020A	(1999) Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
ISO 9000	Quality Management and Quality Assurance Standards
ISO 9001	Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation and Servicing
MIL-PRF-38535	Microcircuit Manufacturing, General Requirements for
MIL-STD-883	Test Method Standards, Microcircuits
MIL-PRF-19500	Semiconductor Devices, General Specification for
QS 9000	Quality System Requirements – Automotive Industry
S0001	General Requirements for Integrated Circuits, Stack International

3 Terms and Definitions

Airborne equipment environment is the applicable environmental conditions (as described per the equipment specification) that the equipment shall be able to withstand without loss or degradation in equipment performance during all of its manufacturing cycle and service life.

Capable is a term used to indicate that a component can be used successfully in the intended application.

Certified indicates compliance to an applicable government standard, an applicable industry consensus standard, or the component manufacturer's documented, equivalent internal standard.

Characterization is a process of testing a sample of components to determine the key electrical parameter values that can be expected of all produced components of the type tested.

Component application is the process that assures that the component meets the design requirements of the equipment in which it is used.

Component manufacturer is the organization responsible for the component specification and its production.

Component obsolescence management is the range of management actions taken to avoid or resolve the effects of components not being procurable due to the manufacturer(s) ceasing production. Component obsolescence management should be considered an element of risk management. (See risk management.)

Component qualification is the process used to demonstrate that the component is capable of meeting its specification in all the required environments.

Component quality assurance is all activities and processes to provide adequate confidence that each individual component is free of defects.

Component selection is the process of choosing a specific component for a specific application.

Dependability is the measure of being dependable through meeting reliability, maintainability or survivability expectations.

Distributor is an organization contractually authorized by a manufacturer to store, split, repack and distribute completely finished components which have been declared by the manufacturer as conforming to their specifications. The distributor is responsible for providing any technical information and traceability information supplied by the component manufacturer.

Electronic Component Management Plan (ECMP) is an equipment manufacturer's document that defines the processes and practices for applying components to an equipment or range of equipment. Generally, it addresses all relevant aspects of controlling components during system design, development, production, and post-production support.

Electronic components are electrical or electronic devices that are not subject to disassembly without destruction or impairment of design use. They are sometimes called *electronic parts,* or *piece parts.* Examples are resistors, capacitors, diodes, integrated circuits, hybrids, application specific integrated circuits, wound components and relays.

Electronic equipment is an item produced by the Plan owner, which incorporates electronic components. Examples are end items, sub-assemblies, line-replaceable units and shop-replaceable units.

May indicates a course of action which is permissible within the limits of this document.

Normative reference is a reference for which compliance is required by this document.

Informative reference is a reference that is for information only, and compliance is not required by this document.

Obsolete component is a component which is no longer manufactured, and may or may not still be available.

Risk is a measure of the potential inability to achieve overall program objectives within defined cost, schedule, and technical constraints. Risk has two components: (1) the probability (or likelihood) of failing to achieve a particular outcome, and (2) the consequences (or impact) of failing to achieve that outcome.

Risk management is the act or practice of dealing with risk. It includes planning for risk, assessing (identifying and analyzing) risk areas, developing risk-handling options, monitoring risks to determine how risks have changed, and documenting the overall risk management program. (See Risk.)

Shall indicates a requirement.

Should offers a guideline or recommendation that might be used or helpful to assure compliance to an objective.

Single event effect is the radiation response of a component caused by the impact of galactic cosmic rays, solar enhanced particles and/or energetic neutrons and protons. The range of responses can include both non-destructive (e.g. upset) and destructive (e.g. latch-up or gate rupture) phenomena.

Subcontractor is a person or entity to whom the holder of obligations under a contract has delegated part or all of such obligations.

Substitute or *substitute component* is a component used as a replacement in equipment after the equipment design has been approved. (In some contexts, the term "alternate component" is used to describe a substitute component that is "equal to or better than" the original component.)

Will expresses a declaration of intent when used in the context of being compliant to this document or to an ECMP.

4 Technical Requirements

The Plan ***shall*** document the processes used by the Plan owner to accomplish the objectives listed in clause 1 of this document. The Plan ***shall*** state clearly, concisely, and unambiguously:

- What the Plan owner does to accomplish each of the objectives;
- How compliance to the Plan is demonstrated; and
- The evidence that is available to show that the objectives have been accomplished.

The Plan ***shall*** document the processes used to address each of the requirements of this clause.

Where specific objectives of clause 1 do not apply, the Plan owner may, with appropriate justification, amend the list of objectives in clause 1 by adding, deleting, or modifying objectives. If this is done, the Plan ***shall*** be assessed according to the amended list of objectives, as stated in the Plan.

If the Plan owner obtains components from a distributor or other third party source, the relevant requirements of this document ***shall*** apply also to that source. The following requirements apply to all electronic components, including commercial-off-the shelf (COTS), which are defined by the component manufacturer data sheet, and custom, which are defined by the design holder specification.

The selected components ***shall*** fulfill all functional requirements and parameters, as specified and required for the overall environment and mission profile (thermal, mechanical, radiation, etc.) for all their forecasted life.

The conditions for use of the component ***shall*** be adequately identified, from the component specification based on the component manufacturer's data sheet and any additional requirements to ensure suitability in the end application. Availability and level of obsolescence risk ***shall*** be considered as a major component selection criterion.

4.1 Component Application

Listed here are some categories of component application processes that may be documented in a Plan. Not all of the categories listed below are relevant to every component application; therefore, the requirements listed below are applicable only if relevant to the given application.

4.1.1 Functionality

The documented processes ***shall*** verify that the selected components satisfy the functional requirements for each application.

Note: Examples of these processes include analysis, modelling, simulation, and testing. If software is used for any of these processes, it should be described briefly.

4.1.2 Electromagnetic Compatibility

The documented processes ***shall*** verify that the component is capable of electromagnetic compatibility (EMC) compliance at the equipment level.

Note: Certain components, e.g., high-power switching devices, may generate stronger electromagnetic signals than others, and some components are more susceptible than others to electromagnetic interference. IEC 47A/532/NP addresses this in more detail.

Note: EMC compatibility may be demonstrated by analysis, testing, and simulation.

4.1.3 De-rating and Stress Analysis

The documented processes ***shall*** define the limits within which the component is used, and the methods and criteria used to determine those limits.

The documented processes ***shall*** verify that the component is used within the limits defined above.

All instances in which a component is not used within the limits defined above ***shall*** be documented in the design records. In all such instances, either corrective action ***shall*** be taken, or justification for not satisfying the criteria ***shall*** be documented.

Note: Typically, the component manufacture provides derating criteria and methods, and they should be used where applicable. If the component manufacturer does not provide this information, or if it is not applicable, then the Plan owner should develop and document them.

4.1.4 Thermal Analysis

The documented processes ***shall*** verify that the component is used within the temperature limits specified by the component manufacturer, or by the Plan owner.

If the component is not used within the temperature limits specified by the component manufacturer, then the processes of IEC CA-AWG/2/DC ***shall*** be followed.

Note: A common maximum temperature for semiconductor devices is the junction temperature. In some instances for semiconductor devices, and for other types of components, other temperatures may be specified.

Note: In some instances, the maximum temperature may not be specified by the manufacturer. In such instances, the maximum temperature may be calculated from other information supplied by the component manufacturer.

Note: Verification processes may include analysis, modelling, thermal survey, simulation, or testing.

4.1.5 Mechanical Analysis

The documented processes ***shall*** verify that the component is mechanically compatible with the application. This includes mechanical fit, as well as the ability to withstand vibration, mechanical shock, mechanical stresses generated by mismatches of coefficients of thermal expansion of the different materials, and other mechanical stresses.

Note: Verification processes may include analysis, modeling, simulation, or testing.

4.1.6 Producibility

The documented processes ***shall*** verify that the component is useable in the production cycle of the equipment, in an efficient manner, without detrimental effects on the component.

4.1.7 Testing, Testability, and Maintainability

The documented processes ***shall*** assure testability of the equipment.

Note: The focus here is on testing and testability with regard to component verification, not on software or system verification. Examples include board level or sub-assembly level testing, provision for test pins, and that other equipment level tests will be available to verify component function at the appropriate level. Exhaustive testing of complex components is not always realistic, but documented processes should assure some level of evaluation of all components at appropriate points in the production flow.

Note: This requirement also includes design for maintainability, e.g., placement for ease of component replacement, mounting that minimises the risk of damage during maintenance and assures equipment quality following maintenance or repair.

4.1.8 Avionics Radiation Environment

The documented processes ***shall*** verify that the component will operate successfully in the application with regard to the effects of atmospheric radiation, including single event upset (SEU), single event latchup (SEL), and single event burnout (SEB). If radiation effects are accommodated by the equipment design, then the method of accommodation ***shall*** be documented in the equipment design records.

4.1.9 Toxic Emissions

The documented processes ***shall*** verify that the component, when overheated or burned, will not emit sufficient quantities of toxic or otherwise harmful gases to compromise the safety or health of personnel associated with the application.

Note: Personnel may include pilots, flight attendants, passengers, maintenance personnel, or others. In some applications, e.g., satellites in service, the relevance of this requirement may be limited or non-existent.

Note: A suitable method to evaluate toxicity of materials is described in BSI PD 6503, Parts 1 and 2.

4.2 General Qualification Requirements

The documented processes ***shall*** verify that the component is qualified using relevant, credible data.

This requirement lists the requirements for qualifying components used within the component manufacturer's specification range. If the component is used outside the manufacturer's specification range, then the processes of IEC CA-AWG/2/DC ***shall*** be used in addition to these requirements.

Note: This clause lists the requirements for qualifying component manufacturers (5.2.1), the qualification requirements for components obtained from qualified component manufactures (5.2.2), and the qualification requirements for components obtained from component manufacturers who have not been qualified (5.2.3).

4.2.1 Component Manufacturer Qualification

The following ***shall*** be required to qualify an electronic component manufacturer

A. Quality Management System: The component manufacturer ***shall*** have a quality management system assessed and approved according to the relevant parts of ISO 9000, or equivalent.

B. Component Qualification: Components manufactured by the component manufacturer ***shall*** be qualified according to an applicable government standard, an applicable industry consensus standard, or the component manufacturer's documented, applicable qualification process.

C. *Component Manufacturing and Quality Assurance:* The component manufacturer ***shall*** have manufacturing and quality assurance processes assessed and approved according to relevant standards.

Note: Recommended assessment bodies are the IECQ, CECC, STACK International, Defense Supply Center Columbus (DSCC), or equivalent.

4.2.2 Qualifying Components from Qualified Component Manufacturers

Components obtained from component manufacturers who have been qualified according to the requirements of 5.2.1 ***shall*** be qualified with data from one or more of the following:

A. *Component Standards:* The components ***shall*** be compliant to an applicable government standard, an applicable industry consensus standard, or the component manufacturer's documented, equivalent internal standard.

B. *Component Qualification Test Data:* Current, relevant data ***shall*** be obtained from a documented qualification test and/or quality assurance or reliability monitor data that includes test procedures, sampling criteria, acceptance criteria and other relevant criteria. Test stress levels ***shall*** exceed those of the application.

Note: The tests may be conducted by the component manufacturer, the Plan owner, or an authorized third party.

C. *Component In-service Data:* If in-service data is used, the analysis for qualifying the component ***shall*** be documented and ***shall*** include the similarity of the products, the quantity of components used in service, the duration of the service and the acceptance criteria for the process.

Note: Analysis of product similarity compares design application attributes such as functions, stresses, de-rating criteria and the operating and environmental conditions.

D. *Similarity to Previously Qualified Components:* The component ***shall*** be similar to one which has been qualified with data from one of the above sources. Similarity criteria are:

- Both components are from the same component manufacturer.
- Both components are produced according to the same standards, e.g. MIL-PRF-38535, AEC Q100, MIL-PRF-19500.
- Both components are of the same technology type, e.g., complementary metal oxide semiconductor (CMOS), memory, logic, thin film resistor, and the same manufacturing process, e.g., 0.5 micron memory, 0.35 micron logic.
- The ratio of the size of the larger component to the smaller component is based on the most important design or performance characteristic; (e.g., number of gates, number of memory cells, number of leads, etc.,) and conforms to the criteria documented in the Plan.

- Both components are of the same package type; e.g., plastic dual-in-line package (DIP), single-in-line package (SIP), ball grid array (BGA), quad flat pack (QFP), small outline integrated circuit (SOIC).
- Both components are specified by the component manufacturer to operate over the same range of temperature, operating voltage, or other critical parameter.

4.2.3 Qualifying Components from Component Manufacturers Who have Not been Qualified

Components from component manufacturers who have not been qualified according to the requirements of 5.2.1 ***shall*** be qualified with data from at least one of the following sources:

A. External Component Standards: The components ***shall*** be certified as compliant to an applicable government standard or an applicable industry consensus standard.

B. Component Qualification Test Data: Current, relevant data ***shall*** be obtained from a documented qualification test that includes test procedures, sampling criteria, acceptance criteria, and other relevant criteria. Test stress levels ***shall*** exceed those of the application.

4.3 Component Quality Assurance

4.3.1 General Quality Assurance Requirements

The documented processes ***shall*** assure the quality (as required by each application) and required performance of each individual component before equipment delivery.

This requirement lists the requirements for quality assurance of components used within the component manufacturer's specification range. If the component is used outside the manufacturer's specification range, then the requirements of IEC CA-AWG/2/DC ***shall*** be used in addition to these requirements.

4.3.2 Component Quality Assurance Methods

Component quality ***shall*** be assured by one or more of the following methods:

A. Component Standards: "Existing component standards used to assure the on-going quality of purchased components, without additional component data, ***shall*** be identified. These include applicable government standards, applicable industry consensus standards, or the component manufacturer's documented, equivalent internal standards."

Note: Examples of government standards are the DOD qualified manufacturers lists and CECC EN 190000 products; examples of industry standards are AEC Q100 and STACK International S0001.

B. Component Manufacturer Quality Assurance Data: The component manufacturer's quality assurance processes ***shall*** be assessed to verify that they are capable of assuring the quality of the components. The assessment shall include process control processes and acceptance criteria.

Note: Typical quality assurance processes include statistical process control, periodic

qualification testing, component testing and screening, etc.

The quality assurance data produced by the component manufacturer, or the Plan owner's component usage data ***shall*** be reviewed regularly to assure the ongoing quality of the components.

Note: Typically, the above data are available in a variety of formats from the component manufacturer, distributor, or other component source.

C. *Screening at the assembly level:* The following requirements apply to screening components at higher levels of assembly:

- All of the components ***shall*** be subjected to the minimum and maximum specified operating temperature limits of the assembly, plus a margin.

Note: This margin is necessary to compensate for variation in components and manufacturing processes. Typically, the margin is 3-5°C. It should be documented in the Plan. The Plan owner also may include ramp rates, dwell times, and other features of the screening process.

- A thermal survey ***shall*** be conducted on a representative sample of the assembly to verify that the component reaches the temperature limits expected in its application.

Note: The thermal survey process may include thermocouple measurements, infrared thermometry, or other test or analysis processes that are equally effective in measuring component temperature extremes.

- The component ***shall*** be monitored functionally, either directly or indirectly, throughout the screening process. The screening process ***shall*** be sufficient to detect and precipitate defective components.
- Manufacturing, customer rejection, and in-service data ***shall*** be monitored to verify that there are no component quality problems.

Note: The higher-assembly-level component screening process may be combined with environmental stress screening (ESS) or other product assurance processes, provided that the requirements of this section are satisfied. In many cases, this will involve modifying the product assurance process.

D. *Screening at the component level:* The following requirements apply to screening at the component level:

- The components ***shall*** be subjected to screening conditions of sufficient rigor and duration to detect defects.

Note: An historic screening process for integrated circuits is static burn-in at 125°C for 168 hours, with steady state power applied.

- The components ***shall*** be tested functionally before and after screening.
- Screening sampling rates may be reduced from 100%, provided that sufficient data are available, and the reject rate is low enough.

Note: A suggested sampling rate is as follows: if data from 1,000 components are available, with a reject rate of less than 1,000 ppm, then the sampling rate may be reduced to 25%; or if data from 5,000 components are available, with a reject rate of less than 500 ppm, then the sampling rate may be reduced to 10%.

4.3.3 Component Design and Manufacturing Process Change Monitoring

Component data ***shall*** be monitored to detect changes in the component design, and in the component manufacturing processes; and corrective actions to accommodate significant changes shall be implemented.

Note: Most of the components used in aerospace applications are designed and manufactured for other industries, e.g., computers, and are beyond the control of the Plan owner. Frequent design and manufacturing changes are made to improve yield, reduce cost, and enhance performance. Although these changes are documented by the component manufacturer and evaluated for their effects on high-volume applications, their effects on the unique applications of the Plan owner may not be evaluated or documented by the component manufacturer. The purpose of this section is to describe a process to monitor the components to detect any changes that may affect their performance in the applications of the Plan owner.

Note: Typically, the processes will include:

(a) An awareness process, such as access to notices of change from the component manufacturer or distributor.

(b) An evaluation process, such as periodic functional testing and/or destructive physical analysis or construction analysis (assuming an initial physical analysis) of a sample of each component.

(c) Review of the component manufacturer reliability monitor data or quality data to look for failures and other reports of change.

Note: Alternatively, a process of periodic re-qualification of the component may be documented. The periodic re-qualification process should be described here and should include the following, as a minimum:

(a) Re-qualification frequency (,e.g., once per quarter),

(b) Sample size per lot (e.g., 77 pieces), and

(c) Number of lots required (e.g., 3).

4.3.4 Failure Disposition

Component failures encountered during equipment manufacturing, and in-service, ***shall*** be identified and recorded. Significant component failure trends ***shall*** be investigated to determine root cause. Appropriate corrective actions ***shall*** be conducted.

4.4 Component Compatibility with the Equipment Manufacturing Process

The documented processes ***shall*** assure the component is usable as supplied (without any quality or reliability impact) throughout:

- Component shipping, handling, and storage
- Equipment manufacturing, assembly, shipping, handling, storage, test, repair and rework

The documented processes ***shall*** identify the key manufacturing, assembly, shipping, handling, storage, test, repair and rework processes; and the Plan ***shall*** describe how their impact on components are identified, documented and controlled.

Note: Of particular concern is the method of storing plastic-encapsulated microcircuits to assure that moisture ingress does not cause popcorning during assembly. Characterization by component manufacturers of component moisture sensitivity rating in accordance with JESD22-A112 and J-STD-020A will assist in controlling this feature. (Check J-STD-033 for applicability)

Note: Also of concern is protection of components from electrostatic discharge (ESD) damage. Use of the relevant sections of EN 100015, and IEC 61340-5-1, and IEC 61340-5-2 will aid in controlling ESD damage. (Include any US standards as well)

4.5 Component Data

The documented processes ***shall*** include a system for collection, storage, retrieval, analysis and reporting of all relevant data from the component, equipment design, equipment manufacturing and equipment use in service; and for keeping the data available throughout the expected life of the application.

Note: The data need not reside within the data system described. A relational approach may be used wherein the data system provides access to the data. For example, if the component qualification data are collected and stored by the component manufacturer, the equipment manufacturer's data system could consist of a process, software, and hardware to access those data through the component manufacturer's web page or other source, provided the access is available when needed. As another example, any data that are specific to a program, such as functional simulation results or thermal analysis data, could be accessible via a path through the program data. The Plan owner may wish to document process that were developed and documented for other initiatives, such as ISO 9000, QS 9000, or AS 9000, to satisfy this requirement.

Note: Typical data include:

(a) Component Data Sheet or Specification Data, e.g., input and output parameters, voltage rating, packaging dimensions, availability data, etc.

(b) Component Application Data, e. g., functional simulation data, breadboard test data, thermal analysis data, structural analysis data, and electromagnetic emission and susceptibility data.

(c) Component Qualification Data, e. g., component manufacturer qualification test data, component qualification data collected by the equipment manufacturer, or a third party test house, similarity analysis results, and component in-service data used for qualification.

(d) Component Quality Assurance Data, e. g., component manufacturer statistical process control data, component manufacturer component screening data, component screening data collected by the equipment manufacturer or a third party test house, and ESS data from higher-level assembly screeningused to reduce or eliminate screening.

(e) Manufacturing and Assembly Data, e. g., equipment manufacturer statistical process control data, ESS data from manufacturing and assembly, and in-process and final functional test.

(f) Customer Reject Data.

(g) In-service Data.

Note: It is anticipated that this information will be available to the customer upon request.

The documented processes ***shall*** ensure that the following are available for each component: data sheet, technical and application notes, conditions of use, packaging data, reliability data, availability information, storage conditions, assembly data (e.g., soldering conditions) and any additional information to ensure suitability in the application.

Note: Most of the above information should be available from the component manufacturer. If the information is modified, or additional information is required to satisfy this objective, then that information falls within this requirement. Examples include results of additional tests or screens conducted by the Plan owner or third parties, programming data, or modifications to the data sheet.

4.6 Configuration Control

The documented processes ***shall*** verify that the equipment configuration control is maintained.

Note: It is anticipated that this information will be available to the customer upon request.

4.6.1 Component Selection

All components ***shall*** be selected according to documented processes.

Note: Because of the highly individual nature of most Plan owners' administrative processes, no detail is included here. It may include the use of a standard component list, provided the requirements of this Plan are met when the components are placed onto the standard list. Components should then be selected from the standard list for use in specific applications. The selection process may include levels of preference; however, all components are required to satisfy the requirements of this Plan regardless of level of preference. This may refer to another process document describing how parts are selected.

It is recommended that:

- The number of component types should be minimized
- Components be selected from those commercially available and produced in large volume

4.6.2 Component Substitution

After the equipment is certified, qualified or otherwise approved, all component substitutions ***shall*** be made according to documented processes.

Note: Because of the highly individual nature of most Plan owners' administrative processes, no details of the actions and decisions are included here. Reference must be made here to other process documents describing parts substitution practices.

4.6.3 Change Documentation

All component substitutions ***shall*** be documented. The documentation ***shall*** include the following information:

(a) CN (change notice) number,

(b) change date,

(c) other related CNs,

(d) name of the substitute component manufacturer,

(e) reason for change,

(f) type of customer notification required (see the note in 4.6.4, also, it is anticipated that this information will be available to the customer upon request),

(g) applications or equipment in which the new component is used,

(h) existing component part number,

(i) existing component specified temperature range,

(j) new component specified temperature range,

(k) application temperature requirement,

(l) existing component qualification process,

(m) existing component quality assurance process,

(n) new component qualification process,

(o) new component quality assurance process,

(p) a statement that the new component is compliant to this Plan,

(q) a statement that the new component meets the functional and performance requirements of the application

(r) impact of the change on reliability, safety, and other critical equipment requirements, and

(s) required signatures (program manager, component engineer, quality assurance representative, etc.).

Note: Usually, CNs are stored in a controlled, retrievable data system. A copy of the CN form may be included as an Annex to the Plan.

4.6.4 Customer Notifications and Approvals

Customer notifications and approvals *may* be required, depending upon agreement between Plan owner and customer.

Note: Documenting the notification and approval process could be difficult because some customers wish to approve all component substitutions, other customers do not want to approve any substitutions, and still other customers could desire to approve some substitutions but not others. The issue is further complicated by the various types of approvals that some customers could wish to grant. For example, approvals could be divided into two categories: (1) those that affect form, fit, or function of the equipment, and (2) those that do not. Furthermore, there could be two types of approval: (1) active approval, in which the supplier is not allowed to proceed without the written authorization of the customer, and (2) passive approval, in which the supplier may proceed after a specified time period has elapsed, provided that the customer has not objected to the substitution. Some Plan owners might want to include this topic in other documents rather than in this Plan.

4.6.5 Focal Organization

A focal organization for configuration control ***shall*** be identified in the Plan.

4.7 Component Dependability

4.7.1 Component Reliability

The documented processes ***shall*** verify that the installed component meets the required data sheet specification requirements throughout equipment manufacturing, storage, and service life.

Note: The data sheet may be as-published by the component manufacturer, or as-modified by the component user, or a third party, by using one of the processes of IEC CA-AWG/2/DC.

The documented processes ***shall*** identify and record all component-level information that may be used for assessing its effect in the reliability of the application.

4.7.2 Component Availability

The documented processes ***shall*** identify risks associated with use of the component, and methods to mitigate those risks.

The documented processes ***shall*** include tracking and reporting the status of risk mitigation efforts.

The documented processes ***shall*** address logistics supportability and life management issues.

Note: The following are primary examples of component risk areas that may be addressed in the Plan, specifically or generically:

(a) New technology availability or maturity for meeting the specified requirements,

(b) Component delivery and production rate schedules,

(c) Component obsolescence during design, production, or support,

(d) Lack of qualification or quality assurance data,

(e) Qualification test schedule (especially risk of failure),

(f) Cost drivers (especially with custom components),

(g) Component changes (design or process changes, known and unknown),

(h) Quality and reliability of product from component manufacturer (especially new manufacturer), and

(i) Radiation effects, such as single event upset.

Note: Use of components outside manufacturers' specifications and component obsolescence are specific risk issues that that may be addressed outside of or included in this section.

4.7.3 Component Obsolescence

The documented processes ***shall*** address the following: