BY ORDER OF THE COMMANDER

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13 June 2008

Supersedes:
New issue

Air Force Space Command

SPACE AND MISSILE SYSTEMS CENTER STANDARD

PARTS, MATERIALS, AND PROCESSES CONTROL PROGRAM FOR SPACE AND LAUNCH VEHICLES

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

FOREWORD

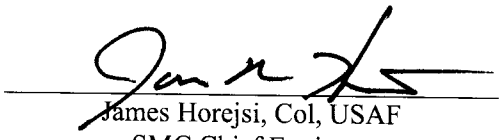
1. This standard defines the Government's requirements and expectations for contractor performance in defense system acquisitions and technology developments.

2. This new-issue SMC standard comprises the text of The Aerospace Corporation report number TOR-2006(8583)-5235.

3. Beneficial comments (recommendations, changes, additions, deletions, etc.) and any pertinent data that may be of use in improving this standard should be forwarded to the following addressee using the Standardization Document Improvement Proposal appearing at the end of this document or by letter:

Division Chief, SMC/EAE
SPACE AND MISSILE SYSTEMS CENTER
Air Force Space Command
483 N. Aviation Blvd.
El Segundo, CA 90245

4. This standard has been approved for use on all Space and Missile Systems Center/Air Force Program Executive Office - Space development, acquisition, and sustainment contracts.



James Horejsi, Col, USAF
SMC Chief Engineer

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1. Scope

1.1 Purpose

This standard establishes the requirements for the preparation, implementation, and operation of a Parts, Materials, and Processes (PMP) engineering control program for use during the design, development, manufacture, assembly, integration and test of space and launch vehicle systems. The implementation of these requirements is intended to:

a. Assure integrated management of the selection, application, procurement, verification, control, and standardization of parts, materials, and processes (PMP).

b. Improve the reliability of program PMP

c. Improve procurement and test of small quantities of piece parts and materials that meet system requirements.

d. Reduce PMP failures at all levels of manufacturing, integration, assembly, and test.

e. Reduce program life cycle costs and enhance product performance during its life cycle.

1.2 Application

This document is intended for use in acquisition of all satellites, upper stages, launch vehicles, and experimental missions intended for spaceflight, where repair is not possible. The document should be cited in the contract statement of work. This document may be tailored by the acquisition activity for the specific application or program prior to contract award.

1.3 Compliance with System Requirements

The requirements of this standard shall not relieve the contractor and subcontractors of the responsibility for complying with all the equipment, system performance, and reliability requirements as set forth in the applicable specifications and contract.

2. Applicable Documents

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or requests for proposal shall apply.

AEROSPACE TOR-2006(8583)-5236	Technical Requirements for Parts, Materials and Processes Used in Space and Launch Vehicles
MIL-STD-1580	Destructive Physical Analysis for Electronic, Electromagnetic, and Electromechanical Parts

NOTE:

All reference in this document to Aerospace Report number TOR-2006(8583)-5236 shall refer to SMC Standard number SMC-S-010 (2008).

3. Definitions and Acronyms

3.1 Definitions

Acquisition Activity	The acquisition activity is the Government, contractor, or subcontractor acquiring the equipment, system, subsystem, part, or material for which this standard is being contractually applied.
As-Built Parts, Materials and Processes List (ABPMPL)	The ABPMPL shall identify all the PMP used in each deliverable end item. The list as a minimum shall include the PMP types, part number, description, quantity, lot date codes, suppliers used in the manufacturing of the item being delivered. All PMP contained "within, or internal to" a deliverable item shall also be listed in the ABPMPL (e.g. elements internal to a hybrid).
As-Designed Parts Materials and Processes List (ADPMPL)	The ADPMPL shall consist of all the PMP items selected and approved for use and listed on the engineering drawing's parts and materials list and on the drawing notes. PMP "within, or internal to" an approved engineering drawing item shall also be listed in the ADPMPL. The list, as a minimum, shall include the part number, description, expected quantity of parts and materials and supplier (See DI-MISC-81276)
Categories of Contractor	The prime contractor is directly responsible to the acquisition activity for ensuring compliance with all the provisions of this standard. Subcontractors and suppliers are subordinate contractors to the prime and are required to meet the provisions of this standard. The prime is responsible for ensuring the flow down of requirements to all subcontractors, suppliers and sub-tier providers, and for managing the implementation of the entire program's PMP activity.
Contracting Officer	A contracting officer is a person with the authority to enter into, administer, or terminate contracts. The term includes authorized representatives of the contracting officer, acting within the limits of delegated authority.
Destructive Physical Analysis	A Destructive Physical Analysis (DPA) is a systematic, logical, detailed examination of parts and complex materials during various stages of disassembly, conducted on a sample of completed parts from a given manufacturing lot, wherein parts or materials are examined for design and workmanship characteristics. The purpose of this examination is to perform analysis of the item to compare it with the approved configuration baseline and to detect anomalies or defects that may be pervasive to the production lot such that they could, at some later date, cause the part or material to fail to meet its' performance or reliability requirements.
Electrical, Electronic, Electromechanical, and Electro-optical (EEEE) Piece Parts	The term "EEEE Parts" is used in a broad sense in this standard and includes electrical, electronic, electromechanical, and electro-optical parts. These parts are associated with electronic assemblies such as computers, communications equipment, control systems, electrical power, guidance, instruments, payloads, and space vehicles.

Electrostatic Discharge (ESD)	ESD is defined as the level of susceptibility of a device to damage by static electricity which is a transfer of electrostatic charge between bodies at different electrostatic potentials caused by direct contact or induced by an electrostatic field. The level of susceptibility of a device is found by ESD classification testing and is used as the basis for assigning an ESD class.
Government Industry Data Exchange Program (GIDEP)	GIDEP is a data-sharing program financed by the Armed Services and managed by the Navy. It is a repository of failure history, usage, and/or test reports on PMP and other commodities. The data is submitted by and distributed to member companies/agencies.
Government Right of Disapproval	The final responsibility for mission success belongs to the government. The government retains the right of review and disapproval of all PMPCB activities and actions. The disapproval means the PMPCB decision or action is rejected, and the approval of the alternative approach is required by the government prior to implementation.
Long Lead PMP	Long lead PMP are items requiring special attention to assure program schedules are met.
Manufacturing Baseline	The manufacturing baseline is a description, normally in the form of a flow chart, of the sequence of manufacturing operations necessary to produce a specific item, part, or material. The manufacturing baseline includes all associated documentation that is identified or referenced, such as: those pertaining to the procurement, receiving inspection, storage, and inventory control of all parts and materials used (even if those parts and materials do not end up as a portion of the completed item). Also included are all manufacturing processes, manufacturing facilities, tooling, test equipment, manufacturing controls,; operator training /certification, inspection/tests, and other quality assurance provisions imposed on the part or material as it moves through the manufacturing process. Any processes, inspections or tests performed at an outside facility must be included in the manufacturing baseline. Documents identified in the manufacturing baseline shall include the following as a minimum: Title, number, date of issue, applicable revision, and date of revision.
Material	Material is a metallic or nonmetallic element, alloy, mixture, or compound used in a manufacturing operation that becomes a permanent portion of the manufactured item.
Material Lot	A material lot refers to material produced as a single batch or in a single continuous operation or production cycle and from the same production lots of raw materials and offered for acceptance at any one time.

Mechanical Piece Parts	The term mechanical piece parts (non-electrical parts) is used in a broad sense in this standard and includes such simple mechanical parts as nuts, bolts, washers, pins, and terminals, as well as more complex assemblies such as, clamps and glass-to-metal seals. Such mechanical parts have a single, non-electrical function (other than electrical grounding), and contain one or more necessary material items. Formed, shaped or otherwise processed portions of packages used by electronic assemblies, such as substrates and lids, shall be considered as mechanical parts.
New PMP Technology	New technology is a part, material, or process (PMP) that has never been previously characterized or qualified for application within the specific space environment, or has limited to no space heritage, or have undergone any changes that may alter the performance, and/or functionality, or reliability of the PMP within the space environment.
Part	A part is one piece, or two or more pieces joined together, which are not normally subjected to disassembly without destruction or impairment of its designed use.
Part / Material Approval Request	A traceability request form for parts (Parts Approval Request, PAR) and materials and processes (Material and Processes Approval Request, MAR) is used to technically justify that a PMP meets program technical requirements.
Parts Derating	Derating is the reduction of operating and environmental stresses as applied to a part or material to reduce its degradation rate and prolong its expected service life. By derating, the margin of safety between operating stress levels and actual failure level for the part or material is increased, providing added protection from system failures. The criteria have been limited to those parts and materials that have generally accepted direct correlation between thermal, voltage or other stresses, and degradation or failure rates.
Parts, Materials and Processes Control Board (PMPCB)	The PMPCB is a formal contractor organization established by contract to manage and control the selection, application, procurement, qualification, and inspection of parts, materials, and processes used in equipment supplied to the standard.
Parts, Materials and Processes Selection List (PMPSL)	The PMPSL is a list of all parts, materials and processes which are approved for design use in a specific contract.
Process	A process is an operation, treatment, or procedure used during a step in the manufacturing or testing of a material, part, or assembly.
Production Lot	A production lot of parts refers to a group of parts of a single part type; defined by a single design and part number; produced in a single production run by means of the same production processes, the same tools and machinery, same raw material, and the same manufacturing and quality controls. All parts in the same lot have the same lot date code, batch number, or equivalent identification.

Program Technical Requirements	These requirements are either stated directly, or derived from the system requirements document, technical requirements document, or listed as technical compliance documents in the contract. Examples of PMP requirements stated or derived from requirements documents are: natural space environments, radiation hardness performance levels, reliability requirements, parts screening requirements, etc.
Prohibited PMP Items	Prohibited PMP are those items that do not meet PMP technical requirements under any circumstances, and are not authorized for utilization.
Restricted or Reliability Suspect PMP	A restricted or reliability suspect PMP is a part, material, or process that is listed in AEROSPACE TOR-2006(8583)-5236 to call attention to special reliability, quality, or other concerns, relating to its procurement, assembly or application.
Space Quality Baseline	The space quality baseline defines available parts, materials, and processes that have been used, manufactured and tested by certified suppliers, and qualified to a set of technical requirements which have been established based on typical satellite and launch system applications.

3.2 Acronyms

ABPMPL	As-Built Parts, Materials and Processes List
ADPMPL	As-Designed Parts, Materials and Processes List
CDRL	Contract Data Report Listing
COTS	Commercial Off the Shelf
CSI	Customer Source Inspection
DPA	Destructive Physical Analysis
DID	Data Item Description
EEEE	Electrical, Electronic, Electromagnetic and Electro-optical parts
ELV	Expendable Launch Vehicle
ESD	Electrostatic Discharge
FARS	Failure Analysis Report Summary
FMECA	Failure Mode Effects and Criticality Analysis
FRACAS	Failure Reporting and Corrective Action System

GFE	Government Furnished Equipment
GIDEP	Government Industry Data Exchange Program
IPT	Integrated Product (or Process) Team
MAR	Material and Process Approval Request
PAR	Part Approval Request
PEMS	Plastic Encapsulated Microcircuit
PMP	Parts, Materials, and Processes
PMPSL	Parts, Materials, and Processes Selection List
PMPCB	Parts, Materials, and Processes Control Board
QML	Qualified Manufacturers List
QPL	Qualified Parts List
RCCR	Request for Change / Clarification to a Requirement
RHA	Radiation Hardness Assurance
RLAT	Radiation Lot Acceptance Testing
SCD	Source Control Drawing
SPC	Statistical Process Control
SQB	Space Quality Baseline
WCA	Worst Case Analysis

4. General Requirements

4.1 Parts, Materials and Processes Control as part of the Overall Systems Acquisition Process

The contractor shall implement a PMP Control Program that meets the programmatic and technical requirements of the contract and statement of work. The contractor is responsible for PMP flowdown and implementation of requirements to all subcontractors, sub-tiers and suppliers.

The contractor shall establish and implement practices, processes and procedures for the PMP technical requirements specified in the following paragraphs, and the contract.

At system design reviews, program management reviews and other reviews (as specified in the contract), the contractor shall present and/or provide objective evidence to the acquisition authority of the contractor's progress in meeting the PMP requirements.

The contractor shall prepare a PMP Program Plan that describes how the contractor's (and all subcontractor's) practices, processes, and procedures for the PMP management and technical requirements specified in this document are implemented. The PMP Program Plan shall be in accordance with DI-MISC-80526.

The contractor shall establish a Parts, Materials, and Processes Control Board (PMPCB) that includes all subcontractors to coordinate the program's PMP control program.

4.1.1 Existing Designs

Existing designs and their attendant PMP shall not be exempt from the PMP management, control, and requirements specified herein. The PMPCB can consider specific requests on a case-by-case basis and provide recommendations to the procurement activity. To support the PMPCB, the requestor shall provide sufficient justification demonstrating the detailed design and parts, material, and processes to be used to fabricate the end item will fully meet the technical, reliability, environmental, and survivability (if required) requirements of the program.

4.1.2 New Technology Insertion Requirements

The contractor shall establish a new technology insertion program for the identification, management, and tracking of new technology. The program shall include a plan that defines the new technology, and the criteria and methodology for characterization and qualification of new technology.

4.2 Parts, Materials, and Processes Control Board

The contractor shall establish a Parts, Materials, and Processes Control Board (PMPCB) to coordinate and manage the program's PMP control program. The Prime Contractor shall designate a PMPCB Chairperson responsible for the planning and execution of all PMPCB actions and decisions. The PMPCB decisions shall not change the contractual requirements of the program. The PMPCB shall include a government member or designated representative who shall: 1) be an active member of the PMPCB, 2) receive all meeting notifications, 3) receive all PMPCB agendas and all PMP data and material(s) with a sufficient amount of time for review. The government or designated representative retains the right of review and disapproval of PMPCB decisions while present at the PMPCB meeting or within a mutually agreed upon period. All PMP items including subcontractors, major suppliers, and

vendors, selected and installed in flight, qualification and proto-qualification hardware shall be managed through the PMPCB. All program contractors and subcontractors shall support the PMPCB performing and/or implementing the decisions, findings, and action items of the PMPCB.

The contractor shall implement procedures and processes that define PMPCB functions, roles, responsibilities, membership, (e.g., organization chart, meeting procedures, data submittals, record keeping (agendas, meeting minutes, decisions, action items, etc.)), and interactions with other program functions; (e.g., failure review boards, material review boards, configuration control boards, survivability working groups, etc.). The PMPCB chairman shall hold regularly scheduled meetings as determined necessary to meet the program requirements.

4.2.1 Delegation

The authority to conduct PMPCB's may be delegated by the prime contractor PMPCB chairman to major subcontractors, where the technical area is appropriate to the subcontractor. Each organization so delegated shall provide the higher acquisition activity PMPCB chairman (or delegate) and the government, and/or representative, the opportunity to participate in PMPCB meetings. All subcontractor PMPCB information and decisions shall be made available in a timely manner to the prime contractor and the government. The prime contractor and the government retain the right of review and disapproval, of delegated PMPCB decisions.

4.2.2 PMPCB Responsibilities

The PMPCB shall establish operating procedures in accordance with this standard, including:

Establish and maintain all Parts, Materials and Processes Lists for the overall system

Review and approve all Parts, Materials or Processes Approval Requests (PARs/MARs), with supporting details, to ensure all PMP program technical requirements (i.e. current version of Aerospace TOR-2006(8583)-5236) are met

Interface with the design activity to ensure the design selection and use of PMP that meets the technical program requirements

Ensure derating of all electronic, electromechanical, and electro-optical parts, and adequate design margins for mechanical parts used in deliverable end items

Ensure the performance of Destructive Physical Analysis (DPA) for all EEEE parts including the establishment of policies, procedures, and reporting formats. DPA problems and anomalies of concern shall be reviewed and dispositioned by the PMPCB.

Ensure the review of the results of DPA Reports, Material Review Board (MRB) actions, Failure Analysis Reports, Failure Review Board actions, and any other actions pertaining to PMP

Ensure the timely identification of long lead and other problem procurements

Ensure the identification and configuration control of any changes to PMPCB approved documentation

Ensure that laboratories and analysis facilities used for screening and/or evaluation of PMP are assessed for capabilities of equipment, personnel and documented practices/procedures before performing analyses in compliance with this standard

Establish and maintain a Prohibited PMP List

Review all GIDEP, NASA, DOD, contractor, subcontractor, and other agency PMP alerts, advisories, and reports for relevance to items used in the program/system and ensure appropriate mitigation is implemented.

4.3 Parts, Materials and Processes Functions, Roles, and Responsibilities

The contractor shall define, plan, and implement the functions, roles, and responsibilities within the program's organization. This shall include both functional and programmatic reporting.

4.3.1 Requirements Derivation and Flowdown Process

The contractor shall implement procedures and processes for the generation, analysis, flowdown, and verification of PMP requirements from the contract statement of work, top level system specification, the system environmental requirement specification(s), and other contractual documents as required, to lower level systems / segments / product specifications, subcontractor statement of work, and PMP specifications.

4.3.2 Parts, Materials and Processes Selection Process

The contractor shall implement procedures and processes for the selection and application of PMP items. All PMP selected and applied in the system shall meet the program technical PMP and system performance requirements. The PMPCB is responsible to ensure that PMP used throughout the system meets the application, reliability, quality, and survivability requirements as derived from the system level requirements. All heritage PMP shall be re-evaluated for "each" Program application. The contractor shall develop a Parts, Materials, and Processes Selection List (PMPSL) to be used by all contractors and subcontractors on the program. Subcontractors may have their own PMPSL which meet all requirements of this standard and is reviewed and approved by the prime contractor PMPCB. All parts and materials approved for use shall be traceable to a Part/Material Approval Request (PAR/MAR) in which the parts and materials are technically justified with approved and qualified sources of supply, approved procurement specifications, and defined application conditions. A PAR/MAR will be prepared and submitted to the PMPCB for approval.

4.3.2.1 PMP Procurement

The prime contractor is responsible for ensuring compliance of any PMP to all system and program requirements specified in the contract. Parts and materials shall be procured on the Space Quality Baseline (SQB) or to contractor prepared drawings (e.g. SCDs) that fulfill the program technical requirements (e.g. AEROSPACE TOR-2006(8583)-5236) and ensure their equivalency to the SQB qualification, characterization, environmental stress capability, long-term reliability, and survivability (if applicable).

The Space Quality Baseline (SQB), as defined in 5.1, represent those PMP items that are available within the industry and have a demonstrated heritage of high reliability, whose technology has been formally qualified to a military standard, and for which the suppliers have been formally certified by

DSCC as having disciplined and documented practices and processes consistent with high reliability applications.

While either approach is technically and contractually acceptable, the government's preference is to maximize the use and procurement of military qualified products listed on the SQB. This will facilitate the continued, consistent and readily available sources of supply for high reliability PMP that meet space system requirements and applications.

All parts and materials shall be procured from the original qualified parts/materials equipment manufacturer (OEM), or its franchised/authorized distributor, and shall come with a certificate of compliance and other required data in accordance with the applicable military specification or space-level-equivalent SCD.

4.3.3 Parts, Materials and Processes Characterization and Evaluation Process

The contractor shall implement procedures and processes for the characterization and evaluation of PMP items to verify that they meet the program performance and PMP technical requirements. The procedures and processes shall include, but are not limited to:

Analytical methodologies used to select PMP components; e.g., functional, design margin

Electrical stress, derating, reliability, thermal, radiation hardness assurance analyses, etc.

Outgassing, contamination, and cleanliness

Corrosion control, stress corrosion cracking, dissimilar metals / materials analysis

Atomic Oxygen and micrometeoroid environmental analysis

Parts and materials obsolescence

Supplier selection and qualification

Technology insertion and qualification

Prohibited and restricted PMP

4.3.3.1 Part & Circuit Stress Analysis

The contractor shall implement procedures and processes for performing part and circuit stress analysis. The contractor shall complete the part and circuit stress analysis prior to design release. The analysis shall take into account part parameters such as steady state and transient power loadings for analog circuits and power circuits, propagation delay compatibility for digital circuits and common mode protection for amplifiers. The analysis shall include temperature profiles for individual parts and thermal models that account for environmental factors, structural conduction, effects of power loading on junction temperatures or other applicable parameters where heat accelerates the wearout mechanism of a given device. The analysis shall also include radiation effects degradation, and other end-of-life phenomenon.

The results of these analyses shall be used as inputs to the Failure Mode Effects and Criticality Analysis (FMECA), Worse Case Analysis (WCA) and other analytical analyses.

4.3.3.2 Parts Derating Criteria

The contractor shall implement procedures and processes to ensure derating criteria meets the system technical requirements. The contractor shall implement procedures and processes to verify that the derating criteria has been implemented on and applied to all parts and materials used for contractor and subcontractor flight, qualification and/or proto-qualification hardware. All electrical, electronic, electro mechanical and electro-optical (EEEE) parts and materials shall be derated for power loading, temperature, duty cycle, service life, and radiation exposure. Approved derating requirements shall be imposed upon all vendors and subcontractors. The PMPCB shall review and approve all derating criteria used in the program. If a part or material is selected for an application that is not covered by the derating criteria defined in AEROSPACE TOR-2006(8583)-5236, the derating shall be determined on a case-by-case basis.

4.3.3.3 Commercial Off the Shelf Components and Assemblies

The contractor shall implement procedures and processes ensuring that Commercial Off the Shelf (COTS) items meet the system performance, application and PMP technical requirements of this standard and shall be approved by the PMPCB. All COTS items shall be treated as new technology.

4.3.4 Parts, Materials, and Processes Drawing Review

The contractor shall implement procedures and processes for review and approval of program engineering drawings and product specifications by the responsible PMP organization. As part of the drawing review process, the responsible PMP organization shall, as a minimum:

Ensure that the proper and correct PMP requirements are stated in program product specifications and in subcontractor procurement specifications

Ensure that the PMP listed on the engineering drawings (parts list and drawing notes) are approved for use in the intended application with its specific thermal, radiation, electrical, and mechanical stresses; and that they are correctly listed on the As-Designed PMP List

Ensure that Prohibited PMP items are not used

Ensure that Restricted usage PMP items (if used) are being used in the intended function with the correct controls, cautions, and application notes

Ensure that the parts and materials are properly derated for thermal, radiation, electrical, and mechanical stresses

Ensure that materials are not selected which may deleteriously interact as a result of corrosion, stress corrosion, outgassing or other degrading mechanisms

4.3.5 Parts, Materials, and Processes Prohibited and Restricted Usage Items

The contractor shall implement procedures and processes to publish, maintain, and conduct full configuration control of a prohibited PMP items list, and a restricted usage PMP list. The restricted usage PMP List shall include parts and materials meeting any of the following:

Restricted in temperature range capability

Exceed outgassing requirements,

Are suspect reliability, or have known reliability hazards due to inherent design weaknesses, GIDEP recalls, internal purge/scrap actions, or any lot-related problem

Are COTS products

Present potential of contamination risk

Have limits and/or application restrictions

GIDEP or other Alert issues

Both lists shall be included in the flowdown of requirements to Program suppliers, and subcontractors. The contractor shall be responsible for ensuring that prohibited items are not used in the design and construction of flight, qualification, and proto-qualification hardware and that all uses of Restricted PMP are reported to the Prime Contractor's PMPCB.

4.3.5.1 Use of Plastic Encapsulated Microcircuits (PEMS)

A PEM shall not be substituted for a form, fit, and functional equivalent, high reliability, hermetic device in flight, qualification or proto-qualification hardware. All usage of PEMS shall be considered new technology, and require appropriate new technology insertion, characterization, and qualification for “each” application.

The contractor shall implement procedures and processes to ensure that the PEM, if used, meets the system performance and PMP technical requirements of the program, and shall have been approved by the PMPCB.

4.3.5.2 Prohibited Materials: Use of Lead-Free Solders, Tin and Other Prohibited Metal Finishes

The contractor shall prohibit the use of pure tin, or >97% tin,(Tin shall be alloyed with a minimum of 3 percent lead (Pb) by weight) pure zinc and pure cadmium coatings or finishes for all flight, qualification and proto-qualification hardware. Lead-free tin alloy coatings or solders have not been approved for use on space hardware. The contractor shall demonstrate that the lead-free tin alloy soldering process used to manufacture the equipment meets the program’s requirements for reliability, mission life, parts compatibility, rework and thermal, vibration and shock environments. The information provided shall include data from design of experiments, life test results, whiskering and /or tin pest susceptibility evaluation results, statistical process control monitor data, temperature / materials compatibility analyses, and mechanical test results. Customer program management shall review and approve this plan. Note that Sn96/Ag4 and Sn95/Sb5 are standard solder-attach materials used in high temperature soldering applications and are acceptable for those applications only.

For continuous applications at temperatures above 60ºC, all tin-alloy finishes shall employ a barrier-metal (such as nickel) when used over a copper base metal.

4.3.6 Parts, Materials, and Processes Risk Management

The contractor shall implement procedures and processes for identifying, assessing, mitigating, tracking, and reporting PMP risk items. Such risks shall include both schedule (delivery) and technical

risks (such as, qualification, temperature, radiation, reliability, single source, off-shore source, new technology, etc). The PMP risk items shall be reported to the PMPCB.

4.3.7 Parts, Materials, and Processes Subcontract and Procurement Management

The contractor shall implement procedures and processes for the procurement of parts and materials from subcontractors, and suppliers. The contractor shall validate that no prohibited part or material is procured. The procedures and processes shall include descriptions for each of the following subparagraphs:

4.3.7.1 Review and Approval of Subcontractor PMP

The contractor shall implement procedures and processes for the review, approval (or disapproval) of subcontractor PMP. The review shall consist of assessing the subcontractor's internal PMP documentation, processes, and procedures to insure compliance with all PMP technical requirements.

4.3.7.2 Parts, Materials, and Processes Supplier Selection, Qualification and Monitoring

The contractor shall implement, and require all subcontractors to implement procedures and processes for the selection, qualification, periodic re-qualification and monitoring of PMP suppliers, manufacturers, and laboratories. The process shall specify the selection criteria, control of software and hardware configuration, frequency of re-visits, problem resolution, and Customer Source Inspection (CSI) procedures. The findings / results of these audits and reviews shall be submitted to the PMPCB for review.

4.3.7.2.1 PMP Qualification

All PMP, including any processes developed to accomplish rework, repair or retrofit, shall be qualified for program use. Only qualified PMP shall be used on flight hardware. For each non-qualified PMP, the contractor through the PMPCB shall prepare a qualification plan and procedure based on the program technical requirements. The qualification plan shall identify all conditions and testing necessary to meet the program and mission reliability requirements. These plans and procedures shall be reviewed and approved by the PMPCB. A summary report of qualification test results shall be submitted to the PMPCB.

4.3.7.3 Authorized Sources of Supply

Parts and materials may only be procured from the PMP manufacturer (OEM) or their franchised/authorized distributor. A certificate of conformance from the PMP manufacturer is required in the procurement documentation.

4.3.7.4 Customer Source Inspection (CSI)

The contractor shall establish and implement processes and procedures for conducting CSI, including determining which products or parts are to be inspected, at what points in the process, and what CSI review activities are required. CSI points shall be identified in the sub-tier procurement documents and flowcharts. The CSI review may include, but is not limited to, the following:

Review of the manufacturer's process documentation

Review of the documentation that accompanies each lot

In-process inspections that are not available non-destructively upon receipt, such as prior to plating, pre-cap visual, etc

Verification that manufacturing steps, tests, and inspections have been performed as specified for each part or item type

Verification that the required inspections by the manufacturer's Quality Control Department have been properly performed, and the travelers completed

Verification of lot integrity and traceability of parts and materials as defined in the specifications

Review of test or inspection data, witnessing and/or performing the required inspections / tests in accordance with detailed instructions and procedures

Review of Statistical Process Control (SPC) and/or Technology Review Board (TRB) optimization data

Review of all Material Review Board (MRB) non-conformance dispositions.

4.3.7.5 Fasteners, Bolts, Screws, Rivets, and other Mechanical Piece Parts

The contractor shall implement procedures and processes to ensure that fasteners, bolts, screws, rivets and other mechanical piece parts meet the structural, strength, torque, and plating requirements of their procurement specification. If fasteners, bolts, screws, rivets, nuts and other mechanical piece parts are procured using Industry Standards (such as ASTM, SAE, ANSI, NASM, AMS, etc), the contractor shall require the supplier to provide a lot qualification report showing that the delivered parts and materials meet the requirements of the procurement specification. A certificate of conformance shall not be substituted for the lot qualification report.

4.3.8 Parts, Materials, and Processes Traceability and Lot Control

The contractor shall implement, and require all subcontractors to implement, procedures and processes for establishing lot date/batch number control and two-way traceability for PMP manufactured into flight, qualification, and proto-qualification hardware. The contractor shall be capable of determining through searching electronic records which part numbers, part manufacturers, and lot date codes are being used in which next higher level assemblies / components.

4.3.9 Parts, Materials, and Processes Incoming Inspection

The contractor shall implement procedures and processes for the incoming inspection of parts and materials, including the verification of the absence of prohibited materials on internal or external metal surfaces of parts or materials. Incoming inspection requirements shall be established consistent with any CSI requirements.

4.3.10 Parts, Materials and Processes Defective Material Control

The contractor shall implement and require all subcontractors to implement procedures and processes for the control and disposition of defective, discrepant and non-compliant PMP items. The disposition of defective, discrepant and non-compliant PMP items shall be reported to and reviewed as necessary

by the Material Review Board and by the PMPCB. The information shall be provided to the contractor's Failure Reporting and Corrective Action System (FRACAS) or equivalent.

4.3.10.1 Re-use of Parts and Materials

The contractor shall implement procedures and processes to ensure that when parts or materials, once installed in an assembly, and then removed from the assembly for any reason, are not re-installed in any flight, qualification, or proto-qualification hardware item without PMPCB approval.

4.3.10.2 Failure Analysis

The contractor shall implement procedures and processes for participation of a PMP representative on the program's failure review board (FRB). The contractor's process shall describe the procedures to be performed for failure analysis on PMP items.

Failure analysis shall be performed on part and material failures experienced during assembly and testing, and all catastrophic failures during part manufacturing and testing. Failures shall be analyzed to the extent necessary to understand the failure mode and cause, to detect and correct out-of-control processes, to determine the necessary corrective actions, and to determine lot disposition. When required, a Failure Summary and Analysis Report (FSAR) in accordance with DI-RELI-80255 and Appendix C herein shall be prepared and reviewed by the PMPCB. The PMPCB shall determine and implement appropriate corrective action for each PMP failure. All failures, and the results of final failure analysis, shall be reported to the PMPCB. Failure analysis reports shall be retrievable for the duration of the contract, and shall be available to the acquisition activity. When required, a Failed Item Analysis Report in accordance with DI-RELI-80253 shall be prepared and reviewed by the PMPCB.

4.3.11 Handling, Storage, Packaging and Preservation Control

4.3.11.1 Handling and Storage Procedures and Processes

The contractor shall implement handling and storage procedures and processes to prevent part and material degradation. The handling and storage procedures shall be maintained from receipt of parts and materials through inspection, kitting and assembly. These procedures shall include, but are not limited to:

Clearly identifiable containers/markings to identify space quality parts

Control measures to limit personnel access to parts and materials during receiving inspection and storage

Facilities/provisions for interim storage of parts and materials, as necessary

Provisions for protective cushioning, as required, on storage area shelves, and in storage and transportation containers

Protective features of transportation equipment design to prevent packages from being dropped or dislodged in transit

Protective bench surfaces on which parts and materials are handled during operations such as test, assembly, inspection, and organizing kits

Required use of gloves, finger cots, tweezers, or other means when handling parts to protect the parts from contact by bare hands

Provisions for protection of parts susceptible to damage by electrostatic discharge

4.3.11.2 Electrostatic Discharge Prevention and Control

The contractor shall implement and require all subcontractors to implement procedures and processes for prevention and protection of Electrostatic Discharge (ESD) sensitive parts and assemblies to the lowest voltage of the most sensitive part. The PMPCB shall review and approve all subcontractor ESD procedures and processes.

4.3.11.3 Preservation and Packaging

The contractor shall implement processes and procedures for the preservation and packaging of parts and materials. All parts that are subject to degradation by electrostatic discharge shall be packaged in accordance with contractor approved ESD procedures.

4.3.12 Destructive Physical Analysis

The contractor shall implement procedures and processes for performing Destructive Physical Analysis (DPA), consistent with program technical requirements and MIL-STD-1580. The procedures shall include provisions for: sample sizes/confidence levels, in-house facility versus an outside test laboratory, part types, and DPA methodology per MIL-STD-1580, or equivalent. Unless otherwise specified in the contract statement of work or system specification, the contractor and all subcontractors shall perform a DPA on the parts types listed below including all devices procured to military specifications. For small lots, the contractor can implement a small lot sampling plan approved by the PMPCB.

Capacitors, All types

Coils, Fixed, Molded

Connectors, All types

Crystals, Quartz

Filters, EMI, Low-Pass, Feed-Thru, EMI, RFI, Metal Cased, RC Network (ARC Suppressor)

Fuses, Subminiature, Hermetically Sealed

Hybrid Modules, All classes

Magnetics (transformers, inductors, RF coils, Motor / actuator windings)

Microcircuits, all classes

Optically Coupled Isolators

Oscillators

Relays

Semiconductors, all classes including Plastic Encapsulated

Switches, Snap Action, Thermal

Thermistors (Disc and Bead) Encapsulated, Glass Bodied Hermetic

Relays (Electromechanical and solid state)

Resistors, All types

Optical/electro-optical devices

The contractor shall receive and maintain electronic copies of all Program DPA reports, including DPA reports from their subcontractors. Unless otherwise required by the contract statement of work, the contractor shall maintain a record of all DPA reports and provide an electronic copy of the reports to the government program office, if requested.

4.3.13 Parts, Materials, and Processes Shelf Life Control

The contractor shall implement, and require all subcontractors to implement shelf life control procedures and processes that identify the shelf life limitations for all parts and materials used on flight, qualification, and proto-qualification hardware. These procedures shall specify the storage conditions, length of time required, and minimum requirements for re-inspection, retest, or any other action required to ensure maintenance of space flight quality and reliability. The procedures shall be reviewed and approved by the PMPCB.

4.3.13.1 Material Shelf Life Control

In addition to general age limitation considerations, the procedures shall identify any specific environmental requirements: i.e., temperature, humidity, storage in dry nitrogen, etc. for storage and any associated limitations on shelf life of materials. Limitations shall be listed on the ADPMPL.

4.3.13.2 Parts Shelf Life Control

The procedures shall identify the part types considered to be potentially age sensitive, and the specific actions necessary to be taken with these age sensitive parts. When parts in storage exceed specified age limits, the contractor shall perform an assessment/retest as determined by the PMPCB to re-establish the flight worthiness of the parts. As a minimum, all EEEE parts with lot date codes in excess of seven (7) calendar years shall be submitted to re-screening and DPA. In addition, the PMPCB shall consider the following when assessing continued use of aged inventory:

Original part quality (Class V/S, SCD, Class B, etc.)

Lot history (supplier's percent defective, quantity used to date, number of failures, etc.)

Review of original screening/test data

Review of problem/GIDEP Alerts

Review of original DPA

Review of storage environment controls (temperature, ESD protection, handling, etc.)

Application criticality, redundancy, etc.

Availability of retest equipment, screening facilities, potential for part damage, etc.

4.3.14 Use of Alternate QCI and Small Lot Sampling Plans

The contractor may implement alternate Quality Conformance Inspection (QCI) procedures and processes and a small lot sample plan for small lot quantities in accordance with the program's technical requirements. The PMPCB shall review these procedures and processes.

4.3.15 Government Industry Data Exchange Program (GIDEP) Alert Participation

The contractor shall implement procedures and processes for their participation in the GIDEP program, including the submission of alerts/advisories to GIDEP when warranted. The processes and procedures shall describe how the contractor (a) receives alerts and advisories from GIDEP and other agencies, (b) determines any impact to their product design and already manufactured hardware, and (c) implements corrective action procedures when design and / or produced hardware are affected by GIDEP and other agency alerts/advisories. The results of all impact assessments for GIDEP and other agency alerts/advisories shall be reported and documented in the PMPCB meeting minutes.

4.3.16 Parts, Materials and Processes Corrosion Control

The contractor shall implement procedures and processes for the analysis and prevention of corrosion. This includes dissimilar metals, launch integration environment(s), and on-orbit operation effects (including atomic oxygen effects, if applicable) on spacecraft surface materials. The total life cycle environment; i.e., manufacturing, test, storage, transportation, satellite integration, launch vehicle integration, launch site preparations, launch pad, ascent, and on-orbit shall be used in the corrosion control analysis.

4.3.17 Contamination Control Program

The contractor shall develop and implement a Contamination Control Program for the development, analysis and implementation of contamination control processes and procedures. A typical example of a contamination control program is defined in Figure 4.3-1.

4.3.17.1 Contamination Control Requirements Analysis

The contractor shall implement processes and procedures for the generation, analysis, flowdown and verification of contamination control requirements. The generation of contamination control requirements shall be based on the System’s Concept of Operations (CONOPS) document, the system environmental specification, manufacturing, assembly, test, integration, launch site integration and on-orbit environments.

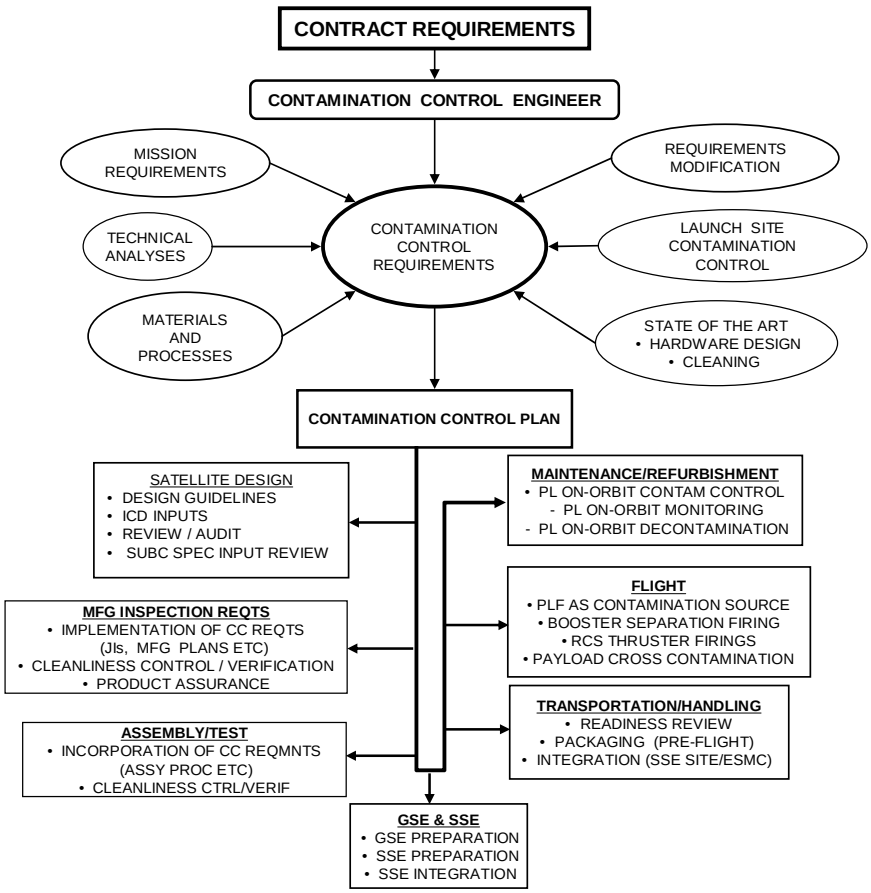

Figure 4.3-1. Typical interactions of contamination control with the program elements.

4.3.17.2 Cleanliness Requirements and Clean Room Environmental Controls

The contractor's processes and procedures shall define materials selection criteria; design techniques for avoiding contamination; cleaning or conditioning methods to be employed; and environmental cleanliness controls for the manufacture, assembly, test, integration, storage and operations of all flight, qualification, and proto-qualification hardware and special test equipment that will be located and/or operated in clean rooms, and, if required, launch site operations.

4.3.17.3 Training and Certification

The contractor shall implement processes and procedures for the training and certification of all personnel who have access to clean rooms. The training and certification procedures shall include prevention of contamination, clean room operating procedures, handling and operating of equipment in the clean room, and notification of a contamination event.

4.3.18 Parts and Materials Radiation Hardness Assurance Control

The contractor shall implement procedures and processes for the participation of the PMP engineering group on the program's survivability working group.

4.3.18.1 Radiation Hardness Assurance Control Program

The contractor shall develop and implement a Radiation Hardness Assurance (RHA) Program for the design, development and production of all qualification, proto-qualification, and flight hardware in accordance with Appendix B. The PMPCB shall be responsible for ensuring that all parts and materials hardness assurance parametric requirements have been established. The plan shall be in accordance with DI-NUOR-80156A. An example of a typical Radiation Hardness Assessment is shown in Figure 4.3-2.

4.3.18.2 Integrating Subcontractor RHA Requirements

The contractor shall flowdown to all subcontractors the applicable RHA requirements to ensure parts and materials hardening requirements are met.

4.3.18.3 Radiation Hardness Assurance Processes and Procedures

The contractor shall implement radiation hardness assurance procedures and processes for:

Hardness assurance requirements derivation/ flowdown to the piece part level considering spacecraft surface materials, space radiation environmental effects analysis on system / circuit performance (natural space and if applicable man-made environments), for the worst case circuit conditions.

Circuit schematic, functional description, pin-out, operation conditions, and application of each critical circuit.

End-of-life radiation environment for each critical material and for piece parts in each critical circuit.

Design margin analysis.

List of piece parts for each critical circuit showing the radiation design margin between worst-case circuit requirements and the degradation of piece parts due to radiation.

List of materials subject to radiation degradation showing the radiation design margin between the worst-case requirements and the anticipated degradation of the material over its design life.

Selection, characterization, and assessment of parts and materials.

Hardness assurance control requirements imposed on subcontractors and suppliers.

Determination of parts requiring radiation lot acceptance testing (RLAT).

RLAT procedures.

Hardness assurance data collecting and reporting.

Testability requirements and description of hardness assurance test items/test structures and process monitors.

Special controls, lot formation control, sample confidence level, screening and testing specified for parts with inadequate design margin.

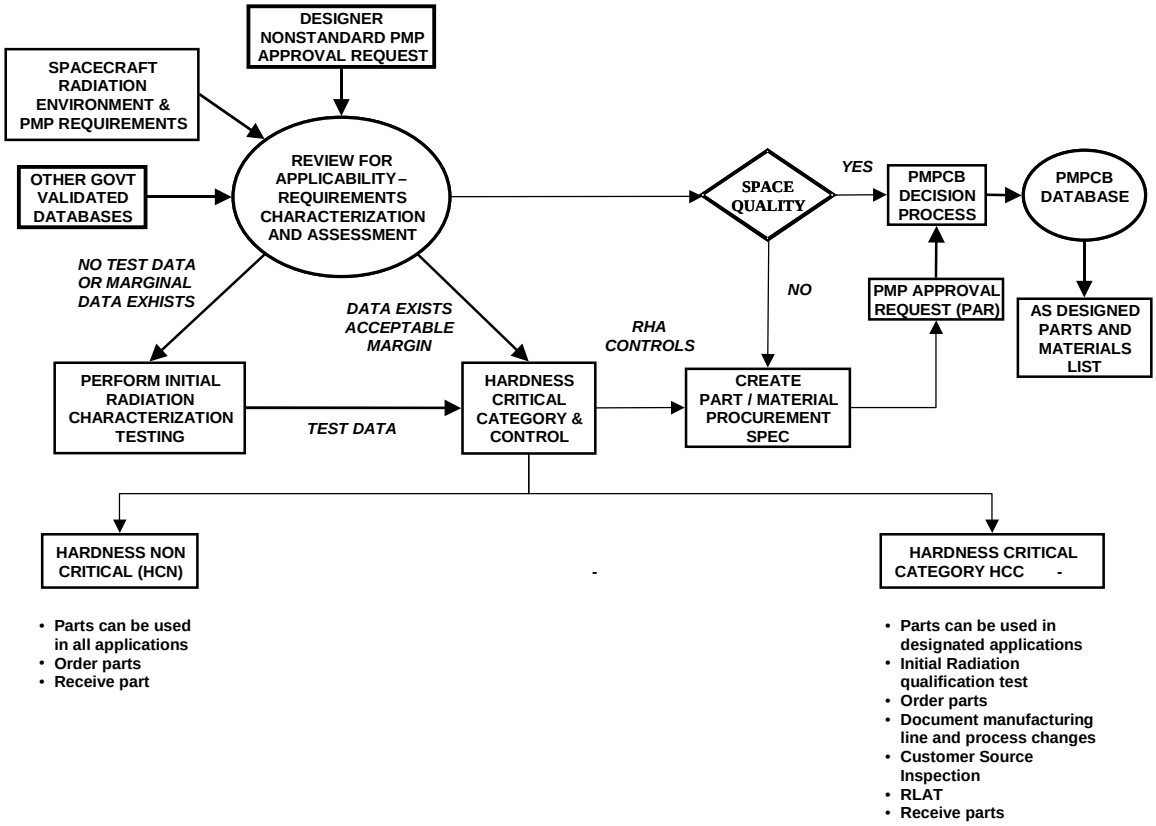

Figure 4.3-2. Typical radiation hardness assessment for selection of EEEE parts process flow.

4.3.18.4 Survivability / Radiation Hardness Assurance Design Guideline Document

The contractor shall prepare a RHA Design Guidelines, which details or references all radiation analysis procedures, test procedures, data formatting and reporting requirements for parts and materials.

4.3.19 Survivability / Radiation Hardness Assurance Test Plan

The contractor shall prepare a system / component survivability test plan. The plan shall specify the test objectives, traceability to originating requirements, and the following:

Radiation test methods and test circuits.

Sample size/confidence level, and sampling method.

Radiation types and specification level.

Pre- and post-radiation response parameters and failure criteria.

Data reporting and analysis.

Radiation test facility and set-up

Dosimetry requirements.

Special radiation tests such as electrical or radiation screening tests.

4.3.20 Government Furnished Equipment

Parts and materials contained in unmodified government furnished equipment (GFE) used in qualification, proto-qualification, and/or flight hardware shall not be subject to the contractor's PMP control.

4.3.21 USAF Space Parts Working Group (SPWG)

The contractor is encouraged to provide representation to the USAF Space Parts Working Group meetings. These meetings are held every year at or near the USAF SMC facility. The purpose of the meeting is to provide a forum for the exchange of information relating to technical, procurement, application and status issues of interest involving space programs and space quality parts, materials and processes.

4.3.22 Data Retention

The contractor shall establish procedures for the retention of data and records to include as a minimum incoming inspection test data, lot qualification and acceptance test data, DPA samples, radiation hardness assurance test data, traceability data and other data as determined by the PMPCB for the life of the program or a period of time specified by the acquisition activity.

4.4 Parts, Materials, and Processes Selection List.

The contractor shall document, maintain and configuration-control a Parts, Materials, and Processes Selection List (PMPSL). As a minimum, unless defined in the contract and statement of work, the contractor shall make available to the acquisition activity the PMPSL at contract award and SDR. This list shall contain a complete listing of all the electrical, electronic, electro-mechanical, electro-optical (EEEE), and mechanical parts, metallic and non-metallic materials, and processes that are available for use in the design of all flight, qualification, and proto-qualification hardware. The list may be in the contractor's format, but shall contain, as a minimum, the information described in the following subparagraphs. The contractor shall provide the PMPSL in electronic format as defined in DI-MISC-81277.

4.4.1 Electrical, Electronic, Electromechanical, and Electro-Optical Parts List

The EEEE parts list shall contain the following data:

MIL-Spec / SMD / DSCC part number (if applicable)

Class / Level (K, V, S, etc.)

Manufacturer's Part Number

Contractor's Source Control Drawing (SCD) or internal part number

Part description, nomenclature, including technology (e.g., CMOS, HBT, etc.)

Additional Screening Requirements (DPA, PIND, RGA, X-ray, RLAT, Groups B, C and/or D screenings, etc.)

Approved / recommended supplier(s)

Application note and/or restriction information

4.4.2 Mechanical Piece Parts

The mechanical parts shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer's part number

Contractor's SCD or internal part number

Part description, Nomenclature

Additional Screening and/or Preparation Requirements (hardness, tensile, surface finish verification testing, etc.)

Approved / recommended supplier(s)

Application note and/or restriction information

4.4.3 Metallic Materials

The metallic materials list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer's part number

Contractor's SCD or internal part number

Material description, Nomenclature

Form (Bar, Sheet, Plate, etc.)

Additional Screening or Handling Requirements (hardness, tensile, surface finish verification testing, etc.)

Approved / recommended supplier(s)

Application note and/or restriction information

4.4.4 Non-Metallic Materials List

The metallic materials list shall contain the following data:

Material type (Adhesive, coating, epoxy, gasket, insulator, sleeving, wire, etc.)

Material description, Nomenclature

Additional Screening or Handling Requirements (hardness, tensile, adhesion verification testing, etc.)

Outgassing data and characteristics

Shelf Life Control

Approved / recommended supplier(s)

Application note and/or restriction information

4.4.5 Processes List

The processes list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS number (if applicable)

Manufacturer's process number

Contractor's internal process number

Type process (Bonding, Coating, Machining, Plating, Soldering, etc.)

Special Handling / Process Characteristics

Approved / recommended supplier(s)

Application note and/or restriction information

4.5 As-Designed Parts, Materials and Processes List

The contractor shall document, maintain and configuration-control an As-Designed Parts, Materials and Processes List (ADPMPL). Unless defined in the contract and statement of work, the contractor shall make available to the acquisition activity the ADPMPL at PDR and CDR with clearly highlighted updates after CDR on an as required basis. This list shall contain a complete listing of all contractor and subcontractor electrical, electronic, electro-mechanical, electro-optical (EEEE), and mechanical parts, metallic and non-metallic materials, and processes used in the design of all flight, qualification, and proto-qualification hardware. The list may be in the contractor's format, but shall contain, as a minimum, the information described in the following subparagraphs and Appendix A herein. The contractor shall provide the ADPMPL in electronic format as defined in the DID (DI-MISC-81276).

4.5.1 Electrical, Electronic, Electromechanical, and Electro-Optical Parts List

The EEEE parts list shall contain the following data:

MIL-Spec / SMD / DSCC part number (if applicable)

Class / Level (K, V, S, etc.)

Manufacturer's Part Number

Contractor’s Source Control Drawing (SCD) or internal part number

Part description, nomenclature, including technology (e.g., CMOS, HBT, etc.)

Additional Screening Requirements (DPA, PIND, RGA, X-ray, RLAT, Groups B, C and/or D screenings, etc.)

Where used (assembly number and name of next higher)

Schematic diagram reference numbers (each reference number for quantity used for each higher assembly)

4.5.2 Mechanical List

The mechanical parts shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer’s part number

Contractor’s SCD or internal part number

Part description, Nomenclature

Additional Screening and/or Preparation Requirements (hardness, tensile, surface finish verification testing, etc.)

Where used (assembly number and name of next higher)

4.5.3 Metallic Materials List

The metallic materials list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer’s part number

Contractor’s SCD or internal part number

Material description, Nomenclature

Form (Bar, Sheet, Plate, etc.)

Additional Screening or Handling Requirements (hardness, tensile, surface finish verification testing, etc.)

Where used (assembly number and name of next higher)

4.5.4 Non-Metallic Materials List

The metallic materials list shall contain the following data:

Material type (Adhesive, coating, epoxy, gasket, insulator, sleeving, wire, etc.)

Material description, Nomenclature

Additional Screening or Handling Requirements (hardness, tensile, adhesion verification testing, etc.)

Outgassing data and characteristics

Shelf Life Control

Where used (assembly number and name of next higher)

4.5.5 Processes List

The processes list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS number (if applicable)

Manufacturer's process number

Contractor's internal process number

Type process (Bonding, Coating, Machining, Plating, Soldering, etc.)

Special Handling / Process Characteristics

Where used (assembly number and name of next higher)

4.6 As-Built Parts, Materials and Processes List

The contractor shall document, maintain and configuration-control an As-Built Parts, Materials and Processes List (ABPMPL) for each end-item being delivered to the contractor's acquisition authority. As a minimum, unless defined in the contract and statement of work, the contractor shall submit the ABPMPL at TRR, and with delivery of each set of flight, qualification, and proto-qualification hardware for contractor and subcontractor items being delivered. This list shall contain a complete listing of all the electrical, electronic, electro-mechanical, electro-optical (EEEE), and mechanical parts, metallic and non-metallic materials and processes used in the manufacturing and assembling of item being delivered to the acquisition authority. All changes from the As-Designed Parts, Materials and Processes List (ADPMPL) to the ABPMPL shall be clearly highlighted by the contractor. The list may be in the contractor's format, but shall contain, as a minimum, the information described in the following subparagraphs and Appendix A herein. . The contractor shall provide the ABPMPL in electronic format as defined in the DID (DI-CMAN-81516).

Electrical, Electronic, Electromechanical, and Electro-Optical Parts List. The EEEE parts list shall contain the following data:

MIL-Spec / SMD / DSCC part number (if applicable)

Class / Level (K, V, S, etc.)

Manufacturer’s Part Number

Contractor’s Source Control Drawing (SCD) or internal part number

Part description, nomenclature

Where used (assembly number and name of next higher)

Schematic diagram reference numbers (each reference number for quantity used for each higher assembly)

Quantity used in each assembly

Supplier’s name and CAGE code

Lot-Date-Code

4.6.1 Mechanical List

The mechanical parts shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer’s part number

Contractor’s SCD or internal part number

Part description, Nomenclature

Where used (assembly number and name of next higher)

Quantity used in next higher assembly

Supplier’s name and CAGE code

Lot-Date-Code/Batch Number

4.6.2 Metallic Materials List

The metallic materials list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS Part number

Manufacturer’s part number

Contractor’s SCD or internal part number

Material description, Nomenclature

Form (Bar, Sheet, Plate, etc.)

Where used (assembly number and name of next higher)

Quantity used in next higher assembly

Supplier's name and CAGE code

Lot-Date-Code/Batch Number

4.6.3 Non-Metallic Materials List

The metallic materials list shall contain the following data:

Material type (Adhesive, coating, epoxy, gasket, insulator, sleeving, wire, etc.)

Material description, Nomenclature

Outgassing data and test report number

Shelf Life Control

Where used (assembly number and name of next higher)

Quantity used in next higher assembly

Supplier's name and CAGE code

Lot-Date-Code/Batch Number

4.6.4 Processes List

The processes list shall contain the following data:

MIL-Spec / ANSI / AMS / NAS number (if applicable)

Manufacturer's process number

Contractor's internal process number

Type process (Bonding, Coating, Plating, Soldering, etc.)

Where used (assembly number and name of next higher)

Supplier's name and CAGE code

4.7 Parts, Materials or Processes Approval Request

A PAR/MAR shall be required for all EEEE parts and materials utilized by the subcontractor and all subcontractors (DI-MISC-80071). This shall include military specification items to be evaluated to ensure compliance with requirements in the intended application.

The requesting organization shall submit a Parts (Materials or Processes) Approval Request (PAR/MAR) to the contractor's PMPCB for review and action. A PAR/MAR form (see example Figure 4.7-3) shall be completed to the extent of available information, but must include the following entries as a minimum:

Initiating sub-tier contractor

Serialization (PAR/MAR identification number)

Part designation (source and generic)

Part identification

Specification(s) number with revision

Justification for usage (description of how the item meets the Program requirements within the intended application)

Critical part designation

System/subsystem/equipment application (where used)

Supplier/manufacturer

Lot Date Code (if applicable)

Qualification status and basis

DPA history

Failure history

GIDEP (If applicable)

Radiation sensitivity (total dose, neutron, gamma, and latch-up)

Package outline

Quantity

The submitting organization shall provide the PAR/MAR to the PMPCB with a copy of the PMP item's procurement specification (Source Control Drawing, Specification, etc.).

(PROGRAM NAME) PARTS (MATERIALS / PROCESSES) APPROVAL REQUEST		PMPCB LOG NO:			DATE SUBMITTED		
SUBMITTED BY				DATE DISPOSITIONED			
SUBSYSTEM/EQUIPMENT USED ON:							
PART PROCUREMENT DOCUMENT NO:							
POTENTIAL SUPPLIERS:				SUPPLIER PART NUMBER			
REASON FOR USE OF NONSTANDARD PART							
REPLY NEEDED BY:				SUBMITTED BY:			
EVALUATOR RECOMMENDATION							
	APPROVAL		DISAPPROVAL		NO RECOMMENDATION		DOCUMENT EVALUATION
	WITHOUT LIMITATION		REPLACE WITH MIL-SPEC PART		INSUFFICIENT INFO		ADEQUATE
	LIMITED APPLICATION		SPEC BEING PREPARED		PART PROBLEM		INADEQUATE
	OTHER LIMITATION		OTHER		OTHER		OTHER
REPLACE WITH MIL/FED OR DOD ADOPTED INDUSTRY STANDARD							
SPEC/STD NUMBER:				MIL-SPEC PART NUMBER:			
SUPPLIER:				SUPPLIER PART NUMBER:			
PART RECOMMENDED ABOVE IS:			INTERCHANGEABLE		SUBSTITUTE		REPLACEMENT
REVIEWER COMMENTS:							
EVALUATOR:		ORGANIZATION:			DATE:		
PROCURING / BUYER AGENCY DECISION							
	IMPLEMENT RECOMMENDATION		APPROVED SUBMITTED PART		DISAPPROVE SUBMITTED PART		
PROCURING AGENCY AND/OR BUYING ACTIVITY COMMENTS:							
PRINTED NAME:		SIGNATURE:		DATE:			

Figure 4.7-3. Parts (Material/Process) Approval Request (PAR/MAR)

5. Space Quality Baseline for the Selection of Parts and Materials

5.1 Space Quality Baseline

The Space Quality Baseline is defined for three types of space systems and the requirements are considered to be the same to ensure that quality and reliability of products meet the technical requirements of a mission:

Satellite systems with on-orbit mission life greater than 1 year

Launch vehicle systems

Satellite systems with on-orbit missions less than 1 year (experimental programs)

Generally, these parts / materials are:

Documented on government specifications (Mil-Spec slash sheets and/or Standard Military Drawings (SMDs)), AEROSPACE TOR-2006(8583)-5236 compliant Source Control Drawing (SCD), DoD Adopted industry specifications, with designators indicating space grade requirements (Classes V, S, K for actives, and Class S/T-level for passives).

Manufactured on government certified / qualified lines with periodic DSCC audits

Tested on government certified / qualified facilities with periodic DSCC audits

5.2 Approved EEEE Parts

5.2.1 Capacitors

MIL-PRF-123

MIL-PRF-23269 types CYR 10, 15, 20 and 30

MIL-PRF-39003/10

MIL-PRF-49470, T-level, and procured from QPL-49470 T-level suppliers

MIL-PRF-87164

MIL-PRF-87217

DSCC Drawings 06013, 06014, 06015, 06016, 06019, 06022

5.2.2 Connectors

MIL-PRF-24308 Revision B (rack and panel, rectangu1ar)

MIL- PRF-83733 (rack and panel, rectangular)

MIL- PRF-38999 (circular, high density)

MIL- PRF-83723 Series III only (circular, environmental resisting)

MIL-C-5015 Series MS345X, Class L (rear release types)

MIL- PRF-55302 (printed circuit boards)

MIL-C-39012 (coaxial connectors)

MIL-PRF-39029 (contacts)

MIL-PRF-26482 (circular, miniature, quick disconnect, environment resisting)

NASA Marshall Space Flight Connectors MSFC 40M38277

NASA Marshall Space Flight Connectors MSFC 40M38298

NASA Marshall Space Plight Center Connectors and hardware MSFC 40M39569

MIL-C-85049 (CANCELED; S/S by SAE-AS85049) Backshells and hardware

MIL-PRF-83513 (rectangular microminiature)

5.2.3 Crystals and Crystal Oscillators

MIL-PRF-55310, Product level S, with compliance to Section 960 of AEROSPACE TOR-2006(8583)-5236

AEROSPACE TOR-2006(8583)-5236, Sections 400 and 960 for hybrid oscillators

5.2.4 Discrete Semiconductors

MIL-PRF-19500 JANS**Filters**

MIL-PRF-28861, Class S, and procured from QPL-28861 suppliers

5.2.6 Fuses

MIL-PRF-23419/12

5.2.7 Hybrid Microcircuits

MIL-PRF-38534 Class K (with compliance to AEROSPACE TOR-2006(8583)-5236, Section 960)

5.2.8 Magnetics (Inductors, Coils and Transformers)

MIL-STD-981, Class S, and procured from QPL suppliers of MIL spec transformers, inductors, coils covered in MIL-STD-981

5.2.9 Monolithic Microcircuits

MIL-PRF-38535 Class V, active MIL-PRF-38510 Class S Slash Sheets

5.2.10 Relays

MIL-PRF-39016 with compliance to Section 1000 of AEROSPACE TOR-2006(8583)-5236.

5.2.11 Resistors

MIL-PRF-39007, T-level

MIL-PRF-32159, T-level

MIL-PRF-55182, T-level

MIL-PRF-55342, T-level

DSCC drawing 04007B, T-level

DSCC drawing 04008B, T-level

DSCC drawing 04009B, T-level

DSCC drawing 94012F, T-level

DSCC drawing 94013F, T-level

DSCC drawing 94014F, T-level

DSCC drawing 94015H, T-level

DSCC drawing 94016G, T-level

DSCC drawing 94017F, T-level

DSCC drawing 94018F, T-level

DSCC drawing 94019F, T-level

DSCC drawing 94025G, T-level

DSCC drawing 94026F, T-level

5.2.12 Wire and Cable

MIL-C-17 (Coax)

NEMA-WC27500 types SC,SR,SS,ST,SP (Multiconductor cable)

SAE AS22759 slash sheets 33, 43, 44, 45 and 46 (Insulated hook-up)

5.3 Mechanical Piece Parts

5.3.1 Fasteners

ASME-FAP-1

5.3.2 Screws

NASM1312

NASM1515

5.3.3 **Terminals**A-A-59126

5.4 Metallic Materials

5.4.1 Aluminum Alloys

ASTM-B26/B26M-03	Aluminum-Alloy Sand Castings
ASTM-B85-03	Aluminum Alloy Die Castings
ASTM-B108-03a	Aluminum Alloy Permanent Mold Castings
ASTM-B209-04	Aluminum and Aluminum Alloy Sheet and Plate
ASTM-B211-03	Aluminum and Aluminum Alloy Bar, Rod and Wire
ASTM-B221-04a	Aluminum and Aluminum Alloy Extruded Bar, Rod, Wire, Profiles and Tubes
ASTM-B241/B241M-02	Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube
ASTM-B308/B308M-02	Aluminum-Alloy 6061-T6 Standard Structural Profiles
MIL-A-21180	Aluminum Alloy Castings, High Strength
SAE AMS-QQ-A-200B	Aluminum Alloy, Bar, Rod, Shapes, Structural Shapes, Tube, and Wire, Extruded
SAE AMS-QQ-A-250A	Aluminum and Aluminum Alloy Plate and Sheet
SAE AMS-QQ-A-367	Aluminum Alloy Forgings
SAE AMS 4290J	Aluminum Alloy, Die Castings 9.5Si - 0.50Mg (360.0-F)
SAE AMS 4291F	Aluminum Alloy, Die Castings 8.53 - 3.5Cu (A380.0-F)

5.4.2 Copper

ASTM B152	Copper Sheet, Strip, Plate, and Rolled Bar

ASTM B272-02	Copper Flat Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)

5.4.3 Corrosion Resistant Steels

ASTM-A240/A240M-05	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications
ASTM-A666-03	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM-A693-03	Precipitation-Hardening Stainless and Heat Resisting Steel Plate, Sheet and Strip
SAE-AMS5513	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 19Cr-9.2Ni (SAE 30304), Solution Heat Treated
SAE-AMS5516-5519	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 18Cr-9.0Ni (SAE 30302), Solution Heat Treated (UNS S30200)
SAE-AMS5901-5907	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 18Cr-8.0Ni (SAE 30301), Solution Heat Treated (Composition similar to UNS S30100)
SAE-AMS5910-5913	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 19Cr-9.2Ni (SAE 30304), Cold Rolled, 125 ksi (862 MPa) Tensile Strength (UNS S30400)

5.4.4 Magnesium

ASTM-B107	Magnesium-Alloy Extruded Bars, Rods, Profiles, Tubes and Wire
SAE-AMS4375	Sheet and Plate, Magnesium Alloy 3.0Al-1.0Zn-020Mn (AZ31B-0), Annealed and Recrystallized (UNS M11311)
SAE-AMS4376	Sheet and Plate, Magnesium Alloy 3.0Al-1.0Zn-020Mn (AZ31B-H26), Cold Rolled, Partially Annealed (UNS M11311)
SAE-AMS4377	Sheet and Plate, Magnesium Alloy 3.0Al-1.0Zn-020Mn (AZ31B-H24), Cold Rolled, Partially Annealed (UNS M11311)

5.4.5 Nickels Alloys

QQ-N-286	Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)

5.4.6 Steels

SAE-AMS6257	Steel Bars, Forgings and Tubing 1.6Si-0.82Cr-1.8Ni-0.40Mo-0.08V (0.40-0.44C), Consumable Electrode Vacuum Remelted, Normalized and Tempered

SAE-AMS6345	Steel, Sheet, Strip and Plate, 0.95Cr-0.20Mo (0.28-0.33C) (SAE 4130), Normalized or Otherwise Heat Treated (Composition similar to UNS G41300)
SAE-AMS6349C	Steel, Bars 0.95Cr-0.20Mo (0.38-0.43C) (SAE 4140), Normalized (Composition similar to UNS G41400)
SAE-AMS6350	Steel, Sheet, Strip and Plate 0.95Cr-0.20Mo (0.28-0.33C) (SAE 4130) UNS G41300
SAE-AMS6351	Steel, Sheet, Strip and Plate 0.95Cr-0.20Mo (0.28-0.33C) (SAE 4130), Spheroidized (Composition similar to G41300)
SAE-AMS6382M	Steel, Bars, Forgings and Rings 0.95Cr-0.20Mo (0.38-0.43C) (SAE 4140), Annealed (Composition similar to G41400)
SAE-AMS6414J	Steel, Bars, Forgings and Tubing 0.80Cr-1.8Ni-0.25Mo (0.38-0.43C) (SAE 4340), Vacuum Consumable Electrode Remelted (Composition similar to G43400)
SAE-AMS-S-5000	Steel, Chrome-Nickel-Molybdenum (E4340) Bars and Reforging Stock
SAE-AMS-T-6736A	Tubing, Chrome-Molybdenum (4130 – 8630) Steel, Seamless and Welded
SAE-AMS-6758	Steel, Chrome-molybdenum (4130), bars and reforging stock (aircraft quality)

5.4.7 Tungsten

MIL-T-21014D(1)	Tungsten Base Metal, High Density

5.5 Non-Metallic Materials

5.5.1 Adhesives

MIL-A-46146	(Silicone RTV Adhesive, requires outgassing test)
SAE AMS-A-25463	Adhesive, Film Form, Metallic Structural Sandwich Construction

5.5.2 Coating, Foaming Molding and Potting Compounds

MIL-I-16923	(Embedding epoxy – requires outgassing test)
MIL-I-46058	(Printed Wiring Assembly Conformal Coating – requires outgassing test)

5.5.3 Core

MIL-C-7438	Aluminum Honeycomb

5.5.4 Elastomers

SAE AMS3216F	Fluorocarbon (FKM) Rubber, High Temperature – Fluid Resistant, Low Compression Set 70 to 80
SAE AMS3218B	Fluorocarbon (FKM) Rubber, High Temperature – Fluid Resistant, Low Compression Set 85 to 95
SAE AMS7259D	Rings, Sealing, Fluorocarbon (FKM) Rubber, High Temperature – Fluid Resistant, Low Compression Set 70 to 80
SAE AMS7276G	Rings, Sealing, Fluorocarbon (FKM) Rubber, High Temperature – Fluid Resistant, Low Compression Set 70 to 80

5.5.5 Fluids, Gas and Liquids

MIL-A-18455

MIL-C-81302

MIL-PRF-27404

MIL-PRF-27407

5.5.6 Insulations

MIL-I-3190

MIL-I-24768

5.5.7 Lubricants

SAE AMS-M-7866	Molybdenum Disulfide, Technical, Lubrication Grade
SAE AS8660	Silicone Compound NATO Code Number S-736

MIL-L-6010

5.5.8 Marking, Primers Paints

MIL-C-83286

MIL-P-23377

A-A-56032

5.5.9 Plastics, Laminates and Fabrics Rubbers

MIL-I-17205

MIL-M-14H

MIL-P-18177

MIL-P-22241B

MIL-P-24074

MIL-P-46036

MIL-P-81390

MIL-R-83248

MIL-P-46112B

IPC4101

5.5.10 Tapes

MIL-I-15126

MIL-I-23594

MIL-I-43435

5.5.11 Thermal Control Materials

MIL-I-631

A-A-55126

MIL-P-46112B

5.5.12 Tubing

MIL-DTL-23053E that meet the outgassing requirements of AEROSPACE TOR-2006(8583)-5236.

MIL-Y-1140

MIL-S-85848

5.6 Approved Processes

5.6.1 Adhesive Bonding

MIL-A-83376	Non-structural adhesive bonding
MIL-HDBK-83377	Structural adhesive bonding

5.6.2 Brazing, soldering (non-electrical), and welding

SAE-AMS-W6858

MIL-W-6873

MIL-B-7883B

5.6.3 Heat Treating and Surface Hardening

MIL-H-81200

MIL-H-6875H

MIL-A-22771

MIL-H-7199

MIL-H-6088

MSFC-SPEC-469

5.6.4 Metal Fabrication Assembly

MIL-S-13165

MIL-A-21180D

5.6.5 Metal Machining Chemical Milling

SAE-AMS-81769

5.6.6 Miscellaneous Processes

MIL-STD-889

5.6.7 Platings and coatings

SAE-AMS-P81728	Tin-Lead
SAE-AMS-2418	Copper
MIL-C-26074	Electroless Nickel
MIL-G-45208C	Gold
MIL-R-46085	Rhodium
QQ-N-290	Nickel
QQ-C-320	Chromium
QQ-S-365	Silver

5.6.8 Printed Wiring Boards/Printed Circuit Cards

See TOR-2006(8583)-5236 for additional requirements.

IPC 6012B with Space addendum	Qualification and Performance Specification for Rigid Printed Wiring Boards, Class 3
IPC 6013A	Qualification and Performance Specification for Flexible Printed Boards, Class 3
MIL-PRF-55110	Performance Specification Printed Wiring Board, Rigid General Specification for MIL-PRF-31032
MIL-PRF-31032	Performance Specification Printed Circuit Board/Printed Wiring Board, General Specification for
IPC 6018	Microwave End Product Board Inspection and Test

5.6.9 Soldering in accordance with the following:

NASA-STD-8739.3

NASA-STD-8739.2

IPC-J-STD-001B with Space Addendum

APPENDIX A
DATA FORMATS

A.1 Scope

This appendix is a mandatory part of the document. The information contained is intended for compliance. This appendix provides the detailed requirements for common terminology for exchange of part experience summary information between contractors and the government. It is necessary to establish a standard reporting convention for parts and pedigree information. Among the standardization objectives to be achieved by these templates are the establishment of a minimum set of reporting requirements, and an increase in the level of detail of reporting.

A.2 Data Entry Templates and Term Definitions

The template for data entry is given in this section. Table A-1 through A-4 list the data required only for electronic parts; Table A-5 lists the data required only for mechanical parts; Table A-6, data only for materials; and

Table A-7, data only for processes. "RIA" indicates "Required If Available". Table A-8 lists the data required for all items.

A.2.1 Electronic Parts Term Definitions

Table A-1. Template for Electronic Parts Data Entry

Data Field	Data Type	Requirement
Type	string (40)	Required
Family	string (40)	Required
Description	string (255)	Required
Number Quantity	integer	Required
Contractor Specification Number	string (40)	Required
Generic part number	string (40)	Required
Military part number	string (40)	Required
Manufacturer part number	string (40)	Required
Lot date code / Batch number	string(40)	Required
Part Manufacturer Cage Code	string (5)	Required
Supplier / Manufacturer name	string (60)	Required
National Stock Number	string (40)	RIA

Part classification	string (40)	Required
Total Ionizing Dose Hardness	float	RIA
Dose Rate Upset Hardness	float	RIA
Dose Rate Survivability Hardness	float	RIA
Singe Event Upset Hardness	float	RIA
Neutron Fluence Hardness	float	RIA
Outgassing TML	float	RIA
Outgassing CVCM	float	RIA
Body / Case Finish	string (40)	Optional
Lead / Contact Finish	string (40)	Optional

Type

The most generic description of the item. Allowed values are:

Table A-2. Allowed Values for Electronic Part "Type"

ASIC	Crystal	EEPROM	Hybrid/MCM	Microcircuit Die	PROM	SRAM	Transformer
Assembly	Delay Line	Filter	Inductor	MMIC	Relay	Switch	Transistor
Capacitor	Diode	FPGA	Integrated Circuit	Optoelectronic	Resistor	Thermistor	Other*
Connector	DRAM	Fuse	Isolator	Oscillator	Solar Cell	Thermostat	

* Requires description in Comments

Family

A more detailed description of the item. Allowed values are:

Table A-3. Allowed Values for Electronic Part "Family"

BiCMOS	CMOS	GaAs/InP	MOS	Resistor Network	Tantalum Solid Leaded
Bipolar	ECL	HBT	MOSFET	Si	Tantalum Non-Solid Leaded
Capacitor Axial Leaded	FET	HEMT	NMOS	SiGe	Wirewound
Capacitor Radial Leaded	Film Chip	InGaP	PHEMT	SOI	N/A
Ceramic Chip	Film Leaded	InP	PMOS	SOS	Other*
Ceramic Stacked	GaAs	MESFET	Resistor Chip	Tantalum Chip	Multiple*

* Requires description in Comments

Description

Specific information describing the item. Examples are: dual flip/flop; 1/8 W 0-115 K; 1/16 W 5K; 60V 32MV; 50V 0.1 MF.

Number Quantity

Number of this item used next higher assembly.

Contractor Specification Number

Enter the Contractor Specification Number.

Generic, Military, and Manufacturer Part Number

Generic: The standard generic number that exists for most parts. This number may or may not include code letters indicating package type, etc. Military: The military equivalent part number associated with the particular part in question. Manufacturer: This field refers to any part number, other than generic or military. Note: if Military part number is not available, use Generic part number.

Lot Date Code / Batch Number

Lot date code or batch number as supplied by manufacturer for this item.

Part Manufacturer Cage Code

Use Federal H4/H8 Cage Code Dictionary.

Supplier / Manufacturer Name

Name of company that supplies or manufactures the item if a Cage Code for the company is not available.

National Stock Number

The 13-digit stock number replacing the 11-digit Federal Stock Number. It consists of the 4-digit Federal Supply Classification code and the 9-digit National Item Identification Number. The National Item Identification Number consists of a 2-digit National Codification Bureau number designating the central cataloging office (whether North Atlantic Treaty Organization or other friendly country) that assigned the number and a 7-digit (xxx-xxxx) non-significant number. The number shall be arranged as follows: 9999-00-999-9999. Also called NSN.

Part Classification

Choose from the following list for allowed values for electronic part classifications:

Entry	Description	Entry	Description
JANS	JAN Class S	C-SCD	Contractor SCD requirements
JANTX	JAN Class TX	COTS	Commercial-Off-the-shelf (COTS)
JANTXV	JAN Class TXV	MIL-SCD	Source Control Drawing Imposing AEROSPACE TOR-2006(8583)-5236 Requirements
QML D	QML Class D	PEMS N	Plastic encapsulated microcircuits (PEMS), Class N
QML E	QML Class E	PPFL L	Passive Parts Failure Level L (2 percent per 1000 hours)
QML G	QML Class G	PPFL M	Passive Parts Failure Level M (1 percent per 1000 hours)
QML H	QML Class H	PPFL B	Passive Parts Failure Level P or Weibull-grade B (0.1 percent per 1000 hours)
QML K	QML Class K	PPFL C	Passive Parts Failure Level R or Weibull-grade C (0.01 percent per 1000 hours)
QML Q	QML Class Q/B	PPFL S	Passive Parts Failure Level S or Weibull-grade D (0.001 percent per 1000 hours)
QML T	QML Class T	PPFL T	Passive Parts Class T or Class S (0.0001 percent per 1000 hours)
QML V	QML Class V/S	QML M	QML M/883-compliant

Total Ionizing Dose Hardness

The specific value to which the item has been approved, in Krad (Si).

Dose Rate Upset Hardness

The specific value to which the item has been approved, in rads (Si)/s.

Dose Rate Survivability Hardness

The specific value to which the item has been approved, in rads (Si)/s.

Single Event Upset Hardness

The specific value to which the item has been approved, in errors/bit-day.

Neutron Fluence Hardness

The specific value to which the item has been approved, in MeV-cm^2/mg.

Outgassing Total Mass Loss (TML) of internal/external organic materials

If tested for outgassing, enter the results for percentage TML.

Outgassing Collected Volatile Condensable Materials (CVCM) of internal/external organic materials

If tested for outgassing, enter the results for percentage CVCM.

Body / Case Finish

Must exactly match one of the choices given in

Table A-4 ("Prohibited" finish required explanation in Comments):

Table A-4. Allowed Values for Electronic Part Finish

Anodized	Nickel	No Finish	Cadmium (Prohibited)
Gold	Passivated Stainless Steel	Other*	Silver (Prohibited)
Gold over Nickel	Solder	N/A	Tin > 98% (Prohibited)
Irridite	Tin < 98%		Zinc (Prohibited)

* Requires description in Comments

Lead / Contact Finish

Must exactly match one of the choices given in

Table A-4 ("Prohibited" finish requires explanation in Comments).

A.2.2 Mechanical Parts Term Definitions

Table A-5. Template for Mechanical Parts Data Entry

Data Field	Data Type	Requirement
Type	string (40)	Required
Family	string (40)	Required
Description	string (255)	Required
Contractor Specification Number	string (40)	Required
Generic part number	string (40)	Required
Military part number	string (40)	Required
Manufacturer part number	string (40)	Required
Lot date code / Batch number	string(40)	Required
Part Manufacturer Cage Code	string (5)	Required
Supplier / Manufacturer name	string (60)	Required
Number Quantity	integer	Required

Type

The most generic description of the item. Examples are: nut; valve; cable tie.

Family

A second level of description of the item; provide the material of which the part is composed. Examples are: CRES; brass; nylon 66.

Description

Specific information describing the item. Examples are: 10 x 32; 1: diameter; fuel; ¼ inch.

Contractor Specification Number

Enter the Contractor Specification Number.

Generic, Military, and Manufacturer Part Number

Generic: The standard generic number that exists for most parts. This number may or may not include code letters indicating package type, etc. Military: The military equivalent part number associated with

the particular part in question. Manufacturer: This field refers to any part number, other than generic or military. Note: if Military part number is not available, use Generic part number.

Lot Date Code / Batch Number

Lot date code or batch number as supplied by manufacturer for this item.

Part Manufacturer Cage Code

Use Federal H4/H8 Cage Code Dictionary.

Supplier / Manufacturer Name

Name of company that supplies or manufactures the item if a Cage Code for the company is not available.

Number Quantity

Number of this item that is used in next-higher assembly.

A.2.3 Materials Term Definitions

Table A-6. Template for Materials Data Entry

Data Field	Data Type	Materials
Type	string (40)	Required
Family	string (40)	Required
Form	string (255)	Required
Contractor Specification Number	string (40)	Required
Trade name	string (60)	Required
Supplier / Manufacturer name	string (60)	Required
Lot date code / Batch number	string(40)	Required
Outgassing TML	float	RIA
Outgassing CVCM	float	RIA
Bulk Quantity	float	Required
Quantity Unit	string (20)	Required
Shelf Life Requirements	string (1)	Required
Hazards	string (1)	Required

Type

The most generic description of the item. Examples are: adhesive coating; epoxy; metal; organic; composite.

Family

A second level of description of the item. Examples are: tin; gold; polymer.

Form

The physical shape of the item. Examples are: bar; rod; sheet; wire.

Contractor Specification Number

Enter the Contractor Specification Number.

Trade Name

Common industry usage name.

Supplier / Manufacturer Name

Name of company that supplies or manufactures the item.

Lot Date Code / Batch Number

Lot date code or batch number as supplied by manufacturer for this item.

Outgassing Total Mass Loss (TML) of internal/external organic materials

If tested for outgassing, enter the results for percentage TML.

Outgassing Collected Volatile Condensable Materials (CVCM) of internal/external organic materials

If tested for outgassing, enter the results for percentage CVCM.

Bulk Quantity and Quantity Unit

Total amount of material used in next-higher assembly, and unit used to measure the amount of item (pounds, gallons, etc.).

Shelf Life Requirements

Has a limited shelf life age, or requires specific temperature or humidity conditions, or has other special environmental requirements (e.g., storage in dry nitrogen). Enter “L” and explain in comments.

Hazardous material. If material is hazardous, use the following codes to describe how it is hazardous:

A	Creates health hazard if not handled properly.
B	Environmental hazard.
C	Fire/explosive hazard.
D	Other (explain in comment field).

A.2.4 Processes Term Definitions

Table A-7. Template for Processes Data Entry

Data Field	Data Type	Requirement
Type	string (40)	Required
Family	string (40)	Required
Description	string (255)	Required
Hazards	string (1)	Required

Type

The most generic description of the process. Examples are: heat treatment; soldering.

Family

A second level of description of the process. Examples are: silver plating; quenching.

Description

Specific information describing the process, such as process number or other description.

Hazardous process. If the process is hazardous, use the following codes to describe how it is hazardous:

A	Creates health hazard if not handled properly.
B	Environmental hazard.
C	Fire/explosive hazard.
D	Other (explain in comment field).

A.2.5 Global Term Definitions

The following term definitions are valid for all types of items.

Table A-8. Template for All Items Data Entry

Data Field	Data Type	Requirement
New Technology	string(1)	Required
Limited Application	string(1)	Required
Qualification status	string (20)	Required
End item part name	string(60)	Required
End item part number	string(60)	Required
End item serial number	string(60)	Required
Comments	string(4000)	Required

New Technology

"Y" or "N"; If "Y", explain in Comments. New Technology is defined as a part, material, or process that has never been previously characterized or qualified for space use; or has limited or no space heritage or commercial technology; or that has recently undergone major changes in the element selection process, assembly, manufacturing, or testing.

Limited Application

"Y" or "N"; If "Y", explain in Comments the way in which the application of the item is limited.

Qualification Status

If item is qualified, use the following entries to describe how:

NAS-STD	MTL-STD	SIMILARITY
FED-STD	DESIGN & TEST	OTHER

End Item Part Name, Part Number, and Serial Number

The unit or black box where the part, material, or process is used in.

Comments

APPENDIX B
HARDNESS ASSURANCE

B.1 Scope

This appendix is a mandatory part of the document. The information contained is intended for compliance. This appendix provides the detailed requirements for managing a PMP radiation hardness assurance program for space vehicles.

B.2 Radiation Hardness Assurance Program

Hardness Assurance of EEEE parts is an integral part of the overall system level survivability program. Accordingly, the contractor shall develop and implement a Radiation Hardness Assurance (RHA) Program applicable to radiation sensitive EEEE parts. This parts hardness assurance program shall define the set of constraints, measures and disciplines that must be applied to design, selection, procurement, testing and application of radiation sensitive parts. Implementation of this RHA Program assures that parts and materials used in equipment are capable of surviving and operating within expected performance boundaries when exposed to the specified radiation environments. As a minimum, the parts hardness assurance program shall include the following:

Performance of characterization testing of radiation sensitive parts and materials in each applicable radiation environment to verify operational/survival thresholds/margins; and also to establish radiation degradation limits used in design and radiation wafer lot acceptance. Characterization test requirements apply where there is no current radiation test data corresponding to the item in question.

Generation of parameter degradation limits at specified confidence level and percentile cut off value. These degradation limits are obtained from sampling data (characterization test), and are intended for dual purposes: 1) These degradation limits allow designers to incorporate end-of-life margin into circuits they design, and 2) these same degradation limits are used as pass/fail criteria for acceptance of flight wafer lots during radiation wafer lot acceptance test (RWLAT).

Timely dissemination of above degradation limits among equipment designers for their use in worst case design (margin) analyses.

Generation of SEE rates applicable to SEE sensitive parts and timely dissemination of these rates among equipment designers. SEE rates shall be based on actual test data, and are intended for box/system level SEE analyses to demonstrate compliance with allocated outage rates and system's availability/dependability requirements.

Performance of Radiation Wafer Lot Acceptance Test (RWLAT). This requirement applies to all wafer lots intended for use in flight equipment.

Generation of a Parts/Materials Hardness Assurance Plan specifying methodology for implementation of the Hardness Assurance Program, and allocation/ownership of hardness assurance tasks

Representation of Hardness Assurance activities (Hardness Assurance Responsible Engineer) in parts selection and parts application forums such as Parts Materials and Processes Control Board (PMPCB) meetings, IPT meetings, Design Review meetings, etc.

Flow down of Hardness Assurance requirements to subcontractors to the extent necessary for the system to meet its operational and survival requirements in the specified radiation environment.

Surveillance of subcontractor's activities to verify compliance with specified hardness assurance requirements.

Provide validation of worst-case analyses at box/system level demonstrating compliance to system level survival and performance requirements at end-of life. Validation consist of verification that only those limits endorsed/sanctioned by cognizant hardness assurance engineer have been used for calculation of parameter's end-of-life values used in node equations.

Provide validation of SEE analyses at box/system level demonstrating compliance to allocated outages and system level availability/dependability requirements. Validation consists of verification that the SEE rates used in the analyses are those that had endorsement/sanction from the cognizant hardness assurance engineer.

Provide validation of box/system level upsettability/operate-thru analyses demonstrating compliance to specified operational, survival and recovery requirements in the specified prompt dose environment (if applicable). Validation consists of verification that upset/survival threshold data used in the analyses are traceable to actual values endorsed/sanctioned by the cognizant hardness assurance engineer.

The contractor shall establish the necessary infrastructure that is needed for incorporation/implementation of the hardness assurance program tasks

The Contractor shall identify the organizational blocks and individuals that are responsible for observance and execution of particular hardness assurance tasks.

B.2.1 Radiation Hardness Assurance (RHA) Program Plan

The contractor shall generate a documented RHA Program Plan that defines methodology for implementation/execution of radiation hardness assurance tasks. The plan shall identify process flow and methodology for integration of the hardness assurance functions into design and manufacturing activities. The plan shall allocate responsibilities/ownership for each hardness assurance task and shall define a timeline for execution of each task. As a minimum, the RHA Program Plan shall include the following:

Detailed description of each hardness assurance task and allocation of ownership, responsibility and timeline for execution of each task

Block/Box diagram of the system (hardware).

List of subcontracted items as well as name of responsible subcontractor

Organizational structure of Program organizational blocks, including program management, systems engineering, design, manufacturing and subordinate specialty engineering functions, supply chain, subcontractor management, etc., depicting their allocated responsibilities and interfaces

Identification of the allocated radiation environments (hazard/threat) that apply to the particular orbit/mission

Part selection criteria in terms of required attributes or minimum hardness levels that parts must have in order to be acceptable for use in equipment.

Prescription of methodology for radiation characterization testing.

Prescription of methodology for generation of radiation degradation limits. Definition of minimum requirements for radiation design margin (R_{DM}), confidence level (C) and proportion of acceptable parts (P)

Prescription of methodology for radiation wafer lot acceptance test (RWLAT)

Conditions necessary for (on the basis of overtest/design margin) RWLAT exemption.

Methodology for ELDRS testing of linear bipolar circuits. Methodology for incorporation of ELDRS effects into parameter EOL limits used in worst-case design.

Methodology for flowdown and verification of hardness assurance requirements to subcontractors.

Methodology for performance of hardness assurance testing of hybrids and MCMs

Methodology for dissemination of radiation degradation limits to equipment designers

Methodology for resolving/dispositioning radiation lot acceptance test failures

Methodology for implementation of all other hardness assurance tasks within the parts hardness assurance program.

Matrix listing all radiation sensitive parts used in the system by generic part number and by the part number used for procurement. This matrix shall also identify the source of supply, radiation test requirements, including RWLAT, dose or exposure level and the AID, SID, or special test requirement document that specifies each applicable radiation test requirement as well as pass fail criteria.

B.2.2 Hardness Assurance Design Documentation

Radiation acceptance test is an integral part of the part acceptance process. For QML/RHA parts, radiation acceptance test is part of QCI. For non-QML/RHA parts, radiation acceptance test is also considered as part of QCI. Accordingly, all radiation sensitive parts that are subjected to radiation testing shall have their radiation test requirements specified in a formally released drawing (SMD, SCD, SID, AID, Special Requirements Document, etc.). In general, the required hardness assurance documentation consists of:

Hardness Assurance Plan

Part procurement specification containing RWLAT requirements (SMD, SCD, AID, SID, etc), or contractor's special requirements document that calls out RLAT test requirements including test level and pass fail criteria

Derating sheet that calls out parameter's degradation limits. These degraded limits are used by designers to incorporate circuit design margin.

SEE performance sheet calling out survival and upset rates of parts. This data is used by designers for their SEE analyses

Prompt dose performance attributes sheet calling out upsettability and burnout thresholds, as well as recovery time. This data is used by designers for their prompt dose upset/survival analyses.

B.2.3 Representation of RHA Issues at Audits and Design Reviews

The contractor shall have an RHA representative at all applicable design reviews, including preliminary and critical design reviews. The contractor shall ensure that all system design decisions are evaluated for their effect upon the hardness assurance of the system and its components. In addition, the representative shall ensure that the RHA Program Plan, the RHA Design Document, and the detailed

specification are updated to incorporate any hardness assurance critical decisions made at the design reviews.

B.2.4 Integrating Subcontractor RHA Capabilities

The contractor shall flow down to subcontractors the applicable RHA requirements to the extent necessary to assure that the system level survivability and operability requirements are met. As a condition for contract award, the contractor shall verify that a subcontractor has the processes and infrastructure necessary to assure compliance with the specified radiation requirements.

B.2.5 Part Procurement Documents

Parts and materials subject to hardness assurance requirements shall be procured in accordance with section 4.3.2.1. The contractor's drawings must include radiation requirements with the following as a minimum and must be approved by the PMPCB:

Radiation test methods and test circuits.

Except for SMD specified RHA parts, contractor's prepared drawings shall call out sample size and sampling and sampling statistics used in lot acceptance

Radiation type, source and dose/exposure level.

End point test, pre- and post-radiation test requirements and acceptance criteria.

Data reporting and analysis.

Special radiation tests such as electrical or radiation screening tests.

B.2.6 Hardness Assurance Verification Analyses

The contractor shall perform and document radiation analyses based on the part or material radiation characterization data to ensure that under worst-case conditions, critical circuits or materials are capable of meeting the RHA requirements.

APPENDIX C
FAILURE SUMMARY AND ANALYSIS REPORT (FSAR)

C.1 Scope

This appendix provides the detail requirements for submitting the parts and materials Failure Summary and Analysis Report (FSAR) over the life of a program for a specific contract This appendix is used by the procuring activity to monitor/evaluate all program piece part failures.

C.2 Format

The FSAR as generated by the work task paragraph 4.3.10.2 shall contain the information of Tables C-l and C-2, but maybe in any format selected by the contractor.

C.2.1 Contents

The FSAR shall include all the items identified as being required in Table C-l.

Part type shall be per Federal Cataloging Handbook H6 and name modifiers.

Each part analyzed, shall be a separate record.

A separate FSAR record shall be required for each part or material number/type analyzed.

Note: the word pan refers to parts, materials or processes.

C.2.2 Revisions to the FSAR

When the contractor revises the FSAR, a new copy shall be in accordance to the same requirements as stated in Table C-2.

Table C-1. FSAR minimum database field requirements

Required fields and minimum field widths along with a recommended format and structure

FIELD NUM	FIELD DATA DESCRIPTION	DB NAME	FIELD WIDTH	REQ'D
1	Failure Analysis Report (FAR) number	FARNO	15	YES
2	Failed pan type (Resistor, Diode, Capacitor, etc.) (C2.5)	PANTYPE	10	YES
3	Pan characteristic (Film, Ceramic, Mica, etc.)	PANCHAR	15	YES
4	Pan description (Voltage, Current, etc.)	PANDESCR	40	OPT
5	Contractor specification number	SPECNO	20	YES
6	Pan supplier/manufacturer name/cage code	MFRNAME	20	YES
7	Generic, Military or Industry pan number	PANNUM	22	YES

8	Program name where pan failed	PROGNAME	8	YES
9	Lot dale code (LDC) Start (note 4)	LDCSTART	10	YES
9a	Lot Date Code (LDC End (note 4)	LDCEND	10	YES
10	Serial number of end item (black box)	SN	10	YES
11	NR: Report Number that caused FAR to be opened	NR	10	YES
12	Next assembly drawing (dwg) number of printed wiring board	PWBDWG	20	YES
13	End item usage (black box) dwg number	ENDITEMDWG	20	YES
14	End item usage name (Receiver)(name of black box)	ENDITEMNAME	20	YES
15	Vehicle dwg/identification where box installed	VEHNUM	10	YES
16	Date failure occurred	DATEFLR	8	YES
17	Date FAR closed	DATECLOSED	8	YES
18	Failure review board number that closed FAR	FRBNUM	6	YES
19	Cause of pan failure (summary in words)	CAUSE	160	YES
20	Corrective action summary	CA SUMMARY	60	YES
21*	Phase of manufacturing (mfg) when failure occurred (C.2.3.1)	PHASE	3	YES
22*	Test event when failure occurred (C.2.3.3)	TEST	5	YES
23*	Level of assembly when failure occurred (C.2.3.2)	LEVEL	3	YES
24*	Pan defect caused by (C.2.4)	DEFECT	5	YES
25	Sub Contractor Name (mfg of black box)	SUBCONT	20	YES
26	Comment (note 3)	COMMENTS	160	OPT

NOTES

1/ "OPT" found in the REQ'D (required) field column indicates that data need not be entered for that field, but shall be part of the database structure.

2/ "*" found in the Field Num column indicates that database field shall be filled with the failure/defect codes identified in the applicable para referenced in the data description field.

3/ The Comment field need only be used when appropriate.

4/ Use Symbol ">" after LDC to indicate all subsequent LDCs are suspect. Use Symbol "<" after LDC to indicate all prior LDCs are suspect Use symbol "S" after LCD to indicate a multiple of LDCs between LDCSTART and LDCEND are suspect.

C.2.3 Recommended code definitions for the applicable database fields

The contractor may use their own codes or add additional codes to describe when, where, and how the failure occurred. The contractor shall provide documentation to describe these codes.

C.2.3.1 Phase of manufacturing when failure occurred (Table C-l #21)

NAME	CODE
Assembly and Integration (A/I)	AI
System	SYS
Post System	POS
Launch Preparations/OPS	OPS
Other	OTH

C.2.3.2 Level of assembly when failure occurred (Table C-l #23)

NAME	CODE
Destructive Physical Analysis	DPA
Receiving Inspection	REC
Lot Acceptance Test	LAT
Printed Wiring Board	PWB
Component (Black Box)	BOX
Subsystem	SUB
Vehicle	VEH
Other	OTH

C.2.3.3 Testing event where failure occurred (Table C-l #22)

NAME	CODE
Pre Acceptance Test Procedure (ATP)	PRATP
1st Electrical	FSTEL
Thermal Cycle Test	TC
Thermal Vacuum Test	TV

Shock Test	SHOCK
Sine Vibration Test	VIBSI
Random Vibration Test	VIBRA
Acceleration Test	ACCEL
Acoustic	ACUST
Climatic (Humidit Altitude, etc.)	CLIMA
Bum-In Test	BURIN
EMI Test	EMI
Special Test	SPEC
Leak Test	LEAK
Pressure Test	PRESS
Mechanical Test	MECH
Final Electrical	FINEL
Other	OTH

C.2.4 Cause code of part failure (Table C-1#24)

PAN DEFECT CAUSED BY PART MANUFACTURER	CODE
Contamination	MC
Short	MS
Open	MO
Out of Tolerance	MT
Drift	MD
Mechanical Damage	MM
Friction	MF
Wrong Material/Defective Material	MD

Wrong Heat Treatment	MH
Pan Workmanship	MW
Pan anomaly could not be detected/duplicated	NP
Manufacturer Other (added to comments Table C-1 #26)	OTH

PAN DEFECT CAUSED BY CONTRACTOR	CODE
Misapplication/Design	CM
Mishandling	CH
Planning Paper Error	CP
Workmanship	CW
Contractor Others (added to comments Table C-1 #26)	COTH

C.2.5 Sample inputs for pan types (see Table C-1, Field Num, 1,2 &3)

PAN TYPE	PAN CHAR	PAN DESCRIPTION	PAN USAGE
MICROCIRCUIT	DIGITAL CMOS	DUAL FLIP/FLOP	HIGH SPD CLOCK
RESISTOR	WIRE	VAR 1/8W 0-115K	PREC TIMING CKT
RESISTOR CHIP	FILM	1/16W 5K	HYBRID
CAPACITOR	TANTALUM SLUG	60V 32MF	FILTER
NUT	10x32, 1” DIAM	CRES	
VALVE	FUEL	BRASS	HYDROGEN
CABLE TIES	¼ INCH	NYLON 66	12-Lb RATING

Table C-2. FSAR database documentation requirements for each submittal

REQUIRED DATA TO BE SUPPLIED WITH EACH NEW OR REVISED FSAR SUBMITTED EACH ENTRY FOR INFORMATION TO BE ON A SEPARATE LINE

CONTRACTOR NAME	_____
CONTRACTOR CAGE CODE	_____
CONTRACTOR ADDRESS	_____
CONTRACTOR CITY	_____
CONTRACTOR STATE	_____
CONTRACTOR ZIP	_____
ADPMPL CONTROL #	_____
ADPMPL REVISION #	_____
CONTRACT#	_____
USER (NASA, NAVY, SMC)	_____
PROGRAM NAME (IUS, DSCS)	_____
DATA ITEM TITLE	_____
DATE OF LAST REVISION	_____
RESPONSIBLE GROUP PHONE #	_____
TOTAL NUMBER OF RECORDS	_____
COMMENTS	_____

SMC Standard Improvement Proposal

INSTRUCTIONS

1. Complete blocks 1 through 7. All blocks must be completed.
2. Send to the Preparing Activity specified in block 8.

NOTE: Do not be used to request copies of documents, or to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Comments submitted on this form do not constitute a commitment by the Preparing Activity to implement the suggestion; the Preparing Authority will coordinate a review of the comment and provide disposition to the comment submitter specified in Block 6.

SMC STANDARD CHANGE RECOMMENDATION:	**1. Document Number**	**2. Document Date**
3. Document Title		

4. Nature of Change
(Identify paragraph number; include proposed revision language and supporting data. Attach extra sheets as needed.)

5. Reason for Recommendation

6. Submitter Information

a. Name	**b. Organization**
c. Address	**d. Telephone**
e. E-mail address	**7. Date Submitted**

8. Preparing Activity

Space and Missile Systems Center
AIR FORCE SPACE COMMAND
483 N. Aviation Blvd.
El Segundo, CA 91245
Attention: SMC/EAE