



Goddard Procedures and Guidelines

DIRECTIVE NO.	<u>GPG</u>	APPROVED BY Signature:	_____
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EXPIRATION DATE:	<u>May 30, 2009</u>	TITLE:	<u>Director</u>

Responsible Office: Code 500/Applied Engineering and Technology Directorate

Title: GSFC EEE Parts Policy

PREFACE

P.1 PURPOSE

It is NASA Goddard Space Flight Center's (GSFC's) policy to control risk and enhance reliability in space flight and critical ground support systems by managing the selection, acquisition, traceability, testing, handling, packaging, storage, application, and derating of electrical, electronic, and electromechanical (EEE) parts.

To carry out this policy, GSFC shall select parts and packaging technologies taking into account performance, environment, mission criticality and lifetime requirements, and cost. To the greatest extent possible, part selection shall be made from the GSFC Common Parts Selection List (CPSL), which will contain commonly used EEE parts from the NASA Parts Selection List (NPSL) and other previously qualified flight parts, e.g., new technology parts. For parts not listed in the GSFC CPSL, selection shall be made from the NPSL. The usage of any other parts, i.e., those not listed in the CPSL or the NPSL, shall be coordinated among several projects whenever feasible to minimize cost.

Key principles of this guideline are to utilize knowledge and experience of the Applied Engineering and Technology Directorate (AETD) parts engineering infrastructure to develop and promote progressive methods of minimizing risks for EEE parts and meet mission reliability goals in a cost-effective way.

P.2 APPLICABILITY

This procedure applies to all GSFC flight projects covered by the scope of the GSFC Quality Management System (QMS), including GSFC projects in support of Earth Sciences, Space Sciences, and Exploration Enterprises. All flight Project Managers (PMs), System Assurance Managers (SAMs), Design Engineers, and Project Parts Engineers (PPEs) shall implement this procedure to meet the applicable part quality requirements as defined by the project.

This procedure does not apply to the sub-orbital projects like balloons, sounding rockets, and Unmanned Aerial Vehicles (UAVs).

P.3 AUTHORITY

- a. [NPD 8730.3](#), NASA Quality Management System Policy (ISO 9000)

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- b. GPG 7120.2, Project Management
- c. [NPD 8730.2A](#), NASA Parts Policy
- d. [NPD 7120.4B](#), Program/Project Management
- e. [NPR 7120.5B](#), NASA Program and Project Management Processes and Requirements
- f. [President's Commission on Implementation of U.S. Space Exploration Policy](#)

P.4 REFERENCES

- a. [GPG 7120.2](#), Project Management
- b. [GPG 8700.2](#), Design Development
- c. EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating

P.5 CANCELLATION

None.

P.6 SAFETY

None.

P.7 TRAINING

Parts engineers receive on-the-job training to develop expertise in various parts commodities, to incorporate new-technology devices into the CPSL, to assist designers with the selection of acceptable flight parts, and to manage parts programs by participating in Parts Control Board (PCB) meetings. This training consists of reviewing military specification test requirements and procedures; qualified manufacturers listing (QML); qualified products listing (QPL); and the selection, screening, qualification, and derating guidelines in GSFC EEE-INST-002.

P.8 RECORDS

Record Title	Record Custodian	Retention
Parts Control Plan (PCP)	Project Office and Code 562	* NPG 8735.1 Minimum of 5 years following launch.
Project Control Board (PCB) Procedures/Minutes	Project Office and Code 562	* NPG 8735.1 Minimum of 5 years following launch.
Project Approved Parts List (PAPL)	Project Office and Code 562	* NPG 8735.1 Minimum of 10 years following launch.
As-Built Parts List (ABPL)	Project Office and Code 562	* NPG 8735.1 Minimum of 10 years following launch.

*NRRS – NASA Records Retention Schedules.

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P.9 METRICS

Metrics shall be monitored every 6 months to determine the effectiveness of this guideline in enhancing the proper establishment and implementation of the Parts Control Program (PCP) and its associated activities. Metrics shall include measurement of the number of parts engineers in place before the implementation phase for the project, availability of the Parts Identification List (PIL) before Preliminary Design Review (PDR), approval of the Project-Approved Parts List (PAPL) or As-Designed Parts List (ADPL) before Critical Design Review (CDR), obtaining the As-Built Parts List (ABPL) before Pre-Ship Review (PSR), and placement of parts lists in the GSFC parts engineering database.

P.10 DEFINITIONS

EEE Parts: EEE parts are defined as devices that depend on a controlled flow of electrons for their functioning. Some examples are microcircuits, transistors, capacitors, resistors, fuses, laser diodes, field programmable gate arrays (FPGAs), application-specific integrated circuits (ASICs), and power converters.

Project Parts Engineer (PPE): The PPE is a Code 562 engineer or in-house support service contractor engineer responsible for providing parts engineering support to flight project personnel.

Parts Control Board (PCB): The PCB is a board constituted to facilitate the management, selection, and incorporation of new-technology parts into the CPSL, and approval of parts for the duration of each flight project.

PROCEDURES

1.0 Parts Management Overview

The chief building blocks of parts management are requirements, evaluation, selection, procurement, and testing.

1.1 Requirements. The projects shall define and document the environmental operating conditions and expected performance requirements for EEE parts in their intended application. Projects shall also define any constraints such as size, criticality, and schedule. The risk associated with the usage of any part shall fall within the risk profile established by Code 400. The project PCP shall dictate how the project shall implement its parts program to meet applicable mission assurance requirements. Test requirements on all parts shall be established according to EEE-INST-002 or an equivalent document approved by the Parts Control Board. These requirements shall flow down to all developers and contractors supporting GSFC projects.

1.2 Evaluation. Part quality evaluation shall be performed to ensure reliable operation for the duration of mission life. This evaluation is especially critical for new part types that have not been used previously

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or are not manufactured to space standards. Evaluation shall determine which parts can be used with no additional testing, parts that require testing before use, and parts that are prohibited from being used on flight missions. Evaluation shall take into consideration application-specific details that may impact the part's reliability. Also, a radiation effect analysis shall be performed to ensure that parts meet their performance requirements in the predicted mission radiation environment. This analysis shall include parts' susceptibility to single-event effects (SEE) and total dose and displacement damage effects as applicable to each part type. SEE susceptibility of each device can vary significantly with the application-specific details, and shall be evaluated appropriately for the intended application.

- 1.3** Selection. EEE parts shall be selected to meet mission goals for reliability and quality in the intended space environment. GSFC flight projects shall select parts from the CPSL as much as possible, and from the NPSL. For parts without flight heritage, the PCB shall perform a candidate evaluation and release parts that have passed evaluation into the CPSL. The PCB shall work with parts, radiation, and material engineers to determine the approval of new part types and to ensure manufacturers' compliance with the procurement specification. At a minimum, designers and PPEs shall jointly establish a preliminary PIL by PDR. The designer, PPE, and PCB shall work together to develop a PAPL or an ADPL prior to CDR. The flight SAM shall ensure that an ABPL is developed prior to PSR.
- 1.4** Procurement. EEE parts procurement shall be coordinated among projects whenever feasible. Code 239 shall provide parts procurement, storage, and handling services. All parts procurements shall be from qualified sources. Results from surveys and audits performed by other NASA Centers or third-party auditors may be used to determine capability and qualification of sources. Also, an effort shall be made to coordinate the procurements with other NASA Centers.
- 1.5** Testing. Testing of all GSFC EEE parts shall be performed at approved test labs coordinated through the AETD parts analysis lab. Screening, qualification, and radiation testing shall be completed before a part lot is kitted for flight. Screening, qualification, and derating of EEE parts shall be conducted in accordance with EEE-INST-002 or as otherwise approved by the project PCB.

2.0 Roles and Responsibilities

Roles and responsibilities of the personnel who establish and enact the procedures and processes in this guideline are provided below.

The Applied Engineering and Technology Directorate, Code 500, shall perform the following:

- ?? Maintain the necessary expertise and knowledge in EEE parts, materials, and radiation effects analysis to effectively handle all EEE parts including hybrids, ASICs, FPGAs, micro-electromechanical systems (MEMS), etc., that are being engineered into GSFC systems.
- ?? Establish and implement a process to identify and control parts for listing in the CPSL from which all GSFC design engineers should select their respective parts.
- ?? Coordinate parts selection during design by integrating the design process with parts manufacturers to ensure cost-effective, reliable, and timely EEE parts delivery.

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- ?? Establish and implement appropriate processes, guidelines, and tools to assure that designers are aware of, and implement the latest application rules from the manufacturers into the design and application of each part, particularly state-of-the-art technology devices.
- ?? Establish and maintain the selection, screening, qualification, and derating requirements in EEE-INST-002.
- ?? Ensure that EEE parts used for building flight hardware meet the requirements in EEE-INST-002. If any commercial units or assemblies are procured as off-the-shelf hardware, the reliability of parts used in these units shall be reviewed for each application.
- ?? Maintain a database of project parts, testing performed, associated research, and supplemental information critical to parts application as learnt from previous flight projects.

The Flight Programs and Projects Directorate, Code 400, shall perform the following:

- ?? Establish part quality level (i.e., levels 1, 2, and 3) as defined in EEE-INST-002 during the formulation phase (i.e., phase A/B) of each project with support from parts, radiation, and material engineering.
- ?? When requesting proposals for flight projects, require that proposals identify how parts, particularly state-of-the-art technology parts, in the proposed designs will meet the quality level requirements established by the project.
- ?? Obtain a Project Parts Engineer from AETD, with support from radiation and materials engineering, prior to starting the implementation phase of the project cycle (i.e., phase C/D) to coordinate parts requirements.
- ?? Establish a PCP including a PCB at the beginning of each project, and implement it effectively during the hardware design and build until launch.

The Office of Systems Safety and Mission Assurance, Code 300, shall perform the following:

- ?? Implement parts control requirements in the Mission Assurance Requirements (MAR).
- ?? Verify and validate that parts control requirements have been implemented in space flight hardware built in house, or by out-of-house developers (i.e., universities or international partners), contractors, and subcontractors.
- ?? Exchange EEE parts data with Safety and Mission Assurance organizations at other NASA Centers, industry, and university and international partners.
- ?? Maintain the NASA Parts Selection List and update the list with new part types from GSFC Common Parts Selection List as appropriate.
- ?? Assess the quality of EEE parts manufacturers that provide parts used in GSFC systems, prior to parts procurement, by establishing a manufacturers database.
- ?? Coordinate alerts and advisories associated with parts and flight hardware.
- ?? Establish and maintain a watch list of list of prohibited EEE materials (pure tin, cadmium, etc.) and problem EEE parts (parts with significant alert/advisory impact on NASA projects), and monitor its implementation to ensure that no items on the watch list are being used in GSFC programs and projects without appropriate risk mitigation.

The Management Operations Directorate, Code 200, shall perform the following:

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- ?? Perform parts procurement, storage, and handling services as defined by Code 500 PPEs.
- ?? Maintain transaction and traceability records for parts procured through the PPE.
- ?? Coordinate the cost and payment of parts with the designated PPE and/or Resource Analyst.
- ?? Maintain residual parts and corresponding documentation and support the GSFC residual parts program through Code 230.

P.11 ACRONYM LIST

ABPL – As-Built Parts List
ADPL – As-Designed Parts List
AETD – Applied Engineering and Technology Directorate
ASIC – Application-Specific Integrated Circuit
CDR – Critical Design Review
CPSL – Common Parts Selection List
EEE – Electrical, Electronic, and Electromechanical (Parts)
FPGA – Field Programmable Gate Array
GPG – GSFC Procedures and Guidelines
GSFC – Goddard Space Flight Center
MAR – Mission Assurance Requirements
MEMS – Micro-electromechanical Systems
NASA – National Aeronautics and Space Administration
NPG – NASA Procedures and Guidelines
NPSL – NASA Parts Selection List
NRRS – NASA Records Retention Schedules
PAPL – Project-Approved Parts List
PCB – Parts Control Board
PCP – Parts Control Program/Plan
PDR – Preliminary Design Review
PIL – Parts Identification List
PM – Project Manager
PPE – Project Parts Engineer
PSR – Pre-Ship Review
QML – Qualified Manufacturers Listing
QMS – Quality Management System
QPL – Qualified Products Listing
SAM – System Assurance Manager
SEE – Single-Event Effects
UAV – Unmanned Aerial Vehicle

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	5/30/04	Initial Release
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