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OCTOBER 22, 2013
Revision: Basic

DESIGN AND DEVELOPMENT ELECTRICAL, ELECTRONIC, ELECTROMECHANICAL (EEE) PARTS PLAN

ENGINEERING AND TECHNOLOGY DIRECTORATE

National Aeronautics and
Space Administration

John F. Kennedy Space Center

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DESIGN AND DEVELOPMENT ELECTRICAL, ELECTRONIC, ELECTROMECHANICAL (EEE) PARTS PLAN

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ACORD	Association for Cooperative Operations Research and Development
AEC	Automotive Electronics Council
AoA	analysis of alternatives
CAGE	Commercial And Government Entity
CDR	Critical Design Review
CoC	Certificate of Compliance
COTS	commercial-off-the-shelf
DD	displacement damage
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DSCC	Defense Supply Center, Columbus
EEE	Electrical, Electronic, and Electromechanical
EGSE	Electrical Ground Support Equipment
ELDRS	Enhanced Low Dose Rate Sensitivity
EMI	Electromagnetic Interference
EOL	end of life
EPARTS	Electronic Parts Applications Reporting and TrackingSystem
EPCP	EEE Parts Control Panel
ERAI	Electronic Resellers Association International
ERD	environmental requirements document
ESD	electrostatic discharge
GIDEP	Government-Industry Data Exchange Program
GSE	Ground Support Equipment
GSS	Ground Support Systems
JANS	Joint Army Navy Class S
KDDMS	Kennedy Design Data Management System
KNPR	Kennedy NASA Procedural Requirements
KSC	John F. Kennedy Space Center
LDC	lot date code
LET	linear energy transfer

MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NE	KSC Engineering and Technology Directorate
NPD	NASA Policy Directive
NPSL	NASA Parts Selection List
NSPAR	Nonstandard Part Approval Requests
OCM	original component manufacturer
OEM	original equipment manufacturer
OIG	Office of the Inspector General
PDN	product discontinuance notice
PEM	plastic encapsulated microcircuits
PDR	Preliminary Design Review
PMN	Program Model Number
PR	Purchase or Procurement Request
QML	Qualified Manufacturing Line
QPL	Qualified Parts List
RDM	radiation design margin
RSAR	Reliability and Safety Assessment Report
SAA	Safety Assurance Analysis
SCD	Source Control Drawing
SEB	single event burnout
SEE	single event effects
SEFI	single event functional interrupts
SEGB	single event gate rupture
SEL	single event latchup
SET	single event transient
SOW	Statement of Work
TID	total ionizing dose
VICD	Vendor Item Control Drawing

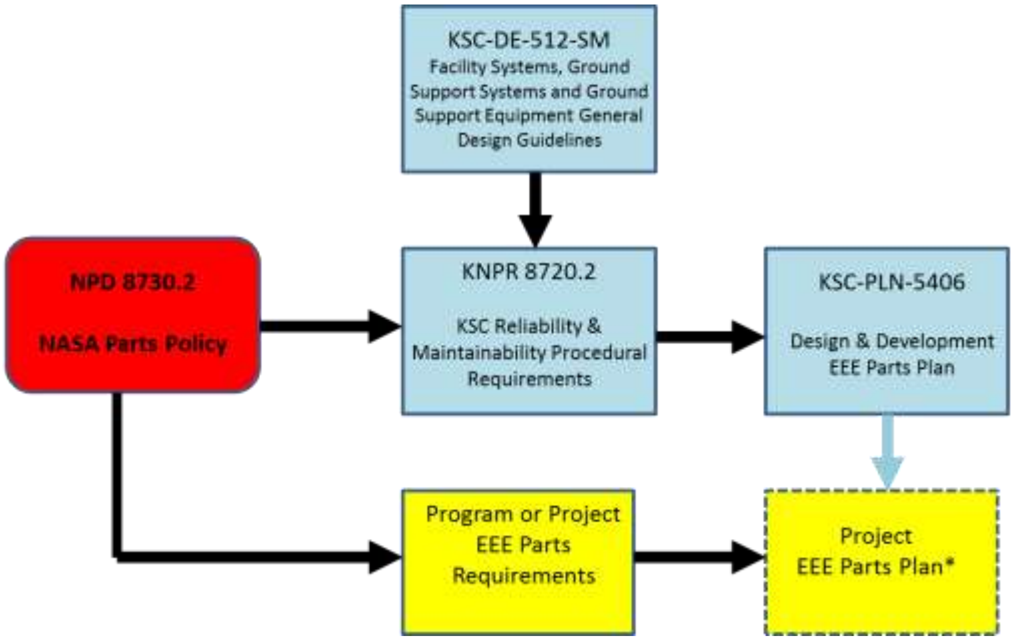
DESIGN AND DEVELOPMENT ELECTRICAL, ELECTRONIC, ELECTROMECHANICAL (EEE) PARTS PLAN

1. SCOPE

This plan establishes guidelines for the implementation of requirements for electrical, electronic, and electromechanical (EEE) parts selection, management, and control for flight projects, flight experiments, and Ground Systems (GS) that include Ground Support Equipment (GSE) and Ground Support Systems (GSS) for Kennedy Space Center (KSC) design and development projects. The implementation of an EEE parts plan greatly increases the predicated reliability of electronic components, assemblies, and subsystems, thus increasing the likelihood of mission success.

As specified in this document, requirements and guidelines differ between flight projects and ground systems. EEE parts include components, assemblies and subassemblies. This plan is tailorable, and is intended to meet the requirements specified in NPD 8730.2, NASA Parts Policy, KNPR 8720.2, KSC Reliability and Maintainability Procedural Requirements, Chapter 3, EEE & Mechanical Parts, Material and Processes, and KSC-DE-512, Facility Systems, Ground Support Systems and Ground Support Equipment General Design Guidelines. The EEE parts requirements flow is shown in Figure 1.The parts requirements and the guidelines described in this document are to be selectively applied based on mission needs, spaceflight project and payload classification, GSE system criticality, and program/project requirements. System needs and requirements should be evaluated to determine the extent to which each requirement and guideline should be applied and documented in the project plan. The tailored plan shall be approved by the KSC EEE Parts Control Panel (EPCP).

The implementation of an EEE parts plan greatly increases the predicated reliability of electronic components, assemblies and subsystems, thus increasing the likelihood of mission success.



* Project EEE Parts Plans may be tailored from KSC-PLN-5406, EEE Parts Plan, and may be as simple as completing the applicability matrix with specific program/project requirements.

Figure 1. EEE Parts Requirement Flow

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein. When this document is used for procurement, including solicitations, or is added to an existing contract, the specific revision levels, amendments, and approval dates of said documents shall be specified in an attachment to the Solicitation/Statement of Work/Contract.

<u>Government</u>

GSFC-EEE-INST-002	EEE-INST-002: Instructions for EEE Parts Selection, Screening, Qualification, and Derating
GSFC-311-QPLD-017	Goddard Spaceflight Center Qualified Parts List
KDP-KSC-P-2102	Kennedy Documented Procedure: GIDEP Evaluation-Disposition
KDP-KSC-P-2103	Kennedy Documented Procedure: GIDEP Initiation & Publication
KNPR 8700.2	KSC System Safety and Reliability Analysis Methodology Procedural Requirements

KNPR 8720.2	KSC Reliability and Maintainability Procedural Requirements
KSC-NE-10074	Electrical Ground Support Equipment Qualification Test Plan
KSC-STD-164	Standard for Environmental Test methods for Ground Support Equipment
KSC-STD-G-0003B	Standard for Qualification of Launch Support and Facility Components
MSFC-STD-3012	Electrical, Electronic, And Electromechanical (EEE) Parts Management And Control Requirements For MSFC Space Flight Hardware
MSFC-STD-3619	MSFC Counterfeit Electrical, Electronic, And Electromechanical Parts Avoidance, Detection, Mitigation, And Disposition Requirements For Space Flight And Critical Ground Support Hardware
NPD 8730.2	NASA Policy Directive: NASA Parts Policy
NPR 7120.5	NASA Space Flight Program and Project Management Requirements
NPR-8705.4	NASA Policy Requirements: Risk Classification for NASA Payloads.

<u>Military</u>

MIL-PRF-27	Performance Specification Transformers And Inductors (Audio, Power, And High-Power Pulse), General Specification For
MIL-PRF-38534	Performance Specification Hybrid Microcircuits, General Specification For
MIL-PRF-39010	Performance Specification Coil, Radio Frequency, Fixed, Molded, Established Reliability And Nonestablished Reliability, General Specification For
MIL-PRF-83446	Performance Specification Coils, Radio-Frequency, Chip, Fixed Or Variable, General Specification For

MIL-STD-883	Test Method Standard Microcircuits
MIL-T-55631	Transformers; Intermediate Frequency, Radio Frequency, and Discriminator, General Specification for

Commercial

ANSI/ESD S20.20	Development of an Electrostatic Discharge Control Program for: Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
AS9003	Inspection and Test Quality Systems
AS9100	Quality Systems – Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing.
AS9120	Quality Management Systems – Aerospace Requirements for Stocklist Distributors.
ISO 9001	International Organization for Standards, Quality Management System Standards.

3. ROLES AND RESPONSIBILITY

3.1 The Program/Project

It is the ultimate responsibility of the program/project to implement the requirements and guidelines specified in this document to meet program/project needs and requirements. The project may develop a tailored EEE Parts Plan which may include only the EEE Parts Applicability Matrix identifying specific program/project requirements and the EEE Parts Design Checklist described in the appendices of this document and verify compliance.

3.2 The EEE Parts Control Panel

The roles and responsibilities of the KSC EEE Parts Control Panel (EPCP) are defined in the EPCP charter.

KSC EPCP responsibilities include:

a. establish KSC EEE parts policy compliance to NPDs and KNPRs,

b. review and approve new parts, materials, and processes as required,

c. approve program/project-tailored EEE Parts Plans as required,

d. approve waivers and exceptions to part-selection requirements specified in this document that do not violate NPD or KNPR requirements,

e. review all proposed commercial-off-the shelf (COTS) hardware for criticality 1 or criticality 2, high-risk, significant-risk or safety risk applications for acceptability and define any additional screening, qualification, inspections, or modifications required before approval for use on the program/project,

f. approve nonstandard part requests.

g. approve part procurements for nonfranchised distributors,

h. initiate investigative action on suspect counterfeit parts and other noncompliances,

i. provide alert notifications to NASA, Government-Industry Data Exchange Program (GIDEP), Electronic Resellers Association International (ERAI), and the Office of the Inspector General (OIG) for counterfeit parts and other noncompliances as required,

j. review and approve submissions of newly qualified EEE parts into the Electronic Parts Applications Reporting and Tracking System (EPARTS) database,

k. review and approve submission of newly identified obsolete and end-of-life (EOL) EEE parts to the EPARTS obsolescence tool,

l. approve using a part that has an expected life less than its design life, and

m. for spaceflight projects, approve project-specified screening requirements that are less stringent than EEE-INST-002

4. APPLICABILITY

NPD 8730.2, The NASA Parts Policy Directive, applies to flight hardware, critical GSE, and critical ground test systems used in Category 1 and Category 2 projects as defined by NPR 7120.5D, NASA Space Flight Program and Project Management Requirements, and/or Class A, B, or C payloads as defined by NPR 8705.4, Risk Classification for NASA Payloads, Appendix A (also specified in Appendix B of this document). Although agency part requirements are specified for the classifications above, there are sound engineering EEE parts practices that should be applied throughout NASA projects. This plan applies to KSC-designed and -developed flight projects and experiments (space and aeronautical), Ground Systems that include GSE and GSS. As specified in this document, requirements and guidelines differ between flight projects and ground systems. The implementation of the parts requirements and guidelines described in this document are tailorable, and should be selectively applied based on mission requirements, spaceflight project and payload classification, GSE system criticality, and program/project requirements. Appendix C shows the EEE parts applicability matrix for payload classes A-D, critical and noncritical GSE, GSS, and other systems. As indicated in the Appendix C matrix, depending on the category, specific project requirements may be added or removed.

EEE part grade selection shall be based upon spaceflight project and payload classification, GSE system criticality, and program/project requirements. A risk assessment shall be performed by the program/project to determine the use of EEE parts.

COTS equipment is used extensively in the design of GS and some low-cost spaceflight projects. It can be cost prohibitive to apply EEE parts requirements to COTS equipment. Implementation of requirements and guidelines for the use of COTS EEE parts and equipment in flight projects and GS are defined within this document.

5. EEE PART TYPES

This document applies to the EEE part types listed in Table 1. Assemblies and subassemblies, including COTS assemblies that contain component part types in Table 1, are considered EEE parts.

The EEE parts requirements also apply to EEE parts in sensor and transducer assemblies and solenoids where basic sensing/transducer pieces are packaged in an assembly with other electrical part types such as wire, connector, resistor, etc.

For flight projects, parts approved for use with waivers/deviations, electronic parts and materials should be manufactured and processed to applicable guidelines referenced in MIL-HDBK-454, General Guidelines for Electronic Equipment, or MIL-HDBK-1547, Electronic Parts, Materials, and Processes for Space and Launch Vehicles.

Part types that do not fall into one of the categories listed in Table 1 shall be reviewed on a case-by-case basis using the closest NASA, Defense Supply Center Columbus (DSCC), or government-controlled specification as a baseline. The review shall ensure that part meets the reliability requirements of its intended application and covers the selection, screening, qualification, and applicable derating. In the event a suitable government baseline specification does not exist, the project shall approach the NASA KSC EPCP.

Table 1. EEE Part Types

Part Type	Federal Stock Class	Part Type	Federal Stock Class
Capacitors	5910	Inductors	5950
Circuit Breakers	5925	Hybrid microcircuits	5962
Connectors	5935	Magnetics	5950
Crystal Oscillators	5955	Misc. Electrical & Electronic Parts	
Diodes & Semiconductors	5961	Monolithic Microcircuits	5962
Electronic Assemblies	5998	Optoelectronics Devices	5980
Fiber Optic Accessories	6070	Pressure. Temp. & Humidity Measuring & Control Instruments	6685
Fiber Optic Cables	6015	Relays & Solenoids	5945
Fiber Optic Conductors	6010	Resistors	5905
Fiber Optic Devices	6030	Switches	5930
Fiber Optic Interconnects	6060	Thermistors	5905
Fiber Optic Switches	6021	Transformers & Coils	5950
Filters	5915	Transistors	5961
Fuses	5920	Wire and Cable	6145

6. PART SELECTION AND GRADE

The design organization shall select the appropriate grade and application of EEE parts to be used in the design or major modification of flight and payload systems and experiments and critical GSE based on the category, criticality, and the criteria detailed in this section. Exceptions to the selection requirements specified in this document must be approved by the NASA KSC EPCP.

6.1 Parts Grade Comparisons

The choice of the appropriate parts grade is significant in determining the reliability and cost associated with EEE parts. The following tables provide some generic guidance for selection of an appropriate parts grade. Automotive grade EEE parts are considered to be somewhere between commercial and military grade parts for robustness, quality, reliability and performance. Automotive grade parts should be Automotive Electronics Council (AEC) certified.

Typical Operating Temperature Ratings:

Commercial Grade: 0 ^{o}C to 70 ^{o}C
Industrial Grade: -40 ^{o}C to 85 ^{o}C
Automotive Grade (1): -40 ^{o}C to 125 ^{o}C
Military Grade: -55 ^{o}C to 125 ^{o}C

Table 2. EEE Parts Grade Description

Grade	Summary	Reliability	MTBF	Cost	Typical Use
1	"Space" quality class qualified parts, or equivalent.	Highest	Longest	Very High	Spaceflight
2	"Full Military" quality class qualified parts, or equivalent.	Very High	Very Long	High	Space flight or critical ground support equipment
3	"Low Military" quality class parts, and Vendor Hi-Rel or equivalent. Automotive grade EEE parts	Medium	Variable	Moderate	Space flight experiments, aeronautical flight experiments, critical ground support equipment, test demonstrations and ground support systems
4	“Commercial" quality class parts. No qualification required. No government process monitors incorporated during manufacturing.	Variable	Variable	Lowest	Aeronautical flight experiments noncritical ground support equipment, ground support systems, test demonstrations and prototypes. Limited critical GSE.

Table 3. Comparison of EE Part Grade Requirements

Item	Grade 1	Grade 2	Grade 3	Grade 4
Typical Minimum Quality Class for First Choice.	Microcircuit: Class S or V Hybrid Microcircuit: Class K Discrete Semiconductor: JANS (Joint Army-Navy, Class S) Cap. Or Resistor: Failure Rate Level (FRL) S, R or C Other: Various	Microcircuit: Class B or Q Hybrid Microcircuit: Class H Discrete Semiconductor: JANTXV Cap. Or Resistor: FRL R, P, or B Other: Various	Microcircuit: Class M, N, T, or /883 Hybrid: Class G, D, or E Discrete Semiconductor: JANTX Cap. or Resistor: P or B, and Other Other: Various Vendor Hi-Rel Automotive grade EEE parts	Commercial (Often is PEM)
PIND & X-Ray	Intrinsic to Class	Accomplished by additional screening	Not required	No
Typical Minimum Piece Part Qualification	Military or NASA or equivalent		As required per program/project qualification plans.	Not specified
Radiation Hardness Assurance (RHA) by Analysis and/or Test	Yes, When Specified		Not required	
Procurement Limited to Qualified Source	Yes			Required for flight systems and experiments, GSE, and GSS. Recommended for others
Lot Quality Conformance Inspection Required	Yes	Yes, but less stringent than Grade 1 requirements	Yes, but much less stringent than Grade 2 requirements	No

Item	Grade 1	Grade 2	Grade 3	Grade 4
Screening	100% required	100% recommended, not as stringent as Grade 1	Limited	Limited if used in critical GSE
Hazard Avoidance	Yes			
Specification and Control Drawings	Military, NASA, or Industry Standard, or Project prepared Control Drawing (e.g. SCD, VICD)	Mostly Military, NASA, or Industry Standards, or Project prepared Control Drawing, but also limited use of Vendor Specifications.	Vendor Specifications, Industry and Organizational Standards, and Military or NASA Standards.	Optional
Derating	Yes			Yes if used in critical GSE
Nonstandard Part Approval Request	For a part not listed as a standard Grade 1 part which may be determined acceptable to use in a Grade 1 application.	Yes if used in critical GSE	For a part not listed as a standard Grade 3 part which may be determined acceptable to use in a Grade 3 application.	Yes if used in critical GSE
As-Designed EEE Parts List	Yes			
Traceability	By Lot and Serial Number as a Minimum			Required for flight systems and experiments, GSE, and GSS. Recommended for others.
Part Selection Preferences Specified	Yes			As determined by design team
Substitutions Restricted	Yes		Substitutions allowed based on parts selection criteria	No
As-Built EEE Parts List	Yes			

6.2 Parts Selection

Grade 1-3 parts shall be selected in accordance with appropriate part type specification and quality level listed in MSFC-STD-3012.

The NASA Parts Selection List (NPSL) (http://nepp.nasa.gov/npsl) and the EPARTS database may be used for additional part selection provided that the part selected meets the qualification and screening criteria for the intended application. The qualification database for Electrical Ground Support Equipment (EGSE) in KDDMS should be used for selection of qualified EGSE components.

The term MFR HI-REL, often referred to as high-reliability parts in the manufacturer's catalog, applies to parts that are procured to a manufacturer-controlled flow as described in the manufacturer's catalog. The part flow is controlled only by the manufacturer. A certificate of compliance (CoC) is furnished by the manufacturer certifying that the parts have been tested and perform according to advertised specifications. In some cases, manufacturers add very little to their commercial process flows, and yet call their product "high reliability." It is the responsibility of the project to obtain test data to verify that the screening and qualification requirements specified in this document were met, or to perform the screening and qualification themselves.

If the project relies on manufacturer-provided test data, it is the responsibility of the project to assess the part-manufacturer's capability to produce quality parts and perform additional screening and qualification tests as defined in this document.

Criticality categories (1, 1R, 1S, 2, 3) are defined in Appendix A.

6.2.1 GSE and GSS Part Selection

For GSE and GSS, a Reliability and Safety Assessment Report (RSAR) shall be developed and may warrant a Safety Assurance Analysis (SAA). The RSAR and SAA identify component failures and categorize them as criticality categories (1, 1R, 1S, 2, 3) or high-risk items, significant-risk items, or safety risk items. Components categorized as criticality categories (1, 1R, 1S, 2, 3) shall adhere to requirements in section 6.2.2-6.2.5. Components identified as high-risk items, significant-risk items, or safety risk items shall use Grade 1 or Grade 2 parts as determined by the program/project. Components not identified in this risk category may use Grade 3 or Grade 4 parts as determined by the program/project. Hazard and safety risks are described in Appendix F.

6.2.2 Grade 1 Parts for Criticality 1 Part Applications

Grade 1 EEE parts typically meet the highest reliability standards, and have been subjected to independent verification. Grade 1 shall be selected for equipment requiring maximum feasible reliability because of critical mission objectives and safety. This includes flight projects with high visibility both within and outside of NASA, and could involve objectives which may be difficult to repeat in another mission. Flight missions of 5 years or longer may also require Grade 1 parts. Repair during the mission is not a practical or desirable option. The parts selection of Grade 1 parts shall conform to the requirements contained in MSFC-STD-3012, Table V. Parts selection should be accomplished in the order indicated. A lower-ranked selection should not be used if a higher-ranked part selection can be obtained.

6.2.3 Grade 2 Parts for Criticalities 1R, 2, 2R, 3, and 1S Part Applications

For hardware items used in criticality 1R#, 2R, 2, 3, and 1S applications, except as noted in sections 6.2.4 and 6.2.5 for Criticality 3 applications, a minimum of grade 2 parts should be used in the design, modification, and fabrication of flight equipment and critical GSE. Maximum use should be made of standard parts that have a history of high reliability.

The parts selection shall conform to the requirements contained in MSFC-STD-3012, Table VI. Parts selection shall be accomplished in the order indicated. A lower ranked selection should not be used if a higher-ranked selection can be obtained. A nonstandard grade 2 part may be used in accordance with MSFC-STD-3012 when a standard part is not available. Commercial-quality-assurance-level parts shall not be used in these applications without EPCP approval. The objective shall be to minimize part types, utilize standard part types to the maximum extent possible, and ensure that appropriate minimum quality levels are maintained.

Grade 2 EEE parts typically meet rigorous (but not the highest) industry reliability standards, and have been subjected to independent verification. Grade 2 should be selected for equipment that requires high reliability, but for which a low risk of failure can be tolerated to meet cost constraints. Flight missions of 1 to 5 years duration may use grade 2 parts. The mission may be multiple or single purpose, with a repeat mission possible. Repair during the mission may be practical. Functional or block redundancy for all primary objectives is desirable but single-string design may be acceptable. The application usually is spaceflight equipment or critical GSE components categorized as high-risk items, significant-risk items, or safety risk items.

6.2.4 Grade 3 Parts for Criticality 3 Applications

For Criticality 3 applications, the program/project may approve the use of grade 3 parts in the design, modification, and fabrication of the flight equipment and critical GSE. Grade 3 parts shall be qualified for its operational environment.

The parts selection of Grade 3 parts shall conform to the requirements contained in MSFC-STD-3012, Table VII. Parts selection should be accomplished in the order indicated. A lower-ranked selection should not be used if a higher-ranked selection can be obtained. A nonstandard grade 3 part may be used in accordance with MSFC-STD-3012 when a standard part is not available. The objective is to minimize part types, utilize standard part types to the maximum extent possible, and ensure that appropriate minimum acceptable quality levels are maintained.

Grade 3 EEE parts typically meet standards for high reliability, but there may be significant exceptions and the parts may not have been independently verified. Grade 3 parts should be selected for equipment where high reliability is desired, but is not mandatory. The flight missions are typically for a single-purpose or routine mission with repeat missions possible. Flight mission duration may be less than 1 year. Repair during the mission would not necessarily be considered worthwhile. Single-string design would normally be acceptable. For critical GSE, redundancy is usually implemented. The application is usually spaceflight and aeronautical experiments or critical GSE and GSS components NOT categorized as high-risk items, significant-risk items, or safety risk items.

Grade 3 parts include "industrial" rated commercial parts. Grade 3 parts shall be qualified for their environment per program/project requirements.

6.2.5 Grade 4 Parts for Criticality 2 and 3 Applications

For Criticality 2 and 3 applications, the EPCP may approve the use of grade 4 parts in the design, modification, and fabrication of the flight equipment and critical GSE components not categorized as high-risk, significant-risk, or safety risk items. The parts selection of Grade 4 parts should conform to the requirements contained in MSFC-STD-3012 Table VIII. A Grade 4 part shall be qualified for its operational environment.

Grade 4 EEE parts typically meet vendor standards for high reliability or commercial marketplace reliability, but have not been independently verified. Grade 4 should be selected for equipment where high reliability is not a primary factor, the mission is not critical, or a repeat mission is possible. The duration of a mission would typically not be lengthy. Repair may be very practical. Typical applications of Grade 4 parts include low-cost flight experiments, test demonstration projects, prototypes, and some GSE and GSS. For GSE applications, redundancy should be implemented.

6.3 Qualified Manufacturer Lists (QMLs)

Use of Qualified Manufacturer Lists (QMLs) can greatly aid in the selection and procurement of qualified EEE parts. "QML" means a list of manufacturers who have had their products examined and tested and who have satisfied all applicable qualification requirements for that product according to manufacturer requirements and military specifications. To select and procure an EEE part using a QML, a Part Identification Number (PIN) is generated for the part. The PIN is generated using the appropriate military performance specification (MIL-PRF) or military detail specification (MIL-DTL) for the desired federal stock class and part grade. Using the PIN, one can query the QML for providers of that part. Purchasing parts from a QML provides the pedigree of that part, and asserts the reliability of the part for a given usage. Information on QML, MIL-PRF, and MIL-DTL can be found on the Defense Logistics Agency website: http://www.landandmaritime.dla.mil/programs/qmlqpl/ .

7. COTS AND NONSTANDARD PARTS

The determination of EEE part grades used in COTS equipment and assemblies is difficult to achieve. Testing and qualification are critical to the implementation of COTS in NASA projects. A nonstandard part is an electronic part that has not been approved for listing in GSFC-EEE-INST-002, KSC EGSE qualified component database or in other applicable NASA-approved parts lists; e.g., EPARTS, NPSL, or does not have a qualification plan and which fits into one of the applicable Federal Stock Classes (i.e., 5905, 5910, 5915, 5920, 5935, 5950, 5961, 5962, or 6145). Nonstandard parts also include lower-grade parts that are used in higher-grade applications outside the requirements specified in paragraph 6.2 of this document.

The selection, application, and testing of COTS and nonstandard parts shall be in accordance to the following criteria:

7.1 Evaluation

Programs/projects and contractors shall evaluate systems using COTS and nonstandard components to determine the criticality category of applications.

System concepts shall be evaluated (performance, availability, etc.) including life cycle/mission profile (transportation and storage, operation mode and sequences, duration, etc.), and environmental conditions (temperature extremes, humidity, shock, vibration, acoustics, electromagnetic compatibility, and radiation).

The following conditions shall apply for the use of COTS and nonstandard parts:

a. For component criticality category 1 or 2 , high-risk items, significant-risk items, or safety risk items, the KSC EPCP shall review all proposed COTS and nonstandard hardware for acceptability, and shall define any additional screening, qualification, inspections, or modifications required before approval for use on the project. A Nonstandard Part Approval Request (NSPAR) form must be completed to use nonstandard parts. An example NSPAR form is shown in Appendix H.

b. A reliability analysis shall be performed (typically performed by safety and reliability engineers).

c. Designers/developers shall evaluate a redundant architecture and implement in the design as required.

d. Designers/developers shall implement derating and adequate design margins.

e. Government Industry Data Exchange Program (GIDEP), NASA and contractor alerts, advisories, and reports shall be reviewed for relevance to potential COTS items before selection or use in the project or system.

7.2 Testing and Qualification

An appropriate prescreening, test, and qualifications plan shall be developed based on the environmental and mission profile requirement.

COTS and nonstandard parts shall also be tested in accordance to its operational/mission profile environment.

Environmental tests such as acoustic, vibration, shock, radiation, pressure, thermal, electromagnetic compatibility, and accelerated life shall be performed on COTS, when applicable.

7.3 Vendor Selection

Authorized vendor sources shall be determined and used to prevent counterfeit parts. Original component/equipment manufacturers have lists of authorized vendors for their products. The supplier quality listings shall be reviewed to determine existing acceptability of any potential vendor.

The vendor’s quality practices (audits), test data, and failure data shall be investigated. The vendor selected shall have in place good design, workmanship, and quality control practices.

The project and design organizations purchasing COTS items shall work with vendors to modify/upgrade parts with higher reliability parts, if necessary. COTS shall be evaluated for lifecycle obsolescence and required logistic spares for the project life cycle.

7.4 Procurement

When parts cannot be procured to appropriate specifications, a drawing, such as a Source Control Drawing, should be prepared by the developer to control procurement requirements. For spaceflight projects, the drawing should include the screening and qualification requirements specified in Tables 2 and 3 of EEE-INST-002 for the applicable part type. The drawing shall also include performance parameters, absolute maximum ratings, dimensions, terminal descriptions, materials, and other unique requirements.

With project approval, unique screening and qualification requirements that are not normally performed by the manufacturer as part of their normal production practice may be placed directly in the purchase order in lieu of preparing a developer-controlled drawing. It is the responsibility of the project to require test data from the manufacturer in order to verify compliance.

The following documents and reports, as applicable, shall be requested as part of the purchase request.

a. certificate of conformance or compliance (CoC)

b. test and analysis reports

c. workmanship certifications

d. test and inspection compliance

e. material certifications

f. screening results

g. calibration records

8. AS-BUILT, AS-DESIGNED PARTS AND MATERIAL LIST

An as-built parts or as-designed parts and materials list for EEE parts shall be prepared and maintained.

The as-built parts or as-designed parts and materials list shall be reviewed against GIDEP failure experience data and NASA Parts Advisories.

The list shall include, as a minimum, the following information:

a. part number

b. part name or description

c. manufacturer name or Commercial and Governmental Entity (CAGE) number

d. quantity

e. schematic reference numbers

f. screening information

g. lot date code

h. drawing number and name of the next higher assembly where part is located

If it is a standard part, the part number shall be the military specification part number or the procurement document number. If it is a nonstandard part, it shall include the manufacturer's part number and the nonstandard part approval number.

9. IONIZING RADIATION

EEE parts intended for use in flight hardware shall be qualified to operate with acceptable performance during and after exposure to the part-level radiation environment specified in the program/project environmental requirements document (ERD).

For grades 1, 2, and 3 parts, and where feasible, for grade 4 parts used in spaceflight applications, the effects of the projected ionizing radiation on each part or assembly shall be determined by analysis and/or test. Radiation evaluation shall address all threats appropriate for the technology, application, and environment, including Total Ionizing Dose (TID), Enhanced Low Dose Rate Sensitivity (ELDRS), Single Event Effects (SEE), and Displacement Damage (DD) as defined in the project ionizing radiation control document and shall be assessed on a lot-specific basis according to the program/project requirements.

Parts shall be selected based upon their ionizing radiation environment and immunity, life cycle, and program/project requirements. Failure mitigation or a design margin shall be established by the project to ensure acceptable performance in the projected radiation environment. Parameter degradation limits shall be developed from the available test data for use in the worst-case analysis and for use in determining acceptance requirements after radiation testing.

Allowable SEE rates shall be defined and used for reference in evaluating designs for suitability. Parts shall be selected so that equipment meets specified performance requirements when exposed to the SEE radiation environment. SEE includes single-event upsets, transients, latch-ups, burnouts, gate ruptures, and snapbacks. Safety-critical circuits shall be designed so that they will not fail because of SEE. The project shall demonstrate through testing or analysis whether the selected parts can withstand SEE.

Table 4 provides ionizing radiation considerations by class as indicated in Appendix B and defined by NPR 8705.4.

Low-cost spaceflight experiments and projects such as Class D payloads that do not require radiation hardened parts should consider the following:

a. Analyze parts for radiation susceptibility, considering environment and project lifetime.

b. Identify critical parts. Use the highest grade feasible for critical parts.

c. Implement redundancy.

d. Utilize watchdog timers and software resets.

Table 4. Radiation Considerations by Class

Requirement	Class A Payload	Class B Payload	Class C Payload	Class D Payload
SEL (Single Event Latchup)	Linear Energy Transfer (LET)th >75 MeV-cm2/mg	LETth >75 MeV-cm2/mg or <10-4 events/yr	LETth >75 MeV-cm2/mg or <10-4 events/yr	LETth >37 MeV-cm2/mg or <10-3 events/yr
SEGR/SEB (Single Event Gate Rupture / Single Event Burnout)	LETth >37 MeV-cm2/mg	LETth >37 MeV-cm2/mg	LETth >37 MeV-cm2/mg	LETth >37 MeV-cm2/mg
SEU (Single Event Upset)	LETth >75 MeV-cm2/mg or <1E-10 per bit per day or by analysis verifying no impact to mission requirements	LETth >75 MeV-cm2/mg or < 1E-10 per bit per day or by analysis verifying no impact to mission requirements	LETth >37 MeV-cm2/mg or <1E-10 per bit per day or by analysis verifying no impact to mission requirements	none
SEFI (Single Event Functional Interrupts)	LETth >75 MeV-cm2/mg or <10-3 events/yr	LETth >75 MeV-cm2/mg or <10-2 events/yr	LETth >37 MeV-cm2/mg or <10-1 events/yr	none
SET (Single Event Transient)	LETth >75 MeV-cm2/mg or by analysis verifying no impact to mission requirements	LETth >75 MeV-cm2/mg or by analysis verifying no impact to mission requirements	LETth >37MeV-cm2/mg or by analysis verifying no impact to mission requirements	none

Requirement	Class A Payload	Class B Payload	Class C Payload	Class D Payload
TID, ELDRS 1/ (Total Ionizing Radiation, Enhanced Low Dose Rate Sensitivity)	Meets ERD level w/RDM (Radiation Design Margin) of 2; Parametric acceptance @ 90% confidence w/ 99% probability of success	Meets ERD level w/RDM of 2; Parametric acceptance @ 90% confidence w/ 99% probability of success	Meets ERD level w/RDM of 2; Parametric acceptance @ 90% confidence w/ 99% probability of success	Meets ERD level w/RDM of 1; Parametric acceptance at specified limits
DD 1/ (Displacement Damage)	Meets ERD level w/ RDM of 2; Survival @ 90% confidence w/ 99% probability of success	Meets ERD level w/ RDM of 2; Survival @ 90% confidence w/ 99% probability of success	Meets ERD level w/ RDM of 2; Survival @ 90% confidence w/ 90% probability of success	Meets ERD level w/ RDM of 1; at go- no-go

Notes:
1/ Parts with spot shielding require an RDM of 3 for Class A, B, and C, and an RDM of 2 for Class D.
Spaceflight classifications are given in Appendix B.

10. SCREENING

Screening tests are intended to remove nonconforming parts (parts with random defects that are likely to result in early failures [known as infant mortality]) from an otherwise acceptable lot and thus increase confidence in the reliability of the parts selected for use.

For spaceflight projects and payload project class A-C, grades 1, 2, and 3 parts shall be subjected to screening. Any required test that is already performed by the procurement specification (military or SCD) or that is normally performed by the manufacturer need not be repeated, however, lot specific attributes data must be submitted to show that tests were performed with acceptable results. The project is responsible for specifying and documenting device-unique requirements, if any. Screening shall be performed in accordance with EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating. The program/project shall determine the appropriate level of screening required based on project classification and criticality. Project specified screening requirements that are less stringent than EEE-INST-002 shall be approved by the KSC EEE Parts Control Panel. For other flight project classifications, screening may be performed based on project requirements.

Traditional screening of GS components is not required. Because electronics designed for KSC GS projects will have a large number of run-time hours prior to launch, are redundant, and are easily accessible for replacement; visual screening, along with functional and performance testing of components and assemblies is sufficient. Functional and performance testing shall be conducted on 100% of assemblies.

11. QUALIFICATION

11.1 Qualification Requirements

When a KSC flight project is required by spaceflight project or payload classification to use grades 1, 2, and 3 EEE parts, these parts should be qualified at the component/part level. Otherwise, assembly-level qualification should be performed. Specified KSC spaceflight projects and payload project class A-C shall perform qualification per Goddard Space Flight Center EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating. For other flight project classifications, the program/project may develop a qualification plan or tailor EEE-INST-002 and KSC-E-NE-10074 to meet program/project requirements.

For KSC GSE projects, grades 1 and 2 EEE parts shall be qualified at the component part level. For projects using grades 3 and 4 EEE parts, assembly level qualification is sufficient. Qualification shall be performed in accordance with KSC-STD-G-0003B, Standard for Qualification of Launch Support and Facility Components. Qualification testing shall be in accordance with KSC-NE-10074, Electrical Ground Support Equipment Qualification Test Plan. Qualification methods shall be in accordance with KSC-STD-164, Standard for Environmental Test Methods for Ground Support Equipment

Any required test that is already performed by the procurement specification (military or SCD) need not be repeated. However, lot specific or generic attributes data, as applicable, must be submitted to show that tests were performed with acceptable results. Qualification is generally considered destructive and samples shall be segregated from flight parts or field-deployed operational GSE.

11.1.1 Component/Part Level

Qualification at the component/part level shall be achieved by meeting designated military or NASA standards component part qualification requirements or by other means as documented for nonstandard part approval. Requirements for qualification of nonstandard parts shall be equivalent to the requirements imposed on similar standard parts, or shall otherwise satisfactorily demonstrate that the part has an approved margin of safety beyond the demands of the equipment in which it will be used.

11.1.2 Assembly Level

Part qualification at the assembly level shall be based upon qualification testing of the assembled equipment. A part shall be qualified for a given application within the assembly by successful performance during qualification testing, or by similarity to a part which has been so qualified.

11.2 Additional Qualification Types

Qualification by usage history or similarity to qualified parts is acceptable as discussed below.

11.2.1 History

A part can be considered qualified if it has been used successfully in (a) applications identical to that proposed (heritage design) or (b) applications different from that proposed if the application, including derating and environmental conditions, is fully documented and is more severe than the proposed application. For spaceflight projects, the part must have been used for 2 years minimum total operating time in orbit. The part must have been built by the same manufacturer in the same facility, using the same materials and processes to an equivalent Source Control Drawings (SCD). It is the program/project's responsibility to have such evidence documented.

11.2.2 Similarity

A part can be considered qualified if it is similar to a part for which qualification test data exists, and the test data (a) satisfies the requirements specified herein for the applicable part level, and (b) is available and is less than 2 years old relative to the lot date code of parts. In order to be considered similar, the part shall be made by the same manufacturer on the same manufacturing line, or on a line with only minor differences, and these differences shall be documented and shown to represent no increased reliability risk.

11.2.3 Existing Test Data

Parts can be qualified by existing test data that meets the requirements specified herein: (a) Lot specific data indicates that parts have the same lot date code as the qualification samples. Lot specific data is always acceptable in place of qualification testing when it meets the requirements specified herein. (b) Generic data is an acceptable basis for qualification if it is less than 1 year old relative to the lot date code of parts, and is acquired and reviewed for acceptability by the designer/developer. The project shall also verify that the data is representative of parts, e.g., built in the same facility using identical or similar processes.

12. DERATING

Derating guidance for flight and ground system EEE parts is provided in Appendix E. Project derating requirements may differ based upon project life cycle, reliability, and performance requirements. GSE is typically designed for a life expectancy of 15-20 years. Derating calculations shall be documented in the system design analysis report.

13. TRACEABILITY

13.1 Traceability Overview

Traceability and certification information shall be captured during the design process in order to prepare for the ultimate certification process. Traceability records include the heritage and compliance for purchased parts and material, along with design compliance with requirement traceability, including all tests, analyses, demonstrations, and inspections accomplished to verify the product has met the intended design. Waivers, deviations, and exceptions to any requirement shall be substantiated, approved, and documented.

Traceability is important because it allows us to track the location and usage of parts in hardware designs. In case of obsolescence, NASA advisory alerts, and GIDEP alerts, it is possible to identify the parts and implement the required resolution.

13.2 Traceability Requirements

a. Identification and traceability data for all EEE parts shall be documented by program/project or design organization.

b. Parts shall be traceable to the next level assembly and to the reference designator level.

c. As a minimum, the following information shall be documented for purchased parts:

   1) Procurement request number

   2) Part name and number

   3) Part manufacturer’s name or CAGE code

   4) Vendor or distributor information (EEE parts shall only be purchased from authorized vendors)

   5) Manufacturer’s lot date code and/or serial number

   6) Logistics arrival date

   7) Quantity purchased

d. A CoC shall be provided by the manufacturer when specified in the procurement request. Although warranties provide the government with rights for repair or replacement, a CoC provides the assurance that the material, part, component, or system is new and that tests have proven that the item provided conforms to the purchase requirement. A CoC may include test and analysis reports, workmanship compliance, material compliance, calibration records, and inspection reports.

13.3 Part Tracking

a. Parts shall be tracked during all phases of the project, procurement, storage (logistics), issuance/kitting, fabrication (assembly and subassemblies), and installation.

b. Piece parts or component-level parts shall be tracked by manufacturer lot numbers.

c. Assemblies and subassemblies, including COTS (when applicable), shall be tracked by serial number. Assemblies shall be serialized.

d. Parts shall be tracked to the assemblies in which they are used. Distributed parts shall be tracked to assembly kit and next level assembly number.

e. A means for parent-child relationships between components, subassemblies, and assemblies, i.e., schematic drawing number, reference designators (Ref Des), and program model numbers (PMN), should be established and documented.

f. Maintenance, refurbishment, replacement, and repair actions shall be traced and documented.

13.4 Traceability Records

Traceability records include the heritage and compliance for purchased parts and material. Applicable records should include the following:

a. certificate of conformance or compliance (CoC)

b. test and analysis reports

c. workmanship certifications

d. test and inspection compliance

e. material certifications

f. screening results

g. calibration records

14. COUNTERFEIT PART PREVENTION

EEE parts shall be procured only from the original component manufacturer (OCM), original equipment manufacturer (OEM), or their franchised (authorized) distributors.

14.1 OCM, OEM, and Franchised Distributors

OCMs, OEMs, and their franchised distributors shall be required to provide CoCs and acquisition traceability. Acquisition traceability consists of the name and location of all supply-chain intermediaries from the part manufacturer to the direct source of the product. CoCs and acquisition traceability requirements shall be clearly stated in the procurement purchase order. If traceability is unknown or documentation is suspect, appropriate risk mitigation shall be used as described in MSFC-STD-3619.

14.2 Nonfranchised Distributors

EEE parts should not be procured from nonfranchised (nonauthorized) distributors. Procurement of parts from a nonfranchised distributor shall require approval from the KSC EEE Parts Control Panel and utilization of these parts shall be in accordance with MSFC-STD-3619.

14.3 Procurement Requirements

To minimize the risk of procuring counterfeit product, the buyer’s procurement contract language shall include requirements that will ensure conforming, authentic material is provided. The seller’s responsibilities shall be plainly stated and agreed upon in Purchase Request (PR) or a Statement of Work (SOW) and shall include the following:

a. The seller shall be capable of providing full traceability for the parts being purchased, including names and addresses of prior sources (if any) to the buyer. Both buyer and seller shall maintain records containing date and/or lot codes, and any serialization associated with the purchase order and invoice.

b. The buyer shall notify the seller of all tests and inspections that the seller will be required to perform to assure product authenticity, including development of accept/reject criteria and qualification of test/inspection personnel.

c. The seller shall be required to comply with and/or be certified to, an appropriate quality standard (e.g., AS9100, AS9120, ISO 9001, and AS9003) as determined by the buyer.

d. The buyer shall notify the seller that the seller may be liable for remedial costs associated with the selling of counterfeit product. Procurement contracts shall state that the buyer is not under obligation to return suspect or confirmed counterfeit product. The buyer may request proof of financial responsibility, such as a product liability/completed operations certificate of insurance (e.g., Association for Cooperative Operations Research and Development [ACORD] Certificate of Liability Insurance) issued from the seller’s insurance agent or broker. Limits of at least $1,000,000 per occurrence and $1,000,000 annual aggregate are common. The buyer may also request similar evidence of professional liability and/or product recall insurance with similar limits from the seller.

e. The buyer shall inform the seller of the specific time period for which their responsibility applies. Terms and conditions between the buyer and seller shall allow for a reasonable time period for the buyer to detect, quarantine, and confirm counterfeit or substandard product. The buyer should perform a level of inspection or test sufficient to detect gross or common indications of counterfeiting before the time expires.

f. The buyer shall provide the seller with clear and specific instructions concerning deliverable documentation from the buyer. Documentation requirements, including certificates of conformance and test/inspection data, should be included in the contract terms and conditions.

g. The buyer shall notify the seller of potential Federal penalties associated with fraud and falsification.

14.4 Detected Counterfeit Parts

If a suspected counterfeit part is detected, the following actions should be taken immediately:

a. Quarantine the product.

b. Notify KSC EEE Parts Control Panel of potential counterfeit parts.

c. Determine part authenticity by further inspection and communications with the OCM, OEM, or supply source.

d. Identify the lot date code.

e. Identify the shipped field product.

f. The KSC EPCP shall initiate investigative action.

g. The KSC EPCP will address anomalous findings and technical issues brought up by either the part supplier or test laboratory performing the part authentication procedures.

h. The KSC EPCP shall provide timely notification to GIDEP, ERAI, and the OIG.

14.5 Part Inspection and Testing

All items shall undergo receiving inspection, as soon as possible upon receipt, and not just prior to installation or placing item(s) in service. Focus on whether the carton and packaging looks worn or reused, if the manufacturer date and serial number on the carton matches the device. Check all accessories and cables to ensure correct and functional.

Verify items are genuine by registering or sending serial numbers to the manufacturer to verify item is new and the buyer is the original owner or licensee.

Counterfeit part inspection and testing requires specialized tools and expertise. This will typically be performed outside of KSC as necessary. Part inspection and testing may be performed in accordance with MSFC-STD-3619.

15. GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM (GIDEP)

EEE Parts shall be reviewed for applicable GIDEP Alerts, GIDEP Safe-Alerts, GIDEP Problem Advisories, and GIDEP Agency Action Notices, collectively called “GIDEP Notices” and NASA Advisories during part selection and procurement phases. The GIDEP evaluation-disposition process shall be in accordance to KDP-KSC-P-2102. The designated KSC GIDEP coordinators may assist in the alert search process.

As manufacturing defects, nonconformances, or problems are identified, a NASA Advisory or GIDEP Notice (as appropriate for the situation) shall be generated and distributed accordingly. GIDEP Notice or NASA Advisory initiation and publication shall be in accordance with KDP-KSC-P-2103.

For parts affected by NASA Advisories, GIDEP Alerts, Safe-Alerts, or Problem Advisories the following procedure should be performed.

a. Identify lot date code and location of parts.

b. Remove and quarantine the parts.

c. Notify KSC EPCP and KSC GIDEP coordinator of affected parts.

16. PART OBSOLESCENCE

Some flight projects have short product life cycles and are not exposed to high risk of being affected by parts obsolescence. However, EEE parts should be evaluated for availability issues to ensure life expectancy exceeds system design and production milestones. This process guarantees selected parts are available beyond initial system design and procurable for production. Performing a parts obsolescence assessment reduces cost, schedule, and technical risk to hardware production for these flight projects.

Projects with extended product life cycles, such as GS, and those that plan to utilize heritage hardware are exposed to high risk of being affected by parts obsolescence. To mitigate this risk, EEE parts should be assessed prior to selection to ensure part availability meets or exceeds production milestones and mission duration. In addition, parts will be monitored throughout the system life cycle to identify and mitigate obsolescence issues before they occur. In the event a system is retained in service beyond its original life expectancy, spare parts will be required for repairs and maintenance operations. Obsolescence monitoring provides notification of part discontinuance to allow projects with sufficient time to procure spares.

16.1 Part Selection

Obsolete and limited-life EEE parts shall not be selected for hardware design unless approved by the program/project and KSC EEE Parts Control Panel. EEE part availability should coincide with project life-cycle requirements to avoid obsolescence impacts. Project As-Designed EEE Parts Lists shall be analyzed prior to preliminary design review (PDR), critical design review (CDR), as well as informal 30%, 45%, 60%, and 90% design reviews, to screen for potential obsolescence issues. This process ensures obsolescence is not incorporated into hardware design and eliminates diminishing manufacturing sources and material shortages (DMSMS) risks to system production.

16.2 Obsolescence Avoidance

16.2.1 Obsolescence Analysis

The best way to avoid implementing obsolete and End of Life (EOL) parts into new designs is to conduct an Obsolescence Analysis. An Obsolescence Analysis of EEE parts should be performed by the designer during the early design stages when the engineer is selecting parts for their design. If a sufficient amount of time has elapsed, another analysis should be done prior to procuring the parts, as well as before fabrication. The NASA EPARTS EEE parts database tool may be used to conduct the Obsolescence Analysis. This tool generates EEE part manufacturing status and part availability projections. EEE parts should be monitored on a continuous basis for manufacturer product discontinuance notification (PDN). EEE part manufacturers announce a product as end-of-life (EOL) to notify consumers of the last buy date for part procurements.

Notification is typically provided one year in advance of the actual obsolescence date. Advanced notification allows the project ample time to plan for product obsolescence and to budget for part procurement. Obsolescence analysis tools such as the EPARTS EEE Parts Obsolescence tool provide direct notification from the manufacturers to announce EOL EEE parts.

16.2.2 Manufacturing Status

A manufacturing status color code is usually assigned to each EEE part to denote the number of current, active manufacturing sources. Table 5 lists each EEE part manufacturing status and associated definition.

Table 5. EEE Part Manufacturing Status

EEE Part Manufacturing Status	Definition
Obsolete (Red)	No production sources are available.
End-of-Life (Orange)	The manufacturer issued a part discontinuance notice.
Sole Source (Yellow)	Only one production source is available.
Two or More Sources (Green)	Two or more production sources are available.
Unknown (White)	EEE Part availability not recognized by tools and requiresmanual research.

16.2.3 Projected Availability

Each EEE part should be assigned projected years of availability and an estimated obsolescence date. This forecasting technique, as seen in Table 6, allows projects to prepare and plan for EEE part obsolescence issues that may occur throughout the system life cycle. Another method of avoidance is the Lifetime or Bridge Buy, as discussed in the next section.

Table 6. EEE Part Availability Projection

Projected Years of Availability	Obsolescence Date
Obsolete	Current Date
1-2 years	Current Date + 1 Year
3-4 years	Current Date + 3 Years
5-7 years	Current Date + 5 Years
8-10 years	Current Date + 9 Years
11-15 years	Current Date + 13 Years
16-18 years	Current Date + 17 Years

16.3 Part Procurement

EEE parts shall be procured only from the OCM or their franchised (authorized) distributors. If parts cannot be procured from authorized sources, then the risk of counterfeit parts shall be avoided by complying with the requirements specified within this document.

16.3.1 Lifetime Buy and Bridge Buy

One method of avoiding obsolete parts is a lifetime buy or bridge buy. Early part procurement entails procuring sufficient part quantities to sustain current and/or future production requirements. A lifetime buy refers to procurement of sufficient quantities to sustain the life of the program, while a bridge buy satisfies part requirements for a specific contract or timeframe. The program/project shall determine the quantity required to sustain the project and comply with the part availability requirements.

16.3.2 Planned Technology Refresh

Proactive resolution of EOL EEE parts reduces the risk of costly, unplanned redesigns of hardware. Continuous monitoring of EEE part availability allows the program/project to plan for technology insertion and redesign. The program/project should consider timeframe for planned upgrades when selecting an obsolescence resolution. DMSMS issues that occur in conjunction with or near a scheduled system upgrade provide optimal timing for technology refresh and mitigation of obsolescence. Identification of known obsolescence and projection of future obsolescence issues are used to prioritize assembly-level refresh cycles. System life cycle, parts sparing requirements, and program/project budget allocations should be considered for obsolescence resolution and technology insertion.

16.4 Obsolete Part Alternatives

If unexpected obsolescence occurs without warning and the program/project is unable to prepare for DMSMS impacts, an Analysis of Alternatives (AoA) shall be performed by the obsolescence management team to identify potential obsolescence resolutions. This approach assumes no authorized sources of supply for the original, obsolete part are available and part procurement (lifetime buy or bridge buy) is not an option. The engineering team will perform an AoA using the mitigation factors specified in Table 7

Table 7. Obsolescence Mitigations

Resolution	Description
Existing Inventory	Utilize existing and in-house inventories.
Form, Fit, Function Alternate Part	Alternate part maintains compatible package type, mounting and function as original part.
Functional Alternate Part	Alternate part maintains same function as original part, but may require a circuit or mounting change.
Equivalent Alternate Part	Alternate part maintains similar attributes as the original part.
New Manufacturing Source	Identification of a new, approved source of supply for the original obsolete part.
Redesign or Technology Refresh	Design-out obsolescence items via engineering changes at system indenture levels, with the goals of enhancing system performance and improving reliability and maintainability.

The engineering and project management team shall evaluate each potential resolution for cost, schedule, and technical risk. Table 8 provides typical risk levels associated with obsolescence resolutions defined in Table 7. Risk levels may vary depending on system life-cycle phase, program/project requirements, and mission duration. Resolution risk factors should be incorporated with the AoA.

Table 8. Obsolescence Mitigation Risk Matrix

Resolution	Risk		
	Cost	Schedule	Technical
Existing Inventory	Low	Low	Low
Form, Fit, Function Alternate Part	Low	Low	Low
Functional Alternate Part	Low	Medium	Medium
Equivalent Alternate Part	Low	Medium	Medium
New Manufacturing Source	High	High	Medium
Redesign or Technology Refresh	High	High	High

Program/project management shall select obsolescence mitigations in accordance with project life-cycle requirements and mission duration. Results of the AoA and resolution risk matrix should be used as guidance for mitigation selection

16.5 Part Obsolescence Tracking

Newly identified obsolete and EOL EEE parts shall be reported to the KSC EPCP. These parts will be entered and tracked in the EPARTS obsolescence tool.

17. EEE PARTS AND QUALIFICATION DATABASES

NASA is establishing a secured centralized database, the Electronic Parts Applications Reporting and Tracking System (EPARTS). The database will serve as a central repository for project specific EEE parts lists provided by the NASA centers. EPARTS will eventually serve as the primary EEE parts repository for KSC projects. EPARTS is located at https:/eparts.nasa.gov/.

The qualification database for Electrical Ground Support Equipment (EGSE) contains a list of all qualified EGSE components. The database will be maintained in KDDMS. Qualified components listed in this database will also be exported into EPARTS.

EEE Parts that are candidates for submission into the EPARTS database must be approved by the KSC EEE Parts Control Panel before submission.

The following resources may also be used for additional part selection provided the part selected meets the qualification and screening criteria for the intended application.

a. NASA Parts Selection List (NPSL) – http://nepp.nasa.gov/npsl/index.htm

b. Goddard Spaceflight Center Qualified Parts List (GSFC-311-QPLD-017) - https://nepp.nasa.gov/index.cfm/12832

c. Goddard Spaceflight Center Parts Database (Access must be requested)- https://partsdb.gsfc.nasa.gov/

18. LIMITED-LIFE PARTS/ITEMS LIST

Limited-life items shall be identified and managed using a limited-life items list.

The list shall present the following data elements: expected life, required life, duty cycle, and rationale for selection. The useful life period starts with fabrication and ends with the completion of the defined mission.

Records shall be maintained that allow evaluation of the cumulative stress (time and/or cycles) for limited-life items, starting when useful life is initiated and indicating the program activity that stressed the items. Refurbishment schedules and procedures shall be included.

The use of an item whose expected life is less than its mission design or project life should be avoided or designed out. Use of these items shall be approved by the NE EEE Parts Control Panel. GS are typically designed for a life expectancy of 15-20 years.

Provisions shall be made to periodically inspect limited life items which have been placed in storage to verify condition and continued usability.

19. AVOIDING HAZARDS

No pure tin (or greater than 97% tin by weight), zinc, cadmium, or other metals that are subject to the growth of metal whiskers, shall be used internally or externally, as an underplating or final finish in the design and manufacture of the hardware, including, but not limited to, EEE parts and their packages/terminals/leads, mounting hardware, solder lugs, electromagnetic interference (EMI) shields, and structures. Tin shall be alloyed with a minimum of 3 percent lead (Pb) by weight.

Lead-free tin alloy coatings or solders have not been approved for use on NASA hardware. Any lead-free tin alloy soldering process used to manufacture the equipment must meet 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. The EEE Parts Control Panel shall review and approve these data.

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.

20. HANDLING AND STORAGE

Electrostatic discharge (ESD) control plans shall be developed in accordance with ANSI/ESD S20.20, or an approved equivalent.

Environmental conditions such as temperature, humidity, and particulate contamination shall be identified and appropriately controlled for parts handling, packaging, and storage.

When required, parts may be stored in logistic areas with restricted access.

Parts shall be stored indicating:

a. project and point of contact
b. part name and number
c. manufacturer's lot date code and/or serial number
d. arrival date
e. Procurement Request number

Documentation received with parts such as certificates of compliance or conformance, warranties, test and inspection reports, material certifications, screening results and calibration records shall be archived.

EEE parts older than 5 years from date of manufacture shall be reviewed by the responsible EEE parts engineering activity to determine the need for rescreening and qualification. Parts stored in conditions where moisture or ESD are not controlled shall not be used.

Suspect or counterfeit parts and parts affected by NASA Advisories, GIDEP Alerts, Problem Advisories, or Safe-Alerts shall be quarantined from general stock and handled appropriately.

Obsolete parts shall be labeled as such.

21. VERIFICATION

The program/project shall verify that applicable requirements specified within this document and defined in the project EEE Parts Applicability Matrix and EEE Parts Design Checklist have been adhered to.

The as-designed EEE Parts List shall be analyzed to determine what EEE parts are used by design.

Nonstandard Part Approval Requests (NSPAR) or equivalent data shall be analyzed to determine the terms for acceptance and use of the applicable EEE parts.

The EEE Parts Derating Analysis Report shall be analyzed to determine what derating is achieved for the application.

The As-built EEE Parts List shall be analyzed to determine that only traceable approved EEE parts and sources are used.

APPENDIX A. DEFINITIONS

Analysis of Alternatives: An analytical comparison of the operational effectiveness, cost, and risks associated with proposed solutions to EEE parts obsolescence issues.

Audit: A systematic, independent, official, examination and verification of: records and other objective evidence of work performed; the process; or the process requirements to determine compliance to requirements; and to assess the effectiveness of implementation and identify potential improvements.

Bridge Buy: The early procurement of EEE part requirements for a specific contract or timeframe.

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

Certificate of Conformance and Traceability (CoCT): A certificate of conformance required by certain military specifications, which requires documented traceability from the Qualified Parts List/Qualified Manufacturing Line (QPL/QML) manufacturer through delivery to the Government if the material is not procured directly from the manufacturer.

Commercial Off-The-Shelf (COTS): Equipment, including hardware and associated software/procedures, that is commercially available from the industrial inventory at the time of purchase.

Counterfeit Part: A part whose material, performance, or characteristics are knowingly misrepresented by a supplier in the supply chain. Examples of counterfeit parts include the following:

a. Parts that do not contain the proper internal construction (die, manufacturer, wire bonding, etc.) consistent with the ordered part.

b. Parts that have been used, refurbished, or reclaimed but are represented as new product.

c. Parts that have different package style or surface plating/finish than the ordered parts.

d. Parts that have not successfully completed the OCM’s full production and test flow but are represented as completed product.

e. Parts sold as upscreened parts, which have not successfully completed upscreening.

f. Parts sold with modified labeling or markings intended to misrepresent the part's form, fit, function, or grade.

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

Critical Ground Support Equipment: a system whose loss of function or improper performance could result in serious injury, damage to flight hardware, loss of mission, or major damage to a significant ground asset.

Critical Ground Test Systems: a system whose loss of function or improper performance could result in serious injury, damage to the item under test, or major damage to a significant ground asset.

Criticality Category 1: A single failure point that could result in loss of vehicle or loss of flight or ground personnel.

Criticality Category 1R: Redundant items, which if all failed, could result in loss of the vehicle or loss of flight or ground personnel.

Criticality Category 1S: A single failure point of the system component designed to provide safety or protection capability against a potentially hazardous condition or event, or a single failure point in a hazard or safety monitoring system that causes the system to fail to detect, or operate when needed during the existence of a hazardous condition that could lead to a loss of flight or ground personnel or vehicle.

Criticality Category 2: A single failure point that could result in loss of a critical mission support capability.

Criticality Category 3: All others.

Note: Some programs/projects may define severity categories differently.

Derating: Derating is the reduction of electrical and thermal stresses applied to a part during normal operation in order to decrease the degradation rate and prolong its expected life.

Diminishing Manufacturing Sources and Material Shortages: The loss or impending loss of manufacturing or production sources or suppliers of components, end-items, and/or raw materials.

End-of-Life: Indication that a manufacturer will no longer produce or support a particular product after a specified discontinuance date.

Finding: A conclusion of importance based on facts established during S&MA audits, reviews, and assessments. There are seven categories of findings for S&MA audits, reviews, and assessments: Catastrophic Noncompliance, Critical Noncompliance, Major Noncompliance, Noncompliance, Minor Noncompliance, Observation, Commendation, and Best Practice.

Franchised Distributor: A source authorized by the original component manufacturer to distribute its parts.

Government Agency: A contract administration office, such as, Air Force, Navy, or Defense Contract Management Command, or another NASA Center, that has been delegated authority by KSC, or any element of KSC, to perform contract administrative service functions.

Government-Industry Data Exchange Program (GIDEP): A cooperative effort to exchange information essential to the research, development, design, testing, acquisition, production, operation, and logistics among U.S. and Canadian governments and industry participants. GIDEP seeks to reduce or eliminate expenditures of time and money. The proper utilization of GIDEP data can materially improve the total quality, reliability, and maintainability of systems and components during the acquisition and logistic phases of the life cycle while reducing costs in the development and manufacture of complex systems and equipment. The goal of GIDEP is to ensure that only reliable and conforming parts, material, and software are in use on all Government programs and to avoid the use of known problem or discontinued parts and materials. (www.gidep.org)

Grade 1: The classification used for higher quality standard parts intended for applications where either:

a. Part performance is critical to safety.

b. Part performance is critical to mission success.

c. Maintenance or replacement is extremely difficult or impossible, and failure would cause major mission degradation.

d. Long-duration spaceflight equipment

Grade 1 parts are Level 1 parts contained in the NASA Parts Selection List (NPSL), Class S/Class V microcircuits, Class K hybrids, JANS semiconductor devices, and established reliability passive parts with failure rate levels S and R.

Grade 2: The classification used for standard parts which meet minimum criteria for inclusion in the NPSL and are intended for applications not requiring Grade 1 parts.

Grade 2 parts are Level 2 parts contained in the NPSL, Class B/Class Q microcircuits, Class H hybrids, JANTXV and JANJ semiconductor devices, and established reliability passive parts with failure rate level P. Grade 2 parts include full Military qualified standard parts.

Grade 3: Grade 3 parts are Level 3 parts contained in the NPSL; Class M/Class N/Class T microcircuits; Class D/Class E hybrids; MIL-STD-883 compliant microcircuits; JANTX and JAN semiconductor devices; and established reliability passive parts with failure rate levels M and L. Grade 3 parts include “low military” quality class and vendor high-reliability (industrial) parts. Parts shall be qualified for its operational environment.

Grade 4: Grade 4 EEE parts typically meet vendor standards for high reliability or commercial market place reliability, but have not been independently verified. The duration of a mission would typically not be lengthy. Repair may be very practical. This is a typical choice for flight experiments and noncritical ground support equipment. Other applications of Grade 4 parts may require screening and qualification.

Ground Support Equipment (GSE): Nonflight equipment, systems, or devices specifically designed and developed for a direct physical or functional interface with flight hardware.

Ground Support System (GSS): equipment or infrastructure (portable or fixed) that provides functional or physical support to GSE. It does not directly interface with flight hardware, although it may supply commodities, power, or data that eventually reaches the flight hardware after being conditioned or controlled by GSE.

Ground Systems (GS): Ground support equipment, ground support systems, and facility ground support systems.

Lifetime Buy: Early procurement of EEE part requirements to sustain the life of a system.

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

Lot Date Code (LDC): A marking, usually inscribed on an EEE part and required by the applicable specification, to identify parts which have been processed as a batch.

Nonfranchised Distributor: A seller of EEE parts or EEE assemblies that may procure from the open market. Brokers or broker distributors, independent distributors, stocking distributors, or suppliers other than the OCM or their franchised distributor are considered nonfranchised distributors, regardless of how many franchised product lines they may have.

Nonstandard Part: An electronic part that has not been approved for listing in GSFC-EEE-INST-002, KSC EGSE qualified component database, or other applicable NASA-approved parts lists; e.g., EPARTS,NPSL, or does not have a qualification plan and which fits into one of the applicable Federal Stock Classes (i.e., 5905, 5910, 5915, 5920, 5935, 5950, 5961, 5962, or 6145). Nonstandard parts also include lower-grade parts that are used in higher-grade applications outside the requirements specified in paragraph 6.2 of this document.

Obsolete Part: A part that is no longer produced or available from the original equipment manufacturer.

Original Component Manufacturer (OCM): An organization that designs and/or engineers a part and is pursuing or has obtained the intellectual property rights to that part.

Notes:

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

Original Equipment Manufacturer (OEM): A company that designs and manufacturers its products (directly or by a third party) from purchased components and sells those products under the company's brand name.

Procedures: Approved written instructions for performing assigned tasks, for example, assembly, test, test preparation, checkout, operation, and maintenance.

Product Discontinuance Notice: Advanced notification from OCM that a part has a planned end of production and procurement date.

Screening: Tests intended to remove nonconforming parts (parts with random defects that are likely to result in early failures, known as infant mortality) from an otherwise acceptable lot and thus increase confidence in the reliability of the parts selected for use.

Source Control Drawing (SCD): Provides an engineering description (including configuration, part number, marking, reliability, environmental, functional/performance characteristics), qualification requirements and acceptance criteria for commercial items or vendor-developed items procurable from a specialized segment of industry that provides for application critical or unique characteristics.

Standard Part: An electronic part approved for listing in GSFC-EEE-INST-002 or other applicable NASA-approved parts lists.

Survey: An independent, official, comprehensive evaluation and assessment of capabilities to ensure programmatic systems are adequately documented, effectively implemented, and suitable for achieving requirements and desired S&MA objectives.

Traceability: The data, reports, and records that document the history of a product or component from the point of origin to final use.

Vendor Item Control Drawing: (Formerly known as Specification Control Drawing) Provides an engineering description (including configuration, performance, reliability, environmental, and functional characteristics) and acceptance criteria for commercial or vendor-developed items that are procurable from a specialized segment of industry. The drawing is used to provide an administrative control number, but the item is marked with the vendor's part number

APPENDIX B. PROJECT AND PAYLOAD CLASSISFICATIONS

Project Categorization Guidelines

Priority Level	LCC < $250M	$250M < LCC < $1B	LCC > $1B, significant radioactive material or human spaceflight
High	Category 2	Category 2	Category 1
Medium	Category 3	Category 2	Category 1
Low	Category 3	Category 2	Category 1

Reference: NPR-7120.5 Rev E, Table 2-1.

Classification Considerations for NASA Class A-D Payloads

Characterization	Class A	Class B	Class C	Class D
Priority (Criticality to Agency Strategic Plan) and Acceptable Risk Level	High priority, very low (minimized) risk	High priority, low risk	Medium priority, medium risk	Low priority, high risk
National significance	Very high	High	Medium	Low to medium
Complexity	Very high to high	High to medium	Medium to low	Medium to low
Mission Lifetime (Primary Baseline Mission	Long, >5years	Medium, 2-5 years	Short, <2 years	Short < 2 years
Cost	High	High to medium	Medium to low	Low
Launch Constraints	Critical	Medium	Few	Few to none
In-Flight Maintenance	N/A	Not feasible or difficult	Maybe feasible	May be feasible and planned
Alternative Research Opportunities or Re-flight Opportunities	No alternative or re-flight opportunities	Few or no alternative or re-flight opportunities	Some or few alternative or re-flight opportunities	Significant alternative or re-flight opportunities
Achievement of Mission Success Criteria	All practical measures are taken to achieve minimum risk to mission success. The highest assurance standards are used.	Stringent assurance standards with only minor compromises in application to maintain a low risk to mission success.	Medium risk of not achieving mission success may be acceptable. Reduced assurance standards are permitted.	Medium or significant risk of not achieving mission success is permitted. Minimal assurance standards are permitted.
Examples	HST, Cassini, JIMO, JWST	MER, MRO, Discovery payloads, ISS Facility Class Payloads, Attached ISS payloads	ESSP, Explorer Payloads, MIDEX, ISS complex subrack payloads	SPARTAN, GAS Can, technology demonstrators, simple ISS, express middeck and subrack payloads, SMEX

Reference: NPR-8705.4 Appendix A

APPENDIX C. EEE PARTS APPLICABILITY MATRIX

EEE Parts Applicability Matrix							
EEE Parts Requirement	**Class A Payload**	**Class B Payload**	**Class C Payload**	**Class D Payload**	**Critical GSE**	**Non-critical GSE & GSS**	**Other[1]**
EEE Part Grade Selection	X	X	X	X[3]	X	X[2]	X[2]
COTS & Nonstandard Parts Utilization	X	X	X	X	X	X	X
As-Built, As-Designed Parts & Material List	X	X	X	X	X	X	X[3]
Ionizing Radiation	X	X	X[3]	X[3]	N/A	N/A	X[3]
Qualification & Screening	X[4]	X[4]	X[4]	X[4]	X[4]	X[4]	X[3]
Derating	X	X	X	X[3]	X	X[3]	X[3]
Traceability	X	X	X	X	X	X	X[3]
Counterfeit Part Prevention	X	X	X	X	X	X	X
GIDEP	X	X	X	X	X	X	X
Parts Obsolescence	X	X[3]	X[3]	X[3]	X	X[3]	X[3]
EEE Parts Database	X	X	X	X	X	X[5]	X[5]
Limited-Life Parts/Items List	X	X	X	X[3]	X	X[3]	X[3]
Hazardous Avoidance	X	X	X	X	X	X	X
Handling & Storage	X	X	X	X	X	X[3]	X[3]
Verification	X[6]	X[6]	X[6]	X[6]	X[6]	X[6]	X[6]

Notes:
1- Other includes nonflight experiments, test demonstrations, prototypes, etc.
2- Grade 3 or 4 EEE Parts are typically used.
3- As required by program/ project requirements
4- Requirements & tailoring as specified by program/project
5- Desired
6- All projects should verify their EEE Parts Requirements

APPENDIX D. EEE PARTS DESIGN GUIDELINE

1. Review KSC-PLN-5406, Design and Development EEE Parts Plan.
2. Determine project classification: Payload Class (A-D), Critical GSE, Noncritical GSE, GSS, or Other.
3. Determine ionizing radiation requirements and considerations by class, if applicable.
4. Complete EEE Parts Applicability Matrix identifying unique program/project requirements and tailoring of this plan.
5. Determine Part Criticalities and EEE Part Grades for the project.
6. Evaluate the use COTS & Nonstandard Parts.
7. Develop Qualification Plan.
8. Parts Selection
    a. Radiation hardened part required?
    b. Select appropriate EEE Part Grade.
    c. Select parts according to grade, design requirements and specifications.
    d. Apply Design Margin and Derating requirements to parts selection.
    e. Review NASA EEE Parts Database & Tool EPARTS for part information.
    f. Review GIDEP Notices and NASA Advisories for notices on selected parts and take appropriate measures. The KSC GIDEP coordinator can assist.
    g. Perform part obsolescence analysis as required using EPARTS and take appropriate measures.
    h. Get appropriate approval of selected parts as required in this document.
9. Part Procurements
    a. Purchase parts from OEM or OCM authorized dealers only.
    b. Request a Certificate of Conformance or Compliance (specify required details of [CoC]).
    c. Perform traceability requirements as specified within this document.

d. Perform Parts Inspection & Screening as required.

10. Handle and store parts appropriately as specified in this document.

11. Perform Qualification. Add newly qualified parts into the qualified EGSE component database in KDDMS and EPARTS database (coordinate with KSC EEE Parts Control Panel).

12. Verify program/project EEE Parts requirements.

APPENDIX E. EEE PARTS DERATING REQUIREMENTS

E.1 Capacitor Derating Requirements

Type	Military Style	Voltage Derating Factor (Note 1)	Maximum Ambient Temperature
Ceramic	CCR, CKS, CKR, CDR **(Note 2)**	0.60	110 °C
Glass	CYR	0.50	110 °C
Plastic Film	CRH, CHS	0.60	85 °C
Tantalum, Foil	CLR25, CLR27, CLR35, CLR3	0.5	70 °C
Tantalum, Wet Slug	CLR79, CLR81	0.60 0.40 **(Note 3)**	70 °C 110 °C
Tantalum, Solid **(Note 4)**	CSR, CSS, CWR	0.50 0.30 **(Note 3)**	70 °C 110 °C

Notes:

1. The derating factor applies to the sum of peak AC ripple and DC polarizing voltage.

2. For low-voltage applications (<10 Vdc), parts shall be rated at least 100 Vdc for styles CCR, CKR, CDR.

3. Derate voltage linearly from 70 °C to 110 °C.

4. The effective series resistance shall be at least 0.1 ohms per volt or 1 ohm, whichever is greater, for Grade 2 applications, and at least 0.3 ohms per volt or 1 ohm whichever is greater, for Grade 1 applications.

E.2 Circuit Breaker Derating Requirements

Part Type	Critical Stress Parameter	Derating Factor	Condition	Note
CIRCUIT BREAKER	Load Current	0.75 Rated Carry Current	TCASE < T(MAX RATED) -20°C	Compatibility with transients for various types of load is largely influenced by type of circuit breaker and how that type responds to transients. Excessive derating of the carry current of a circuit breaker can reduce circuit protection unnecessarily. Use of series resistance should be considered to moderate inrush currents where necessary.

E.3 Connector Derating Requirements

Connectors of all types/styles are derated by limiting the voltage stress placed on the dielectric material, and by limiting the current flow and consequent temperature rise due to the effects of resistive heating across mated contacts within the dielectric insert.

The following table establishes minimum derating for connectors.

Parameter	Derating Factor
Operating Voltage	25% of the connector Dielectric Withstanding test Voltage (at sea level, unconditioned) - or – 75% of the connector rated operating (working) voltage (at sea level). **(Note 1)**
Contact Current	Less than or equal the values listed in Wire Derating (Section E20) for the conductor size selected for use with the contact. **(Note 2)**
Temperature	Rated maximum temperature, less 25°C

Notes:

1. Example: MIL-DTL-38999 series I connectors have a DWV test voltage of 1300VAC. They also have a suggested operating (working) voltage of 400VAC at sea level. Derated voltage would be 25% of 1300VAC (325VAC) or 75% of 400VAC (300VAC). Either value is acceptable.

2. For printed circuit connectors, apply derating based on the contact size vs. the equivalent wire size in section E.22. Example, as a minimum, a size 20 contact shall be derated the same as a 20 AWG wire used in a bundled cable assembly.

E.4 Crystal Derating Requirements

Derating of crystals is accomplished by multiplying the stress parameter by the appropriate derating factors specified below.

Critical Stress Parameters (Note 1)	Derating Factor
Maximum Rated Current	0.5
Maximum Rated Power	0.25

Notes

1. Choose either current or power to derate, but do not derate both. These deratings apply over the manufacturer’s recommended operating temperature range.

E.5 Crystal Oscillator Derating Requirements

Derating of crystal oscillators is accomplished by multiplying the parameters by the appropriate derating factor specified below.

Stress Parameter	Derating Factor for Circuit Implementation By Part Type	
	Digital Parts	Linear Parts
Maximum Supply Voltage/Input Voltage **(Note 1)**	0.9	0.8
Maximum Specified Operating Junction Temperature **(Note 2)**	0.8	0.75
Maximum Output Current	0.8	0.8

Notes:

1. Use manufacturer's recommended operating conditions but do not exceed 90% of maximum supply voltage. For voltage regulators, derate $V_{IN} - V_{OUT}$ to 0.9.
2. Do not exceed Tj = 110 °C, or 40 °C below the manufacturer's maximum rating, whichever is lower or less.

E.6 Diode Derating Requirements

Derating for diodes is accomplished by multiplying the stress parameter by the appropriate derating factor.

Diode Type	Stress Parameter	Derating Factor
General Purpose, Rectifier, Switching, Pin/Schottky, and Thyristors	PIV	0.70
	Surge Current	0.50
	Forward Current **(Note 3)**	0.50
	Maximum Junction Temperature	**(Note 1)**
Varactor	Power	0.50
	Reverse Voltage	0.75
	Forward Current	0.75
	Maximum Junction Temperature	**(Note 1)**
Voltage Regulator	Power	0.50
	Zener Current	0.75
	Maximum Junction Temperature	**(Note 1)**
Voltage Reference	Zener Current	**(Note 2)**
	Maximum Junction Temperature	**(Note 1)**
Zener Voltage Suppressor	Power Dissipation	0.50
	Maximum Junction Temperature	**(Note 1)**
Bidirectional Voltage Suppressor	Power Dissipation	0.50
	Maximum Junction Temperature	**(Note 1)**
FET Current Regulator	Peak Operating Voltage	0.80
	Maximum Junction Temperature	**(Note 1)**
LED, Laser	Forward Current	**(Note 4)**
	Maximum Junction Temperature	**(Note 1)**

Notes:

1. Do not exceed Tj = 125 °C or 40 °C below the manufacturer's maximum rating, whichever is lower.
2. Operate at the manufacturer's specified Zener current (IZT) to optimize temperature
3. Forward current derating does not apply to chassis-mounted power diodes as long as Note 1 is adhered to.
4. Use manufacturer's recommended operating current.

E.7 Electromagnetic Relay Derating Requirements

(Note 1)

Style	**Make, Break, and/or Carry Load Currents**	**Transient Current Surges (Note 3)**
All	Select the appropriate factors for T, R, and L from the subtables: Iderated = Irated x T x R x L **(Note 2)**	For t ≤ 10µs, Imax ≤ 4 x Irated For t > 10 µs, $(Imax)^2$ x t ≤ 16 x $(Irated)^2$ x 10^{-5} (A^2s)

Subtable L		**Subtable R**		**Subtable T**	
Load Application	**Factor**	**Cycle Rate Per Hour**	**Factor**	**Temperature Range**	**Factor**
Make, break, and/or carry loads with an on-time duration of 0 to 500 ms. Off-time is equal to or greater than on-time.	1	>10	0.85	+85 °C to +125 °C	0.7
Carry-only loads. Relay does not make or break the load. Maximum on-time is 5 minutes. Off-time is equal to or greater than ontime.	1.5	1 to 10	0.9	+40 °C to +84 °C	0.85
All other load conditions.	0.8	<1	0.85	-20 °C to +39 °C	0.9
				-65 °C to –21 °C	0.85

Notes:

1. Warning: *Do not* derate coil voltage or current. Operating a relay at less-than-nominal coil rating can result in either switching failures or increased switching times. The latter condition induces contact damage because of the longer arcing time, thus reducing relay reliability.

2. $I_{derated}$ = derated contact current carrying capacity

I_{rated} = rated contact current

3. If during switching, transient current surges exceed the *derated* contact current, the following applies, where:

t = period of time that transient current exceeds rated contact current (I_{rated})

I_{max} = maximum permitted surge
I_{rated} = rated contact current

E.8 Filter Derating Requirements

Class	Stress Parameter (Note 1)	Derating Factor
All	Rated current	0.50 **(Note 2)**
	Rated voltage	0.50 **(Note 2)**
	Maximum ambient temperature	85 °C or 30 °C less than maximum rated temperature, whichever is less

Notes:

1. Applies to rated operating current or voltage, not the absolute maximum.
2. For power filter applications, .75 derating factor can be used for flight and GSE projects.

E.9 Fuse Derating Requirements for Cartridge Style

Fuses are derated by multiplying the rated amperes by the appropriate derating factor listed below.

Fuse Current Rating (Amperes) @ 25 °C	Current Derating Factor	Temperature Derating Factor	Remarks
2, 2-1/2, 3, 4, 5, 7, 10, 15	.50	There is an additional derating of 0.2%/°C for an increase in the temperature of fuse body above 25 °C.	
1, 1-1/2	.45		
3/4	.40		
1/2	.40		The flight use of fuses rated 1/2 ampere or less require application approval by the project.
3/8	.35		
1/4	.30		
1/8	.25		

Notes:

General: For GSE a derating factor of .50 is acceptable for all fuse current ratings.

1. Fuses are specified to interrupt within a maximum of 5 seconds when driven at 200% of their rated current for nominal ratings up to and including 10 amperes. A fuse with a nominal rating of 15 amperes is specified to interrupt within a maximum of 10 seconds when driven at 200% of its rated current. The power supply shall be capable of delivering appropriate levels of current to achieve short fusing times.

2. In a space environment, the possible escape of air from inside the fuses reduces the filament cooling mechanism (heat transfer by conduction). This lowers the blow current rating and decreases current capacity with time, making it necessary to derate current ratings on fuses used in space applications.

3. Fuses rated at 1/2 ampere or below are especially affected by loss of air; thus, their derating factors are larger.

4. Current derating factors are based on data from fuses mounted on printed circuit boards and conformal coated. Other types of mountings require project approval. It should be noted that the lifetime of the fuses is controlled by two factors: cold resistance of the fuse and the heat sinking provided by the installer. The thermal resistance of the fuse to the thermal ground is very important, as is the case with power transistors and power diodes mounted on circuit boards.

5. Recent studies have shown the occurrence of enduring arcs in fuses rated at 125 volts when the applied voltage is greater than 50 volts. Therefore, the voltages on these fuses should be derated to 50 volts or less.

6. Electrical transients produce thermal cycling and mechanical fatigue that could affect the life of the fuse. For each application, the capability of the fuse to withstand the expected pulse conditions should be established by considering the pulse cycle withstanding capability for nominal I2t (energy let through the fuse) specified by the manufacturer.

E.10 Heater Derating Requirements

Class	Stress Parameter (Note 1)	Derating Factor
All	Rated Current	Use within manufacturer's recommended operating current.
	Rated Voltage	Use within manufacturer's recommended operating voltage.
	Maximum Ambient Temperature	85 °C or 30 °C less than maximum rated temperature, whichever is less.

Note: 1. Applies to rated operating current or voltage, not the absolute maximum.

E.11 Hybrid Microcircuit Derating Requirements

For hybrid devices, derating guidelines are divided into two categories: derating of components used in hybrid design and manufacture, and derating for applications in which the part is used.

These guidelines are provided as follows:

a. Derating of components used in hybrid design and manufacture:

   (1) Derating analysis for existing hybrid devices that are qualified to MIL-PRF-38534 is not required.

   (2) Custom hybrids shall be designed such that all internal components comply with the electrical and temperature derating requirements set forth in this document for the specific commodity device types (i.e., diodes, capacitors, etc.). Derating analysis shall be reviewed and approved by the project.

b. Application derating for hybrids:

   (1) General requirements for all applications and all device types:

- Specific electrical parameter derating shall be based on the requirements set forth for similar microcircuit device types.
- Case temperature derating shall be 75% of the maximum rated case temperature specified by the manufacturer or 80 °C, whichever is lower.

(2) Special requirements for high-temperature applications and high-power hybrids (ex: DC-DC converters):

Additional derating beyond the general requirements stated above may be required in order to prevent localized device overheating within the hybrid, and tailored on a case-by-case basis to account for the application temperature and power dissipation needs. In this case, a derating analysis shall be performed.

E.12 Inductor Derating Requirements

Insulation Class			**Stress Parameter**	**Minimum Derating**
MIL-PRF-27	MIL-PRF-39010	MIL-PRF-15305/ MIL-T-55631	Maximum Operating Temperature **(Notes 1, 2)**	Derated Operating Temperature
Q	-	O	+85 °C	+65 °C
R	A	A	+105 °C	+85 °C
S	-	-	+130 °C	+115 °C
-	B	B	+125 °C	+105 °C
-		C	>+125 °C	Max Temp -20 °C
-	F	-	+150 °C	+130 °C
V	-	-	+155 °C	+135 °C
T	-	-	+170 °C	+155 °C
MIL-PRF-83446 - Chip Inductors				Max Temp -20 °C
All Part Types			Operating Voltage	Derate to 50% of the rated Dielectric Withstanding Voltage

Notes:

1a. Maximum operating temperature equals ambient temperature plus temperature rise plus 10 °C allowance for hot spots. The temperature rise may be calculated in accordance with MIL-PRF-27, paragraph 4.7.13. The formula is:

$$\Delta T = \frac{R - r}{r}(t + 234.5) - (T - t)$$

Where:
ΔT = Temperature rise (in °C) above specified maximum ambient temperature
R = Resistance of winding (in ohms) at temperature (T+ΔT)
r = Resistance of winding (in ohms) at temperature (t)
t = Specified initial ambient temperature in °C)
T = maximum ambient temperature (in °C) at time of power shutoff. (T) shall not differ from (t) by more than 5°C.

1b. The insulation classes of MIL-style inductive parts generally have maximum operating temperature ratings based on a life expectancy of 10,000 hours. The derated operating temperatures are selected to extend the life expectancy to 50,000 hours at rated voltage.

1c. Custom made inductive devices shall be evaluated on a materials basis to determine the maximum operating temperature. Devices with temperature ratings different from the military insulation classes shall be derated to 0.75 times maximum operating temperature.

2. MIL-PRF-21038 has a maximum operating temperature range of 130 °C. For MIL-PRF-83446, refer to the detailed specification sheet for the maximum operating temperature.

E.13 Microcircuit Derating Requirements

Derating of microcircuits is accomplished by multiplying the stress parameter by the appropriate derating factor specified below.

Stress Parameter	Derating Factor	
	Digital	Linear
Maximum Supply Voltage/Input Voltage **(Note 1)**	0.9	0.8
Power Dissipation	0.8	0.75
Maximum Specified Operating Junction Temperature **(Note 2)**	0.8	0.75
Maximum Output Current	0.8	0.8
Clock Frequency	0.8	0.8
Radiation Effects **(Note 3)**	Check with project radiation engineer.	

Notes:
1. Do not exceed 90% of absolute maximum supply voltage for digital devices and 80% of absolute maximum supply voltage for linear/mixed signal devices except to meet the manufacturer's recommended operating conditions. For voltage regulators, derate VIN – VOUT to 0.9.
    1.a. For low-voltage (< 5V) devices, use manufacturer's recommended operating conditions.
2. Do not exceed Tj = 110 °C or 40 °C below the manufacturer's maximum rating, whichever is lower.
3. Consult the project radiation engineer to determine derating guidelines

E.14 PEM Derating Requirements

Derating requirements for Plastic Encapsulated Microcircuits (PEMs) are listed in the table. Taking a conservative approach, derating requirements for PEMs should be more stringent than the requirements for their high-reliability equivalents. In addition to the requirements in the table, derating specific to some PEMs may be required based on design and technology of the part intended for special application. All part-specific derating shall be approved by the project.

Stress Parameter	Derating Equation/Factor	
	Digital	**Linear /Mixed Signal**
Maximum Supply Voltage **(Note 1)**	0.9	0.8
Maximum Input Voltage	-	0.8
Maximum Operating Junction Temperature **(Note 2)**	0.8 or 95 °C (whichever is lesser)	0.7 or 85 °C (whichever is lesser)
Maximum Output Current	0.8	0.7
Maximum Operating Frequency	0.8	0.7

Notes:
1. Do not exceed 90% of absolute maximum supply voltage for digital devices and 80% of absolute maximum supply voltage for linear/mixed signal devices except to meet the manufacturer's recommended operating conditions. For voltage regulators, derate VIN – VOUT to 0.9.
2. For power devices, do not exceed 110 °C or 40 °C below the manufacturer's rating, whichever is lower.

E.15 Resistor Derating Requirements

Style	Description	Derating Factors (Note 1) (Note 2)		Derating Temperatures (°C)		Zero Power Temp. (°C)
		Power	Voltage	T1	T2	T3
G311P672	Fixed, High Voltage	0.6	0.8	70	94	110
G311P683	Fixed, Precision, High Voltage	0.6	0.8	125	185	225
G311P742	Fixed, Low TC, Precision	0.6	0.8	125	155	175
RBR	Fixed, Wirewound (Accurate), ER					
1%		0.6	0.8	125	137	145
0.5%		0.35	0.8	125	132	145
0.1%		0.25	0.8	125	130	145
RWR	Fixed, Wirewound (Power Type), ER	0.6	0.8	25	175	250
RCR	Fixed, Composition (Insulated), ER	0.6	0.8	70	**(Note 3)**	**(Note 3)**
RER	Fixed, Wirewound (Power Type), Chassis Mounted, ER	0.6	0.8	25	175	250
RTR	Variable, Wirewound (Lead Screw Actuated), ER	0.6	0.8	85	124	150
RLR	Fixed, Film (Insulated), ER					
100ppm		0.6	0.8	70	118	150
350ppm		0.6	0.8	70	103	125
RNC, RNR, RNN	Fixed, Film, ER	0.6	0.8	125	155	175
RM	Fixed, Film, Chip, ER	0.6	0.8	70	118	150
RZ	Fixed, Film, Networks	0.6	0.8	70	103	125
Others	Various	0.5	0.8	**(Note 4)**	**(Note 4)**	**(Note 4)**

Notes:

1. Compute the resistor's derated power level by multiplying its nominal power rating by the appropriate derating factor for ambient temperatures ≤ T1. If the resistor is operated above T1, derate linearly from the T1 power level to the zero power level at T2. Exposing the resistor to temperatures exceeding T3, even under no load conditions, may result in permanent degradation.

2. The maximum applied voltage shall not exceed the lesser of the following: (1) 80% of the specified maximum voltage rating, or (2) $\sqrt{PR}$ where

P = Derated power (Watts)

R = Resistance of that portion of the element actually active in the circuit.

This voltage derating applies to dc and regular ac waveform applications. For pulse and other irregular waveform applications, consult the manufacturer.

3. Determine the zero power temperature (T3) from the applicable detail specification. Compute the derated zero power temperature (T2) from the following formula:

$$T2 = D_F (T3 - T1) + T1$$

where:
T2 = Derated zero power temperature
D_F = Derating factor
T3 = Zero power temperature
T1 = Rated power temperature

4. Determine the rated power, the rated power temperature (T1), and the zero power temperature (T3) from the manufacturer's specification. Calculate the derated zero power temperature (T2) as per the previous note.

E.16 Switch Derating Requirements

Switch contacts are usually provided with multiple ratings dependent on the type of load being switched. For lamp (filament), motor, inductive and capacitive loads, the inrush current at the instant the switch actuates, is several times higher than the nominal current flow. Switches are seldom rated for capacitive loads that are subject to similar inrush surge currents as lamp (filament) or inductive loads. Ratings for all of these types of loads are less than resistive loads.

Derating is applied by the table herein to the rated resistive, inductive and lamp ratings. Pressure-sensitive switches have additional derating applied for temperatures above 85 °C.

As a minimum, commercial switches have a resistive rating and may not be rated for inductive, motor, lamp or capacitive loads.

When switches are not rated for these loads, they must be derated as a percentage of the rated resistive load.

The following table establishes derating for switches.

	Current Derating Factor @ Application Ambient Temperature			
	Military		**Commercial (Note 1)**	
Load Type	0°C to 85°C	Above 85°C **(Note 2)**	0°C to 85°C	Above 85°C **(Note 2)**
Resistive	75% of rated Resistive load	60% of rated Resistive load	75% of rated Resistive load	60% of rated Resistive load
Inductive & Motor	75% of rated Inductive load	60% of rated Inductive load	40% of rated Resistive load	30% of rated Resistive load
Capacitive & Lamp	75% of rated Capacitive load	60% of rated Capacitive load	25% of rated Resistive load	20% of rated Resistive load

Notes:
1. Applies mainly to switches that are rated with a resistive load current rating only.
2. Temperature derating is not applicable to thermostatic switches.

E.17 Thermistor Derating Requirements

Type	Derating
Positive Temperature Coefficient	Derate to 50% of rated power.
Negative Temperature Coefficient	Derate to a power level that limits dissipation constant to a maximum increase of 50 times, or to a maximum case temperature of 100°C, whichever is less.

Notes:

1. Derating is applicable to thermistors operating in the self-heating mode.

E.18 Transformer Coil Derating Requirements

Transformer Type: MIL-PRF-27 — Insulation Class	Transformer Type: MIL-PRF-27 — Rated Operating Temperature (T_{RATED})	Critical Stress Parameter	Derating Factor	Derated Operating Temperature ($T_{DERATED}$)	Note
Q	+85°C	Operating Voltage	0.50 of DWV	+65°C	Custom-made transformers shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range from +85° to +130°C shall be derated as follows: $T_{DERATED} = 0.75 * T_{RATED}$ (°C) Devices having a maximum rated operating temperature greater than 130°C shall be derated as follows: $T_{DERATED} = T_{RATED} - 25$°C.
R	+105°C			+85°C	
S	+130°C			+105°C	
V	+155°C			+130°C	
T	+170°C			+155°C	
MIL-PRF-21038				T_{RATED} - 25°C	MIL-PRF-21038 transformers have no insulation class.

E.19 Transistor Operating Requirements

Part Type	Critical Stress Parameter	Derating Factor	Condition	Notes
TRANSISTOR Bipolar: General Purpose, Switching, Power	Power	0.50	125°C Max Junction Temp	
	Current	0.75		
	Voltage	0.75		1
TRANSISTOR Field Effect: JFET, MOSFET **(Note 2)**	Power	0.50	125°C Max Junction Temp	
	Current (I_D)	0.75		
	Voltage	0.75		1

Notes:

1. Worst case combination of DC, AC, and transient voltages should be no greater than the derated limit.
2. For power MOSFET devices, also derate the gate to source voltage (VGS) to 60% of the maximum rated.

E.20 Wire and Cable Derating Requirements

Wire and cable derating for KSC ground systems shall comply with NFPA-70 Article 310, Conductors for General Wiring

Wire and cable derating for KSC designed flight systems shall comply with the following:

Derating shall be accomplished by determining a single wire maximum current from a combination of wire size and bundle size using the wire information below. Dielectric withstanding voltage rating requires at least two times the highest application voltage. Derating values listed apply only to round single conductors on helically wound bundles. For derating information for ribbon cable, flat cable, and other wire types refer to the manufacturer’s recommendation.

Single Wire Current
(Note 1)

Wire Size (AWG)	Vacuum (< 4.3 PSIA)	Non Vacuum (≥ 4.3 PSIA)
	Maximum Nominal Allowed Single Wire Current (I_{sw}) (amps) (Notes 2, 3, 4)	Maximum Nominal Allowed Single Wire Current (I_{sw}) (amps) (Notes 3, 5, 6, 7)
26	3.4	3.8
24	4.7	5.4
22	6.5	7.4
20	8.8	10.0
18	11.6	13.2
16	13.3	15.0
14	18.0	20.0
12	25.0	29.0

Wire Size (AWG)	Vacuum (< 4.3 PSIA)	Non Vacuum (≥ 4.3 PSIA)
	Maximum Nominal Allowed Single Wire Current (I_{sw}) (amps) (Notes 2, 3, 4)	**Maximum Nominal Allowed Single Wire Current (I_{sw}) (amps) (Notes 3, 5, 6, 7)**
10	34.8	40.0
8	56.0	63.0
6	80.0	92.0
4	110.0	120.0
2	150.5	170.5
1/0	220.5	260.0

NOTES:

1. When wire is bundled, the maximum design current for each individual wire shall be derated according to the following:

For N < 15 IBW = ISW X (29 - N)/28

For N > 15 IBW = (0.5) X ISW

Where: N = number of wires
IBW = current, bundle wire
ISW = current, single wire

2. These currents are for wires in a vacuum at 94°C (200°F) ambient.
3. Deratings listed are for wire rated for 200°C maximum temperature. Derating factors for lower temperature rated wire shall be as follows:
    A. For 150°C wire, use 65% of value shown in vacuum column, and 80% of value shown in nonvacuum column.
    B. For 135°C wire, use 45% of value shown in vacuum column, and 75% of value shown in nonvacuum column.
    C. For 105°C wire, do not use this wire in vacuum environments, and use 65% of value shown in nonvacuum column.
4. Maximum wire temperature for the maximum single wire current is 147°C (295°F).
5. These currents are for wires on-orbit in cabin ambient at 22°C (72°F).
6. Wire with these currents and temperatures are not to be accessible to the crew.
7. Maximum wire temperature for the maximum single wire current 118°C (242°F).

APPENDIX F. HAZARD AND SAFETY RISKS

Consequence and Likelihood levels associated with hazards/safety-related risks are as defined in KNPR 8700.2, KSC Safety and Reliability Analysis Methodology Procedural Requirements, and shown in the following Tables. Hazards/risks with a Likelihood level of 1 are considered controlled risks.

Consequence Definitions

Consequence Risk Attribute Definitions					
Level	**1**	**2**	**3**	**4**	**5**
Consequence	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Personnel Safety	A condition that could cause the need for minor first aid	A condition that may cause minor injury, impairment, or incapacitation	A condition that may cause moderate injury, impairment, or incapacitation	A condition that may cause severe injury, impairment, or incapacitation	A condition that may cause loss of life
Facilities/Equipment	A condition that subjects facilities, equipment, or flight hardware to more than normal wear and tear	A condition that may cause minor property damage to facilities, systems, equipment, or flight hardware	A condition that may cause moderate property damage to facilities, systems, equipment, or flight hardware	A condition that may cause major property damage to facilities, systems, equipment, or flight hardware	A condition that may cause destruction of critical facilities on the ground, major systems, or vehicle during ground operations
Environmental	Negligible environmental impact, negligible OSHA/EPA violation – nonreportable	Minor environmental impact, minor reportable OSHA/EPA violation	Moderate environmental impact, moderate reportable OSHA/EPA violation which requires immediate remediation	Major environmental impact, major reportable OSHA/EPA violation causing temporary stoppage	Catastrophic environmental impact, serious or repeat OSHA/EPA violations resulting in termination

Likelihood Definitions

Likelihood Classification Definitions		
Level	**Likelihood**	**Definition**
Level 1 (Very Low)	Highly Unlikely	Existing controls are strong and very likely to prevent this risk scenario.
Level 2 (Low)	Unlikely	Existing controls have minor limitations and/or uncertainties and usually are sufficient to prevent this risk scenario; some additional actions may be required.
Level 3 (Moderate)	Could Happen	Existing controls have some limitations and/or uncertainties and may prevent this risk scenario; additional actions may be required.
Level 4 (High)	Likely	Existing controls have significant limitations and/or uncertainties and cannot prevent this risk scenario; additional actions will be required.
Level 5 (Very High)	Highly Likely	Existing controls have little or no effect and cannot prevent this risk scenario; no alternative controls are available.

Component failures are segregated into three categories to provide added visibility into the effects of the components' failures on people, assets/environment, and safety systems:

- High-risk items
- Significant-risk items
- Safety system risk items

High- and significant-risk items are components that, if failed, can result in a Level 4 or 5 consequence/severity hazard (per the KNPR 8700.2 definitions), and the component must also meet one of these criteria:

A. is a single-failure point,

B. is redundant, but is NOT normally verified during ground processing OR the health and status of the redundant items are not readily detectable by a person or a system AND corrective action cannot be accomplished quickly enough such that the time to detect and correct is less than the time to effect

C. is redundant but a credible common cause (e.g., contamination) exists that could cause both redundant items to fail

If, when the component fails, the hazardous consequences affect people, the item is said to be a High risk item. If, when a component fails, the hazardous consequences affect flight hardware, facilities, ground systems, ground support equipment, or the environment, the item is said to be a "Significant-Risk" item.

"Safety System Risk" items are those components in a safety system whose single failure can result in inability of the safety system to perform its intended safety function.

APPENDIX G. WEBPAGES AND HYPERLINK REFERENCES

Defense Logistics Agency:

HTTP://WWW.LANDANDMARITIME.DLA.MIL/PROGRAMS/QMLQPL/

Electrical GSE Qualification (Includes link to qualification database):

HTTPS://WIKI.KSC.NASA.GOV/EIPT/INDEX.PHP?TITLE=QUALIFICATION

Electronic Parts Applications Reporting and Tracking System (EPARTS):

HTTPS:/EPARTS.NASA.GOV

Government-Industry Data Exchange Program (GIDEP):

WWW.GIDEP.ORG

Goddard Spaceflight Center Qualified Parts List (GSFC-311-QPLD-017):

HTTPS://NEPP.NASA.GOV/INDEX.CFM/12832

Goddard Spaceflight Center Parts Database (Access must be requested):

HTTPS://PARTSDB.GSFC.NASA.GOV/

NASA Parts Selection List (NPSL):

HTTP://NEPP.NASA.GOV/NPSL

NASA Standards Website- Standards & Technical Assistance Resource Tool (START):

HTTPS://STANDARDS.NASA.GOV

APPENDIX H. EXAMPLE NONSTANDARD PART APPROVAL REQUEST (NSPAR) FORM

NSPAR ID:		**Submission Date:**		**Part Status:**	New
Review Status:		**Part Grade Approved For:**	Pending		
Submitter Info:		**Major Assembly/End Item Info:**			
Project or Subsystem:		Next Higher Level Assembly:			
Name:		Criticality or Risk Item Category:			
Phone:		Manufacturer			
Email:		POC:			
Company:		Phone:			
		Email:			
Part Information:					
Part Grade Requested:		Package Type:			
Part Type:					
Description:					
Part Number					
Specification or Drawing #:					
Manufacturer:				Cage Code:	
Estimated Lead Time:					
Other Sources:					
Prohibited Items or Materials:	*Response & Comments:*				
Radiation Requirements:					
Special Requirements:					
Part Application Description, Data and Analysis:					
Justification for Use:					
Required Testing and Status:					
Additional Testing Required:					
Qualification Tests Required:					
Screening Required:					
Additional Derating Required:					
Radiation Tests Required:					
Additional Information:					
KSC EEE Parts Control Panel (EPCP) Disposition:					
KSC EPCP Authorizations:					
EPCP Chair:			Date:		
EPCP Co-Chair:			Date:		

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