Introducing the:

ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PARTS MANAGEMENT AND CONTROL REQUIREMENTS FOR SPACE FLIGHT HARDWARE & CRITICAL GROUND SUPPORT EQUIPMENT

...aka...The NASA EEE Parts Standard
## Acronyms

<table>
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<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ARC</td>
<td>Commercial Off The Shelf</td>
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<tr>
<td>COTS</td>
<td>Commercial Off The Shelf</td>
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<tr>
<td>EEE</td>
<td>Electrical, Electronic, and Electromechanical</td>
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<tr>
<td>EPARTS</td>
<td>Electronic Parts Applications Reporting and Tracking System</td>
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<tr>
<td>EPMCP</td>
<td>EEE Parts Management and Control Plan</td>
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<tr>
<td>ESA</td>
<td>European Space Agency</td>
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<tr>
<td>GRC</td>
<td>Glenn Research Center</td>
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<tr>
<td>GSE</td>
<td>Ground Support Equipment</td>
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<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
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<tr>
<td>ISS</td>
<td>International Space Station</td>
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<td>JAXA</td>
<td>Japan Aerospace Exploration Agency</td>
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<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
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<td>JSC</td>
<td>Johnson Space Center</td>
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<td>KSC</td>
<td>Kennedy Space Center</td>
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<tr>
<td>LaRC</td>
<td>Langley Research Center</td>
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<tr>
<td>MSFC</td>
<td>Marshall Space Flight Center</td>
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<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NPD</td>
<td>NASA Policy Directive</td>
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<td>NPR</td>
<td>NASA Procedural Requirements</td>
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<td>OSMA</td>
<td>Office of Safety and Mission Assurance</td>
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<td>PEMS</td>
<td>Plastic Encapsulated Modules</td>
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Current Policy Documents

NPD 8730.2 NASA Parts Policy

• Control Risk and Enhance Reliability
• Covers
  ▪ EEE Parts, Electronic Packaging and Interconnect Systems
  ▪ Mechanical parts and Manufacturing Materials

NPR 8705.4 Risk Classification for NASA Payloads

• Appendix B: Guidance on acceptable risk levels
• Appendix C: Recommended SMA – Related Requirements
  ▪ Critical Single Point Failures
  ▪ EEE Part Levels
  ▪ Reliability

Center EEE Part Documents

• GSFC: EEE-INST-002
• MSFC-STD-3012
• Others
Gap Analysis of Documents

Comparison of Agency and Center Documents

- Topics from all source documents used for cross-reference
- No one document covered all topics (portion shown below)
- Agency level documents had most gaps
- Goal was to make Agency level document that covered all topics

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<thead>
<tr>
<th>TOPICS</th>
<th>Agency</th>
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<th>JPL</th>
<th>MSFC</th>
<th>GSFC</th>
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<td>Part Grades</td>
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<td>78157 2.0</td>
<td>4.1</td>
<td>2.0 &amp; 6.0</td>
<td>3.2.1.2...</td>
<td>2.0 &amp; 6.0</td>
<td>7.1</td>
<td>5.2.2</td>
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<td>6.7.1</td>
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<td>S&amp;MA Requirement</td>
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<td>1F301.4</td>
<td>57732 Appdx A</td>
<td>5.2.2 &amp; 5.9.2</td>
<td>6.2.7</td>
<td>3.16</td>
<td>6.2.7</td>
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<td>3.11</td>
<td>7.13</td>
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<td>6.1</td>
<td>5.1</td>
<td>6.1</td>
<td>6.2 &amp; 7.1.2</td>
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<td>1F306</td>
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<td>7.1.1</td>
<td>5.2.5</td>
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<td>5.1.2</td>
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Create Agency-Level Document

- Capture list of issues that must be addressed
- Single document referenced in Agency contracts
- Not overburden “higher risk” projects with excessive requirements
- Not require changes to Center documents

Maintain Center-to-Project relationship

- Center still has ample control
- Project still assumes the risk
Details

Applicability

- Flight hardware - Launch vehicles - Critical ground support equipment (GSE) - Critical ground test systems
- Category 1 and Category 2 projects as defined by NPR 7120.5, NASA Space Flight Program and Project Management Requirements
- Class A, B, C or D payloads as defined by NPR 8705.4, Risk Classification for NASA Payloads, Appendix A.

Non – Applicability

- Institutional projects as defined by NPR 7120.7, NASA Information Technology and Institutional Infrastructure Program and Project Requirements
- Research and Technology Development Programs and Projects as defined by NPR 7120.8, NASA Research and Technology Program and Project Management Requirements

Tailoring

- Individual NASA Centers may establish program/project-specific requirements and/or guidelines, as appropriate. To do this, individual provisions of this standard may be tailored (i.e., modified or deleted) by contract or program specifications to meet specific constraints and program/project needs.
- Formally documented as part of program or project requirements and approved by the Technical Authority in accordance with procedures in NPR 8715.3, NASA General Safety Program Requirements & and NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority.
Every EEE part intended for use in space flight and critical ground support equipment shall be reviewed and approved for compatibility with the intended environment and mission life, as applicable.

Parts shall be selected so that flight hardware meets all performance and reliability requirements in the worst-case predicted mission environment.

EEE Part Grade Description

<table>
<thead>
<tr>
<th>GRADE</th>
<th>SUMMARY</th>
<th>RELIABILITY</th>
<th>RISK</th>
<th>MTBF</th>
<th>COST</th>
<th>TYPICAL USE</th>
</tr>
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<tr>
<td>1</td>
<td>Space quality class qualified parts, or equivalent.</td>
<td>Highest</td>
<td>Very Low</td>
<td>Longest</td>
<td>Very High</td>
<td>Spaceflight</td>
</tr>
<tr>
<td>2</td>
<td>Full Military quality class qualified parts, or equivalent.</td>
<td>Very High</td>
<td>Low</td>
<td>Very Long</td>
<td>High</td>
<td>Space flight or critical ground support equipment</td>
</tr>
<tr>
<td>3</td>
<td>Low Military quality class parts, and Vendor Hi-Rel or equivalent.</td>
<td>Medium</td>
<td>Medium</td>
<td>Variable</td>
<td>Moderate</td>
<td>Space flight experiments, aeronautical flight experiments, critical ground support equipment, test demonstrations and ground support systems</td>
</tr>
<tr>
<td>4</td>
<td>&quot;Commercial&quot; quality class parts. Qualification data at manufacturer’s discretion. No government process monitors incorporated during manufacturing.</td>
<td>Variable</td>
<td>High</td>
<td>Variable</td>
<td>Lowest</td>
<td>Aeronautical flight experiments noncritical ground support equipment, ground support systems, test demonstrations and prototypes. Limited critical GSE.</td>
</tr>
</tbody>
</table>
ESA and JAXA EEE Parts

- Extensive qualification programs for manufacturers and individual parts along with qualified parts lists
  - Similar to the DLA QML and QPL programs
  - Space grade parts
  - Includes periodic audits and process review
  - Category 1 and Category 2 projects as defined by NPR 7120.5, NASA Space Flight Program and Project Management Requirements
  - Class A, B, C or D payloads as defined by NPR 8705.4, Risk Classification for NASA Payloads, Appendix A.

- Recommendation for NASA Projects/programs to review screening and qualification requirements
More Details...

- **Parts Assurance**
  - Qualification
    - Part Level
    - Assembly Level
  - Screening
  - Receiving and Inspection

- **Parts Selection**
  - Reliability
    - Criticality
  - Derating
  - Environment
    - Radiation
  - COTS / PEMS

- **Parts Management**
  - Procurement
  - Obsolescence
  - Counterfeit Avoidance
Program / Project EEE Parts Management and Control Plan (EPMCP)

- Plan can be stand-alone documents of part of Project Product Assurance Plan
- Specific Issue Plans may be contained in EPMCP or stand alone doc’s

Parts Lists

- (EPARTS recommended)
- As Designed Parts List
- Approval Record
- As Built Parts List

Analyses

- Derating Analysis
- Parts Obsolescence
Specific Issue Plans

• Radiation Hardness Assurance Plan
  
  ![Radiation Hardness Assurance Plan](Source: NASA MSFC)

• Counterfeit Control Plan
  
  ![Counterfeit Control Plan](Source: NASA GSFC)

• Prohibited Materials Plan
  
  ![Prohibited Materials Plan](Source: NASA GSFC)

• Red Plague Control Plan
  
  ![Red Plague Control Plan](Source: NASA JSC)
Current Status

- Draft document is written
- Final Work Group review finished
- HQ OSMA Document Review – Finished
  - Agency-wide Stakeholder Review – In Progress
    - Other Agency Organizations
  - Publish and Publicize