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Geospace Dynamics Constellation (GDC) Project

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Instrument Mission Assurance Requirements (IMAR)

Mission Risk Classification – NPR 7120.5 Class C

GDC GSFC CMO

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RELEASED

Goddard Space Flight Center
Greenbelt, Maryland

National Aeronautics and Space Administration

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GDC Instrument Mission Assurance Requirements (IMAR)

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Preface

This Explorers & Heliophysics Projects Division signature-controlled Instrument Mission Assurance Requirements document was developed in support of NASA Flight Payloads with a Risk Classification of C per NPR 8705.4.

All of the requirements in this document assume the use of the word "shall" unless otherwise stated.

Questions or comments concerning this document should be addressed to:

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Change History Log

Revision	Effective Date	Description of Changes
Revision -	01/08/2021	Released per email approvals (attached to document record) prior to GDC having a TDMS available. Final Chair approval obtained at 01/08/21 CCB Meeting.

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1 GENERAL

This Instrument Mission Assurance Requirements (IMAR) document is in accordance with the requirements of NPR 7120.5.

1.1 Systems Safety and Mission Assurance Program

The developer shall provide a IMAR Compliance Matrix with proposal – see Appendix D and Appendix A DID 1-1.

The developer shall prepare, document, and implement a Instrument Mission Assurance Implementation Plan (IMAIP) – see Appendix A DID 1-1. While the MAIP represents how the contractor will meet the IMAR requirements using their internal documentation, it does not supersede IMAR requirements.

Important Note: All changes between the IMAR Compliance Matrix (submitted with proposal) and final IMAR Compliance Matrix will need to be highlighted and supported with rationale.

1.2 Management

The developer shall designate a manager for assurance activities that is not responsible for project costs and schedules other than those pertaining to assurance activities.

The assurance manager shall have direct access to management that is independent of project management and the functional freedom and authority to interact with all elements of the project.

1.3 Requirements Flowdown

The developer shall apply system safety and mission assurance requirements to subcontractors and suppliers to the extent necessary to ensure the delivered product meets performance requirements and this IMAR.

The developer's contract review and purchasing processes shall indicate the method of documenting, communicating, and reviewing requirements with sub-tier suppliers to ensure requirements are met.

The developer is responsible for ensuring that quality plans, processes, procedures, hardware and software submitted by developer's sub-tier suppliers are compliant with the requirements of this IMAR, as applicable.

The developer IMAIP shall include specifics of the subcontractor requirements flow-down and oversight process in support of this project.

Developer flow-down requirements shall be made available upon request.

1.4 Suspension of Work Activities

The developer shall direct the suspension of any work activity that presents a hazard, imminent danger, or future hazard to personnel, property, or mission operations resulting from unsafe acts or conditions that are identified by inspection, test, or analysis.

1.5 Contract Data Requirements List (CDRL)

The CDRL identifies Data Item Descriptions (DID) for deliverables. The developer shall deliver data items per the requirements of the applicable CDRL/DID. DIDs listed in Appendix A

The developer shall perform work in accordance with the following definitions:

a. Deliver for Approval: The Explorers and Heliophysics Projects Division (EHPD) approves the deliverable within the specified period of time (per SOW) before the developer proceeds with the associated work.
b. Deliver for review: The Explorers and Heliophysics Projects Division (EHPD) reviews the deliverable and provides comments with the specified period of time (per SOW) before the developer proceeds with the associated work. The developer can continue with the associated work while preparing a response to the GSFC comments unless directed to stop work.
c. Deliver for information: For Explorers and Heliophysics Projects Division (EHPD) information only (per SOW). The developer continues with the associated work.

Note: The developer may combine deliverables if the requirements for the individual deliverables are addressed

1.6 Supply Chain Quality

The developer shall grant access for National Aeronautics and Space Administration (NASA) and NASA assurance representatives to conduct audits, assessments, inspections, or surveys upon notice.

The developer and its suppliers shall supply documents, records, equipment, and a suitable work area within the developer's facilities.

The developer shall maintain and provide a list of key suppliers used for product produced under this contract (DID 1-2).

Note: See Federal Acquisition Regulations (FAR) Parts 46.103, 46.104, 46.202-2, 46.4, and 46.5 for government quality assurance requirements at contractor facilities. See FAR Part 52.246 for inspection clauses by contract type.

1.7 Use of Inherited Products/Items

For inherited products, defined as those that will be build-to-print (BTP), or rebuilt with modification, or are available as commercial-off-the-shelf (COTS), or were previously developed and exist (e.g., spares), the developer may propose to follow the GSFC Inherited Item Risk Assessment process (DID 1-3). With this process the Government reviews risk for using the

product that is based on established prior history, changes in design, environment or operations, and information regarding the processes used to develop the product and data supplied by developer.

The developer shall comply with all requirements of the IMAR and SOW (e.g., contractual performance and functional requirements) unless specifically relieved by EHPD Program Management as a result of the Inherited Item Risk Assessment.

1.8 Government Mandatory Inspection Points (GMIPS)

The developer and their supplier(s) shall plan for Government Mandatory Inspection Points (GMIPs). NASA has the right to specify GMIPS. The developer should provide documentation indicating both developer and subcontractor workflow to NASA with any planned inspection points to facilitate efficient assignment. Below are examples of activities that may be subject to GMIPs:

a. Circuit Card/Hardware Assemblies - Final Solder before Conformal Coating and Staking
b. Circuit Card/Hardware Assemblies - Post Conformal Coating, Potting, Staking
c. Harness – pre-integration (pre-staking or potting)
d. Mechanical – final assembly (unit/component, subsystem, and top-level assembly)
e. Rework and repairs to flight hardware
f. Acceptance Testing (monitor/witness test set-up and testing)

Note: NASA’s goal is to coordinate GMIPs with developer to the greatest extent possible in order to maximize efficiency and minimize impact to schedule.

2 QUALITY MANAGEMENT SYSTEM

2.1 General

The developer shall have a quality management system that complies with SAE AS9100 Quality Systems – Requirements for Aviation, Space and Defense Organizations or ISO 9001 Quality Management System and grant NASA access to their Quality Manual upon request.

2.2 Supplemental Quality Management System Requirements

2.2.1 Control of Nonconforming Product

The developer shall have a documented closed loop system for identifying, reporting, and correcting product nonconformances.

The system shall ensure that the adequacy of corrective action is determined by audit, inspection, or test, that objective evidence is collected, and that preventive action is implemented to preclude recurrence.

2.2.2 Material Review Board (MRB)

The developer/subcontractors shall have a documented process for the establishment and operation of an MRB to process nonconformances, including the definitions of major and minor nonconformances. Note: “Repair” and “Use As Is” dispositions always fall under major MRB classification.

The developer shall appoint an MRB chairperson who is responsible for implementing the MRB process and functional and project representatives as MRB members.

The MRB shall include the EHPD Program Chief Safety and Mission Assurance Officer (CSO) or designee, who shall be a voting member on MRB actions involving major nonconformances.

The government representative shall have access to the applicable documentation in advance of the scheduled MRB.

The developer shall inform the government of MRB actions (DID 2-1).

The MRB shall use the following disposition actions:

a. Scrap — the product is not usable
b. Re-work — the product will be re-worked to conform to existing requirements
c. Return to supplier — the product will be returned to the supplier
d. Repair — the product will be repaired using a repair process approved by the MRB
e. Use as is — the product will be used as is

2.3 Anomaly Reporting and Disposition

The developer shall have a documented process for anomaly reporting and disposition. The process will establish an Anomaly Review Board (ARB) whose membership shall include the

EHPD Program CSO or their designee, as a voting member with approval authority for proposed actions on all major anomalies.

Major anomalies are those that have resulted in hardware or software test failures and damage or potential damage to hardware. *Examples of major anomalies are overvoltage or over current conditions, exceedance of test limits resulting in overstress, blown fuses, and unexpected system responses.*

The process shall require major anomalies to be submitted to the ARB and the government (DID 2-2).

The developer shall report major hardware anomalies beginning with the first application of power, major software anomalies beginning with flight software acceptance testing and when interfacing with flight hardware, and major mechanical system anomalies beginning with the first operation.

The developer may disposition minor anomalies with an appropriate subset of the ARB. Minor anomalies are those that have not resulted in hardware failure or have caused no damage or stress to hardware or required no change in flight software. *Examples of minor anomalies are those that can be resolved immediately, procedural errors, database problems, operator errors, and exceedance of test limits that do not affect the end item.*

Anomaly/Failures that either cannot be duplicated, have unknown root cause, cannot be verified, or have uncertainty in corrective action shall be analyzed for residual risk and consequence, declared as red flag anomaly/failure record.

2.4 Orbital Debris Assessment Report (ODAR) and End of Mission Plan (EOMP)

The developer shall provide support/information as requested by the Spacecraft Developer necessary for the development of the ODAR and the EOMP deliveries per the content defined in NASA-STD 8719.14, Processing for Orbital Debris.

3 SYSTEM SAFETY

3.1 General

The instrument developer shall document and implement a system safety program, comply with launch service provider requirements, and comply with launch range safety requirements.

Specific safety requirements include the following:

a. The instrument developer shall add an independent inhibit to bus inhibits in the design (single failure tolerant) if a system failure may lead to a critical hazard. A critical hazard is defined as a condition that may cause a severe injury or occupational illness to personnel or major property damage to facilities.
b. The instrument developer shall adhere to specific detailed safety requirements, including compliance verification that must be met for design elements with hazards that cannot be controlled by failure tolerance. The process by which safety is incorporated into these design elements (e.g., structures and pressure vessels) is called "Design for Minimum Risk".

3.2 Mission Related Safety Requirements Documentation

The instrument developer shall implement launch range safety requirements as applicable for the specific launch site.

The following represents pertinent requirements documentation for common ranges used by NASA mission, others may apply.

ELV Eastern Test Range (ETR) or Western Test Range (WTR) Missions

a. NASA-STD 8719.24 (with Annex) NASA Expendable Launch Vehicle Payload Safety Requirements
b. KNPR 8715.3 KSC Safety Practices Procedural Requirements (applicable at KSC property, KSC-controlled property, and offsite facility areas where KSC has operational responsibility)
c. NPR 8715.7 Expendable Launch Vehicle Payload Safety Program
d. Launch Site Facility-specific Safety Requirements, as applicable (e.g., Astrotech)

3.3 Safety Deliverables

3.3.1 System Safety Program Plan

The instrument developer shall prepare a System Safety Program Plan (SSPP) that describes the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards to the hardware, software, and system design by reducing the associated risk to an acceptable level throughout the system life cycle, including launch range safety requirements (DID 3-1).

3.3.2 Safety Requirements Compliance Checklist

The instrument developer shall document and implement a Safety Requirements Compliance Checklist (SRCC) to demonstrate that the payload is in compliance with NASA and range safety requirements (DID 3-2).

3.3.3 Hazard Analyses

3.3.3.1 Hazard Analysis (HA)

The instrument developer shall deliver the HA with Preliminary Instrument Safety Assessment Report (ISAR) (DID 3-4).

3.3.3.2 Operations Hazard Analysis (OHA)

The instrument developer shall document, implement, and maintain an Operations Hazard Analysis (OHA) to demonstrate that hardware operations, test equipment operations, and integration and test (I&T) activities comply with facility safety requirements (DID 3-3).

3.3.3.3 Manual Lifting Device Safety Requirements

Manual lifting is assumed for GDC Instruments. Safe manual lifting may be performed up to 100 pounds. If multiple copies of the instrument are shipped in a single shipping container, etc. such that mechanized lift is required, then the following section applies.

Instrument developers planning to perform mechanized lift activities at GSFC shall comply to NASA-STD-8719.9 and all applicable GSFC requirements.

The instrument developer shall implement the following safety requirements for mechanized lifting devices and equipment when performing NASA work at non-NASA facilities:

a. Ensure that for mechanized lifts overhead cranes, winches, and hoists have dual holding brakes. A single holding brake in combination with a motor drive that automatically tests the holding ability of the brake prior to every release of the brake is acceptable as a second brake as long as the crane has a notification device to alert operator of failure of the braking system.
b. Label mechanized LDE at the applied load if the SWL test is performed at a value lower than that allowed by the manufacturer.
c. Perform a proof test at 100% of the mechanized lift SWL with the following exceptions;
    - A proof test at 125% of the SWL for overhead and mobile cranes and for aerial platforms such as scissor or boom lifts that will be used near critical hardware.
    - A proof test at 200% of the SWL for shackles, turnbuckles, and similar items.
d. Perform mechanized lift SWL proof test every four years after the initial test. Note: Instrument developer LDE planned for use at GSFC requires annual SWL proof test.
e. Perform Nondestructive Testing (NDT) inspections of critical welds on mechanized LDE after initial proof test and load testing.

3.3.3.4 Not applicable

3.3.4 Instrument Assessment Safety Report (ISAR)

The instrument developer shall generate an ISAR to document the comprehensive evaluation of the risk being assumed prior to the testing or operation of an instrument. The spacecraft developer will use the ISAR as an input to the Safety Data Package (SDP) (DID 3-4).

3.3.5 Verification Tracking Log (VTL)

The VTL shall identify hazard controls that are not verified as closed and delivered to the EHPD Program Office with the final ISAR (DID 3-4).

3.3.6 Hazardous Procedures for Payload I&T and Pre-launch Processing

The instrument developer shall document instrument hazardous procedures that will be implemented when performing integration and test activities and pre-launch activities are performed at processing facilities and launch site (DID 3-5).

The instrument developer shall ensure that the instrument procedures comply with applicable facility safety requirements.

The instrument developer shall provide instrument safety support for the implementation of hazardous procedures/operations.

3.3.7 Safety Waivers

The instrument developer shall not request waivers. Tailoring for variations from the applicable safety requirements per paragraph 1.4 of NPR 8715.7 Expendable Launch Vehicle (ELV) Payload Safety Program. Instrument tailoring shall be approved by Range Safety prior to CDR.

3.3.8 NASA Expendable Launch Vehicle (ELV) Payload Safety Program Forms

The instrument developer shall prepare NASA Expendable Launch Vehicle Payload Safety Forms. The forms are available at URL https://kscsma.ksc.nasa.gov/PayloadSafety/forms.

3.3.9 Mishap Reporting and Investigation

The instrument developer shall support the GDC Project's Mishap Plan and notify the GSFC GDC Project as soon as possible (no later than 24 hours) of any mishap occurrence. Note: The Project's Mishap Plan is generated in accordance with NPR 8621.1 (NASA Procedural Requirements for Mishap and Close Call Reporting, Investigation, and Record Keeping).

4 RELIABILITY

4.1 Reliability Program Plan (RPP)

The developer shall document and implement an RPP using both qualitative and quantitative techniques to support decisions regarding mission success and safety throughout system development (DID 4-1).

The developer shall include a detailed approach to the analysis of hardware and software for their contributions to systems reliability and mission success.

4.2 Failure Modes Effects and Critical Analysis (FMECA) and Critical Items List (CIL)

The developer shall perform and maintain FMECAs that addresses flight hardware, software, and ground equipment that interfaces with flight systems that is being designed, built, or provided by from project initiation through launch and mission operations. The developer shall include likelihood, cause, detection and mitigation, and the effects of each failure mode at the local, subsystem, and system or mission levels to the interface level for existing systems and to the box or functional level for modified or new systems (DID 4-2).

The developer shall prepare and maintain a Critical Items List (CIL) for severity categories 1, 1R, 1S, and 2, per Table 4.1 (DID 4-2).

The developer shall prepare and maintain a single point failure list for modes resulting in severity categories 1 and 1S per Table 4.1, and document applicable failure causes, corresponding mitigation, and retention rationale.

In performing the likelihood part of this analysis, the developer shall predict the likelihood score from 1-5 for each failure mode, using the *Technical Likelihood* criteria shown in Table 4-2, to facilitate risk assessment using the FMEA results. Each likelihood prediction can be based on qualitative assessment and/or failure rate data from other analyses (i.e., system predictions) in order to score each failure mode for the mission duration.

Table 4-1. Severity Categories

Category	Severity	Description
1	Catastrophic	Failure modes that could result in loss of life, or permanently disabling or injuring of personnel, (flight or ground), and/or complete loss of flight or ground systems.
1R		Failure modes of identical or equivalent redundant hardware or software elements that could result in Category 1 effects if all failed.
1S		Failure in a safety or hazard monitoring system that could cause the system to fail to detect a hazardous condition or fail to operate during such condition and lead to Category 1 consequences.
2	Critical	Failure modes that could result in loss of one or more mission objectives as defined by the GSFC project or causes severe injury or occupational illness.
2R		Failure modes of identical or equivalent redundant hardware or software that could result in Category 2 effects if all failed.
3	Significant	Failure modes that could cause degradation to mission objectives.
4	Minor	Failure modes that could result in insignificant or no loss to mission objectives

Table 4-2. Likelihood Rankings

Likelihood	Safety (Estimated likelihood of safety event occurrence)	Technical (Estimated likelihood of not meeting performance requirements)	Cost/Schedule (Estimated likelihood of not meeting cost or schedule commitment)
5 Very High	($P_{SE} > 10^{-1}$)	($P_T > 50\%$)	($P_{CS} > 75\%$)
4 High	($10^{-2} < P_{SE} \leq 10^{-1}$)	($25\% < P_T \leq 50\%$)	($50\% < P_{CS} \leq 75\%$)
3 Moderate	($10^{-3} < P_{SE} \leq 10^{-2}$)	($15\% < P_T \leq 25\%$)	($25\% < P_{CS} \leq 50\%$)
2 Low	($10^{-5} < P_{SE} \leq 10^{-3}$)	($2\% < P_T \leq 15\%$)	($10\% < P_{CS} \leq 25\%$)
1 Very Low	($10^{-6} < P_{SE} \leq 10^{-5}$)	($0.1\% < P_T \leq 2\%$)	($2\% < P_{CS} \leq 10\%$)

4.3 Fault Tree Analysis (FTA)

The developer shall perform and maintain qualitative fault tree analyses (FTA) to address mission failure, and/or degraded modes of operation (DID 4-3).

Fault tree analyses shall address both hardware and software contributions to analyze scenarios and identify cut sets of interest and risks.

In the event the developer or the project identifies a major mission risk contributor in the FMECA or FTA, the developer shall quantify the FTA or the portion of the FTA necessary for detailed risk assessment.

4.4 Parts Stress Analysis

The developer shall perform parts stress and derating analyses for electrical, electronic, and electromechanical (EEE) parts in accordance with GSFC EEE-INST-002 Instruction for EEE Parts Selection, Screening, Qualification, and Derating (DID 4-4).

4.5 Limited Life Items

The developer shall document and implement a plan to identify and manage limited life items (in IMAIP). Records shall be maintained for limited-life items and presented at PDR, CDR, and PSR (DID 4-5).

The developer shall prepare and maintain a list of limited life items that includes expected life, required life, duty cycles, an assessment of life margin that includes servicing and maintenance, and the retention rationale for items with an expected life of less than 2x the requirement (DID 4-5).

Note 1: Limited Life items are generally defined as items that have a limited shelf life, operational life, or cycle life whose life expectancy is less than 2x the requirement. The risk assessment and mitigation plans may factor in the wear caused by atomic oxygen, solar and trapped radiation, shelf-life, extreme temperatures, thermal cycling, mechanical wear or fatigue, and include refurbishment and maintenance plans.

Note 2: Examples of potential limited-life items shall include, but not necessarily be limited to: selected consumables; structures; mechanisms; batteries; seals; thermal control surfaces; solar arrays; and, electromechanical mechanisms.

4.6 Worst-Case Analysis

The developer shall perform worst-case analyses (WCA) for circuits that are identified by other analyses as critical or mission success risks (DID 4-6).

4.7 Not Applicable

4.8 Redundant Systems

The developer shall ensure that redundant systems or functions that are implemented for risk mitigation are independent such that the failure of one system or function does not affect the other system or function.

4.9 Trend Analysis

The developer shall present trending approach at PDR and results at CDR, PER, and PSR.

4.10 Not Applicable

5 SOFTWARE ASSURANCE

5.1 Applicable Software Definitions

When identifying, developing, verifying, and maintaining software, the developer shall apply the following definitions:

a. Software: Instrument computer programs, procedures, scripts, rules, and associated documentation pertaining to the development and operation of a computer system. Software includes commercial–off-the-shelf (COTS) software, government-off-the-shelf (GOTS) software, modified-off-the-shelf (MOTS) software, custom software, reused software, heritage software, auto-generated code, and code executed on microprocessors.
b. Mission-Critical Software: Instrument software that can cause, contribute to, or mitigate the loss of capabilities that are essential to the primary mission objectives. The software reliability assessment and analysis is focused on failure modes specific to post-separation mission phases.
c. Safety-Critical Software: Instrument software that can cause, contribute to, or mitigate human safety hazards or damage to facilities. The software safety assessment and analysis is focused on hazards specific integration and test, launch, and up through spacecraft separation.

Note: The above definitions for Mission and Safety Critical Software are derived from Safety Critical as defined by the NASA Software Standard. The delineation is meant only to provide clarification for organizations with separate processes for assessing pre-separation and post-separation hazards and failures.

5.2 Software Assurance Program

The developer shall plan and implement a Software Assurance Program that complies with definitions in Section 5.1 and the documents listed below in a Software Assurance Plan (DID 5-1).

a. NASA-STD-8739.8 NASA Standard for Software Assurance
b. NASA-STD-8719.13 Software Safety Standard

The developer shall identify the person responsible for directing and managing the software assurance program and interfacing with government assurance personnel.

5.3 Surveillance of Software Development, Maintenance, and Assurance Activities

The developer shall provide the following:

a. Direct access to the software problem reporting system
b. Electronic access to the software documentation (i.e., management plans, assurance plans, configuration management plans, requirements specifications, design documents, test plans, test cases, test procedures, test results, schedule, maintenance plans)
c. Electronic access to source code
d. Schedule of software development activities and critical milestones
e. Schedule of assurance reviews, audits, and assessments of the developer’s processes and

products

f. Access to the corrective actions from process and product audits
g. Access to review action item status and resolution
h. Access to requirements traceability matrices and data prepared per the requirements of NPR 7150.2 NASA Software Engineering Requirements
i. Software assurance status report
j. Access to monthly software measurement and metrics data prepared per the requirements of NPR 7150.2 NASA Software Engineering Requirements
k. Electronic access to the software review results

6 WORKMANSHIP

6.1 General

The developer shall implement a workmanship program to assure that electronic packaging technologies, processes, and workmanship meet mission objectives for quality and reliability per the requirements of the following standards:

a. NASA-STD-8739.1 Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies
b. NASA-STD-8739.4 Crimping, Interconnecting Cables, Harnesses, and Wiring
c. NASA-STD-8739.5 Fiber Optic Terminations, Cable Assemblies, and Installation
d. NASA-STD-8739.6, Implementation Requirements for NASA Workmanship Standards
e. GSFC-STD-6001, Ceramic Column Grid Array Design and Manufacturing Rules for Flight Hardware
f. IPC-J-STD-001xS (Space Addendum "S", where x signifies latest revision), Joint Industry Standard, Space Applications Electronic Hardware Addendum (except Chapter 10 of IPC-J-STD-001)
g. IPC-2221 Generic Standard on Printed Board Design
h. IPC-2222 Sectional Design Standard for Rigid Organic Printed Boards
i. IPC-2223 Sectional Design Standard for Flexible Printed Boards
j. IPC-2225 Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
k. IPC-6011 Generic Performance Specification for Printed Boards (Class 3 requirements)
l. IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 requirements)
m. MIL-PRF-50884, Performance Specification: Printed Wiring Board, Flexible or Rigid-Flex, General Specification For
n. IPC-6015 Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures
o. IPC-6018 Qualification and Performance Specification for High Frequency (Microwave) Printed Boards (Space Addendum)

The developer shall comply with one of the following standards for rigid printed circuit boards:

a. IPC-6012 Qualification and Performance Specification for Rigid Printed Boards (Class 3 Requirements)
b. MIL-PRF-55110H Performance Specification: Printed Wiring Board, Rigid, General Specification For
c. ECSS-Q-ST-70-60C Qualification and Procurement of Printed Circuit Boards

6.2 Design and Process Qualification

The developer shall perform and document qualification of designs and processes that are not covered by or do not conform to the above standards, including the establishment of quality controls and inspections for non-standard configurations and submit a waiver request for government approval.

6.3 Electrostatic Discharge Control (ESD)

The developer shall prepare and implement an ESD control program that conforms to the requirements of ANSI/ESD S20.20, Protection of Electrical and Electronic Parts, Assemblies and Equipment [Excluding Electrically Initiated Explosive Devices] (made available upon request).

6.4 Splices, Circuit Board Trace Cuts, and Jumper Wires

The developer shall not incorporate splices, board trace cuts, or jumper wires into flight hardware, including inherited hardware, unless approved by the MRB.

6.5 Printed Wiring Board (PWB) Test Coupons

The developer shall provide sufficient detail in the procurement instructions to ensure that PWB test coupons are fabricated for each design and that sufficient numbers are produced to meet requirements for testing per IPC-2221 Generic Standard on Printed Board Design, to satisfy required supplier acceptance testing per the selected standard from section 6.1, and for GSFC (or GSFC approved laboratory) micro-sectioning evaluations.

The developer shall provide printed wiring board test coupons that are directly traceable to each board that is intended for use in hardware for structural integrity analysis to the GSFC or to a GSFC- approved facility (DID 6-1). Coupon reports generated at GSFC or at a GSFC approved facility that indicate non-conformances to requirement will be processed per developers MRB process.

Any non-conformance being considered for flight use shall be processed per major MRB, requiring GSFC approval. The developer shall seek to identify the root cause of the nonconformance and appropriate corrective action prior to beginning a replacement production run.

The developer shall not populate printed circuit boards (PCBs) until all approvals to proceed are granted.

6.6 Use of Water Soluble Flux

The developer shall comply with the requirements of GSFC-STD-8002 GSFC Standard Quality Assurance Requirements for the Use of Water Soluble Flux (DID 6-2).

6.7 Not Applicable

7 EEE PARTS

7.1 General

Minimum requirements for parts is Level 2 as identified in GSFC EEE-INST-002 Instruction for EEE Parts Selection, Screening, Qualification, and Derating.

The developer shall document and implement a Parts Control Plan (PCP) to meet the above minimum parts requirement for all EEE part categories (DID 7-1). Refer to GSFC-EEE-INST-002 Section 1, Para 5.1/5.2 for Part Type Categories.

The PCP shall address all EEE component radiation effects in accordance with project requirements.

Parts using new technologies and parts not explicitly covered by the EEE-INST-002 shall be evaluated by the PCB for suitability for flight use.

The developer shall identify the person responsible for directing and managing the EEE parts program, chairing parts control board, and interfacing with government assurance personnel.

Note 1: Plastic-Encapsulated Microcircuits (PEMs) may be used per the process prescribed in EEE-INST-002, section M4, when accepted by the Parts Control Board (PCB).

Note 2: A higher level/quality part is recommended for use in critical applications impacting mission success and parts with significant history of known issues such as complex hybrids.

7.2 Nonstandard Parts

The PCB shall document, evaluate, and approve Non-Standard parts. Non-standard parts are parts that do not have a military specification part number or Source Control Drawing (SCD) that reflects the required screening level (Level 2 or greater requirements per EEE-INST-002).

7.3 Parts Control Board

The developer shall establish a Parts Control Board (PCB) that is responsible for the planning, management, and coordination of the selection, application, and procurement requirements of EEE parts.

The PCB implementation and process shall be addressed within the Parts Control Plan (PCP).

The EHPD Program Parts Engineer (GSFC) shall be an active/voting member of the PCB.

7.4 Re-use of EEE Parts

Re-use of EEE parts installed, then removed is prohibited unless approved by the MRB.

7.5 Master EEE Parts List

The developer shall develop and maintain a Master EEE Parts List (DID 7-2).

8 MATERIALS AND PROCESSES

8.1 General

The developer shall prepare and implement a Materials and Processes (M&P) Selection, Control, and Implementation Plan that addresses the Project's specific requirements (DID 8-1).

The EHPD Program Materials and Processes Engineer shall be an active/voting member of the Materials and Processes Control Board or equivalent process.

8.2 Materials Identification and Usage List (MIUL)

The developer shall prepare a materials identification and usage list (DID 8-2).

8.3 Materials Usage Agreement (MUA)

The developers shall prepare materials usage agreements (DID 8-3).

8.4 Life Test Plan and Final Report for Lubricated Mechanisms

The developer shall prepare and implement a life test plan for lubricated mechanisms and submit a final report (DID 8-4).

9 CONTAMINATION CONTROL and FOREIGN OBJECT DEBRIS CONTROL

9.1 Contamination Control and Foreign Object Debris Prevention Control Plan

The developer shall prepare and implement a Contamination Control and Foreign Object Debris Prevention Control program (DID 9-1).

10 METROLOGY AND CALIBRATION CONTROL

10.1 Metrology and Calibration Program

The developer shall comply with one of the following standards for the calibration of measuring and test equipment:

a. ANSI/NCSL Z540.1 Calibration Laboratories & Measuring & Test Equipment - General Requirements
b. ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment
c. ISO 17025 General requirements for the competence of testing and calibration laboratories

10.2 Use of Calibrated and Non-calibrated Instruments

The developer shall maintain the calibration of test and measuring equipment and safety instruments used for: acceptance testing; inspection; maintenance; flight hardware qualification; measurement where accuracy is essential for the safety of personnel or the public; telecommunication, transmission, and test equipment where exact signal interfaces and circuit confirmations are essential to mission success; development, testing, and special applications where the specifications, end products, or data are accuracy sensitive, including instruments used in hazardous and critical applications.

The developer shall calibrate any article of equipment used to take measurements to meet accuracy requirements within the project to one of the standards in 10.1. The developer may calibrate torque wrenches per one of the standards in 10.1 or may verify against a calibrated torque tester prior to use.

The developer shall record the measurements that require accuracy in applicable project build documents (e.g., WOAs, job orders, task sheets or test plans), including the article of calibrated equipment used to take the measurement and its calibration end date.

The developer is not required to calibrate an article of test and measuring equipment if the accuracy of the equipment's signals or measurements has been verified to meet minimum requirements against calibrated instruments or intrinsic standards, using a documented measurement procedure.

The developer shall perform verification within a timeframe that has been demonstrated to provide appropriate levels of reliability, in the same facility, and under the same conditions that will be encountered during the process. If this method is employed, the developer shall record the following items in the work order, test plan, or procedure:

a. Measurement process or procedure used to perform the verification
b. Unambiguous identification of the item(s) being verified (Model/Part Number and Serial/Asset Number, or in the case of a multi-unit configuration, a Model/Part/Drawing number and configuration listing that provides identification of all verified sub components)
c. Measurement parameters that must be verified
d. Acceptance limits for each parameter being verified
e. Actual measurements at each parameter being verified

f. Verification status (pass/fail)
g. Traceability
    - Unambiguous identification of calibrated instruments utilized, including the end date of its calibration, or
    - Type and method of verification against an intrinsic standard (examples are ice baths, monochromatic light source, etc.)

The developer shall limit the use of non-calibrated and non-verified instruments to applications where substantiated accuracy is not required or for indication-only purposes in non-hazardous, non-critical applications.

11 GIDEP ALERTS AND PROBLEM ADVISORIES

11.1 Government-Industry Data Exchange Program (GIDEP)

The developer shall participate in GIDEP per the GIDEP Operations Manual (Note: this document is available through http://www.gidep.org).

11.2 Alert Disposition

The developer shall review the following, hereafter referred to collectively as Alerts, for affects on EEE parts, materials, equipment and software used in NASA products: GIDEP Alerts; GIDEP SAFE-ALERTS; GIDEP Problem Advisories; GIDEP Agency Action Notices; NASA Advisories.

When the developer has identified an applicable item in their design, inventory, or assembly that is documented in a GIDEP or NASA advisory, the developer shall document this through their standard nonconformance reporting system as a Major MRB nonconformance.

11.3 GIDEP Reporting

The developer shall prepare and submit failure experience data and safety issue reports per the requirements of the GIDEP Operations Manual whenever failed or nonconforming items that are available to other buyers.

11.4 Review Reporting

The developer shall report the status of NASA products that are affected by Alerts or by significant EEE parts, materials, and safety problems at monthly status reviews, parts control board meetings, program milestone reviews and readiness reviews.

The developer shall include a summary of the review status for EEE parts and materials lists and of actions taken to eliminate or mitigate negative effects.

12 END ITEM ACCEPTANCE DATA PACKAGE

The End Item Acceptance Data Package shall be maintained throughout the projects lifecycle and delivered in accordance with DID 12-1.

APPENDIX A: Data Item Descriptions

Important Note: All DIDs become CDRLs at the time of contract award

Title: Instrument Mission Assurance Implementation Plan (IMAIP)/ Compliance Matrix	**DID No.: 1-1**
IMAR Paragraph: 1.1	**CDRL No.:**

Use:

- Documents the developer's compliance with the contractual system safety and mission assurance requirements.

Reference Documents:

Place/Time/Purpose of Delivery:

- Deliver IMAR Compliance Matrix with proposal for information
- Deliver final IMAIP and IMAR Compliance Matrix to the EHPD Program Office sixty (60) days after contract award for approval (*see note under Preparations)
- Deliver IMAIP and IMAR Compliance Matrix updates to the EHPD Program Office thirty (30) days prior to implementation for approval

Preparation Information:

1. The Instrument Mission Assurance Implementation Plan / Compliance Matrix (Appendix D) shall address/include:
   a. Each IMAR Section and Requirement
   b. All flight hardware and software that is designed, built, or provided by the developer and its subcontractors, or furnished by the government, from project initiation through launch and mission operations
   c. The electrical and mechanical ground support/systems that interfaces with flight items to the extent necessary to assure the integrity and safety of flight items
   d. The ground data system to the extent necessary to assure performance as required by the Statement of Work
   e. Test bed/simulator fidelity and certification process - when used to evaluate, test, or qualify/validate flight software and hardware
   f. Identified variances and acceptance rationale for processes, procedures, and standards that are proposed as alternatives. A sufficiently documented alternative process in the IMAIP can take the place of a waiver/deviation.
   g. Traceability to the vendor's internal documentation (number, title and revision) being used in lieu of the referenced and applicable documents in this IMAR.

Note 1: All changes between IMAR Compliance Matrix (submitted with proposal) and final IMAR Compliance Matrix will need to be highlighted and supported with rationale.
Note 2: The Instrument Mission Assurance Compliance Matrix shall identify variances and acceptance rationale for processes, procedures, and standards that are proposed as alternates to the contractual requirements.

Title: Key Supplier List	**DID No.: 1-2**
IMAR Paragraph: 1.6	**CDRL No.:**

Use:

- Provides a list of the key suppliers used by the developer under this contract.

Reference Documents:

Place/Time/Purpose of Delivery:

- Deliver list sixty (60) days after contract award for information
- Deliver updates quarterly (90 days) beginning six months after contract award for information

Preparation Information:

1. The developer and its suppliers shall provide the following information for key suppliers that have been contracted to provide products or services:
   a. Supplier name
   b. Location(s)
   c. Cage code(s)
   d. Product or service description
   e. System or sub-system for which the product or service is associated
   f. Contract start and end dates
   g. Delivery date

Title: Use of Inherited Products/Items	**DID No.: 1-3**
IMAR Paragraph: 1.7	**CDRL No.:**

Use:
- Government Risk of Inherited Products/Items

Reference Documents:
- GPR 8730.5 Safety and Mission Assurance Acceptance of Inherited and Build-to-Print Products

Place/Time/Purpose of Delivery:
- Initial Proposed Inherited Items List: Sixty (60) days after contract award for review
- Final Proposed Inherited Items List: Thirty (30) days after System Requirements Review for approval
- Each Inherited Item Data Package: Ninety (90) days prior to risk assessment/requirement tailoring need date for information
- Updates to Inherited Items Data Package within thirty (30) days of additional data need or data change identification for information

Preparation Information:
Inherited Item Data Package submissions for each Inherited Item must be accompanied by Developers Major MRB Form or Waiver for Inherited Item not meeting IMAR requirements.

Important Notes:
Note 1: Use of this process does not relieve the developer from meeting contractual performance and functional requirements.
Note 2: For EHPD Projects this Inherited Items Risk Assessment is used to support project planned reviews and meetings.
Note 3: The developer shall participate in Technical Interchange Meetings (TIM) regarding the baseline risk and risk mitigation strategies for Inherited Products.

1. For the Proposed Inherited Items List, the developer shall provide the following data in table format:
   a. Name and Model of Inherited Products/Items proposed for Inherited Item Risk Assessment process
   b. Manufacturer
   c. Part Number
   d. Origin (e.g., build to print / COTS, modified design of a previous build, existing product / flight spare)
   e. Requirement tailoring need date (e.g. subcontractor/supplier award date)

2. For the Inherited Item Data Package, the developer shall provide the following data:
   a. Name and Model of Inherited Product/Item, Manufacturer, Manufacturer's Part number, statement regarding their origin (e.g. build to print, COTS, modified design of a previous build, existing product, flight spare, or combination thereof)
   b. Summary results of qualification, acceptance, or prototype/proto-flight testing, or comparison of current qualification or proto-qualification requirements to that of the inherited product, including environments, required design margins, and life
   c. Flight history and specific attributes for each flight, including comparison of environment to the current environmental requirements, including duty cycle and general concept of operations
   d. MRB disposition for inherited products that do not meet this IMAR or mission requirements
   e. Ground and on-orbit anomaly and failure history including the determination of root causes or information that root cause was not determined (ground anomalies may be restricted to major anomalies, where component performance requirements were violated)
   f. Reliability analyses performed for the most recent version of the product
   g. Identification of significant changes in manufacturing from the qualified product to current product (e.g., facility, process, sub-tier supplier, testing, company change of ownership), and changes in design or materials, including electronic parts, printed circuit boards, or standards used

3. The developer may provide information from the following to mitigate risk:
   a. Deviations of the product from the original design and reasons for each deviation (e.g., white wires, cut traces, and splices). Note; if the design was qualified on a previous GSFC project in the same environment and same risk posture, then the deviations may be discussed relative to the previously qualified design
   b. Specifications and standards used to develop/build the inherited product (e.g., IPC, J-STD, NASA, or GSFC requirements, including fastener integrity approach, or company standards). For products with minimal prior flight history, company standards or detailed synopses of such should be provided, if such are used to develop the product

c. Previous as-built parts list, including lot date codes, and the differences for new inherited item. This should include evidence that Government Industry Data Exchange Program (GIDEP) alerts and advisories have been properly dispositioned, if the parts have already been procured. Note that GIDEP should always be used as an aid in procuring new parts or pulling parts from inventory. Reference to prior project deliveries to GSFC is acceptable, in which case, an amendment may be delivered to indicate any changes
d. Known obsolete parts that are to be supplied from existing inventory, including the quantity required and the quantity available. If available, include the sparing plan (quantity required, quantity available, and sparing philosophy)
e. Materials list and approved Material Usage Agreements (MUAs). Materials list should include lot date codes and evidence that GIDEP alerts and advisories have been properly dispositioned, if the materials have already been procured. Such evidence should be encompassed in GIDEP closure records for each of the items that have impacts. Reference to prior project deliveries to GSFC is acceptable, in which case, an amendment may be delivered to indicate any changes.
f. List of major electrical and mechanical analyses completed and summary of results

Title: Reporting of MRB Actions	**DID No.: 2-1**
IMAR Paragraph: 2.2.2	**CDRL No.:**

Use:

- Report MRB actions to the EHPD Program Office.

Reference Documents:

- SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

Place/Time/Purpose of Delivery:

- Major MRB actions: Notify EHPD Program CSO when generated (within 24 hours of occurrence), for meetings, status change, approval, and closure review
- Minor MRB actions: Available via electronic reporting system

Preparation Information:

1. Developer's MRB System (for majors and minors) shall be made available (remotely) electronically to EHPD Program team.
2. The developer shall document the MRB action per the developer's MRB system form, which shall contain at a minimum:
   a. MRB Classification (major/minor)
   b. Dates (opened, closed, etc.)
   c. Condition Observed
   d. Cause
   e. Corrective Action Taken
   f. Preventive Action
   g. MRB meeting notes, actions, rationale, authorizations

Title: Anomaly Reporting	**DID No.: 2-2**
IMAR Paragraph: 2.3	**CDRL No.:**

Use:
- Document anomalies, investigative activities, rationale for closure, and corrective and preventive actions.

Reference Documents:
- SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

Place/Time/Purpose of Delivery:
- Major Anomaly: Notify EHPD Program CSO within 24 hours of the initial event, prior to meetings, approval, and closure review.
- Minor Anomaly: Available via electronic reporting system.

Preparation Information:

1. Developer's Anomaly Reporting System (for majors and minors) shall be made available (remotely) electronically to EHPD Program team.
2. Document anomalies, changes in status, or proposed closures shall identify the following information:
   a. Identification of project, system, or sub-system
   b. Identification of failed item (e.g., assembly, sub-assembly, or part)
   c. Description of item
   d. Identification of next higher assembly
   e. Description of anomaly, including activities leading up to anomaly, if known
   f. Names and contact information of individuals involved in anomaly
   g. Date and time of anomaly
   h. Status of item
   i. Contact information for personnel who originated the report
   j. Date of original submission
   k. Anomaly cause (include investigation steps, activity, and ARB notes/authorization)
   l. Corrective and Preventive actions implemented (include ARB notes/authorization)
   m. Retesting performed and results
   n. Other items affected
   o. Risk ratings – the numerical ratings for failure effect risk and corrective action risk per the following criteria:

Failure Effect Risk Rating – indicates the potential impact of the anomaly on hardware or software performance if it occurred during the mission. Redundancy shall be ignored in establishing this rating. The project shall assign a failure effect risk rating per the criteria and corresponding numerical values as listed below. The developer shall assess the failure risk ratings and failure effect risk ratings for major anomalies and identify those that have a failure effect risk rating of 2 or 3 and a failure corrective action risk rating of 3 or 4 as a significant residual risk (red-flag).

1 Negligible or no effect on mission, system or instrument performance, reliability or safety.
2 Moderate or significant effect on the mission, system or instrument performance, reliability or safety, defined as: an appreciable change in functional capability, an appreciable degradation of engineering or science telemetry, causing significant operational difficulties or constraints, or causing a reduction in mission lifetime.
3 Catastrophic or major degradation to mission, system or instrument performance, reliability or safety.

Corrective Action Rating – indicates the confidence in the root cause and the corrective action. The project shall assign a failure corrective action risk rating per the following criteria:

1 Recurrence very unlikely – the root cause of the anomaly has been determined with confidence by analysis or test. Corrective action has been determined, implemented, and verified with certainty. There is a very low probability of recurrence.
2 Recurrence unlikely – the root cause of the anomaly has not been determined with confidence. However, some corrective action has been determined, implemented, and verified to the extent that there is a very low probability of recurrence.
3 Recurrence possible – the root cause is considered known and understood with confidence. Corrective action has not been determined, implemented, or verified with certainty. There exists a possibility that the anomaly may recur.
4 Recurrence credible – the root cause has not been determined with confidence. Corrective action has not been determined, implemented, or verified with certainty. There exists a possibility that the anomaly may recur.

DID 2-3: Not Applicable

Title: System Safety Program Plan	DID No.: 3-1
IMAR Paragraph: 3.3.1	CDRL No.:

Use:
- The Instrument System Safety Program Plan (SSPP) describes the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards to the hardware, software, and system design by reducing the associated risk to an acceptable level throughout the system life cycle.

Reference Documents:
- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- NASA-STD-8719.9 Lifting Devices and Equipment

Place/Time/Purpose of Delivery:
- Deliver Instrument SSPP preliminary plan to the EHPD Program Office fifteen days (15) prior to SSR for review.
- Deliver Instrument SSPP final plan to the EHPD Program Office forty-five (45) days prior to PDR for review.
- Deliver updates to the plan no later than thirty (30) days prior to implementation for review.

Preparation Information:
1. The instrument developer shall prepare a instrument SSPP that describes the development and implementation of a system safety program that complies with the requirements of the Safety Requirements Compliance Checklist (SRCC). The instrument developer shall:
   a. Define the roles and responsibilities of instrument personnel
   b. Address instrument support for Safety Reviews, Safety Working Group Meetings and TIMs
   c. Provide for early identification and control of instrument hazards to personnel, facilities, support equipment, and the flight system during product development
   d. Address instrument compliance with the applicable launch range safety requirements (ie. SRCC)
   e. Address instrument compliance with industrial safety requirements imposed by NASA and OSHA design and operational needs (e.g., NASA-STD-8719.9 Lifting Devices and Equipment for any mechanized lifts) and contractually imposed mission unique obligations

Title: Safety Requirements Compliance Checklist	DID No.: 3-2
IMAR Paragraph: 3.3.2	CDRL No.:

Use:
- The Safety Requirements Compliance Checklist (SRCC) indicates for each requirement whether the proposed design is compliant, non-compliant but meets intent, non-compliant, or if the requirement is not applicable. An indication other than compliant will include rationale.

Reference Documents:
- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- Reference IMAR Section 3.2, Mission Related Safety Requirements Documentation

Place/Time/Purpose of Delivery:
- Deliver Instrument SRCC Preliminary version to the EHPD Program Office forty-five (45) days prior to SSR for interim approval
- Deliver Instrument SRCC Final version to the EHPD Program Office forty-five (45) days prior to PDR for approval
- Deliver Instrument SRCC updates (45) forty-five days prior to CDR for approval

Preparation Information:
1. The instrument developer shall prepare a compliance checklist of all design, test, analysis, and data submittal requirements. The following shall be included:
   a. Criteria and requirement.
   b. System
   c. Indication of compliance, noncompliance, or not applicable
   d. Rationale for indications other than compliant
   e. Resolution
   f. Reference
   g. Copies of Range Safety and NASA approved non-compliances, including waivers and equivalent levels of safety certifications

Note 1: The instrument developer shall submit safety tailoring for non-compliant design elements per paragraph 3.3.7.

Title: Operations Hazard Analysis	**DID No.: 3-3**
IMAR Paragraph: 3.3.3.2	**CDRL No.:**

Use:

- The Operations Hazard Analysis (OHA) shall demonstrate that hazards related to the operation of hardware and test equipment during integration and test activities have been addressed with respect to facility safety requirements.

Reference Documents:

- GSFC 500-PG-8715.1.2 AETD Safety Manual (for operations at GSFC)
- NASA-STD-8719.9 Standard for Mechanized Lifting Devices and Equipment

Place/Time/Purpose of Delivery:

- Deliver the OHA for flight hardware to the EHPD Program Office forty-five (45) days prior to Systems Integration Review or Pre-Environmental Review for review

Preparation Information:

1. The OHA shall include the following information:
   a. System Description – a description of instrument system hardware and configuration, with a list of subsystem components and schedules for integration and testing
   b. Analysis of Hazards
   c. List of real or potential instrument hazards to personnel, equipment, and property during I&T processing
   d. The following information shall be included for each instrument hazard:
      - System Description and Hazard Identification, Indication:
        - A complete description of the actual or potential hazard resulting from normal instrument actions or equipment failures; indicate whether the hazard will cause personnel injury and equipment damage.
        - A description of instrument warning indicators for the operator/crew that includes all means of identifying the hazard to operational/maintenance personnel.
        - A description of the instrument safety hazards of software controlling hardware systems where the hardware effects are safety critical.
      - Effect on instrument System – the detrimental effects of an uncontrolled hazard on the instrument system
      - Risk Assessment.
      - Caution and Warning Notes – a list of warnings, cautions, procedures required in instrument operating and maintenance manuals, training courses, and test plans
      - Status/Remarks – the status of actions to implement hazard controls.
   e. References (e.g., test reports, preliminary operating and maintenance manuals, and other hazard analyses)

Title: Instrument Safety Assessment Report (ISAR)	**DID No.: 3-4**
IMAR Paragraph: 3.3.4	**CDRL No.:**

Use:

- The Instrument Safety Assessment Report (ISAR) documents the comprehensive evaluation of the risk being assumed prior to the testing or operation of an instrument. The spacecraft developer will append the ISAR as an input to the Safety Data Package (SDP) and will verify inhibit controls ultimately used in whole or part to control instrument hazards at the observatory level.

Reference Documents:

- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- KNPR 8715.3 KSC Safety Practices Procedural Requirements (applicable at KSC property, KSC-controlled property, and offsite facility areas where KSC has operational responsibility)
- Launch Site Facility-specific Safety Requirements, as applicable (e.g., Astrotech)

Place/Time/Purpose of Delivery:

- Deliver the Preliminary ISAR to the EHPD Program Office thirty (30) days prior to instrument PDR for review.
- Deliver the Intermediate ISAR to the EHPD Program Office thirty (30) days prior to instrument CDR for review.
- Deliver the Final ISAR to the EHPD Program Office thirty (30) days prior to instrument PSR for approval.

Preparation Information:

The ISAR will identify safety features of the hardware, software, and system design as well as procedural, hardware, and software related hazards that may be present in the instrument. This includes specific procedural controls and precautions that should be followed. The ISAR will include the following information:

1. The safety criteria and methodology used to classify and rank hazards, including assumptions upon which the criteria or methodologies were based or derived
2. The results of hazard analyses and tests used to identify hazards in the system including:
    a. Those hazards that still have a residual risk and the actions that have been taken to reduce the associated risk to a level contractually specified as acceptable
    b. Results of tests conducted to validate safety criteria, requirements, and analyses
    c. Hazard reports documenting the results of the hazard analyses to include a list of all significant hazards along with specific safety recommendations or precautions required to ensure safety of personnel, property, or the environment. NOTE: Identify whether or not the risks may be expected under normal or abnormal operating conditions.
    d. Any hazardous materials generated by or used in the system
    e. The conclusion that all identified hazards have been eliminated or their associated risks controlled to levels contractually specified as acceptable and that the instrument is ready to test, operate, or proceed to the next phase
3. Identification of stored energy sources in order to aid the spacecraft developer in completing an orbital debris assessment; examples include pressure vessels, Dewars, batteries or energy sources that can be passivated at end of life.
    c. A statement signed by the developer's System Safety Manager and Program Manager certifying that all identified hazards have been eliminated or controlled and that the system is ready to test, operate, or proceed to the next acquisition phase. Included as part of the final ISAR delivery, the Verification Tracking Log shall identify hazard controls that are not verified as closed.

Title: Hazardous Procedures for Payload I&T and Pre-launch Processing	DID No.: 3-5
IMAR Paragraph: 3.3.6	CDRL No.:

Use:
- Documents instrument hazardous procedures and associated safeguards that the developer will use for integration and test activities and pre-launch activities that comply with the applicable safety requirements of the installation where the activities are performed.

Reference Documents:
- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- KNPR 8715.3, KSC Safety Practices Procedural Requirements (as applicable)
- GSFC 500-PG-8715.1.2 AETD Safety Manual, for GSFC I&T operations (as applicable)
- Launch Site Facility-specific Safety Requirements, as applicable (e.g., Astrotech)

Place/Time/Purpose of Delivery:
- Deliver Payload I&T Hazardous Instrument Procedures to the EHPD Program Office seven (7) days before first use for review.
- Deliver Launch Range Hazardous Instrument Procedures sixty-five (65) days prior to first use; EHPD Program Office approval is required within ten (10) days of delivery with subsequent Range Safety Approval.

Preparation Information:

1. The instrument developer shall document the hazardous procedures and associated safeguards that will be used for integration and test activities and pre-launch activities. The safeguards will comply with the applicable safety requirements for the installation where the activities will be performed.

Title: Reliability Program Plan	DID No.: 4-1
IMAR Paragraph: 4.1	CDRL No.:

Use:
- Planning and implementation of reliability activities.

Reference Documents:
- NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy
- NASA-STD-8729.1, Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program.
- NPR 8705.4 Risk Classification for NASA Payloads
- NPR 8705.5 PRA Procedures for NASA Programs and Projects

Place/Time/Purpose of Delivery:
- Deliver draft plan to the EHPD Program Office thirty (30) days prior to the Systems Requirements Review for information.
- Deliver Final plan to the EHPD Program Office within thirty (30) days following the Systems Requirements Review for review.
- Deliver activity reports related to implementation of the plan at milestone reviews beginning with the Systems Requirements Review for information.

Preparation Information:

1. The Reliability Program Plan shall include:
   a. A discussion of how the developer intends to implement and comply with Reliability program requirements.
   b. Charts and statements describing organizational responsibilities and functions conducting each task to be performed as part of the Program.
   c. A summary (matrix or other brief form) that indicates for each requirement, the organization responsible for implementing and generating the necessary documents.
   d. Identify the approval, oversight, or review authority for each task.
   e. Narrative descriptions, time or milestone schedules, and supporting documents describing the execution and management plan for each task.
   f. Documentation, methods, procedures, and reporting specific to each task in the plan.
   g. Reporting of test results, analysis, and trend data

Title: FMECA and Critical Items List (CIL)	**DID No.: 4-2**
IMAR Paragraph: 4.2	**CDRL No.:**

Use:

- Used to evaluate design against requirements, to identify single point failures and hazards, and to identify modes of failure within a system design for the early mitigation of potential catastrophic and critical failures.

Reference Documents

- NPR 8705.4 Risk Classification for NASA Payloads
- NASA-STD-8719.13, NASA Software Safety Standard (for Software Safety Criticality)

Place/Time/Purpose of Delivery:

- Deliver preliminary FMECA and CIL to the EHPD Program Office thirty (30) days before PDR for review.
- Deliver updated FMECA and CIL to the EHPD Program Office thirty (30) days prior to CDR and each subsequent milestone review up to Launch Readiness Review for approval.

Preparation Information:

1. The developer shall:
   a. Identify failure modes completely and characterize each with its failure causes resulting in severity categories 1, 1R, 1S, 2, 2R, 3, and 4, local/next-level and mission impacts, likelihood, and mitigation/detection of the failure (including but not limited to autonomous functions identified by name).
   b. Identify items with severity categories 1, 1R, 1S, or 2 failure modes as Critical Items.
   c. Identify and assess common cause failure modes and causes for category 1R and 2R items
   d. Address flight hardware and software that is designed, built, or provided by their organization or subcontractors, from project initiation through launch and mission operations.
   e. Address the ground system that interfaces with flight equipment to the extent necessary to assure the integrity and safety of flight items.
   f. Identify and address safety critical software, as defined in Section 5.
   g. Identify failure modes with severity categories 1 or 1S as Single Point Failures (SPFs).

2. The FMECA Report shall include the following:
   a. A discussion of the approach of the analysis, methodologies, assumptions, results, conclusions, and recommendations.
   b. Objectives
   c. Level of the analysis
   d. Ground rules
   e. Functional description
   f. Functional block diagrams
   g. Reliability block diagrams
   h. Equipment analyzed
   i. Data sources used
   j. Problems identified
   k. Corrective actions
   l. Work sheets identifying failure modes, causes, severity category, and effects at the item, next higher level, and mission level, detection methods, and mitigating provisions.
   m. Critical Items List (CIL) for severity categories 1, 1R, 1S, and 2, including item identification, cross-reference to FMEA/FMECA line items, and retention rationale. Appropriate retention rationale may include design features, historical performance, acceptance testing, manufacturing product assurance, corrective action recommendation/elimination of undesirable failure modes, proper design controls, and failure detection methods. The rationale also will contain data that describes operational constraints caused by occurrence of the failure and any measures that can be taken to restore the function on orbit where known.

Title: Fault Tree Analysis (FTA)	DID No.: 4-3
IMAR Paragraph: 4.3	CDRL No.:

Use:
- Used to assess mission failure from the top-level perspective. Undesired top-level states are identified, and combinations of lower-level events are considered to derive credible failure scenarios. The technique provides a methodical approach to identify events or environments that can adversely affect mission success and provides an informed basis for assessing system risks.

Reference Documents:
- NASA Fault Tree Handbook with Aerospace Applications (http://www.hq.nasa.gov/office/codeq/doctree/fthb.pdf)
- NPR 8705.4 Risk Classification for NASA Payloads
- NPR 8715.3 NASA General Safety Program Requirements

Place/Time/Purpose of Delivery:
- Deliver preliminary qualitative mission FTA report to EHPD Program Office ninety (90) days prior to PDR for review.
- Deliver final qualitative mission FTA report to EHPD Program Office ninety (90) days prior to CDR for approval.
- Deliver qualitative mission FTA report to EHPD Program Office within thirty (30) days of updates/changes for approval.

Preparation Information:
1. The mission FTA Report shall contain:
   a. Analysis ground rules including definitions of undesirable end states (includes hardware and software and their interactions/dependencies)
   b. References to documents and data used
   c. Fault tree diagrams
   d. Results and conclusions

Note 1: Separate FTA reports are not required for fault trees generated in support of pivotal event analysis in the PRA report.

Title: Parts Stress Analysis	DID No.: 4-4
IMAR Paragraph: 4.4	CDRL No.:

Use:
- Provides EEE parts stress analyses for verifying circuit design conformance to derating requirements; demonstrates that environmental operational stresses on parts comply with project derating requirements.

Reference Documents
- GSFC EEE-INST-002 Instruction for EEE Parts Selection, Screening, Qualification, and Derating http://nepp.nasa.gov/DocUploads/FFB52B88-36AE-4378-A05B2C084B5EE2CC/EEE-INST-002_add1.pdf
- NASA Parts Selection List http://nepp.nasa.gov/npsl/index.htm

Place/Time/Purpose of Delivery:
- Deliver Parts Stress Analysis Report to EHDP Program Office forty-five (45) days prior to CDR for review.
- Deliver revisions to Parts Stress Analysis Report to the EHPD Program Office within thirty (30) days of changes for review.

Preparation Information:
1. The Parts Stress Analysis Report shall contain:
   1. Analysis ground rules
   2. Reference documents and data used
   3. Results and conclusions including:
      - Design trade study results
      - Parts stress analysis results impacting design
      - Risk
   4. Analysis worksheets; the worksheets at a minimum shall include:
      - Part identification (traceable to circuit diagrams)
      - Assumed environmental (consider all expected environments)
      - Rated stress
      - Applied stress (consider all significant operating parameter stresses at the extremes of anticipated environments)
      - Ratio of applied-to-rated stress

Title: Limited-Life Items List	DID No.: 4-5
IMAR Paragraph: 4.5	CDRL No.:

Use:
- Tracks the selection and application of limited-life items and the predicted impact on mission operations.

Related Documents:
- None

Place/Time/Purpose of Delivery:
- Deliver Limited-Life Items List to the EHPD Program Office thirty (30) days prior to PDR for review.
- Deliver updates to the EHPD Program Office no later than thirty (30) days after identification for review.

Preparation Information:
1. For each life-limited item the list shall include:
   a. Expected life, required life, duty cycles, and rationale for selecting and using the item
   b. Analysis of predicted/expected versus required life of all potential limited life items which may include such items as structures, thermal control surfaces, solar arrays, electromechanical mechanisms, batteries, compressors, seals, bearings, valves, tape recorders, momentum wheels, gyros, actuators and scan devices.
   c. Environmental or application factors that may affect the items include such things as atomic oxygen, solar and trapped radiation, shelf-life, extreme temperatures, thermal cycling, mechanical wear/fatigue, and/or refurbishment/maintenance plans.
   d. Predicted impact on mission operations
   e. Risk and control recommendations

Title: Worst Case Analysis	DID No.: 4-6
IMAR Paragraph: 4.6	CDRL No.:

Use:
- Demonstrate design margins in electronic and electrical circuits, optics, and electromechanical and mechanical items.

Reference Documents:
- NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy.
- NASA-STD-8729.1, Planning, Developing and Managing an Effective R&M Program.
- NPR 8705.4, Risk Classification for NASA Payloads

Place/Time/Purpose of Delivery:
- Deliver Worst Case Analysis Report to EHPD Program Office thirty (30) days prior to CDR for review.
- Deliver revisions to Worst Case Analysis Report to EHPD Program Office within thirty (30) days of identification for review.

Preparation Information:
1. The Worst Case Analysis Report shall include the following:
   a. Address worst case conditions performed on each component.
   b. Discuss how each analysis includes the mission life.
   c. Discuss consideration of critical parameters at maximum and minimum limits.
   d. The effect of environmental stresses on the operational parameters being evaluated.

Title: Software Assurance Plan	**DID No.: 5-1**
IMAR Paragraph: 5.2	**CDRL No.:**

Use:

- Documents the developers' Software Assurance roles and responsibilities and surveillance activities to be performed as outlined in the NASA Software Assurance Standard.

Reference Documents:

- NASA-STD-8739.8, NASA Standard for Software Assurance
- NASA-STD-8719.13, NASA Software Safety Standard
- IEEE Standard 730-2002, Software Quality Assurance Plans
- NPR 7150.2 NASA Software Engineering Requirements

Place/Time/Purpose of Delivery:

- Deliver preliminary plan to the EHPD Program Office thirty (30) days prior to SRR for information.
- Deliver final plan to the EHPD Program Office forty-five (15) days prior to PDR for review.
- Deliver updates to the EHPD Program Office thirty (30) days prior to implementation for review.

Preparation Information:

1. The Software Assurance Plan (SAP) shall address the following:
    a. Purpose
    b. Scope
    c. Reference documents and definitions
    d. Assurance Organization and Management – including roles and responsibilities
    e. Assurance Activities by discipline
        - Software Quality (process and product)
        - Software Safety
        - Software Reliability
        - Software Verification and Validation
        - Independent Verification and Validation (if applicable)
    f. Assurance Activities for Complex Programmable Logic Devices
    g. Assurance tools, techniques, and methodologies
    h. Software Assurance Program Metrics
    i. Problem Reporting and Corrective Action
    j. Assurance records, collection, maintenance, and retention
    k. Training
    l. Risk Management
    m. Requirements Compliance Matrix (NASA-STD-8739.8 Appendix C)
    n. SAP Change procedure and history

Title: Printed Circuit Board (PCB) Coupon / Evaluation Reports	**DID No.: 6-1**
IMAR Paragraph: 6.5	**CDRL No.:**

Use:

- PCB test coupons are evaluated to validate that PCBs are suitable for use in space flight and mission critical ground applications. The laboratory reports provide the information needed to decide to use or reject the PCBs.

Reference Documents:

- IPC-6011 Generic Performance Specifications for Printed Boards (Class 3 Requirements)
- GSFC Form 23-16 GSFC PCB Coupon Submittal Form
- IPC-6012 (Class 3) Qualification and Performance Specification for Rigid Printed Boards.
- IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 Requirements)
- IPC-6018 (Space Addendum) Qualification and Performance Specification for High Frequency (Microwave) Printed Boards
- MIL-PRF-50884F, Performance Specification: Printed Wiring Board, Flexible Rigid-Flex, General Specification For
- MIL-PRF-55110H, Performance Specification: Printed Wiring Board, Rigid, General Specification For
- IPC-2221 Generic Stand on Printed Board Design
- ECSS-Q-ST-70-60C Qualification and Procurement of Printed Circuit Boards

Place/Time/Purpose of Delivery:

- The developer shall notify and deliver test coupons and supporting manufacturing information traceable to the flight boards to GSFC (submit via GSFC Form 23-16) or a GSFC approved laboratory as soon as practicable for approval.
- If a GSFC-approved laboratory is used for coupon evaluation, the developer shall deliver the laboratory results to EHPD Program CSO upon receipt for approval.

Notes:

1. Coupon specimens do not need to be submitted for single-sided PWBs or double-sided PWBs that don't contain any plated through holes or vias.
2. If a GSFC-approved laboratory is used for coupon evaluation, the developer shall store remnants and coupon microsections.
3. The developer shall not populate printed wiring boards until all approvals to proceed are granted.

Preparation Information:

1. Notify GSFC regarding shipment of PWB test coupons to either GSFC or GSFC-approved laboratory.
2. The developer shall provide:
   a. Coupon specimens with sufficient A, B, A/B coupons, or their equivalent per IPC-2221 for both unstressed and thermally stressed micro-sectioned coupon evaluation per section 3.6 of the applicable specification.
   b. If the represented PWB design contains a blind, buried, or micro via, the developer shall provide additional B or A/B coupons for each contained feature for thermally stressed evaluation.
   c. M coupon or equivalent if a specialty plating is used (e.g., ENIG, ENIPIG).
   d. Supporting manufacturing documentation that is traceable to the flight boards and that includes: the specification to which the board was produced; board drawing or drawing notes; class of printed board; type of printed board; indication if there are blind, buried, or micro vias present; laminate information; part number; serial number and Vendor ID (CAGE Code for a US manufacturer).

Notes:

1. Custom coupons or a qualification board may be submitted instead of the coupons required above. The test vehicle shall comply with IPC-2221 and contain at a minimum two sets of three holes, one each in the X and Y dimensional planes, as well as a set of three holes to evaluate blind, buried, and micro via structures if contained in the represented panel. If ENIG or ENEPIG is a final finish, the test vehicle shall contain a pad with a minimum size of 0.060 in x 0.060 in for the plating measurement.

Title: Use of Water Soluble Flux	**DID No.: 6-2**
IMAR Paragraph: 6.6	**CDRL No.:**

Use:

- Documents the compliance of the developer's processes and procedures for the use of water soluble flux with GSFC requirements.

Reference Documents:

- GSFC-STD-8002 GSFC Standard Quality Assurance Requirements for the Use of Water Soluble Flux

Place/Time/Purpose of Delivery:

- Deliver the applicable qualification or delta qualification documentation and test vehicles to the EHPD Program Office thirty (30) days prior to first use for approval

Preparation Information:

1. The supplier shall provide documentation and test vehicles per the requirements of GSFC-STD-8002 GSFC Standard Quality Assurance Requirements for the Use of Water Soluble Flux for the appropriate Mission Risk Class.

Title: EEE Parts Control Plan	**DID No.: 7-1**
IMAR Paragraph: 7.1	**CDRL No.:**

Use:

- Development and implementation of an EEE parts control plan that addresses the system requirements for mission lifetime and reliability.

Reference Documents

- GSFC EEE-INST-002 Instructions for EEE Parts Selection, Screening, Qualification, and Derating
- S-311-M-70 Specification for Destructive Physical Analysis
- 500-PG-4520.2.1 Electrical, Electronic and Electromechanical (EEE) Counterfeit Parts Avoidance Plan (CPAP) or SAE AS5553 Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition

Place/Time/Purpose of Delivery:

- Deliver the PCP to the EHPD Program Office thirty (30) days after contract award for approval

Preparation Information:

The PCP shall address the following:

1. Parts control program organization and management
2. Parts Control Board Operations
    a. Organization and membership
    b. Meeting schedule and notices
    c. Distribution of meeting agenda, notes, and minutes
    d. Review and approval responsibilities and processes
    e. Documentation and records
3. Parts Selection
    a. EEE Parts selection per GSFC EEE-INST-002
    b. Radiation hardness assurance program, which shall address: total ionizing dose; displacement damage (total non-ionizing dose); destructive and non-destructive single-event effects; single-event effect rates; proton hardness/tolerance
    c. Parts application derating
    d. GIDEP Alerts and Problem Advisories
    e. Procedures regarding application specific integrated circuits, gate arrays, system-on-chip, and custom integrated circuits
    f. Sparing policies
4. Parts Procurement, Handling, and Storage
    a. Counterfeit parts control plan per AS5553 Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition
    b. Incoming inspection and test
    c. Supplier and manufacturer surveillance
    d. Alternate quality conformance inspection and small lot sampling
    e. Traceability and lot control
    f. Defective parts controls program
    g. Handling, preservation, and packing
    h. Contamination control
    i. Shelf life control plan
5. Parts Testing and Evaluation
    a. Failure analysis
    b. Destructive physical analysis per S-311-M-70 Specification for Destructive Physical Analysis

Title: Master EEE Parts List	**DID No.: 7-2**
IMAR Paragraph: 7.5	**CDRL No.:**

Use:

- Tracking EEE parts from preliminary design through final flight hardware fabrication

Reference Documents:

Place/Time/Purpose of Delivery:

- Obtain Parts Control Board approval for each of the phases listed below
- Submit EEE parts additions/changes to the to the Parts Control Board for approval (prior to use)

Preparation Information:

1. The developer shall maintain the Master EEE Parts List in a searchable electronic format – with access granted to EHPD Program Parts Engineer.
2. The developer shall generate and maintain a Master Parts List with the minimum information listed below for the various stages throughout the project's lifecycle:

Phase A/B: Initial Parts Identification List shall contain the following

a. Flight component identity to the circuit board level
b. Complete part number (i.e. Defense Supply Center Columbus part number, Specification Control Drawing part number, with all suffixes)
c. Manufacturer's Generic Part number
d. Manufacturer (not distributor)
e. Part Description (please include meaningful detail)
f. Federal Supply Class
g. Procurement Specification
h. Comments and clarifications, as appropriate
i. Estimated quantity required (for procurement forecasting)

Phase B: Parts that are approved for flight use shall be updated to include the following information

a. Procurement Part Number
b. Flight Part Number (if different from the procurement part number)
c. Package Style/Designation
d. Single Event Latch-up (SEL) Hardness/Tolerance and Data Source
e. Single Event Upset (SEU) Hardness/Tolerance and Data Source
f. Total Ionizing Dose (TID) Hardness/Tolerance and Data Source
g. Displacement Damage Hardness/Tolerance (total non-ionizing dose) and Data Source
h. Proton Hardness/Tolerance and Data Source
i. PCB Status
j. PCB Approval Date
k. PCB Required Testing/Evaluations

Phase C: Once a design is approved for build the parts list shall be updated to reflect the as designed configuration

o Assembly Name/Number
a. Next Level of Assembly
b. Need Quantity
c. Reference Designator(s)
d. Item number (if applicable)

Phase C/D: Once flight hardware fabrication has completed the list shall be updated to reflect the as built configuration

a. Assembly serial number
b. Item revision
c. Next Level of Assembly serial number
d. Lot/Date/Batch/Heat/Manufacturing Code, as applicable
e. Manufacturer's Cage Code (specific plant location when relevant)
f. Distributor/supplier, if applicable
g. Part number
h. Part serial number (if applicable)

Title: Materials and Processes Selection, Control, & Implementation Plan	**DID No.: 8-1**
IMAR Paragraph: 8.1	**CDRL No.:**

Use:

- Defines the implementation of NASA-STD-6016A with prescribed changes as described in the Preparation Information.

Reference Documents:

- NASA GSFC/JSC Materials and Processes Inter-center Agreement (Dated 1992) – ISS Payloads Only
- NASA-STD-6016A Standard Materials and Processes Requirement for Spacecraft
- NASA-STD-6008 NASA Fastener Procurement, Receiving Inspection, and Storage Practices for Spaceflight Hardware
- 541-PG-8072.1.2 Goddard Space Flight Center Fastener Integrity Requirements

Place/Time/Purpose of Delivery:

- Deliver to the EHPD Program Office sixty (60) days after contract award for approval.

Preparation Information:

The plan shall address each paragraph in Section 4 of NASA-STD-6016A, with the changes prescribed below, and describe the method of implementation and degree of conformance for each applicable requirement. If tailoring of the requirements is planned or necessary, alternate approaches to NASA-STD-6016A may be submitted in the plan, which meet or exceed the stated requirements. This tailoring approach will allow for the approval of alternate requirements.

The plan shall address the following:

1. Conformance to the requirements of NASA-STD-6016A with the changes prescribed below and a description of the method of implementation.
2. Organizational authority and responsibility for review and approval of Materials and Processes (M&P) specified prior to release of engineering documentation.
3. Identification and documentation of Materials and Processes.
4. Procedures and data documentation for proposed test programs to support materials screening and verification testing.
5. Materials Usage Agreement (MUA) procedures for a material or process that does not meet the requirements of NASA-STD-6016A or a government-approved developer standard.
6. Determination of material design properties, including statistical approaches to be employed.
7. Identification of process specifications used to implement requirements in NASA-STD-6016A.
8. In paragraph 4.1.5, the developer may use GFSC forms or the developer's equivalent forms in lieu of the MAPTIS format with approval from the GSFC MPE.
9. The developer may use the GSFC outgassing database (URL http://outgassing.nasa.gov) in addition to MAPTIS (URL http://maptis.nasa.gov).

Prescribed changes to NASA-STD-6016A:

a. The developer shall meet the applicable launch site requirements documented in paragraph 3.2 of the IMAR.
b. In addition to the requirements of paragraph 4.2.3.6, the developer shall provide the vacuum bake out schedule for materials that fail outgassing requirements with the MIUL or provide an MUA.
c. In paragraph 4.2.5.1, the developer shall develop and implement a Non-Destructive Evaluation Plan for fracture critical flight hardware only.
d. Instead of NASA-STD-6008, the developer may use 541-PG-8072.1.2 or a demonstrated successful developer practice for procuring, receiving, inspecting, and storing fasteners used for spaceflight hardware.
e. Paragraph 4.2.6.7 does not apply; the contamination control plan is addressed per DID 9-1.

Title: Materials Identification and Usage List (MIUL)	**DID No.: 8-2**
IMAR Paragraph: 8.2	**CDRL No.:**

Use:
- Establishes the Materials Identification and Usage List (MIUL).

Reference Documents:
- NASA-STD-6016A Standard Materials and Processes Requirement for Spacecraft

Place/Time/Purpose of Delivery:
- Deliver to the EHPD Program Office thirty (30) days prior to PDR for review
- Deliver to the EHPD Program Office thirty (30) days prior to CDR approval
- Deliver an As-Built Materials Identification and Usage List (MUIL) thirty (30) days prior to the developer's Pre-Ship Review (PSR) for approval
- Deliver updates to the EHPD Program Office within thirty (30) days of identification for review and approval

Preparation Information:
1. The MIUL documentation approach shall be defined in the Materials and Processes Selection, Control, and Implementation Plan (see DID 8-1).

Note 1: The developer shall include soldering flux and solvents used for cleaning flight electronic assemblies in the MIUL.

Title: Materials Usage Agreement (MUA)	**DID No.: 8-3**
IMAR Paragraph: 8.3	**CDRL No.:**

Use:
- Establishes the process for submitting a MUA for a material or process that does not meet the requirements of NASA-STD-6016A and does not affect reliability or safety when used per the Materials and Processes Selection, Control, and Implementation Plan.

Reference Documents:
- NASA-STD-6016A Standard Materials and Processes Requirement for Spacecraft
- MSFC-STD-3029 Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments

Place/Time/Purpose of Delivery:
- Deliver new MUAs to the EHPD Program Office thirty (30) days prior to CDR for approval.
- After the initial submission of MUAs, revised MUAs shall be delivered to the EHPD Program Office within thirty (30) days of their identification for approval.

Preparation Information:
1. The MUA system shall be defined in the Materials and Processes Selection, Control, and Implementation Plan as approved per paragraph 8.1 (see DID 8-1).
1. The MUA package shall include the technical information required to justify the application. MUAs for stress corrosion shall include a Stress Corrosion Cracking Evaluation Form per MSFC-STD-3029 (see NASA-STD-6016A) and a stress analysis.

Title: Life Test Plan for Lubricated Mechanisms	**DID No.: 8-4**
IMAR Paragraph: 8.4	**CDRL No.:**

Use:
- Defines the life test evaluation process, acceptance criteria, and reporting for lubricated mechanisms.

Reference Documents:
- NASA-STD-6016A Standard Materials and Processes Requirement for Spacecraft
- NASA-TM-86556 Lubrication Handbook for the Space Industry (Part A: Solid Lubricants, Part B: Liquid Lubricants)
- NASA/CR-2005-213424 Lubrication for Space Applications

Place/Time/Purpose of Delivery:
- Deliver plan to the EHPD Program Office thirty (30) days prior to PDR for approval.
- Deliver report to the EHPD Program Office thirty (30) days after acceptance test completion for review.

Preparation Information:
1. The Life Test Plan for Lubricated Mechanisms shall contain:
   a. Table of Contents
   b. Description of lubricated mechanisms, performance functions, summary of subsystem specification, and life requirements.
   c. Heritage of identical mechanisms and descriptions of identical applications.
   d. Design, drawings, and lubrication system used by the mechanism.
   e. Test plan, including vacuum, temperature, and vibration test environmental conditions.
   f. Criteria for a successful test.
2. Final report.

Note 1: In addition to the requirements of NASA-STD-6016A paragraph 4.2.3.4, the developer shall qualify all lubricated mechanisms either by life testing in accordance with a life test plan or heritage with an identical mechanism used in an identical application. The developer shall perform a lubricant loss analysis for all mechanisms to show that the design meets a 10X margin.

Title: Contamination Control and Foreign Object Debris Prevention Control Plan and Data	**DID No.: 9-1**
IMAR Paragraph: 9.1	**CDRL No.:**

Use:
- To establish contamination allowances, methods for controlling contamination, and record test results
- To provide guidance regarding the prevention and control of foreign object debris with respect to flight hardware

Reference Documents:
- GSFC-STD-7000 General Environmental Verification Standard (GEVS)
- GSFC-STD-1000 Rules for the Design, Development, Verification, and Operation of Flight Systems
- ASTM E595 Standard Test Methods for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
- ASTM E1548 Standard Practice for Preparation of Aerospace Contamination Control Plans
- Outgassing Data for Selecting Spacecraft Materials (URL: http://outgassing.nasa.gov/)
- NAS 412 Foreign Object Damage/Foreign Object Debris (FOD) Prevention
- NASA-STD-6016A Standard Materials and Processes Requirements for Spacecraft
- ISO 146441-1 Cleanrooms and Associated Controlled Environments – Classification of Air Cleanliness
- IEST-STD-CC1246E Product Cleanliness Levels and Contamination Control Program

Place/Time/Purpose of Delivery:
- Deliver to the EHPD Program Office thirty (30) days before PDR for GSFC review.
- Deliver to the EHPD Program Office thirty (30) days before the CDR for approval.
- Final thermal vacuum bakeout results delivered to the EHPD Program Office within thirty (30) of completion for review.
- Deliver preliminary cleaning procedures for all external surfaces thirty (30) days before PDR for review
- Deliver updated cleaning procedures for all external surfaces thirty (30) days before CDR for review
- Deliver contamination certificate of compliance with End Item Acceptance Data Package (DID 12-1).

Preparation Information:

1. The developer shall provide: material properties data; design features; test data; system tolerance of degraded performance; methods to prevent degradation. The items below shall be addressed in the plan:
   a. Provide CCP in accordance with ASTM E1548 or standard Vendor CCP that meets project defined contamination requirements/plan.
   b. Defines beginning-of-life and end-of-life requirements for all flight parts and flight assemblies.
   c. Defines methods and procedures to measure and maintain acceptable cleanliness levels during each phase of the program. This includes, but is not limited to protective covers, environmental constraints, purges, cleaning/monitoring procedures, etc.
   d. Provide material properties data; design features; test data; system tolerance of degraded performance; and methods to prevent degradation.
   e. Identifies facilities and environmental parameters (i.e. air quality, controls for atmospheric contaminants, temperature, and relative humidity) during fabrication, build, integration and test, storage, transportation, and launch.
   f. Includes a contamination-monitoring plan for thermal vacuum and bake-out tests. This includes: vacuum test data, QCM and cold-finger location and temperature, pressure data, system temperature profile and shroud temperature, and bake-out requirement (if applicable).
   g. Identifies design features of shipping containers. The design features should prevent the exceedance of contamination requirements for flight parts and flight assemblies during shipment and storage.
   h. List efforts/controls to prevent electrostatic damage.
   i. Indicates methods and frequency for monitoring and certifying cleanliness levels (and accretions) of flight hardware.
   j. Provides a contamination-training program, to address facility operations and personnel handling of flight hardware.
   k. Defines overall vent location and orientation policy, indicating how unintentional venting is avoided. (All applicable drawings should show vent locations that comply with venting analysis.)
   l. Identifies cleaning procedures, inspection methods, and types of bagging material to be used for parts and flight assemblies.
   m. Lists a schedule for cleaning and housekeeping activities, including a reference of procedures.
   n. Materials will meet requirements of < 1% total mass loss (TML) and < 0.1% collected volatile condensable material (CVCM) at 125C under vacuum for twenty-four hours when tested to ASTM E595 Standard Test Methods for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.
   o. Defines criteria for materials selection and acceptance relative to contamination control. The criteria includes outgassing as a function of temperature and time, the nature of outgassing chemistry, and areas, weight, location, view factors of critical surfaces.
   p. Provide a data package on test results for materials and as-built products.
   q. Address the preservation of product with respect to foreign object debris prevention per the requirements of NAS 412 Foreign Object Damage/Foreign Object Debris (FOD) Prevention and ASTM-E1548-09.

Title: End Item Acceptance Data Package	**DID No.: 12-1**
IMAR Paragraph: 12	**CDRL No.:**

Use:

- The End Item Acceptance Data Package documents the design, fabrication, assembly, test, and integration of the hardware and software being delivered and is included with the end item delivery.

Reference Documents:

Place/Time/Purpose of Delivery:

- **End Item Acceptance Data Package shall be maintained throughout the project's life cycle and available during inspections, acceptance test, and upon request.**
- Deliver the End Item Acceptance Data Package to the EHPD Program Office fourteen (14) days prior to end item PSR for approval.
- Deliver the End Item Acceptance Data Package to the EHPD Program Office seven (7) days prior to end item delivery (or launch) for approval.
- Deliver updates to End Item Acceptance Data Package to the EHDP Program Office for approval, as necessary

Preparation Information:

1. The developer prepares/maintains the End Item Acceptance Data Package as part of design development and implementation such that it is completed prior to delivery.
2. The following items shall be included:
   a. The deliverable item name, serial number, part number, and classification status (e.g., flight, non-flight, ground support, etc.).
   b. Appropriate approval signatures (e.g., developers' quality representative, product design lead, government Representative, etc.)
   c. List of shortages or open items at the time of acceptance with supporting rationale.
   d. As-built serialization (include initial install and all changes throughout life cycle)
   e. As-built vs. As-designed configuration (revisions throughout life cycle)
   f. In-process Work Orders (available for review at developers--not a deliverable)
   g. Final assembly and test Work Order
   h. Major MRB records
   i. Major Anomaly/problem failure reports with root cause and corrective action dispositions
   j. Acceptance testing procedures (as-run) and report(s), including environmental testing
   k. Trend data
   l. Master EEE parts list (Final - PCB approved)
   m. As-built materials identification and usage list (Final – MCB approved)
   n. Chronological history, including:
      - Events throughout life cycle (some sample items listed below)
        - Acceptance Test Procedure and power on/off applications
        - Thermal transitions, stabilizations, and soaks
        - Anomaly report number, time, investigation activity, and testing
        - EMI/EMC test elements
        - Vibration/Acoustic test with axes identification
        - Any unexplained events effecting the flight hardware or ground support equipment
        - Changes in software configuration
        - Changes in location of flight hardware
        - Test configuration changes, etc.
      - Total operating hours and failure-free hours of operation
      - Total number of mechanical cycles and remaining cycle life
   o. Limited life items, including data regarding the life used and remaining
   p. As-built final assembly drawings and parts list
   q. PWB coupon results (for PWB's related to final item only)
   r. Photographic documentation of hardware (pre and post-conformal coating for printed wiring assemblies, box or unit, subsystem, system, harness, structure, etc.)
   s. Waivers
   t. Certificate of Compliance, including contamination certificates of compliance, which is signed by management

APPENDIX B: Abbreviations and Acronyms

ANSI	American National Standards Institute	IMAR	Instrument Mission Assurance Requirements
ARB	Anomaly Review Board	MIUL	Material Identification and Usage List
ASNT	American Society of Non-Destructive Testing	MOTS	Modified-Off-The-Shelf
BTP	Build-to-Print	MRB	Material Review Board
CCB	Change Control Board	MUA	Material Usage Agreement
CDR	Critical Design Review	NASA	National Aeronautics and Space Administration
CDRL	Contact Data Requirements List	NDT	Nondestructive Testing
CIL	Critical Items List	NPR	NASA Procedural Requirement
COTS	Commercial-Off-The-Shelf	O&SHA	Operating and Support Hazard Analysis
CSO	Chief Safety and Mission Assurance Officer	ODAR	Orbital Debris Assessment Report
DID	Data Item Deliverable	OHA	Operations Hazard Analysis
EEE	Electrical, Electronic, and Electro-mechanical	OSHA	Occupational Safety and Health Administration
EHDP	Explorers and Heliophysics Projects Division	PCB	Parts Control Board
ELV	Expendable Launch Vehicle	PCB	Printed Circuit Board
EOMP	End of Mission Plan	PCP	Parts Control Plan
ESD	Electro-Static Discharge	PDF	Portable Document Format
ETR	Eastern Test Range	PDR	Preliminary Design Review
FAR	Federal Acquisition Requirements	PER	Pre-Environmental Review
FMEA	Failure Modes and Effects Analysis	PEMS	Plastic-Encapsulated Microcircuits
FMECA	Failure Modes and Effects Criticality Analysis	PHA	Preliminary Hazard Analysis
FTA	Fault Tree Analysis	PSR	Pre-Ship Review
GDC	Geospace Dynamics Constellation	PWB	Printed Wiring Board
GIDEP	Government-Industry Data Exchange Program	RPP	Reliability Program Plan
GMIPS	Government Mandatory Inspection Points	SAP	Software Assurance Plan
GOTS	Government Off-The-Shelf Software	SDP	Safety Data Package
GSFC	Goddard Space Flight Center	SOW	Statement of Work
IPC	International trade association for electronic assemblies	SRR	System Requirements Review
IRD	Interface Requirements Document	SSPP	System Safety Program Plan
ISAR	Instrument Safety Assessment Report	STD	Standard
ISO	International Standards Organization	SWL	Safe Working Load
I&T	Integration and Test	TBD	To Be Determined
IV&V	Independent Verification & Validation	TBR	To Be Revised
KSC	Kennedy Space Center	VTL	Verification Tracking Log
LDE	Lifting Devices and Equipment	WCA	Worst-case Analysis
MAIP	Mission Assurance Implementation Plan	WTR	Western Test Range

APPENDIX C: Document List

Note: Document Revisions per Contract Statement of Work

Document Number	Title
	Joseph G. Wohl, "Maintainability Prediction Revisited: Diagnostic Behavior, System Complexity, and Repair Time", IEEE Transactions On Systems, Man, And Cybernetics, Vol. SMC-12, No. 3, May/June 1982 pp. 241 – 250
	NASA Fault Tree Handbook with Aerospace Applications (http://www.hq.nasa.gov/office/codeq/doctree/fthb.pdf)
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment [Excluding Electrically Initiated Explosive Devices]
ANSI/NCSL Z540.1	Calibration Laboratories & Measuring & Test Equipment - General Requirements
ANSI/NCSL Z540.3	Requirements for the Calibration of Measuring and Test Equipment
ASTM E595	Standard Test Methods for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
ASTM E1548	Standard Practice for Preparation of Aerospace Contamination Control Plans
Chinese standard GJB/z 299B	Reliability Prediction Model for Electronic Equipment
ECSS-Q-ST-70-60C	Qualification and Procurement of Printed Circuit Boards
Federal Acquisition Regulations	Parts 46.103, 46.104, 46.202-2, 46.4, 46.5, and 52.246
GPR 8730.5	Safety and Mission Assurance Acceptance of Inherited and Build to Print Products
GSFC 500-PG-4520.2.1	Electrical, Electronic, and Electromechanical (EEE) Counterfeit Parts Avoidance Plan
GSFC 500-PG-8715.1.2	AETD Safety Manual, I&T Operations (for Operations at GSFC)
GSFC 541-PG-8072.1.2	Goddard Space Flight Center Fastener Integrity Requirements
GSFC EEE-INST-002	Instruction for EEE Parts Selection, Screening, Qualification, and De-rating
GSFC FORM 23-16	GSFC PCB Coupon Submittal Form
GSFC-STD-1000	Rules for the Design, Development, Verification, and Operation of Flight Systems
GSFC-STD-6001	Ceramic Column Grid Array Design and Manufacturing Rules for Flight Hardware
GSFC-STD-7000	General Environmental Verification Standard
GSFC-STD-8002	GSFC Standard Quality Assurance Requirements for Use of Water Soluble Flux
HRD5	Handbook for Reliability Data for Electronic Components used in Telecommunications Systems, Developed by British Telecommunications
IEEE Standard 730-2002	Software Quality Assurance Plans
IEEE Std 1413-1998	IEEE Standard Methodology for Reliability Prediction and Assessment for Electronic Systems and Equipment
IEC TR 62380	Model is based on the Reliability Data Handbook - Universal Model for Reliability Prediction of Electronic Components, PCBs, and Equipment
IEST-STD-CC1246E	Product Cleanliness Levels and Contamination Control Program
IPC-2221	Generic Standard on Printed Board Design
IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards
IPC-2223	Sectional Design Standard for Flexible Printed Boards
IPC-2225	Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
IPC-6011	Generic Performance Specification for Printed Boards
IPC-6012 (Class 3)	Qualification and Performance Specification for Rigid Printed Boards
IPC-6013	Qualification and Performance Specification for Flexible Printed Boards
IPC-6015	Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures
IPC-6018_S	Microwave End Product Board Inspection and Test

Document Number	Title
IPC-J-STD-001-S	Joint Industry Standard, Space Applications Electronic Hardware Addendum
ISO 146441-1	Cleanrooms and Associated Controlled Environments – Classification of Air Cleanliness
ISO 17025	General requirements for the competence of testing and calibration laboratories
ISO 9001	Quality Management System
J-STD-001_S	Joint Industry Standard, Space Applications Electronic Hardware Addendum (except Chapter 10 of IPC-J-STD-001)
KNPR 8715.3	KSC Safety Practices Procedural Requirements (applicable at KSC property, KSC-controlled property, and offsite facility areas where KSC has operational responsibility)
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-472	Maintainability Prediction
MIL-PRF-50884F	Performance Specification: Printed Wiring Board, Flexible or Rigid-Flex, General
MIL-PRF-55110H	Performance Specification: Printed Wiring Board, Rigid, General Specification For
MIL-STD-756	Reliability Prediction
MSFC-STD-3029	Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments
NAS 412	Foreign Object Damage/Foreign Object Debris (FOD) Prevention
NASA/CR-2005-213424	Lubrication for Space Applications
NASA/SP-2009-569	Bayesian Inference for NASA Probabilistic Risk and Reliability Analysis
NASA-STD-6008	NASA Fastener Procurement, Receiving Inspection, and Storage Practices for Spaceflight Hardware
NASA-STD-6016A	Standard Materials and Processes Requirement for Spacecraft
NASA-STD-8715.7	Expendable Launch Vehicle Payload Safety Program
NASA-STD-8719.8	Expendable Launch Vehicle Payload Safety Review Process
NASA-STD-8719.9	Standard for Lifting Devices and Equipment
NASA-STD 8719.14	Process for Limiting Orbital Debris
NASA-STD 8719.24	(with Annex) NASA Expendable Launch Vehicle Payload Safety Requirements
NASA-STD-8719.13	NASA Software Safety Standard
NASA-STD-8729.1	Planning, Developing, and Managing and Effective R&M Program
NASA-STD-8739.1	Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses, and Wiring
NASA-STD-8739.5	Fiber Optic Terminations, Cable Assemblies, and Installation
NASA-STD-8739.6	Implementation Requirements for NASA Workmanship Standards
NASA-STD-8739.8	NASA Standard for Software Assurance
NASA-TM-86556	Lubrication Handbook for the Space Industry (Part A: Solid Lubricants, Part B: Liquid Lubricants)
NPD 8720.1	NASA Reliability and Maintainability (R&M) Program Policy
NPR 7120.5	NASA Space Flight Program and Project Management Requirements
NPR 7150.2	NASA Software Engineering Requirements
NPR 8705.4	Risk Classification for NASA Payloads
NPR 8705.5	Probabilistic Risk Assessment Technical Procedures for Safety and Mission Success for NASA Programs and Projects
NPR 8715.3	NASA General Safety Program Requirements
NPR 8715.7	Expendable Launch Vehicle Payload Safety Program
NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting
NSWC-07	The Handbook of Reliability Prediction Procedures for Mechanical Equipment, issued by the Naval Surface Warfare Center Carderock Division, July 31, 2007
RIAC-HDBK-217Plus	Handbook of 217Plus Reliability Prediction Models
S-311-M-70	Specification for Destructive Physical Analysis
SAE AS5553	Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition

Document Number	Title
SAE AS9100	Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing
SR-332 Issue 2	Reliability Prediction Procedure for Electronic Equipment, issued by Telcordia Technologies, September, 2006
SSP-50835	ISS Pressurized Volume Hardware Common Interface Requirements Document (Dragon)
SSP 57012	ISS FRAM Based Payload Common Launch Interface Requirements Document

APPENDIX D: Instrument Mission Assurance Compliance Matrix

Enter *Yes* or *No* regarding compliance with the requirements:

- A response of ***Yes*** indicates full compliance with the requirements. ***The Comment column shall be used to indicate how compliance will be achieved***, e.g., through a specified requirements document or equivalent procedure.
- A response of ***No*** indicates less than full compliance with the requirements and ***requires an entry in the Comment column to explain the deviation from full compliance***.

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
1 General			
1.1	System Safety and Mission Assurance Program		
1.2	Management		
1.3	Requirements Flow-down		
1.4	Suspension of Work Activities		
1.5	Contract Data Requirements List		
1.6	Supply Chain Quality		
1.7	Use of Inherited Products/Items		
1.8	Government Mandatory Inspection Points		
DID 1-1	Instrument Mission Assurance Implementation Plan / Compliance Matrix		
DID 1-2	Key Supplier List		
DID 1-3	Use of Inherited Products/Items		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
2 Quality Management System			
2.1	General		
2.2	Supplemental Quality Management System Requirements		
2.2.1	Control of Nonconforming Product		
2.2.2	Material Review Board		
2.3	Anomaly Reporting and Disposition		
2.4	Orbital Debris Assessment Report (ODAR) and End of Mission Plan (EOMP)		
DID 2-1	Reporting of MRB Actions		
DID 2-2	Anomaly Reporting		
3 System Safety			
3.1	General		
3.2	Mission Related Safety Requirements Documentation		
3.3	System Safety Deliverables		
3.3.1	System Safety Program Plan		
3.3.2	Safety Requirements Compliance Checklist		
3.3.3	Hazard Analyses		
3.3.3.1	Hazard Analysis		
3.3.3.2	Operations Hazard Analysis (OHA)		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
3.3.3.3	Manual Lifting Devices Safety Requirements		
3.3.3.4	Not Applicable		
3.3.4	Instrument Safety Assessment Report		
3.3.5	Verification Tracking Log		
3.3.6	Hazardous Procedures for Payload I&T and Pre-Launch Processing		
3.3.7	Safety Waivers		
3.3.8	NASA Expendable Launch Vehicle (EVL) Payload Safety Program Forms		
3.3.9	Mishap Reporting and Investigation		
DID 3-1	System Safety Program Plan		
DID 3-2	Safety Requirements Compliance Checklist		
DID 3-3	Operations Hazard Analysis		
DID 3-4	Instrument Safety Assessment Report		
DID 3-5	Hazardous Procedures for Payload I&T and Pre-Launch Processing		
4 Reliability			
4.1	Reliability Program Plan		
4.2	FMECA and Critical Items List (CIL)		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
4.3	Fault Tree Analysis		
4.4	Parts Stress Analysis		
4.5	Limited Life Items		
4.6	Worst-Case Analysis		
4.7	Not Applicable		
4.8	Redundant Systems		
4.9	Trend Analysis		
4.10	Not Applicable		
DID 4-1	Reliability Program Plan		
DID 4-2	FMECA and Critical Items List (CIL)		
DID 4-3	Fault Tree Analysis		
DID 4-4	Parts Stress Analysis		
DID 4-5	Limited Life Items List		
DID 4-6	Worst Case Analysis		
DID 4-7	Not Applicable		
DID 4-8	Not Applicable		
5 Software Assurance (Flight and Ground Segments)			
5.1	Applicable Software Definition		
5.2	Software Assurance Program		
5.3	Surveillance of Software Development, Maintenance, and Assurance Activities		
DID 5-1	Software Assurance Plan		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
6 Workmanship			
6.1	General		
6.2	Design and Process Qualification		
6.3	Electrostatic Discharge Control (ESD)		
6.4	Splices, Circuit Board Trace Cuts, and Jumper Wires		
6.5	Printed Wiring Board (PWB) Test Coupons		
6.6	Use of Water Soluble Flux		
6.7	Not Applicable		
DID 6-1	Printed Wiring Board Test Coupons		
DID 6-2	Use of Water Soluble Flux		
DID 6-3	Not Applicable		
7 EEE Parts			
7.1	General		
7.2	Nonstandard Parts		
7.3	Parts Control Board		
7.4	Re-use of EEE Parts		
7.5	Master EEE Parts List		
DID 7-1	EEE Parts Control Plan		
DID 7-2	Master EEE Parts List		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
8 Materials and Processes			
8.1	General		
8.2	Materials Identification and Usage List (MIUL)		
8.3	Materials Usage Agreement (MUA)		
8.4	Life Test Plan and Final Report for Lubricated Mechanisms		
DID 8-1	Materials & Processes Selection, Control, and Implementation Plan		
DID 8-2	Materials Identification and Usage List		
DID 8-3	Materials Usage Agreement (MUA)		
DID 8-4	Life Test Plan for Lubricated Mechanisms		
9 Contamination Control and Foreign Object Debris Control			
9.1	Contamination Control and Foreign Object Debris Prevention Control Plan		
DID 9-1	Contamination Control and Foreign Object Debris Prevention Control Plan and Data		
10 Metrology and Calibration			
10.1	Metrology and Calibration Program		
10.2	Use of Non-calibrated Instruments		

Paragraph or DID	Title	Comply Y / N	Document Number, Title, Revision and Comments
11 GIDEP Alerts and Problem Advisories			
11.1	Government-Industry Data Exchange Program (GIDEP)		
11.2	Alert Disposition		
11.3	GIDEP Reporting		
11.4	Review Reporting		
12 End Item Acceptance Data Package			
12	End Item Acceptance Data Package		
DID 12-1	End Item Acceptance Data Package		