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Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Flight Project

Spacecraft (SC)

Mission Assurance Requirements (MAR)

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National Aeronautics and Space Administration

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Geostationary Operational Environmental Satellite (GOES)
GOES-R Series
Spacecraft (SC)
Mission Assurance Requirements (MAR)

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SCMAR

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SCMAR1	1	# 1 Overall Requirements
SCMAR2	1.1	## 1.1 Description of Overall Requirements
SCMAR3	1.1.0-1	The Contractor **shall** plan and implement an organized System Safety and Mission Assurance program that encompasses: a) All flight hardware, whether designed/built by the Contractor or sub-tier contractors from project initiation through launch operations and mission operations. b) Ground support equipment that interfaces to flight hardware to assure the integrity and safety of flight items. c) All software critical for mission success.
SCMAR4	1.1.0-2	Any deviations/waivers from this MAR **shall** be submitted to the GOES-R Project for approval. These deviations/waivers will be controlled and maintained by the GOES-R Project Office.
SCMAR5	1.1.0-3	Contractor personnel responsible for assurance activities **shall** have direct access to Contractor management, independent of project management, with the functional freedom and authority to interact with all other elements of the project.
SCMAR6	1.1.0-4	Contractor **shall** ensure that appropriate review processes are in place at their level to certify the safety and operational readiness of flight hardware/software, mission-critical support equipment, hazardous facilities/operations, and high-energy ground-based systems.
SCMAR7	1.1.0-5	Not withstanding any other requirements Contractor **shall** direct the suspension of any operation that presents an immediate and unacceptable danger to personnel, property, or mission operations.
SCMAR8	1.1.0-6	The Contractor's Mission Assurance Implementation Plan **shall** be provided in accordance with the CDRL.
SCMAR515	1.1.0-7	The Contractor **shall** document by photographic means all assembly operations from the PCB level and above.
SCMAR516	1.1.0-8	The contractor **shall** document by photographic means all test configurations.
SCMAR517	1.1.0-9	The contractor **shall** document by photographic means all items submitted for MRB and/or FRB.
SCMAR9	1.2	## 1.2 Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware
SCMAR10	1.2.0-1	When hardware that was designed, fabricated, or flown on a previous project is considered to have demonstrated compliance with some or all of the requirements of this document such that certain tasks need not be repeated, the Contractor **shall** demonstrate how the hardware complies with requirements.
SCMAR11	1.2.0-2	The Contractor **shall** submit the substantiating documentation in accordance with the Contract Data Requirements List (CDRL).
SCMAR12	1.3	## 1.3 Surveillance of the Contractor
SCMAR13	1.3.0-1	The work activities, operations, and documentation performed by the Contractor and sub-tier contractors or suppliers **shall** be subject to evaluation, review, audit/assessments, and inspection by government-designated representatives from GSFC, the Government Inspection Agency (GIA), or an Independent Assurance Contractor (IAC). GSFC will delegate in-plant responsibilities and authority to those agencies via a letter of delegation and task assignment.

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SCMAR14	1.3.0-2	The contractor and/or suppliers **shall** grant access for NASA and/or NASA representatives to conduct assessments/surveys upon notice.
SCMAR15	1.3.0-3	Resources **shall** be provided to assist with the assessments/surveys with minimal disruption to work activities.
SCMAR16	1.3.0-4	The contractor, upon request, **shall** provide government assurance representatives with documents, records, and equipment required to perform their mission assurance and safety activities.
SCMAR17	1.3.0-5	The contractor **shall** also provide the government assurance representative(s) with an acceptable work area within contractor facilities.
SCMAR18	1.4	**1.4 Applicable and Reference Documents**
SCMAR19	1.4.0-1	The effective version of all documents referenced in Section 12 is the versions noted. They form a part of this specification to the extent specified in Section 12. In the event of conflict between documents specified in Section 12 and other detailed content of the MAR, the MAR **shall** be the superseding requirement.
SCMAR20	1.4.0-2	Deliverables referenced in this document **shall** be delivered in accordance with the CDRL.
SCMAR21	1.5	**1.5 Verification Matrix**
SCMAR22	1.5.0-1	The contractor **shall** develop and maintain, under configuration control, a Requirements Compliance Verification Matrix.
SCMAR23	1.5.0-2	The matrix **shall** document each requirement and the method used to verify compliance.
SCMAR24	1.5.0-3	The matrix **shall** be incorporated in the GOES-R Mission Assurance Plan.
SCMAR25	1.5.0-4	This matrix **shall** be part of the end item data package.

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SCMAR26	2	# 2 Quality Management System
SCMAR27	2.0-1	The Contractor **shall** have a Quality Management System (QMS) that is compliant with the minimum requirements of ISO 9001 Rev 2000, Quality Management Systems - Requirements.
SCMAR28	2.1	## 2.1 QA Management System Requirements Augmentation
SCMAR29	2.1.0-1	The following requirements augment identified portions of the ISO requirements.
SCMAR30	2.1.1	## 2.1.1 Nonconformance Reporting
SCMAR31	2.1.1.0-1	The Contractor **shall** have a system for identifying and reporting all hardware and software nonconformances through a closed loop reporting system; ensuring that positive corrective action is implemented to preclude recurrence and verification of the adequacy of implemented corrective action.
SCMAR32	2.1.1.0-2	Reporting of all non-conformances **shall** begin with the first power application or the first operation of a mechanical item.
SCMAR33	2.1.1.0-3	All non-conformances **shall** be reported to the GPO within 24 hrs of occurrence.
SCMAR34	2.1.1.0-4	Non-conformance reporting **shall** continue through on orbit checkout.
SCMAR35	2.1.1.1	### 2.1.1.1 Material Review Board (MRB)
SCMAR36	2.1.1.1.0-1	The material review process **shall** be initiated with the identification and documentation of a nonconformance.
SCMAR37	2.1.1.1.0-2	MRB dispositions **shall** include: scrap, rework, return to supplier, using a standard repair process previously approved by the MRB and /or government Quality Assurance (QA) organization, used as is upon concurrence with the government Quality Assurance (QA) organization or request for major waiver.
SCMAR38	2.1.1.1.0-3	All repair procedures proposed for use **shall** have NASA approval prior to use.
SCMAR39	2.1.1.1.0-4	The Contractor **shall** establish a Material Review Board.
SCMAR40	2.1.1.1.0-5	The MRB **shall** contain a core team with other disciplines brought in as necessary.
SCMAR41	2.1.1.1.0-6	The MRB **shall** be chaired by a Contractor Quality representative responsible for ensuring that the MRB actions are performed in compliance with this standard as implemented by Contractor procedures.
SCMAR42	2.1.1.1.0-7	The MRB **shall** consist of the appropriate functional and project representatives that are needed to ensure timely determination, implementation and close out of the recommended MRB disposition. A GOES-R Mission Assurance Lead or an appointed designee will participate as voting members in MRB activities. Completed MRBs will be approved by the NASA Mission Assurance Lead or designee.
SCMAR43	2.1.1.1.0-8	The MRB process **shall** investigate, in a timely manner, each nonconforming item in sufficient depth to determine proper disposition.
SCMAR44	2.1.1.1.0-9	For each reported nonconformance, there **shall** be an investigation and engineering analysis sufficient to determine cause and corrective actions for the nonconformance.
SCMAR45	2.1.1.1.0-10	Written authorization **shall** be documented to disposition the nonconforming product.
SCMAR46	2.1.1.1.0-11	A process for recurrence control of problems **shall** be implemented through a closed-loop corrective and preventive action system.

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SCMAR47	2.1.1.1.0-12	Written authorization **shall** be provided to disposition the nonconformances.
SCMAR48	2.1.1.1.0-13	The MRB close-out **shall** included documented objective evidence of the verification of effective corrective action.
SCMAR49	2.1.1.2	**2.1.1.2 Failure Review Board (FRB)**
SCMAR50	2.1.1.2.0-1	All nonconformances are dispositioned as test failures **shall** be referred to the Failure Review Board for disposition.
SCMAR51	2.1.1.2.0-2	FRB dispositions **shall** include: those items that fail; show performance at limits of tolerance and out of family type operation. Scrap, rework, return to supplier, repair by standard or non-standard repair procedures, use-as-is, and request for waiver is also FRB type dispositions.
SCMAR52	2.1.1.2.0-3	The Contractor **shall** establish a Failure Review Board.
SCMAR53	2.1.1.2.0-4	The FRB **shall** contain a core team with other disciplines brought in as necessary.
SCMAR54	2.1.1.2.0-5	The FRB **shall** be chaired by a Contractor Quality representative responsible for ensuring that the FRB actions are performed in compliance with this standard as implemented by Contractor procedures.
SCMAR55	2.1.1.2.0-6	The FRB **shall** consist of the appropriate functional and project representatives that are needed to ensure timely determination, implementation and close out of the recommended FRB disposition. A GOES-R Mission Assurance Lead designee, and other GOES-R Project members as required, will participate as voting members in FRB activities. Completed FRB's will be approved by the GSFC Mission Assurance Lead or designee.
SCMAR56	2.1.1.2.0-7	The FRB process **shall** investigate, in a timely manner, each nonconforming item in sufficient depth to determine proper disposition.
SCMAR57	2.1.1.2.0-8	For each reported nonconformance, there **shall** be an investigation and engineering analysis sufficient to determine cause and corrective actions for the nonconformance.
SCMAR58	2.1.1.2.0-9	Written authorization **shall** be documented to disposition the nonconforming product.
SCMAR59	2.1.1.2.0-10	A process for recurrence control of problems **shall** be implemented through a closed-loop corrective and preventive action system.
SCMAR60	2.1.1.2.0-11	Written authorization **shall** be provided to disposition the nonconformances.
SCMAR61	2.1.1.2.0-12	The FRB close-out **shall** included documented objective evidence of the verification of effective corrective action.
SCMAR62	2.1.2	**2.1.2 Calibration**
SCMAR63	2.1.2.0-1	Testing and Calibration Laboratories **shall** be compliant with the requirements of ISO/IEC-17025 General Requirements for the Competence of Testing and Calibration Laboratories.
SCMAR64	2.1.3	**2.1.3 Lessons Learned**
SCMAR65	2.1.3.0-1	The Contractor **shall** collect lessons learned and submit them to the GOES-R Project for input into a Government Lessons Learned Database.
SCMAR66	2.1.4	**2.1.4 Flow-Down**
SCMAR67	2.1.4.0-1	The Contractor's QA program **shall** ensure the flow-down of technical and product assurance requirements to all suppliers.

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SCMAR68	2.1.4.0-2	The Contractor's QA program **shall** document and implement a process to verify compliance.
SCMAR69	2.1.4.0-3	Specifically, the Contractor's Contract Review and Purchasing processes **shall** establish the process for documenting, communicating, and reviewing requirements with sub-tier suppliers to ensure requirements are met.

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SCMAR70	3	**3 System Safety**
SCMAR71	3.1	**3.1 *System Safety Requirements***
SCMAR72	3.1.0-1	The Contractor **shall** plan and implement a system safety program to include their facility, the spacecraft integrator's facility and the launch facilities.
SCMAR73	3.1.0-2	The System Safety program **shall** provide for early identification and control of hazards during design, fabrication, test, transportation, and ground activities.
SCMAR74	3.1.0-3	The Safety program **shall** satisfy the applicable guidelines, constraints, and requirements stated in Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements and NPR 8715.3 NASA Safety Manual.
SCMAR75	3.1.0-4	If a system failure may lead to a catastrophic hazard, the system **shall** have three inhibits (dual fault tolerant). A Catastrophic hazard is defined as a condition that may cause death or permanently disabling injury, major system or facility destruction on the ground, or vehicle during the mission.
SCMAR76	3.1.0-5	If a system failure may lead to a critical hazard, the system **shall** have two inhibits (single fault tolerant). A Critical hazard is defined as a condition that may cause severe injury or occupational illness, or major property damage to facilities, systems, or flight hardware
SCMAR77	3.1.0-6	Hazards which cannot be controlled by failure tolerance (e.g., structures, pressure vessels, etc.) are called "Design for Minimum Risk" areas of design and have separate, detailed safety requirements that they must meet. Hazard controls related to these areas are extremely critical and warrant careful attention to the details of verification of compliance on the part of the Contractor. Safety Requirements documents for GOES-R: AFSPCMAN 91-710 which defines the Range Safety Program responsibilities and authorities and which delineates policies, processes, and approvals for all activities from the design concept through test, check-out, assembly, and the launch of launch vehicles and payloads to orbital insertion or impact from or onto the Eastern Range (ER) or the Western Range (WR). It also establishes minimum design, test, inspection, and data requirements for hazardous and safety critical launch vehicles, payloads, and ground support equipment, systems, and materials for ER/WR users.
SCMAR78	3.2	**3.2 *System Safety Deliverables***
SCMAR79	3.2.1	**3.2.1 System Safety Program Plan**
SCMAR80	3.2.1.0-1	The System Safety Program Plan (SSPP) **shall** describe the system safety implementation process which includes analysis, reduction, and/or elimination of hazards.
SCMAR81	3.2.1.0-2	The SSPP **shall** define the required safety documentation, applicable documents, associated schedules for completion, roles and responsibilities on the project, methodologies for the conduct of any required safety analyses, reviews, and safety data package as defined by NPR 8715.3 NASA Safety Manual.
SCMAR82	3.2.1.0-3	The Contractor **shall** deliver the SSPP in accordance with the CDRL.
SCMAR83	3.2.2	**3.2.2 Pre-Mishap Plan**
SCMAR84	3.2.2.0-1	The contractor **shall** provide an initial Pre-Mishap Plan prior to initiating any project operations with potential for personnel injury or hardware damage.
SCMAR85	3.2.2.0-2	The plan **shall** describe the procedures to comply with NPR 8621.1 notification, reporting, investigating, and recording requirements.

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SCMAR86	3.2.2.0-3	The Contractor **shall** deliver the Pre-Mishap Plan in accordance with the CDRL.
SCMAR87	3.2.3	**3.2.3 Safety Requirements Compliance Checklist**
SCMAR88	3.2.3.0-1	The Contractor **shall** demonstrate that the payload is in compliance with all safety requirements and any non-compliant areas have been identified.
SCMAR89	3.2.3.0-2	The Contractor **shall** document this in a Compliance Checklist.
SCMAR90	3.2.3.0-3	The Contractor **shall** deliver the Safety Requirements Compliance Checklist in accordance with the CDRL.
SCMAR91	3.2.4	**3.2.4 Hazard Analyses**
SCMAR92	3.2.4.0-1	The Contractor **shall** document the results of all Hazard Analyses in the Safety Data Package.
SCMAR93	3.2.4.1	**3.2.4.1 Preliminary Hazard Analysis**
SCMAR94	3.2.4.1.0-1	The Contractor **shall** perform and document a preliminary hazard analysis (PHA) in accordance with AFSPCMAN 91-710 to obtain an initial risk assessment of the spacecraft system.
SCMAR95	3.2.4.1.0-2	Based on the best available data, including mishap data from similar systems and other lessons learned, hazards associated with the proposed spacecraft design **shall** be evaluated for hazard severity, hazard probability, and operational constraints.
SCMAR96	3.2.4.1.0-3	Spacecraft and Instrument hazard reports **shall** be included in the Safety Data Package.
SCMAR97	3.2.4.1.0-4	The Contractor **shall** deliver the PHA in accordance with the CDRL.
SCMAR98	3.2.4.2	**3.2.4.2 Operations Hazard Analysis**
SCMAR99	3.2.4.2.0-1	An Operations Hazard Analysis (OHA) **shall** be performed to identify the hazards to payload or personnel when a facility is being used or an activity is being performed.
SCMAR100	3.2.4.2.0-2	The OHA **shall** document all controls and methods of verifications for each hazard listed. The OHA process considers the timing and sequence of tasks with respect to the equipment/hardware/software design, human engineering provisions, assembly, test, and operating procedures, and the facility environments for each specific operation being performed.
SCMAR101	3.2.4.2.0-3	The Operations Hazard Analysis **shall** be delivered in accordance with the CDRL.
SCMAR102	3.2.4.3	**3.2.4.3 Operating and Support Hazard Analysis**
SCMAR103	3.2.4.3.0-1	The Contractor **shall** perform and document an Operating and Support Hazard Analysis (O&SHA) to evaluate procedurally controlled activities for hazards or risks introduced into the system during pre-launch processing (i.e., launch site or processing facilities) and to evaluate adequacy of procedures used to eliminate, control, or abate identified hazards or risks.
SCMAR104	3.2.4.3.0-2	The Contractor **shall** document the results of the O&SHA in the Safety Data Package.
SCMAR105	3.2.4.4	**3.2.4.4 Software Safety Analysis**
SCMAR106	3.2.4.4.0-1	The Contractor **shall** identify hazards caused by software as a part of the nominal hazard analysis process, and their controls will be verified prior to acceptance.
SCMAR107	3.2.5	**3.2.5 Safety Data Package (SDP)**
SCMAR108	3.2.5.0-1	The spacecraft Contractor **shall** prepare and submit a Safety Data Package (SDP).

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SCMAR109	3.2.5.0-2	Early in the design phase and continuing throughout the development effort, the Contractor **shall** identify hazards associated with the flight system, ground support equipment, and their interfaces that affect personnel, launch vehicle hardware, or the spacecraft.
SCMAR110	3.2.5.0-3	The SAR's from instrument and subsystem Contractor **shall** be used as inputs for the development of the SDP.
SCMAR111	3.2.5.0-4	The Contractor **shall** deliver the SDP in accordance with the CDRL.
SCMAR112	3.2.6	**3.2.6 Verification Tracking Log (VTL)**
SCMAR113	3.2.6.0-1	The VTL **shall** provide documentation of a Hazard Control and Verification Tracking process or "closed-loop system" that assures safety compliance has been satisfied in accordance to AFSPCMAN 91-710, Range Safety User Requirements.
SCMAR114	3.2.6.0-2	The Contractor **shall** deliver the VTL in accordance with the CDRL.
SCMAR115	3.2.7	**3.2.7 Miscellaneous Submittal For Range Use**
SCMAR116	3.2.7.0-1	The Contractor **shall** submit a Materials List for Plastic Films, Foams, and Adhesive Tapes to ETR/KSC and a copy to GSFC 60 days prior to shipment of Payload. KSC evaluates materials for ESD, flammability, and compatibility with hypergols. Ref: TI-5212C_plastic_films_adhesive A Material Selection List for Plastic Films, Foams, and Adhesive Tapes is published in GP-1098, KSC Ground Operations Safety Plan, Volume I, Safety Requirements, and is updated quarterly. (http://rtreport.ksc.nasa.gov/techreports/95report/msf/ms10.html)
SCMAR117	3.2.7.0-2	The Contractor **shall** submit completed Radiation forms/analysis - KHB 1860.1 (KSC Ionizing Radiation Protection Program) and KHB 1860.2 (KSC Non-Ionizing Radiation Protection Program) to ETR/KSC and copies to GSFC 120 days prior to shipment of payload. The forms must be completed to provide information on the radiation source(s) and the source user(s) including ionizing and non-ionizing radiation from RF, light, laser, and radioactive sources.
SCMAR118	3.2.7.0-3	Process Waste Questionnaire (PWQ) (KSC/Eastern Range Only) - PWQ records all the hazardous materials that are brought to the range with the payload. Specific information on storage, containment, and spill control are required. (Ship- 60 days to KSC/ETR)
SCMAR119	3.2.7.0-4	Environmental Impact Statement (EIS) (KSC/Eastern Range Only) - An EIS is required to define the impact of an aborted/terminated launch. (Ship-60 days to KSC/ETR)
SCMAR120	3.2.8	**3.2.8 Ground Operations Procedures**
SCMAR121	3.2.8.0-1	Ground Operation Procedures **shall** document all ground operations to be used at GSFC facilities, other integration facilities, or the launch site.
SCMAR122	3.2.8.0-2	The Contractor **shall** insure that all launch site procedures comply with the launch site and NASA safety regulations. GSFC OSSMA will review and approve all hazardous procedures prior to submittal to the launch range.
SCMAR123	3.2.8.0-3	All Ground Operations procedures to be used at the launch site **shall** be submitted to the GOES-R Project Office at GSFC in accordance with the CDRL.
SCMAR124	3.2.9	**3.2.9 Safety Noncompliance/Waiver Requests**

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SCMAR125	3.2.9.0-1	When a specific safety requirement cannot be met the Contractor **shall** submit an associated safety noncompliance/waiver request which identifies the hazard and shows rationale for approval of the waiver, as defined by AFSPCMAN 91-710.
SCMAR126	3.2.9.0-2	Safety Noncompliance/Waiver Requests **shall** be delivered in accordance with the CDRL.
SCMAR127	3.3	**3.3 Support for Safety Working Group Meetings**
SCMAR128	3.3.0-1	Contractor safety personnel **shall** support Safety Working Group (SWG) meetings, Technical Interface Meetings (TIM), and technical reviews, as required.
SCMAR129	3.4	**3.4 Orbital Debris Assessment**
SCMAR130	3.4.0-1	An Orbital Debris Assessment (or the information required to produce the assessment) consistent with NPD 8710.3B, Policy for Limiting Orbital Debris Generation and NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris **shall** be provided.
SCMAR131	3.4.0-2	The contractor **shall** ensure the implementation of orbital debris mitigation measures for all mission hardware in Earth orbit in accordance with NPD 8710.3B, “NASA Policy for Limiting Orbital Debris Generation,” and NSS 1740.14.
SCMAR132	3.4.0-3	The Contractor **shall** deliver the ODA in accordance with the CDRL.
SCMAR133	3.5	**3.5 Mishap Reporting and Investigations**
SCMAR134	3.5.0-1	All mishaps and close calls that affect the GOES-R Program, including those occurring at sub tier suppliers, **shall** be reported within 24 hours of occurrence to GSFC.
SCMAR135	3.5.0-2	A follow-up report **shall** be documented in accordance with NPR 8621.1, NASA Procedures and Requirements for Mishap Reporting.
SCMAR136	3.5.0-3	Reports **shall** be delivered in accordance with the CDRL.
SCMAR137	3.6	**3.6 Handling**
SCMAR138	3.6.0-1	The Contractor **shall** insure that the requirements of NASA-STD-8719.9 are met during the handling of all instruments and spacecraft.

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SCMAR139	4	# 4 Reliability
SCMAR140	4.1	## 4.1 General
SCMAR141	4.1.0-1	The contractor **shall** prepare and deliver a Reliability Program Plan (RPP) in accordance with the CDRL, and implement a reliability and Probabilistic Risk Assessment (PRA) program throughout the life cycle that interacts effectively with other disciplines, including systems engineering, risk management, hardware design, software design, and product assurance to: a) Assure the specified reliability (probability of success) is achieved; b) Demonstrate that redundant functions, including alternative paths and work-a-rounds, are independent to the extent practicable; c) Demonstrate that the stress applied to parts meet applicable derating criteria; d) Identify single failure points, their effect on the attainment of mission objectives, and possible safety degradation; e) Identify limited-life items and ensure that special precautions are taken to conserve their useful life for on-orbit operations; and f) Perform trend analysis during fabrication and pre-launch I&T activities.
SCMAR142	4.1.0-2	The contractor **shall** provide technical support to the GOES-R Project for the NASA-chaired Reliability Working Group (RWG) meetings and technical reviews, as required. The RWG will meet as necessary, and as convened by NASA, to review reliability and PRA requirements and analyses, to assist in resolving reliability issues and concerns, and to discuss any situations that may arise with respect to the overall mission reliability.
SCMAR143	4.1.0-3	The contractor **shall** formally report on the progress of their reliability efforts through the project status reports and management meetings, and provide real-time progress reports to the GSFC GOES-R Reliability Engineer through informal communications such as teleconferences and e-mails.
SCMAR144	4.2	## 4.2 Probabilistic Risk Assessment
SCMAR146	4.2.0-1	The contractor **shall** present results of the PRA at major design reviews. Each presentation shall include design trade-study results and PRA results impact design or risk decisions.
SCMAR518	4.2.0-2	The contractor **shall** Conduct a full scope PRA per NPR 8705.5, *PRA Procedures for NASA Programs and Projects*, commensurate with a Class A mission as defined in NPR 8705.4, *Risk Classification for NASA Payloads.* to identify possible failure scenarios and assure the risks associated with these scenarios are acceptable to the mission.
SCMAR147	4.3	## 4.3 Reliability Analyses
SCMAR148	4.3.0-1	The contractor **shall** perform reliability analyses concurrently with other development life cycle activities to optimize system configurations and to identify and promptly correct potential reliability problems that could contribute to mission risk.
SCMAR149	4.3.1	### 4.3.1 Failure Mode and Effects Analysis and Critical Items List
SCMAR150	4.3.1.0-1	Failure Mode and Effect Analysis (FMEA) **shall** be performed, in accordance with the CDRL, early in the design phase and revised as the design evolves and matures.
SCMAR151	4.3.1.0-2	The contractor **shall**: a) Assess failure modes at a level sufficient to identify potential single point failure modes and failure modes that may propagate across interfaces (e.g., component interface, circuit

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SCMAR151 4.3.1.0-2

card function, transistor, Integrated Circuit level);

b) Address all mission phases (e.g., ground handling, launch, deployment, on-orbit storage, on-orbit operation);

c) Analyze failure modes resulting in Severity Categories 1, 1R, 1S, or 2 at a greater depth to identify the root failure causes;

d) Analyze redundancies to ensure that redundant paths are isolated or protected such that any single failure that causes the loss of a functional path will not affect the other functional path(s) or the capability to switch operation to that redundant path;

e) Use the FMEA results to evaluate the design relative to requirements;

f) Assign a severity category per the table below to each failure mode based on the most severe effect caused by that failure.

SEVERITY CATEGORIES TABLE

Category	Severity	Description
1	Catastrophic	Failure modes that could result in serious injury, loss of life (flight or ground personnel), or loss of launch vehicle.
1 R		Failures modes of identical or equivalent redundant hardware items that, if all failed could result in category 1 effects.
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 Severity Category 1 consequences.
2	Critical	Failure modes that could result in loss of one or more mission objectives as defined by the GOES-R Project Office per the Spacecraft Performance Specification requirements.
2R		Failure modes of identical or equivalent redundant hardware items 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.

g) Ensure that identified discrepancies are evaluated by management and design groups to determine the need for corrective actions;

h) Itemize failure modes assigned to severity categories 1, 1R, 1S, and 2 on a Critical Items List (CIL) within the FMEA report, along with the rationale for retaining the potential failure mode in the design;

i) Describe a plan, within the FMEA report, which identifies the specific controls and procedures introduced into design, manufacturing, and test phases to mitigate risks associated with each identified critical item; and

j) Present FMEA results and comment on how the analysis was used to influence design and risk management decisions, at design reviews starting with the PDR.

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SCMAR152	4.3.2	**4.3.2 Worst Case Analyses**
SCMAR153	4.3.2.0-1	The contractor **shall** perform Worst Case Analyses on all circuits with common cause failures (such as replicated circuitry) or where failures result in a FMEA severity category of 1 or 2.
SCMAR154	4.3.2.0-2	Worst Case Analyses **shall** be documented and delivered in accordance with the CDRL.
SCMAR155	4.3.2.0-3	The most sensitive design parameters, including those that are subject to variations that could degrade performance **shall** be subjected to the analysis.
SCMAR156	4.3.2.0-4	The analyses **shall** consider all parameters set at worst case limits and worst case environmental stresses for the parameter or operation being evaluated. Depending on mission parameters and parts selection methods, part parameter values for the analysis will typically include: manufacturing variability, variability due to temperature, aging effects of environment, and variability due to cumulative radiation.
SCMAR157	4.3.2.0-5	The analyses **shall** be updated in keeping with design changes. The results of any analyses will be presented at all design reviews starting with peer reviews.
SCMAR158	4.3.3	**4.3.3 Reliability Predictions**
SCMAR159	4.3.3.0-1	The contractor **shall** develop and deliver Reliability Block Diagrams and predictions in accordance with the CDRL to: a) Validate that the design meets the requirements of the specification; b) Evaluate alternative design concepts, redundancy and cross-strapping approaches; c) Identify elements of the design, which are the greatest detractors of system reliability; d) Identify those potential mission limiting elements and components that will require special attention in part selection, testing, environmental isolation, and/or special operations; and e) Evaluate the impact of proposed engineering change and waiver requests on reliability.
SCMAR160	4.3.3.0-2	Reliability data based on: on-orbit performance of similar equipment, test data, MIL-HDBK-217F2, Reliability Prediction of Electronic Equipment, with updated failure rates (e.g., Handbook of 217Plus Reliability Prediction Models) from the Reliability Information Analysis Center (RIAC) or equivalent, **shall** be used as the source of failure rates unless otherwise approved by GSFC.
SCMAR161	4.3.3.0-3	The assessments and updates will be submitted to GSFC in accordance with the CDRL. The results of reliability assessments **shall** be reported at PDR and CDR.
SCMAR162	4.3.4	**4.3.4 Trend Analysis**
SCMAR163	4.3.4.0-1	As part of the routine system assessment, the contractor **shall** assess all subassemblies and units to determine measurable parameters that relate to performance stability.
SCMAR164	4.3.4.0-2	A list of subassemblies and units to be assessed and the parameters to be monitored and the trend analysis reports **shall** be maintained and submitted in accordance with the CDRL.
SCMAR165	4.3.4.0-3	Selected parameters **shall** be monitored for trends starting at the 1st functional test of a subassembly or unit and continue during all system integration and test phases. The monitoring will be accomplished within the normal test framework; i.e., during functional tests, environmental tests, etc.
SCMAR166	4.3.4.0-4	The contractor **shall** establish a system for recording and analyzing the parameters as well as any changes from the nominal (out of family) even if the levels are within specified limits.

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SCMAR167	4.3.5	**4.3.5 Limited-Life Items**
SCMAR168	4.3.5.0-1	All limited-life items **shall** be identified, and managed as described in the RPP.
SCMAR169	4.3.5.0-2	A list of limited life items **shall** be presented in the PDR and CDR and delivered in accordance with the CDRL.
SCMAR170	4.3.5.0-3	The list of limited-life items **shall** include electromechanical mechanisms.
SCMAR171	4.3.5.0-4	Atomic oxygen, solar radiation, shelf-life, extreme temperatures, thermal cycling, wear and fatigue **shall** be used to identify limited-life thermal control surfaces and structure items.
SCMAR172	4.3.5.0-5	Mechanisms such as compressors, seals, bearings, valves, actuators, and scan devices **shall** be included when aging, wear, fatigue and lubricant degradation limit their life.
SCMAR173	4.3.5.0-6	Records **shall** be maintained that allows evaluation of the cumulative stress (time and/or cycles) for limited-life items starting when useful life is initiated and indicating the project activity that will stress the items. The use of an item whose expected life is less than its mission design life must be approved by GSFC.
SCMAR174	4.4	**4.4 Parts Stress Analyses**
SCMAR175	4.4.0-1	Each application of electrical, electronic, and electromechanical (EEE) parts **shall** be subjected to stress analyses for conformance with the applicable derating guidelines. GSFC EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating.
SCMAR176	4.4.0-2	The analyses **shall** be performed at the most stressful values that result from specified performance and environmental requirements (e.g., temperature and voltage) on the assembly or part.
SCMAR177	4.4.0-3	The results of the analyses **shall** be presented at all design reviews starting with the PDR.
SCMAR178	4.4.0-4	The analyses with summary sheets and updates **shall** be submitted in accordance with the CDRL.
SCMAR179	4.4.0-5	Presentations **shall** include comments on how the analysis was used to perform design trade-offs and how the results were taken into consideration when making design or risk management decisions.

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SCMAR180	5	# 5 Software Assurance Requirements
SCMAR181	5.0-1	Software assurance is the planned and systematic set of activities and disciplines that ensures that software lifecycle processes and products conform to requirements, standards, and procedures. These disciplines include Software Quality Assurance (SQA), Software Safety, Verification and Validation (V&V), and Independent Verification and Validation (IV&V). The contractor's QMS **shall** address software assurance functions for all software developed under this contract.
SCMAR182	5.1	## 5.1 Software Quality Assurance
SCMAR183	5.1.0-1	The contractor **shall** implement a Software Quality program to assure the quality of all software products and processes.
SCMAR184	5.1.0-2	This program **shall** assure that the standards, processes and procedures are appropriate for the project, correctly implemented, and that all efforts adhere to the requirements, plans, procedures and standards.
SCMAR519	5.1.0-3	Formal verification testing of all flight software **shall** include demonstration of error free operations-like scenarios over a minimum uninterrupted 72 hour duration
SCMAR520	5.1.0-4	Any Test or GSE software that interfaces with or evaluates flight software or hardware **shall** successfully complete its own verification testing prior to being used to test or evaluate flight software or hardware.

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SCMAR185	6	**6 Workmanship Standards**
SCMAR186	6.0-1	The contractor **shall** plan and implement a Workmanship Program to assure that all electronic packaging technologies, processes, and workmanship activities selected and applied meet mission objectives for quality and reliability.
SCMAR504	6.0-2	This Workmanship Program Plan **shall** be submitted, no later than PDR, for review and approval.
SCMAR188	6.0-3	The following standards in their entirety (or alternates submitted as described in SCMAR240) apply to all flight hardware and **shall** be flowed down to subcontractors as appropriate to the scope of efforts being performed by those subcontractors. a) Conformal Coating and Staking: NASA-STD-8739.1, Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies b) Soldering - Flight: NASA-STD-8739.3, Soldered Electrical Connections. c) Surface mount: NASA-STD-8739.2, NASA Workmanship Standard for Surface Mount Technology. d) Crimping, Wiring, and Harnessing: NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring e) Fiber Optics: NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation f) Printed Wiring Board (PWB) Design: 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) Printed Wiring Board Manufacture: k) IPC-6011, Generic Performance Specification for Printed Boards l) IPC-6012B Qualification and Performance Specification for Rigid Printed Boards - all flight boards shall be in compliance with the Performance Specification Sheet for Space and Military Avionics (SMA specification sheet). In the event of a conflict between the Design and Manufacture Specifications, the SMA specification shall take precedence. m) IPC-6013, Qualification and Performance Specification for Flexible Printed Boards n) IPC-6018 (Microwave End Product Performance Inspection and Test o) IPC A-600 Acceptability of Printed Boards.
SCMAR189	6.0-4	It is recognized that contractors may wish to use similar but not identical workmanship standards, procedures and training. Any such alternatives **shall** be accompanied by a comparison to the standards in SCMAR238 and a discussion of significant differences and rationale for use.
SCMAR190	6.0-5	Where differences are proposed, alternate standards **shall** be submitted to the GOES-R Project office, for review and approval, at least 120 days prior to use.
SCMAR191	6.0-6	Prior to the start of manufacturing, the Contractor **shall** assure that all workmanship requirements and associated procedures and training are in place or that changes or waivers have been approved by the Government.
SCMAR192	6.1	**6.1 Ground Systems That Interface With Space Flight Hardware**

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SCMAR193	6.1.0-1	Any portion of ground system assemblies that mate with the flight hardware, or that will reside with the space flight hardware in environmental chambers or other test facilities that simulate a space flight environment (e.g., connectors, test cables, etc.), **shall** be designed and fabricated using space flight materials and processes.
SCMAR194	6.1.0-2	Connector savers **shall** be used for testing all flight connectors.
SCMAR195	6.1.0-3	Mate/Demate logs **shall** be maintained for all flight connectors and connector savers.
SCMAR196	6.2	**6.2 Training and Certification**
SCMAR197	6.2.0-1	All personnel working on GOES hardware **shall** be certified as having completed the required training, appropriate to their involvement, as defined in the above standards or in the contractor's quality manual.
SCMAR198	6.2.0-2	At a minimum, certification **shall** include successful completion of formal training and demonstrated performance in the appropriate discipline.
SCMAR199	6.3	**6.3 Printed Wiring Boards**
SCMAR200	6.3.0-1	Rigid PWBs **shall** be manufactured in accordance with the Class 3/A Requirements per the IPC 6012B standard.
SCMAR201	6.3.0-2	All other PWBs **shall** be manufactured in accordance with the Class 3 Requirements in the applicable (Section 6.0) PWB manufacturing standards.
SCMAR202	6.3.0-3	The contractor **shall** provide PWB coupons to GSFC Systems Assurance Manager (SAM) or a GSFC approved laboratory for evaluation.
SCMAR203	6.3.0-4	Approval **shall** be obtained prior to population of flight PWBs.
SCMAR204	6.3.0-5	Coupons and test reports are not required for delivery to GSFC/Materials Engineering Branch (MEB) if the contractor has the coupons evaluated by a laboratory that has been approved by the GSFC/MEB, however, they **shall** be retained and included as part of the Project's documentation/data deliverables package.
SCMAR205	6.3.0-6	Planar magnetic devices, where the coils are an integral part of the design of a printed circuit board, are not subject to the assembly and screening requirements of MIL-STD-981 (refer to MAR444). The testing of any such devices **shall** be defined in the requirements for the printed circuit board or the next higher level assembly.)
SCMAR206	6.4	**6.4 Handling**
SCMAR207	6.4.0-1	Handling (including storage) procedures **shall** be instituted to prevent part and material degradation.
SCMAR208	6.4.0-2	The handling procedures **shall** be retained through inspection, kitting, and assembly.
SCMAR209	6.4.0-3	The handling procedures **shall** be identified on “build to” documentation.
SCMAR210	6.4.0-4	The following criteria **shall** be used as a minimum for establishing handling and storage procedures for parts and materials: a) Control of environment, such as temperature, humidity, contamination, and pressure. b) Measures and facilities to segregate and protect parts and materials routed to different locations such as, to the materials review crib, or to a laboratory for inspection, or returned to the manufacturer from unaccepted shipments. c) Easily identifiable containers to identify space quality parts.

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SCMAR210	6.4.0-4	d) Control measures to limit personnel access to parts and materials during receiving inspection and storage. e) Facilities for interim storage of parts and materials. f) Provisions for protective cushioning, as required, on storage area shelves, and in storage and transportation containers. g) Protective features of transportation equipment design to prevent packages from being dropped or dislodged in transit h) Protective bench surfaces on which parts and materials are handled during operations such as test, assembly, inspection, and organizing kits. i) Required use of gloves, finger cots, tweezers, or other means when handling parts to protect the parts from contact by bare hands. j) Provisions for protection of parts and assemblies susceptible to damage by electrostatic discharge. k) Unique parts and materials criteria.
SCMAR211	6.4.0-5	Shock sensors, or other shock recording devices, **shall** be used to insure that instrument have not seen shock levels in excess of requirements.
SCMAR212	6.4.0-6	All materials contacting the flight hardware **shall** meet the requirements for contamination control. This includes gloves, finger cots, swabs, and wipes.
SCMAR213	6.5	**6.5 Preservation and Packaging**
SCMAR214	6.5.0-1	Preservation and packaging **shall** be in accordance with the item packaging requirements and NPR 6000.1.
SCMAR215	6.5.0-2	All parts that are subject to degradation by electrostatic discharge **shall** be packaged in accordance with the approved ESD procedures.

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SCMAR216	7	# 7 EEE Parts Requirements
SCMAR217	7.1	## 7.1 General
SCMAR218	7.1.0-1	The Contractor **shall** plan and implement an Electrical, Electronic, and Electromechanical (EEE) Parts Control Program to assure that all parts selected for use in flight hardware meet mission objectives for quality and reliability.
SCMAR219	7.1.0-2	The program **shall** be in place in time to effectively support the design and selection processes.
SCMAR220	7.1.0-3	All parts **shall** be selected, processed, tested, and derated in accordance with GSFC EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating.
SCMAR221	7.1.0-4	All parts **shall** meet EEE-INST-002 requirements for part quality level 1. For those parts not readily available as part quality level 1 but are available at part quality level 2, parts require appropriate additional testing to bring parts into level 1 compliance.
SCMAR222	7.1.0-5	The Contractor **shall** control the selection, application, evaluation, and acceptance of all parts through a Parts and Materials Control Board (PMCB), or another documented system of parts control that is approved by the GOES-R project.
SCMAR223	7.1.0-6	The Contractor **shall** prepare a Parts Control Plan (PCP) describing the approach and methodology for implementing the Parts Control Program.
SCMAR224	7.1.0-7	The Parts Control Plan (PCP) **shall** also define the Contractor's criteria for parts selection, screening, radiation requirements' compliance and approval based on the guidelines of this section.
SCMAR225	7.1.0-8	The Parts Control Plan (PCP) **shall** be delivered in accordance with the CDRL.
SCMAR226	7.2	## 7.2 Single Point of Contact
SCMAR227	7.2.0-1	The Contractor and each Subcontractor **shall** designate a key individual to be their Project Parts Engineer (PPE).
SCMAR228	7.2.0-2	The PPE **shall** have the prime responsibility for management of their EEE parts control program.
SCMAR229	7.2.0-3	This individual **shall** have direct, independent and unimpeded access to the GOES-R Project PPE and Parts and Material Control Board (PMCB).
SCMAR230	7.2.0-4	Tasks typically performed by the prime contractor PPE and each subcontractor PPE **shall** include but are not limited to the following: a) Work with GOES-R GSFC PPE to perform parts control. b) Provide PMCB agenda, prepare Parts Identification Lists and provide supporting part information for part evaluation and approval by the PMCB. c) Coordinate Parts and Material Control Board meetings, maintain minutes, develop and maintain the Project Approved Parts List (PAPL), develop and maintain As-Designed and As-Built Parts Lists (ADPL, ABPL). d) Perform Customer Source Inspections (CSI) and audits at supplier’s facilities as necessary or as directed by the PMCB. e) Prepare part procurement, screening, qualification, and modification specifications, as required. f) Disposition / track part nonconformance’s and part failure investigations g) Track and report impact of ALERTS and advisories on flight hardware.

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SCMAR231	7.3	**7.3 Parts and Materials Control Board (PMCB)**
SCMAR232	7.3.0-1	The Contractor **shall** establish a Parts and Materials Control Board (PMCB) or a similar documented system to facilitate the management, selection, standardization, and control of parts, materials and associated documentation for the duration of the contract.
SCMAR233	7.3.0-2	The PMCB **shall** be responsible for the review and approval of all EEE parts, for conformance to established criteria of section 7.4 (including radiation effects), and for developing and maintaining a PAPL. The PMCB is responsible for all parts activities such as failure investigations, disposition of non-conformances, and problem resolutions.
SCMAR234	7.3.0-3	In addition the PMCB **shall** review and approve materials for use on the spacecraft in accordance with materials section of the MAR.
SCMAR235	7.3.0-4	PMCB operating procedures **shall** be included in the EEE Parts Control Plan (PCP) and Materials and Processes Control Plan.
SCMAR236	7.3.1	**7.3.1 PMCB Responsibilities**
SCMAR237	7.3.1.0-1	The PMCB **shall** be responsible for:
SCMAR238	7.3.1.0-2	If there are any parts issues that cannot be resolved at the PMCB level, the issues **shall** be elevated to the GOES-R Program at NASA/GSFC for resolution.
SCMAR505	7.3.2	**7.3.2 PMCB Meetings and Notification**
SCMAR240	7.3.2.0-1	The GOES-R GSFC PPE will participate in all PMCB meetings and **shall** be notified in advance of all upcoming meetings.
SCMAR241	7.3.2.0-2	Meeting minutes or records **shall** be maintained by the Contractor to document all decisions made and a copy provided to GOES R GSFC PPE within five (5) working days of convening the meeting.
SCMAR242	7.3.2.0-3	Minutes **shall** include justification for deviations to Level 1 requirements.
SCMAR243	7.3.2.0-4	The Contractor PPE **shall** notify attendees at least five (5) days in advance of upcoming meetings as a goal.
SCMAR244	7.3.2.0-5	Notification **shall** as a minimum, include a proposed agenda and Parts Identification List (PIL) of candidate parts.
SCMAR506	7.3.3	**7.3.3 PMCB Membership**
SCMAR246	7.3.3.0-1	As a minimum, the PMCB voting membership **shall** consist of the Spacecraft Contractor, Subcontractors, GOES-R Project Parts Engineer (PPE) and the GOES-R Materials Engineer (ME).
SCMAR247	7.3.3.0-2	The Contractor PPE and GSFC GOES-R Project Parts Engineer will participate in all PMCB meetings.
SCMAR248	7.3.3.0-3	The Contractor, and Subcontractors PPE **shall** assure that the appropriate individuals with engineering knowledge and skills are represented as necessary at meetings, such as part commodity specialists, Radiation Engineers or the appropriate subsystem design engineer. GOES-R Project Parts Engineer (PPE) has the right to request GSFC specialists, such as the GOES-R Project Radiation Engineer, to participate in PMCB meetings.
SCMAR249	7.4	**7.4 Part Selection And Processing**

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SCMAR250	7.4.1	**7.4.1 General**
SCMAR251	7.4.1.0-1	All part commodities identified in the NASA Part Selection List (NPSL) are considered EEE parts and **shall** be subjected to the requirements set forth in this section.
SCMAR252	7.4.1.0-2	Custom or advanced technology devices such as custom hybrid microcircuits, detectors, Application Specific Integrated Circuits (ASICs), and Multi-Chip Module (MCM) **shall** also be subject to parts control appropriate for the individual technology.
SCMAR253	7.4.2	**7.4.2 Selection**
SCMAR254	7.4.2.0-1	All spacecraft parts selected from the NASA Parts Selection List (NPSL) **shall** be quality level 1. All other EEE parts shall be selected, manufactured, processed, screened, and qualified, as a minimum, to the requirements of EEE-INST-002, Instructions for EEE Parts Selection, Screening Qualification and Derating Level 1.
SCMAR255	7.4.3	**7.4.3 Radiation Requirements for Part Selection**
SCMAR256	7.4.3.0-1	All parts **shall** be selected to perform their function in their intended application for 2X the 90% CL mission radiation dose based on 417-R-RPT-0027, The Radiation Environment for Electronic Devices on the GOES-R Series Satellites, and any associated analyses. The radiation environment poses three main risks to active parts that must be considered during part selection.
SCMAR257	7.4.3.1	**7.4.3.1 Total Ionizing Dose (TID)**
SCMAR258	7.4.3.1.0-1	Total Ionizing Dose including Enhanced Low Dose Rate (ELDR) effects. Parts **shall** be selected to ensure their adequate performance in the application up to a dose of 2x the expected mission dose based on ray trace analysis. Without ray trace information, parts must have a minimum of 250 mils (635mm) AL equivalent shielding and be guaranteed or lot tested for 100 krads (Si).
SCMAR259	7.4.3.1.0-2	Linear bipolar parts **shall** be assumed to be ELDR susceptible unless they have been successfully tested and shown to be insensitive.
SCMAR260	7.4.3.2	**7.4.3.2 Displacement Damage**
SCMAR261	7.4.3.2.0-1	EEE Parts **shall** be selected to ensure their adequate performance in the application up to a dose of 2x the expected 90% CL mission displacement damage dose. Solar arrays are not to be considered EEE parts. Appropriate margins will be determined where appropriate by the power subsystem.
SCMAR262	7.4.3.3	**7.4.3.3 Single-Event Effects (SEE)**
SCMAR263	7.4.3.3.0-1	The contractor **shall** carry out an analysis documenting the consequences of single-event induced error modes to the part, circuit, subsystem, and spacecraft system.
SCMAR264	7.4.3.3.0-2	In particular, the analysis **shall** consider the consequences of Single Event Upset (SEU) or Single Event Transient (SET) in each application of the part. Parts susceptible to Single Event Latch up (SEL) should be avoided.
SCMAR265	7.4.3.3.0-3	If performance demands the use of an SEL susceptible part, measures **shall** be implemented to ensure that SEL induced damage (both prompt and latent) are mitigated and that the mission success is not compromised. These measures must be approved by the contractor PRE and PPE and the GSFC project PRE and PPE before the part can be added to the PAPL.
SCMAR266	7.4.3.3.0-4	Applied voltages for power MOSFETs, FETs and bipolar junction transistors **shall** be in the safe operating ranges for these devices. Commercial, non-rad-hard MOSFETS shall require lot specific SEE testing.

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SCMAR267	7.4.4	**7.4.4 Custom or Advanced Technology Devices**
SCMAR268	7.4.4.0-1	Devices such as custom hybrid microcircuits, detectors, ASICs, and MCMs **shall** be subject to parts control and include a design review appropriate for the individual technology.
SCMAR269	7.4.4.0-2	The design review **shall** address items such as element analysis and, when necessary - packaging, qualification, and screening requirements.
SCMAR270	7.4.4.0-3	The GSFC Materials Branch **shall** be consulted to evaluate differences in coefficients of thermal expansion between materials. A Customer Source Inspection may be required. A procurement specification may be required for parts in this category based on the recommendation of the PPE.
SCMAR271	7.4.4.0-4	If a procurement specification is generated, it **shall** fully identify the item being procured.
SCMAR272	7.4.4.0-5	A specification **shall** include physical, mechanical, electrical, and environmental test requirements and quality assurance provisions necessary to control manufacture and acceptance.
SCMAR273	7.4.4.0-6	If screening requirements are included in the procurement specification, these requirements **shall** include test conditions, burn-in circuits, failure criteria, and lot rejection criteria.
SCMAR274	7.4.4.0-7	For lot acceptance or rejection, the Percentage of Defectives Allowable (PDA) in a screened lot **shall** be in accordance with EEE-INST-002.
SCMAR275	7.4.4.0-8	If the screening and qualification requirements are not included in the procurement specification, a separate screening specification **shall** be prepared for the part, which includes test conditions, burn-in circuits, failure criteria, and lot rejection criteria.
SCMAR276	7.4.5	**7.4.5 Plastic Encapsulated Microcircuits (PEMs)**
SCMAR277	7.4.5.0-1	The use of Plastic Encapsulated Microcircuits and plastic semi-conductors is discouraged. However, when use is necessary to achieve unique requirements that can not be found in hermetic high reliability microcircuits, plastic encapsulated parts **shall** meet the requirements of PLASTIC ENCAPSULATED MICROCIRCUITS (PEMs) Section of GSFC EEE-INST-002, INSTRUCTIONS FOR SELECTION, SCREENING AND QUALIFICATION.
SCMAR278	7.4.5.0-2	The PMCB **shall** review the procurement specification for appropriate testing, and also review application, procurement and storage processes for the plastic encapsulated part(s) to assure that all aspects of the GSFC policy have been met. The PMCB may grant Preliminary Approval when the GSFC requirements have been met. Use of EEE PEMs shall require lot specific radiation testing and approval of GOES-R Project Radiation Affects Engineer (RAE).
SCMAR279	7.4.5.0-3	Final approval for the use of the PEM(s) **shall** be obtained from the GOES-R Project Office.
SCMAR280	7.4.6	**7.4.6 Verification Testing**
SCMAR281	7.4.6.0-1	Re-performance of lot specific screening tests, which were performed by the manufacturer or authorized test house as required by military or procurement specification, is not required unless deemed necessary as indicated by failure history, GIDEP Alerts, age or other reliability concerns.
SCMAR282	7.4.6.0-2	If required, testing **shall** be performed in accordance with EEE-INST-002 or as determined by the PMCB.
SCMAR283	7.4.7	**7.4.7 Parts Approved on Prior Programs**
SCMAR284	7.4.7.0-1	"Grandfather approval" of parts previously approved by GSFC via a Nonstandard Parts Approval Request (NSPAR) or prior PMCB activity **shall** not be permitted. However, existing approvals may be presented to the PMCB as an aid to review candidate parts for approval.

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SCMAR285	7.4.7.0-2	Such candidate parts **shall** be evaluated by the PMCB for compliance to current Program requirements by determining that: a) No changes have been made to the previously approved NSPAR, Source Control Drawing (SCD) or vendor list. b) All stipulations cited in the previous NSPAR approval have been implemented on the current flight lot, including performance of any additional testing. c) The previous program's parts quality level is identical to the current program quality level and respective EEE-INST-002 requirements have not changed. d) No new information has become available which would preclude the use of the previously approved part in a high reliability space flight application.
SCMAR286	7.4.8	**7.4.8 Parts Used in Off-the-Shelf Assemblies**
SCMAR287	7.4.8.0-1	Units or assemblies that are purchased as "off-the-shelf" hardware items **shall** be subjected to an evaluation of the parts used within them.
SCMAR288	7.4.8.0-2	The parts **shall** be evaluated for screening and qualification in compliance to EEE-INST-002, established reliability level, and include a radiation analysis.
SCMAR289	7.4.8.0-3	Units may be required to undergo modification for use of higher reliability parts or Radiation hardened parts.
SCMAR290	7.4.8.0-4	All parts **shall** be subject to PMCB approval.
SCMAR291	7.4.8.0-5	Modifications such as additional shielding for radiation effectiveness or replacing radiation soft parts for radiation hardened parts may be required and **shall** be subject to PRE approval.
SCMAR292	7.5	**7.5 Value Added Testing**
SCMAR293	7.5.0-1	The following value - added tests provide for enhanced reliability of parts and all additional testing **shall** be noted in the PAPL (SCMAR400, Section 7.8).
SCMAR294	7.5.0-2	Unless otherwise specified, testing **shall** be in accordance with the test methods referenced in EEE-INST-002.
SCMAR295	7.5.1	**7.5.1 Particle Impact Noise Detection (PIND)**
SCMAR296	7.5.1.0-1	All EEE devices with internal cavities (such as transistors, microcircuits, hybrids, relays and switches) **shall** be subjected to Particle Impact Noise Detection (PIND) screening, in accordance with the applicable specification. The PMCB may waive this requirement for part types where the testing will be destructive or the presence of a particle will not impair the operation of the part.
SCMAR297	7.5.1.0-2	Any device failing this screen **shall** not be used in any flight application.
SCMAR298	7.5.2	**7.5.2 Capacitors**
SCMAR299	7.5.2.1	**7.5.2.1 Surge Current Screening for Tantalum Capacitors**
SCMAR300	7.5.2.1.0-1	All solid tantalum capacitors used in filtering applications **shall** be subjected to surge current screening.
SCMAR301	7.5.2.1.0-2	Chip devices **shall** receive surge current testing in accordance with the requirements of MIL-PRF-55365, Capacitor, Fixed, Electrolytic (Tantalum), Chip, Non-established Reliability, Established Reliability, General Specification For, as imposed by surge current Option B of the specification. Parts may be ordered from the manufacturers with this testing by adding the "A" or "B" suffix as the last digit of the military part number.

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SCMAR302	7.5.2.1.0-3	Leaded devices **shall** receive surge current testing in accordance with MIL-PRF-39003/10, Capacitors, Fixed, Electrolytic (Solid Electrolyte) Tantalum, (Polarized sintered slug), Established Reliability Styles CSS13 and CSS33 (High Reliability Applications).
SCMAR303	7.5.2.2	**7.5.2.2 Dielectric Screening for Ceramic Capacitors**
SCMAR304	7.5.2.2.0-1	Ceramic capacitors used in circuits at or below 10V shall be rated at 100V or greater except as follows.
SCMAR305	7.5.2.2.0-2	Each lot of capacitors rated below 100V, **shall** have samples subjected to Humidity Steady State Low Voltage testing (85°C and 85% relative humidity) in accordance with MIL-PRF-123, Capacitors, Fixed, Ceramic Dielectric (Temperature Stable and General Purpose), High Reliability, General Specification for (12 piece sample for each lot/date code with zero failures (12(0)).
SCMAR306	7.5.2.2.0-3	Following humidity exposure, a Destructive Physical Analysis (DPA) **shall** be performed in accordance with MIL-PRF-123 (sample size of 5 pieces for each lot/date code) prior to acceptance.
SCMAR307	7.5.3	**7.5.3 Screening for Magnetic Components**
SCMAR308	7.5.3.0-1	Custom magnetic devices (transformers and inductors) **shall** be designed and manufactured to the requirements of MIL-STD-981, Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications for Class S devices.
SCMAR521	7.5.3.0-2	Family part type groupings, screening and qualification **shall** be in accordance with EEE-INST-002 quality level 1.
SCMAR309	7.5.3.0-3	Planar magnetic devices, where the coils are an integral part of the design of a printed circuit board, are not subject to the assembly and screening requirements of MIL-STD-981.
SCMAR310	7.5.3.0-4	The testing of any such devices **shall** be defined in the requirements for the printed circuit board or the next higher level assembly and require PCMB approval.
SCMAR522	7.5.4	**7.5.4 Electromechanical Relay Requirements**
SCMAR523	7.5.4.0-1	Relays procured to GSFC S-311-P-754 are preferred for Level 1 applications. When designed relay is not covered by S-311-P-754 (see EEE-INST-002 for list), Military relays **shall** be subjected to small particle cleaning, internal inspection during assembly and PIND testing afterwards. Whenever Military relays cannot be procured to meet the above criteria, a SCD will be generated based upon EEE-INST-002, quality level 1 requirements and require PMCB approval. DPA is required on all lots of relays used on Level 1 applications
SCMAR313	7.6	**7.6 Part Analysis**
SCMAR314	7.6.1	**7.6.1 Destructive Physical Analysis**
SCMAR315	7.6.1.0-1	A sample of each lot date code of all cavity devices, including microcircuits, hybrid microcircuits, EMI filters, relays, capacitors, oscillators, resistor networks, Resistance Temperature Detectors (RTDs), Platinum Resistance Temperature Detectors (PRTDs), thermostatic switches, Plastic Encapsulated Microcircuits (PEMs) and semiconductor devices **shall** be subjected to a Destructive Physical Analysis (DPA) based on PMCB recommendation.
SCMAR316	7.6.1.0-2	All other parts may require a sample DPA if it is deemed necessary as indicated by failure history, GIDEP Alerts, or other reliability concerns.
SCMAR317	7.6.1.0-3	DPA tests, procedures, sample size and criteria **shall** be as specified in GSFC specification S-311-M-70.

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SCMAR318	7.6.1.0-4	Contractor's procedures for DPA may be used in place of S-311-M-70 and **shall** be submitted to the PMCP for concurrence prior to use.
SCMAR319	7.6.1.0-5	The PMCB on a case-by-case basis **shall** consider variation to the DPA sample size requirements, due to part complexity, availability or cost.
SCMAR320	7.6.2	**7.6.2 Failure Analysis**
SCMAR321	7.6.2.0-1	The Contractor **shall** perform part Failure Analysis essential to achieve a timely resolution and closeout of each failure incident.
SCMAR322	7.6.2.0-2	The Contractor PPE **shall** submit the completed EEE part failure report with all supporting data, analyses, and photographs to the PMCB for review and approval within 10 working days of initiating corrective action.
SCMAR323	7.6.2.0-3	The failure report form **shall** as a minimum, provide the following information: a) The failed part's identity (part name, part number, reference designator, manufacturer, manufacturing lot / date code, and part serial number if applicable), and symptoms by which the failure was identified (the conditions observed as opposed to those expected). b) The name of the unit or subsystem on which the failure occurred, the contract number, date of failure, the test phase, and the environment in which the test was being conducted. c) The results of the failure analyses conducted and the nature of the rework / retest / corrective action taken in response. d) An indication of whether the failure of the part or item in question constitutes a primary or a secondary (collateral) failure.
SCMAR324	7.6.2.0-4	The completed failure report **shall** include copies of any supporting photographs, X-rays, metallurgical data, microprobe or spectrographic data, scanning electronic microscope photographs, pertinent variables (electrical and radiation) data, etc.
SCMAR325	7.6.2.0-5	Radiation data **shall** be submitted where it is deemed pertinent to the failure mechanism.
SCMAR326	7.7	**7.7 Additional Requirements**
SCMAR327	7.7.1	**7.7.1 Parts Age and Storage Control**
SCMAR328	7.7.1.0-1	All parts procured with date codes indicating that more than five (5) years have elapsed from the date of manufacture to date of procurement **shall** be subjected to a re-screen and sample DPA per PMCB recommendation. Alternate test plans may be used as approved by the PMCB on a case-by case basis.
SCMAR329	7.7.1.0-2	Parts taken from user inventory older than 5 years do not require re-screening, provided they have been in controlled storage. (Controlled Storage to mean Nitrogen purged bags, dry box, sealed purged container)
SCMAR330	7.7.1.0-3	Parts over 10 years old from the date of manufacture to date of procurement **shall** not be
SCMAR331	7.7.2	**7.7.2 Derating**
SCMAR332	7.7.2.0-1	All EEE parts **shall** be used in accordance with the derating guidelines of EEE-INST-002.
SCMAR333	7.7.2.0-2	The Contractor's derating policy may be used in place of the EEE-INST-002 guidelines and **shall** be defined in the Contractor's PMCP.

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SCMAR334	7.7.2.0-3	The Contractor **shall** maintain documentation on parts derating analysis and make it available for GSFC review.
SCMAR335	7.7.3	**7.7.3 Traceability**
SCMAR336	7.7.3.0-1	The Contractor **shall** utilize traceability database(s) that provide the capability to retrieve historical records of EEE parts from initial procurement and receipt through, storage, kitting, assembly, test, and final acceptance of the deliverable product.
SCMAR337	7.7.3.0-2	The database **shall** permit the traceability to the procurement document and provide for: a) Cross-referencing and traceability of part manufacturer and date code to the assembly traveler or production plan. b) The storage of the accumulated data records.
SCMAR507	7.7.3.0-3	All flight EEE parts **shall** be traceable to the lot date code or the manufacturer's inspection lot code.
SCMAR338	7.7.3.0-4	Traceability **shall** be maintained throughout manufacturing for each deliverable item.
SCMAR339	7.7.3.0-5	When necessary for radiation hardness or other requirements, the parts **shall** be traceable to the wafer lot, as determined by the PMCB.
SCMAR340	7.7.4	**7.7.4 Prohibited Metals**
SCMAR341	7.7.4.0-1	Pure tin plating **shall** not be used in the construction and surface finish of EEE parts proposed for space hardware. Only alloys containing less than 97% tin are acceptable. The use of cadmium or zinc plating is prohibited in the construction and surface finish of space hardware.
SCMAR342	7.7.4.0-2	All cadmium alloys or zinc alloys (e.g. brass) **shall** be completely over plated with an approved metal.
SCMAR524	7.7.5	**7.7.5 Use of Polymeric Materials**
SCMAR525	7.7.5.0-1	Materials and processes to be used for polymeric applications **shall** be selected and qualified to meet the mechanical, environmental and performance requirements of the finished assembly.
SCMAR526	7.7.5.0-2	Qualification reports, including test methods, data, and results, will be made available for review, on request.
SCMAR527	7.7.5.0-3	All polymeric materials and, as applicable, their location where used (e.g. staking, bonding, encapsulation) **shall** be included on the engineering design drawings
SCMAR343	7.7.6	**7.7.6 Supplier and Manufacturer Surveillance (Monitoring)**
SCMAR344	7.7.6.0-1	The PMCB **shall** establish a policy and procedures for the periodic surveillance and auditing of suppliers, vendors, laboratories and manufacturers to ensure compliance to procurement, quality, reliability and survivability requirements. Contractor's surveillance is not required for laboratories, suppliers, vendors, and manufacturers that have been approved as a part of Qualified Parts List (QPL) or Qualified Manufacturer's List (QML) program for products listed in the space quality baseline.
SCMAR345	7.7.6.0-2	When surveillance/audit data is available from other sources (e.g. other contractor programs, other contractor sub-contractors, independent audits reports, etc.), the contractor may utilize the results of the data contingent on the review and approval by the PMCB. Acceptability of the data **shall** be based on technical considerations, as well as timeliness and confidence in the source of the data.

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SCMAR346	7.7.7	**7.7.7 Re-use of Parts and Materials**
SCMAR347	7.7.7.0-1	Parts and materials which have been installed in an assembly, and are then removed from the assembly for any reason, **shall** not be used again in any item of flight or spare hardware without prior approval of the PMCB based on the submission of evidence that this practice does not degrade the system performance.
SCMAR348	7.8	**7.8 Parts Lists**
SCMAR349	7.8.0-1	The Contractor **shall** create and maintain a Program Approved Parts List (PAPL) and Parts Identification List (PIL) for the duration of the program.
SCMAR350	7.8.0-2	Clear distinctions **shall** be made as to parts approval status and whether parts are planned for use in flight hardware.
SCMAR351	7.8.0-3	Parts **shall** be approved for listing on the PAPL or PIL before initiation of procurement activity.
SCMAR352	7.8.1	**7.8.1 Program Approved Parts List (PAPL)**
SCMAR353	7.8.1.0-1	The PAPL **shall** be the only listing of approved parts for flight hardware, and as such may contain parts not actually in flight design.
SCMAR354	7.8.1.0-2	Only parts that have been evaluated and approved by the PMCB **shall** be listed in the PAPL.
SCMAR355	7.8.1.0-3	The PMCB **shall** assure standardization and the maximum use of parts listed in the PAPL. (See Parts List Required Fields Table SCMAR416)
SCMAR356	7.8.2	**7.8.2 Parts Identification List (PIL)**
SCMAR357	7.8.2.0-1	The PIL **shall** list all parts proposed for use in flight hardware. The PIL is prepared from design team inputs or subcontractor inputs, to be used for presenting candidate parts to the PMCB.
SCMAR358	7.8.2.0-2	The PIL **shall** include as a minimum the following information: part number, part name or description, manufacturer, manufacturer's generic part number, drawing number, specifications, comments as necessary to indicate problems, long lead times, additional testing imposed, application unique notes, etc.
SCMAR359	7.8.3	**7.8.3 As-Designed Parts List (ADPL)**
SCMAR360	7.8.3.0-1	The Contractor PPE **shall** establish an As-Designed Parts List (ADPL) as soon as practical after the preliminary release of designs for CDR.
SCMAR361	7.8.3.0-2	The ADPL **shall** follow the Parts Lists Required Fields Table (SCMAR416).
SCMAR362	7.8.3.0-3	The Contractor **shall** submit the final version of the ADPL in accordance with the CDRL.
SCMAR363	7.8.4	**7.8.4 As-Built Parts List (ABPL)**
SCMAR364	7.8.4.0-1	An As-Built Parts List (ABPL) **shall** also be prepared and submitted in accordance with the CDRL. The ABPL is generally a final compilation of all parts as installed in flight equipment, with additional “as-installed” part information such as manufacturer name, CAGE code, Lot-Date Code, part serial number (if applicable), quantity used and box or board location. The manufacturer's plant specific CAGE code is preferred, but if unknown, the supplier's general cage code is sufficient (See Parts List Required Fields Table below).

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Parts Lists Required Fields Table

FIELD	Required Field for Parts List Type		
	ADPL	PAPL	ABPL
Item Number	X	X	X
Spacecraft Name	X	X	X
Instrument Name	X	X	X
Generic Part Number	X	X	X
Procurement Part Number	X	X	X
Flight Part Number		X	X
Description	X	X	X
Package: Case Style and Number of Pins	X	X	X
Lot Date Code			X
Manufacturer	X	X	X
Cage Code	X	X	X
Distributor	X		
Additional Testing Required	X	X	
Quantity needed	X		X
Quantity Procured	X		
Radiation Hardness Evaluation: TID, Krads	X	X	X
Radiation Hardness Evaluation: SEL, MeV	X	X	X
Radiation Hardness Evaluation: SEU, MeV	X	X	X
Radiation Hardness Evaluation: Displacement Damage	X	X	X
Radiation Data Source: TID	X		
Radiation Data Source: SEE	X		
Notes	X		
PMCB Comments	X	X	
Approval Date	X	X	X
Box Identification	X	X	X
Part Location (Circuit Identifier)			X

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7.9 Data Requirements

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SCMAR366	7.9.1	**7.9.1 General**
SCMAR367	7.9.1.0-1	Attributes (parametric test) summary data **shall** be available to GSFC for all testing performed.
SCMAR368	7.9.1.0-2	Variable data (read and record) **shall** be recorded for initial, interim and final electrical test points.
SCMAR369	7.9.1.0-3	Test data **shall** be available to GSFC.
SCMAR370	7.9.1.0-4	For those parts potentially susceptible to radiation effects in the GOES-R environment, a summary radiation report that identifies parameter degradation behavior **shall** be provided to the PMCB.
SCMAR371	7.9.1.0-5	Variables data acquired during radiation testing **shall** be available to GSFC.
SCMAR372	7.9.2	**7.9.2 Retention of Data and Test Samples**
SCMAR373	7.9.2.0-1	All builders of flight hardware **shall** have a method in place for retention of data generated for parts tested and used in flight hardware.
SCMAR374	7.9.2.0-2	The data **shall** be kept on file in order to facilitate future risk assessment and technical evaluation, as needed.
SCMAR375	7.9.2.0-3	In addition, the prime contractor and subcontractors **shall** retain all part functional failures, all destructive and non-flight non-destructive test samples, which could be used for future validation of parts for performance under certain conditions not previously accounted for.
SCMAR376	7.9.2.0-4	PIND test failures may be submitted for DPA, radiation testing or used in engineering models.
SCMAR377	7.9.2.0-5	Parts and data **shall** be retained for the useful life of the spacecraft unless otherwise permitted by the PMCB.
SCMAR378	7.9.2.0-6	All historical quality records and those data required to support these records **shall** be retained until contract completion.
SCMAR379	7.9.3	**7.9.3 End Item Acceptance Data Package**
SCMAR380	7.9.3.0-1	The spacecraft Contractor PPE **shall** establish and maintain an EEE parts data package for each spacecraft produced under the contract.
SCMAR381	7.9.3.0-2	The data package **shall** identify and include all parts in the spacecraft.
SCMAR382	7.9.3.0-3	Each spacecraft EEE parts data package **shall** contain, as a minimum: a) "As- designed'' to ''As- Built" parts list configuration comparison. b) Part nonconformance documentation, including part failure reports, and waiver/deviation reports. c) Dispositions for installed parts impacted by GIDEP ALERTS Problem Advisories, NASA Advisories, or contractor purges. d) PMCB defined data relevant to the use of the part in that spacecraft.

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SCMAR383	8	# 8 Materials, Processes, and Lubrication Requirements
SCMAR384	8.1	## 8.1 General
SCMAR385	8.1.0-1	The Contractor **shall** prepare a Materials and Processes Control Plan. Materials, Processes, and Lubrication approval by the PMCB is required for each usage or application in space-flight hardware. The GSFC Materials Assurance Engineer (MAE) shall be a permanent member of the PMCB.
SCMAR386	8.1.0-2	The Contractor **shall** submit the as-designed Materials, Processes, and Lubrication List in accordance with the CDRL.
SCMAR387	8.1.0-3	The Contractor **shall** submit the as-built Materials, Processes and Lubrication List in accordance with the CDRL.
SCMAR388	8.2	## 8.2 Materials Selection Requirements
SCMAR389	8.2.0-1	In order to anticipate and minimize materials problems during space hardware development and operation, the Contractor **shall**, when selecting materials and lubricants, consider potential problem areas such as radiation effects, thermal cycling, stress corrosion cracking, galvanic corrosion, hydrogen embrittlement, lubrication, contamination of surfaces, particulate contaminates, composite materials, useful life, vacuum outgassing, toxic offgassing, flammability and fracture toughness as well as the properties required by each material usage or application.
SCMAR390	8.2.0-2	The suitability and durability of materials used for spaceflight components **shall** be established on the basis of flight experience or tests.
SCMAR391	8.2.0-3	The materials used **shall** conform to NASA approved specifications to ensure that the materials have the strength, modulus, coefficient of thermal expansion, thermal conductivity and other properties assumed in the design data.
SCMAR392	8.2.0-4	Furthermore, material selection **shall** take into account the effects of environmental conditions expected during the life of the instrument.
SCMAR393	8.2.0-5	Materials **shall** be corrosion resistant or be suitably treated to resist corrosion when subjected to the specified environments.
SCMAR394	8.2.0-6	Where practicable, fungus inert materials **shall** be used.
SCMAR395	8.2.0-7	The following materials **shall** be considered as prohibited: a) Cadmium b) Zinc c) Pure Tin (>97% content) d) Silicone Greases and adhesive tapes e) Plasticized Polymers especially Polyvinyl Chlorides (PVCs) f) Particle/debris generating materials
SCMAR396	8.2.1	## 8.2.1 Compliant Materials
SCMAR397	8.2.1.0-1	The Contractor **shall** use compliant materials in the fabrication of hardware to the extent practicable.

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SCMAR398	8.2.1.0-2	In order to be compliant, a material **shall** be used in a conventional application and meet the applicable selection criteria identified in Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements volume 3. The proposed use of a non-compliant material requires that a Materials Usage Agreement (MUA) and/or a Stress Corrosion Evaluation Form or Contractor's equivalent forms (Material Usage Agreement Form SCMAR837, Stress Corrosion Evaluation Form SCMAR838), be submitted to GSFC for approval in accordance with the CDRL.
SCMAR399	8.2.1.0-3	The instrument structural parts **shall** consist of only the materials approved by the Parts and Materials Control Board (PMCB). Table 1 of MSFC-STD-3029 MultiProgram/Project Common-Use Document Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments Materials, Processes, and Manufacturing Department Metallic Materials and Processes Group are examples of materials that can be considered for use.
SCMAR400	8.2.1.1	**8.2.1.1 Materials Used in "Off-the-Shelf-Hardware"**
SCMAR401	8.2.1.1.0-1	"Off-the-shelf hardware" for which a detailed materials list is not available and where the included materials cannot be easily identified and/or changed **shall** be treated as non-compliant.
SCMAR402	8.2.1.1.0-2	The Contractor **shall** define on a MUA, what measures shall be used to ensure that all materials in the hardware are acceptable for use. Such measures might include any one or a combination of the following: hermetic sealing, vacuum bake-out, material changes for known non-compliant materials, etc.
SCMAR403	8.2.2	**8.2.2 Conventional Applications**
SCMAR404	8.2.2.0-1	Conventional applications or usage of materials is the use of compliant materials in a manner for which there is extensive satisfactory aerospace heritage.
SCMAR405	8.2.3	**8.2.3 Non-conventional Applications**
SCMAR406	8.2.3.0-1	The proposed use of a compliant material for an application for which there is limited satisfactory aerospace usage **shall** be considered a non-conventional application. Under these circumstances, the PMCB will review any/all the information required in a Non-conventional Material, Process, and Lubrication Report so that it may fully understand and approve the application.
SCMAR407	8.2.4	**8.2.4 Polymeric Materials**
SCMAR408	8.2.4.0-1	The Contractor **shall** prepare and submit a polymeric materials and composites usage/applications list or the Contractor's equivalent. Refer to Polymeric Materials and Composites Usage List SCMAR510. The list shall be submitted to the PMCB for review and approval. In addition, the Contractor may be requested to submit supporting applications data.
SCMAR409	8.2.4.1	**8.2.4.1 Flammability and Toxic Offgassing**
SCMAR410	8.2.4.1.0-1	Hazardous material requirements, including flammability, toxic offgassing and compatibility **shall** be in accordance with Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements.
SCMAR411	8.2.4.1.0-2	The Contractor **shall** identify through a safety analysis, materials that pose a safety risk due to their flammability or toxic out gassing characteristics.
SCMAR412	8.2.4.1.0-3	The Contractor **shall** submit those materials for testing.
SCMAR413	8.2.4.1.0-4	The information gained from this testing **shall** be submitted to the Parts and Materials Control Board (PMCP) for review and approval.

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SCMAR414	8.2.4.2	**8.2.4.2 Vacuum Outgassing**
SCMAR415	8.2.4.2.0-1	Material vacuum outgassing **shall** be determined in accordance with ASTM E595 Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment. In general, a material is qualified on a product-by-product basis. However, the PMCB may require lot testing of any material for which lot variation is suspected or for which recent data is not available. In such cases, material approval is contingent upon lot testing.
SCMAR416	8.2.4.2.0-2	Only materials that have a total mass loss (TML) less than 1.00% and a collected volatile condensable material (CVCM) less than 0.10% **shall** be considered approved for use in a vacuum environment unless application considerations listed on a MUA dictate otherwise.
SCMAR417	8.2.4.3	**8.2.4.3 Shelf-Life-Controlled Materials**
SCMAR418	8.2.4.3.0-1	Polymeric materials that have a limited shelf life **shall** be controlled by a process that identifies the start date (manufacturer's processing, shipment date, or date of receipt, etc.), the storage conditions associated with a specified shelf life, and expiration date.
SCMAR419	8.2.4.3.0-2	Materials such as o-rings, rubber seals, tape, uncured polymers, lubricated bearings, paints, solder flux, and flux-cored solder **shall** be included.
SCMAR420	8.2.4.3.0-3	The Contractor **shall** provide their proposed shelf life control process to the PMCB for approval. Once approval is obtained, only deviations from the process need be submitted to the PMCB for disposition.
SCMAR421	8.2.4.3.0-4	The Contractor **shall** demonstrate, by means of appropriate tests, that the properties of the materials have not been compromised for their intended use.
SCMAR422	8.2.4.3.0-5	When a limited-life piece part is installed in a subassembly, its usage **shall** be approved by the PMCB and included in the As Built Materials, Process, and Lubrication List.
SCMAR423	8.2.5	**8.2.5 Inorganic Materials**
SCMAR424	8.2.5.0-1	The Contractor **shall** prepare and document an inorganic materials and composites usage list (Inorganic Materials and Composites Usage List SCMAR511) or the Contractor's equivalent.
SCMAR425	8.2.5.0-2	The list **shall** be submitted to the PMCB for review and approval. In addition, the Contractor may be requested to submit supporting applications data.
SCMAR426	8.2.5.0-3	The criteria specified in MSFC-STD-3029 **shall** be used as a guide to determine that metallic materials meet the stress corrosion cracking criteria. Materials selected require approval by the PMCB.
SCMAR427	8.2.5.0-4	A MUA and Stress Corrosion Evaluation Form **shall** be submitted to the PMCB for each material usage from Table 2 or Table 3 of the MSFC STD-3029 requirements.
SCMAR428	8.2.5.0-5	Additionally, for GSFC to approve usage of individual materials, a stress corrosion evaluation form, as discussed in SCMAR509 or an equivalent Contractor form or any/all of the information contained in the stress corrosion evaluation form **shall** be prepared and made available to GSFC upon request.
SCMAR429	8.2.5.1	**8.2.5.1 Fasteners**
SCMAR430	8.2.5.1.0-1	The Contractor **shall** prepare a Fastener Control Plan.
SCMAR431	8.2.5.1.0-2	The plan **shall** be included in the Materials and Processes Control Plan.

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SCMAR432	8.2.5.1.0-3	The PMCB will approve all flight fasteners as part of the parts, processes, and materials list approval process.
SCMAR433	8.2.5.1.0-4	The Contractor **shall** comply with the procurement documentation and test requirements for flight hardware and critical ground support equipment fasteners contained in 541-PG-8072.1.2, Goddard Space Flight Center Fastener Integrity Requirements.
SCMAR434	8.2.5.1.0-5	Material test reports for fastener lots **shall** be retained and made available for government inspection.
SCMAR435	8.2.5.1.0-6	Fasteners made of plain carbon or low alloy steel **shall** be protected from corrosion.
SCMAR436	8.2.5.1.0-7	When plating is specified, it **shall** be compatible with the space environment. Cadmium, pure Tin and Zinc are unacceptable.
SCMAR437	8.2.5.1.0-8	On steels harder than RC 33, the fastener **shall** be plated by a process that does not cause embrittlement.
SCMAR438	8.2.5.2	**8.2.5.2 Locking Features**
SCMAR439	8.2.5.2.0-1	Each removable bolt, screw, nut, pin or other removable fastener **shall** use a locking feature.
SCMAR440	8.2.5.3	**8.2.5.3 Dissimilar Metals**
SCMAR441	8.2.5.3.0-1	Use of dissimilar metals in contact, as defined by MIL-STD-889, Dissimilar Metals, **shall** be limited to applications where similar metals cannot be used due to design requirements.
SCMAR442	8.2.5.3.0-2	When use is unavoidable, metals **shall** be protected against galvanic corrosion by a method listed in MIL-STD-889.
SCMAR443	8.2.5.3.0-3	Composite materials containing graphite fibers **shall** be treated as graphite in MIL-STD-889.
SCMAR508	8.2.5.3.0-4	

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR508 8.2.5.3.0-4 **Material Usage Agreement Form**

MATERIAL USAGE AGREEMENT			USAGE AGREEMENT NO.:			PAGE OF		
PROJECT:	SUBSYSTEM:		ORIGINATOR:			ORGANIZATION:		
DETAIL DRAWING	NOMENCLATURE		USING ASSEMBLY			NOMENCLATURE		
MATERIAL & SPECIFICATION			MANUFACTURER & TRADE NAME					
USAGE	THICKNESS	WEIGHT	EXPOSED AREA	ENVIRONMENT				
				PRESSURE	TEMPERATURE	MEDIA		
APPLICATION:								
RATIONALE:								
ORIGINATOR:			PROJECT MANAGER:			DATE:		

SCMAR509 8.2.5.3.0-5

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR509 8.2.5.3.0-5 **Stress Corrosion Evaluation Form**

1. Part Number _____
2. Part Name _____
3. Next Assembly Number _____
4. Manufacturer _____
5. Material _____
6. Heat Treatment _____
7. Size and Form _____
8. Sustained Tensile Stresses-Magnitude and Direction
   a. Process Residual _____
   b. Assembly _____
   c. Design, Static _____
9. Special Processing _____
10. Weldments
    a. Alloy Form, Temper of Parent Metal _____
    b. Filler Alloy, if none, indicate _____
    c. Welding Process _____
    d. Weld Bead Removed - Yes ( ), No ( ) _____
    e. Post-Weld Thermal Treatment _____
    f. Post-Weld Stress Relief _____
11. Environment _____
12. Protective Finish _____
13. Function of Part _____
    _____
14. Effect of Failure _____
    _____
15. Evaluation of Stress Corrosion Susceptibility _____
    _____
16. Remarks: _____

SCMAR444 8.2.6

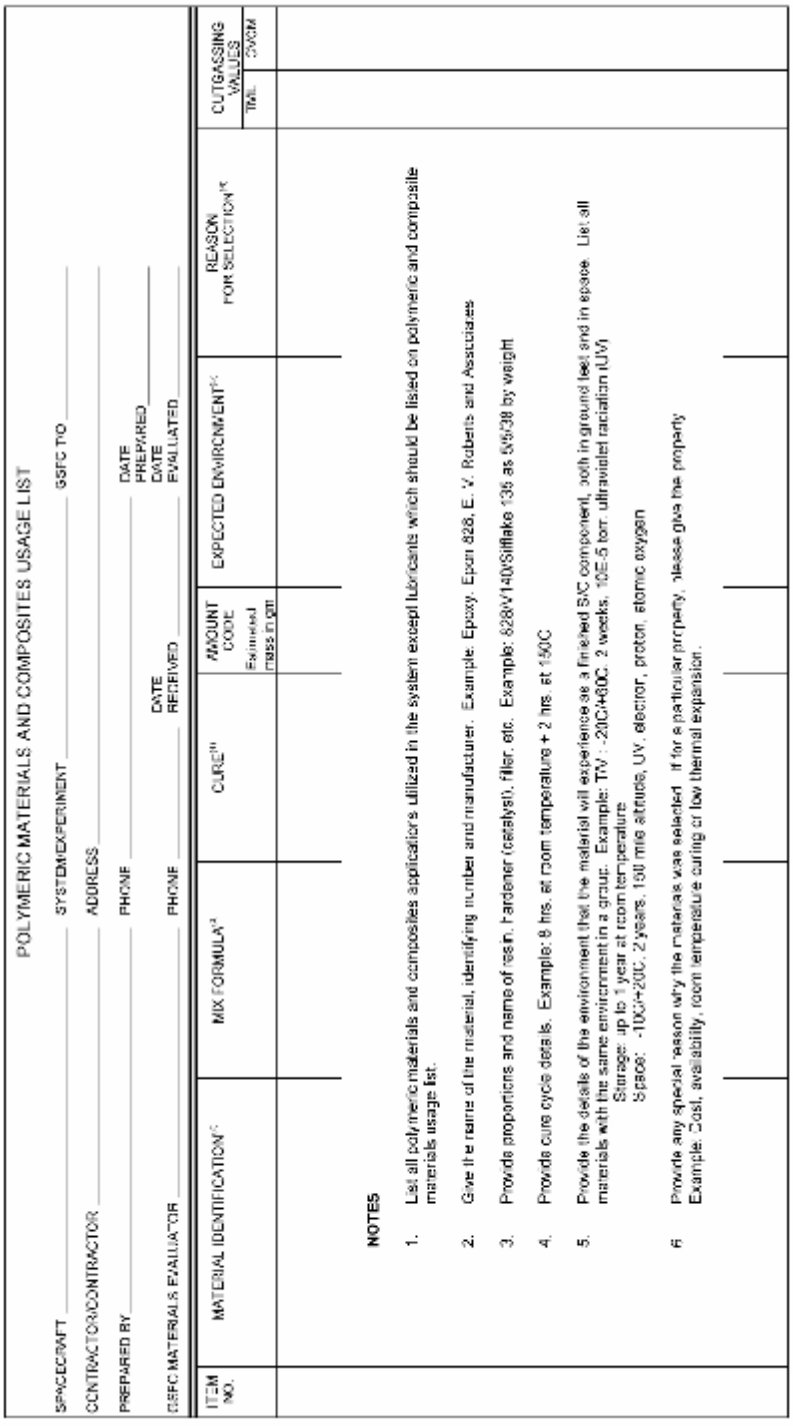
8.2.6 Lubrication

SCMAR445 8.2.6.0-1 The Contractor **shall** prepare and document a lubrication usage list (Lubrication Usage List SCMAR512) or the Contractor's equivalent.

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR446	8.2.6.0-2	The list **shall** be submitted to the PMCB for review and approval. The Contractor may be requested to submit supporting applications data.
SCMAR447	8.2.6.0-3	Lubricants **shall** be selected for use with materials on the basis of valid test results that confirm the suitability of the composition and the performance characteristics for each specific application, including compatibility with the anticipated environment and contamination effects.
SCMAR448	8.2.6.0-4	All lubricated mechanisms **shall** be qualified by life testing in accordance with the life test plan or heritage of an identical mechanism used in identical applications.
SCMAR449	8.3	**8.3 Process Selection Requirements**
SCMAR450	8.3.0-1	The Contractor **shall** prepare and document a material process utilization list or the Contractor's equivalent (Materials Process Utilization List SCMAR513). The list shall be submitted to the PMCB for review and approval. The Contractor may be requested to submit supporting applications data.
SCMAR451	8.3.0-2	A copy of any process **shall** be submitted for review upon request.
SCMAR452	8.3.0-3	Manufacturing processes (e.g., lubrication, heat treatment, welding, and chemical or metallic coatings) **shall** be carefully selected to prevent any unacceptable material property changes that could cause adverse effects of materials applications.
SCMAR453	8.4	**8.4 Procurement Requirements**
SCMAR454	8.4.1	**8.4.1 Purchased Raw Materials**
SCMAR455	8.4.1.0-1	Raw materials purchased by the Contractor and his suppliers **shall** be accompanied by the results of nondestructive, chemical and physical tests, or a Certificate of Compliance. This information need only be provided to PMCB when there is a direct question concerning the material's flightworthiness.
SCMAR510	8.4.1.0-2	

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR510 8.4.1.0-2 **Polymeric Materials and Composites Usage List** (for reference only)



POLYMERIC MATERIALS AND COMPOSITES USAGE LIST

SPACECRAFT _____ SYSTEM/EXPERIMENT _____ GSFC P/O _____

CONTRACTOR/CONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

GSFC MATERIALS EVALUATOR _____ PHONE _____ DATE RECEIVED _____ DATE EVALUATED _____

ITEM NO.	MATERIAL IDENTIFICATION[2]	MIX FORMULA[3]	CURE[4]	AMOUNT CODE (Estimated mass in gm	EXPECTED ENVIRONMENT[5]	REASON FOR SELECTION[6]	OUTGASSING VALUES TML	CVCM

NOTES

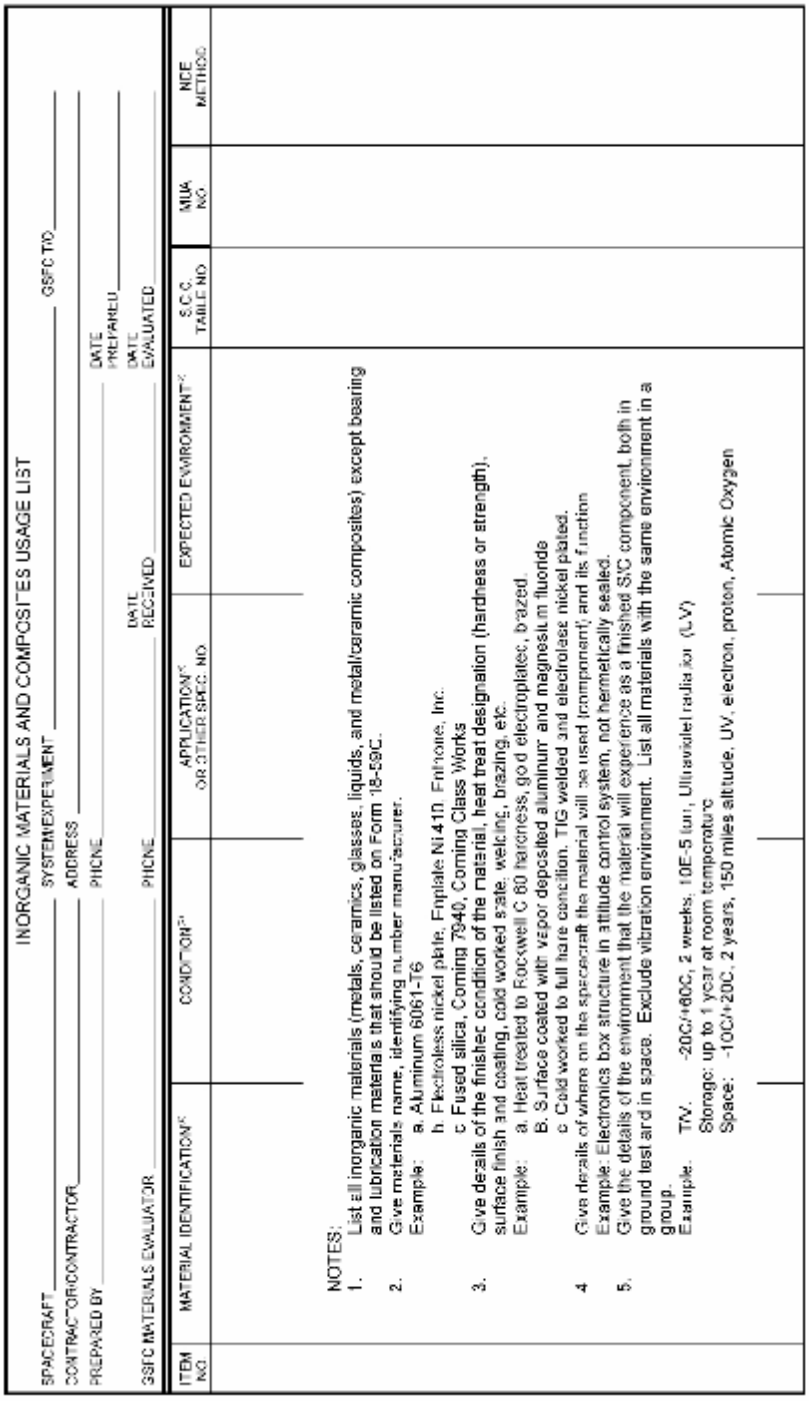
1. List all polymeric materials and composites applications utilized in the system except lubricants which should be listed on polymeric and composite materials usage list.
2. Give the name of the material, identifying number and manufacturer. Example: Epoxy, Epon 828, E. V. Roberts and Associates
3. Provide proportions and name of resin, hardener (catalyst), filler, etc. Example: 828/V140/Silflake 135 as 5/5/38 by weight
4. Provide cure cycle details. Example: 8 hrs. at room temperature + 2 hrs. at 150C
5. Provide the details of the environment that the material will experience as a finished S/C component, both in ground test and in space. List all materials with the same environment in a group. Example: T/V : -20C/+80C, 2 weeks, 10E-5 torr, ultraviolet radiation (UV)
   Storage: up to 1 year at room temperature
   Space: -100/+200C, 2 years, 100 mile altitude, UV, electron, proton, atomic oxygen
6. Provide any special reason why the materials was selected. If for a particular property, please give the property
   Example: Cost, availability, room temperature curing or low thermal expansion.

SCMAR511 8.4.1.0-3

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR511 8.4.1.0-3

Inorganic Materials and Composites Usage List (for reference only)



INORGANIC MATERIALS AND COMPOSITES USAGE LIST

SPACECRAFT _____ SYSTEM/EXPERIMENT _____ GSFC TID _____

CONTRACTOR/CONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

GSFC MATERIALS EVALUATOR _____ PHONE _____ DATE RECEIVED _____ DATE EVALUATED _____

ITEM NO	MATERIAL IDENTIFICATION[1]	CONDITION[2]	APPLICATION[3] OR OTHER SPEC. NO	EXPECTED ENVIRONMENT[4]	S.C.C. TABLE NO	MUA NO	NDE METHOD

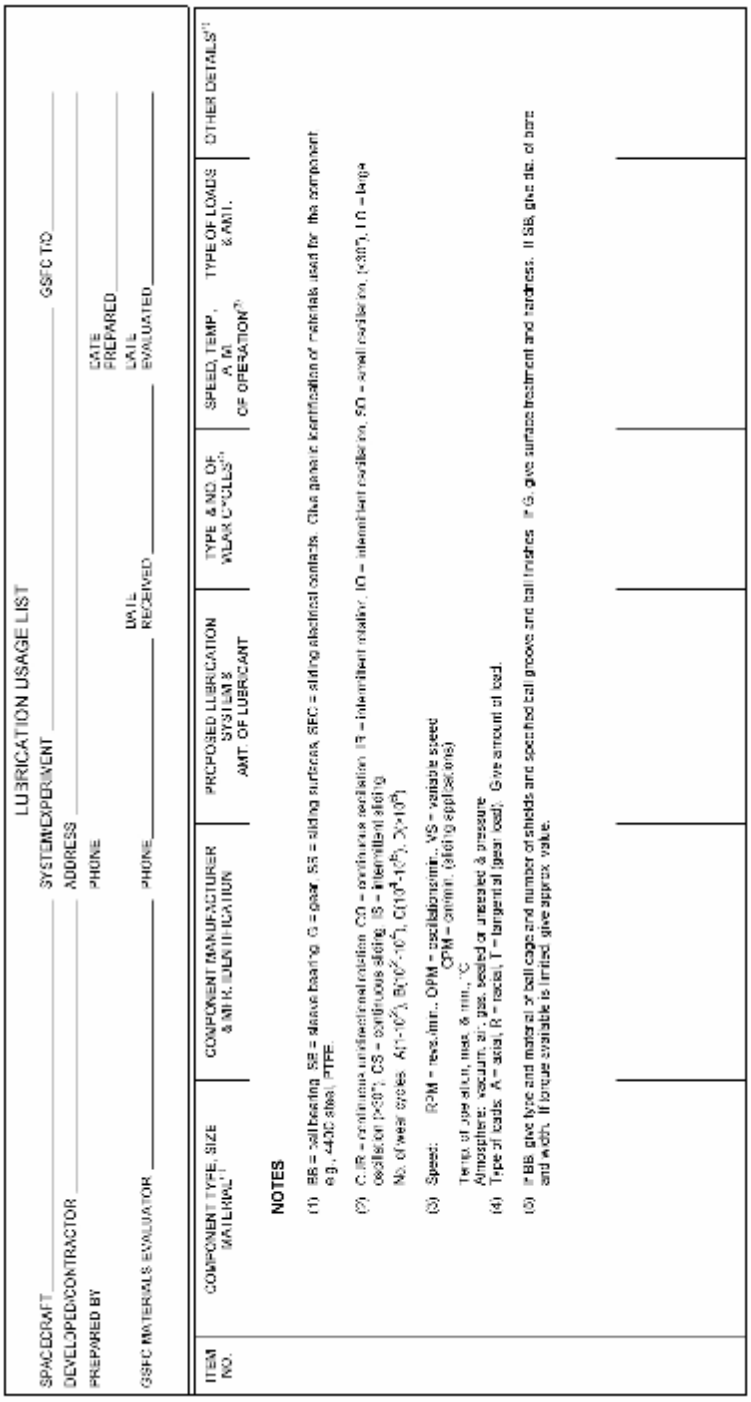
NOTES:

1. List all inorganic materials (metals, ceramics, glasses, liquids, and metal/ceramic composites) except bearing and lubrication materials that should be listed on Form 18-69C.
2. Give materials name, identifying number manufacturer.
   Example: a. Aluminum 6061-T6
   b. Electroless nickel plate, Finplate Ni 410 Finnone, Inc.
   c. Fused silica, Corning 7940, Corning Class Works
3. Give details of the finished condition of the material, heat treat designation (hardness or strength), surface finish and coating, cold worked state, welding, brazing, etc.
   Example: a. Heat treated to Rockwell C 60 hardness, gold electroplated, brazed
   B. Surface coated with vapor deposited aluminum and magnesium fluoride
   c. Cold worked to full hare condition. TIG welded and electroless nickel plated.
4. Give details of where on the spacecraft the material will be used (temporary) and its function
   Example: Electronics box structure in attitude control system, not hermetically sealed.
5. Give the details of the environment that the material will experience as a finished S/C component, both in ground test and in space. Exclude vibration environment. List all materials with the same environment in a group.
   Example: T/V: -20C/+60C, 2 weeks, 10E-5 torr, Ultraviolet radiation (LV)
   Storage: up to 1 year at room temperature
   Space: -10C/+20C, 2 years, 150 miles altitude, UV, electron, proton, Atomic Oxygen

SCMAR512 8.4.1.0-4

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR512 8.4.1.0-4 **Lubrication Usage** List (for reference only)



LUBRICATION USAGE LIST

SPACECRAFT _____ SYSTEM/EXPERIMENT _____ GSFC TO _____

DEVELOPER/CONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

GSFC MATERIALS EVALUATOR _____ PHONE _____ DATE RECEIVED _____ DATE EVALUATED _____

ITEM NO.	COMPONENT TYPE, SIZE (MATL/PART)[1]	COMPONENT MANUFACTURER & MFR. IDENTIFICATION	PROPOSED LUBRICATION SYSTEM & AMT. OF LUBRICANT	TYPE & NO. OF WEAR CYCLES[2]	SPEED, TEMP., & NO. OF OPERATION[3]	TYPE OF LOADS & AMT.	OTHER DETAILS[4]

NOTES

(1) BB = ball bearing, SB = sleeve bearing, G = gear, SS = sliding surfaces, SEC = sliding electrical contacts. Give generic identification of materials used for the component e.g., 440C steel, PTFE.

(2) C, IR = continuous unidirectional rotation, CO = continuous oscillation, IR = intermittent rotation, IO = intermittent oscillation, SO = small oscillation, (<30°), LO = large oscillation (>30°), CS = continuous sliding, IS = intermittent sliding
No. of wear cycles: A(1-10^4), B(10^4-10^5), C(10^5-10^6), D(>10^6)

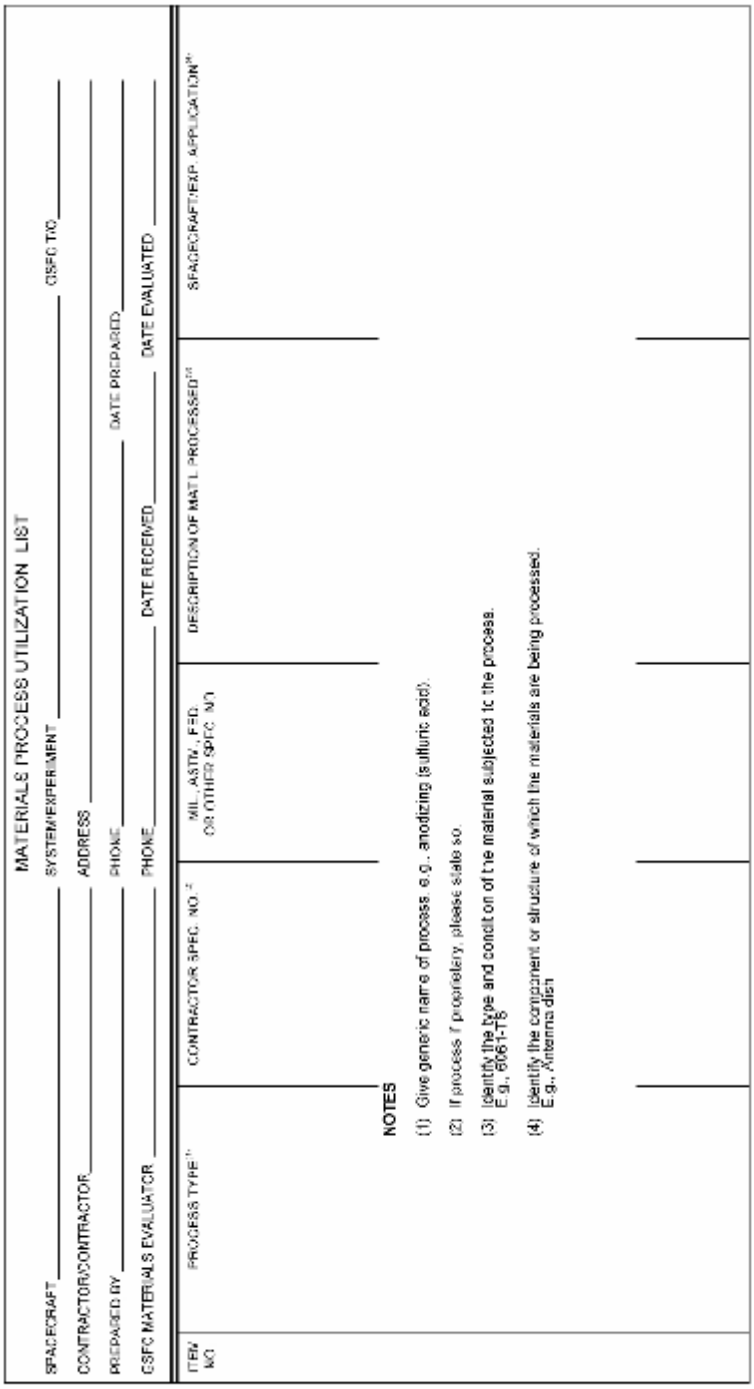
(3) Speed: RPM = revs./min., OPM = oscillations/min., VS = variable speed
OPM = gimbal (sling applications)
Temp. of operation, max. & min., °C
Atmosphere: vacuum, air, gas, sealed or unsealed & pressure
(4) Type of loads: A = axial, R = radial, T = tangential (gear load). Give amount of load

(5) If BB give type and material of ball cage and number of shields and specified ball groove and ball finishes. If G, give surface treatment and hardness. If SB, give dia. of bore and width. If torque available is limited, give approx. value.

SCMAR513 8.4.1.0-5

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR513 8.4.1.0-5 **Materials Process Utilization List** (for reference only)



MATERIALS PROCESS UTILIZATION LIST

SPACECRAFT _____ SYSTEM/EXPERIMENT _____ CSFC T/O _____

CONTRACTOR/CONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

CSFC MATERIALS EVALUATOR _____ PHONE _____ DATE RECEIVED _____ DATE EVALUATED _____

ITEM NO	PROCESS TYPE [1]	CONTRACTOR SPEC. NO. [2]	MIL, ASTM, FED OR OTHER SPEC. NO	DESCRIPTION OF MATL PROCESSED [3]	SPACECRAFT/EXP. APPLICATION [4]

NOTES

(1) Give generic name of process e.g., anodizing (sulfuric acid).

(2) If process if proprietary, please state so.

(3) Identify the type and condition of the material subjected to the process.
E.g., 6061-T6

(4) Identify the component or structure of which the materials are being processed.
E.g., Antenna dish

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR456	9	# 9 Design Verification Requirements
SCMAR457	9.1	## 9.1 General
SCMAR458	9.1.0-1	The following requirements represent only a portion of the overall system verification (i.e., contractor derived requirements are not described) that must be integrated into the total system program which verifies that the system will meet the mission requirements.
SCMAR459	9.1.0-2	The contractor **shall** establish a system performance verification program documenting the overall verification plan, implementation, and results which will provide traceability from mission specification requirements to launch and initial on-orbit capability. This will also provide the baseline for tracking on-orbit performance versus pre-launch capability.
SCMAR460	9.2	## 9.2 System Performance Verification Plan and Matrix
SCMAR461	9.2.0-1	A System Performance Verification Plan and Matrix, **shall** be prepared and delivered in accordance with the CDRL.
SCMAR462	9.3	## 9.3 Criteria for Unsatisfactory Performance
SCMAR463	9.3.1	## 9.3.1 General
SCMAR464	9.3.1.0-1	Failure or significant change, in performance of any test item **shall** be documented and processed in accordance with the following.
SCMAR465	9.3.1.0-2	Deterioration or change in performance of any test item that does or could in any manner prevent the item from meeting its functional, operational, or design requirements throughout its mission **shall** be reason to consider the test item as having failed. Other factors concerning failure are considered in the following paragraphs.
SCMAR466	9.3.1.1	### 9.3.1.1 Failure
SCMAR467	9.3.1.1.0-1	When a failure occurs, a determination **shall** be made as to the feasibility and value of continuing the test to it specified conclusion.
SCMAR468	9.3.1.1.0-2	If corrective action is taken, the test **shall** be repeated to the extent necessary to demonstrate that the test item's performance is satisfactory.
SCMAR469	9.3.1.2	### 9.3.1.2 Failure with Retroactive Effect
SCMAR470	9.3.1.2.0-1	If corrective action taken as a result of failure, e.g., redesign of a component, affects the validity of previously completed tests, prior tests **shall** be repeated to the extent necessary to demonstrate satisfactory performance.
SCMAR471	9.3.1.3	### 9.3.1.3 Failure Reporting
SCMAR472	9.3.1.3.0-1	Every failure **shall** be recorded and reported in accordance with the failure reporting provisions of SCMAR Section 2.
SCMAR473	9.3.1.4	### 9.3.1.4 Wear Out

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR474	9.3.1.4.0-1	A spare may be substituted if during a test sequence a test item is: a) Operated in excess of design life and wears out. b) Becomes unsuitable for further testing from causes other than deficiencies. If the substitution affects the significance of test results, the test during which the item was replaced and any previously completed tests that are affected **shall** be repeated to the extent necessary to demonstrate satisfactory performance.

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR476	10	**10 Electrostatic Discharge (ESD) Control**
SCMAR477	10.0-1	The contractor **shall** document and implement an ESD Control Program to assure that all manufacturing, inspection, testing, and other processes will not compromise mission objectives for quality and reliability due to ESD events.
SCMAR478	10.1	**10.1 Electrostatic Discharge Control Requirements**
SCMAR479	10.1.0-1	The contractor **shall** document and implement an ESD Control Program in accordance with ANSI/ESDS20.20, ESD Association Standard for the Development of an ESD Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) suitable to protect the most sensitive component involved.
SCMAR480	10.1.0-2	At a minimum, the ESD Control Program **shall** address training, protected work area procedures and verification schedules, packaging, facility maintenance, storage, and shipping.
SCMAR529	10.1.0-3	If design contains Class Zero Ultra Sensitive ESD devices, such as FPGAs, NASA’s GSFC-WM-001A procedure **shall** be imposed.
SCMAR481	10.1.0-4	The ESD Control Plan **shall** be submitted and approved in accordance with the CDRL.
SCMAR482	10.1.0-5	All personnel who manufacture, inspect, test, otherwise process electronic hardware, or require unescorted access into ESD protected areas **shall** be certified as having completed the required training, appropriate to their involvement, as defined in the contractor's quality manual prior to handling any electronic hardware.
SCMAR483	10.1.0-6	Electronic hardware **shall** be manufactured, inspected, tested, or otherwise processed only at designated ESD protective work areas.
SCMAR484	10.1.0-7	These work areas **shall** be verified on a regular schedule as identified in the contractor's ESD Control Program.
SCMAR485	10.1.0-8	Electronic hardware **shall** be properly packaged in ESD protective packaging at all times when not actively being manufactured, inspected, tested, or otherwise processed.

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR486	11	# 11 GIDEP Alerts and Problem Advisories
SCMAR487	11.1	## 11.1 GIDEP Participation
SCMAR488	11.1.0-1	The contractor and all subcontractors unless prohibited by export control regulations **shall** participate in the Government-Industry Data Exchange Program (GIDEP) in accordance with the requirements of the S0300-BT-PRO-010, GIDEP Operations Manual and S0300-BU-GYD-010 Government Industry Data Exchange Program Requirements Guide, available from the GIDEP Operations Center, PO Box 8000, Corona, California 91718-8000.
SCMAR489	11.1.0-2	The contractor **shall** review all GIDEP ALERTS, GIDEP SAFE-ALERTS, GIDEP Problem Advisories, GIDEP Agency Action Notices, and NASA Advisories to determine if they affect the contractors products produced for NASA.
SCMAR490	11.1.0-3	If a subcontractor is not a GIDEP participant, the contractor will solicit the necessary information from the subcontractor or may elect to determine any impact by its own review of subcontractor-supplied documentation, such as an As-Design or As-Built Parts List.
SCMAR491	11.1.0-4	The contractor **shall** review, document and submit impact statements of GIDEP reports and NASA advisories in accordance with the CDRL.
SCMAR530	11.1.0-5	Impact statements **shall** include whether affected part is being used and whether affected manufacturer is being used. If so, provide procured part number, lot date code for all affected device(s), and impact mitigation.
SCMAR492	11.1.0-6	For GIDEP ALERTS, GIDEP SAFE-ALERTS, GIDEP Problem Advisories, GIDEP Agency Action Notices, and NASA Advisories that are determined to affect the program, the contractor **shall** take action to eliminate or mitigate any negative effect to an acceptable level.
SCMAR493	11.1.0-7	The contractor **shall** generate the appropriate failure experience data report(s) (GIDEP ALERT, GIDEP S AFE-ALERT, GIDEP Problem Advisory) in accordance with the requirements of S0300-BT-PRO-010 and S0300-BU-GYD-010 whenever failed or nonconforming items, available to other buyers, are discovered during the course of the contract.
SCMAR494	11.1.0-8	NASA/GSFC will inform the contractor of all GIDEP reports and NASA Advisories that it deems to be of interest. The contractor **shall** distribute this information to its subcontractors and solicit their responses as to the impact of the document.

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR495	12	# 12 Applicable Documents List
SCMAR496	12.1	## 12.1 Applicable Documents
SCMAR497	12.1.0-1	**Section 2** ANSI/ISO/ASQ-Q9001 Rev. 2000, Quality Management Systems-Requirements ISO/IEC-17025 Rev. 1999, General Requirements for the Competence of Testing and Calibration Laboratories **Section 3** AFSPCMAN 91-710, Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements, July 2004. NPR 8621.1A, NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping, February 11, 2004 NPD 8710.3B, Policy for Limiting Orbital Debris Generation NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris NASA-STD-8719.8 “Expendable Launch Vehicle Payloads Safety Review Process Standard” **Section 4** MIL-HDBK-217 Rev. F, Change Notice 2, Reliability Prediction of Electronic Equipment, February, 1995 **Section 5** NASA-STD-8739.8, NASA Software Assurance Standard, July 28, 2004 NASA-STD-8719.13 NASA Software Safety Standard, July 8, 2005 NPR 7150.2, NASA Software Engineering Requirements, September 27, 2004 **Section 6** NASA-STD-8739.1, Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies, August 6, 1999 NASA-STD-8739.2, NASA Workmanship Standard for Surface Mount Technology, August 31, 1999 NASA-STD-8739.3, w/Change 2, Soldered Electrical Connections, January 18, 2001 NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring, February 9, 1998 NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation, February 9, 1998 NPR 6000.1G, Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment and Associated Components, March 28, 2005 IPC-2221 Rev A, Generic Standard on Printed Board Design, May 2003 IPC-2222, Sectional Design Standard for Rigid Organic Printed Boards, February 1998 IPC-2223, Sectional Design Standard for Flexible Printed Boards, November 1998 IPC-6011, Generic Performance Specification for Printed Boards, July 1996

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR497	12.1.0-1	IPC-6012B, Qualification and Performance Specification for Rigid Printed Boards, August 1, 2004 IPC-6013 Rev A, Qualification and Performance Specification for Flexible Printed Boards, November 2003 MIL-STD-981 Rev B(4), Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications **Section 7** GSFC EEE-INST-002, Instructions for EEE Parts Selecting Screening, Qualification, and Derating, May 2003 MIL-PRF-55365 Rev F., Capacitors, Chip, Fixed, Tantalum, Established Reliability, Style CWR11 (Metric) MIL-PRF-39003/10 Rev B (Am1), Capacitors, Fixed, Electrolytic (Solid Electrolyte) Tantalum, (Polarized, sintered slug), Established Reliability, Styles, CSS13 and CSS33 (High Reliability Applications) MIL-PRF 123 Rev C (sup. 1), Capacitors, Fixed, Ceramic Dielectric (Temperature Stable and General Purpose), High Reliability, General Specification for GSFC S-311-M70 Rev A, Specification for Destructive Physical Analysis. January 7, 1991 MIL-STD-981 Rev B(4), Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications 417-R-RPT-0027, The Radiation Environment for Electronic Devices on the GOES-R Series Satellites **Section 8** MSFC-STD-3029, Multi Program/Project Common-Use Document Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments Materials, Processes, and Manufacturing Department Metallic Materials and Processes Group, May 22, 2000 ASTM E-595 Rev 2007, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment MIL-STD-889 Rev. B (VN2), Dissimilar Metals 541-PG-8072.1.2, Goddard Space Flight Center Fastener Integrity Requirements, March 5, 2001 Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements, July 1, 2004 **Section 9** MIL-STD-461 Rev E, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment GSFC-STD-7000, General Environmental Verification Standard (GEVS) For GSFC Flight Programs and Projects **Section 10** ANSI/ESD-S20.20 Rev 1999, ESD Association Standard for the Development of an ESD Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR497	12.1.0-1	**Section 11** S0300-BT-PRO-01, GIDEP Operations Manual S0300-BU-GYD-01, Government-Industry Data Exchange Program Requirements Guide, November 1994 *(CCR 01153)*
SCMAR498	12.2	**12.2 Reference Documents**
SCMAR499	12.2.0-1	The following documents can be used as reference documents for the development of the performance verification test program. NASA-STD-7001, Payload Vibroacoustic Test Criteria NASA-STD-7002, Payload Test Requirements NASA-HDBK-4002, Avoiding Problems Caused by Spacecraft On-Orbit Internal Charging Effects MIL-HDBK-340 Rev. A, Test Requirements for Launch, Upper Stage, and Space Vehicles Vol. I: Baselines, Vol. II: Application Guidelines MIL-STD-1540 Rev. D, Product Verification Requirements for Launch, Upper stage, and Space Vehicles MIL-A-83577B, Assemblies, Moving Mechanical, for Space and Launch Vehicles, General Specification for DOD-HDBK-343, Design, Construction, and Testing Requirements for One of a Kind Space Equipment NPSL, NASA Part Selection List : <<http://nepp.nasa.gov/npsl>> GSFC-STD-1000, Goddard Space Flight Center Rules for the Design, Development, Verification, and Operation of Flight Systems TI-5212C_plastic_films_adhesive

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR500	13	**13 Acronyms and Glossary**
SCMAR501	13.1	**13.1 Acronyms**

SCMAR514 13.1.0-1

ABPL	As-Built Parts List
ADPL	As-Designed Parts List
AFSPCMAN	Air Force Space Command Manual
ANSI	American National Standards Institute
ASD	Acceleration Spectral Density
ASIC	Application Specific Integrated Circuits
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
BOL	Beginning of Life
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CIL	Critical Items List
CPT	Comprehensive Performance Test
CS	Conducted Susceptibility
CSI	Customer Source Inspections
CVCM	Collected Volatile Condensable Material
DCS	Data Collection System
DID	Data Item Description
DoD	Department of Defense
DPA	Destructive Physical Analysis
EEE	Electrical, Electronic, and Electromechanical
ELDR	Enhanced Low Dose Rate
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ER/WR	Eastern Range/Western Range
ESD	Electrostatic Discharge
FET	Field Effect Transistor
FRB	Failure Review Board
FMEA	Failure Modes and Effects Analysis
FTA	Fault Tree Analysis
GEVS-SE	General Environmental Verification Specification for STS & ELV Payloads, Subsystems, and Components
GIA	Government Inspection Agency
GIDEP	Government Industry Data Exchange Program
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
HDBK	Handbook
HP	Hewlett Packard
ICD	Interface Control Document
IEC	International Electrotechnical Commission
IESD	Internal Electrostatic Discharge
INS	Instruction
IPC	Association Connecting Electronics Industries
ISO	International Standards Organization
IV&V	Independent Verification and Validation
LPT	Limited Performance Test
MAR	Mission Assurance Requirements
MAT	Mission Allowable Temperatures

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document

SCMAR514 13.1.0-1

MCM	Multi-Chip Module
MEB	Materials Engineering Branch
MIL	Military
MITEQ	Microwave Information Transmission Equipment
MLI	Multilayered Insulation
MOSFET	Metal Oxide-Silicon Field Effect Transistor
MRB	Material Review Board
MSFC	Marshall Space Flight Center
MSPSP	Missile Systems Pre-Launch Safety Package
MUA	Materials Usage Agreement
NASA	National Aeronautics and Space Administration
NOMAT	Non Operational Mission Allowable Temperatures
NOT	Non-operational Temperatures
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NPR	NASA Procedural Requirements
NPSL	NASA Parts Selection List
NSPAR	Nonstandard Parts Approval Request
ODA	Orbital Debris Assessment
OHA	Operations Hazard Analysis
OMAT	Operational Mission Allowable Temperatures
OSHA	Occupational Safety & Health Administration
PAPL	Project Approved Parts List
PCB	Printed Circuit Board
PDA	Percentage of Defectives Allowable
PDR	Preliminary Design Review
PEM	Plastic Encapsulated Microcircuit
PG	Procedures and Guidelines
PHA	Preliminary Hazard Analysis
PIL	Parts Identification List
PIND	Particle Impact Noise Detection
PMCB	Parts and Materials Control Board
PMCP	Parts and Materials Control Plan
PORD	Performance and Operational Requirements Document
PPE	Project Parts Engineer
PRA	Probabilistic Risk Assessment
PRF	Performance Requirements For
PSM	Project Safety Manager
PWB	Printed Wiring Board
QMS	Quality Management System
QML	Qualified Manufacturers List
QPL	Qualified Parts List
RE	Radiation Engineer
RPP	Reliability Program Plan
RPT	Report
SAM	Systems Assurance Manager
SAR	Search and Rescue, Safety Assessment Report
S/C	Spacecraft
SCCB	Software Configuration Control Board
SCD	Source Control Drawing
SCM	Software Configuration Management
SDP	Safety Data Package
SEE	Single Event Effect
SEL	Single Event Latch-up
SET	Single Event Transient

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		SOW	Statement of Work
		SQA	Software Quality Assurance
		SSPP	System Safety Program Plan
		STD	Standard
		TB	Thermal Balance
		TBS	To be supplied
		TID	Total Ionizing Dose
		TIM	Technical Interface Meeting
		TML	Total Mass Loss
		TV	Thermal Vacuum
		VTL	Verification Tracking Log
		V&V	Verification and Validation

SCMAR502 13.2

13.2 Definitions

SCMAR503 13.2.0-1 The following definitions apply within the context of this document:

Acceptance Tests: The validation process that demonstrates that hardware is acceptable for flight. It also serves as a quality control screen to detect deficiencies and, normally, to provide the basis for delivery of an item under terms of a contract.

Audit: A review of the Contractor's, contractor's or subcontractor's documentation or hardware to verify that it complies with project requirements.

Close Call: An event. An occurrence or a condition of employee concern in which there is no injury or only minor injury requiring first aid and no significant equipment/property damage/mission failure (less than $1000), but which possesses a potential to cause a mishap.

Collected Volatile Condensable Material (CVCM): The quantity of outgassed matter from a test specimen that condenses on a collector maintained at a specific constant temperature for a specified time.

Configuration: The functional and physical characteristics of the payload and all its integral parts, assemblies and systems that are capable of fulfilling the fit, form and functional requirements defined by performance specifications and engineering drawings.

Configuration Control: The systematic evaluation, coordination, and formal approval/disapproval of proposed changes and implementation of all approved changes to the design and production of an item the configuration of which has been formally approved by the contractor or by the purchaser, or both.

Configuration Management: The systematic control and evaluation of all changes to baseline documentation and subsequent changes to that documentation which define the original scope of effort to be accomplished (contract and reference documentation) and the systematic control, identification, status accounting and verification of all configuration items.

Contamination: The presence of materials of molecular or particulate nature, which degrade the performance of hardware.

Component: See Level of Assembly

Derating: The reduction of the applied load (or rating) of a device to improve reliability or to permit operation at high ambient temperatures.

Designated Representative: An individual (such as a NASA plant representative), firm (such as

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assessment contractor), Department of Defense (DOD) plant representative, or other government representative designated and authorized by NASA to perform a specific function for NASA. As related to the contractor's effort, this may include evaluation, assessment, design review, participation, and review/approval of certain documents or actions.

Destructive Physical Analysis (DPA): An internal destructive examination of a finished part or device to assess design, workmanship, assembly, and any other processing associated with fabrication of the part.

Deviation: A written authorization accepting a known departure from requirements prior to any manufacturing taking place.

Discrepancy: See Nonconformance.

Design Qualification Tests: Tests intended to demonstrate that the test item will function within performance specifications under simulated conditions more severe than those expected from ground handling, launch, and orbital operations. Their purpose is to uncover deficiencies in design and method of manufacture. They are not intended to exceed design safety margins or to introduce unrealistic modes of failure. The design qualification tests may be to either “prototype” or “protoflight” test levels.

Discrepancy: See Nonconformance

Electromagnetic Compatibility (EMC): The condition that prevails when various electronic devices are performing their functions according to design in a common electromagnetic environment.

Electromagnetic Interference (EMI): Electromagnetic energy which interrupts, obstructs, or otherwise degrades or limits the effective performance of electrical equipment.

Electromagnetic Susceptibility: Undesired response by a component, subsystem, or system to conducted or radiated electromagnetic emissions.

Failure: A departure from specification that is discovered in the functioning or operation of the hardware or software. See nonconformance. Loss or degradation of designed-in redundant components shall be counted as failures.

Failure Modes and Effects Analysis (FMEA): A procedure by which each credible failure mode of each item from a low indenture level to the highest is analyzed to determine the effects on the system and to classify each potential failure mode in accordance with the severity of its effect.

Flight Acceptance: See Acceptance Tests.

Functional Tests: The operation of a unit in accordance with a defined operational procedure to determine whether performance is within the specified requirements.

Hardware: As used in this document, there are two major categories of hardware as follows:

a) **Prototype Hardware:** Hardware of a new design; it is subject to a design qualification test program; it is not intended for flight.

b) **Flight Hardware:** Hardware to be used operationally in space. It includes the following subsets:

1) **Protoflight Hardware:** Flight hardware of a new design; it is subject to a qualification test program that combines elements of prototype and flight acceptance validation; that is, the application of design qualification test levels and duration of flight acceptance tests.

2) **Follow-On Hardware:** Flight hardware built in accordance with a design that

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SCMAR503	13.2.0-1	has been qualified either as prototype or as protoflight hardware; follow-on hardware is subject to a flight acceptance test program. 3) **Spare Hardware:** Hardware the design of which has been proven in a design qualification test program; it is subject to a flight acceptance test program and is used to replace flight hardware that is no longer acceptable for flight.

Inspection: The process of measuring, examining, gauging, or otherwise comparing an article or service with specified requirements.

Level of Assembly: The environmental test requirements of GEVS generally start at the component or unit-level assembly and continue hardware/software build through the system level (referred to in GEVS as the payload or spacecraft level). The assurance program includes the part level. Validation testing may also include testing at the assembly and subassembly levels of assembly; for test record keeping these levels are combined into a "subassembly" level. The validation program continues through launch, and on-orbit performance. The following levels of assembly are used for describing test and analysis configurations:

- **Part:** A hardware element that is not normally subject to further subdivision or disassembly without destruction of design use. Examples include resistor, integrated circuit, relay, connector, bolt, and gaskets.
- **Subassembly:** A subdivision of an assembly. Examples are wire harness and loaded printed circuit boards.
- **Assembly:** A functional subdivision of a component consisting of parts or subassemblies that perform functions necessary for the operation of the component as a whole. Examples are a power amplifier and gyroscope.
- **Component or unit:** A functional subdivision of a subsystem and generally a self-contained combination of items performing a function necessary for the subsystem's operation. Examples are electronic box, transmitter, gyro package, actuator, motor, battery. For the purposes of this document, "component" and "unit" are used interchangeably.
- **Subsystem:** A functional subdivision of a payload consisting of two or more components. Examples are structural, attitude control, electrical power, and communication subsystems. Also included as subsystems of the payload are the science instruments or experiments.
- **Instrument:** A spacecraft subsystem consisting of sensors and associated hardware for making measurements or observations in space. For the purposes of this document, an instrument is considered a subsystem (of the spacecraft).

Limited Life Items: Spaceflight hardware (1) that has an expected failure-free life that is less than the projected mission life, when considering cumulative ground operation, storage and on-orbit operation, (2) limited shelf life material used to fabricate flight hardware.

Margin: The amount by which hardware capability exceeds mission requirements

Material Review Board (MRB): The formal Contractor board established for the purpose of reviewing, evaluating, and disposing of specific nonconforming materials, supplies or services, and for ensuring the implementation and accomplishment of corrective action to preclude recurrence.

Monitor: To keep track of the progress of a performance assurance activity; the monitor need not be present at the scene during the entire course of the activity, but he will review resulting data or other associated documentation (see Witness).

Nominal: The mission that will be accomplished if no problems occur.

Nonconformance: A condition of any hardware, software, material, or service in which one or more characteristics do not conform to requirements. As applied in quality assurance, nonconformance's fall into two categories--discrepancies and failures. A discrepancy is a departure from specification that is detected during inspection or process control testing, etc.,

ID	Object Number	417-R-SCMAR-0011, RM Version, Spacecraft Mission Assurance Requirements (SCMAR) Document
SCMAR503	13.2.0-1	while the hardware or software is not functioning or operating. A failure is a departure from specification that is discovered in the functioning or operation of the hardware or software. **Nonconformance, minor:** A nonconformance that is not likely to materially reduce the usability of the supplies or services for their intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the supplies or services. **Offgassing:** The emanation of volatile matter of any kind from materials into a manned pressurized volume. **Outgassing:** The emanation of volatile materials resulting in a mass loss and/or material condensation on nearby surfaces. **Protoflight Testing:** See Hardware. **Prototype Testing:** See Hardware. **Qualification:** See Design Qualification Tests. **Redundancy** (of design)**:** The use of more than one independent means of accomplishing a given function. **Repair:** A corrective maintenance action performed as a result of a failure so as to restore an item to operate within specified limits. **Rework:** Return for completion of operations (complete to drawing). The article shall be reprocessed to conform to the original specifications or drawings. **Single Point Failure:** A single element of hardware the failure of which would result in loss of mission objectives, hardware, or crew, as defined for the specific application or project for which a single point failure analysis is performed. **Software:** Computer programs, procedures, rules, and associated documentation and data pertaining to the development and operation of a computer system. Software also includes Commercial Off-the-Shelf (COTS), Government Off-the-Shelf (GOTS), Modified Off-the-Shelf (MOTS), embedded software, reuse, heritage, legacy, auto generated code, firmware (instructions, logic, or associated data loaded into programmable devices (e.g. ASICs and FPGAs), and open source software components. **Temperature Cycle:** A transition from some initial temperature condition to temperature stabilization at one extreme and then to temperature stabilization at the opposite extreme and returning to the initial temperature condition. **Thermal Balance Test:** A test conducted to verify the adequacy of the thermal model, the adequacy of the thermal design, and the capability of the thermal control system to maintain thermal conditions within established mission limits. **Thermal-Vacuum Test:** A test conducted to demonstrate the capability of the test item to operate satisfactorily in vacuum at temperatures based on those expected for the mission. The test, including the gradient shifts induced by cycling between temperature extremes, can also uncover latent defects in design, parts, and workmanship. **Total Mass Loss (TML):** Total mass of material outgassed from a specimen that is maintained at a specified constant temperature and operating pressure for a specified time. **Validation:** Proof that Operations Concept, Requirements, and Architecture and Design will meet Mission Objectives, that they are consistent, and that the "right system" has been designed.

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Verification: Proof of compliance with requirements and that the system has been "designed and built right." May be determined by a combination of test, analysis, and inspection.

Waiver: A written authorization to accept an item that is found to depart from specific requirements, either during the manufacturing process or after having been submitted for Government inspection or acceptance but nevertheless is considered “acceptable as is”, or after repair by an approved method.

Witness: A personal, on-the-scene observation of a performance assurance activity with the purpose of verifying compliance with project requirements (see Monitor).

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