NNG06HX12C

Geostationary Lightning Mapper (GLM)

CONTRACT

(2|9|06)

SOLICITATION, OFFER AND AWARD	1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)	RATING DO-C9	PAGE OF 1 ~~105~~ (A-J) 51

2. CONTRACT NO.	3. SOLICITATION NO.	4. TYPE OF SOLICITATION	5. DATE ISSUED	6. REQUISITION/PURCHASE NO.
NNG06HX12C	NNG05-088738R	NEGOTIATED (RFP)	02/09/2006	XXXXXXXX4200144986

7. ISSUED BY	CODE 210.Y	8. ADDRESS OFFER TO *(If other than Item 7)*
NASA/Goddard Space Flight Center 210.Y Procurement Branch Greenbelt Road Greenbelt, MD 20771		(See Section L.14 PROPOSAL MARKING AND DELIVERY)

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder"

SOLICITATION

9. Sealed offers in original and copies for furnishing the supplies or services in the Schedule will be received at the place specified in Item 8, or if hand carried, in the depository located in See **Section L.14 (Item 8 above)** until _____ local time **1:00 PM**.

CAUTION — LATE Submissions, Modifications, and Withdrawals: See Section L, Provision No. 52.214-7 or 52.215-1. All offers are subject to all terms and conditions contained in this solicitation.

10. FOR INFORMATION CALL:	A. NAME:	B. TELEPHONE NO. *(Include area code) (NO COLLECT CALLS)*	C. E-MAIL ADDRESS:

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OFFER ***(Must be fully completed by offeror)*** ***Filed with RFP documents.**

NOTE: Item 12 does not apply if the solicitation includes the provisions at 52.214-16, Minimum Bid Acceptance Period.

12. In compliance with the above, the undersigned agrees, if this offer is accepted within 180 calendar days *(180 calendar days unless a different period is inserted by the offeror)* from the date for receipt of offers specified above, to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the schedule.

13. DISCOUNT FOR PROMPT PAYMENT *(See Section I, Clause No. 52.232-8)*	10 CALENDAR DAYS %	20 CALENDAR DAYS %	30 CALENDAR DAYS %	CALENDAR DAYS %

14. ACKNOWLEDGMENT OF AMENDMENTS *(The offeror acknowledges receipt of amendments to the SOLICITATION for offerors and related documents Numbered and dated:*	AMENDMENT NO.	DATE	AMENDMENT NO.	DATE
	01	7/26/05	04	9/22/2005
	02	7/26/05	05	9/22/2005
	03	7/26/05		

15A. NAME AND ADDRESS OF OFFEROR	CODE 65113 FACILITY	16. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*
	Lockheed Martin Space Systems Co. **3251 Hanover Street** **Palo Alto, CA. 94304-1191**	**Stephen J. Aubuchon** **Contracts Negotiator, Sr.**

15B. TELEPHONE NO. *(Include area code)*	15C. CHECK IF REMITTANCE ADDRESS IS DIFFERENT FROM ABOVE – ENTER SUCH ADDRESS IN SCHEDULE.	17. SIGNATURE	18. OFFER DATE
650-354-5895	___	Stephen J Aubuchon	8/26/05

AWARD ***(To be completed by Government)***

19. ACCEPTED AS TO ITEMS NUMBERED All (see Clause B.1)	20. AMOUNT $	21. ACCOUNTING AND APPROPRIATION

22. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:	23. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified)*	ITEM 210.7
10 U.S.C. 2304(c) 41 U.S.C. 253(c)( )		

24. ADMINISTERED BY *(If other than Item 7)* CODE	25. PAYMENT WILL BE MADE BY CODE 155
	NASA Goddard Space Flight Center Cost and Commercial Accounts Department Greenbelt, MD 20771

26. NAME OF CONTRACTING OFFICER *(Type or print)*	27. UNITED STATES OF AMERICA	28. AWARD DATE
~~Tammy E. Seidel~~ **Donna L. Santos**	Donna L Santos *(Signature of Contracting Officer)*	02/09/2006

IMPORTANT – Award will be made on this Form, or on Standard Form 26, or by other authorized official written notice.

AUTHORIZED FOR LOCAL REPRODUCTION STANDARD FORM 33 (Rev. 9-97)
Previous edition is unusable
Prescribed by GSA - FAR (48 CFR) 53.214(c)

FILE COPY

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SECTION I--CONTRACT CLAUSES

SECTION J--LIST OF ATTACHMENTS

J. 1 LIST OF ATTACHMENTS (GSFC 52.211-101) (OCT 1988)

Attachment	Description
A	Statement of Work
B	Performance and Operational Requirements Document
C	Unique Instrument Interface Document
D	Mission Assurance Requirements
E	Small Business Subcontracting Plan
F	General Interface Requirements Documents

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SECTION B OF NNG06HX12C
SUPPLIES OR SERVICES AND PRICES/COSTS

B. 1 DELIVERABLE REQUIREMENTS (GSFC 52.211-90) (OCT 1988)

The contractor shall deliver all items specified below. Payment will be made in the amounts in the value column.

Item	Description	Reference	Quantity	Value
1	Kick-Off Review Plus Documentation	SOW 3.1	1	$250,000
2	Progress Review #1 Plus Documentation	SOW 3.2	1	$300,000
3	Mid-Term Review Plus Documentation	SOW 3.3	1	$650,000
4	Progress Review #2 Plus Documentation	SOW 3.2	1	$650,000
5	Formulation Phase Concept & Cost Review Plus Documentation	SOW 3.4	1	$50,000
6	Action Item Review Plus Documentation	SOW 3.5	1	$100,000
7	New Technology Reportable Items Reports	Clause G.3		Not Separately Priced
8	Small Business Subcontracting Reports SF294/295	Clause H.8		Not Separately Priced
9	VETS 100 Reporting	Section I.2 52.222-37		Not Separately Priced
10	IT Security Plan	Clause I.11 NFS 1852.204-76		Not Separately Priced

NFS 1852.204-76

End of Clause

B. 2 FIRM FIXED PRICE (1852.216-78) (DEC 1988)

The total firm fixed price of this contract is $2,000,000.

(End of clause)

SECTION C OF NNG06HX12C
DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

C. 1 SCOPE OF WORK (GSFC 52.211-91) (FEB 1991)

The Contractor shall provide the personnel, materials, and facilities necessary to provide a concept design of the Geostationary Lightning Mapper (GLM) and to furnish the items specified in Section B of this contract in accordance with the attachments listed in Section J of this contract. The detailed GLM requirements are referenced in the Statement of Work which is Attachment A to the RFP.

(End of clause)

C.2 REPORT OF WORK

(a) Kick-Off Review. The Kick-Off Review shall be conducted as set forth in the Statement of Work, paragraph 3.1. The Contractor shall provide an electronic copy of the preliminary version of the presentation materials, in Microsoft Office 97 or PDF format, via e-mail to the Contracting Officer and COTR, at least 2 calendar days prior to the review. The Contractor shall post the deliverable documents on the company's GOES-R web site after the review. The Contractor shall provide an electronic copy of the final version of the presentation materials 7 calendar days after the review.

(b) Progress Reviews. Progress Reviews Number 1 and 2 shall be conducted as set forth in the Statement of Work, paragraph 3.2. The Contractor shall provide an electronic copy of the preliminary version of the presentation materials, in Microsoft Office 97 or PDF format, via e-mail to the Contracting Officer and COTR, at least 7 calendar days prior to the review. The Contractor shall provide an electronic copy of the final version of the presentation materials 7 calendar days after the review and post the deliverable documents on the company's GOES-R web site after the review. System trade studies and systems analyses shall be delivered via the web page.

(c) Mid-Term Data Package. The Contractor shall submit a mid-term data package in accordance with the Statement of Work, paragraph 3.3. The data package shall consist of the Mid-Term Review viewgraph package with comprehensive facing page text. The Contractor shall provide an electronic copy of the preliminary version of the presentation materials, in Microsoft Office 97 or PDF format, via e-mail to the Contracting Officer and COTR, at least 14 calendar days prior to the review. The Contractor shall provide an electronic copy of the final version of the presentation materials 7 calendar days after the Mid Term Review, and post the documents on the company's GOES-R web site.

(d) Mid-Term Review. The Mid-Term Review shall be conducted in accordance with the Statement of Work, paragraph 3.3. The review presentation materials are to be provided as part of the Mid-Term Report as described in Section.

(e) Formulation Phase Concept and Cost Review (FPCCR). The FPCCR shall be conducted in accordance with the Statement of Work, paragraph 3.4. The Contractor shall provide an electronic copy of the preliminary version of the presentation materials, in Microsoft Office 97 or PDF format, via e-mail to the Contracting Officer and COTR, at least 14 calendar days prior to the review. The Contractor shall provide an electronic copy of the final version of the presentation materials 7 calendar days after the review and post the documents on the company's GOES-R web site after the review. System trade studies and systems analyses shall be delivered via the web page.

(f) Action Item Review. An action item review shall be conducted in accordance with the Statement of Work, paragraph 3.5. The Contractor shall provide an electronic copy of the preliminary version of the action item review presentation materials and the preliminary Final Report Package, in Microsoft Office via e-mail to the Contracting Officer and COTR, at least 14 calendar days prior to the review. The Contractor shall provide an electronic copy of the final version of the presentation materials 7 calendar days after the review and post the documents on the company's GOES-R web site immediately after the review.

The copies of the final report package will be provided to the Center for Aerospace Information and shall comply with NPG 2200.2A, "Guidelines for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information. Refer to NASA FAR Supplement clause 1852.235-70, "Center for Aerospace Information" and 1852.235-73, "Final Scientific and Technical Reports" of this contract. Information regarding appropriate electronic formats for final reports is available at http://www.sti.nasa.gov under "Publish STI – Electronic File Formats". The last page of the final report shall be a completed Standard Form (SF) 298, Report Documentation Page.

(g) Final Report Package. The Final Report package shall be submitted in accordance with the Statement of Work, paragraph 3.6. The Final Report Package shall consist of the FPCCR package with facing text and any changes due to action items from the FPCCR. In addition, the report will also show a compilation of all products that document the work performed under the Formulation Phase. This Final Report Package will satisfy the requirements listed in Section C, Subsection C.3 (a).

(h) Submission. In addition to the submission of electronic copies, as set forth in (a) through (g), the Contractor shall submit 1 hard copy of the final versions of the documentation to the addressees list below the same day as posted to the contractor's web site:

Copies	Item	Addressee	Mail Code
1	a,b,c d,e,f,g,	Contracting Officer	210.6
1	a,b,c e,d,f,g,	Contracting Officer's Technical Representative (COTR)	417
1	a,b,c d,e,f,g,	GOES-R Instrument Systems Manager	417
1	a,b,c d,e,f,g	GOES-R Project Library	417
1	a,b,c,d ,e,f.g	NOAA Representative	417
1	d,e,f,	Technical Information	293
2	e,g	Center for Aerospace Information (CASI)	

Acquisitions Collections Development Specialist
Parkway Center
7121 Standard Drive
Hanover, MD 21076-1320

In addition, the Contractor shall provide at least 25 hard copies to the Government at each review.

(End of Clause)

C. 3 FINAL SCIENTIFIC AND TECHNICAL REPORTS (1852.235-73)(FEB 2003)

(a) The Contractor shall submit to the Contracting Officer a final report that summarizes the results of the entire contract, including recommendations and conclusions based on the experience and results obtained. The final report should include tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to explain comprehensively the results achieved under the contract.

(b) The final report shall be of a quality suitable for publication and shall follow the formatting and stylistic guidelines contained in NPG 2200.2A, Guidelines for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information. Electronic formats for submission of reports should be used to the maximum extent practical. Before electronically submitting reports containing scientific and technical information (STI) that is export-controlled or limited or restricted, contact the Contracting Officer to determine the requirements to electronically transmit these forms of STI. If appropriate electronic safeguards are not available at the time of submission, a paper copy or a CD-ROM of the report shall be required. Information regarding appropriate electronic formats for final reports is available at http://www.sti.nasa.gov under "Publish STI – Electronic File Formats."

(c) The last page of the final report shall be a completed Standard Form (SF) 298, Report Documentation Page.

(d) In addition to the final report submitted to the Contracting Officer, the Contractor should concurrently provide to the Center STI/Publication Manager and the NASA Center for Aerospace Information (CASI) a copy of the letter transmitting the final report to the Contracting Officer. The copy of the letter shall be submitted to CASI at the following address:

Center for Aerospace Information (CASI)
Attn: Acquisitions Collections Development Specialist
7121 Standard Drive
Hanover, Maryland 21076-1320

(e) In accordance with paragraph (d) of the Rights in Data --General clause (52.227-14) of this contract, the Contractor may publish, or otherwise disseminate, data produced during the performance of this contract, including data contained in the final report, and any additional reports required by 1852.235-74 when included in the contract, without prior review by NASA. The Contractor is responsible for reviewing publication or dissemination of the data for conformance with laws and regulations governing its distribution, including intellectual property rights, export control, national security and other requirements, and to the extent the contractor receives or is given access to data necessary for the performance of the contract which contain restrictive markings, for complying with such restrictive markings. Should the

Contractor seek to publish or otherwise disseminate the final report, or any additional reports required by 1852.235-74 if applicable, as delivered to NASA under this contract, the Contractor may do so once NASA has completed its document availability authorization review, and availability of the report has been determined.

*The final report shall be the Formulation Preliminary Concept and Cost Review package (FPCCR) as defined in the GLM SOW.

(End of clause)

C.4 LIMITED RIGHTS DATA OR RESTRICTED COMPUTER SOFTWARE (GSFC 52.227-90) (OCT 1988)

In accordance with the Rights in Data – General clause of this contract, the following * shall be delivered in accordance with the delivery requirements for the data and /or software, specified elsewhere in this contract.

Note: * None identified at this time, however, as this is a Formulation Phase, this does not preclude the fact that there may be limited rights data or restricted computer software identified in the future.

(End of clause)

SECTION D OF NNG06HX12C
PACKAGING AND MARKING

[THERE ARE NO CLAUSES IN THIS SECTION.]

SECTION E OF NNG06HX12C
INSPECTION AND ACCEPTANCE

E. 1 ACCEPTANCE—SINGLE LOCATION (GSFC 52.246-92) (SEP 1989)

The Contracting Officer or authorized representative will accomplish acceptance at Goddard Space Flight Center, Greenbelt, Maryland. For the purpose of this clause, the Contracting Officer's Technical Representative named in this contract is the authorized representative. The Contracting Officer reserves the right to unilaterally designate a different Government agent as the authorized representative. The Contractor will be notified by a written notice or by a copy of the delegation of authority if different representative are designated.

If this is a fixed price type contract, acceptance shall be deemed to have occurred constructively--for the sole purpose of computing an interest penalty that might be due the Contractor under the Prompt Payment Act--on the 30th day after the Contractor has delivered the supplies or services in accordance with the terms and conditions of the contract. In the event that actual acceptance occurs within the constructive acceptance period, the determination of an interest penalty shall be based on the date of the actual acceptance.

(End of clause)

E. 2 INSPECTION SYSTEM RECORDS (GSFC 52.246-102) (OCT 1988)

The Contractor shall maintain records evidencing inspections in accordance with the Inspection clause of this contract for two (2) years after delivery of all items and/or completion of all services called for by the contract.

(End of clause)

E.3 INSPECTION OF RESEARCH AND DEVELOPMENT (SHORT FORM) (52.246-9) (APR 1984)

The Government has the right to inspect and evaluate the work performed or being performed under the contract, and the premises where the work is being performed, at all reasonable times and in a manner that will not unduly delay the work. If the Government performs inspection or evaluation on the premises of the Contractor or a subcontractor, the Contractor shall furnish and shall require subcontractors to furnish all reasonable facilities and assistance for the safe and convenient performance of these duties.

(End of clause)

SECTION F OF NNG06HX12C
DELIVERIES OR PERFORMANCE

F. 1 DELIVERY SCHEDULE (GSFC 52.211-96) (SEP 1998)

The items required by this contract shall be delivered as follows:

Item	Description	Quantity	Date
1	Kick-Off Review Plus Documentation	1 Meeting	2 weeks After Contract Award
2	Progress Review #1 Plus Documentation	1 Meeting	3 months After Contract Award
3	Mid-Term Review Plus Documentation	1 Meeting	6 months After Contract Award
4	Progress Review #2 Plus Documentation	1 Meeting	9 months After Contract Award
5	Formulation Phase Concept & Cost Review Plus Documentation	1 Meeting	11 months After Contract Award
6	Action Item Review Plus Documentation	1 Meeting	12 months After Contract Award
7	New Technology Reportable Items Reports	Clause G.3	No specific date is required. The reports are due only if and when required under the terms and conditions of clause G.3
8	Small Business Subcontracting Reports SF294/295	Clause H.8	As Required by Clause H.8
9	VETS 100 Reporting	Section I.2 52.222-37	As required in I.2 Clause 52.222-37
10	IT Security Plan	Clause I.11 NFS 1852.204-76	As required by Clause I.11 NFS 1852.204-76

(End of clause)

F. 2 SHIPPING INSTRUCTIONS—NON-CENTRAL RECEIVING (GSFC 52.247-95) (OCT 1988)

Shipment of the items required under this contract shall be to:

Item	Address	Marked For
All	National Aeronautics & Space Administration Goddard Space Flight Center Building 16W, Room N90 Code 210.6 Greenbelt, Maryland 20771	Contracting Officer & *COTR

*Compliance with this clause is necessary to assure verification of delivery and acceptance and prompt payment. All reports shall be delivered to the Contracting Officer via U.S. Mail or commercial carriers, such as Federal Express, Airborne, DHL or United Parcel Service.

(End of clause)

F. 3 STOP-WORK ORDER (52.242-15) (AUG 1989)

(a) The Contracting Officer may, at any time, by written order to the Contractor, require the Contractor to stop all, or any part, of the work called for by this contract for a period of 90 days after the order is delivered to the Contractor, and for any further period to which the parties may agree. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Within a period of 90 days after a stop-work order is delivered to the Contractor, or within any extension of that period to which the parties shall have agreed, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled or the period of the order or any extension thereof expires, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to the adjustment within 30 days after the end of the period of work stoppage; provided, that, if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon the claim submitted at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(End of clause)

F.4 PLACE OF PERFORMANCE

The services specified by this contract shall be performed at the following location:
Lockheed Martin Space Systems Company
3251 Hanover Street
Palo Alto, California 94304-1911

(End of Provision)

F.5 F.O.B. DESTINATION (52.247-34) (NOV 1991)

(a) The term "f.o.b. destination," as used in this clause, means--

(1) Free of expense to the Government, on board the carrier's conveyance, at a specified delivery point where the consignee's facility (plant, warehouse, store, lot, or other location to which shipment can be made) is located, and

(2) Supplies shall be delivered to the destination consignee's wharf (if destination is a port city and supplies are for export), warehouse unloading platform, or receiving dock, at the expense of the Contractor. The Government shall not be liable for any delivery, storage, demurrage, accessorial, or other charges involved before the actual delivery (or "constructive placement" as defined in carrier tariffs) of the supplies to the destination, unless such charges are caused by an act or order of the Government acting in its contractual capacity. If rail carrier is used, supplies shall be delivered to the specified unloading platform of the consignee. If motor carrier (including "piggyback") is used, supplies shall be delivered to truck tailgate at the unloading platform of the consignee, except when the supplies delivered meet the requirements of Item 568 of the National Motor Freight Classification for "heavy or bulky freight". When supplies meeting the requirements of the referenced Item 568 are delivered, unloading (including movement to the tailgate) shall be performed by the consignee, with assistance from the truck driver, if requested. If the Contractor uses rail carrier or freight forwarder for less than carload shipments, the Contractor shall ensure that the carrier will furnish tailgate delivery, when required, if transfer to truck is required to complete delivery to consignee.

(b) The Contractor shall--

(1) (i) Pack and mark the shipment to comply with contract specifications; or

(ii) In the absence of specifications, prepare the shipment in conformance with carrier requirements;

(2) Prepare and distribute commercial bills of lading;

(3) Deliver the shipment in good order and condition to the point of delivery specified in the contract;

(4) Be responsible for any loss of and/or damage to the goods occurring before receipt of the shipment by the consignee at the delivery point specified in the contract;

(5) Furnish a delivery schedule and designate the mode of delivering carrier; and

(6) Pay and bear all charges to the specified point of delivery.

(End of clause)

SECTION G OF NNG06HX12C
CONTRACT ADMINISTRATION DATA

G. 1 INVOICES – SUBMISSION OF (GSFC 52.232-95) (AUG 2000)

Invoices shall be prepared in accordance with the Prompt Payment clause of this contract and submitted to the Cost and Commercial Accounts Department, Code 155, NASA/Goddard Space Flight Center, Greenbelt, MD 20771. For purposes of the Prompt Payment Act, the above office is considered to be the "Designated Billing Office" and the "Designated Payment Office".

(End of clause)

G. 2 NEW TECHNOLOGY (1852.227-70) (MAY 2002)

(a) Definitions.

(1) "Administrator," as used in this clause, means the Administrator of the National Aeronautics and Space Administration (NASA) or duly authorized representative.

(2) "Contract," as used in this clause, means any actual or proposed contract, agreement, understanding, or other arrangement, and includes any assignment, substitution of parties, or subcontract executed or entered into there under.

(3) "Made," as used in this clause, means conception or first actual reduction to practice; provided, that in the case of a variety of plant, the date of determination (as defined in Section 41(d) of the Plant Variety Protection Act, 7 U.S.C. 2401(d) shall also occur during the period of contract performance.

(4) "Nonprofit organization," as used in this clause, means a domestic university or other institution of higher education or an organization of the type described in section 501(c)(3) of the Internal Revenue Code of 1954 (26 U.S.C. 501(c)) and exempt from taxation under section 501(a) of the Internal Revenue Code (26 U.S.C. 501(a)), or any domestic nonprofit scientific or educational organization qualified under a State nonprofit organization statute.

(5) "Practical application," as used in this clause, means to manufacture, in the case of a composition or product; to practice, in the case of a process or method; or to operate, in case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are, to the extent permitted by law or Government regulations, available to the public on reasonable terms.

(6) "Reportable item," as used in this clause, means any invention, discovery, improvement, or innovation of the Contractor, whether or not patentable or otherwise protected under Title 35 of the United States Code, made in performance of any work under any NASA contract or in the performance of any work that is reimbursable under any clause in any NASA contract providing for reimbursement of costs incurred before the effective date of the contract. Reportable items include, but are not limited to, new processes, machines, manufactures, and compositions of matter, and improvements to, or new applications of, existing processes, machines, manufactures, and compositions of matter. Reportable items also include new computer programs, and improvements to, or new

applications of, existing computer programs, whether or not copyrightable or otherwise protected under Title 17 of the United States Code.

(7) "Small business firm," as used in this clause means a domestic small business concern as defined at 15 U.S.C. 632 and implementing regulations of the Administrator of the Small Business Administration. (For the purpose of this definition, the size standard contained in 13 CFR 121.3-8 for small business contractors and in 13 CFR 121.3-12 for small business subcontractors will be used.)

(8) "Subject invention," as used in this clause, means any reportable item, which is, or may be patentable or otherwise protected under Title 35 of the United States Code, or any novel variety of plant that is or maybe protected under the Plant Variety Protection Act (7 U.S.C. 2321, et seq.).

(b) Allocation of principal rights.

(1) Presumption of title.

(i) Any reportable item that the Administrator considers to be a subject invention shall be presumed to have been made in the manner specified in paragraph (1) or (2) of Section 305(a) of the National Aeronautics and Space Act of 1958 (42 U.S.C. 2457(a)) (hereinafter called "the Act"), and the above presumption shall be Contractor submits to the Contracting Officer a written statement, containing supporting details, demonstrating that the reportable item was not made in the manner specified in paragraph (1) or (2) of Section 305(a) of the Act.

(ii) Regardless of whether title to a given subject invention would otherwise be subject to an advance waiver or is the subject of a petition for waiver, the Contractor may nevertheless file the statement described in paragraph (b)(1)(i) of this clause. The Administrator will review the information furnished by the Contractor in any such statement and any other available information relating to the circumstances surrounding the making of the subject invention and will notify the Contractor whether the Administrator has determined that the subject invention was made in the manner specified in paragraph (1) or (2) of Section 305(a) of the Act.

(2) Property rights in subject inventions.

Each subject invention for which the presumption of paragraph (b)(1)(i) above is conclusive, or for which there has been a determination that it was made in the manner specified in paragraph (1) or (2) of Section 305(a) of the Act, shall be the exclusive property of the United States as represented by NASA unless the Administrator waives all or any part of the rights of the United States, as provided in paragraph (b)(3) of this clause.

(3) Waiver of rights.

(i) Section 305(f) of the Act provides for the promulgation of regulations by which the Administrator may waive the rights of the United States with respect to any invention or class

of inventions made or that may be made under conditions specified in paragraph (1) or (2) of Section 305(a) of the Act. The promulgated NASA Patent Waiver Regulations, 14 CFR Section 1245, Subpart 1, have adopted the Presidential Memorandum on Government Patent Policy of February 18, 1983, as a guide in acting on petitions (requests) for such waiver of rights.

(ii) As provided in 14 CFR 1245, Subpart 1, Contractors may petition, either prior to execution of the contract or within 30 days after execution of the contract, for advance waiver of rights to any or all of the inventions that may be made under a contract. If such a petition is not submitted, or if after submission it is denied, the Contractor (or an employee inventor of the Contractor) may petition for waiver of rights to an identified subject invention within 8 months of first disclosure of invention pursuant to paragraph (e)(2) of this clause, or within such longer period as may be authorized in accordance with 14 CFR 1245.105.

(c) Minimum rights reserved by the Government.

(1) With respect to each subject invention for which a waiver of rights is applicable pursuant to 14 CFR Section 1245, Subpart 1, the Government reserves--

(i) An irrevocable, nonexclusive, nontransferable, royalty-free license for the practice of such invention throughout the world by or on behalf of the United States or any foreign government pursuant to any treaty or agreement with the United States; and

(ii) Such other rights as set forth in 14 CFR 1245.107.

(2) Nothing contained in this paragraph (c) shall be considered to grant to the Government any rights with respect to any invention other than a subject invention.

(d) Minimum rights to the Contractor.

(1) The Contractor is hereby granted a revocable, nonexclusive, royalty-free license in each patent application filed in any country on a subject invention and any resulting patent in which the Government acquires title, unless the Contractor fails to disclose the subject invention within the times specified in paragraph (e)(2) of this clause. The Contractor's license extends to its domestic subsidiaries and affiliates, if any, within the corporate structure of which the Contractor is a party and includes the right to grant sublicenses of the same scope to the extent the Contractor was legally obligated to do so at the time the contract was awarded. The license is transferable only with the approval of the Administrator except when transferred to the successor of that part of the Contractor's business to which the invention pertains.

(2) The Contractor's domestic license may be revoked or modified by the Administrator to the extent necessary to achieve expeditious practical application of the subject invention pursuant to an application for an exclusive license submitted in accordance with 37 CFR Part 404, Licensing of Government Owned Inventions. This license will not be revoked in that field of use or the geographical areas in which the Contractor has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of the Administrator to the extent the

Contractor, its licensees, or its domestic subsidiaries or affiliates have failed to achieve practical application in that foreign country.

(3) Before revocation or modification of the license, the Contractor will be provided a written notice of the Administrator's intention to revoke or modify the license, and the Contractor will be allowed 30 days (or such other time as may be authorized by the Administrator for good cause shown by the Contractor) after the notice to show cause why the license should not be revoked or modified. The Contractor has the right to appeal to the Administrator any decision concerning the revocation or modification of its license.

(e) Invention identification, disclosures, and reports.

(1) The Contractor shall establish and maintain active and effective procedures to assure that reportable items are promptly identified and disclosed to Contractor personnel responsible for the administration of this New Technology clause within 6 months of conception and/or first actual reduction to practice, whichever occurs first in the performance of work under this contract. These procedures shall include the maintenance of laboratory notebooks or equivalent records and other records as are reasonably necessary to document the conception and/or the first actual reduction to practice of the reportable items, and records that show that the procedures for identifying and disclosing reportable items are followed. Upon request, the Contractor shall furnish the Contracting Officer a description of such procedures for evaluation and for determination as to their effectiveness.

(2) The Contractor will disclose each reportable item to the Contracting Officer within two months after the inventor discloses it in writing to Contractor personnel responsible for the administration of this New Technology clause or, if earlier, within 6 months after the Contractor becomes aware that a reportable item has been made, but in any event for subject inventions before any on sale, public use, or publication of such invention known to the Contractor. The disclosure to the agency shall be in the form of a written report and shall identify the contract under which the reportable item was made and the inventor(s) or innovator(s). It shall be sufficiently complete in technical detail to convey a clear understanding, to the extent known at the time of the disclosure, of the nature, purpose, operation, and physical, chemical, biological, or electrical characteristics of the reportable item. The disclosure shall also identify any publication, on sale, or public use of any subject invention and whether a manuscript describing such invention has been submitted for publication and, if so, whether it has been accepted for publication at the time of disclosure. In addition, after disclosure to the agency, the Contractor will promptly notify the agency of the acceptance of any manuscript describing a subject invention for publication or of any on sale or public use planned by the Contractor for such invention.

(3) The Contractor may use whatever format is convenient to disclose reportable items required in subparagraph (e)(2). NASA prefers that the Contractor use either the electronic or paper version of NASA Form 1679, Disclosure of Invention and New Technology (Including Software) to disclose reportable items. Both the electronic and paper versions of NASA Form 1679 may be accessed at the electronic New Technology Reporting Web site http://invention.nasa.gov.

(4) The Contractor shall furnish the Contracting Officer the following:

(i) Interim reports every 12 months (or such longer period as may be specified by the Contracting Officer) from the date of the contract, listing reportable items during that period, and certifying that all reportable items have been disclosed (or that there are no such inventions) and that the procedures required by paragraph (e)(1) of this clause have been followed.

(ii) A final report, within 3 months after completion of the contracted work, listing all reportable items or certifying that there were no such reportable items, and listing all subcontracts at any tier containing a patent rights clause or certifying that there were no such subcontracts.

(4) The Contractor agrees, upon written request of the Contracting Officer, to furnish additional technical and other information available to the Contractor as is necessary for the preparation of a patent application on a subject invention and for the prosecution of the patent application, and to execute all papers necessary to file patent applications on subject inventions and to establish the Government's rights in the subject inventions.

(5) The Contractor agrees, subject to paragraph 27.302(i), of the Federal Acquisition Regulation (FAR), that the Government may duplicate and disclose subject invention disclosures and all other reports and papers furnished or required to be furnished pursuant to this clause.

(f) Examination of records relating to inventions.

(1) The Contracting Officer or any authorized representative shall, until 3 years after final payment under this contract, have the right to examine any books (including laboratory notebooks), records, and documents of the Contractor relating to the conception or first actual reduction to practice of inventions in the same field of technology as the work under this contract to determine whether--

(i) Any such inventions are subject inventions;
(ii) The Contractor has established and maintained the procedures required by paragraph (e)(1) of this clause; and

(iii)The Contractor and its inventors have complied with the procedures.

(2) If the Contracting Officer learns of an unreported Contract invention that the Contracting Officer believes may be a subject invention, the Contractor may be required to disclose the invention to the agency for a determination of ownership rights.

(3) Any examination of records under this paragraph will be subject to appropriate conditions to protect the confidentiality of the information involved.

(g) Withholding of payment (this paragraph does not apply to subcontracts).

(1) Any time before final payment under this contract, the Contracting Officer may, in the

Government's interest, withhold payment until a reserve not exceeding $50,000 or 5 percent of the amount of this contract whichever is less, shall have been set aside if, in the Contracting Officer's opinion, the Contractor fails to--

(i) Establish, maintain, and follow effective procedures for identifying and disclosing reportable items pursuant to paragraph (e)(1) of this clause;

(ii) Disclose any reportable items pursuant to paragraph (e)(2) of this clause;

(iii) Deliver acceptable interim reports pursuant to paragraph (e)(3)(I) of this clause; or

(iv) Provide the information regarding subcontracts pursuant to paragraph (h)(4) of this clause.

(2) Such reserve or balance shall be withheld until the Contracting Officer has determined that the Contractor has rectified whatever deficiencies exist and has delivered all reports, disclosures, and other information required by this clause.

(3) Final payment under this contract shall not be made before the Contractor delivers to the Contracting Officer all disclosures of reportable items required by paragraph (e)(2) of this clause, and an acceptable final report pursuant to paragraph (e)(3)(ii) of this clause.

(4) The Contracting Officer may decrease or increase the sums withheld up to the maximum authorized above. No amount shall be withheld under this paragraph while the amount specified by this paragraph is being withheld under other provisions of the contract. The withholding of any amount or the subsequent payment thereof shall not be construed as a waiver of any Government rights.

(h) Subcontracts.

(1) Unless otherwise authorized or directed by the Contracting Officer, the Contractor shall--

(i) Include this clause (suitably modified to identify the parties) in any subcontract hereunder (regardless of tier) with other than a small business firm or nonprofit organization for the performance of experimental, developmental, or research work; and

(ii) Include the clause at FAR 52.227-11 (suitably modified to identify the parties) in any subcontract hereunder (regardless of tier) with a small business firm or nonprofit organization for the performance of experimental, developmental, or research work.

(2) In the event of a refusal by a prospective subcontractor to accept such a clause the Contractor--

(i) Shall promptly submit a written notice to the Contracting Officer setting forth the subcontractor's reasons for such refusal and other pertinent information that may expedite disposition of the matter; and

(ii) Shall not proceed with such subcontract without the written authorization of the Contracting Officer.

(3) In the case of subcontracts at any tier, the agency, subcontractor, and Contractor agree that the mutual obligations of the parties created by this clause constitute a contract between the subcontractor and NASA with respect to those matters covered by this clause.

(4) The Contractor shall promptly notify the Contracting Officer in writing upon the award of any subcontract at any tier containing a patent rights clause by identifying the subcontractor, the applicable patent rights clause, the work to be performed under the subcontract, and the dates of award and estimated completion. Upon request of the Contracting Officer, the Contractor shall furnish a copy of such subcontract, and, no more frequently than annually, a listing of the subcontracts that have been awarded.

(5) The subcontractor will retain all rights provided for the Contractor in the clause of subparagraph (1)(I) or (ii) of this clause, whichever is included in the subcontract, and the Contractor will not, as part of the consideration for awarding the subcontract, obtain rights in the subcontractor's subject inventions.

(i) Preference for United States industry. Unless provided otherwise, no Contractor that receives title to any subject invention and no assignee of any such Contractor shall grant to any person the exclusive right to use or sell any subject invention in the United States unless such person agrees that any products embodying the subject invention will be manufactured substantially in the United States. However, in individual cases, the requirement may be waived by the Administrator upon a showing by the Contractor or assignee that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that under the circumstances domestic manufacture is not commercially feasible.

(End of clause)

G. 3 DESIGNATION OF NEW TECHNOLOGY REPRESENTATIVE AND PATENT REPRESENTATIVE (1852.227-72) (JULY 1997)

(a) For purposes of administration of the clause of this contract entitled "New Technology" or "Patent Rights -- Retention by the Contractor (Short Form)", whichever is included, the following named representatives are hereby designated by the Contracting Officer to administer such clause:

Title Code	Office	Address (including zip code)

New Technology	504	Goddard Space Flight Center Representative Greenbelt, MD 20771
Patent	503	Goddard Space Flight Center Representative Greenbelt, MD 20771

(b) Reports of reportable items, and disclosure of subject inventions, interim reports, final reports, utilization reports, and other reports required by the clause, as well as any correspondence with respect to such matters, should be directed to the New Technology Representative unless transmitted in response to correspondence or request from the Patent Representative. Inquiries or requests regarding disposition of rights, election of rights, or related matters should be directed to the Patent Representative. This clause shall be included in any subcontract hereunder requiring a "New Technology" clause or "Patent Rights--Retention by the Contractor (Short Form)" clause, unless otherwise authorized or directed by the Contracting Officer. The respective responsibilities and authorities of the above-named representatives are set forth in 1827.305-370 of the NASA FAR Supplement.

(End of clause)

G. 4 COMMERCIAL COMPUTER SOFTWARE--LICENSING (1852.227-86) (DEC 1987)

(a) Any delivered commercial computer software (including documentation thereof) developed at private expense and claimed as proprietary shall be subject to the restricted rights in paragraph (d) of this clause. Where the vendor/contractor proposes its standard commercial software license, those applicable portions thereof consistent with Federal laws, standard industry practices, the Federal Acquisition Regulations (FAR) and the NASA FAR Supplement, including the restricted rights in paragraph (d) of this clause, are incorporated into and made a part of this purchase order/contract.

(b) Although the vendor/contractor may not propose its standard commercial software license until after this purchase order/contract has been issued, or at or after the time the computer software is delivered, such license shall nevertheless be deemed incorporated into and made a part of this purchase order/contract under the same terms and conditions as in paragraph (a) of this clause. For purposes of receiving updates, correction notices, consultation, and similar activities on the computer software, the NASA Contracting Officer or the NASA Contracting Officer's Technical Representative/User may sign any agreement, license, or registration form or card and return it directly to the vendor/contractor; however, such signing shall not alter any of the terms and conditions of this clause.

(c) The vendor's/contractor's acceptance is expressly limited to the terms and conditions of this purchase order/contract. If the specified computer software is shipped or delivered to NASA, it shall be understood that the vendor/contractor has unconditionally accepted the terms and conditions set forth in this clause, and that such terms and conditions (including the incorporated license) constitute the entire agreement between the parties concerning rights in the computer software.

(d) The following restricted rights shall apply:

(1) The commercial computer software may not be used, reproduced, or disclosed by the Government except as provided below or otherwise expressly stated in the purchase order/contract.

(2) The commercial computer software may be--

(i) Used, or copied for use, in or with any computer owned or leased by, or on behalf of, the Government; provided, the software is not used, nor copied for use, in or with more than one computer simultaneously, unless otherwise permitted by the license incorporated under paragraphs (a) or (b) of this clause;

(ii) Reproduced for safekeeping (archives) or backup purposes;

(iii) Modified, adapted, or combined with other computer software, provided that the modified, combined, or adapted portions of the derivative software incorporating restricted computer software shall be subject to the same restricted rights; and

(iv) Disclosed and reproduced for use by Government contractors or their subcontractors in accordance with the restricted rights in subparagraphs (d)(2)(i), (ii), and (iii) of this clause; provided they have the Government's permission to use the computer software and have also agreed to protect the computer software from unauthorized use and disclosure.

(3) If the incorporated vendor's/contractor's software license contains provisions or rights that are less restrictive than the restricted rights in subparagraph (d)(2) of this clause, then the less restrictive provisions or rights shall prevail.

(4) If the computer software is published, copyrighted computer software, it is licensed to the Government, without disclosure prohibitions, with the rights in subparagraphs (d)(2) and (3) of this clause.

(5) The computer software may be marked with any appropriate proprietary notice that is consistent with the rights in subparagraphs (d)(2), (3), and (4) of this clause.

(End of clause)

SECTION H OF NNG06HX12C
SPECIAL CONTRACT REQUIREMENTS

H. 1 INTENTIONALLY LEFT BLANK

H.2 CENTRAL CONTRACTOR REGISTRATION (52.204-7) (OCT 2003)

(a) Definitions. As used in this clause-

"Central Contractor Registration (CCR) database" means the primary Government repository for Contractor information required for the conduct of business with the Government.

"Data Universal Numbering System (DUNS) number" means the 9-digit number assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

"Data Universal Numbering System +4 (DUNS+4) number" means the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional CCR records for identifying alternative Electronic Funds Transfer (EFT) accounts (see the FAR at Subpart 32.11) for the same parent concern.

"Registered in the CCR database" means that-

(1) The Contractor has entered all mandatory information, including the DUNS number or the DUNS+4 number, into the CCR database; and
(2) The Government has validated all mandatory data fields and has marked the record "Active".
(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the CCR database prior to award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.
(2) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" or "DUNS +4" followed by the DUNS or DUNS +4 numbers that identifies the offeror's name and address exactly as stated in the offer. The DUNS number will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.
(c) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one.
(1) An offeror may obtain a DUNS number-
(i) If located within the United States, by calling Dun and Bradstreet at 1-866-705-5711 or via the Internet at *http://www.dnb.com*; or
(ii) If located outside the United States, by contacting the local Dun and Bradstreet office.
(2) The offeror should be prepared to provide the following information:
(i) Company legal business.
(ii) Trade style, doing business, or other name by which your entity is commonly recognized.
(iii) Company Physical Street Address, City, State, and Zip Code.
(iv) Company Mailing Address, City, State and Zip Code (if separate from physical).
(v) Company Telephone Number.
(vi) Date the company was started.
(vii) Number of employees at your location.
(viii) Chief executive officer/key manager.
(ix) Line of business (industry).

(x) Company Headquarters name and address (reporting relationship within your entity).
(d) If the Offeror does not become registered in the CCR database in the time prescribed by the Contracting Officer, the Contracting Officer will proceed to award to the next otherwise successful registered Offeror.
(e) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.
(f) The Contractor is responsible for the accuracy and completeness of the data within the CCR database, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to review and update on an annual basis from the date of initial registration or subsequent updates its information in the CCR database to ensure it is current, accurate and complete. Updating information in the CCR does not alter the terms and conditions of this contract and is not a substitute for a properly executed contractual document.
(g) (1) (i) If a Contractor has legally changed its business name, "doing business as" name, or division name (whichever is shown on the contract), or has transferred the assets used in performing the contract, but has not completed the necessary requirements regarding novation and change-of-name agreements in Subpart 42.12, the Contractor shall provide the responsible Contracting Officer a minimum of one business day's written notification of its intention to (A) change the name in the CCR database; (B) comply with the requirements of Subpart 42.12 of the FAR; and (C) agree in writing to the timeline and procedures specified by the responsible Contracting Officer. The Contractor shall provide with the notification sufficient documentation to support the legally changed name.
(ii) If the Contractor fails to comply with the requirements of paragraph (g)(1)(i) of this clause, or fails to perform the agreement at paragraph (g)(1)(i)(C) of this clause, and, in the absence of a properly executed novation or change-of-name agreement, the CCR information that shows the Contractor to be other than the Contractor indicated in the contract will be considered to be incorrect information within the meaning of the "Suspension of Payment" paragraph of the electronic funds transfer (EFT) clause of this contract.
(2) The Contractor shall not change the name or address for EFT payments or manual payments, as appropriate, in the CCR record to reflect an assignee for the purpose of assignment of claims (see FAR Subpart 32.8, Assignment of Claims). Assignees shall be separately registered in the CCR database. Information provided to the Contractor's CCR record that indicates payments, including those made by EFT, to an ultimate recipient other than that Contractor will be considered to be incorrect information within the meaning of the "Suspension of payment" paragraph of the EFT clause of this contract.
(h) Offerors and Contractors may obtain information on registration and annual confirmation requirements via the internet at *http://www.ccr.gov* or by calling 1-888-227-2423, or 269-961-5757.

(End of clause)

H. 3 MAJOR BREACH OF SAFETY OR SECURITY (1852.223-75) (FEB 2002)

(a) Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. Safety is essential to NASA and is a material part of this contract. NASA's safety priority is to protect: (1) the public; (2) astronauts and pilots; (3) the NASA workforce (including contractor employees working on NASA contracts); and (4) high-value equipment and property. A major breach of safety may constitute a breach of contract that entitles the Government to exercise any of its rights and remedies applicable to material parts of this contract, including termination for default. A major breach of safety shall be related directly to the work on the contract. A major breach of safety is an act or omission of the Contractor that consists of an accident, incident, or

exposure resulting in a fatality or mission failure; or in damage to equipment or property equal to or greater than $1 million; or in any "willful" or "repeat" violation cited by the Occupational Safety and Health Administration (OSHA) or by a state agency operating under an OSHA approved plan.

(b) Security is the condition of safeguarding against espionage, sabotage, crime (including computer crime), or attack. A major breach of security may constitute a breach of contract that entitles the Government to exercise any of its rights and remedies applicable to material parts of this contract, including termination for default. A major breach of security may occur on or off Government installations, but shall be related directly to the work on the contract. A major breach of security is an act or omission by the Contractor that results in compromise of classified information; illegal technology transfer; workplace violence resulting in criminal conviction; sabotage; compromise or denial of information technology services; equipment or property damage from vandalism greater than $250,000 or theft greater than $250,000.

(c) In the event of a major breach of safety or security, the Contractor shall report the breach to the Contracting Officer. If directed by the Contracting Officer, the Contractor shall conduct its own investigation and report the results to the Government. The Contractor shall cooperate with the Government investigation, if conducted.

(End of clause)

H.4 GEOGRAPHIC PARTICIPATION IN THE AEROSPACE PROGRAM (18-52.244-70) (APR 1985)

(a) It is the policy of the National Aeronautics and Space Administration to advance a broad participation by all geographic regions in filling the scientific, technical, research and development, and other needs of the aerospace program.

(b) The Contractor agrees to use its best efforts to solicit subcontract sources on the broadest feasible geographic basis consistent with efficient contract performance and without impairment of program effectiveness or increase in program cost.

(c) The Contractor further agrees to insert this clause in all subcontracts of $100,000 and over.

(End of clause)

H. 5 HANDLING OF DATA (GSFC 52.203-90) (JAN 1995)

(a) In the performance of this contract, it is anticipated that the Contractor may have access to, be furnished, or use the following categories of data (which may be technical data, computer software, administrative, management information, or financial, including cost or pricing):

(1) Data of third parties which the Government has agreed to handle under protective arrangements; and

(2) Government data, the use and dissemination of which, the Government intends to control.

(b) In order to protect the interests of the Government and the owners, licensors and licensees of such data, the Contractor agrees, with respect to any such third party or Government data that is either marked with a restrictive legend, specifically identified in this contract, or otherwise identified in writing by the Contracting Officer as being subject to this clause, to:

(1) Use, disclose, and reproduce such data only to the extent necessary to perform the work required under this contract;

(2) Allow access to such data only to those of its employees that require access for their performance under this contract;

(3) Preclude access and disclosure of such data outside the Contractor's organization; and

(4) Return or dispose of such data, as the Contracting Officer may direct, when the data is no longer needed for contract performance.

(c) The Contractor agrees to inform and instruct its employees of its and their obligations under this clause and to appropriately bind its employees contractually to comply with the access, use, disclosure, and reproduction provisions of this clause.

(d) In the event that data includes a legend that the Contractor deems to be ambiguous or unauthorized, the Contractor may inform the Contracting Officer of such condition. Notwithstanding such a legend, as long as such legend provides an indication that a restriction on use or disclosure was intended; the Contractor shall treat such data pursuant to the requirements of this clause unless otherwise directed, in writing, by the Contracting Officer.

(e) Notwithstanding the above, the Contractor shall not be restricted in use, disclosure, and reproduction of any data that:
(1) Is, or becomes, generally available or public knowledge without breach of this clause by the Contractor;

(2) Is known to, in the possession of, or is developed by the Contractor independently of any disclosure of, or without reference to, proprietary, restricted, confidential, or otherwise protectible data under this clause;

(3) Is rightfully received by the Contractor from a third party without restriction;

(4) Or is required to be produced by the Contractor pursuant to a court order or other Government action.

If the Contractor believes that any of these events or conditions that remove restrictions on the use, disclosure, and reproduction of the data apply, the Contractor shall promptly notify the Contracting Officer of such belief prior to acting on such belief, and, in any event, shall give notice to the Contracting Officer prior to any unrestricted use, disclosure, or reproduction of such data.

(End of clause)

H. 6 LIMITED RELEASE OF CONTRACTOR CONFIDENTIAL BUSINESS INFORMATION (GSFC 52.203-91) (JUN 2002)

(a) NASA may find it necessary to release information submitted by the Contractor, either in response to this solicitation or pursuant to the provisions of this contract, to individuals not employed by NASA. Business information that would ordinarily be entitled to confidential treatment may be included in the information released to these individuals. Accordingly, by submission of this proposal, or signature on this contract or other contracts, the Contractor hereby consents to a limited release of its confidential business information (CBI).

(b) Possible circumstances where the Agency may release the Contractor's CBI include, but are not limited to, the following:

(1) To other Agency contractors and subcontractors, and their employees tasked with assisting the Agency in handling and processing information and documents in the evaluation, the award or the administration of Agency contracts, such as providing both pre-award and post award audit support and specialized technical support to NASA's technical evaluation panels;

(2) To NASA contractors and subcontractors, and their employees engaged in information systems analysis, development, operation, and maintenance, including performing data processing and management functions for the Agency.

(c) Except where otherwise provided by law, NASA will permit the limited release of CBI under subparagraphs (1) or (2) only pursuant to non-disclosure agreements signed by the assisting contractor or subcontractor, and their individual employees who may require access to the CBI to perform the assisting contract).

(d) NASA's responsibilities under the Freedom of Information Act are not affected by this clause.

(e) The Contractor agrees to include this clause, including this paragraph (e), in all subcontracts at all levels awarded pursuant to this contract that require the furnishing of confidential business information by the subcontractor.

(End of clause)

H. 7 REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFEROR (GSFC 52.215-90) (NOV 1999)

In accordance with FAR 15.204-1(b), the completed and submitted "Representations, Certifications, and Other Statements of Offeror", are incorporated by reference in this resulting contract.

(End of clause)

H. 8 SMALL BUSINESS SUBCONTRACTING PLAN AND REPORTS (GSFC 52.219-90) (OCT 1999)

a. Subcontracting Plan (Contractor)

FAR clause 52.219-9, "Small Business Subcontracting Plan" is included in this contract. The agreed to Subcontracting Plan required by the clause is included as an attachment to the contract.

b. Subcontracting Plan (Subcontractors)

In accordance with FAR clause 52.219-9, the Contractor shall require that certain subcontractors adopt a plan similar to the Plan agreed to between the Contractor and the Government.

c. Reporting to Contracting Officer (SF 294--Semi-annual and Final)

The Contractor shall prepare and submit Standard Form 294 (Rev. 12-98), "Subcontracting Report for Individual Contracts" in accordance with the instructions on the back of the form.

The SF 294 shall be submitted to the Contracting Officer on a semi-annual basis. This report shall be received no later than April 30 and October 30 each year for the reporting periods ending March 31 and September 30, respectively. A final SF 294 shall be submitted after contract completion. The final SF 294 submittal shall be received no later than the due date for what would have been the next semi-annual report.

d. Reporting to NASA Headquarters (SF 295--Semi-annual)

The Contractor shall prepare and submit Standard Form 295 (Rev. 12-98), "Summary Subcontract Report" in accordance with the instructions on the back of the form and in accordance with NASA FAR Supplement clause 1852.219-75, "Small Business Subcontracting Reporting" of this contract.

The SF 295 shall be submitted to "NASA, Office of Procurement, Code HS, Washington, D.C. 20546-0001" on a semi-annual basis no later than April 30 and October 30 each year for the reporting periods ending March 31 and September 30, respectively.

e. Subcontractor Reporting

FAR clause 52.219-9 and NASA FAR Supplement clause 1852.219-75 require that the Contractor ensure that SF 294 and SF 295 reports are submitted by those subcontractors that have been required to adopt a Subcontracting Plan under the terms of the clause. These subcontractor reports shall be submitted as required by paragraphs (c)and (d) above. The reports may be submitted though the Contractor or submitted directly. Regardless, the Contractor is responsible for ensuring proper and timely submittal of the required reports.

(End of clause)

H.9 SMALL DISADVANTAGED BUSINESS PARTICIPATION—CONTRACT TARGETS (GSFC 52.219-91) (AUG 2001) (for offeror fill-in)

(a) This clause does not apply to, and should not be completed by, Small Disadvantaged Business (SDB) Offerors unless the SDB offeror has waived the price adjustment evaluation adjustment [see para (c.) of FAR clause 52.219-23].

(b) FAR 19.1202-4(a) requires that SDB subcontracting targets be incorporated in the contract. Targets for this contract are as follows:

*NAICS Industry Sub sectors	Dollar Target	Percent of Contract Value Total
None		

*North American Industry Classification System (NAICS) Industry Sub sectors as determined by the Department of Commerce

(c.) FAR 19.1202-4(b) requires that SDB concerns that are specifically identified by the offeror be listed in the contract when the extent of the identification of such subcontractors was part of the SDB evaluation sub factor. SDB concerns (subcontractors) specifically identified by the offeror are as follows:

Name of Concern(s) N/A

The contractor shall notify the Contracting Officer of any substitutions of firms that are not SDB concerns.

(d) If the prime offeror is an SDB that has waived the price evaluation adjustment, the target for the work it intends to perform as a prime contractor is as follows:

Dollars	Percent of Contract Value
N/A	

(End of clause)

H.10 EXPORT LICENSES (1852.225-70) (FEB 2000)

(a) The Contractor shall comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of hardware, technical data, and software, or for the provision of technical assistance.

(b) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation, where the foreign person will have access to export-controlled technical data or software.

(c) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

(d) The Contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

(End of clause)

H.11 LIMITATION OF FUNDS (FIXED-PRICE CONTRACT) (1852.232-77) (MAR 1989)

(a) Of the total price of items 1 through 10, the sum of $ ***2,000,000.00*** is presently available for payment and allotted to this contract. **This contract if fully funded, and the balance of this clause, below, is NOT APPLICABLE. Reference PR Number 4200144986 for Accounting and Appropriation Data.**

It is anticipated that from time to time additional funds will be allocated to the contract in accordance with the following schedule, until the total price of said item is allotted:

SCHEDULE FOR ALLOTMENT OF FUNDS

Date	Amounts
(To be Completed at Award)	***(To be Completed at Award)***

(b) The Contractor agrees to perform or have performed work on the items specified in paragraph (a) above up to the point at which, if this contract is terminated pursuant to the Termination for Convenience of the Government clause of this contract, the total amount payable by the Government (including amounts payable for subcontracts and settlement costs) pursuant to paragraphs (f) and (g) if that clause would, in the exercise of reasonable judgment by the Contractor, approximate the total amount at the time allotted to the contract. The Contractor is not obligated to continue performance of the work beyond that point. The Government is not obligated in any event to pay or reimburse the Contractor more than the amount from time to time allotted to the contract, anything to the contrary in the Termination for Convenience of the Government clause notwithstanding.

(c) (1) It is contemplated that funds presently allotted to this contract will cover the work to be performed until ***(To be Completed at Award)***

(2) If funds allotted are considered by the Contractor to be inadequate to cover the work to be performed until that date, or an agreed date substituted for it, the Contractor shall notify the Contracting Officer in writing when within the next 60 days the work will reach a point at which, if the contract is terminated pursuant to the Termination for Convenience of the Government clause of this contract, the total amount payable by the Government (including amounts payable for subcontracts and settlement costs) pursuant to paragraphs (f) and (g) of that clause will approximate 75 percent of the total amount then allotted to the contract.

(3) (i) The notice shall state the estimated date when the point referred to in subparagraph (2) above will be reached and the estimated amount of additional funds required to continue performance to the date specified in subparagraph (1) above, or an agreed date substituted for it.

(ii) The Contractor shall, 60 days in advance of the date specified in subparagraph (1) above, or an agreed date substituted for it, advise the Contracting Officer in writing as to the estimated amount of additional funds required for the timely performance of the contract for a further period as may be specified in the contract or otherwise agreed to by the parties.

(4) If, after the notification referred to in subdivision (3)(ii) above, additional funds are not allotted by the date specified in subparagraph (1) above, or an agreed date substituted for it, the Contracting Officer shall, upon the Contractor's written request, terminate this contract on that date or on the date set forth in the request, whichever is later, pursuant to the Termination for Convenience of the Government clause.

(d) When additional funds are allotted from time to time for continued performance of the work under this contract, the parties shall agree on the applicable period of contract performance to be covered by these funds. The provisions of paragraphs (b) and (c) above shall apply to these additional allotted funds and substituted date pertaining to them, and the contract shall be modified accordingly.

(e) If, solely by reason of the Government's failure to allot additional funds in amounts sufficient for the timely performance of this contract, the Contractor incurs additional costs or is delayed in the performance of the work under this contract, and if additional funds are allotted, an equitable adjustment shall be made in the price or prices (including appropriate target, billing, and ceiling prices where applicable) of the items to be delivered, or in the time of delivery or both.

(f) The Government may at any time before termination, and, with the consent of the Contractor, after notice of termination, allot additional funds for this contract.

(g) The provisions of this clause with respect to termination shall in no way be deemed to limit the rights of the Government under the Default clause of this contract. The provisions of this Limitation of Funds clause are limited to the work on and allotment of funds for the items set forth in paragraph (a) above. This clause shall become inoperative upon the allotment of funds for the total price of said work except for rights and obligations then existing under this clause.

(h) Nothing in this clause shall affect the right of the Government to terminate this contract pursuant to the Termination for Convenience of the Government clause of this contract.

(End of clause)

H. 12 ADVANCE UNDERSTANDING REGARDING DATA RIGHTS AND DATA HANDLING

Deliverable Data Rights

All data deliverables under this Formulation Phase shall be subject to Section (g)(2) of the "Rights in Data - General" clause as limited rights data if so declared by the Contractor in accordance with that Clause, but only until (a) the award of the Implementation Phase contract, regardless of whether the Contractor is awarded the Implementation Phase contract, or (b) a determination by NASA not to award an Implementation Phase contract. At such time, the Government shall possess unlimited rights to such data which shall not be subject to any confidential treatment; except that this clause shall not be construed to grant the Government unlimited rights in data determined to be developed at private expense, in accordance with FAR Clause 52.227-14 - RIGHTS IN DATA - GENERAL (JUN 1987), and included in the deliverable data with the Government's consent. The Contractor shall indicate the data that it considers to be proprietary, that is, that data which is pre-existing to the contract, that was developed at Contractor expense and that the Contractor wishes to keep confidential, in any Limited Rights Notice which may be affixed to data in accordance with the "Rights in Data - General (Alternate II)" clause.

Pursuant to Section (g)(2) of the "Rights in Data - General" clause, for the period the Government holds only limited rights to any Formulation Phase data the Contractor hereby authorizes the Government to disclose such data to non-Government evaluators as stated in the Limited Rights Notice provision of Section (g)(2). The Contractor shall insert this condition in any Limited Rights Notice, which may be affixed to the data in accordance with the "Rights in Data - General (Alternate II)" clause.

Data Handling

The Contractor is authorized to provide the data covered by Clause H.5, HANDLING OF DATA, to its subcontractors as long as the provisions of clause H.5 are included in the subcontract.

(End of text)

H.13 CONTRACTOR-PROPOSED ENHANCEMENTS

The Contractor shall provide the enhancements that are described in Section J, Attachment G. The Contractor in the proposal submitted in response to the Geostationary Lightning Mapper Request for Proposal proposed these enhancements, which are over and above the requirements required by the contract terms and conditions and Geostationary Lightning Mapper Statement of Work. The incorporation of these enhancements does not relieve the Contractor from the responsibilities of meeting all other contract terms and conditions and Geostationary Lightning Mapper Statement of Work. The Contractor shall perform these enhancements on all work performed, unless specifically waived by the Contracting Officer in writing.

(End of clause)

SECTION I OF NNG06HX12C
CONTRACT CLAUSES

I.1 CLAUSES INCORPORATED BY REFERENCE (52.252-2) (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):

Federal Acquisition Regulation (FAR) clauses: **http://www.arnet.gov/far/**

NASA FAR Supplement (NFS) clauses:

http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm

(End of clause)

I. 2 SECTION I CLAUSES INCORPORATED BY REFERENCE

52.202-1	Definitions	(JUL 2004)
52.203-3	Gratuities	(APR 1984)
52.203-5	Covenant Against Contingent Fees	(APR 1984)
52.203-6	Restrictions On Subcontractor Sales To The Government	(JUL 1995)
52.203-7	Anti-Kickback Procedures	(JUL 1995)
52.203-8	Cancellation, Rescission, And Recovery Of Funds For Illegal Or Improper Activity	(JAN 1997)
52.203-10	Price Or Fee Adjustment For Illegal Or Improper Activity	(JAN 1997)
52.203-12	Limitation On Payments To Influence Certain Federal Transactions	(JUN 2003)
52.204-4	Printed Or Copied Double-Sided On Recycled Paper	(AUG 2000)
52.209-6	Protecting The Government's Interest When Subcontracting With Contractors Debarred, Suspended, Or Proposed For Debarment	(JAN 2005)
52.211-15	Defense Priority And Allocation Requirements	(SEP 1990)
52.215-2	Audit And Records--Negotiation	(JUN 1999)
52.215-8	Order Of Precedence--Uniform Contract Format	(OCT 1997)
52.215-10	Price Reduction For Defective Cost Or Pricing Data	(OCT 1997)
52.215-13	Subcontractor Cost Or Pricing Data-Modifications	(OCT 1997)
52.215-14	Integrity Of Unit Prices	(OCT 1997)
52.215-15	Pension Adjustments and Asset Reversions	(OCT 2004)
52.215-18	Reversion Or Adjustment Of Plans For Postretirement Benefits (PRB) Other Than Pensions	(OCT 1997)
52.215-19	Notification Of Ownership Changes	(OCT 1997)
52.215-21	Requirements For Cost Or Pricing Data Or Information Other Than Cost or Pricing Data--Modifications	(OCT 1997)
52.219-8	Utilization Of Small Business Concerns	(MAY 2004)
52.219-9	Small Business Subcontracting Plan--Alternate II (Oct 2001)	(JAN 2002)
52.219-16	Liquidated Damages--Subcontracting Plan	(JAN 1999)
52.219-25	Small Disadvantaged Business Participation Program--Disadvantaged Status And Reporting	(OCT 1999)

SECTION I OF NNG06HX12C
CONTRACT CLAUSES

52.222-1	Notice To The Government Of Labor Disputes	(FEB 1997)
52.222-3	Convict Labor	(JUN 2003)
52.222-19	Child Labor--Cooperation With Authorities And Remedies	(JUN 2004)
52.222-20	Walsh-Healey Public Contracts Act	(DEC 1996)
52.222-21	Prohibition Of Segregated Facilities	(FEB 1999)
52.222-26	Equal Opportunity	(APR 2002)
52.222-35	Equal Opportunity For Special Disabled Veterans, Veterans Of The Vietnam Era, And Other Eligible Veterans	(DEC 2001)
52.222-36	Affirmative Action For Workers With Disabilities	(JUN 1998)
52.222-37	Employment Reports On Special Disabled Veterans, Veterans Of The Vietnam Era, And Other Eligible Veterans	(DEC 2001)
52.223-6	Drug Free Work Place	(MAY 2001)
52.223-14	Toxic Chemical Release Reporting	(AUG 2003)
52.227-1	Authorization And Consent (Apr 1984)--Alternate I	(JUL 1995)
52.227-2	Notice And Assistance Regarding Patent And Copyright Infringement	(AUG 1996)
52.227-11	Patent Rights – Retention by the Contractor (Short Form) as modified by NASA FAR Supplement 1852.227-11.	(JUN 1997)
52.227-14	Rights In Data-General (Jun 1987) As Modified By NASA Far Supplement 1852.227-14--Alternate II	(JUN 1987)
52.227-16	Additional Data Requirements	(JUN 1987)
52.229-3	Federal, State, And Local Taxes	(APR 2003)
52.230-2	Cost Accounting Standards	(APR 1998)
52.230-6	Administration Of Cost Accounting Standards	(APR 2005)
52.232-8	Discounts For Prompt Payment	(FEB 2002)
52.232-17	Interest	(JUN 1996)
52.232-23	Assignment Of Claims	(JAN 1986)
52.232-25	Prompt Payment	(OCT 2003)
52.233-1	Disputes	(JUL 2002)
52.233-3	Protest After Award	(AUG 1996)
52.233-4	Applicable Law for Breach of Contract Claim	(OCT 2004)
52.242-1	Notice Of Intent To Disallow Costs	(APR 1984)
52.242-13	Bankruptcy	(JUL 1995)
52.243-1	Changes--Fixed Price --Alternate V (Aug 1984)	(AUG 1987)
52.245-2	Government Property (Fixed Price Contract)	(MAY 2004)
52.247-63	Preference for U.S. Flag Air Carriers	(JUN 2003)
52.248-1	Value Engineering	(FEB 2000)
52.249-2	Termination For Convenience Of The Government (Fixed Price)	(MAY 2004)
52.249-9	Default (Fixed-Price Research And Development)	(APR 1984)

The following clauses are NASA Federal Acquisition Regulation Supplement clauses

1852.208-81	Restrictions on Printing and Duplicating	(NOV 2004)
1852.223-72	Safety and Health (Short Form)	(APR 2002)
1852.243-71	Shared Savings	(MAR 1997)

(End of By Reference Section)

I.3 NOTICE OF PRICE EVALUATION ADJUSTMENT FOR SMALL DISADVANTAGED BUSINESS CONCERNS (52.219- 23) (June 2003)--Alternate I (June 2003)

(a) Definitions. As used in this clause—
"Small disadvantaged business concern" means an offeror that represents, as part of its offer, that it is a small business under the size standard applicable to this acquisition; and either—

(1) It has received certification by the Small Business Administration as a small disadvantaged business concern consistent with 13 CFR 124, Subpart B; and

(i) No material change in disadvantaged ownership and control has occurred since its certification;

(ii) Where the concern is owned by one or more disadvantaged individuals, the net worth of each individual upon whom the certification is based does not exceed $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(iii) It is identified on the date of its representation, as a certified small disadvantaged business concern in the database maintained by the Small Business Administration (PRO-Net).

(2) It has submitted a completed application to the Small Business Administration or a Private Certifier to be certified as a small disadvantaged business concern in accordance with 13 CFR 124, Subpart B, and a decision on that application is pending, and that no material change in disadvantaged ownership and control has occurred since its application was submitted. In this case, in order to receive the benefit of a price evaluation adjustment, an offeror shall receive certification as a small disadvantaged business concern by the Small Business Administration prior to contract award; or

(3) Is a joint venture as defined in 13 CFR 124.1002(f).

"Historically black college or university" means an institution determined by the Secretary of Education to meet the requirements of 34 CFR 608.2. For the Department of Defense (DoD), the National Aeronautics and Space Administration (NASA), and the Coast Guard, the term also includes any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.
"Minority institution" means an institution of higher education meeting the requirements of Section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1067k, including a Hispanic-serving institution of higher education, as defined in Section 316(b)(1) of the Act (20 U.S.C. 1101(a)).

(b) Evaluation adjustment. (1) The Contracting Officer will evaluate offers by adding a factor of 10 percent to the price of all offers, except—

(i) Offers from small disadvantaged business concerns that have not waived the adjustment;

(ii) An otherwise successful offer of eligible products under the Trade Agreements Act when the dollar threshold for application of the Act is equaled or exceeded (see section 25.402 of the Federal Acquisition Regulation (FAR));

(iii) An otherwise successful offer where application of the factor would be inconsistent with a Memorandum of Understanding or other international agreement with a foreign government;

(iv) For DoD, NASA, and Coast Guard acquisitions, an otherwise successful offer from a historically black college or university or minority institution; and

(v) For DoD acquisitions, an otherwise successful offer of qualifying country end products (see sections 225.000-70 and 252.225-7001 of the Defense FAR Supplement).

(2) The Contracting Officer will apply the factor to a line item or a group of line items on which award may be made. The Contracting Officer will apply other evaluation factors described in the solicitation before application of the factor. The factor may not be applied if using the adjustment would cause the

contract award to be made at a price that exceeds the fair market price by more than the factor in paragraph (b)(1) of this clause.

(c) Waiver of evaluation adjustment. A small disadvantaged business concern may elect to waive the adjustment, in which case the factor will be added to its offer for evaluation purposes. The agreements in paragraph (d) of this clause do not apply to offers that waive the adjustment.
_N/A_ Offeror elects to waive the adjustment.

(d) Agreements. (1) A small disadvantaged business concern, that did not waive the adjustment, agrees that in performance of the contract, in the case of a contract for— (i) Services, except construction, at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern;

(ii) Supplies (other than procurement from a non-manufacturer of such supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern; or

(iii) General construction, at least 15 percent of the cost of the contract, excluding the cost of materials, will be performed by employees of the concern; or

(iv) Construction by special trade contractors, at least 25 percent of the cost of the contract, excluding the cost of materials, will be performed by employees of the concern.

(2) A small disadvantaged business concern submitting an offer in its own name agrees to furnish in performing this contract only end items manufactured or produced by small business concerns in the United States or its outlying areas. This paragraph does not apply in connection with construction or service contracts.

(End of clause)

I. 4 RIGHTS TO PROPOSAL DATA (52.227-23) (TECHNICAL) (JUN 1987)

Except for data contained on pages LMSSC-X050019P-all, it is agreed that as a condition of award of this contract, and notwithstanding the conditions of any notice appearing thereon, the Government shall have unlimited rights (as defined in the "Rights in Data--General" clause contained in this contract) in and to the technical data contained in the proposal dated 29 August 2005, upon which this contract is based.

(End of Clause)

I. 5 PAYMENTS UNDER FIXED-PRICE RESEARCH AND DEVELOPMENT CONTRACTS (52.232-2) (APR 1984)

The Government shall pay the Contractor, upon submission of proper invoices or vouchers, the prices stipulated in this contract for work delivered or rendered and accepted, less any deductions provided in this contract. Unless otherwise specified, payment shall be made upon acceptance of any portion of the work delivered or rendered for which a price is separately stated in the contract.

(End of clause)

I.6 PAYMENT BY ELECTRONIC FUNDS TRANSFER—OTHER THAN CENTRAL CONTRACTOR REGISTRATION (52.232-34) (MAY 1999)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT) except as provided in paragraph (a)(2) of this clause. As used in this clause, the term "EFT" refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend payment due dates until such time as the Government makes payment by EFT (but see paragraph (d) of this clause).

(b) Mandatory submission of Contractor's EFT information. (1) The Contractor is required to provide the Government with the information required to make payment by EFT (see paragraph (j) of this clause). The Contractor shall provide this information directly to the office designated in this contract to receive that information: (hereafter: "designated office")--

Cost and Commercial Accounts Department
Code 155
NASA/ Goddard Space Flight Center
Greenbelt, Maryland 20771
Fax No. 301-286-1748

no later than concurrent with the first request for payment. If not otherwise specified in this contract, the payment office is the designated office for receipt of the Contractor's EFT information. If more than one designated office is named for the contract, the Contractor shall provide a separate notice to each office. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the designated office(s).

(2) If the Contractor provides EFT information applicable to multiple contracts, the Contractor shall specifically state the applicability of this EFT information in terms acceptable to the designated office. However, EFT information supplied to a designated office shall be applicable only to contracts that identify that designated office as the office to receive EFT information for that contract.

(c.) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fed wire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. (1) The Government is not required to make any payment under this contract until after receipt, by the designated office, of the correct EFT payment information from the Contractor. Until receipt of the correct EFT information, any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(2) If the EFT information changes after submission of correct EFT information, the Government shall begin using the changed EFT information no later than 30 days after its receipt by the designated office to the extent payment is made by EFT. However, the Contractor may request that no further payments be made until the updated EFT information is implemented by the payment office. If such suspension would

result in a late payment under the prompt payment terms of this contract, the Contractor's request for suspension shall extend the due date for payment by the number of days of the suspension.

(e) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;
(ii) Paying any prompt payment penalty due; and
(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and—

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment and the provisions of paragraph (d) shall apply.

(f) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(g) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall provide the EFT information required by paragraph (j) of this clause to the designated office, and shall be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(h) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information provided by the Contractor's financial agent.

(i) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address in the contract.

(j) EFT information. The Contractor shall provide the following information to the designated office. The Contractor may supply this data for this or multiple contracts (see paragraph (b) of this clause). The Contractor shall designate a single financial agent per contract capable of receiving and processing the EFT information using the EFT methods described in paragraph (c) of this clause.

(1) The contract number (or other procurement identification number).
(2) The Contractor's name and remittance address, as stated in the contract(s).
(3) The signature (manual or electronic, as appropriate), title, and telephone number of the Contractor official authorized to provide this information.
(4) The name, address, and 9-digit Routing Transit Number of the Contractor's financial agent.
(5) The Contractor's account number and the type of account (checking, saving, or lockbox).
(6) If applicable, the Fed wire Transfer System telegraphic abbreviation of the Contractor's Financial agent.
(7) If applicable, the Contractor shall also provide the name, address, telegraphic abbreviation, And 9-digit Routing Transit Number of the correspondent financial institution receiving the wire transfer payment if the Contractor's financial agent is not directly on-line to the Fed wire Transfer System; and, therefore, not the receiver of the wire transfer payment.

(End of clause)

I. 7 NOTIFICATION OF CHANGES (52.243-7) (APR 1984)

(a) Definitions. "Contracting Officer," as used in this clause, does not include any representative of the Contracting Officer. "Specifically authorized representative (SAR)," as used in this clause, means any person the Contracting Officer has so designated by written notice (a copy of which shall be provided to the Contractor) which shall refer to this subparagraph and shall be issued to the designated representative before the SAR exercises such authority.

(b) Notice. The primary purpose of this clause is to obtain prompt reporting of Government conduct that the Contractor considers to constitute a change to this contract. Except for changes identified as such in writing and signed by the Contracting Officer, the Contractor shall notify the Administrative Contracting Officer in writing promptly, within.....(to be negotiated) calendar days from the date that the Contractor identifies any Government conduct (including actions, inactions, and written or oral communications) that the Contractor regards as a change to the contract terms and conditions. On the basis of the most accurate information available to the Contractor, the notice shall state--

(1) The date, nature, and circumstances of the conduct regarded as a change;

(2) The name, function, and activity of each Government individual and Contractor official or employee involved in or knowledgeable about such conduct;

(3) The identification of any documents and the substance of any oral communication involved in such conduct;

(4) In the instance of alleged acceleration of scheduled performance or delivery, the basis upon which it arose;

(5) The particular elements of contract performance for which the Contractor may seek an equitable adjustment under this clause, including--

(i) What contract line items have been or may be affected by the alleged change,

(ii) What labor or materials or both have been or may be added, deleted, or wasted by the alleged change;

(iii) To the extent practicable, what delay and disruption in the manner and sequence of performance and effect on continued performance have been or may be caused by the alleged change;

(iv) What adjustments to contract price, delivery schedule, and other provisions affected by the alleged change are estimated; and

(6) The Contractor's estimate of the time by which the Government shall respond to the Contractor's notice to minimize cost, delay or disruption of performance.

(c) Continued performance. Following submission of the notice required by (b) above, the Contractor shall diligently continue performance of this contract to the maximum extent possible in accordance with its terms and conditions as construed by the Contractor, unless the notice reports a direction of the Contracting Officer or a communication from a SAR of the Contracting Officer, in either of which events the Contractor shall continue performance; provided, however, that if the Contractor regards the direction or communication as a change as described in (b) above, notice shall be given in the manner provided. All directions, communications, interpretations, orders and similar actions of the SAR shall be reduced to writing promptly and copies furnished to the Contractor and to the Contracting Officer. The Contracting Officer shall promptly countermand any action, which exceeds the authority of the SAR.

(d) Government response. The Contracting Officer shall promptly, within..... (to be negotiated) calendar days after receipt of notice, respond to the notice in writing. In responding, the Contracting Officer shall either--

(1) Confirm that the conduct of which the Contractor gave notice constitutes a change and when necessary direct the mode of further performance;

(2) Countermand any communication regarded as a change;

(3) Deny that the conduct of which the Contractor gave notice constitutes a change and when necessary direct the mode of further performance; or

(4) In the event the Contractor's notice information is inadequate to make a decision under (1), (2), or (3) above, advise the Contractor what additional information is required, and establish the date by which it should be furnished and the date thereafter by which the Government will respond.

(e) Equitable adjustments. (1) If the Contracting Officer confirms that Government conduct effected a change as alleged by the Contractor, and the conduct causes an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether changed or not changed by such conduct, an equitable adjustment shall be made--

(i) In the contract price or delivery schedule or both; and

(ii) In such other provisions of the contract as may be affected.

(2) The contract shall be modified in writing accordingly. In the case of drawings, designs or specifications which are defective and for which the Government is responsible, the equitable adjustment shall include the cost and time extension for delay reasonably incurred by the Contractor in attempting to comply with the defective drawings, designs or specifications before the Contractor identified, or reasonably should have identified, such defect. When the cost of property made obsolete or excess as a result of a change confirmed by the Contracting Officer under this clause is included in the equitable adjustment, the Contracting Officer shall have the right to prescribe the manner of disposition of the property. The equitable adjustment shall not include increased costs or time extensions for delay resulting from the Contractor's failure to provide notice or to continue performance as provided, respectively, in (b) and (c) above.

NOTE: The phrases "contract price" and "cost" wherever they appear in the clause, may be appropriately modified to apply to cost-reimbursement or incentive contracts, or to combinations thereof.

(End of clause)

I.8 SUBCONTRACTS FOR COMMERCIAL ITEMS (JULY 2004)

(a) *Definitions.* As used in this clause--

"Commercial item" has the meaning contained Federal Acquisition Regulation 2.101, Definitions.

"Subcontract" includes a transfer of commercial items between divisions, subsidiaries, or affiliates of the Contractor or subcontractor at any tier.

(b) To the maximum extent practicable, the Contractor shall incorporate, and require its subcontractors at all tiers to incorporate, commercial items or nondevelopmental items as components of items to be supplied under this contract.

(c)

(1) The Contractor shall insert the following clauses in subcontracts for commercial items:

(i) 52.219-8, Utilization of Small Business Concerns (May 2004) (15 U.S.C. 637(d)(2)(3)), in all subcontracts that offer further subcontracting opportunities. If the subcontract (except subcontracts to small business concerns) exceed $500,000 ($1,000,000 for construction of any public facility), the subcontractor must include 52.219-8 in lower tier subcontracts that offer subcontracting opportunities.

(ii) 52.222-26, Equal Opportunity (Apr 2002) (E.O. 11246).

(iii) 52.222-35, Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans (Dec 2001) (38 U.S.C. 4212(a));

(iv) 52.222-36, Affirmative Action for Workers with Disabilities (Jun 1998) (29 U.S.C. 793).

(v) 52.247-64, Preference for Privately Owned U.S.-Flag Commercial Vessels (APR 2003) (46 U.S.C. Appx 1241 and 10 U.S.C. 2631) (flow down required in accordance with paragraph (d) of FAR clause 52.247-64).

(2) While not required, the Contractor may flow down to subcontracts for commercial items a minimal number of additional clauses necessary to satisfy its contractual obligations.

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract.

(End of Clause)

I.9 AUTHORIZED DEVIATIONS IN CLAUSES (52.252-6) (APR 1984)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the clause.

(b) The use in this solicitation or contract of any NASA FAR Supplement Regulation (48 CFR Chapter 18) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of clause)

I.10 COMPUTER GENERATED FORMS (52.253-1) (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(c) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

I.11 SECURITY REQUIREMENTS FOR UNCLASSIFIED INFORMATION TECHNOLOGY RESOURCES (1852.204-76) (JULY 2002)

(a) The Contractor shall be responsible for Information Technology security for all systems connected to a NASA network or operated by the Contractor for NASA, regardless of location. This clause is applicable to all or any part of the contract that includes information technology resources or services in which the Contractor shall have physical or electronic access to NASA's sensitive information contained in unclassified systems that directly support the mission of the Agency. This includes information technology, hardware, software, and the management, operation, maintenance, programming, and system administration of computer systems, networks, and telecommunications systems. Examples of tasks that require security provisions include:

(1) Computer control of spacecraft, satellites, or aircraft or their payloads;
(2) Acquisition, transmission or analysis of data owned by NASA with significant replacement cost should the contractor's copy be corrupted; and
(3) Access to NASA networks or computers at a level beyond that granted the general public, e.g. bypassing a firewall.

(b) The Contractor shall provide, implement, and maintain an IT Security Plan. This plan shall describe the processes and procedures that will be followed to ensure appropriate security of IT resources that are developed, processed, or used under this contract. The plan shall describe those parts of the contract to which this clause applies. The Contractor's IT Security Plan shall be compliant with Federal laws that include, but are not limited to, the Computer Security Act of 1987 (40 U.S.C. 1441 et seq.) and the Government Information Security Reform Act of 2000. The plan shall meet IT security requirements in accordance with Federal and NASA policies and procedures that include, but are not limited to:

(1) OMB Circular A-130, Management of Federal Information Resources, Appendix III, Security of Federal Automated Information Resources;
(2) NASA Procedures and Guidelines (NPG) 2810.1, Security of Information Technology; and
(3) Chapter 3 of NPG 1620.1, NASA Security Procedures and Guidelines.

(c) Within 30 days after contract award, the contractor shall submit for NASA approval an IT Security Plan. This plan shall be consistent with and further detail the approach contained in the Offerors proposal or sealed bid that resulted in the award of this contract and in compliance with the requirements stated in this clause. The plan, as approved by the Contracting Officer, shall be incorporated into the contract as a compliance document in Section J of the contract..

(d)(1) Contractor personnel requiring privileged access or limited privileged access to systems operated by the Contractor for NASA or interconnected to a NASA network shall be screened at an appropriate level in accordance with NPG 2810.1, Section 4.5; NPG 1620.1, Chapter 3; and paragraph (d)(2) of this clause. Those Contractor personnel with non-privileged access do not require personnel screening. NASA shall provide screening using standard personnel screening National Agency Check (NAC) forms listed in paragraph (d)(3) of this clause, unless contractor screening in accordance with paragraph (d)(4) is approved. The Contractor shall submit the required forms to the NASA Center Chief of Security (CCS) within fourteen (14) days after contract award or assignment of an individual to a position requiring screening. The forms

may be obtained from the CCS. At the option of the government, interim access may be granted pending completion of the NAC.

(2) Guidance for selecting the appropriate level of screening is based on the risk of adverse impact to NASA missions. NASA defines three levels of risk for which screening is required (IT-1 has the highest level of risk):

(i) IT-1--Individuals having privileged access or limited privileged access to systems whose misuse can cause very serious adverse impact to NASA missions. These systems include, for example, those that can transmit commands directly modifying the behavior of spacecraft, satellites or aircraft.

(ii) IT-2--Individuals having privileged access or limited privileged access to systems whose misuse can cause serious adverse impact to NASA missions. These systems include, for example, those that can transmit commands directly modifying the behavior of payloads on spacecraft, satellites or aircraft; and those that contain the primary copy of "level 1" data whose cost to replace exceeds one million dollars.

(iii) IT-3--Individuals having privileged access or limited privileged access to systems whose misuse can cause significant adverse impact to NASA missions. These systems include, for example, those that interconnect with a NASA network in a way that exceeds access by the general public, such as bypassing firewalls; and systems operated by the contractor for NASA whose function or data has substantial cost to replace, even if these systems are not interconnected with a NASA network.

(3) Screening for individuals shall employ forms appropriate for the level of risk as follows:
(i) IT-1: Fingerprint Card (FC) 258 and Standard Form (SF) 85P, Questionnaire for Public Trust Positions;
(ii) IT-2: FC 258 and SF 85, Questionnaire for Non-Sensitive Positions; and
(iii) IT-3: NASA Form 531, Name Check, and FC 258.

(4) The Contracting Officer may allow the Contractor to conduct its own screening of individuals requiring privileged access or limited privileged access provided the Contractor can demonstrate that the procedures used by the Contractor are equivalent to NASA's personnel screening procedures. As used here, equivalent includes a check for criminal history, as would be conducted by NASA, and completion of a questionnaire covering the same information as would be required by NASA.

(5) Screening of contractor personnel may be waived by the Contracting Officer for those individuals who have proof of--
(i) Current or recent national security clearances (within last three years);
(ii) Screening conducted by NASA within last three years; or
(iii) Screening conducted by the Contractor, within last three years, that is equivalent to the NASA personnel screening procedures as approved by the Contracting Officer under paragraph (d)(4) of this clause.

(e) The Contractor shall ensure that its employees, in performance of the contract, receive annual IT security training in NASA IT Security policies, procedures, computer ethics, and best practices in accordance with NPG 2810.1, Section 4.3 requirements. The contractor may use web-based training available from NASA to meet this requirement.

(f) The Contractor shall afford NASA, including the Office of Inspector General, access to the Contractor's and subcontractors' facilities, installations, operations, documentation, databases and personnel used in performance of the contract. Access shall be provided to the extent required to carry out a program of IT inspection, investigation and audit to safeguard against threats and hazards to the integrity, availability and confidentiality of NASA data or to the function of computer systems operated on behalf of NASA, and to preserve evidence of computer crime.

(g) The Contractor shall incorporate the substance of this clause in all subcontracts that meet the conditions in paragraph (a) of this clause.

(End of clause)

I.12 OMBUDSMAN (1852.215-84) (OCT 2003)

(a) An ombudsman has been appointed to hear and facilitate the resolution of concerns from Offerors, potential Offerors, and contractors during the pre-award and post award phases of this acquisition. When requested, the ombudsman will maintain strict confidentiality as to the source of the concern. The existence of the ombudsman is not to diminish the authority of the contracting officer, the Source Evaluation Board, or the selection official. Further, the ombudsman does not participate in the evaluation of proposals, the source selection process, or the adjudication of formal contract disputes. Therefore, before consulting with an ombudsman, interested parties shall first address their concerns, issues, disagreements, and/or recommendations to the contracting officer for resolution.

(b) If resolution cannot be made by the contracting officer, interested parties may contact the installation ombudsman, Dorothy C. Perkins at:

Goddard Space Flight Center
Mail Stop 100
Greenbelt, MD 20771
Business Phone: 301 286-5066
Fax Number: 301 286-1714
E-mail address: Dorothy.C.Perkins@nasa.gov

Concerns, issues, disagreements, and recommendations, which cannot be resolved at the installation, may be referred to the NASA ombudsman, the Director of the Contract Management Division, at 202-358-0445, facsimile 202-358-3083, e-mail james.a.balinskas@nasa.gov. Please do not contact the ombudsman to request copies of the solicitation, verify offer due date, or clarify technical requirements. Such inquiries shall be directed to the Contracting Officer or as specified elsewhere in this document.

(End of clause)

I.13 PHASED ACQUISITION USING DOWN-SELECTION PROCEDURES (1852.217-71) (MAY 2000)

(a) This solicitation is for the acquisition of the Geostationary Lightning Mapper. The acquisition will be conducted as a two-phased procurement using a competitive down-selection technique between phases. In this technique, two or more contractors will be selected for Phase 1. It is expected that the single contractor for Phase 2 will be chosen from among these Contractors after a competitive down-selection.

(b) Phase 1 includes completion of detailed trade studies to develop a concept design that ensures successful completion of all the requirements in the Performance Operation Requirements Document, The Unique Instrument Interface Document, and the Statement of Work. Phase 2, the implementation phase, is a detailed design, fabrication, integration and test, delivery and post delivery support for the Geostationary Lightning Mapper.

(c) The competition for Phase 2 will be based on the results of Phase 1, and the award criteria for Phase 2 will include successful completion of Phase 1 requirements. Note: Phase 2 will be a separately awarded contract.

(d) NASA will issue a separate, formal solicitation for Phase 2 that will include all information required for preparation of proposals, including the final evaluation factors.

(e) Phase 2 will be synopsized in the Commerce Business Daily (CBD) in accordance with FAR 5.201 and 5.203 unless one of the exceptions in FAR 5.202 applies. Notwithstanding NASA's expectation that only the Phase 1 Contractors will be capable of successfully competing for Phase 2, all proposals will be considered. Any other responsible source may indicate its desire to submit a proposal by responding to the Phase 2 synopsis, and NASA will provide that source a solicitation.

(f) To be considered for Phase 2 award, Offerors shall demonstrate a design maturity equivalent to that of the Phase 1 contractors. This demonstration shall include the following Phase 1 deliverables upon which Phase 2 award will be based:

Final Report Package as defined in Paragraph 3.6 and 3.7.1 of the Statement of Work. The final report package will consist of The Formulation Phase Concept and Cost Review (FPCCR) report in full text, providing the results of the trades and analyses and a description of "The Concept Design, with Table of Contents, Tables and Figures. The Final Package is a compilation of all products that document the work performed under the formulation Phase."

Failure to fully and completely demonstrate the appropriate level of design maturity may render the proposal unacceptable with no further consideration for contract award.

(g) The following draft Phase 2 evaluation factors are provided for your information. Please note that these evaluation factors are not final, and NASA reserves the right to change them at any time up to and including the date upon which Phase 2 proposals are solicited.

➢ Anticipated Mission Suitability subfactors – Phase 2 Implementation

- System engineering and instrument design
- Management and risk mitigation
- Small disadvantaged business participation program
- Health and safety

- Cost Factor
- Past Performance Factor

(h) Although NASA will request Phase 2 proposals from Phase 1 contractors, submission of the Phase 2 proposal is not a requirement of the Phase 1 contract. Accordingly, the costs of preparing these proposals shall not be a direct charge to the Phase 1 contract or any other Government contract.

(i) The anticipated schedule for conducting this phased procurement is provided for your information. These dates are projections only and are not intended to commit NASA to complete a particular action at a given time.

Phase 1 award -	120 days after Final RFP Release
Phase 2 synopsis -	December 1, 2006
Phase 2 proposal requested -	March 1, 2007
Phase 2 proposal receipt -	April 1, 2007
Phase 2 award -	September 1, 2007

(End of clause)

I.14 USE OF RURAL AREA SMALL BUSINESSES(1852.219-74) (SEP 1990)

(a) Definitions.

"Rural area" means any county with a population of fewer than twenty thousand individuals.

"Small business concern," as used in this clause, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding under this contract, and qualified as a small business under the criteria and size standards in 13 CFR 121.

(b) NASA prime and subcontractors are encouraged to use their best efforts to award subcontracts to small business concerns located in rural areas.

(c) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as small business concerns located in rural areas.

(d) The Contractor agrees to insert the provisions of this clause, including this paragraph (d), in all subcontracts hereunder that offer subcontracting possibilities.

(End of clause)

I.15 SMALL BUSINESS SUBCONTRACTING REPORTING (1852.219-75) (MAY 1999)

(a) The Contractor shall submit the Summary Subcontract Report (Standard Form (SF) 295) semiannually for the reporting periods specified in block 4 of the form. All other instructions for SF 295 remain in effect.

(b) The Contractor shall include this clause in all subcontracts that include the clause at FAR 52.219-9.

(End of clause)

I.16 NASA 8 PERCENT GOAL (1852.219-76) (JUL 1997)

(a) Definitions.

"Historically Black Colleges or University", as used in this clause means an institution determined by the Secretary of Education to meet the requirements of 34 CFR Section 608.2. The term also includes any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

"Minority institutions", as used in this clause, means an institution of higher education meeting the requirements of section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)) which for the purposes of this clause includes a Hispanic-serving institution of higher education as defined in section 316(b)(1) of the Act (20 U.S.C. 1059c(b)(1)).

"Small disadvantaged business concern", as used in this clause, means a small business concern that (1) is at least 51 percent unconditionally owned by one or more individuals who are both socially and economically disadvantaged, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one or more socially and economically disadvantaged individuals, and (2) has its management and daily business controlled by one or more such individuals. This term also means a small business concern that is at least 51 percent unconditionally owned by an economically disadvantaged Indian tribe or Native Hawaiian Organization, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one or more of these entities, which has its management and daily business controlled by members of an economically disadvantaged Indian tribe or Native Hawaiian Organization, and which meets the requirements of 13 CFR 124.

"Women-owned small business concern", as used in this clause, means a small business concern (1) which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women, and (2) whose management and daily business operations are controlled by one or more women.

(b) The NASA Administrator is required by statute to establish annually a goal to make available to small disadvantaged business concerns, Historically Black Colleges and Universities, minority institutions, and women-owned small business concerns, at least 8 percent of NASA's procurement dollars under prime

contracts or subcontracts awarded in support of authorized programs, including the space station by the time operational status is obtained.

(c) The contractor hereby agrees to assist NASA in achieving this goal by using its best efforts to award subcontracts to such entities to the fullest extent consistent with efficient contract performance.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as small disadvantaged business concerns, Historically Black Colleges and Universities, minority institutions, and women-owned small business concerns.

(End of clause)

I.17 CENTER FOR AEROSPACE INFORMATION (1852.235-70) (FEB 2003)

(a) The Contractor should register with and avail itself of the services provided by the NASA Center for Aerospace Information (CASI) (http://www.sti.nasa.gov) for the conduct of research or research and development required under this contract. CASI provides a variety of services and products as a NASA repository and database of research information, which may enhance contract performance.

(b) Should the CASI information or service requested by the Contractor be unavailable or not in the exact form necessary by the Contractor, neither CASI nor NASA is obligated to search for or change the format of the information. A failure to furnish information shall not entitle the Contractor to an equitable adjustment under the terms and conditions of this contract.

(c) Information regarding CASI and the services available can be obtained at the Internet address contained in paragraph (a) of this clause or at the following address:

Center for Aerospace Information (CASI)
7121 Standard Drive
Hanover, Maryland 21076-1320
Email: help@sti.nasa.gov
Phone: 301-621-0390
FAX: 301-621-0134

(End of clause)

I. 18 EMERGENCY MEDICAL SERVICES AND EVACUATION (1852.242-78)(APR 2001)

The Contractor shall, at its own expense, be responsible for making all arrangements for emergency medical services and evacuation, if required, for its employees while performing work under this contract outside the United States or in remote locations in the United States. If necessary to deal with certain emergencies, the Contractor may request the Government to provide medical or evacuation services. If the Government provides such services, the Contractor shall reimburse the Government for the costs incurred.

(End of clause)

J. 1 LIST OF ATTACHMENTS (GSFC 52.211-101) (OCT 1988)

The following attachments constitute part of this contract:

Attachment	Description	Date	No. of Pages
A	Statement of Work	7/25/2005	20
B	Performance and Operational Requirements Document (Geostationary Lightning Mapper)	7/12/2005	19
C	Unique Instrument Interface Document (Geostationary Lightning Mapper)	7/20/2005	9
D	Mission Assurance Requirements Geostationary Lightning Mapper	6/13/2005	90
E	General Interface Requirements Document	6/13/2005	54
F	Small Business Subcontracting Plan	8/26/2005	2
G	IT Security Plan		Due 30 Days after Contract Award

(End of Clause)

Effective Date: April 20, 2007
Responsible Organization: GOES-R/Code 417

417-R-GLMSOW-0073
Version 2.0

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Geostationary Lightning Mapper (GLM)

Statement of Work (SOW)

April 20, 2007

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Geostationary Operational Environmental Satellite (GOES)
GOES-R Series
Geostationary Lightning Mapper (GLM)
Statement of Work (SOW)

Prepared By:

Bert T. Dixon, NASA GSFC
GOES-R Series GLM Instrument Manager

4-20-07
Date

Review By:

Fred G. Cunningham, NASA GSFC
GOES-R Series Instrument Systems Manager

4-20-07
Date

Approved By:

Michael L. Donnelly, NASA GSFC
GOES-R Series Project Manager

4/20/07
Date

/GLM

GLM SOW

417-R-GLMSOW-0073, RM Version, Geostationary Lightning Mapper (GLM) Statement of Work (SOW)

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ID	Object Number	417-R-GLMSOW-0073, RM Version, Geostationary Lightning Mapper (GLM) Statement of Work (SOW)
GLMSOW1	1	**1 Program Scope and Management**
GLMSOW2	1.0-1	This Statement of Work (SOW) defines those tasks necessary to design, analyze, develop, fabricate, integrate, test, evaluate and support launch of the Geostationary Lightning Mapper (GLM), supply and maintain the instrument Ground Support Equipment (GSE), and support the Satellite Operations Control Center (SOCC). The GLM is classified as a non-primary instrument suite on the GOES-R satellite and has a risk classification of B. The Contractor **shall** provide the personnel, materials, facilities and other resources to design, develop, deliver (to the designated destination) and support under the basic contract: a) Parts and materials for a Prototype Model and 4 Flight Models b) One GLM Prototype Model (PTM) c) One GLM Proto-Flight Model (PFM) designated Flight Model-1 (FM-1) d) Three sets of the Electrical System Test Equipment (ESTE) e) Two GLM Emulators (GLME) f) Two Flight Software Development Environments (FSDEs) g) One Ground Processing Demonstration System (GPDS) h) Spares for the four FMs i) All additional GLM Mechanical and Electrical Ground Support Equipment (MGSE and EGSE) called out elsewhere in this document j) All items and documents specified in all contract documents
GLMSOW3	1.0-2	The Contractor **shall** provide the personnel, materials, facilities and other resources to design, develop, deliver and support: a) Option 1 for an additional Flight Model (FM-2) b) Option 2 for an additional Flight Model (FM-3) c) Option 3 for an additional Flight Model (FM-4)
GLMSOW4	1.0-3	PERIOD OF CONTRACT COVERAGE The period of contract coverage is from contract award through the life of the mission for the last GLM successfully launched, including post launch evaluation and on-orbit anomaly investigations. APPLICABLE DOCUMENTS The documents listed in this section apply directly to the performance of the GLM contract. These documents establish detailed specifications, requirements, and interface information necessary for the performance of the contract. REFERENCE DOCUMENTS NPD 2820.1C: NASA Software Policy NPR 7150.2: NASA Software Engineering Requirements 500-PG-8700.2.7: Design of Space Flight Field Programmable Gate Arrays
GLMSOW6	1.1	**1.1 Program Management Office**
GLMSOW7	1.1.0-1	The Contractor **shall** establish a Program Management Office (PMO) responsible for the leadership and overall direction of all phases of the work specified in this SOW.

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GLMSOW8	1.1.0-2	The Contractor **shall** establish effective communication with the Government Project Office through the Contracting Officer's Technical Representative (COTR) that includes, but is not limited to, e-mail and telephone contact as necessary, weekly telecons with the Government GLM team, and one-on-one contact between National Aeronautics and Space Administration (NASA) and Contractor discipline engineers, to be coordinated by the COTR.
GLMSOW9	1.1.0-3	Once instrument integration and test (I&T) begins, the Contractor **shall** include the Government team in its regularly scheduled I&T meetings attended by the Government in person or via telecon.
GLMSOW10	1.1.0-4	The Contractor **shall** establish a Subcontract Management and Control System to provide technical direction and effective sub-contract management utilizing schedule milestone controls.
GLMSOW11	1.1.0-5	The Contractor **shall** develop and maintain a Master Action Item Data Base (MAID), or spreadsheet, listing all Request for Actions (RFA) or Action Items from formal reviews, Government status reviews, internal technical reviews, peer reviews, all other reviews required by the contract, technical meetings, telecons, etc., listing author and origin (PDR, telecon, etc.) of the RFA, person responsible for closure, wording of the RFA, response, persons(s) authorizing final closure, due date , date closed, and a column for Government concurrence.
GLMSOW12	1.1.0-6	The Contractor **shall** not delete closed action items from the MAID.
GLMSOW13	1.1.0-7	The Contractor **shall** retain all documents and test data for the life of the contract.
GLMSOW14	1.2	**1.2 Reserved**
GLMSOW15	1.3	**1.3 Resource Management**
GLMSOW16	1.3.0-1	The Contractor **shall** establish, implement and maintain a comprehensive Resources Management System (RMS) for planning, authorizing, and controlling the total resource effort for each WBS element, and for providing timely and adequate visibility into manpower, materials, cost, schedule, travel and subcontract performance.
GLMSOW17	1.3.0-2	The RMS **shall** be consistent with the contract Work Breakdown Structure and provide timely and traceable incorporation of contract changes, and document the effect on the resource management baseline.
GLMSOW18	1.3.0-3	The Contractor **shall** utilize Microsoft Project (latest version) as the scheduling tool for the generation and reporting of project schedules.
GLMSOW19	1.3.0-4	The Contractor **shall** implement an Earned Value Management System by which cost and schedule performance can be tracked and reported monthly.
GLMSOW20	1.3.0-5	The Contractor **shall** provide private office space, furniture, copier(s), facsimile machine(s), phones and high-speed internet access in the vicinity of the PMO for one Government resident and one visiting representative.
GLMSOW21	1.3.0-6	The contractor **shall** provide additional meeting space in the vicinity of the PMO for use by Government representatives during reviews or other functions that will increase the number of on-site Government representatives.
GLMSOW22	1.3.0-7	The Contractor **shall** provide office space, furniture, copier(s), printer, phones and high speed internet access for these additional Government representatives during instrument integration and testing, in the vicinity of the activity.
GLMSOW23	1.4	**1.4 Configuration and Information Management**
GLMSOW24	1.4.0-1	The Contractor **shall** oversee and manage the generation, configuration control and distribution of all documents required by the contract.

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GLMSOW25	1.4.0-2	The Contractor **shall** establish, implement, and maintain a government approved Configuration Management System that provides Configuration Management control of configured items including all flight hardware and software, all GSE hardware and software, and all documentation developed under this contract, including drawings, procedures, plans, CDRLs, and program review materials.
GLMSOW26	1.4.0-3	The Contractor **shall** provide all documents called out in the Contract Data Requirement List (CDRL) plus all updates and revisions in accordance with the CDRL.
GLMSOW27	1.4.0-4	The Contractor **shall** produce, control and maintain contract documentation in accordance with the CDRL. The Government will establish and maintain a secure website, called the GOES-R Portal. A folder will be maintained on the portal for GLM only, accessible by the Contractor and selected government personnel, for document delivery and the exchange of information only.
GLMSOW28	1.4.0-5	The Contractor **shall** place on the GOES-R Portal, as generated or changed, all CDRLs. The Government will post on the website Government deliverables and technical documentation generated in support of the GLM mission.
GLMSOW29	1.4.0-6	The Contractor **shall** place on the GLM government website, as generated or changed, all technical and programmatic documentation generated on the contract that includes, but is not limited to, the MAID, system engineering reports, design memos, internal technical memoranda, drawings, schematics, design specifications and test procedures.
GLMSOW30	1.4.0-7	The Contractor **shall** notify the selected Government personnel by e-mail that a document has been posted on the GLM government website. The Government will provide similar notification to the Contractor.
GLMSOW31	1.4.0-8	The Contractor **shall** develop, implement and maintain a Software Configuration Management System that provides baseline management and control of software requirements, design, source code, data and documentation.
GLMSOW32	1.4.0-9	The Contractor **shall** employ a source code version control tool to check in/check out current or previous versions of a source file.
GLMSOW33	1.4.0-10	The Contractor **shall** establish a Configuration Control Board(s) to review and approve changes to the flight models, software, GSE and all controlled documents.
GLMSOW34	1.4.0-11	The Contractor **shall** submit Class I changes to the Government for approval before implementation of the change.
GLMSOW35	1.4.0-12	The Contractor **shall** submit Class II changes to the Government for concurrence with the classification.
GLMSOW36	1.4.0-13	If GSFC determines that a Class II classification is incorrect the Contractor **shall** resubmit the change as a Class I change.
GLMSOW37	1.4.0-14	The Contractor **shall** provide technical, schedule and cost impacts to Government proposed changes.
GLMSOW38	1.4.0-15	The Contractor **shall** implement a knowledge capture program so that the knowledge base developed during design and development of the PTM and all FMs will be available to the engineering staff that will be called upon to maintain the program through the life of the mission.
GLMSOW39	1.5	**1.5 Program Review Requirements**
GLMSOW40	1.5.0-1	The Contractor **shall** provide the technical and administrative support for all program reviews and meetings including, but not limited to, Instrument Design Reviews, Project Status Reviews, Technical Meetings, Data Reviews, Design Modification/Upgrade Reviews, and Subcontract Reviews.

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GLMSOW41	1.5.0-2	The Contractor **shall** provide technical support to observatory system level reviews, observatory integration and test reviews and mission operations reviews.
GLMSOW42	1.5.0-3	Unless otherwise stipulated, all reviews and meetings will be held at the Contractor's facility.
GLMSOW43	1.5.1	**1.5.1 Kick-Off Meeting**
GLMSOW44	1.5.1.0-1	Approximately one month after award the Contractor **shall** prepare and conduct a Kick-Off Meeting consisting of a management status review, an IBR planning briefing by NASA financial management personnel followed by a line-by-line review of the contract schedule and clauses, SOW, CDRLs, and any changes to the requirements of the PORD, GIRD, UIID, and IMAR since the Requirements Walk Through of the Formulation phase.
GLMSOW45	1.5.1.0-2	The Contractor **shall** plan for a five-day review.
GLMSOW46	1.5.1.0-3	If the review is not complete in five days, the Contractor **shall** continue to conduct and support the review, at a time to be agreed upon by the Contractor and the Government, until the Government deems the review complete.
GLMSOW47	1.5.2	**1.5.2 Project Baseline Manpower Exercise - Planning Meeting**
GLMSOW48	1.5.2.0-1	Approximately two months after award the Contractor **shall** conduct a Project Implementation and Manpower Exercise meeting with the Government in preparation for the IBR, intended to establish a baseline schedule and work flow plan.
GLMSOW49	1.5.2.0-2	The Contractor **shall** plan for a three day Planning Meeting.
GLMSOW50	1.5.3	**1.5.3 Integrated Baseline Review (IBR)**
GLMSOW51	1.5.3.0-1	Approximately 4 to 6 months after contract award, the Contractor **shall** conduct an Integrated Baseline Review (IBR).
GLMSOW52	1.5.3.0-2	The IBR **shall** include a review of the Contractor's earned value assessment and reporting system.
GLMSOW53	1.5.3.0-3	The Contractor **shall** plan for a three day review.
GLMSOW54	1.5.3.0-4	The IBR **shall** follow the WBS based schedule in sufficient depth of detail to show the critical path, all linkages to lower tasks to expose missing dependencies, and to ensure a smooth work flow plan through CDR, and in lesser detail through delivery of PFM (FM-1).
GLMSOW55	1.5.4	**1.5.4 Peer Reviews**
GLMSOW56	1.5.4.0-1	The Contractor **shall** implement a program of periodic tabletop engineering reviews (peer reviews) throughout the development life cycle to identify and resolve concerns as they arise in the design process, and prior to formal, system level reviews.
GLMSOW57	1.5.4.0-2	Peer review teams **shall** be comprised of technical experts with significant practical experience relevant to the technology and requirements to be reviewed.
GLMSOW58	1.5.4.0-3	The Contractor **shall** provide three or more days prior notification so that government representatives can be present.
GLMSOW59	1.5.5	**1.5.5 Instrument Design Reviews**
GLMSOW60	1.5.5.0-1	The Contractor **shall** prepare and conduct Instrument Design Reviews for the Independent Integrated Review Team that will be chaired by the Government. The reviews will cover all aspects of flight and ground hardware, software and operations for which the Contractor has responsibility.

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GLMSOW61	1.5.5.0-2	The Contractor **shall** conduct a dry run of each design review, with the government GLM team in attendance, approximately 2 weeks prior to the review.
GLMSOW62	1.5.5.0-3	After each review, the Contractor **shall** document all RFAs in the MAID within 1 week of receipt.
GLMSOW63	1.5.5.0-4	Each design review, (PDR, CDR, etc) is not considered complete until approved by the Government. If the Government determines that a delta review is necessary, the Contractor **shall** conduct such review at a time to be mutually agreed upon with the Government.
GLMSOW64	1.5.5.1	**1.5.5.1 System Definition Review (SDR)**
GLMSOW65	1.5.5.1.0-1	Approximately 4 months after contract award the Contractor **shall** prepare and conduct an SDR covering the GLM system specification including: instrument requirements, interfaces, GSE, flight software and ground test software requirements and ground processing algorithms requirements.
GLMSOW66	1.5.5.1.0-2	The Contractor **shall** plan for a 3 day review, not including resolution of RFAs.
GLMSOW67	1.5.5.2	**1.5.5.2 Preliminary Design Review (PDR)**
GLMSOW68	1.5.5.2.0-1	The Contractor **shall** prepare and conduct a PDR at the conclusion of the preliminary design efforts and after testing the breadboard or brassboard models of critical subassemblies/assemblies.
GLMSOW69	1.5.5.2.0-2	The Contractor **shall** plan for a 3 day review, not including resolution of RFAs.
GLMSOW70	1.5.5.3	**1.5.5.3 Critical Design Review (CDR)**
GLMSOW71	1.5.5.3.0-1	The Contractor **shall** prepare and conduct a CDR prior to the start of manufacture of the PTM hardware unless the Contractor requests and the Government concurs with an earlier start.
GLMSOW72	1.5.5.3.0-2	The Contractor **shall** plan for a three day review, not including resolution of RFAs.
GLMSOW73	1.5.5.4	**1.5.5.4 Pre-Environmental Review (PER) - Each Instrument**
GLMSOW74	1.5.5.4.0-1	The Contractor **shall** prepare and conduct a PER prior to the start of environmental testing of the PTM and each FM to establish the readiness of the system and to evaluate the environmental test plans and procedures.
GLMSOW75	1.5.5.4.0-2	The Contractor **shall** plan for a three-day review, not including resolution of RFAs.
GLMSOW76	1.5.5.5	**1.5.5.5 Pre-Storage/Pre-Shipment Review - Each Instrument**
GLMSOW77	1.5.5.5.0-1	The Contractor **shall** prepare and conduct a pre-storage review prior to placement of the PTM and each flight model into storage at the Contractor's facilities.
GLMSOW78	1.5.5.5.0-2	The Contractor **shall** plan for a three-day pre-storage review, not including resolution of RFAs.
GLMSOW79	1.5.5.5.0-3	The Contractor **shall** prepare and conduct a pre-ship review prior to the shipment of the PTM and each flight model.
GLMSOW80	1.5.5.5.0-4	The Contractor **shall** plan for a three-day pre-ship review, not including resolution of RFAs.
GLMSOW81	1.5.5.6	**1.5.5.6 Design Modification Reviews**
GLMSOW82	1.5.5.6.0-1	For any design change resulting from the PTM test program, the Contractor **shall** hold a Design Modification Review.
GLMSOW83	1.5.5.6.0-2	If such a review(s) is/are held, the Contractor **shall** plan for a 2 day review not including resolution of RFAs.

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GLMSOW84	1.5.5.6.0-3	The Government reserves the right to request the Contractor hold a Design Modification Review for Class I CCRs following CDR.
GLMSOW85	1.5.6	**1.5.6 Observatory Level Reviews**
GLMSOW86	1.5.6.0-1	The Contractor **shall** provide technical support to all Observatory level and Mission reviews.
GLMSOW87	1.5.6.0-2	The Contractor **shall** support the Observatory level reviews by presentations and/or documentation; for example, an instrument overview or design summary, test and data evaluation summaries, etc.
GLMSOW88	1.5.6.0-3	The Contractor **shall** attend all Observatory Reviews including but not necessarily limited to: a) Observatory System Definition Review (3 days) b) Observatory Preliminary Design Review (3 days) c) Observatory Critical Design Review (3 days) d) Observatory Pre-environmental Review (3 days for each FM) e) Observatory Pre-storage Review (3 days for each FM) f) Observatory Pre-shipment Review (3 days for each FM) g) Mission Operations Review (3 days for each FM) h) Flight Readiness Review (1 day for each FM) i) Launch Readiness Review (1 day for each FM) Meetings (a) through (g) will be held at the spacecraft contractor's facility. Meetings (h) and (i) will be held at the launch site.
GLMSOW89	1.5.7	**1.5.7 Project Management Status Reviews**
GLMSOW90	1.5.7.0-1	The Contractor **shall** prepare and hold bi-monthly Project Management Status Reviews (PMSR) for the purpose of reviewing the status of the instrument and GSE development, and the overall status of the project. The status reviews will be held at the Contractor's facility through successful completion of the CDR, then alternate between government designated facilities and the Contractors facilities. Specific agenda items may be required by the Government.
GLMSOW91	1.5.8	**1.5.8 Test Reviews**
GLMSOW92	1.5.8.0-1	The Contractor **shall** prepare and conduct table-top test reviews with government personnel on the overall instrument status and performance.
GLMSOW93	1.5.8.0-2	Test data reviews **shall** include instrument sub-assemblies and subcontracted subassemblies as well as instrument and instrument suite level test data.
GLMSOW94	1.5.8.0-3	The Contractor **shall** conduct data reviews prior to the shipment of deliverable GSE.
GLMSOW95	1.5.8.0-4	The Contractor **shall** prepare and conduct reviews of the interim data following any instrument or system level performance verification or calibration test prior to the breakdown of any test setup to ensure collection of good data, and prior to the Pre-Storage and Pre-Shipment Reviews to determine readiness.
GLMSOW96	1.5.9	**1.5.9 Technical Meetings**
GLMSOW97	1.5.9.0-1	The Contractor **shall** provide technical meetings and reviews as deemed necessary by the Government for the purpose of discussing and/or resolving problems or items of interest.

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GLMSOW98	1.5.9.0-2	The Contractor **shall** conduct Technical Interchange Meetings with subcontractors for instruments, critical assemblies and subassemblies and provide the Government 7 days advanced notice so that government representatives can attend.
GLMSOW99	1.5.10	**1.5.10 Subcontract, Subsystem, and Instrument Reviews**
GLMSOW100	1.5.10.0-1	The Contractor **shall** plan a series of subsystem reviews and document that plan as part of the Project Management Plan.
GLMSOW101	1.5.10.0-2	The Contractor **shall** conduct PDR and CDR reviews of all major sub-systems whether these subsystems are provided by the Contractor or by a subcontractor.
GLMSOW102	1.5.10.0-3	Whether internal or external, sub-system reviews **shall** be chaired by the Contractor and conducted by personnel not directly responsible for design or procurement of the hardware under review. The Government reserves the right to attend these reviews and requires 10 business days notification.
GLMSOW103	1.5.10.0-4	The Contractor **shall** chair all subcontractor reviews.
GLMSOW104	1.5.10.0-5	The Contractor **shall** document the minutes and action items that result from these reviews.
GLMSOW105	1.5.10.0-6	Action Items that result from these reviews **shall** be documented in the MAID.
GLMSOW106	1.5.10.0-7	The MAID and all minutes that result from these reviews **shall** be placed on the GOES-R Portal.
GLMSOW107	1.5.10.0-8	The Contractor **shall** plan a series of software reviews and document that plan as part of the Software Management Plan. Software reviews will include the following: a) Software Requirements Specification Review/Walkthrough b) Software Preliminary Design Review c) Software Critical Design Review d) Software Test Readiness Review e) Software Qualification Review
GLMSOW108	1.5.10.0-9	The Contractor **shall** conduct software peer reviews; the Government reserves the right to attend and requires three business days advance notice.
GLMSOW109	1.5.10.0-10	The scope and process for conducting software peer reviews **shall** be documented in the Software Management Plan.
GLMSOW110	1.6	**1.6 Risk Management**
GLMSOW111	1.6.0-1	The Contractor **shall** implement and maintain a Risk Management Program which addresses all programmatic, performance and reliability risks.
GLMSOW112	1.6.0-2	The Contractor **shall** evaluate, classify, and prioritize all identified reliability and quality risks and assess their potential impact on cost and schedule.
GLMSOW113	1.6.0-3	The Contractor **shall** develop and implement risk management strategies, actions (mitigate, watch or research), and assign tasks and appropriate resources to manage and control the risks.
GLMSOW114	1.6.0-4	The Contractor **shall** track all risks being mitigated on an ongoing basis; capture risk attributes and mitigation information by collecting data; establish performance metrics; examine trends, deviations and anomalies.

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GLMSOW115	1.6.0-5	The Contractor **shall** allow the Government remote access to the Contractor's risk management system.

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GLMSOW116	2	**2 Systems Engineering**
GLMSOW117	2.0-1	The Contractor **shall** establish and maintain a Systems Engineering Program for directing, specifying and overseeing the design and technical development of the GLM, GSE, and ground algorithms.
GLMSOW118	2.0-2	The Contractor **shall** utilize DOORS as the Requirements Management tool.
GLMSOW119	2.1	**2.1 Systems Management and Engineering**
GLMSOW120	2.1.0-1	The Contractor **shall** perform all system studies, trades and risk assessments necessary to develop an instrument system design which meets the system performance.
GLMSOW121	2.1.0-2	The Contractor **shall** flowdown the GLM performance requirements into engineering functional requirements, detailed equipment and end item design requirements.
GLMSOW122	2.1.0-3	The Contractor **shall** ensure that all subsystems, both individually and in combination, meet the intended design and performance specifications and that the design specifications are sufficient to meet the mission life requirements.
GLMSOW123	2.1.0-4	The Contractor **shall** establish and maintain a System Performance and Environmental Verification Program that demonstrates that the FMs meet all mandated and derived performance requirements and that the GSE meets all design and interface requirements and is safe to use with the PTM and flight hardware.
GLMSOW124	2.2	**2.2 Observatory Interface and Accommodation**
GLMSOW125	2.2.0-1	The Contractor **shall** coordinate with the observatory Contractor and support technical interchange meetings to refine the instrument accommodations and interfaces between instrument and observatory as well as instrument GSE to observatory GSE interfaces for data analysis.
GLMSOW126	2.2.0-2	The Contractor **shall** provide inputs and support the development of the GLM-to-spacecraft ICD.
GLMSOW127	2.2.0-3	The Contractor **shall** support the observatory implementation contractor in design and test of all GLM to observatory interfaces: mechanical, including the location of the GLM on the observatory, electrical, and thermal.
GLMSOW128	2.3	**2.3 System Analysis and Allocations**
GLMSOW129	2.3.0-1	The Contractor **shall** conduct complete analyses of the technical requirements that fully establish and define budget allocations for all required performance and design parameters, including but not limited to, mass, power and volume allocations, alignment, contamination control, thermal, on-board processing resources, and data timeliness.
GLMSOW130	2.3.0-2	The Contractor **shall** maintain and control budgets (i.e. allocations and margins) for all instrument resources.
GLMSOW131	2.3.0-3	The Contractor **shall** develop alignment budgets necessary to meet the performance requirements of the GLM.
GLMSOW132	2.3.0-4	The Contractor **shall** conduct the analyses required to confirm the integrity of the instrument design, and to ensure that instrument performance requirements will be met over the operational design life.
GLMSOW133	2.3.0-5	The Contractor **shall** conduct analyses and simulations required to assure the combined subsystems function properly as an integrated unit.

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GLMSOW134	2.3.0-6	The Contractor **shall** conduct data analysis and trending and maintain a trend database during instrument level testing, suite level testing, observatory level testing and post-launch testing operations, in order to ensure stability of instrument performance.
GLMSOW135	2.3.0-7	The Contractor **shall** conduct end-to-end analyses of the instrument to demonstrate the designs will meet all performance requirements.
GLMSOW136	2.3.0-8	The Contractor **shall** develop and maintain for the life of the program, a computer simulation(s) and models for these end-to-end GLM system analyses.
GLMSOW137	2.3.0-9	The Contractor **shall** define the observatory models required for evaluation of GLM end-to-end performance.
GLMSOW138	2.4	**2.4 Contamination Control and Analysis**
GLMSOW139	2.4.0-1	The Contractor **shall** establish a Contamination Control Program and provide the resources necessary to assure that appropriate contamination control is maintained through all phases of instrument manufacture, build-up/assembly, integration and test, and observatory integration and test, launch site processing, and on-orbit operation.
GLMSOW140	2.4.0-2	The Contractor **shall** establish and document contamination allowances and budgets for performance degradation of thermal contamination-sensitive hardware such that, even when degraded by contamination within the stated allowance, the hardware will meet its end-of-life mission objectives.
GLMSOW141	2.4.0-3	The Contractor **shall** provide a mass transport analysis and a particle generation analysis for the instrument.
GLMSOW142	2.4.0-4	The Contractor **shall** perform all cleaning that is required to maintain contamination at defined levels.
GLMSOW143	2.4.0-5	The Contractor **shall** report the status of all contamination control activities at Instrument Design Reviews, technical meetings and PMSRs.
GLMSOW144	2.5	**2.5 Magnetic Control Program**
GLMSOW145	2.5.0-1	The Contractor **shall** implement a magnetic control program to ensure that the instrument generated magnetic fields do not exceed the field limits during instrument operation.
GLMSOW146	2.6	**2.6 Special Engineering Analysis**
GLMSOW147	2.6.0-1	The Contractor **shall** conduct special engineering tasks and/or analyses relating to the development, implementation, and operation of the GLM and ground systems as required and authorized by Contract clauses H.6 and H.12.
GLMSOW148	2.6.0-2	Upon request by the Contracting Officer, the Contractor **shall** prepare and submit a Contractor Task Plan.
GLMSOW149	2.6.0-3	The Contractor **shall** document the results of the study in an Engineering Analyses Report delivered to the Government no later than the date specified by the Government.
GLMSOW150	2.6.1	**2.6.1 Radiator Study**
GLMSOW151	2.6.1.0-1	The Contractor **shall** assess the feasibility and impacts (cost, schedule, mass, power, data rate and risk) of the contractor providing the radiator for the GLM sensor.
GLMSOW152	2.6.1.0-2	The Contractor **shall** provide the results of this study in an Engineering Analysis Report delivered to the Government no later than 30 days following the Contract Award.

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GLMSOW153	3	**3 Prototype Model (PTM)**
GLMSOW154	3.0-1	The Contractor **shall** develop a non-flight GLM Prototype Model (PTM), to qualify the designs and procedures for the FM builds.
GLMSOW155	3.0-2	The PTM **shall** fully reflect the FM design including full redundancy and the use of flight Electrical, Electronic, and Electromechanical (EEE) parts.
GLMSOW156	3.0-3	If flight parts are not available when needed by the PTM, the Contractor **shall** propose alternative parts and submit to the Government for approval.
GLMSOW157	3.0-4	The PTM **shall** be fabricated with full reliability and quality control measures. An exception is that the PTM may be fabricated and tested to red-lined drawings only if the drawings are under full configuration control.
GLMSOW158	3.0-5	The PTM **shall** be functionally tested and environmentally tested to prototype qualification levels and durations as defined in the IMAR using Government approved test procedures.
GLMSOW159	3.0-6	The PTM **shall** be calibrated using Government approved test procedures.
GLMSOW160	3.1	**3.1 Design and Analysis**
GLMSOW161	3.1.1	**3.1.1 Instrument Design**
GLMSOW162	3.1.1.0-1	The Contractor **shall** design the instrument to meet the Performance and Interface requirements of all contractual documents.
GLMSOW163	3.1.1.0-2	The Contractor **shall** perform subassembly/assembly level design and testing to verify expected performance of critical and high risk systems prior to start of instrument fabrication.
GLMSOW164	3.1.1.0-3	The Contractor **shall** conduct life tests of all mechanisms and other critical assemblies as specified in the IMAR.
GLMSOW165	3.1.1.0-4	The Contractor **shall** verify the expected performance of any design change before proceeding with fabrication of the changed article.
GLMSOW166	3.1.2	**3.1.2 Flight and Ground Test Software Development**
GLMSOW167	3.1.2.0-1	The Contractor **shall** establish and maintain a Software Management Program to plan and document software development processes and procedures, software tools, reviews, resources, schedules and deliverables.
GLMSOW168	3.1.2.0-2	The Contractor **shall** maintain a table mapping applicable software processes and/or Software Management Plan sections to show compliance with the following NPR 7150.2 sections: 2.2, 2.3, 2.4, 3 (all), 4.1, 4.2, 4.3, 4.4.1, 4.4.2, 4.4.3, and 5 for each software classification/CSCI, including those accomplished by subcontracts.
GLMSOW405	3.1.2.0-3	The Contractor **shall** submit, for Government approval, a preliminary classification for each Computer Software Configuration Item (CSCI) in accordance with the software classification definitions for Class A, B, C, D, E, F, G and H in Appendix B of NPR 7150.2.
GLMSOW406	3.1.2.0-4	The Contractor **shall** classify all GLM flight software as Class B software.
GLMSOW169	3.1.2.0-5	The Contractor **shall** provide technical support for NASA Independent Verification and Validation (IV&V) efforts in accordance with the IMAR.

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GLMSOW170	3.1.2.0-6	For all Class B software (as defined in NPR 7150.2), the personnel responsible for the development of software test documents (e.g. Software Test Plans, Software Test Procedures, Software Test Descriptions) **shall** be different from those personnel responsible for the design and development of that CSCI.
GLMSOW171	3.1.2.0-7	The contractor **shall** document their Software V&V program in the Software Management Plan, in accordance with the CDRL.
GLMSOW172	3.1.2.0-8	The contractor **shall** ensure that all software loaded onto flight hardware is flight qualified.
GLMSOW173	3.1.2.0-9	The contractor **shall** conduct an Unused Code Analysis, as specified in Section 8.5.4 of NASA Guidebook 8719.13B, for any flight qualified Class B software.
GLMSOW174	3.1.2.0-10	The results of the Unused Code Analysis **shall** be presented as part of the Software Test Readiness Review Data Package, in accordance with the CDRL.
GLMSOW175	3.1.2.0-11	The contractor **shall** ensure that the flight software installed and operated on the flight hardware is identical to the flight software that was tested and qualified during the contractor's V&V activity.
GLMSOW176	3.1.2.0-12	The Contractor **shall** design, develop, test and implement flight software and GSE ground test software for the PTM and FMs.
GLMSOW177	3.1.2.0-13	The Contractor **shall** specify, design, review, develop, configuration control, and test the software component of firmware, consisting of computer programs and data loaded into a class of memory not dynamically modifiable by the computer during processing (e.g., Programmable Read Only Memories, Application Specific Integrated Circuits with embedded read only memory, Microcontrollers with embedded read only memory, etc.), in the same rigorous manner as the flight software.
GLMSOW180	3.1.2.0-14	The Contractor **shall** provide and maintain one FSDE, including hardware, software, procedures and associated documentation, to be used for the life cycle management, development and verification of the flight software at the Contractor's facility.
GLMSOW181	3.1.2.0-15	The Contractor **shall** provide and maintain one FSDE, including hardware, software, procedures and associated documentation for delivery to the Government for development, test and verification of software patches that may be required throughout the operational phase of the GLM mission.
GLMSOW182	3.1.2.0-16	The Contractor **shall** provide and maintain a GSE Ground Test Software Development System to be used for the life cycle management of the ground test software at the Contractor's facility.
GLMSOW183	3.1.2.0-17	The Contractor **shall** implement the safety requirements of NASA-STD-8719.13 when a system or subsystem is determined to have safety critical software.
GLMSOW184	3.1.2.0-18	The Contractor **shall** provide Government insight into software design, development and test activities including monitoring of integration and verification adequacy, trade study data, auditing the software design and development process, and participation in all software peer reviews and technical interchange meetings.
GLMSOW403	3.1.2.0-19	The Contractor **shall** document the Government's insight into software activities/processes in the Software Management Plan.
GLMSOW186	3.1.3	**3.1.3 Ground Processing Algorithms (GPA)**
GLMSOW187	3.1.3.0-1	The Contractor **shall** provide Ground Processing Algorithms (GPAs) to produce data to be compliant with the requirements specified in the GLM PORD.

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GLMSOW188	3.1.3.0-2	The Contractor **shall** provide an Algorithm Description Document (ADD) which provides the theoretical basis from which the GPAs for the production of GLM Level 1B data will be developed. Note: The Contractor may provide algorithms for post-Level 1B processing for Government consideration.
GLMSOW189	3.1.3.0-3	The Contractor **shall** conduct a comprehensive verification and validation program of the GPAs and demonstrate that the algorithms can produce Level 1B data that meets the requirements of the GLM PORD, all within the required data latency period.
GLMSOW190	3.1.3.0-4	The Contractor **shall** provide a copy of the operational GPA source code "as run" for verification and validation.
GLMSOW191	3.1.3.0-5	The Contractor **shall** provide a copy of the input test scenes used to verify and validate the functionality of the GPAs.
GLMSOW192	3.1.3.0-6	The Contractor **shall** provide post-PTM test design changes to the GPAs.
GLMSOW193	3.1.3.0-7	The Contractor **shall** conduct a comprehensive test and validation program for any changes to the GPAs and demonstrate that the algorithms can produce data that meets the requirements of the PORD, all within the required data latency period.
GLMSOW194	3.1.3.0-8	The Contractor **shall** provide a copy of the post-PTM updated operational GPA source code "as run" for verification and validation.
GLMSOW195	3.1.3.0-9	The Contractor **shall** certify the implementation of the GPA once the NOAA ground system contractor has successfully demonstrated acceptable performance.
GLMSOW407	3.1.4	**3.1.4 Field Programmable Gate Array (FPGA) Design and Development**
GLMSOW408	3.1.4-1	The Contractor **shall** provide Government insight into FPGA design, development and test activities including: monitoring verification adequacy, trade study data, auditing the FPGA design and development process, and participation in all FPGA peer reviews and technical interchange meetings.
GLMSOW409	3.1.4-2	The Contractor **shall** document the Government's insight into FPGA activities/processes in the FPGA Development Plan.
GLMSOW410	3.1.4-3	The contractor **shall** provide a FPGA Design Data Package for each FPGA after Place and Route, Timing Analysis and Signal Integrity Analysis have been completed for that FPGA.
GLMSOW411	3.1.4-4	NASA will perform an independent assessment of all FPGA designs against the design guidelines contained in 500-PG-8700.2.7: Design of Space Flight Field Programmable Gate Arrays, using the information in the FPGA Design Data Package CDRL.
GLMSOW412	3.1.4-5	The contractor **shall** review and assess all NASA FPGA design findings and recommendations.
GLMSOW413	3.1.4-6	The contractor **shall** notify NASA of those instances where they decided not to take corrective action on specific FPGA design findings and recommendations.
GLMSOW196	3.2	**3.2 Parts Procurement, Fabrication and Subassembly Testing**
GLMSOW197	3.2.0-1	The Contractor **shall** procure all parts required for the PTM, four FMs and all GSE.
GLMSOW198	3.2.0-2	If it is necessary to procure parts due to long lead times or potential parts obsolescence prior to the CDR, the Contractor **shall** obtain the Government's consent prior to doing so.

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GLMSOW199	3.2.0-3	The Contractor **shall** procure and maintain an adequate supply of spare parts and subassemblies to minimize cost, schedule, and performance risks caused by part damage or shortages.
GLMSOW200	3.2.0-4	The Contractor **shall** provide assembled and tested spares of critical assemblies to be replaced as needed to prevent costly schedule delays. The minimum requirements are: a) Focal Plane Arrays - 2 spare sets b) Thermal Blankets - 1 spare set c) Optics - 1 each d) Electronics Boards - 1 flight set each e) Mechanisms - 1 each f) Light Baffle - 1 spare g) Connectors - 1 spare set (including flight mating connectors) h) Intra-Instrument harness (Sensor unit-to-Electronics Module) - 1 spare set
GLMSOW201	3.2.0-5	The Contractor **shall** procure and deliver to the observatory contractor, mating flight connectors for all electrical interfaces to the Government for the four FMs.
GLMSOW202	3.2.0-6	The Contractor **shall** perform fabrication and assembly/subassembly testing of all flight hardware, life test items and needed spares.
GLMSOW203	3.2.0-7	The Contractor **shall** provide all harnesses between instrument units.
GLMSOW204	3.2.0-8	The Contractor **shall** provide all instrument mounting hardware (i.e., all kinematic mounts and any vibration isolation hardware) and thermal isolation hardware.
GLMSOW205	3.2.0-9	The Contractor **shall** provide one set of thermal blankets built to flight specifications.
GLMSOW206	3.2.0-10	The Contractor **shall** tag all non-flight items to be removed prior to flight with a red tag stating "Remove before flight."
GLMSOW207	3.2.0-11	The Contractor **shall** tag all flight items to be installed prior to flight with a green tag stating "Install before flight."
GLMSOW208	3.3	**3.3 Integration and Test**
GLMSOW209	3.3.0-1	The Contractor **shall** integrate the instrument and perform a testing, calibration and data analysis regimen to qualify the instrument design, verify that instrument performance meets all requirements, proof test fixturing and debug all test and calibration procedures.
GLMSOW210	3.3.0-2	The Contractor **shall** perform a safe-to-mate and signal characterization on all instrument hardware and GSE prior to electrical mating.
GLMSOW211	3.3.1	**3.3.1 Integration**
GLMSOW212	3.3.1.0-1	The Contractor **shall** integrate the PTM and certify that the instrument is ready for the application of power.
GLMSOW213	3.3.1.0-2	The Contractor **shall** perform initial tests to demonstrate that the instrument is performing as designed and is ready to proceed with Functional Testing.
GLMSOW214	3.3.1.0-3	During the course of PTM testing the Contractor **shall** debug and correct test procedures, GSE and fixtures as use indicates.
GLMSOW215	3.3.1.0-4	The PTM may be tested with red-lined procedures providing the changes are reviewed and approved by Test Engineering, Contractor Systems Engineering and Mission Assurance.

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GLMSOW216	3.3.2	**3.3.2 Performance Verification and Design Qualification**
GLMSOW217	3.3.2.0-1	The Contractor **shall** develop and maintain all verification test procedures.
GLMSOW218	3.3.2.0-2	The Contractor **shall** perform data reduction and provide analysis of test results at the subassembly, assembly, unit, and instrument level, and verification of observatory interfaces.
GLMSOW219	3.3.2.0-3	The Contractor **shall** prepare and provide Test Reports following completion of instrument functional and performance testing, life testing, environmental testing, and calibration testing commencing at the sub-assembly level.
GLMSOW220	3.3.2.1	**3.3.2.1 Functional and Performance Testing**
GLMSOW221	3.3.2.1.0-1	The Contractor **shall** conduct Functional and Performance Tests that includes Electrical Interface Tests, Comprehensive Performance Tests, Limited Performance Tests, Operating Time and Failure-free Performance Testing in accordance with the IMAR.
GLMSOW222	3.3.2.1.0-2	During each Comprehensive Performance Test the Contractor **shall** collect and analyze all available electrical functional data, performance data, diagnostic data, and survival data.
GLMSOW223	3.3.2.2	**3.3.2.2 Structural and Mechanical Testing**
GLMSOW224	3.3.2.2.0-1	The Contractor **shall** demonstrate the mass properties of each unit of the GLM and document the information in the IDD.
GLMSOW225	3.3.2.2.0-2	The Contractor **shall** measure: a) Each unit mass to an accuracy of ±0.5 kg; b) Launch and on-orbit center of mass of each unit to an accuracy of ±5 mm referenced to the individual coordinate axes.
GLMSOW226	3.3.2.2.0-3	The Contractor **shall** determine by analysis the launch and on-orbit moments and products of inertia referenced to the coordinate axes with an origin at the center of gravity.
GLMSOW227	3.3.2.2.0-4	The Contractor **shall** measure the alignment angles between the sensor line of sight and the sensor alignment reference.
GLMSOW228	3.3.2.2.0-5	The Contractor **shall** conduct a mechanical test program at prototype levels that includes a modal survey, strength qualification, random vibration testing, sinusoidal vibration testing, shock testing, mechanical functional testing and pressure profile verification, in accordance with the IMAR to demonstrate that the GLM meets all structural and mechanical performance requirements.
GLMSOW229	3.3.2.2.0-6	Prior to the start of, and after the completion of vibration testing the Contractor **shall** perform a Comprehensive Performance Test.
GLMSOW230	3.3.2.2.0-7	The Contractor **shall** perform a Limited Performance Test following each axis of vibration testing.
GLMSOW231	3.3.2.2.0-8	The Contractor **shall** conduct Life Tests of all mechanisms and other critical assemblies in accordance with the IMAR.
GLMSOW232	3.3.2.2.0-9	The Contractor **shall** perform a full range of motion test of all deployable hardware.
GLMSOW233	3.3.2.3	**3.3.2.3 Electromagnetic Compatibility Testing**
GLMSOW234	3.3.2.3.0-1	The Contractor **shall** conduct a comprehensive EMI/EMC test program that includes conducted emission testing, common mode noise testing, conducted susceptibility testing, radiated emissions testing, radiated susceptibility testing, and electrostatic arc-discharge susceptibility verification, in accordance with the IMAR to demonstrate that the instrument meets all EMI/EMC performance requirements.

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GLMSOW235	3.3.2.4	**3.3.2.4 Magnetic Properties Testing**
GLMSOW236	3.3.2.4.0-1	The Contractor **shall** conduct a magnetic test program in accordance with the IMAR.
GLMSOW237	3.3.2.5	**3.3.2.5 Thermal Testing**
GLMSOW238	3.3.2.5.0-1	The Contractor **shall** conduct a thermal test program at prototype levels that includes thermal balance and thermal vacuum testing, in accordance with the IMAR to demonstrate compatibility of the GLM design with the orbital environment.
GLMSOW239	3.3.2.5.0-2	The Contractor **shall** perform Comprehensive Performance Tests at each temperature plateau.
GLMSOW240	3.3.3	**3.3.3 Calibration**
GLMSOW241	3.3.3.0-1	The Contractor **shall** define, document, and implement a comprehensive calibration program.
GLMSOW242	3.3.3.0-2	The calibration program **shall** include but not be limited to: a) A basic, full aperture radiance calibration of a uniform scene at 100 percent albedo, with an accuracy of 10 percent b) An estimating process for determining event radiant energy at an accuracy commensurate with the 10 percent calibration accuracy requirement c) A demonstration of detection of simulated lightning individual optical pulses with a probability of detection and false alarm rate within specification, over the highest expected background to night condition d) A system linearly characterization over the signal range of zero to 100 percent albedo
GLMSOW243	3.3.3.0-3	The Calibration Program **shall** be peer reviewed jointly by the Contractor's experts and the GOES-R Calibration Review Committee. Quarterly calibration TIMs begin at SDR and will continue through PTM calibration.
GLMSOW244	3.3.3.0-4	The Contractor **shall** characterize the temperature dependence of calibration coefficients at acceptance temperatures.
GLMSOW245	3.3.3.0-5	The Contractor **shall** provide all GSE and sources used for aliveness testing at the instrument Contractor's facility and at the observatory Contractor's facility.
GLMSOW246	3.4	**3.4 Logistics**
GLMSOW247	3.4.1	**3.4.1 Transportation and Handling**
GLMSOW248	3.4.1.0-1	During transportation periods, the PTM **shall** be bagged in ESD protective material that has been backfilled with dry GN_2 before closure, and placed in a sealed shipping/storage container.
GLMSOW249	3.4.2	**3.4.2 Storage**
GLMSOW250	3.4.2.0-1	The Contractor **shall** store the PTM at the instrument Contractor's facility until needed at the observatory Contractor's facility.
GLMSOW251	3.4.2.0-2	The Contractor **shall** perform storage and post-storage testing of the PTM as defined in the Storage and Test Plan.
GLMSOW252	3.4.2.0-3	During the period the Flight Models are under development and test the PTM may be stored on the bench in the GLM clean room providing the instrument is covered with ESD protective material and under purge.
GLMSOW253	3.4.2.0-4	The Contractor **shall** store the PTM in proximity to the GLM clean room to be readily available for support of FM activities.

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GLMSOW254	3.5	**3.5 Post Delivery Support**
GLMSOW255	3.5.0-1	The Contractor **shall** support up to four months of post delivery activities including, post delivery GSE and instrument checkout, observatory integration and test support.
GLMSOW256	3.5.0-2	The Contractor **shall** be responsible for handling the PTM and associated test equipment until the PTM is integrated on the observatory. The observatory contractor will supply technician support for moving all equipment.

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GLMSOW257	4	# 4 Flight Model-1 (FM-1)
GLMSOW258	4.0-1	The Contractor **shall** develop and deliver a Proto-flight Model (PFM), designated as Flight Model-1 (FM-1).
GLMSOW259	4.0-2	The effort **shall** include fabrication, assembly, test, maintenance, storage, delivery and post-delivery support through the life of the mission.
GLMSOW260	4.0-3	The FM-1 **shall** be functionally tested and environmentally tested to proto-flight levels. The purpose is to qualify design and procedure changes since PTM qualification and to test to levels compatible with the selected GOES-R observatory/launch vehicle.
GLMSOW261	4.1	## 4.1 Design and Analysis
GLMSOW262	4.1.1	### 4.1.1 Instrument Design
GLMSOW263	4.1.1.0-1	The Contractor **shall** provide post-PTM test design changes, fabrication, assembly, test, qualification acceptance test, storage, delivery and post-delivery support through the life of the FM-1 mission.
GLMSOW264	4.1.1.0-2	The Contractor **shall** verify the expected performance of any design change before proceeding with fabrication of the changed article.
GLMSOW265	4.1.2	### 4.1.2 Flight and Ground Test Software Maintenance
GLMSOW266	4.1.2.0-1	The Contractor **shall** update and maintain all flight software, ground test software, processes, procedures and software tools required for support of the FM integration, test and verification program in accordance with the Software Management Plan.
GLMSOW267	4.1.2.0-2	The Contractor **shall** maintain the FSDE used for the life cycle management of the flight software at the Contractor's facility.
GLMSOW268	4.1.2.0-3	The Contractor **shall** maintain the GSE Ground Test Software Development System used for the life cycle management of the ground test software at the Contractor's facility.
GLMSOW269	4.1.3	### 4.1.3 Ground Processing Algorithms
GLMSOW270	4.1.3.0-1	The Contractor **shall** participate in Technical Interchange Meetings with the NOAA ground system contractor to define algorithm format, testing and other required support.
GLMSOW271	4.1.3.0-2	The Contractor **shall** provide ½ person-year of support for the implementation and testing of the GPA by the ground systems contractor.
GLMSOW272	4.1.3.0-3	The Contractor **shall** identify all discrepancies in the GPA acceptance test results.
GLMSOW273	4.1.3.0-4	The Contractor **shall** independently assess the implementation of the GPA once the ground system contractor has successfully demonstrated acceptable performance.
GLMSOW274	4.2	## 4.2 Fabrication and Subassembly Testing
GLMSOW275	4.2.0-1	The Contractor **shall** perform fabrication and assembly/subassembly and testing of the FM-1.
GLMSOW276	4.2.0-2	The Contractor **shall** provide, other than parts and materials specified elsewhere, all components necessary to fabricate FM-1.
GLMSOW277	4.2.0-3	The Contractor **shall** tag all non-flight items to be removed prior to flight with a red tag stating "Remove before flight."

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GLMSOW278	4.2.0-4	The Contractor **shall** tag all flight items to be installed prior to flight with a green tag stating "Install before flight."
GLMSOW279	4.2.0-5	The Contractor **shall** provide and install the critical temperature sensors.
GLMSOW280	4.3	**4.3 Integration and Test**
GLMSOW281	4.3.0-1	The Contractor **shall** integrate the instrument and perform a comprehensive testing, calibration and data analysis regimen to qualify any instrument design changes, verify that instrument performance meets all requirements, proof test fixturing changes and debug all test and calibration procedure changes.
GLMSOW282	4.3.0-2	The Contractor **shall** perform a safe-to-mate and signal characterization on all instrument hardware and GSE prior to electrical mating.
GLMSOW283	4.3.1	**4.3.1 Integration**
GLMSOW284	4.3.1.0-1	The Contractor **shall** integrate the instrument and certify that the instrument is ready for the application of power.
GLMSOW285	4.3.1.0-2	The Contractor **shall** perform initial tests to demonstrate that the instrument is performing as designed and is ready to proceed with Functional Testing.
GLMSOW286	4.3.1.0-3	During the course of FM testing the Contractor **shall** debug and correct or modify test procedures, GSE and fixtures as use indicates.
GLMSOW287	4.3.2	**4.3.2 Performance Verification and Acceptance Testing**
GLMSOW288	4.3.2.0-1	The Contractor **shall** perform all tasks as set forth under the Performance Verification and Design Qualification section of this SOW and all of its subsections, with the exception that: a) Environmental testing will be performed at protoflight levels and durations as defined in the IMAR.
GLMSOW289	.4.3.3	**4.3.3 Calibration**
GLMSOW290	4.3.3.0-1	The Contractor **shall** comply with all requirements as set forth in the Calibration section of this SOW.
GLMSOW291	4.4	**4.4 Logistics**
GLMSOW292	4.4.1	**4.4.1 Transportation and Handling**
GLMSOW293	4.4.1.0-1	The Contractor **shall** prepare, pack and ship the GLM and associated GSE, test equipment and other deliverable hardware to the observatory I&T facility, to SOCC or the launch site as stipulated in the Contract.
GLMSOW294	4.4.1.0-2	The Contractor **shall** deliver with the GLM all other test equipment and fixtures needed to perform post ship testing and support the integration of the GLM on the observatory.
GLMSOW295	4.4.1.0-3	The Contractor **shall** validate and test the shipping container(s) prior to GLM installation to verify operation of the environmental control system.
GLMSOW296	4.4.1.0-4	The Contractor **shall** clean and certify that the shipping container meets all contamination control requirements prior to GLM installation.
GLMSOW297	4.4.1.0-5	The Contractor **shall** deliver the GLM to the observatory contractor with the GLM mounts installed.

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GLMSOW298	4.4.1.0-6	During transportation periods, the FM-1 **shall** be bagged in ESD protective material that has been backfilled with dry GN_2 before closure, and placed in a sealed shipping/storage container.
GLMSOW299	4.4.2	**4.4.2 Storage**
GLMSOW300	4.4.2.0-1	The Contractor **shall** store the GLM at the instrument Contractor's facility until needed at the observatory Contractor's facility.
GLMSOW301	4.4.2.0-2	The Contractor **shall** perform storage and post-storage testing of the GLM as defined in the Storage and Test Plan.
GLMSOW302	4.5	**4.5 Post Delivery Support**
GLMSOW303	4.5.0-1	The Contractor **shall** support the post delivery activities including, post delivery GSE and instrument checkout, observatory integration and test support, launch site support and mission operations support.
GLMSOW304	4.5.0-2	The Contractor **shall** be responsible for handling the GLM and associated test equipment until the GLM is integrated on the observatory. The observatory contractor will supply technician support for moving all equipment.
GLMSOW305	4.5.1	**4.5.1 Resident Office**
GLMSOW306	4.5.1.0-1	The Contractor **shall** provide a full time GLM instrument representative to reside at the observatory contractor's facility beginning 1 month prior to instrument shipment and extending through the observatory test program.
GLMSOW307	4.5.2	**4.5.2 Observatory Integration and Test Support**
GLMSOW308	4.5.2.0-1	The Contractor **shall** support observatory and Integration and Test Support for up to a period of 24 months.
GLMSOW309	4.5.2.0-2	The Contractor **shall** perform a complete post shipment checkout of the GLM and all GSE.
GLMSOW310	4.5.2.0-3	The Contractor **shall** certify that the GSE is ready for use with the GLM.
GLMSOW311	4.5.2.0-4	The Contractor **shall** perform safe-to-mate and signal characterization tests on the GLM and GSE prior to electrical mating.
GLMSOW312	4.5.2.0-5	The Contractor **shall** review all post shipment test data and certify that the GLM is ready for integration with the observatory.
GLMSOW313	4.5.2.0-6	If integration of the GLM with the observatory is not imminent the Contractor **shall** reinstall the GLM into its shipping container for storage.
GLMSOW314	4.5.2.0-7	The Contractor **shall** provide support to the observatory contractor during mounting of the GLM onto the observatory.
GLMSOW315	4.5.2.0-8	The Contractor **shall** support the electrical mating of the GLM to the observatory including safe-to-mate and signal characterization testing.
GLMSOW316	4.5.2.0-9	The Contractor **shall** review all commands and test procedures written by the spacecraft contractor for use in testing the GLM on the observatory.
GLMSOW317	4.5.2.0-10	The Contractor **shall** provide on-site support of all performance testing of the GLM after integration on the observatory, covering all shifts worked by the observatory contractor.
GLMSOW318	4.5.2.0-11	Performance testing **shall** include functional testing and CPTs before and after each individual environmental test.

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GLMSOW319	4.5.2.0-12	The Contractor **shall** monitor instrument testing in real time and perform on-site review and evaluation of instrument data anytime the GLM is operating.
GLMSOW320	4.5.2.0-13	The Contractor **shall** perform off line data evaluation as necessary.
GLMSOW321	4.5.2.0-14	The Contractor **shall** provide on-site data analysis for all environmental testing on a 24/7 basis, or whenever the Observatory Contractor is performing tests that affect your instruments.
GLMSOW322	4.5.2.0-15	Environmental testing includes the following: a) Vibration, with LPTs between each axis b) Acoustic c) Shock d) EMI/EMC testing e) Thermal Vacuum, 24/7, minimum of 60 days
GLMSOW323	4.5.2.0-16	In the case of an instrument anomaly, the Contractor **shall** immediately notify the test director and cognizant Government representative on-site, and recommend corrective action, if needed, to prevent damage to the instrument.
GLMSOW324	4.5.2.0-17	The Contractor **shall** investigate, resolve and implement corrective actions for all instrument anomalies.
GLMSOW325	4.5.2.0-18	The Contractor **shall** support resolution of all anomalies and failures.
GLMSOW326	4.5.2.0-19	The Contractor **shall** provide target (source) installation and alignment support to the observatory contactor during observatory thermal balance and thermal vacuum set up and testing phases.
GLMSOW327	4.5.2.0-20	The Contractor **shall** support blanket fit checks at the observatory contractor's facility as needed.
GLMSOW328	4.5.2.0-21	The Contractor **shall** support GLM blanket closeout prior to thermal vacuum testing and observatory shipping preparations.
GLMSOW329	4.5.3	**4.5.3 Launch Operations Support**
GLMSOW330	4.5.3.0-1	The Contractor **shall** support all Observatory launch site operations from the day of arrival through launch, a period of approximately 3 months.
GLMSOW331	4.5.3.0-2	The Contractor **shall** provide data review and support to the SOCC for launch simulations and actual launch operations.
GLMSOW332	4.5.3.0-3	The Contractor **shall** attend all daily meetings of the launch site team and other meetings as necessary.
GLMSOW333	4.5.3.0-4	The Contractor **shall** provide support for all launch site Observatory testing.
GLMSOW334	4.5.3.0-5	The Contractor **shall** provide on-site support of all instrument testing, covering all shifts worked by the observatory contractor.
GLMSOW335	4.5.3.0-6	The Contractor **shall** monitor instrument testing in real time and provide on-site review and evaluation of instrument data in real time.
GLMSOW336	4.5.3.0-7	The Contractor **shall** provide off-site data evaluation as necessary.
GLMSOW337	4.5.3.0-8	In the case of an instrument anomaly, the Contractor **shall** immediately notify the test director and responsible Government representative on-site, and recommend corrective action, if needed, to prevent damage to the instrument.

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GLMSOW338	4.5.3.0-9	The Contractor **shall** investigate, resolve and implement corrective actions for all instrument anomalies.
GLMSOW339	4.5.3.0-10	The Contractor **shall** document the results of the data analysis in the On-Site Data Analysis Reports in accordance with the CDRL.
GLMSOW340	4.5.3.0-11	The Contractor **shall** support the generation and review of instrument operational and contingency procedures.
GLMSOW341	4.5.4	**4.5.4 Mission Operations Support**
GLMSOW342	4.5.4.0-1	The Contractor **shall** provide FSDE training, including two, 3-day, FSDE training sessions at the NOAA SOCC facilities (L-15 months, and L-7 months).
GLMSOW343	4.5.4.0-2	The Contractor **shall** establish a GLME training program which includes two, 3-day, GLME training sessions at the NOAA SOCC facilities (L-15 months, and L-7 months).
GLMSOW344	4.5.4.0-3	The Contractor **shall** provide instrument training to the NASA/NOAA Mission Operations Support Team (MOST). This effort **shall** include the following: a) Participate in a series of spacecraft contractor sponsored Spacecraft Training activities (5 days at L-18 months, and 5 days at L-3 months) b) Support in the generation of Mission Operations Command Procedures c) Support in the generation of Mission Operations Contingency Operation Procedures d) Participate in a series of NASA sponsored MOST launch readiness training simulations/exercises at the NOAA Suitland Operations Control Center, SOCC (6, 3-day simulations starting at L-6 months, one per month)
GLMSOW345	4.5.4.0-4	The Contractor **shall** support launch, orbit raising (approximately 2 weeks), activation and post launch testing (approximately 6 months) at the SOCC.
GLMSOW346	4.5.4.0-5	The Contractor **shall** provide 24/7 console support from launch through orbit raising.
GLMSOW347	4.5.4.0-6	The Contractor **shall** monitor instrument testing in real time and provide on-site review and evaluation of instrument data.
GLMSOW348	4.5.4.0-7	The Contractor **shall** provide off-site data evaluation as necessary.
GLMSOW349	4.5.4.0-8	In case of an instrument anomaly, the Contractor **shall** immediately notify the test director and responsible Government representative on-site, and recommend corrective action, if needed, to prevent damage to the instrument.
GLMSOW350	4.5.4.0-9	The Contractor **shall** document the results of the data analysis in the On-Site Data Analysis Reports in accordance with the CDRL.
GLMSOW351	4.5.4.0-10	The Contractor **shall** perform an assessment of all GLM on-orbit anomalies and provide inputs into In-orbit Anomaly Investigation Reports for the life of the mission.
GLMSOW352	4.5.4.0-11	The Contractor **shall** participate in weekly technical interchange meetings/telecons to review on-orbit anomaly status.
GLMSOW353	4.5.4.0-12	The Contractor **shall**, in conjunction with the Mission Operations Support Team (MOST) perform on-orbit verification of the end-to-end navigation performance.

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GLMSOW354	5	**5 Option 1 Flight Model-2 (FM-2)**
GLMSOW355	5.0-1	The Contractor **shall** develop and deliver a Flight Model (FM), designated as FM-2.
GLMSOW356	5.0-2	The effort **shall** include fabrication, assembly, test, maintenance, storage, delivery and post-delivery support through the life of the mission.
GLMSOW357	5.0-3	The Contractor **shall** comply with all requirements as set forth in Section 4 FM-1 of the SOW, except that all environmental testing will be conducted to acceptance level as and durations as defined in the IMAR.

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GLMSOW358	6	**6 Option 2 Flight Model-3 (FM-3)**
GLMSOW359	6.0-1	The Contractor **shall** develop and deliver a Flight Model, designated as FM-3.
GLMSOW360	6.0-2	The effort **shall** include fabrication, assembly, test, maintenance, storage, delivery and post-delivery support through the life of the mission.
GLMSOW361	6.0-3	For FM-3, the Contractor **shall** perform as required for FM-2 as set forth in Section 5 of this SOW.

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GLMSOW362	7	**7 Option 3 Flight Model-4 (FM-4)**
GLMSOW363	7.0-1	The Contractor **shall** develop and deliver a Flight Model designated as FM-4.
GLMSOW364	7.0-2	The effort **shall** include fabrication, assembly, test, acceptance test, maintenance, storage, delivery and post-delivery support through the life of the mission.
GLMSOW365	7.0-3	For FM-4, the Contractor **shall** perform as required for FM-2 as set forth in Section 5 of this SOW.

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GLMSOW366	8	**8 Ground Support Equipment**
GLMSOW367	8.0-1	The Contractor **shall** design, develop, fabricate, test, assure the quality of, and implement all GLM GSE.
GLMSOW368	8.0-2	The Contractor **shall** document and maintain all GSE hardware, software and firmware.
GLMSOW369	8.0-3	The Contractor **shall** collect and provide GLM packetized data to the SOCC and observatory contractor to be used in testing and debugging ingest and analysis capabilities of the various ground systems and test equipment.
GLMSOW370	8.0-4	The Contractor **shall** provide the packetized data on Government-specified media.
GLMSOW371	8.1	**8.1 Electrical Ground Support Equipment**
GLMSOW372	8.1.1	**8.1.1 Electrical System Test Equipment**
GLMSOW373	8.1.1.0-1	The Contractor **shall** design, develop and provide three sets of ESTE for operation, control and testing of the GLM.
GLMSOW374	8.1.1.0-2	The Contractor **shall** retain two sets of ESTE for testing of the PTM and FMs, and one set of ESTE will be delivered to the observatory contractor's facility with the initial delivery of the PTM.
GLMSOW375	8.1.1.0-3	The Contractor **shall** maintain the three sets of ESTE through the launch of the last GLM.
GLMSOW376	8.1.1.0-4	The Contractor **shall** maintain one set of ESTE through end of contract.
GLMSOW377	8.1.2	**8.1.2 GLM Emulator (GLME)**
GLMSOW378	8.1.2.0-1	The Contractor **shall** design, develop, provide and maintain two GLMEs that will be integrated with spacecraft emulators by the observatory contractor for subsequent use by the SOCC for command validation throughout the operational phase of the mission.
GLMSOW379	8.1.2.0-2	The Contractor **shall** support technical interchange meetings with the observatory contractor to define the interfaces between the GLME and the spacecraft emulator.
GLMSOW380	8.1.2.0-3	The Contractor **shall** maintain the GLME hardware, software, and associated documentation through end of contract, after which time handover of maintenance will be transitioned to NOAA.
GLMSOW381	8.1.2.0-4	The Contractor **shall** upgrade the GLME hardware and software as needed to maintain compatibility with instrument changes.
GLMSOW382	8.1.2.0-5	The Contractor **shall** provide 2 weeks of support to the initial integration of the GLME with the spacecraft emulator, including, but not limited to, providing training to the spacecraft contractor, assisting the spacecraft contractor in resolving interface issues and answering questions concerning the GLME.
GLMSOW383	8.1.3	**8.1.3 Connectors**
GLMSOW384	8.1.3.0-1	The Contractor **shall** provide connector savers, made with flight hardware, to mate with the FM hardware including intra-instrument cabling.
GLMSOW385	8.1.3.0-2	Connector savers **shall** be used for all electrical connections except when the GLM is undergoing environmental testing and calibration.
GLMSOW386	8.1.3.0-3	The Contractor **shall** establish and maintain a flight connector mate/de-mate log for the FMs to catalog mate/de-mate cycles of the flight connectors.

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GLMSOW387	8.1.4	**8.1.4 Other EGSE**
GLMSOW388	8.1.4.0-1	The Contractor **shall** provide all other GLM specific electrical test equipment necessary to the performance of the contract, such as test cables, breakout boxes, etc. for the PTM and FMs.
GLMSOW389	8.2	**8.2 Mechanical Ground Support Equipment**
GLMSOW390	8.2.0-1	The Contractor **shall** design, develop, implement and maintain the GLM MGSE. The MGSE includes but is not limited to: a) Sufficient Lifting/Handling Fixtures for use in lifting, moving or handling the PTM and FMs at the Contractor' facility; b) One Lifting/Handling Fixture for delivery to and retention at the observatory contractor's facility for use in post delivery instrument tests and for integration of the PTM and FMs with the observatory; c) One Shipping / Storage Container for the PTM under basic contract; d) One Shipping / Storage Container for the FM under basic contract; e) One purge cart for the PTM under the basic contract; f) One purge cart for the FM under the basic contract; g) One shipping/storage container for each FM under each option; h) One purge cart for each FM under each option; i) Visible illumination source(s) for calibration of the PTM and FMs. j) Near IR sources(s) for use during the optical pulse calibration of the PTM and FMs. k) Sources for observatory-level testing for delivery and retention at the observatory contractor's facility for post-delivery instrument test at ambient and for testing during observatory thermal vac. l) Two alignment Drill Templates for the GLM mounting holes, labeled with appropriate alignment, orientation, location reference information, and alignment cubes if necessary, one for use by the Contractor and one for delivery to the observatory contractor; m) Instrument moving carts sufficient for the program; n) Assembly jigs sufficient for the program; o) Calibration test fixtures sufficient for the program; p) Vibration test fixtures sufficient for the program; q) Thermal Vacuum test fixtures sufficient for the program; r) Non-flight protective covers for all sensitive surfaces.
GLMSOW392	8.2.0-2	The Contractor **shall** proof test all Lifting/Handling fixtures to be used with equipment having a mass in excess of 15kg to 2 times the working load.
GLMSOW393	8.2.0-3	The Contractor **shall** re-certify annually all Lifting/Handling fixtures to be used with equipment having a mass in excess of 15 kg to at least the working load.
GLMSOW394	8.3	**8.3 Ground Processing Demonstration System (GPDS)**
GLMSOW395	8.3.0-1	The Contractor **shall** design, develop, implement and maintain a GLM GPDS that includes all hardware, software, firmware and software licenses.
GLMSOW396	8.3.0-2	The Contractor **shall** use the GPDS to demonstrate and verify the full performance and functionality of the GLM Ground Processing Algorithms to accurately produce Level 1B data products within the allocated data latency period.
GLMSOW414	8.3.0-3	The Contractor **shall** provide a copy of the source code "as run" on the GPDS, and as updated, for verification and validation.

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GLMSOW397	9	**9 Mission Assurance**
GLMSOW398	9.0-1	The Contractor **shall** establish and maintain a Mission Assurance (MA) program to ensure that all hardware, software, GSE, ground processing algorithms comply with all contract and performance requirements.
GLMSOW399	9.0-2	The Contractor **shall** provide input to safety documents that will be generated by the observatory contractor.
GLMSOW400	9.0-3	The Contractor **shall** provide Digital Image Records of the entire assembly and testing process of the FMs, beginning at the sub-assembly level to after completion of final instrument testing, including subcontracted items.
GLMSOW401	9.0-4	The Contractor **shall** provide Video Records of all critical operations of the FMs.

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GLMSOW402 10

10 Acronyms

GLMSOW404 10.0-1

CDR	Critical Design Review
CDRL	Contract Data Requirements List
COTR	Contracting Officer's Technical Representative
EGSE	Electrical Ground Support Equipment
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESTE	Electrical System Test Equipment
FM	Flight Model
FPGA	Field Programmable Gate Array
FSDE	Flight Software Development Environment
GIRD	General Interface Requirements Document
GLM	Geostationary Lightning Mapper
GLME	GLM Emulator
GOES	Geostationary Operational Environmental Satellite
GPA	Ground Processing Algorithm
GPDS	Ground Processing Demonstration System
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
I&T	Integration & Test
IBR	Integrated Baseline Review
IDD	Instrument Description Document
IMAR	Instrument Mission Assurance Requirements Document
IV&V	Independent Verification and Validation
L	Launch
MA	Mission Assurance
MAID	Master Action Item Data Base
MGSE	Mechanical Ground Support Equipment
MOST	Mission Operations Support Team
NASA	National Aeronautics and Space Administration
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPD	National Aeronautics and Space Administration Policy Directive
PDR	Preliminary Design Review
PDRR	Program Definition and Risk Reduction
PER	Pre-Environmental Review
PFM	Protoflight Model

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GLMSOW404	10.0-1	PTM	Prototype Model
		PMO	Program Management Office
		PMSR	Project Management Status Review
		PORD	Performance and Operation Requirements Document
		RFA	Request For Action
		RMS	Resources Management System
		SDR	System Definition Review
		SOCC	Satellite Operations Control Center
		SOW	Statement of Work
		UIID	Unique Instrument Interface Document
		WBS	Work Breakdown Structure

Effective Date: July 12, 2005
Responsible Organization: GOES-R/Code 417

417-R-GLMPORD-0057
Version 2.0

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Geostationary Lightning Mapper (GLM)

Performance and Operational Requirements Document (PORD)

May 22, 2007

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Geostationary Operational Environmental Satellite (GOES)
GOES-R Series
Geostationary Lightning Mapper (GLM)
Performance and Operational Requirements Document (PORD)

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Date

To verify the correct version of this document, please contact the GOES-R Series Configuration Management Office.

/GLM

GLM PORD

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GLMPORD1	1	# 1 Scope
GLMPORD2	1.1	## 1.1 Identification
GLMPORD3	1.1.0-1	This Performance and Operational Requirements Document (PORD) sets forth the performance requirements for the National Oceanic and Atmospheric Administration (NOAA) Geostationary Lightning Mapper (GLM).
GLMPORD4	1.2	## 1.2 Mission Review
GLMPORD5	1.2.0-1	The GLM instrument, designated as GLM in this document, is a single-channel, near-IR optical detector, used to detect, locate and measure the optical pulses associated with lightning over the full-disk at sufficient spatial and temporal resolution to allow tracking of each lightning flash within a specific storm cell and calculation of its optical center over time. The GLM is part of a 3-axis stabilized, geostationary weather satellite system. *(CCR 00348)*
GLMPORD6	1.2.0-2	The GLM objectives are as follows: a) Provide continuous full-disk lightning measurements for storm warning and nowcasting. b) Provide longer warnings of tornado activity. c) Accumulate a long-term database to track decadal changes in lightning activity. The overarching requirement for GLM is a post-processing data product that captures at greater than 70% of the global lightning flashes with a false alarm rate less than 5%. The initial phase of the processing (Level 1b) is to identify optical transient signals (events), which are lightning-induced, from the totality of measurable events. *(CCR 00348) (CCR 01039)*
GLMPORD7	1.2.0-3	The GLM instrument, designated as GLM in this document, provides event data to the GLM Ground System, designated as GLM-GS in this document, via the spacecraft communication system. The GLM-GS takes the GLM data, spacecraft telemetry data, orbit determination data and other required information and autonomously generates calibrated and navigated data for the NOAA users' further data processing. *(CCR 00348)* Data forwarded to the GLM from the spacecraft is not required to be downlinked. This spacecraft data will be available to the GLM-GS as soon as GLM science data is available. *(CCR 00379)* Radiometric calibration is performed before launch. The GLM-GS will be procured separately by the Government but will implement algorithms developed by the GLM contractor to satisfy GLM performance requirements.
GLMPORD8	1.3	## 1.3 Document Overview
GLMPORD9	1.3.0-1	This document contains all performance requirements for the GLM instrument and Ground Support Equipment (GSE). This document, the General Interface Requirements Document (GIRD), and the GLM Unique Instrument Interface Document (UIID) define all instrument-to-spacecraft interfaces for the GLM instrument.
GLMPORD10	1.4	## 1.4 Terminology

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GLMPORD11 1.4.0-1

This document contains all performance requirements for the sensor except those labeled "TBD" and "TBR". The term "TBD," meaning "to be determined," applied to a missing requirement means that the contractor will determine the missing requirement in coordination with the government and the observatory contractor. The term "TBR," meaning "to be reviewed," implies that the requirement is subject to review for appropriateness by the contractor or the government. The government may change "TBR" requirements in the course of the contract.

GLMPORD12 1.5

1.5 Definitions

GLMPORD13 1.5.0-1

Throughout this document, the following definitions apply:

Background: A sample value that does not include an event.

Background Image: A scene composed of the background from all detector elements in the focal plane.

CONUS: Defined as a nadir-viewed rectangle 8.0215 x 4.8129 degrees, 5000 East/West x 3000 North/South kilometers, approximately in the geographic area of 10N-50N latitude and 60W-125W longitude.

Detection Probability: Fraction of lightning flashes detected by the GLM. This is computed as an average over the minimum full-disk as defined below with equal weight given to all pixels.

Dynamic Range: Ratio of strongest non-saturated lightning signal to the weakest at 100% albedo with minimum required detection efficiency.

Eclipse: Defined as when the solar disk is completely occulted by the Earth or Moon, as viewed from the GOES satellite.

Event: The occurrence of a sample exceeding the threshold (not to be confused with event-logging or event messages defined in GLMPORD 164 (Section 3.3.5).

Events may include but are not limited to:

a) Optical lightning events
b) Radiation-induced events
c) Surface glint-induced events
d) Electronic noise-induced events
e) Jitter-Induced events

False Alarm Probability: Fraction of GLM flash detections that are not lightning. This is computed as an average over the minimum full-disk as defined below with equal weight given to all pixels.

Fixed-Grid: Refers to the idealized geo-referenced positions for pixel locations. The fixed-grid has the following characteristics:

a) The fixed-grid is rectified to a GRS80 geoid viewed from the idealized geostationary position.
b) The pixels have the same angular separation for East/West and North/South.
c) From the viewpoint of a right-handed coordinate system of the idealized geostationary satellite with its x-axis in the direction of the velocity and the z-axis pointed at nadir, the North/South angle is determined by a rotation about the x-axis and the East/West

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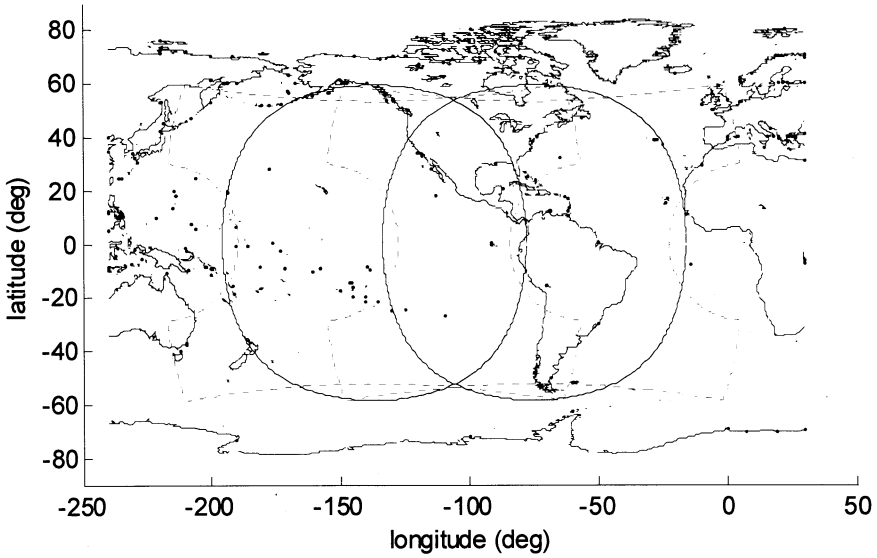
GLMPORD13	1.5.0-1	angle is determined by a rotation about the rotated y-axis.

d) Pixels within an angular radius of 8.66 degrees from the ideal geosynchronous satellite position vector use the ideal satellite as the viewpoint.

Flash: Series of optical lightning pulses grouped by proximity in location and time.

Frame: The set of all samples from a single integration period.

Full Disk: The GLM full-disk is defined as the intersection of circular and square Earth-centered fields-of-view having minimum diameter 16.0° and minimum length 15.1° respectively.



Fully-Functional Configuration: Being able to perform the following functions on-orbit: lightning optical pulse detection, sensor health and status data acquisition, CCSDS packet generation (science, health and status data) plus command reception and execution.

Geolocation: Determination of sample locations on the Earth surface (GRS80 geoid) in terms of latitude and longitude. (This assumes that the GLM sees down to the Earth surface.)

Launch: The period of time between lift off and the separation of the GOES-R series satellite from the launch vehicle.

Level 1b Data: Optical lightning events that have been calibrated, navigated and time tagged.

Navigation: Refers to the determination of sample locations relative to fixed-grid angle coordinates.

Navigation Error: Refers to the angular error of sample locations in the fixed-grid.

Pulse: An optical signal generated by lightning whose nominal duration is on the order of 1 ms. A pulse, as viewed by the GLM, can generate one or more optical events, distributed spatially and or temporally.

Radiant Energy: The integral of object radiance over the instrument integration time.

Sample: Digitized signal from a single physical detector element.

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GLMPORD13	1.5.0-1	Threshold: Minimum amount which a signal must exceed for an event to be detected. 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 electronics unit and sensor unit. *(CCR 00219) (CCR 00348) (CCR 00379)*
GLMPORD14	1.5.0-2	All requirements/all performance requirements/all operational requirements: Refers to any performance characteristic or requirement in the GLM PORD, GLM UIID, and the GIRD.
GLMPORD15	1.5.0-3	The requirements in this GLM PORD pertain to the GLM 'system' which may include optics, detectors, signal processing electronics and software, and ground processing. The GLM contractor is not responsible for the whole GLM-GS, but certain GLM specifications, e.g., navigation, will require some level of ground processing after collection but before data distribution. *(CCR 00219)*
GLMPORD16	1.5.0-4	All requirements apply over the entire life of the GLM mission. Data performance requirements, such as navigation, apply to data after level-1b ground processing. *(CCR 00219)*

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GLMPORD17	2	**2 Documents *(CCR 00379)***
GLMPORD268	2.1	**2.1 Applicable Documents *(CCR 00379)***
GLMPORD18	2.1.0-1	The following form a part of this specification to the extent specified herein. GOES-R General Interface Requirements Document, NASA-GSFC, Document Number 417-R-GIRD-0009 GLM Unique Instrument Interface Document (UIID), NASA-GSFC, Document Number 417-R-GLMUIID-0058 CCSDS Recommendation for Space Data System Standards, Lossless Data Compression, CCSDS 121.0-B-1, May 1997. Structural Design and Test Factors of Safety for Spaceflight Hardware, NASA, Document Number NASA-STD-5001, June 21, 1996 General Specification for Assemblies, Moving Mechanical, for Space and Launch Vehicles, Document Number MIL-A-83577B, February 1, 1988 Space Mechanisms Handbook, Document Number NASA TP-1999-206988 General Environmental Verification Standard (GEVS) for GSFC Flight Programs and Projects, Document Number GSFC-STD-7000, April 2005 AFSPCMAN 91-710, Range Safety User Requirements, July 2004 Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems, Document Number MIL-STD-1522, Sept. 4, 1992 *(CCR 00379)*
GLMPORD269	2.2	**2.2 Reference Documents *(CCR 00379)***

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GLMPORD270	2.2.0-1	The following articles provide scientific background based on earlier lightning studies and are provided for reference only. *Algorithm Theoretical Basis Document (ATBD) for the Lightning Imaging Sensor (LIS)*, NASA (H.J. Christian, R.J. Blakeslee, S.J. Goodman, and D.M. Mach), 1 February 2000 "Optical Observations of Lightning from a High-Altitude Airplane", H.J. Christian and S.J. Goodman, *J. of Atmospheric and Oceanic Technology*, vol. 4, December 1987, pp. 701-711 "The Detection of Lightning From Geostationary Orbit", Hugh J. Christian, Richard J. Blakeslee and Steven J. Goodman, *J. of Geophysical Research*, vol. 94, no. D11, September 1989, pp. 13329-13337 "Laboratory Calibration of the Optical Transient Detector and the Lightning Imaging Sensor", William J. Koshak, Mike F. Stewart, Jugh J. Christian, James W. Bergstrom, John M. Hall, and Richard J. Solakiewicz, *J. of Atmospheric and Oceanic Technology*, vol. 17, July 2000, pp. 905-915 "Lightning optical pulse statistics from storm overflights during the Altus Cumulus Electrification Study", D.M. Mach, R.J. Blakeslee, J.C. Bailey, W.M. Farrell, R.A. Goldberg, M.D. Desch, and J.G. Houser, *Atmospheric Research 76 (2005)*, pp. 386-401 *(CCR 00348) (CCR 00379)*

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GLMPORD19	3	**3 GLM Sensor Requirements**
GLMPORD20	3.1	**3.1 GLM Functional Requirements**
GLMPORD21	3.1.1	**3.1.1 GLM Modes**
GLMPORD259	3.1.1.0-1	The contractor may propose additional modes for GLM.
GLMPORD22	3.1.1.1	**3.1.1.1 Safe Mode**
GLMPORD23	3.1.1.1.0-1	The GLM **shall** implement a Safe Mode which is a thermally, electrically and optically safe configuration that protects the instrument from the spacecraft and the environment.
GLMPORD24	3.1.1.1.0-2	The GLM **shall** be maintainable in Safe Mode for an indefinite period of time.
GLMPORD25	3.1.1.1.0-3	The GLM **shall** enter Safe Mode upon receipt of a ground command, receipt of an autonomous safe mode command from the observatory, or detection of internal faults that could cause damage to the instrument. *(CCR 00379)*
GLMPORD26	3.1.1.2	**3.1.1.2 Normal Operational Mode**
GLMPORD27	3.1.1.2.0-1	The GLM **shall** be in a fully functional configuration while in Normal Operational Mode.
GLMPORD28	3.1.1.3	**3.1.1.3 Diagnostic Mode**
GLMPORD29	3.1.1.3.0-1	The GLM **shall** implement a Diagnostic Mode.
GLMPORD30	3.1.1.3.0-2	The GLM **shall** enter Diagnostic Mode only on command. *(CCR 00379)*
GLMPORD271	3.1.1.3.0-3	The GLM **shall,** by command, send dwell data (increased samples per second of a particular telemetry measurand) while in Diagnostic Mode. *(CCR 00379)*
GLMPORD272	3.1.1.3.0-4	The GLM **shall** be in a fully-functional configuration while in Diagnostic Mode. *(CCR 00379)*
GLMPORD273	3.1.1.3.0-5	The GLM **shall,** by command, send all bits from the science data A/D converters while in Diagnostic Mode. *CCR 00379)*
GLMPORD274	3.1.1.3.0-6	The GLM **shall,** by command, suspend downlink of event data and send background images so as to fill the available downlink bandwidth. *(CCR 00379)*
GLMPORD31	3.1.1.3.0-7	The Contractor may add capabilities and functions to the Diagnostic Mode. *(CCR 00379)*
GLMPORD32	3.1.1.4	**3.1.1.4 Survival Mode**
GLMPORD33	3.1.1.4.0-1	The GLM **shall** implement a Survival Mode in which all power is off except for survival heater power, and only passive telemetry is available.
GLMPORD34	3.1.1.5	**3.1.1.5 Mode Transitions**
GLMPORD35	3.1.1.5.0-1	The GLM **shall** transition from any defined mode to any other defined mode upon command.
GLMPORD36	3.1.2	**3.1.2 On-Orbit Operations**
GLMPORD37	3.1.2.1	**3.1.2.1 Zones of Reduced Data Quality**
GLMPORD38	3.1.2.1.0-1	The GLM **shall** meet all operational and performance requirements for all samples whose distance from the center of the un-eclipsed portion of the sun is greater than 10°. *(CCR 00219) (CCR 00348)*

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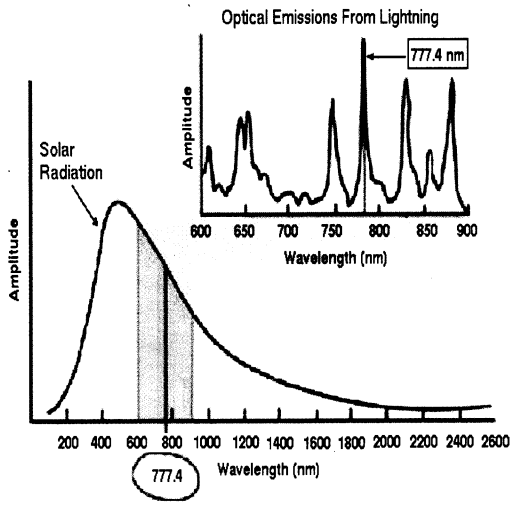
GLMPORD39	3.1.2.1.0-2	For all samples whose distance from the center of the un-eclipsed portion of the sun is between 5° and 10°, the GLM **shall** meet all requirements, except for a two times degradation in the flash detection and false alarm probabilities. *(CCR 00219) (CCR 00348)*
GLMPORD40	3.1.2.2	**3.1.2.2 Solar Intrusion**
GLMPORD42	3.1.2.3	**3.1.2.3 Eclipse**
GLMPORD43	3.1.2.3.0-1	The GLM **shall** operate continuously through eclipse periods.
GLMPORD44	3.1.2.4	**3.1.2.4 Post-Maneuver**
GLMPORD45	3.1.2.4.0-1	The GLM **shall** meet all detection, coverage and navigation requirements after spacecraft attitude has been within specification for 30 minutes following a yaw-flip. *(CCR 00219) (CCR 00348)*
GLMPORD47	3.1.2.4.0-2	The GLM **shall** meet all requirements after spacecraft attitude has been within specification for 30 minutes following a station-keeping maneuver. *(CCR 00348)*
GLMPORD48	3.1.2.4.0-3	The GLM **shall** meet all requirements within 30 minutes of GLM turn-on after being in on orbit storage. *(CCR 00348)*
GLMPORD49	3.2	**3.2 GLM Performance Requirements**
GLMPORD50	3.2.1	**3.2.1 GLM Coverage Requirements**
GLMPORD51	3.2.1.0-1	The GLM **shall** provide continuous optical lightning pulse detection over the full-disk. *(CCR 00219) (CCR 00348)*
GLMPORD54	3.2.2	**3.2.2 GLM Spectral Requirements**
GLMPORD55	3.2.2.0-1	The GLM **shall** measure scene radiant energy centered at 777.4 nm. The lightning spectrum is shown in the Lightning Spectrum Figure below. *(CCR 00219) (CCR 00348)*



Lightning Spectrum Figure

This figure comes from an untitled slide package provided by Hugh Christian.

Discussion: This is the wavelength band used on the TRMM Lightning Imaging Sensor (LIS), and the MSFC LMS study.

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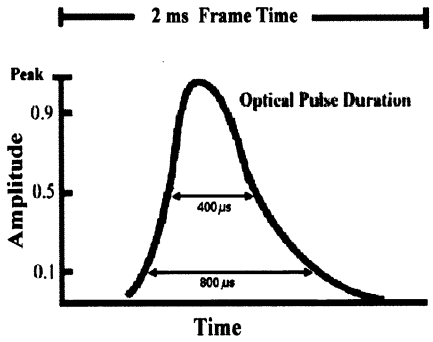
GLMPORD63	3.2.3	**3.2.3 GLM Lightning Detection**
GLMPORD64	3.2.3.1	**3.2.3.1 GLM Basic Detection Requirements**
GLMPORD65	3.2.3.1.0-1	GLM event detection **shall** be autonomous. *(CCR 00219)*
GLMPORD67	3.2.3.1.0-2	The GLM calibration error (radiant energy bias) **shall** be less than 10% of pulse signal strength over the full dynamic range, within the limits of digital resolution, as determined from pre-launch ground calibration. *(CCR 00219) (CCR 00348)*
GLMPORD267	3.2.3.1.0-3	The GLM **shall** report event radiant energy to an accuracy equal to 10% of signal strength over the required dynamic range within the limits imposed by digital resolution. *(CCR 00348)*
GLMPORD69	3.2.3.2	**3.2.3.2 GLM Sensitivity and Dynamic Range**
GLMPORD70	3.2.3.2.0-1	The GLM **shall** detect optical lightning pulses. The average temporal variation of a lightning pulse is shown in the Lightning Pulse Duration Figure below. *(CCR 00219)*



Lightning Pulse Duration Figure

Flashes are composed of multiple pulses. While pulse duration is on the order of a millisecond, flash duration is typically on the order of one second.

GLMPORD74	3.2.3.2.0-2	The flash detection probability **shall** be at least 70% after Level 1b processing. The time span for this computation is 24 hours. *(CCR 00219) (CCR 00348)*
GLMPORD75	3.2.3.2.0-3	The flash false alarm probability **shall** be less than 5% after Level 1b processing. The time span for this computation is 24 hours. *(CCR 00219) (CCR 00348)*
GLMPORD76	3.2.3.2.0-4	The GLM **shall** provide an event dynamic range after background subtraction greater than 100 at all times. *(CCR 00379)*
GLMPORD78	3.2.3.2.0-5	The GLM **shall** be able to detect events in the same detector element in consecutive frames. *(CCR 00219) (CCR 00348)*
GLMPORD275	3.2.3.2.0-6	The GLM **shall** meet its performance requirements throughout the mission despite focal plane degradation. *(CCR 00379)*
GLMPORD79	3.2.3.3	**3.2.3.3 GLM Command and Control Requirements**
GLMPORD80	3.2.3.3.0-1	Receipt and processing of commands and data **shall** not interfere with GLM data collection in any mode. *(CCR 00379)*
GLMPORD81	3.2.3.3.0-2	The GLM **shall** execute commands to individually enable and disable each autonomous function.

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GLMPORD82	3.2.3.3.0-3	The GLM **shall** initiate all commanded mode transitions in no more than 5 seconds after receipt of command. *(CCR 00348)* Note: Exceptions to this requirement are acceptable within the first 60 seconds after a power on, a commanded CPU reset/reboot, or an unplanned CPU watchdog reset. *(CCR 01039)*
GLMPORD83	3.2.3.3.0-4	The GLM **shall** make limits and triggers of autonomous functions changeable by command.
GLMPORD84	3.2.3.3.0-5	The GLM **shall** transition from its current mode to any other mode without causing damage to itself. *(CCR 00379)*
GLMPORD86	3.2.3.3.0-6	The GLM **shall** indicate the instrument mode in housekeeping telemetry.
GLMPORD87	3.2.3.3.0-7	The GLM **shall** provide command and housekeeping telemetry functions in all powered modes. Note: Exceptions to this requirement are acceptable within the first 60 seconds after a power on, a commanded CPU reset/reboot, or an unplanned CPU watchdog reset. *(CCR 01039)*
GLMPORD89	3.2.3.3.0-8	The GLM **shall** provide an event detection threshold that is adjustable by command. *(CCR 00219)*
GLMPORD91	3.2.3.4	**3.2.3.4 GLM Navigation Requirements *(CCR 00219)***
GLMPORD92	3.2.3.4.0-1	The GLM **shall** navigate each optical lightning event. *(CCR 00219)*
GLMPORD93	3.2.3.4.0-2	All navigation requirements listed herein apply to optical lightning events, i.e., the requirements apply to the end-to-end system, taking all instrument, spacecraft and ground processing effects into account. Unless otherwise specified, all navigation requirements in this document are specified in microradians as North/South and East/West angles, 3-sigma, and refer to all hours of operation. In addition, for purposes of this section, 3-sigma is defined as the average ±3 times the square root of the variance for a population of 1000 consecutive observations. *(CCR 00348)* The vendor will be responsible for the navigation algorithm. *(CCR 00219)*
GLMPORD94	3.2.3.4.0-3	The GLM navigation error **shall** not exceed ±112 microradians. *(CCR 00219) (CCR 00348)*
GLMPORD276	3.2.3.4.0-4	The GLM **shall** geolocate each optical lightning event. *(CCR 00379)*
GLMPORD95	3.2.3.5	**3.2.3.5 GLM Data Requirements**
GLMPORD96	3.2.3.5.0-1	The GLM **shall** contribute no more than 10 seconds to the total data latency from event detection through generation of Level 1b products. *(CCR 00348)* Discussion: The GLM contribution to data latency includes delay of data delivery to the spacecraft and delay due to Level 1b ground processing. *(CCR 00219) (CCR 00348)*
GLMPORD97	3.2.3.5.0-2	The GLM **shall** report each event. *(CCR 00219)*
GLMPORD98	3.2.3.5.0-3	The GLM **shall** time tag each event to an accuracy of 1 millisecond. *(CCR 00219)(CCR 00348) (CCR 00379)*
GLMPORD278	3.2.3.5.0-4	The GLM **shall** synchronize its clock with the spacecraft-provided time code and use this time to tag all GLM data. *(CCR 00379)*
GLMPORD99	3.2.3.5.0-5	The GLM **shall** provide the radiant energy of each event. *(CCR 00219) (CCR 00348)*
GLMPORD100	3.2.3.5.0-6	The GLM **shall** provide the threshold used to detect each event. *(CCR 00219)*
GLMPORD101	3.2.3.5.0-7	The GLM **shall** provide the background of each event. *(CCR 00219)*

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GLMPORD102	3.2.3.5.0-8	The GLM **shall** identify the detector element for each event. *(CCR 00219)*
GLMPORD103	3.2.3.5.0-9	The GLM **shall** provide background images autonomously at least once every 5 minutes, or upon ground command. *(CCR 00219) (CCR 00348)*
GLMPORD261	3.2.3.5.0-10	The readout of a background image **shall** not interfere with the detection and reporting of events. *(CCR 00219)*
GLMPORD104	3.2.3.5.0-11	The GLM **shall** provide engineering data, health and safety telemetry, and diagnostic data. *(CCR 00379)*
GLMPORD111	3.3	**3.3 Design Requirements**
GLMPORD112	3.3.1	**3.3.1 Reliability**
GLMPORD113	3.3.1.0-1	The GLM **shall** demonstrate by analysis a Reliability (R) of at least 0.6 after 10 years of on-orbit operations, preceded by up to 5 years of ground storage and up to 5 years of on-orbit storage.
GLMPORD114	3.3.1.0-2	The GLM **shall** demonstrate by analysis a Mean Mission Duration (MMD) of 8.4 years for a design life of 10 years. *(CCR 00348)*
GLMPORD115	3.3.1.0-3	The GLM **shall** provide redundancy to eliminate all credible single-point failures.
GLMPORD116	3.3.1.0-4	The GLM redundant components **shall** be selectable by external command only.
GLMPORD117	3.3.1.0-5	The GLM units of any Flight Model **shall** be interchangeable, without modification, with the equivalent units of any other GLM Flight Model.
GLMPORD118	3.3.1.0-6	The GLM **shall** withstand without damage the sudden removal of operational power.
GLMPORD119	3.3.2	**3.3.2 Mechanical Requirements**
GLMPORD279	3.3.2.1	**3.3.2.1 Design Limit Loads *(CCR 00379)***
GLMPORD120	3.3.2.1.0-1	Each GLM unit structure **shall** possess sufficient strength, rigidity and other characteristics required to survive the critical loading conditions that exist within the envelope of handling and mission requirements.
GLMPORD121	3.3.2.1.0-2	The GLM structures **shall** withstand all limit loads without loss of any required function. *(CCR 00379)* Limit loads are defined as all worst case load conditions including acceleration, vibration and temperature effects from the environments expected during all phases of the structure's service life including manufacturing, ground handling, transportation, environmental testing, integration, pre-launch, launch and on-orbit operations and storage.
GLMPORD280	3.3.2.2	**3.3.2.2 Nonlinear Loads *(CCR 00379)***
GLMPORD122	3.3.2.2.0-1	The GLM structures **shall** withstand redistribution of internal and external loads resulting from nonlinear effects including deflections under load.
GLMPORD281	3.3.2.3	**3.3.2.3 Strength *(CCR 00379)***
GLMPORD123	3.3.2.3.0-1	Structural analysis and design factors of safety **shall** apply to all systems in accordance with NASA-STD-7000 (GEVS) Section 2.2.5. *(CCR 00379)*

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GLMPORD124	3.3.2.3.0-2	While subjected to any operational loads up to yield operational loads, the resulting deformation **shall** not interfere with the operation of the GLM flight units. *(CCR 00379)* Operational load is defined as the expected on-orbit loads while the GLM is operating.
GLMPORD282	3.3.2.4	**3.3.2.4 Reserved *(CCR 00379)***
GLMPORD283	3.3.2.5	**3.3.2.5 Structural Stiffness *(CCR 00379)***
GLMPORD126	3.3.2.5.0-1	Stiffness of the GLM structures and their attachments **shall** be determined by their performance requirements and their handling, transportation and launch environments.
GLMPORD127	3.3.2.5.0-2	Special stowage provisions **shall** be used, if required, to prevent excessive dynamic amplification during handling, transportation and transient flight events.
GLMPORD284	3.3.2.6	**3.3.2.6 Unit Stiffness *(CCR 00379)***
GLMPORD128	3.3.2.6.0-1	The fundamental resonant frequency of the GLM sensor and electronics units **shall** be 50 Hz or greater when the GLM sensor and electronics units are rigidly constrained at their spacecraft interface and the GLM sensor is in its launch configuration. *(CCR 00348)* The fundamental resonant frequency is defined as the lowest mode with more than 2% effective modal mass in any direction. *(CCR 00379)*
GLMPORD129	3.3.2.6.0-2	The GLM sensor and electronics units **shall** survive the spacecraft system level testing with notching of interface forces to design limits only. *(CCR 00379)*
GLMPORD285	3.3.2.7	**3.3.2.7 Material Properties *(CCR 00379)***
GLMPORD130	3.3.2.7.0-1	Material properties **shall** be based on sufficient tests of the material meeting approved specifications to establish design values on a statistical basis.
GLMPORD131	3.3.2.7.0-2	Design values **shall** account for the probability of structural failures and loss of any required function due to material variability.
GLMPORD286	3.3.2.8	**3.3.2.8 Critical Members Design Values *(CCR 00379)***
GLMPORD132	3.3.2.8.0-1	For critical members, design values **shall** be selected to assure strength with a minimum of 99 percent probability and 95 percent confidence. Structural members are classified as critical when their failure would result in loss of structural integrity of the flight units. *(CCR 00379)*
GLMPORD287	3.3.2.9	**3.3.2.9 Redundant Members Design Values *(CCR 00379)***
GLMPORD133	3.3.2.9.0-1	For redundant members, design values **shall** be selected to assure strength with a minimum of 90 percent probability and 95 percent confidence. Structural members are classified as redundant when their failure would result in the redistribution of applied loads to other structural members without loss of structural integrity. *(CCR 00379)*
GLMPORD288	3.3.2.10	**3.3.2.10 Selective Design Values *(CCR 00379)***
GLMPORD289	3.3.2.10.0-1	As an exception to GLMPORD132 [Critical Members Design Values] and GLMPORD133 [Redundant Members Design Values], greater design values may be used if a representative portion of the material used in the structural member is tested before use to determine that the actual strength properties of that particular structural member will equal or exceed those used in the design. *(CCR 00379)*

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GLMPORD290	3.3.2.11	**3.3.2.11 Structural Reliability *(CCR 00379)***
GLMPORD134	3.3.2.11.0-1	The strength, detailed design, and fabrication of the structure **shall** prevent any critical failure, resulting in the loss of any mission objective, due to fatigue, corrosion, manufacturing defects and fracture throughout the life of the GLM.
GLMPORD135	3.3.2.11.0-2	Accounting for the presence of stress concentrations and the growth of undetectable flaws, the GLM structures **shall** withstand loads equivalent to four complete service lifetimes.
GLMPORD136	3.3.2.11.0-3	While subjected to any flight operational load up to limit flight operational loads, the resulting deformation of the residual GLM structures **shall** not interfere with the operation of the GLM units.
GLMPORD137	3.3.2.11.0-4	After any load up to limit loads, the resulting permanent deformation of the residual instrument flight unit structures **shall** not interfere with the operation of the GLM units.
GLMPORD141	3.3.2.12	**3.3.2.12 Mechanisms**
GLMPORD142	3.3.2.12.0-1	Deployment, sensor, pointing, drive or separation mechanisms and other moving mechanical assemblies may be designed using MIL-A-83577B and NASA TP-1999-206988.
GLMPORD143	3.3.2.12.0-2	GLM mechanisms **shall** meet performance requirements while operating in an Earth gravity environment with any orientation of the gravity vector. *(CCR 00348)*
GLMPORD144	3.3.2.12.0-3	GLM moving mechanical assemblies **shall** provide torque and force ratios per section 2.4.5.3 of GSFC-STD-7000 using the following factors of safety.

Program Phase	Known Torque Factor of Safety (FS_k)	Variable Torque Factor of Safety (FS_y)
Preliminary Design Review	2.0	4.0
Critical Design Review	1.5	3.0
Acceptance/Qualification Test	1.5	3.0

(CCR 00379)

GLMPORD145	3.3.2.12.0-4	Rotational GLM actuators **shall** provide a continuous maximum torque output greater than 7.0 milli-Nm for all operating points of the actuators.
GLMPORD146	3.3.2.12.0-5	Linear GLM actuators **shall** provide a continuous maximum force output greater than 0.28 N for all operating points of the actuators.
GLMPORD147	3.3.2.12.0-6	GLM mechanisms using closed-loop control **shall** provide gain and phase margins greater than 12 dB and 40°, respectively, including the effects of the dynamic properties of any flexible structure.
GLMPORD148	3.3.2.12.0-7	GLM mechanisms requiring restraint during launch **shall** be caged during launch without requiring power to maintain the caged condition.
GLMPORD149	3.3.2.12.0-8	GLM mechanisms requiring restraint during launch **shall** be released from the caged condition by command.
GLMPORD150	3.3.2.12.0-9	GLM mechanisms requiring restraint during launch **shall** be returned to a caged condition ready for launch by either command or by manual actuation of an accessible caging device.
GLMPORD291	3.3.2.13	**3.3.2.13 Pressurized Units *(CCR 00379)***
GLMPORD292	3.3.2.13.0-1	GLM pressurized systems **shall** follow the requirements in accordance with AFSPCMAN 91-710 and MIL-STD-1522A for the design of pressurized systems. *(CCR 00379)*

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GLMPORD293	3.3.2.13.0-2	The GLM **shall** have no open fluid reservoirs when delivered to the spacecraft contractor. *(CCR 00379)*
GLMPORD294	3.3.2.14	**3.3.2.14 Alignment Reference *(CCR 00379)***
GLMPORD295	3.3.2.14.0-1	The GLM sensor unit **shall** provide a permanent flight worthy optical alignment reference composed of a minimum 2.54 cm alignment cube and a mounting surface datum. *(CCR 00379)*
GLMPORD296	3.3.2.14.0-2	The GLM **shall** provide a flight worthy cover for the optical alignment cube. Flight worthy cover means that the cover will capture the cube should it separate from the spacecraft during launch. *(CCR 00379)*
GLMPORD297	3.3.2.14.0-3	The GLM sensor unit **shall** provide fiduciary marks locating the X, Y, and Z axes of the unit. *(CCR 00379)*
GLMPORD298	3.3.2.15	**3.3.2.15 Precision Component Assembly *(CCR 00379)***
GLMPORD299	3.3.2.15.0-1	When precise location of a component is required, the design **shall** use a stable, positive location system without relying on friction as the primary means of attachment. *(CCR 00379)*
GLMPORD151	3.3.3	**3.3.3 Thermal Requirements**
GLMPORD152	3.3.3.0-1	The GLM contractor **shall** establish Mission Allowable Temperatures (MAT) for the GLM accommodating at least 5 K of analytical/test uncertainty at each temperature extreme. Thermal margin is defined as the temperature delta between MAT versus the bounding predictions plus analytical uncertainty.
GLMPORD153	3.3.3.0-2	The GLM **shall** maintain thermally independent units and their internal components within MAT limits during all flight operational conditions including bounding worst-case environments.
GLMPORD154	3.3.3.0-3	The GLM **shall** survive without damage over the Non-Operational Temperatures (NOT) range extending from at least 20 K warmer than the hot MAT and at least 20 K colder than the cold MAT. *(CCR 00379)*
GLMPORD155	3.3.3.0-4	The GLM cold NOT **shall** be 248 K or colder. *(CCR 00379)*
GLMPORD156	3.3.3.0-5	The GLM **shall** provide two or more serial and independent controls for disabling any heater where any failed on condition would cause over-temperature conditions or exceed the instrument power budget.
GLMPORD157	3.3.3.0-6	The GLM heaters **shall** be sized to provide 25% margin for worst case conditions.
GLMPORD158	3.3.3.0-7	The GLM survival heaters **shall** be thermostatically controlled.
GLMPORD159	3.3.4	**3.3.4 Onboard Processors Requirements**
GLMPORD160	3.3.4.0-1	The entire GLM flight software image **shall** be contained in non-volatile memory at launch.
GLMPORD161	3.3.4.0-2	The GLM **shall** provide for reset of the On-board Processor by command.
GLMPORD162	3.3.4.0-3	The GLM On-Board Processor **shall** initialize upon power-up into a predetermined configuration.
GLMPORD163	3.3.4.0-4	The GLM **shall** provide a fail-safe recovery mode dependent on a minimal hardware configuration capable of accepting and processing a minimal command subset sufficient to load and dump memory.

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GLMPORD164	3.3.5	**3.3.5 Flight Software Requirements**
GLMPORD165	3.3.5.0-1	All software developed for the GLM instrument **shall** be developed with ANSI/ISO standard languages and a widely-accepted, industry-standard, formal software design methodology. With NASA approval, minimal use of processor-specific assembly language is permitted for certain low-level programs such as interrupt service routines and device drivers.
GLMPORD166	3.3.5.0-2	The GLM flight software **shall** be re-programmable on-orbit without computer restart.
GLMPORD167	3.3.5.0-3	The GLM flight software **shall** be uploadable in Computer Software Units (CSUs) and usable immediately after completion of the modified unit upload.
GLMPORD168	3.3.5.0-4	Activation of the modified GLM CSUs **shall** not require completion of an upload of the entire flight software image.
GLMPORD169	3.3.5.0-5	The GLM flight software **shall** be deterministic in terms of scheduling and prioritization of critical processing tasks to ensure their timely completion.
GLMPORD170	3.3.5.0-6	All GLM software data that are modifiable and examinable by ground operators **shall** be organized into tables that can be referenced by table number so table data can be loaded and dumped by the ground without reference to memory address.
GLMPORD171	3.3.5.0-7	The definition of GLM commands within the ground database **shall** not be dependent on physical memory addresses within the flight software.
GLMPORD172	3.3.5.0-8	All GLM software and firmware versions **shall** be implemented with an internal identifier (embedded in the executive program) that can be included in the instrument engineering data.
GLMPORD173	3.3.5.0-9	The GLM software internal identifier **shall** be keyed to the configuration management process.
GLMPORD174	3.3.5.0-10	During development, GLM flight processors providing computing resources for instrument subsystems **shall** be sized for worst case utilization not to exceed the capacity shown below (measured as a percentage of total available resource capacity): **Flight Processor Resource Utilization Limits**

	S/W PDR	S/W CDR	S/W AR
RAM Memory	40%	50%	60%
ROM Memory	50%	60%	70%
CPU	40%	50%	60%

GLMPORD196	3.3.5.0-11	The GLM flight software **shall** provide time-tagged event logging in telemetry.
GLMPORD197	3.3.5.0-12	The GLM event messages **shall** include all anomalous events, mode transitions, and system performance events.
GLMPORD198	3.3.5.0-13	All GLM flight software components **shall** utilize a common format for event messages.
GLMPORD199	3.3.5.0-14	GLM flight software **shall** provide commands to enable and disable queuing of individual event messages.
GLMPORD200	3.3.5.0-15	GLM flight software **shall** buffer a minimum of 1000 event messages while the event messages are queued for telemetering to the ground. *(CCR 00348)*

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GLMPORD201	3.3.5.0-16	The GLM event message queue **shall** be configurable by command to either a) discard the new event messages, or b) overwrite oldest event messages when the queue is full. *(CCR 00379)*
GLMPORD301	3.3.5.0-17	The GLM **shall** downlink new event messages whether the event message queue is overwriting or discarding new event messages. *(CCR 00379)*
GLMPORD302	3.3.5.0-18	The GLM **shall** downlink event messages to the event message queue whenever GLM receives operational power from the spacecraft. *(CCR 00379)*
GLMPORD202	3.3.5.0-19	GLM flight software **shall** maintain counters for: a) the total number of event messages generated b) the number of event messages discarded because of queue overflow c) the number of event messages not queued due to being disabled
GLMPORD203	3.3.5.0-20	GLM flight software **shall** provide a restart by command with preservation of the event message queue and memory tables.
GLMPORD204	3.3.5.0-21	GLM flight software **shall** provide a mechanism to verify the contents of all memory areas.
GLMPORD205	3.3.5.0-22	GLM flight software, and associated on-board computer hardware, **shall** provide for dumping any location and any size of on-board memory to the ground upon command.
GLMPORD206	3.3.5.0-23	The GLM flight software memory dump capability **shall** not disturb normal operations and instrument data processing.
GLMPORD207	3.3.5.0-24	Telemetry points sampled by the GLM **shall** be controlled by an on-orbit modifiable table.
GLMPORD208	3.3.5.0-25	The sample rate of every GLM telemetry point **shall** be controlled by an on-orbit modifiable table.
GLMPORD209	3.3.6	**3.3.6 Power Requirements**
GLMPORD210	3.3.6.0-1	The GLM power regulators and supplies **shall** provide a phase margin of greater than 35 degrees.
GLMPORD211	3.3.6.0-2	The GLM power regulators and supplies **shall** provide a gain margin of greater than 20 dB.
GLMPORD212	3.3.6.0-3	The GLM **shall** not contain fuses.
GLMPORD213	3.3.6.0-4	The GLM **shall** provide flight qualified covers for all test point connectors.
GLMPORD214	3.3.7	**3.3.7 Magnetic Properties**
GLMPORD215	3.3.7.0-1	The change in the magnetic field produced by the GLM sensor, electronics, or power supply modules **shall** be less than 30 nanotesla peak-to-peak for any operating mode, up to a low-pass bandwidth of 4.0 Hz, along any axis when measured at a distance of 1 meter from any face of a module.
GLMPORD216	3.3.8	**3.3.8 Spacecraft Level Ground Testing**
GLMPORD217	3.3.8.0-1	The GLM **shall** accommodate operational testing in all modes and states for indefinite periods during Spacecraft level Thermal Vacuum Testing in at least the following two orientations: 1) Spacecraft +Y axis aligned with the gravity vector and pointed down. 2) Spacecraft -X aligned with the gravity vector and pointed down. *(CCR 00348)*

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GLMPORD218	3.3.9	**3.3.9 Electrical System Test Equipment**
GLMPORD219	3.3.9.0-1	The Electrical System Test Equipment (ESTE) **shall** operate the GLM and electrical ground support equipment during performance verification and calibration testing.
GLMPORD220	3.3.9.0-2	The ESTE **shall** simulate the spacecraft interface with power, clock pulses, command, and telemetry functions.
GLMPORD221	3.3.9.0-3	The ESTE **shall** include all test equipment necessary to operate and control the GLM in all phases of operation and test modes.
GLMPORD222	3.3.9.0-4	The ESTE **shall** generate and maintain command logs.
GLMPORD223	3.3.9.0-5	The ESTE **shall** limit check all health and safety data.
GLMPORD224	3.3.9.0-6	The ESTE **shall** capture and archive all raw GLM data.
GLMPORD225	3.3.9.0-7	The ESTE **shall** provide near real-time and off-line data analysis of all GLM data necessary to determine the performance characteristics of the instrument. *(CCR 00379)*
GLMPORD226	3.3.9.0-8	The ESTE **shall** interface with the Spacecraft Ground Support Equipment at the Spacecraft Contractor's facility to extract GLM science and engineering data.
GLMPORD227	3.3.9.0-9	The ESTE **shall** prohibit hazardous or critical commands being sent to the GLM without operator verification.
GLMPORD228	3.3.10	**3.3.10 Flight Software Development Environment**
GLMPORD229	3.3.10.0-1	The Flight Software Development Environment (FSDE) **shall** consist of the hardware and software systems used for real-time, closed-loop testing on flight-like hardware to develop, test, verify, and demonstrate that the flight software is ready for Government acceptance. *(CCR 00379) (CCR 01035)*
GLMPORD230	3.3.10.0-2	The FSDE **shall** support all lifecycle activities (development, test, and validation) simultaneously.
GLMPORD231	3.3.10.0-3	The FSDE **shall** contain all items (software, databases, compilers, debuggers, etc.) needed to prepare flight software for the target processor.
GLMPORD232	3.3.10.0-4	The FSDE **shall** contain engineering (hardware) models of necessary flight hardware as well as dynamic software models comprising the remainder of the instrument and the necessary on-orbit environment.
GLMPORD233	3.3.11	**3.3.11 Shipping Containers**
GLMPORD234	3.3.11.0-1	The GLM shipping container **shall** be compatible with shipment by air or air-ride van.
GLMPORD235	3.3.11.0-2	The GLM shipping container **shall** be purgeable, and electrically equipped for testing instrument aliveness while in storage, without opening.
GLMPORD236	3.3.11.0-3	The GLM shipping container **shall** have internal temperature, humidity, and pressure monitors with external indicators.
GLMPORD237	3.3.11.0-4	The GLM shipping container **shall** have shock recorders.
GLMPORD238	3.3.11.0-5	The GLM shipping container **shall** meet all contamination control requirements imposed on the GLM instrument units.
GLMPORD239	3.3.11.0-6	The GLM GSE shipping container(s) **shall** be compatible with shipment by air or air ride van.

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GLMPORD242	3.3.12	**3.3.12 GLM Emulator**
GLMPORD243	3.3.12.0-1	The GLM emulator **shall** simulate all instrument modes and mode transitions.
GLMPORD244	3.3.12.0-2	The GLM emulator **shall** simulate predefined, scripted anomalies.
GLMPORD245	3.3.12.0-3	The GLM emulator **shall** communicate with a spacecraft emulator for instrument command, telemetry, and science packets using Space Wire.
GLMPORD246	3.3.12.0-4	The GLM emulator **shall** use commercial power.
GLMPORD247	3.3.12.0-5	The GLM emulator **shall** execute GLM flight code.
GLMPORD248	3.3.12.0-6	The GLM emulator **shall** accept simulation control commands from a standalone console.
GLMPORD249	3.3.12.0-7	The GLM emulator **shall** accept simulation control commands from the spacecraft emulator.
GLMPORD250	3.3.12.0-8	The GLM emulator **shall** generate housekeeping data reflective of commanded mode.
GLMPORD251	3.3.12.0-9	The GLM emulator **shall** accept real-time inputs to change simulated telemetry or modeling parameters.
GLMPORD252	3.3.12.0-10	The GLM emulator **shall** maintain a log of all instrument commands received indicating validity, command mnemonic, and raw bit pattern.
GLMPORD253	3.3.12.0-11	The GLM emulator **shall** maintain a log of all simulation directives received.

ID	Object Number	417-R-GLMPORD-0057, RM Version, Geostationary Lightning Mapper (GLM) Performance and Operational Requirements Document (PORD)
GLMPORD254	4	**4 Acronyms**

ID	Object Number	417-R-GLMPORD-0057, RM Version, Geostationary Lightning Mapper (GLM) Performance and Operational Requirements Document (PORD)

GLMPORD255 4.0-1

A/D	analog-to-digital
ABI	Advanced Baseline Imager
ANSI	American National Standards Insititute
AR	acceptance review
CDR	critical design review
cm	centimeter
CONUS	continental United States (excluding Alaska and Hawaii)
CPU	central processing unit
CSU	computer software units
CTE	coefficient of thermal expansion
EOL	end-of-life
ESD	electrostatic discharge
ESTE	electrical system test equipment
FOV	field-of-view
FSDE	flight software development environment
GEVS	General Environmental Verification Specification
GIRD	General Interface Requirements Document
GLM	Geostationary Lightning Mapper
GOES	Geostationary Operational Environmental Satellite
GS	ground system
GSD	ground sample distance
GSE	ground support equipment
INR	image navigation and registration
ISO	International Organization for Standardization
J	joules
K	Kelvin
km	kilometers
LIS	Lightning Imaging Sensor
LMS	Lightning Mapping Sensor
m	meters
MAT	mission allowable temperature
MMD	mean mission duration
MRD	Mission Requirements Document
ms	milliseconds
N	Newtons
NASA	National Aeronautics and Space Administration
NBOF	narrow-band optical filter
NEDN	noise equivalent delta radiant energy
nm	nanometer
Nm	Newton-meter
NOAA	National Oceanic and Atmospheric Administration
NOT	non-operating temperature
OTD	Optical Transient Detector
PDR	Preliminary Design Review
PORD	Performance Operational Requirements Document
RAM	random access memory
ROM	read-only memory
SNR	signal-to-noise ratio
sr	steradian
S/W	software
TBD	to be determined
TBR	to be reviewed
TBS	to be supplied
TRMM	Tropical Rainfall Mapping Mission
UIID	Unique Instrument Interface Document

(CCR 00348)

417-R-GLMPORD-0057 DCR

CCR #: 00233 Rev
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CCB Status: **Approved**
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Title: Relax Field-of-Regard Restriction
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMPORD-0057
3.2.1
DOORS Version: GLMPORD 0.0 Inc in: 1.0
DOORS ID #: GLMPORD52 (3.2.1.0-2)

CCR #: 00219 Rev
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Title: GLM PORD Definitions
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMPORD-0057
Doc Section 1.5, 3.2.1, 3.2.2, 3.2.3
DOORS Version: GLMPORD 1.0 Inc in: 1.1
DOORS ID #: All

CCR #: 00348 Rev
Contract # NNG0 - 6HX11C, 6HX12C, 6HX13C
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Title: GLM PORD Clean-Up
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMPORD-0057
Doc Section 1.2, 2.0, 1.5, 3.1.2, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.3.3, 3.3.6.
DOORS Version: GLMPORD 1.1 Inc in: 1.2
DOORS ID #: See change pages

CCR #: 00379 Rev
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Title: GLM RFP PORD Changes
GOES S/C: R Effectivity: GLM Instrument
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DOORS ID #: All

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Title: GLM RFP PORD Changes
GOES S/C: R Effectivity: GLM Instrument
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DOORS ID #: All

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417-R-GLMUIID-0058
Baseline Version 2.0

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Geostationary Lightning Mapper (GLM)

Unique Instrument Interface Document (UIID)

May 22, 2007

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

To verify the correct version of this document, please contact the GOES-R Series Configuration Management Office

Geostationary Operational Environmental Satellite (GOES)
GOES-R Series
Geostationary Lightning Mapper (GLM)
Unique Instrument Interface Document (UIID)

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7/20/05
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7/20/05
Date

To verify the correct version of this document, please contact the GOES-R Series Configuration Management Office.

/GLM

GLM UIID

417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)

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No filter applied.

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Contents

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID1	1	# 1 Scope
GLMUIID2	1.0-1	The purpose of this Unique Instrument Interface Document (UIID) is two-fold. The first is to allocate GOES-R series spacecraft resources to the Geostationary Lightning Mapper (GLM). The second is to serve as a core building block on which the GLM-spacecraft interface can be designed.
GLMUIID3	1.0-2	The spacecraft integrating contractor and the GLM contractor **shall** meet each of their respective interface requirements as defined in this document.
GLMUIID4	1.0-3	The Government will be the system integrator until a system performance contractor or spacecraft contractor with that responsibility is selected. Until that time, the Government will be responsible for accommodation trades, resource allocation (weight, power, space, bandwidth, etc.), and resolving interface issues. This UIID will govern the development of an Interface Control Document (ICD) which will be a joint activity of the GLM and spacecraft contractors.
GLMUIID5	1.0-4	The GLM ICD establishes the details of the electrical, communications, mechanical, thermal, integration and test, and command and data handling (C&DH) interfaces between the GLM instrument and the GOES-R spacecraft.
GLMUIID6	1.0-5	After the ICD is signed and approved by all parties, the spacecraft contractor **shall** maintain the ICD.
GLMUIID7	1.0-6	The GLM is a single-wavelength, non-scanning imaging instrument designed to detect lightning. The instruments collect data on a three-axis body-stabilized satellite in geosynchronous orbit. Probability of detection and false alarm, coverage, resolution and geolocation accuracy are prime requirements of the system. The instrument requires primary power and command input data from the spacecraft. Instrument output data to the spacecraft contains instrument information, instrument telemetry and ancillary data. The sensor units contain the optical system, detectors and their cooling systems, if required, and directly related electronics. The electronics unit contains the power supply module, command, control, and data processing circuitry.
GLMUIID8	1.1	## 1.1 Document Overview
GLMUIID9	1.1.0-1	Together, the General Interface Requirements Document (GIRD) and the GLM UIID establish the GLM-spacecraft interface requirements. The GIRD applies to all GOES-R instruments while the GLM UIID is specific to the GLM. Section 1 explains the use of this document. Section 2 lists reference documents. Section 3 allocates spacecraft resources, such as mass, power, and data rate, to the GLM instrument. Section 4 contains government-accepted operation constraints. Section 5 contains government-accepted deviations from the GIRD. Section 6 contains a list of acronyms used within this document.
GLMUIID10	1.2	## 1.2 Missing Requirements
GLMUIID11	1.2.0-1	This document contains all performance requirements for the sensor except those labeled "TBD," "TBS," and "TBR". The term "TBD," meaning "to be determined," applied to a missing requirement means that the contractor should determine the missing requirement in coordination with the government. The term "TBS," meaning "to be specified," indicates that the government will supply the missing information in the course of the contract. The term "TBR," meaning "to be reviewed," implies that the requirement is subject to review for appropriateness by the contractor or the government. The government may change "TBR" requirements in the course of the contract.
GLMUIID12	1.3	## 1.3 Order of Precedence

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID13	1.3.0-1	The order of precedence of interface requirements documents is the UIID at the highest level, followed in order by the GIRD, ICD, and Instrument Description Document (IDD).

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID14	2	**2 Applicable Documents**
GLMUIID15	2.0-1	Reserved

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID16	3	**3 Allocations**
GLMUIID17	3.0-1	The GOES-R spacecraft provides communications, power and a platform for the GLM instrument. The following paragraphs allocate these resources to GLM.
GLMUIID18	3.1	**3.1 Command and Data Handling**
GLMUIID19	3.1.1	**3.1.1 Instrument-to-Spacecraft Science Rate**
GLMUIID20	3.1.1.0-1	The instrument science and engineering data rate, including all overhead associated with the Consultative Committee for Space Data Systems (CCSDS) packetization by the instrument, at the spacecraft interface **shall** not exceed 5 mega (10^6) bits per second when averaged over any 5 second period. *(CCR 00234)*
GLMUIID21	3.1.2	**3.1.2 Telemetry Data Rate**
GLMUIID22	3.1.2.0-1	Housekeeping telemetry data rate, including all overhead associated with CCSDS packetization by the instrument, at the spacecraft interface **shall** not exceed 1024 bits per second when averaged over any 5 second period.
GLMUIID23	3.1.3	**3.1.3 Application Process Identifiers**
GLMUIID24	3.1.3.0-1	The GLM **shall** use no more than 255 consecutive Application Process Identifiers (APIDs) for science, telemetry, and command packets.
GLMUIID25	3.2	**3.2 Power**
GLMUIID26	3.2.1	**3.2.1 Average Operational Power *(CCR 00246)***
GLMUIID27	3.2.1.0-1	The GLM average operational power, averaged over any 5 minute period, and including operational heater power, **shall** be no more than 260 watts. *(CCR 00246)*
GLMUIID28	3.2.2	**3.2.2 Maximum Operational Power *(CCR 00246)***
GLMUIID29	3.2.2.0-1	The GLM maximum operational power, averaged over any 20 ms period, and including operational heater power, **shall** be no more than 325 watts. *(CCR 00246)*
GLMUIID30	3.2.3	**3.2.3 Average Survival Power *(CCR 00240)***
GLMUIID31	3.2.3.0-1	When operational power is removed from GLM, the average survival power, averaged over any 72 minute period, **shall** be no more than the 92 watts. *(CCR 00246)*
GLMUIID96	3.2.4	**3.2.4 Maximum Survival Power *(CCR 00246)***
GLMUIID97	3.2.4.0-1	When operational power is removed from GLM, the maximum survival power, averaged over any 20 ms period, **shall** be no more than 130 watts. *(CCR 00246)*
GLMUIID32	3.3	**3.3 Mechanical**
GLMUIID33	3.3.0-1	The requirements in this section apply to the structural and mechanical components of the instrument flight units. *(CCR 00270)*
GLMUIID34	3.3.1	**3.3.1 Mass Properties**
GLMUIID35	3.3.1.0-1	The GLM, including all units and cabling between units, **shall** have mass less than *65* kilograms.
GLMUIID36	3.3.2	**3.3.2 Cabling Between Units**

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID37	3.3.2.0-1	If there are external units mounted directly to the spacecraft, the GLM **shall** accommodate any cable length between the units up to but not exceeding 2.5 meters. *(CCR 00270)*
GLMUIID51	3.3.2.0-2	Cables between GLM units will be the responsibility of the GLM contractor.
GLMUIID52	3.3.3	**3.3.3 Volume**
GLMUIID53	3.3.3.0-1	The GLM sensor and electronics units, including mounts, thermal blankets and connectors for both stowed and operational configurations, **shall** have dimensions that do not exceed the limits listed in the Instrument Unit Envelopes table.

Instrument Unit Envelopes Table

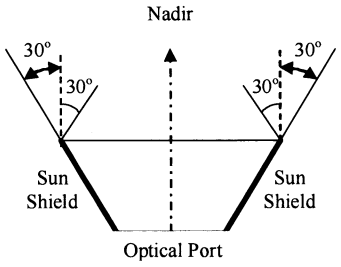
Component	Width (cm) (X)	Height (cm) (Y)	Depth (cm) (Z)
Sensor unit*	80.0	65.0	150
Auxiliary Electronics	50.0	50.0	37.5

(CCR 00197) (CCR 00270)

*Discussion: For the sensor unit only, width is in the X direction of the body reference frame (BRF) defined in the GIRD. Height is measured in the Y direction of the BRF, and depth is in the Z direction of the BRF. For the electronic units, height is the direction normal to the mechanical interface plane.

GLMUIID98	3.3.3.0-2	In going from the stowed to the operational configuration, sensor unit depth (z-axis dimension) **shall** always be less than or equal to 170 cm. *(CCR 00349)*
GLMUIID55	3.3.4	**3.3.4 Optical Port Field-of-View**
GLMUIID56	3.3.4.0-1	The spacecraft **shall** provide the sensor unit's optical port a clear field-of-view within 30° of nadir as shown in the Optical Port Field-of-View Figure below. *(CCR 00349)*

Optical Port Field of View

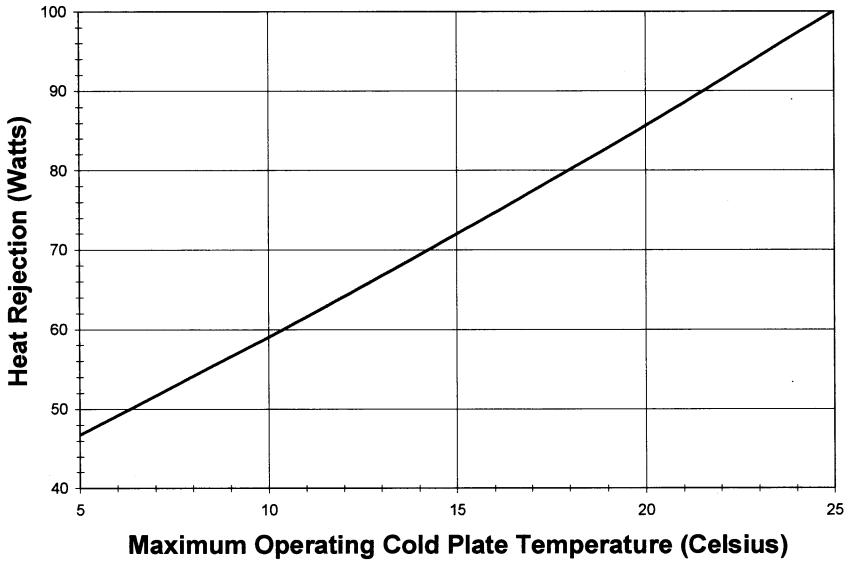


(CCR 00349)

GLMUIID67	3.3.5	**3.3.5 Mounting**
GLMUIID68	3.3.5.0-1	The spacecraft **shall** provide the instrument sensor unit a nadir-facing mounting surface.
GLMUIID69	3.3.5.0-2	The spacecraft mounting surface **shall** have as a minimum the same dimensions of the sensor unit envelope anti-nadir plane.

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID70	3.3.5.0-3	The sensor unit mechanical interface **shall** lie within the anti-nadir plane of the sensor unit envelope.
GLMUIID71	3.3.5.0-4	The instrument sensor unit **shall** use kinematic mounts for its mechanical interface to the spacecraft.
GLMUIID99	3.3.5.0-5	The instrument **shall** meet its performance requirements while the sensor unit is mounted to a rigid plate supported at three flexible points with a first mode between 20 and 30 Hz. *(CCR 00349)*
GLMUIID100	3.3.5.0-6	The instrument **shall** meet its performance requirements when the diagonal modal viscous damping factors associated with the three flexible points are 0.5%. *(CCR 00349)*
GLMUIID101	3.3.5.0-7	The placement of the GLM alignment reference frame with respect to the spacecraft IRU reference frame **shall** be to within 0.125 degrees per axis, including variation over all launch and on-orbit environments. *(CCR 00349)*
GLMUIID102	3.3.5.0-8	Nominal GLM mounting orientations **shall** have the instrument Z axis parallel to the spacecraft Z axis and the instrument Y axis either parallel to or anti-parallel to the spacecraft Y axis. *(CCR 00349)*
GLMUIID73	3.4	**3.4 Thermal**
GLMUIID74	3.4.0-1	The instrument electronics module total heat transfer to the spacecraft **shall** not exceed 200 Watts. *(CCR 00270)*
GLMUIID103	3.4.1	**3.4.1 Cold Plate *(CCR 00349)***
GLMUIID104	3.4.1.0-1	The spacecraft **shall** provide the means (herein referred to as the cold plate) for the GLM sensor unit to reject heat. *(CCR 00349)*
GLMUIID105	3.4.1.0-2	The cold plate **shall** be located at the +Y surface of the allocated GLM sensor unit envelope. *(CCR 00349)*
GLMUIID106	3.4.1.0-3	The GLM vendor **shall** select a cold plate maximum operating temperature between 10°C and 25°C. *(CCR 00349)*
GLMUIID107	3.4.1.0-4	In normal operations, the spacecraft **shall** maintain the cold plate within 10°C of its maximum temperature. *(CCR 00349)*
GLMUIID108	3.4.1.0-5	In survival mode, the spacecraft **shall** maintain the cold plate temperature between -30°C and + 50°C. *(CCR 00349)*
GLMUIID109	3.4.1.0-6	Cold plate heat rejection **shall** be as shown in the following Cold Plate Heat Rejection Figure. *(CCR 00349)*

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID109	3.4.1.0-6	



Cold Plate Heat Rejection Figure ***(CCR 00349)***

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID75	4	**4 Constraints**
GLMUIID76	4.0-1	In order to ensure proper instrument performance or to prevent possible instrument damage, the following Government-approved constraints are imposed by the instrument developer on spacecraft integration and test activities, including launch, activation and operations. No constraints have been identified at this time.

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID77	5	**5 GIRD Deviations**
GLMUIID78	5.0-1	This section identifies GIRD requirements that the Government has deviated from for this instrument. Where appropriate, corresponding GIRD paragraph titles and numbers are identified in parentheses.
GLMUIID83	5.1	**5.1 SpaceWire Data Rate**
GLMUIID84	5.1.0-1	(GIRD requirement GIRD441 in Section 3.2.5.5, SpaceWire Data Rate, is not applicable to the GLM instrument and is superceded by the following requirement) Data transferred over the SpaceWire data bus **shall** be clocked at 10 MHz. Note: This clock rate allows for a 8 Mbps data rate accounting for SpaceWire overhead.
GLMUIID85	5.2	**5.2 Instrument to Spacecraft Disturbances *(CCR 00240)***
GLMUIID86	5.2.0-1	The following instrument requirements apply during the operational mode of the spacecraft. *(CCR 00240)*
GLMUIID90	5.2.1	**5.2.1 Instrument Disturbance Torque Limits *(CCR 00240)***
GLMUIID92	5.2.1.0-1	(GIRD requirement GIRD160 in Section 3.2.1.7.2.1 titled Instrument Disturbance Torque Limits is not applicable to the GLM instrument and is superseded by the following requirement.) *(CCR 00240)*
GLMUIID93	5.2.1.0-2	The sum of the magnitude of the instrument sensor unit's uncompensated torques and the magnitude of its uncompensated linear forces multiplied by a lever arm of 2 meters **shall** not exceed 0.001 N-m (TBR). *(CCR 00240)*
GLMUIID89	5.2.2	**5.2.2 Instrument Allowable Angular Momentum *(CCR 00240)***
GLMUIID94	5.2.2.0-1	(GIRD requirement GIRD163 in Section 3.2.1.7.2.2 titled Instrument Allowable Angular Momentum is not applicable to the GLM instrument and is superseded by the following requirement.) *(CCR 00240)*
GLMUIID95	5.2.2.0-2	The magnitude of the instrument sensor unit's uncompensated angular momentum **shall** not exceed 0.001 N-m-sec (TBR). *(CCR 00240)*
GLMUIID110	5.3	**5.3 Spacecraft Attitude Knowledge *(CCR 00349)***
GLMUIID111	5.3.0-1	This section establishes separate static, slow dynamic and fast dynamic attitude knowledge requirements and supersedes GIRD635 and GIRD1088. *(CCR 00349)*
GLMUIID112	5.3.0-2	The attitude data provided by the spacecraft **shall** have a static error less than 1200 microradians (3σ).*(CCR 00349)*
GLMUIID113	5.3.0-3	The attitude data provided by the spacecraft **shall** have a diurnal error less than 30 microradians (3σ), where "diurnal error" refers to that portion of the error that repeats from day-to-day. *(CCR 00349)*
GLMUIID115	5.3.0-4	The root sum square of the diurnal Fourier cosine (A_i) and sine (B_i) amplitudes **shall** be less than

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)
GLMUIID115	5.3.0-4	$\frac{20\mu rad}{i^2} > \sqrt{A_i^2 + B_i^2}$ where each component of the diurnal error θ is assumed to be of the form $\theta(t) = \sum_{i=1}^{N} A_i \cos i\omega_0 t + B_i \sin i\omega_0 t$ The fundamental angular frequency ω_0 is $\omega_0 = 2\pi/T$ where T is the 24 hour period. *(CCR 01041)*
GLMUIID114	5.3.0-5	The attitude data provided by the spacecraft **shall** have a dynamic error (non-static and non-diurnal) less than 30 microradians (3σ). *(CCR 00349)*

ID	Object Number	417-R-GLMUIID-0058, RM Version, Geostationary Lightning Mapper (GLM) Unique Instrument Interface Document (UIID)

GLMUIID79 6

6 Acronyms

GLMUIID80 6.0-1

APID	Application Process Identifier
C&DH	Command and Data Handling
CCSDS	Consultative Committee for Space Data Systems
GIRD	General Interface Requirements Document
GLM	Geostationary Lightning Mapper
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
IDD	Instrument Description Document
NASA	National Aeronautics and Space Administration
PORD	Performance and Operational Requirements Document
TBD	to be determined
TBR	to be resolved
TBS	to be specified
UIID	Unique Instrument Interface Document

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Title: GLM Science Data Bandwidth Increase
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMUIID-0058
Doc Section 3.1.1
DOORS Version: GLMUIID 0.0
DOORS ID #: GLMUIID20 (3.1.1.0-1)

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CCB Status: **Approved**
CCB Date: 8/1/2006
Contract Mod#:
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Title: GLM Volume Increase
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMUIID-0058
Doc Section 3.3.3
DOORS Version: GLMUIID 0.0
DOORS ID #: GLMUIID53 (3.3.3.0-1)

CCR #: 00240 Rev
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CCB Date: 7/26/2006
Contract Mod#:
Doc Change Date: 8/1/2006

Title: GLM Disturbance Torque and Angular Momentum Limits
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMUIID-0058
Doc Section 5.2(new), 5.2.1, 5.2.2
DOORS Version: GLMUIID 1.0
DOORS ID #: GLMUIID(TBD)

CCR #: 00246 Rev
Contract # NNG0 - Info 6HX11C, 6HX12C, 6HX13C
CCB Status: **Approved**
CCB Date: 7/26/2006
Contract Mod#:
Doc Change Date: 8/1/2006

Title: GLM Survival Power Limits
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMUIID-0058
Doc Section 3.2.1, 322, 3.2.3, 3.2.4 (new)
DOORS Version: GLMUIID 1.0
DOORS ID #: GLMUIID26 (3.2.1), 27 (3.2.1.0-1), 28 (3.2.2), 29 (3.2.2.0-1), 30 (3.2.3), 31 (3.2.3.0-1), TBD (3.2.4), TBD (3.2.4.0-1)

CCR #: 00269 Rev
Contract # NNG0 - Info 6HX11C, 6HX12C, 6HX13C
CCB Status: **Approved**
CCB Date: 8/10/2006
Contract Mod#:
Doc Change Date: 8/10/2006

Title: GLM Cold Plate Thermal Limits
GOES S/C: R Effectivity: GLM Instrument

Doc #: 417-R-GLMUIID-0058
Doc Section 3.3.5
DOORS Version: GLMUIID 1.1
DOORS ID #: GLMUIID59 (3.3.5.0-1)

CCR #: 00270 Rev
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Title: Eliminate Reference to Auxiliary Electronics Box
GOES S/C: R Effectivity: GLM Instrument

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Version 2.4

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Instrument Mission Assurance Requirements (IMAR)

February 12, 2007

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Geostationary Operational Environmental Satellite (GOES)
GOES-R Series
Instrument Mission Assurance Requirements (IMAR)

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/Mission Assurance

IMAR

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IMAR1	1	**1 Overall Requirements**
IMAR3	1.1	**1.1 Description of Overall Requirements**
IMAR4	1.1.0-1	The Contractor **shall** plan and implement an organized Mission Assurance program that encompasses (1) all flight hardware, whether designed/built by the Contractor or sub-tier contractors, from project initiation through launch operations, (2) ground support equipment that interfaces to flight hardware to assure the integrity and safety of flight items, and (3) all software critical for mission success.
IMAR1093	1.1.0-2	Any deviations/waivers from this IMAR **shall** be submitted to the GOES-R Project for approval. These deviations/waviers will be controlled and maintained by the GOES-R Project Office.
IMAR1094	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.
IMAR8	1.2	**1.2 Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware**
IMAR9	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.
IMAR10	1.2.0-2	The Contractor **shall** submit the substantiating documentation in accordance with the Contract Data Requirements List (CDRL).
IMAR11	1.3	**1.3 Surveillance of the Contractor**
IMAR12	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, 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. *(CCR 00053)*
IMAR13	1.3.0-2	The contractor and/or suppliers **shall** grant access for NASA and/or NASA representatives to conduct assessments/surveys upon notice.
IMAR14	1.3.0-3	Resources **shall** be provided to assist with the assessments/surveys with minimal disruption to work activities.
IMAR15	1.3.0-4	The contractor, upon request, **shall** provide government assurance representatives with documents, records, and equipment required to perform their assurance and safety activities.
IMAR16	1.3.0-5	The contractor **shall** also provide the government assurance representative(s) with an acceptable work area within contractor facilities.
IMAR17	1.4	**1.4 Applicable and Reference Documents**
IMAR18	1.4.0-1	The effective version of all documents referenced in Section 12 are 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 IMAR, the IMAR **shall** be the superseding requirement. *(CCR 00112)*
IMAR19	1.4.0-2	Deliverables referenced in this document **shall** be delivered in accordance with the instrument CDRL. *(CCR 00112)*

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IMAR20	2	# 2 Quality Management System
IMAR21	2.0-1	The Contractor **shall** have a Quality Management System (QMS) that is compliant with the minimum requirements of ANSI/ISO/ASQC Q9001 Rev 2000, Quality Management Systems - Requirements.
IMAR23	2.1	## 2.1 QA Management System Requirements Augmentation
IMAR24	2.1.0-1	The following requirements augment identified portions of the ISO requirements.
IMAR25	2.1.1	### 2.1.1 Nonconformance Reporting
IMAR26	2.1.1.0-1	The Contractor **shall** have a system for identifying and reporting 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.
IMAR27	2.1.1.0-2	Nonconformances **shall** be reported in accordance with the CDRL.
IMAR28	2.1.1.1	#### 2.1.1.1 Preliminary Review
IMAR29	2.1.1.1.0-1	The material review process **shall** be initiated with the identification and documentation of a nonconformance.
IMAR30	2.1.1.1.0-2	A preliminary review **shall** be the initial step performed by Contractor-appointed personnel to determine if the nonconformance is minor and can readily be processed using the following disposition actions: a) Scrap, because the product is unusable for the intended purposes and cannot be economically reworked or repaired. b) Rework (or retest), to result in a characteristic that completely conforms to the standards, procedures, or drawing requirements. c) Return to supplier, for rework or replacement. d) Refer to Material Review Board when the above actions do not apply to the nonconformance. Note that Preliminary Review does not negate the requirement to identify, segregate, document, report and disposition nonconformances.
IMAR31	2.1.1.2	#### 2.1.1.2 Material Review Board (MRB)
IMAR32	2.1.1.2.0-1	Nonconformances not dispositioned by Preliminary Review **shall** be referred to the MRB for disposition.
IMAR33	2.1.1.2.0-2	MRB dispositions **shall** include: scrap, rework, return to supplier, repair by standard or non-standard repair procedures, use-as-is, or request for major waiver.
IMAR34	2.1.1.2.0-3	The Contractor **shall** establish a Material Review Board.
IMAR35	2.1.1.2.0-4	The MRB **shall** contain a core team with other disciplines brought in as necessary.
IMAR36	2.1.1.2.0-5	The MRB **shall** be chaired by a Contractor representative responsible for ensuring that the MRB actions are performed in compliance with this standard as implemented by Contractor procedures.
IMAR37	2.1.1.2.0-6	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.

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IMAR38	2.1.1.2.0-7	A GOES-R SAM representative will participate as voting members in MRB activities. Completed MRBs will be approved by the SAM or his designee.
IMAR39	2.1.1.2.0-8	The MRB process **shall** investigate, in a timely manner, each nonconforming item in sufficient depth to determine proper disposition.
IMAR40	2.1.1.2.0-9	For each reported nonconformance, there **shall** be an investigation and engineering analysis sufficient to determine cause and corrective actions for the nonconformance.
IMAR41	2.1.1.2.0-10	Written authorization **shall** be documented to disposition the nonconforming product.
IMAR42	2.1.1.3	**2.1.1.3 Failure Review Board (FRB)**
IMAR43	2.1.1.3.0-1	Nonconformance's not dispositioned by Preliminary Review or Material Review Board **shall** be referred to the Failure Review Board for disposition.
IMAR44	2.1.1.3.0-2	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, or request for waiver are also FRB type dispositions.
IMAR45	2.1.1.3.0-3	The Contractor **shall** establish a Failure Review Board.
IMAR46	2.1.1.3.0-4	The FRB **shall** contain a core team with other disciplines brought in as necessary.
IMAR47	2.1.1.3.0-5	The FRB **shall** be chaired by a Contractor representative responsible for ensuring that the FRB actions are performed in compliance with this standard as implemented by Contractor procedures.
IMAR48	2.1.1.3.0-6	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.
IMAR49	2.1.1.3.0-7	A GOES-R SAM representative will participate as voting members in FRB activities. Completed FRB's will be approved by the SAM or his designee.
IMAR50	2.1.1.3.0-8	The FRB process **shall** investigate, in a timely manner, each nonconforming item in sufficient depth to determine proper disposition.
IMAR51	2.1.1.3.0-9	For each reported nonconformance, there **shall** be an investigation and engineering analysis sufficient to determine cause and corrective actions for the nonconformance.
IMAR52	2.1.1.3.0-10	Written authorization **shall** be documented to disposition the nonconforming product.
IMAR53	2.1.1.4	**2.1.1.4 Reporting of Nonconformances**
IMAR54	2.1.1.4.0-1	Reporting of all nonconformances **shall** begin with the first power application or the first operation of a mechanical item.
IMAR55	2.1.1.4.0-2	Non-conformance reporting **shall** continue through on orbit checkout.
IMAR56	2.1.2	**2.1.2 Calibration**
IMAR57	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.
IMAR58	2.1.3	**2.1.3 Lessons Learned**
IMAR59	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.
IMAR61	2.1.4	**2.1.4 Flow-Down**

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IMAR62	2.1.4.0-1	The Contractor's QA program **shall** ensure the flow-down of technical and product assurance requirements to all suppliers.
IMAR63	2.1.4.0-2	The Contractor's QA program **shall** document and implement a process to verify compliance.
IMAR64	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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IMAR65	3	# 3 System Safety Requirements
IMAR67	3.1	## 3.1 System Safety Requirements
IMAR68	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.
IMAR69	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.
IMAR70	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. Specific safety requirements include the following: a) 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. b) 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 c) 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 developer. *(CCR 00050B)*
IMAR71	3.1.0-4	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. *(CCR 00050B)*
IMAR73	3.2	## 3.2 System Safety Program Plan
IMAR74	3.2.0-1	The System Safety Program Plan (SSPP) **shall** describe the system safety implementation process which includes analysis, reduction, and/or elimination of hazards. *(CCR 00050B)*
IMAR76	3.2.0-2	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.
IMAR77	3.2.0-3	The Contractor **shall** deliver the SSPP in accordance with the CDRL.
IMAR78	3.3	## 3.3 Safety Assessment Report *(CCR 00050B)*
IMAR79	3.3.0-1	The instrument or subsystem developer shall perform and document a comprehensive evaluation of the mishap risk of their instrument or subsystem. This report is used to assist the spacecraft developer/integrator in preparing the Missile System Prelaunch Safety Package (MSPSP) for submittal to the launch range. This safety assessment **shall** identify all safety features of the hardware, software, and system design, as well as operational hazards present in the system. *(CCR 00050B)*

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IMAR80	3.3.0-2	The Contractor **shall** deliver the SAR in accordance with the CDRL. *(CCR 00050B)*
IMAR81	3.3.0-3	The SAR **shall** begin at Contract Award and continue throughout all phases of the mission lifecycle.
IMAR85	3.4	**3.4 Verification Tracking Log (VTL)** *(CCR 00050B)*
IMAR88	3.4.0-1	All verifications that are listed on the hazard reports **shall** reference the test, analyses, and/or inspections that were performed to verify the hazard is controlled or eliminated.
IMAR89	3.4.0-2	The VTL **shall** be delivered with the final SAR and updated regularly until all items are closed.
IMAR1183	3.4.0-3	Individual VTL items **shall** be closed with appropriate documentation verifying the stated hazard control has been implemented, and individual closures shall be complete prior to first operational use/restraint. *(CCR 00050B)*
IMAR96	3.5	**3.5 Ground Operations Procedures**
IMAR97	3.5.0-1	All ground operations procedures to be used at the launch site **shall** be submitted to the GOES-R Project Safety Manager (PSM) for review and approval. The GOES-R Project reserves the right to review, on request, contractor site operations procedures to ensure compliance. *(CCR 00050B)*
IMAR102	3.6	**3.6 Safety Noncompliance/Waiver Requests**
IMAR103	3.6.0-1	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. *(CCR 00050B)*
IMAR104	3.6.0-2	The noncompliance request **shall** include the following information: a) A statement of the specific safety requirement and its associated source document name and paragraph number for which the waiver or deviation is being requested. b) A detailed technical justification for the exception. c) Analyses to show that the mishap potential of the proposed alternate requirement, method or process, as compared to the specified requirement. d) A narrative assessment of the risk involved in accepting the waiver or deviation. e) A narrative on possible ways of reducing hazard severity and probability, and existing compliance activities. f) Starting and expiration date for the waiver/deviation.
IMAR105	3.6.0-3	Safety Noncompliance/Waiver Requests **shall** be delivered in accordance with the CDRL.
IMAR110	3.7	**3.7 Support for Safety Working Group Meetings**
IMAR111	3.7.0-1	Contractor safety personnel **shall** support Safety Working Group (SWG) meetings, Technical Interface Meetings (TIM), and technical reviews, as required. The SWG will meet as necessary to review procedures and analyses that contain or examine safety critical functions or as convened by the GOES-R Project Safety Manager (PSM) to discuss any situations that may arise with respect to overall project safety. Meetings are normally held as a sidebar to other reviews and meetings to minimize extra travel. There is no required number of meetings. *(CCR 00050B)*
IMAR116	3.8	**3.8 Hazard Analyses**

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IMAR117	3.8.1	**3.8.1 Preliminary Hazard Analyses**
IMAR118	3.8.1.0-1	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 instrument system. *(CCR 00050B)*
IMAR119	3.8.1.0-2	Based on the best available data, including mishap data from similar systems and other lessons learned, hazards associated with the proposed instrument design **shall** be evaluated for hazard severity, hazard probability, and operational constraints.
IMAR120	3.8.1.0-3	The PHA **shall** consider the following for identification and evaluation of hazards as a minimum: a) Hazardous components b) Safety related interface considerations among various elements of the system, including consideration of the potential contribution by software to system and subsystem mishaps. c) Environmental constraints including the operating environments. d) Operating, test, maintenance, built-in-tests, diagnostics, and emergency procedures. e) Facilities. f) Safety related equipment, safe guards, and possible alternate approaches. g) Malfunctions to the system, subsystems, or software. This list is not all-inclusive; there are other areas that should be considered when conducting a PHA.
IMAR121	3.8.1.0-4	The contractor **shall** develop analyses for identifying the hazards associated with the hardware, support equipment, software, instrument ground operations and ground support equipment, and their interfaces. *(CCR 00050B)*
IMAR122	3.8.1.0-5	The contractor **shall** take measures to minimize each identified hazard.
IMAR123	3.8.1.0-6	The analysis **shall** be updated as all hardware and software progresses through the stages of design, fabrication, test, transportation, and launch.
IMAR124	3.8.1.0-7	Hazard reports **shall** be generated for all identified system hazards.
IMAR125	3.8.1.0-8	The hazard reports **shall** document the causes, controls, verification methods and status of verification for each hazard.
IMAR126	3.8.1.0-9	Instrument hazard reports **shall** be supplied to GSFC as part of the SAR for forwarding to the S/C contractor and inclusion in the S/C MSPSP. *(CCR 00050B)*
IMAR128	3.8.2	**3.8.2 Operations Hazard Analysis**
IMAR129	3.8.2.0-1	An Operations Hazard Analysis (OHA) will be performed to identify the hazards to payload or personnel when a facility is being used or an activity is being performed.
IMAR130	3.8.2.0-2	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. *(CCR 00050B)*
IMAR131	3.8.2.0-3	The Operations Hazard Analysis **shall** be delivered in accordance with the CDRL.
IMAR132	3.9	**3.9 Reviews**

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IMAR133	3.9.0-1	The contractor's system safety program **shall** be presented at GSFC assurance reviews and payload safety reviews.
IMAR134	3.9.0-2	At each review the contractor **shall** describe the actions being taken to reduce and control hazards.
IMAR135	3.10	**3.10 Mishap Reporting**
IMAR136	3.10.0-1	All mishaps and close calls that affect the GOES-R Program **shall** be reported within 24 hours of occurrence to GSFC.
IMAR137	3.10.0-2	A follow-up report **shall** be documented in accordance with NPR 8621.1, NASA Procedures and Requirements for Mishap Reporting. NPR 8621.1 defines a Close Call as 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 (less than $1000), but which possesses a potential to cause a mishap. *(CCR 00050B)*
IMAR138	3.10.0-3	Reports **shall** be delivered in accordance with the CDRL.
IMAR139	3.11	**3.11 Software Safety**
IMAR140	3.11.0-1	Section 5.1.2 describes desired software safety activities to meet NASA HQ guidelines. Hazards caused by software will be identified as a part of the nominal hazard analysis process, and their controls will be verified prior to acceptance. *(CCR 00051B)*
IMAR152	3.12	**3.12 Test Safety Responsibilities**
IMAR158	3.12.1	**3.12.1 Treatment of Hazards**
IMAR159	3.12.1.0-1	As hazards are discovered, every attempt **shall** be made to eliminate them. This may be accomplished by redesign, controlling energy sources, revising the test, or by some other method.
IMAR160	3.12.1.0-2	If the hazard cannot be eliminated, automatic safety controls **shall** be applied, for example: pressure relief devices, electrical circuit protection devices, or mechanical interlocks.
IMAR161	3.12.1.0-3	If that is not possible or is too costly, warning devices **shall** be considered.
IMAR162	3.12.1.0-4	If none of the foregoing methods are practicable, control procedures must be developed and applied. In practice, a combination of all four methods may be the best solution to the hazards posed by a complex system.
IMAR163	3.12.1.0-5	Before any test begins, the Contractor project manager and test facility management **shall** agree on the hazard control method(s) that are to be used. *(CCR 00231)*
IMAR164	3.12.2	**3.12.2 Facility Safety**
IMAR165	3.12.2.0-1	The contractor **shall** verify that the test facility and normal operations present no unacceptable hazard to the test item, test and support equipment, or personnel.
IMAR166	3.12.2.0-2	The contractor **shall** ensure that facility personnel abide by all applicable regulations, (ie., OSHA and NASA) observe all appropriate industrial safety measures, and follow all requirements for personal protective equipment. *(CCR 00050B)*
IMAR167	3.12.2.0-3	The contractor **shall** ensure that all facility personnel are trained and qualified for their positions. Training should include the handling of emergencies by the simulation of emergency conditions.
IMAR168	3.12.2.0-4	Analysis, tests and inspections **shall** be performed to verify that the safety requirements are satisfied.

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IMAR175	4	# 4 Reliability Requirements
IMAR176	4.0-1	This section addresses the Reliability Requirements for the Instrument.
IMAR178	4.1	## 4.1 General
IMAR179	4.1.0-1	The contractor **shall** plan and implement a reliability program that interacts effectively with other project disciplines, including systems engineering, hardware design, and product assurance.
IMAR180	4.1.0-2	The program **shall** be tailored to: a) Assure the specified reliability probability of success is achieved. b) Demonstrate that redundant functions, including alternative paths and work-arounds, are independent to the extent practicable c) Demonstrate that the stress applied to parts meet applicable derating criteria. d) Identify single failure items/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.
IMAR1096	4.1.0-3	The Government will perform a Probabilistic Risk Assessment (PRA) for the mission. Instrument data required under the CDRL is used for this analysis. The Contractor **shall** attend meetings and answer questions related to CDRL items to support the development of the PRA.
IMAR1097	4.1.0-4	The Contractor **shall** develop and deliver a Reliability Program Plan (RPP) in accordance with the CDRL.
IMAR189	4.2	## 4.2 Reliability Analyses
IMAR190	4.2.0-1	Reliability analyses **shall** be performed concurrently with design.
IMAR191	4.2.1	### 4.2.1 Failure Modes Effects and Criticality Analysis and Critical Items List
IMAR192	4.2.1.0-1	A Failure Modes Effects and Criticality Analysis (FMECA) **shall** be performed and delivered, in accordance with the CDRL. As additional design information becomes available the FMECA will be refined and updated.
IMAR193	4.2.1.0-2	Failure modes **shall** be assessed at a level sufficient to identify all single point failure modes at the piece part (e.g transistor, Integrated Circuit) level.
IMAR194	4.2.1.0-3	The failure mode **shall** be assigned a severity category based on the most severe effect caused by a failure.
IMAR195	4.2.1.0-4	All mission phases (e.g., ground handling, launch, deployment, on orbit storage, on-orbit operation) **shall** be addressed in the analysis.
IMAR196	4.2.1.0-5	Severity categories will be determined in accordance with the table below.

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IMAR196 4.2.1.0-5 **TABLE SEVERITY CATEGORIES**

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.
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.

(CCR 00142)

IMAR213 4.2.1.0-6 FMECA analysis procedures and documentation **shall** be performed in accordance with documented procedures.

IMAR214 4.2.1.0-7 Failure modes resulting in Severity Categories 1or 2 **shall** be analyzed at a greater depth, to the single parts if necessary, to identify the cause of failure.

IMAR215 4.2.1.0-8 Results of the FMECA **shall** be used to evaluate the design relative to requirements (e.g., no single instrument failure will prevent removal of power from the instrument).

IMAR216 4.2.1.0-9 Identified discrepancies **shall** be evaluated by management and design groups for assessment of the need for corrective action.

IMAR217 4.2.1.0-10 The FMECA **shall** 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.

IMAR218 4.2.1.0-11 All failure modes that are assigned to Severity Categories 1 and 2, **shall** be itemized on a Critical Items List (CIL) and maintained with the FMECA report.

IMAR219 4.2.1.0-12 Rationale for retaining the items **shall** be included on the CIL.

IMAR220 4.2.1.0-13 Results of the FMECA, as well as the CIL, **shall** be presented at all design reviews starting with the PDR.

IMAR221 4.2.1.0-14 The presentations **shall** include comments on how the analysis was used to perform design trade-offs or how the results were taken into consideration when making design or risk management decisions.

IMAR222 4.2.2 ## 4.2.2 Worst Case Analyses

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IMAR223	4.2.2.0-1	Worst Case Analyses **shall** be performed on all circuits where failure results in a severity category of 1or 2 or where de-rating guidelines are violated.
IMAR224	4.2.2.0-2	Worst case analyses **shall** be documented and delivered in accordance with the CDRL.
IMAR225	4.2.2.0-3	The most sensitive design parameters, including those that are subject to variations that could degrade performance, **shall** be subjected to the analysis.
IMAR226	4.2.2.0-4	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.
IMAR227	4.2.2.0-5	The analyses **shall** be updated in keeping with design changes.
IMAR228	4.2.2.0-6	The results of any analyses will be presented at all design reviews starting with peer reviews.
IMAR229	4.2.3	**4.2.3 Reliability Predictions**
IMAR230	4.2.3.0-1	The contractor **shall** perform numerical reliability prediction to validate that the design meets the requirements of the specification and to assist: a) Evaluation of alternative design concepts, redundancy and cross-strapping approaches. b) Identification of the elements of the design, which are the greatest detractors of system reliability. c) Identification of those potential mission limiting elements and components that will require special attention in part selection, testing, environmental isolation, and/or special operations. d) Evaluation of the impact of proposed engineering change and waiver requests on reliability.
IMAR231	4.2.3.0-2	MIL-HDBK-217, Reliability Prediction of Electronic Equipment , with updated failure rates from the Reliability Analysis Center or equivalent, **shall** be used as the source of failure rates unless otherwise approved by GSFC.
IMAR232	4.2.3.0-3	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.
IMAR233	4.2.3.0-4	As part of the reliability prediction the contractor **shall** provide and update a Reliability Block Diagram.
IMAR234	4.2.4	**4.2.4 Trend Analysis**
IMAR235	4.2.4.0-1	As part of the routine system assessment, the contractor **shall** assess all subassemblies and units to determine measurable parameters that relate to performance stability.
IMAR239	4.2.4.0-2	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.
IMAR236	4.2.4.0-3	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.
IMAR237	4.2.4.0-4	The monitoring will be accomplished within the normal test framework; i.e., during functional tests, environmental tests, etc.

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IMAR238	4.2.4.0-5	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.
IMAR242	4.2.5	**4.2.5 Limited-Life Items**
IMAR243	4.2.5.0-1	Limited-life items **shall** be identified, and managed as described in the RPP.
IMAR244	4.2.5.0-2	A list of limited life items **shall** be presented in the PDR and CDR and delivered in accordance with the CDRL.
IMAR245	4.2.5.0-3	The list of limited-life items **shall** include electromechanical mechanisms.
IMAR246	4.2.5.0-4	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.
IMAR247	4.2.5.0-5	Mechanisms such as compressors, seals, bearings, valves, actuators, and scan devices **shall** be included when aging, wear, fatigue and lubricant degradation limit their life.
IMAR248	4.2.5.0-6	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.
IMAR249	4.2.5.0-7	The use of an item whose expected life is less than its mission design life must be approved by GSFC.
IMAR251	4.3	**4.3 Fault Tree Analysis**
IMAR252	4.3.0-1	A fault tree analyses (FTA) **shall** be performed and delivered in accordance with the CDRL that addresses instrument failures and degraded modes of operation.
IMAR253	4.3.0-2	Beginning with each undesired state (instrument failure or degraded mode of operation), the fault tree **shall** be expanded to include all credible combinations of events/faults and environments that could lead to the undesired state.
IMAR254	4.3.0-3	Subassembly hardware/software failures, external hardware/software failures and human factors **shall** be considered in the analysis.
IMAR256	4.4	**4.4 Parts Stress Analyses**
IMAR257	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.
IMAR258	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.
IMAR259	4.4.0-3	The results of the analyses **shall** be presented at all design reviews starting with the PDR.
IMAR260	4.4.0-4	The analyses with summary sheets and updates **shall** be submitted as part of the Reliability Predictions.
IMAR261	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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IMAR262	5	# 5 Software Assurance Requirements
IMAR263	5.0-1	The contractor's QMS **shall** address software assurance functions for all software and firmware developed under this contract.
IMAR264	5.0-2	The contractor **shall** plan and document software development processes and procedures, software tools, reviews, resources, schedules and deliverables.
IMAR265	5.0-3	A Software Management Plan **shall** be prepared and delivered in accordance with the CDRL.
IMAR267	5.1	## 5.1 Software Assurance
IMAR268	5.1.0-1	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).
IMAR269	5.1.1	### 5.1.1 Software Quality
IMAR270	5.1.1.0-1	The contractor **shall** implement a Software Quality program to assure the quality of all software products.
IMAR272	5.1.1.0-2	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.
IMAR273	5.1.1.0-3	The contractor **shall** prepare and document a Software Assurance Plan delivered in accordance with the CDRL.
IMAR275	5.1.2	### 5.1.2 Software Safety
IMAR278	5.1.2.0-1	Software safety is the aspects of software engineering and software assurance that provide a systematic approach to identifying, analyzing, and tracking software mitigation and control of hazards and hazardous functions (e.g. data and commands) to ensure safer software operation within a system. *(CCR 00051B)*
IMAR1115	5.1.2.0-2	The contractor **shall** conduct a software safety program that is integrated with the overall software assurance and systems safety program, as described in Section 4.2 of NASA-STD-8719.13B. *(CCR 00051B)*
IMAR1116	5.1.2.0-3	The contractor **shall** document their approach to the software safety program in the Software Management Plan. *(CCR 00051B)*
IMAR1117	5.1.2.0-4	The contractor **shall** determine and identify software that is safety critical, based upon the determination process listed in Section 4.1 of NASA-STD-8719.13B, using any hazards identified in the PHA and Safety Assessment Report (SAR). *(CCR 00051B)*
IMAR1118	5.1.2.0-5	The contractor **shall** document all software safety analyses used to determine software safety critical software. *(CCR 00051B)*
IMAR1119	5.1.2.0-6	For software classified as safety critical, the contractor **shall** identify and document the risk posed by each item in terms of criticality, severity, and likelihood of occurrence. *(CCR 00051B)*
IMAR1120	5.1.2.0-7	The contractor **shall** ensure that software safety requirements development and analysis is performed as described in Section 6.1 of NASA-STD-8719.13B. *(CCR 00051B)*
IMAR1121	5.1.2.0-8	Software safety requirements, both generic and specific, **shall** be clearly identified as such in the Software Requirements Specification. *(CCR 00051B)*

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IMAR1122	5.1.2.0-9	In cases where the contractor cannot meet a software safety requirement and/or feels that it is not in the best interest of the project to implement, the contractor **shall** document these items in a waiver request, detailing the justification to support the waiver. *(CCR 00051B)*
IMAR1123	5.1.2.0-10	The contractor **shall** iteratively perform system and software safety analyses over the life of the system as the system is better defined or changes are made. *(CCR 00051B)*
IMAR279	5.1.3	**5.1.3 Verification and Validation**
IMAR280	5.1.3.0-1	The contractor **shall** implement a Verification and Validation (V&V) program to ensure that software being developed or maintained satisfies functional and other requirements at each stage of the development process and that the final product meets customer requirements.
IMAR281	5.1.3.0-2	To assist in the V&V of software requirements, the contractor **shall** develop and maintain under configuration control a Software Requirements Verification Matrix.
IMAR282	5.1.3.0-3	This matrix **shall** document the flow-down of each requirement to the test case and test method used to verify compliance and the test results.
IMAR284	5.1.3.0-4	The Matrix **shall** be incorporated in the overall System Performance Verification Plan and the System Performance Verification Matrix.
IMAR283	5.1.3.0-5	The contractor **shall** install and operate identical flight software on flight and test hardware.
IMAR285	5.1.4	**5.1.4 Independent Verification and Validation**
IMAR286	5.1.4.0-1	NASA will perform an Independent Verification and Validation (IV&V) effort.
IMAR287	5.1.4.0-2	This will require, but is not limited to, access to all software reviews and reports, contractor plans and procedures, software code, software design documentation, and software problem reporting data.
IMAR288	5.1.4.0-3	Wherever possible, the contractor **shall** permit electronic access to the required information or furnish soft copies of requested information to NASA IV&V personnel.
IMAR289	5.1.4.0-4	The contractor **shall** review and assess all NASA IV&V findings and recommendations.
IMAR290	5.1.4.0-5	The contractor **shall** take necessary corrective action based upon their assessment and notify NASA of this corrective action.
IMAR291	5.1.4.0-6	The contractor **shall** also notify NASA of those instances where they decided not to take corrective action on specific IV&V findings and recommendations.
IMAR292	5.1.4.0-7	Detailed justification **shall** be provided if no corrective action is proposed for software critical items.
IMAR293	5.2	**5.2 Peer Reviews**
IMAR294	5.2.0-1	Software peer reviews (e.g., design walkthroughs or code inspections) **shall** be implemented in accordance with the Project Review Requirements section of the SOW.
IMAR295	5.3	**5.3 Software Configuration Management**
IMAR296	5.3.0-1	The contractor **shall** develop and implement a Software Configuration Management (SCM) system that provides baseline management and control of software requirements, design, source code, data, and documentation.
IMAR297	5.3.0-2	As part of the SCM, the contractor **shall** employ a source code version control tool to check in/check out current or previous versions of a source file.

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IMAR298	5.3.0-3	As part of the SCM system, the contractor **shall** document, create and maintain a Software Configuration Control Board (SCCB) to classify, manage, assess and control all changes.
IMAR299	5.3.0-4	Class 1 changes **shall** be forwarded to GSFC for approval. Class 1 changes are defined to include those which impact System requirements, System safety, System reliability, Software requirements, Software safety, and external interfaces.
IMAR300	5.3.0-5	Class 2 changes **shall** be dispositioned by the contractor, but made available to GSFC for review and concurrence of classification in accordance with the SOW.
IMAR301	5.3.0-6	SCCB class 1 and class 2 changes **shall** be delivered in accordance with the CDRL.
IMAR302	5.4	**5.4 Software Problem Reporting and Corrective Action**
IMAR303	5.4.0-1	The contractor **shall** implement a process for Software Problem Reporting and Corrective Action that addresses reporting, analyzing and correcting software nonconformances throughout the development lifecycle.
IMAR304	5.4.0-2	The contractor's QMS **shall** provide for a corrective action process that tracks every software nonconformance to its final disposition.

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IMAR305	6	**6 Workmanship Standards**
IMAR306	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.
IMAR316	6.0-2	The following standards in their entirety (or alternates submitted as described in IMAR308) 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 Electrrical 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 Printed Wiring Board (PWB) Design: f) IPC-2221, Generic Standard on Printed Board Design g) IPC-2222, Sectional Design Standard for Rigid Organic Printed Boards h) IPC-2223, Sectional Design Standard for Flexible Printed Boards Printed Wiring Board Manufacture: i) IPC-6011, Generic Performance Specification for Printed Boards j) 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. *(CCR 00075)* k) IPC-6013, Qualification and Performance Specification for Flexible Printed Boards
IMAR307	6.0-3	It is recognized that contractors may wish to use similar but not identical workmanship standards, procedures and training. *(CCR 00142)*
IMAR309	6.0-4	Any such alternatives **shall** be accompanied by a comparison to the standards in IMAR316 and a discussion of significant differences and rationale for use.
IMAR308	6.0-5	Where differences are proposed, alternate standards **shall** be submitted to the GOES-R Project office at least 120 days prior to use. *(CCR 00142)*
IMAR317	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.

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IMAR319	6.1	**6.1 Ground Systems That Interface With Space Flight Hardware**
IMAR320	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. *(CCR 00142)*
IMAR321	6.1.0-2	Connector savers **shall** be used for testing all flight connectors.
IMAR322	6.1.0-3	Mate/Demate logs **shall** be maintained for all flight connectors and connector savers. *(CCR 00142)*
IMAR323	6.2	**6.2 Training and Certification**
IMAR324	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.
IMAR325	6.2.0-2	At a minimum, certification **shall** include successful completion of formal training and demonstrated performance in the appropriate discipline.
IMAR326	6.3	**6.3 Printed Wiring Boards**
IMAR327	6.3.0-1	PWBs **shall** be manufactured in accordance with the Class 3 Requirements in the applicable (Section 6.0)PWB manufacturing standards. *(CCR 00142)*
IMAR328	6.3.0-2	The contractor **shall** provide PWB coupons to GSFC Systems Assurance Manager (SAM) or a GSFC approved laboratory for evaluation.
IMAR329	6.3.0-3	Approval **shall** be obtained prior to population of flight PWBs.
IMAR330	6.3.0-4	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.
IMAR1114	6.3.0-5	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. *(CCR 00079)*
IMAR333	6.4	**6.4 Handling**
IMAR334	6.4.0-1	Handling (including storage) procedures **shall** be instituted to prevent part and material degradation.
IMAR335	6.4.0-2	The handling procedures **shall** be retained through inspection, kitting, and assembly and **shall** be identified on "build to" documentation.
IMAR336	6.4.0-3	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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IMAR336	6.4.0-3	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 susceptible to damage by electrostatic discharge. k) Unique parts and materials criteria.
IMAR1132	6.4.0-4	All materials contacting the flight hardware **shall** meet the requirements for contamination control. *(CCR 00075)*
IMAR337	6.5	**6.5 Preservation and Packaging**
IMAR338	6.5.0-1	Preservation and packaging **shall** be in accordance with the item packaging requirements and NPR 6000.1. *(CCR 000064)*.
IMAR339	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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IMAR340	7	# 7 Parts Requirements
IMAR342	7.1	## 7.1 General
IMAR343	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.
IMAR344	7.1.0-2	The program **shall** be in place in time to effectively support the design and selection processes.
IMAR345	7.1.0-3	All parts **shall** be selected, processed, and derated in accordance with GSFC EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and Derating.
IMAR1136	7.1.0-4	Parts for primary instruments **shall** be to the requirements for part quality level 1.
IMAR1137	7.1.0-5	Parts for non-primary instruments **shall** be to the requirements for part quality level 2.
IMAR346	7.1.0-6	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.
IMAR347	7.1.0-7	The Contractor **shall** control the selection, application, evaluation, and acceptance of all parts through a Parts Control Board (PMCB), or another documented system of parts control that is approved by the GOES-R project.
IMAR348	7.1.0-8	The Contractor **shall** prepare a Parts and Materials Control Plan (PMCP) describing the approach and methodology for implementing the Parts and Materials Control Program.
IMAR349	7.1.0-9	PMCP **shall** also define the Contractor's criteria for parts selection and approval based on the guidelines of this section.
IMAR350	7.1.0-10	The PMCP **shall** be delivered in accordance with the CDRL.
IMAR351	7.2	## 7.2 Single Point of Contact
IMAR353	7.2.0-1	The Contractor and each Subcontractor **shall** designate a key individual to be their Project Parts Engineer (PPE).
IMAR354	7.2.0-2	The PPE **shall** have the prime responsibility for management of their EEE parts control program.
IMAR355	7.2.0-3	This individual **shall** have direct, independent and unimpeded access to the GOES-R Project PPE and Parts Control Board.

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IMAR356	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 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 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.
IMAR357	7.3	**7.3 Parts and Materials Control Board (PMCB)**
IMAR358	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.
IMAR359	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.
IMAR360	7.3.0-3	In addition the PMCB **shall** review and approve materials for use on the instrument in accordance with materials section of the IMAR.
IMAR361	7.3.0-4	PMCB operating procedures **shall** be included as part of the PMCP.
IMAR362	7.3.1	**7.3.1 PMCB Responsibilities**
IMAR364	7.3.1.0-1	The PMCB **shall** be responsible for: a) Evaluation of EEE parts for conformance to established criteria and inclusion in the PAPL, b) Review and approve EEE part derating as necessary for unique applications, c) Define testing requirements, d) Review non-preferred applications (including radiation effects), e) Track part failure investigations and nonconformances.
IMAR365	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 Program at NASA for resolution.
IMAR366	7.3.2	**7.3.2 PMCB Meetings and Notification**
IMAR368	7.3.2.0-1	The GOES-R Project Parts Engineer will participate in all PMCB meetings and **shall** be notified in advance of all upcoming meetings.

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IMAR369	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 GSFC within five (5) working days of convening the meeting.
IMAR370	7.3.2.0-3	The GOES-R Project will retain the right to overturn decisions involving nonconformances within five working days after receipt of meeting minutes.
IMAR371	7.3.2.0-4	The Contractor PPE **shall** notify attendees at least five (5) days in advance of upcoming meetings as a goal.
IMAR372	7.3.2.0-5	Notification **shall** as a minimum, include a proposed agenda and Parts Identification List (PIL) of candidate parts.
IMAR373	7.3.3	**7.3.3 PMCB Membership**
IMAR374	7.3.3.0-1	As a minimum, the PMCB voting membership **shall** consist of the Instrument Contractor, Subcontractors, GOES-R Project Parts Engineer (PPE) and GOES-R Project Radiation Engineer (RE) and the GOES-R Materials Engineer (ME).
IMAR375	7.3.3.0-2	The Contractor PPE and GSFC GOES-R Project Parts Engineer will participate in all PMCB meetings.
IMAR378	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.
IMAR380	7.4	**7.4 Part Selection And Processing**
IMAR381	7.4.1	**7.4.1 General**
IMAR382	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.
IMAR383	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.
IMAR384	7.4.2	**7.4.2 Selection**
IMAR385	7.4.2.0-1	For primary instruments, parts selected from the NASA Parts Selection List (NPSL) for quality level 1 are preferred. For non-primary instruments, parts listed as quality level 2 are acceptable.
IMAR386	7.4.2.0-2	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. *(CCR 00103)*
IMAR387	7.4.3	**7.4.3 Radiation Requirements for Part Selection**
IMAR388	7.4.3.0-1	All parts **shall** be selected to perform their function in their intended application for a 2X 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.
IMAR389	7.4.3.0-2	The radiation environment poses three main risks to active parts that must be considered during part selection:
IMAR390	7.4.3.1	**7.4.3.1 Total Ionizing Dose (TID)**
IMAR391	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.

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IMAR392	7.4.3.1.0-2	Linear bipolar parts **shall** be assumed to be ELDR susceptible unless the parts have been successfully tested and shown to be insensitive.
IMAR393	7.4.3.2	**7.4.3.2 Displacement Damage**
IMAR394	7.4.3.2.0-1	Parts **shall** be selected to ensure their adequate performance in the application up to a dose of 2x the expected mission displacement damage dose. As an example, for silicon devices, and assuming shielding equivalent to 100 mils aluminum, parts must be able to withstand a minimum fluence equivalent to 2.68×10^{12} Protons/cm^2 (Si) at an equivalent energy level of 50 MeV without system-level degradation. Again, because of the dominance of electrons in geostationary orbit, displacement damage decreases rapidly with added shielding up to at least the first 300 mils Al equivalent.
IMAR395	7.4.3.3	**7.4.3.3 Single-Event Effects (SEE)**
IMAR396	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 instrument system.
IMAR397	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.
IMAR398	7.4.3.3.0-3	Parts susceptible to Single Event Latch up (SEL) should be avoided.
IMAR399	7.4.3.3.0-4	NOTE: 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 RE and PPE and the project RE and PPE before the part can be added to the PAPL. *(CCR 00062)*
IMAR401	7.4.3.3.0-5	Applied voltages for power MOSFETs, FETs and bipolar junction transistors **shall** be in the safe operating ranges for these devices.
IMAR402	7.4.4	**7.4.4 Custom or Advanced Technology Devices**
IMAR403	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.
IMAR404	7.4.4.0-2	The design review **shall** address items such as element analysis and, when necessary - packaging, qualification, and screening requirements. *(CCR 00038)*
IMAR1098	7.4.4.0-3	The GSFC Materials Branch **shall** be consulted to evaluate differences in coefficients of thermal expansion between materials.
IMAR405	7.4.4.0-4	A Customer Source Inspection may be required.
IMAR406	7.4.4.0-5	A procurement specification may be required for parts in this category based on the recommendation of the PPE.
IMAR407	7.4.4.0-6	If a procurement specification is generated it **shall** fully identify the item being procured. *(CCR 00080)*
IMAR1099	7.4.4.0-7	A specification **shall** include physical, mechanical, electrical, and environmental test requirements and quality assurance provisions necessary to control manufacture and acceptance. *(CCR 00080)*
IMAR408	7.4.4.0-8	If screening requirements are included in the procurement specification, these requirements **shall** include test conditions, burn-in circuits, failure criteria, and lot rejection criteria. *(CCR 00080)*
IMAR409	7.4.4.0-9	For lot acceptance or rejection, the Percentage of Defectives Allowable (PDA) in a screened lot **shall** be in accordance with EEE-INST-002.

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IMAR1133	7.4.4.0-10	If the screening 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. *(CCR 00080)*
IMAR410	7.4.5	**7.4.5 Plastic Encapsulated Microcircuits (PEMs)**
IMAR411	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 NASA GSFC Supplement to GFSC EEE-INST-002, *INSTRUCTIONS FOR* PLASTIC ENCAPSULATED MICROCIRCUITS (PEMs) SELECTION, SCREENING AND QUALIFICATION.
IMAR412	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.
IMAR1082	7.4.5.0-3	Final approval for the use of the PEM(s) **shall** be obtained from the GOES-R Project Office.
IMAR413	7.4.6	**7.4.6 Verification Testing**
IMAR414	7.4.6.0-1	Re-performance of 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.
IMAR415	7.4.6.0-2	If required, testing **shall** be performed in accordance with EEE-INST-002 or as determined by the PMCB.
IMAR417	7.4.7	**7.4.7 Parts Approved on Prior Programs**
IMAR418	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.
IMAR419	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. d) No new information has become available which would preclude the use of the previously approved part in a high reliability space flight application.
IMAR420	7.4.8	**7.4.8 Parts Used in Off-the-Shelf Assemblies**
IMAR421	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.
IMAR422	7.4.8.0-2	The parts **shall** be evaluated for screening compliance to EEE-INST-002, established reliability level, and include a radiation analysis.
IMAR423	7.4.8.0-3	Units may be required to undergo modification for use of higher reliability parts or Radiation hardened parts.

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IMAR424	7.4.8.0-4	All parts **shall** be subject to PMCB approval.
IMAR425	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 RE approval.
IMAR427	7.5	**7.5 Value Added Testing**
IMAR428	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 (Section 7.8).
IMAR429	7.5.0-2	Unless otherwise specified, testing **shall** be in accordance with the test methods referenced in EEE-INST-002.
IMAR430	7.5.1	**7.5.1 Particle Impact Noise Detection (PIND)**
IMAR431	7.5.1.0-1	All EEE devices with internal cavities (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. *(CCR 00034)*
IMAR432	7.5.1.0-2	Any device failing this screen **shall** not be used in any flight application.
IMAR433	7.5.2	**7.5.2 Capacitors**
IMAR434	7.5.2.1	**7.5.2.1 Surge Current Screening for Tantalum Capacitors**
IMAR435	7.5.2.1.0-1	All solid tantalum capacitors used in filtering applications **shall** be subjected to surge current screening.
IMAR436	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. *(CCR 00060)*
IMAR1138	7.5.2.1.0-3	For a primary instrument, chip devices **shall** be tested in accordance with Option B of the specification.
IMAR1139	7.5.2.1.0-4	For a non-primary instrument, chip devices **shall** be tested in accordance with Option A of the specification. Parts may be ordered from the manufacturers with this testing by adding the appropriate symbol ("A" or "B") as the last character of the military part number.
IMAR437	7.5.2.1.0-5	For a primary instrument, 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). *(CCR 00060)*
IMAR1140	7.5.2.1.0-6	For a non-primary instrument, leaded devices **shall** receive surge current testing in accordance with MIL-PRF-39003/9, Capacitor, Fixed, Electrolytic (Solid Electrolyte) Tantalum, (Polarized Sintered Slug), High Frequency, Established Reliability Styles CSR21.
IMAR438	7.5.2.2	**7.5.2.2 Dielectric Screening for Ceramic Capacitors**
IMAR439	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.

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IMAR440	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).
IMAR1141	7.5.2.2.0-3	For a primary instrument, the sample size **shall** be 12 pieces with zero failures (12 (0)) for each lot/date code.
IMAR1142	7.5.2.2.0-4	For a non-primary instrument, the sample size **shall** be 5 pieces with zero failures (5/(0)) for each lot/date code.
IMAR441	7.5.2.2.0-5	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. *(CCR 00061)*
IMAR442	7.5.3	**7.5.3 Screening for Magnetic Components**
IMAR444	7.5.3.0-1	Custom magnetic devices (transformers and inductors) **shall** be assembled and screened to the requirements of MIL-STD-981, Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications. *(CCR 00079)*
IMAR1143	7.5.3.0-2	For use in a primary instrument, the parts **shall** meet the requirements for Class S.
IMAR1144	7.5.3.0-3	For use in a non-primary instrument, the parts **shall** meet the requirements for Class B. 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. The testing of any such devices **shall** be defined in the requirements for the printed circuit board or the next higher level assembly.
IMAR445	7.5.3.0-4	Burn-in screening **shall** be considered based on vendor history, performance stability requirements, device complexity, and application criticality.
IMAR446	7.5.3.0-5	Simple toroidal coils with one layer of windings may be exempted from burn in unless required by the core manufacturer to stabilize its properties, and such decisions require PMCB documentation and approval.
IMAR447	7.6	**7.6 Part Analysis**
IMAR449	7.6.1	**7.6.1 Destructive Physical Analysis**
IMAR450	7.6.1.0-1	A sample of each lot date code of microcircuits, hybrid microcircuits, EMI filters, relays, capacitors, oscillators, and semiconductor devices **shall** be subjected to a Destructive Physical Analysis (DPA) based on PMCB recommendation.
IMAR451	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.
IMAR452	7.6.1.0-3	DPA tests, procedures, sample size and criteria **shall** be as specified in GSFC specification S-311-M-70.
IMAR453	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.
IMAR454	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.
IMAR455	7.6.2	**7.6.2 Failure Analysis**

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IMAR456	7.6.2.0-1	The Contractor **shall** perform part Failure Analysis essential to achieve a timely resolution and closeout of each failure incident.
IMAR457	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.
IMAR458	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.
IMAR459	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.
IMAR460	7.6.2.0-5	Radiation data **shall** be submitted where it is deemed pertinent to the failure mechanism.
IMAR461	7.7	**7.7 Additional Requirements**
IMAR462	7.7.1	**7.7.1 Parts Age and Storage Control**
IMAR463	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.
IMAR464	7.7.1.0-2	Alternate test plans may be used as approved by the PMCB on a case-by case basis.
IMAR465	7.7.1.0-3	Parts taken from user inventory older than 5 years do not require re screen, provided they have been properly stored.
IMAR466	7.7.1.0-4	Parts over 10 years old from the date of manufacture to date of procurement **shall** not be procured. *(CCR 00059)*
IMAR467	7.7.2	**7.7.2 Derating**
IMAR468	7.7.2.0-1	All EEE parts **shall** be used in accordance with the derating guidelines of EEE-INST-002.
IMAR469	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. *(CCR 00058)*
IMAR470	7.7.2.0-3	The Contractor **shall** maintain documentation on parts derating analysis and make it available for GSFC review.
IMAR471	7.7.3	**7.7.3 Traceability**
IMAR473	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.

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IMAR475	7.7.3.0-2	Also, 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.
IMAR477	7.7.3.0-3	All flight EEE parts **shall** be traceable to the lot date code or the manufacturer's inspection lot code. *(CCR 00032)*
IMAR478	7.7.3.0-4	Traceability **shall** be maintained throughout manufacturing for each deliverable item.
IMAR1113	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. *(CCR 00032)*
IMAR483	7.7.4	**7.7.4 Prohibited Metals**
IMAR484	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.
IMAR485	7.7.4.0-2	Only alloys containing less than 97% tin are acceptable.
IMAR486	7.7.4.0-3	The use of cadmium or zinc is prohibited in the construction and surface finish of space hardware.
IMAR487	7.7.4.0-4	All cadmium alloys or zinc alloys (e.g. brass) **shall** be completely over plated with an approved metal.
IMAR489	7.7.5	**7.7.5 Supplier and Manufacturer Surveillance (Monitoring)**
IMAR490	7.7.5.0-1	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.
IMAR491	7.7.5.0-2	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.
IMAR492	7.7.5.0-3	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.
IMAR493	7.7.6	**7.7.6 Re-use of Parts and Materials**
IMAR494	7.7.6.0-1	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.
IMAR495	7.8	**7.8 Parts Lists**
IMAR496	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.
IMAR498	7.8.0-2	Clear distinctions **shall** be made as to parts approval status and whether parts are planned for use in flight hardware.

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IMAR499	7.8.0-3	Parts **shall** be approved for listing on the PAPL or PIL before initiation of procurement activity. *(CCR 00057)*
IMAR500	7.8.1	**7.8.1 Program Approved Parts List (PAPL)**
IMAR501	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.
IMAR502	7.8.1.0-2	Only parts that have been evaluated and approved by the PMCB **shall** be listed in the PAPL.
IMAR503	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 IMAR513)
IMAR504	7.8.2	**7.8.2 Parts Identification List (PIL)**
IMAR505	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.
IMAR506	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.
IMAR507	7.8.3	**7.8.3 As-Designed Parts List (ADPL)**
IMAR508	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.
IMAR509	7.8.3.0-2	The ADPL **shall** follow the Parts Lists Required Fields Table (IMAR513). *(CCR 00031)*
IMAR1083	7.8.3.0-3	The Contractor **shall** submit the final version of the ADPL in accordance with the CDRL.
IMAR510	7.8.4	**7.8.4 As-Built Parts List (ABPL)**
IMAR511	7.8.4.0-1	An As-Built Parts List (ABPL) **shall** also be prepared and submitted in accordance with the CDRL.
IMAR512	7.8.4.0-2	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 IMAR513).
IMAR513	7.8.4.0-3	Parts Lists Required Fields Table.

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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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IMAR515	7.9.1	**7.9.1 General**
IMAR516	7.9.1.0-1	Attributes (parametric test) summary data **shall** be available to GSFC for all testing performed.
IMAR517	7.9.1.0-2	Variable data (read and record) **shall** be recorded for initial, interim and final electrical test points.
IMAR518	7.9.1.0-3	Test data **shall** be available to GSFC.
IMAR519	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.
IMAR520	7.9.1.0-5	Variables data acquired during radiation testing **shall** be available to GSFC.
IMAR521	7.9.2	**7.9.2 Retention of Data and Test Samples**
IMAR522	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.
IMAR523	7.9.2.0-2	The data **shall** be kept on file in order to facilitate future risk assessment and technical evaluation, as needed.
IMAR524	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.
IMAR525	7.9.2.0-4	PIND test failures may be submitted for DPA, radiation testing or used in engineering models.
IMAR526	7.9.2.0-5	Parts and data **shall** be retained for the useful life of the instrument unless otherwise permitted by the PMCB.
IMAR527	7.9.2.0-6	All historical quality records and those data required to support these records **shall** be retained until contract completion.
IMAR528	7.9.3	**7.9.3 End Item Acceptance Data Package**
IMAR529	7.9.3.0-1	The Instrument Contractor PPE **shall** establish and maintain an EEE parts data package for each instrument produced under the contract. *(CCR 00056)*
IMAR530	7.9.3.0-2	The data package **shall** identify and include all parts in the instrument. *(CCR 00056)*
IMAR531	7.9.3.0-3	Each instrument 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 instrument. *(CCR 00056)*

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IMAR543	8	# 8 Materials, Processes, and Lubrication Requirements
IMAR545	8.1	## 8.1 General
IMAR546	8.1.0-1	The Contractor **shall** prepare a Materials and Processes Plan and integrate that plan with the Parts and Materials Control Plan described above.
IMAR547	8.1.0-2	Materials and lubrication approval by the PMCB is required for each usage or application in space-flight hardware.
IMAR1100	8.1.0-3	The contractor **shall** submit the as-designed Materials and Lubrication List in accordance with the CDRL.
IMAR1084	8.1.0-4	The Contractor **shall** submit the as-built Materials and Lubrication List in accordance with the CDRL.
IMAR548	8.2	## 8.2 Materials Selection Requirements
IMAR549	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.
IMAR550	8.2.0-2	The suitability and durability of materials used for parts **shall** be established on the basis of flight experience or tests.
IMAR551	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.
IMAR552	8.2.0-4	Furthermore, material selection **shall** take into account the effects of environmental conditions expected during the life of the instrument.
IMAR1085	8.2.0-5	Materials **shall** be corrosion resistant or be suitably treated to resist corrosion when subjected to the specified environments.
IMAR553	8.2.0-6	Where practicable, fungus inert materials **shall** be used.
IMAR554	8.2.1	## 8.2.1 Compliant Materials
IMAR555	8.2.1.0-1	The Contractor **shall** use compliant materials in the fabrication of hardware to the extent practicable.
IMAR556	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. *(CCR 00074A)*
IMAR557	8.2.1.0-3	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 IMAR600, Stress Corrosion Evaluation Form IMAR601 and Polymeric Materials and Composites Usage Lists IMAR 615), be submitted to GSFC for approval in accordance with the CDRL.

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IMAR558	8.2.1.0-4	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. *(CCR 00066)*
IMAR559	8.2.1.1	**8.2.1.1 Materials Used in "Off-the-Shelf-Hardware"**
IMAR560	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.
IMAR561	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
IMAR562	8.2.2	**8.2.2 Conventional Applications**
IMAR563	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.
IMAR564	8.2.3	**8.2.3 Non-conventional Applications**
IMAR565	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 and Lubrication Report so that it may fully understand and approve the application.
IMAR566	8.2.4	**8.2.4 Polymeric Materials**
IMAR567	8.2.4.0-1	The Contractor **shall** prepare and submit a polymeric materials and composites usage list or the Contractor's equivalent. Refer to Polymeric Materials and Composites Usage List IMAR615.
IMAR568	8.2.4.1	**8.2.4.1 Flammability and Toxic Offgassing**
IMAR569	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. *(CCR 00074A)*
IMAR570	8.2.4.2	**8.2.4.2 Vacuum Outgassing**
IMAR571	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. In such cases, material approval is contingent upon lot testing.
IMAR572	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. *(CCR 00074A)*
IMAR573	8.2.4.3	**8.2.4.3 Shelf-Life-Controlled Materials**
IMAR574	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.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR575	8.2.4.3.0-2	Materials such as o-rings, rubber seals, tape, uncured polymers, lubricated bearings and paints **shall** be included.
IMAR576	8.2.4.3.0-3	The use of materials whose date code has expired **shall** be approved by the PMCB. *(CCR 00067)*
IMAR577	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. *(CCR 00067)*
IMAR578	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 CDRL. *(CCR 00067)*
IMAR579	8.2.5	**8.2.5 Inorganic Materials**
IMAR580	8.2.5.0-1	The Contractor **shall** prepare and document an inorganic materials and composites usage list (Inorganic Materials and Composites Usage List IMAR616) or the Contractor's equivalent.
IMAR581	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.
IMAR582	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. *(CCR 00074A)*
IMAR583	8.2.5.0-4	An MUA **shall** be submitted for each material usage from table 2 or table 3 of the MSFC STD-3029 requirements. *(CCR 00074A)*
IMAR584	8.2.5.0-5	Additionally, for GSFC to approve usage of individual materials, a stress corrosion evaluation form, as discussed in IMAR601 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.
IMAR585	8.2.5.1	**8.2.5.1 Fasteners**
IMAR586	8.2.5.1.0-1	The Contractor **shall** prepare a Fastener Control Plan.
IMAR587	8.2.5.1.0-2	The plan **shall** be included in the PMCP.
IMAR588	8.2.5.1.0-3	The PMCB will approve all flight fasteners as part of the parts and materials list approval process.
IMAR589	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. *(CCR 00074A)*
IMAR590	8.2.5.1.0-5	Material test reports for fastener lots **shall** be retained and made available for government inspection.
IMAR591	8.2.5.1.0-6	Fasteners made of plain carbon or low alloy steel **shall** be protected from corrosion.
IMAR592	8.2.5.1.0-7	When plating is specified, it **shall** be compatible with the space environment.
IMAR593	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.
IMAR594	8.2.5.2	**8.2.5.2 Locking Features**
IMAR595	8.2.5.2.0-1	Each removable bolt, screw, nut, pin or other removable fastener **shall** use a locking feature.
IMAR596	8.2.5.3	**8.2.5.3 Dissimilar Metals**

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR597	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.
IMAR598	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.
IMAR599	8.2.5.3.0-3	Composite materials containing graphite fibers **shall** be treated as graphite in MIL-STD-889.
IMAR600	8.2.5.3.0-4	Material Usage Agreement Form

<table>
<tr><td colspan="4">MATERIAL USAGE AGREEMENT</td><td colspan="3">USAGE AGREEMENT NO.:</td><td>PAGE OF</td></tr>
<tr><td colspan="2">PROJECT:</td><td>SUBSYSTEM:</td><td colspan="3">ORIGINATOR:</td><td colspan="2">ORGANIZATION:</td></tr>
<tr><td colspan="2">DETAIL DRAWING</td><td>NOMENCLATURE</td><td colspan="2">USING ASSEMBLY</td><td colspan="2">NOMENCLATURE</td></tr>
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<tr><td colspan="4">MATERIAL & SPECIFICATION</td><td colspan="4">MANUFACTURER & TRADE NAME</td></tr>
<tr><td colspan="4"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">USAGE</td><td rowspan="2">THICKNESS</td><td rowspan="2">WEIGHT</td><td rowspan="2">EXPOSED AREA</td><td colspan="4">ENVIRONMENT</td></tr>
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<tr><td colspan="8">RATIONALE:</td></tr>
<tr><td colspan="4">ORIGINATOR:</td><td colspan="3">PROJECT MANAGER:</td><td>DATE:</td></tr>
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IMAR601	8.2.5.3.0-5	

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR601 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: _____

IMAR603 8.2.6 **8.2.6 Lubrication**

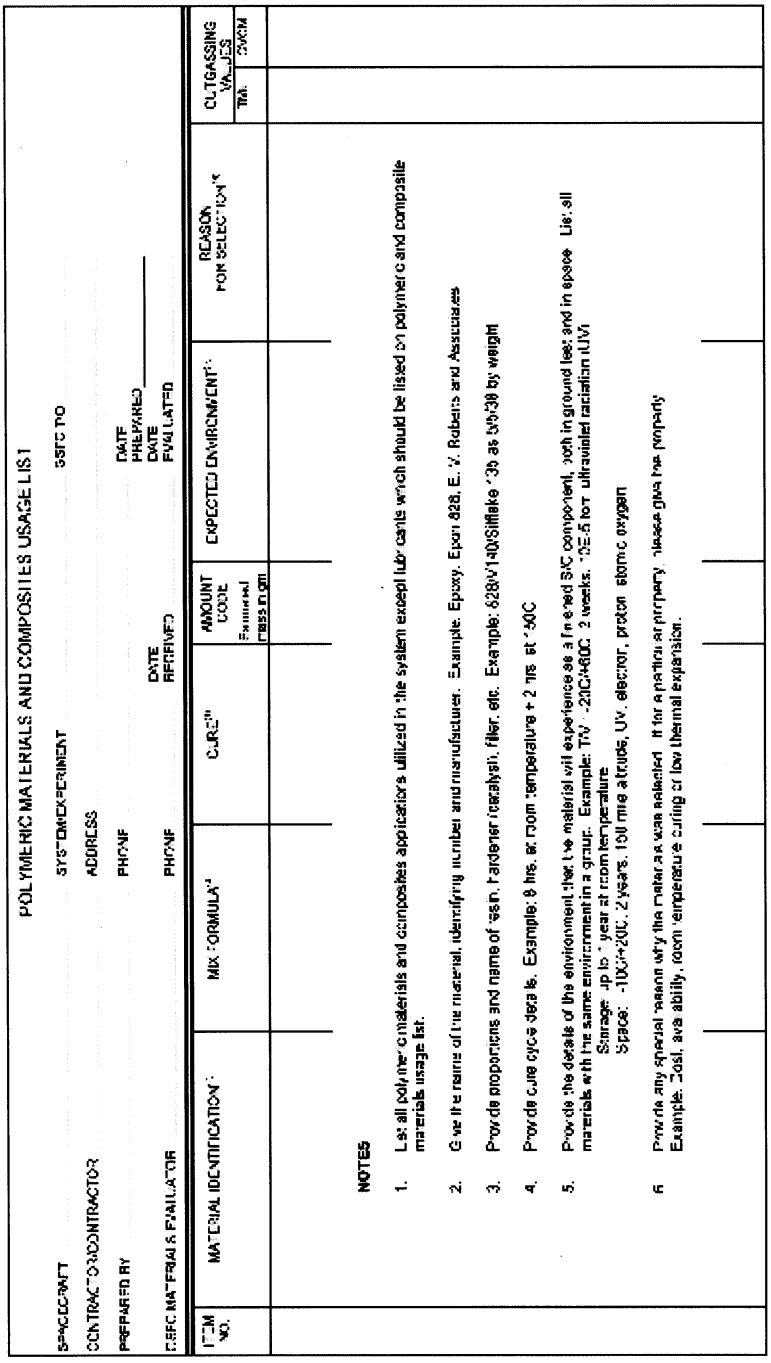
IMAR604 8.2.6-1 The Contractor **shall** prepare and document a lubrication usage list (Lubrication Usage List IMAR617) or the Contractor's equivalent. *(CCR 00074A)*

IMAR605 8.2.6-2 The list **shall** be submitted to the PMCB for approval. The Contractor may be requested to submit supporting applications data. *(CCR 00074A)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR606	8.2.6-3	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. *(CCR 00074A)*
IMAR607	8.2.6-4	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. *(CCR 00074A)*
IMAR608	8.3	**8.3 Process Selection Requirements**
IMAR609	8.3.0-1	The Contractor **shall** prepare and document a material process utilization list or the Contractor's equivalent (Materials Process Utilization List IMAR618).
IMAR610	8.3.0-1.0-1	A copy of any process **shall** be submitted for review upon request.
IMAR611	8.3.0-1.0-1.0-1	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.
IMAR612	8.4	**8.4 Procurement Requirements**
IMAR613	8.4.1	**8.4.1 Purchased Raw Materials**
IMAR614	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.
IMAR615	8.4.1.0-2	Polymeric Materials and Composites Usage List

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR615 8.4.1.0-2



POLYMERIC MATERIALS AND COMPOSITES USAGE LIST

SPACECRAFT SYSTEM/EXPERIMENT SSFC NO

CONTRACTOR/CONTRACTOR ADDRESS

PREPARED BY PHONE DATE PREPARED

SSFC MATERIALS EVALUATOR PHONE DATE RECEIVED DATE EVALUATED

ITEM NO.	MATERIAL IDENTIFICATION[1]	MIX FORMULA[2]	CURE[3]	AMOUNT USED (Estimated mass in gm)	EXPECTED ENVIRONMENT[4]	REASON FOR SELECTION[5]	OUTGASSING VALUES TML	CVCM

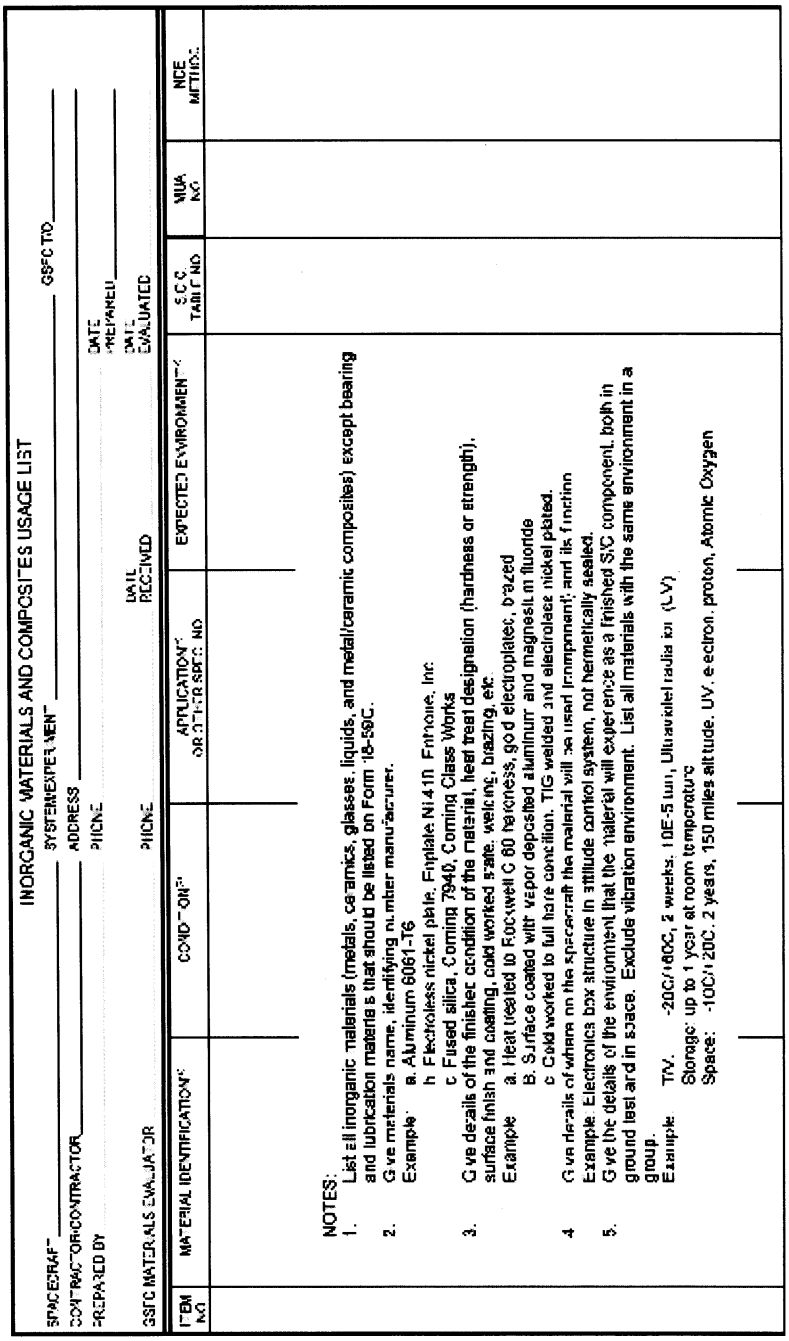
NOTES

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: TV: -20C/+60C 2 weeks. 10E-5 torr ultraviolet radiation (UV)
   Storage: up to 1 year at room temperature
   Space: -100/+20C, 2 years, 100 mile altitude, UV, electron, proton atomic oxygen
6. Provide any special reasons why the material was selected. If for aesthetic or property, please give the property. Example: Cost, available, room temperature curing or low thermal expansion.

IMAR616 8.4.1.0-3 Inorganic Materials and Composites Usage List *(CCR 00086)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR616 8.4.1.0-3



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/ORIENTATION/SURFACE NO	EXPECTED ENVIRONMENT[3]	S.C.C. TABLE NO	WUA NO	NCE 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 18-59C.
2. Give materials name, identifying number, manufacturer.
   Example: a. Aluminum 6061-T6
   b. Electroless nickel plate, Finplate Ni 411, Finnone, Inc.
   c. Fused silica, Corning 7940, Corning Glass 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 hard condition. TIG welded and electroless nickel plated.
4. Give details of where on the spacecraft the material will be used (component) 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 (UV)
   Storage: up to 1 year at room temperature
   Space: -10C/+20C, 2 years, 150 miles altitude, UV, electron, proton, Atomic Oxygen

IMAR617 8.4.1.0-4 Lubrication Usage List *(CCR 00086)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR617	8.4.1.0-4	

LUBRICATION USAGE LIST

SPACECRAFT	SYSTEM/EXPERIMENT	GSFC T/O
DEVELOPER/CONTRACTOR	ADDRESS	
PREPARED BY	PHONE	DATE PREPARED
GSFC MATERIALS EVALUATOR ________	PHONE ________ DATE RECEIVED ________	DATE EVALUATED ________

ITEM NO.	COMPONENT TYPE, SIZE MATERIAL[1]	COMPONENT MANUFACTURER & MFR. IDENTIFICATION	PROPOSED LUBRICATION SYSTEMS AMT OF LUBRICANT	TYPE & NO. OF WEAR CYCLES[2]	SPEED, TEMP., ATM OF OPERATION[3]	TYPE OF LOADS & AMT.[4]	OTHER DETAILS[5]

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) CUR = 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(<10^2), B(10^2-10^3), C(10^3-10^5), D(>10^5)

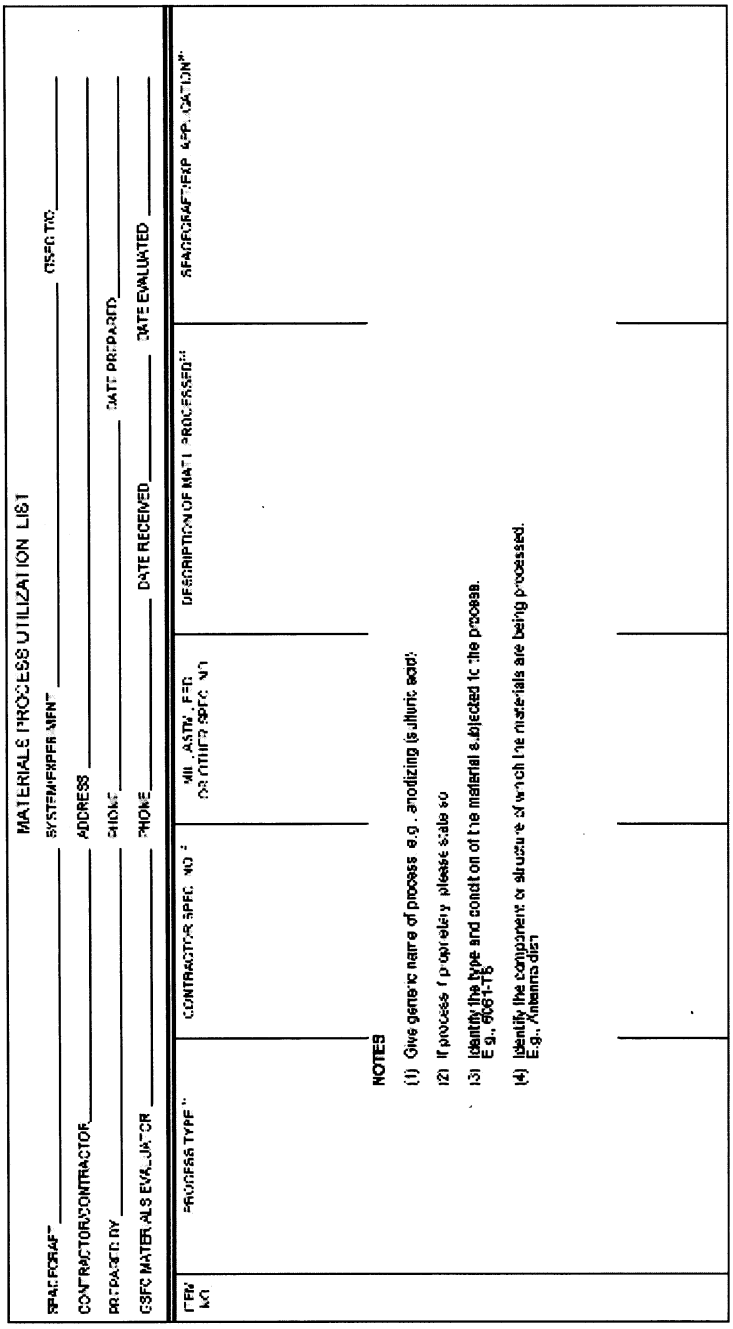
(3) Speed: RPM = revs/min., OPM = oscillations/min., VS = variable speed, CPM = cm/min. (sliding applications)
Temp. of operation, max & min., °C
Atmosphere: vacuum, air, gas, sealed or unsealed & pressure

(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.

IMAR618	8.4.1.0-5	Materials Process Utilization List *(CCR 00086)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR618	8.4.1.0-5	



MATERIALS PROCESS UTILIZATION LIST

SPACECRAFT _____ SYSTEM/PROGRAM _____ DISPOSITION _____

CONTRACTOR/SUBCONTRACTOR _____ ADDRESS _____

PREPARED BY _____ PHONE _____ DATE PREPARED _____

GSFC 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 is 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-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR619	9	# 9 Design Verification Requirements
IMAR620	9.1	## 9.1 General
IMAR621	9.1.0-1	The following requirements represents 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. A system performance verification program documenting the overall verification plan, implementation, and results is required 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.
IMAR622	9.2	## 9.2 System Performance Verification Plan and Matrix
IMAR623	9.2.0-1	A System Performance Verification Plan and Matrix, **shall** be prepared and delivered in accordance with the CDRL.
IMAR639	9.3	## 9.3 Criteria for Unsatisfactory Performance
IMAR640	9.3.1	## 9.3.1 General
IMAR641	9.3.1.0-1	Failure (see definitions) or significant change, in performance of any test item **shall** be documented and processed in accordance with the following.
IMAR1101	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.
IMAR642	9.3.1.1	### 9.3.1.1 Failure
IMAR643	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.
IMAR644	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.
IMAR645	9.3.1.2	### 9.3.1.2 Failure with Retroactive Effect
IMAR646	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.
IMAR647	9.3.1.3	### 9.3.1.3 Failure Reporting
IMAR648	9.3.1.3.0-1	Every failure **shall** be recorded and reported in accordance with the failure reporting provisions of Section 2.
IMAR649	9.3.1.4	### 9.3.1.4 Wear Out
IMAR650	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 or 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.
IMAR665	9.4	## 9.4 Environmental Verification Specification

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR666	9.4.0-1	An Environmental Verification Specification **shall** be prepared that defines the specific environmental parameters that each hardware element is subjected to either by test or analysis in order to demonstrate its ability to meet the mission performance requirements.
IMAR667	9.4.0-2	The Environmental Verification Specification **shall** be delivered in accordance with the CDRL.
IMAR668	9.5	**9.5 Performance Verification Procedures**
IMAR669	9.5.0-1	For each verification test activity conducted at the unit, subsystem or instrument level (or other appropriate levels) of assembly, a Performance Verification Procedure **shall** be prepared that describes the configuration of the device under test, and how each test activity contained in the verification plan and specification will be implemented.
IMAR670	9.5.0-2	Performance Verification Procedures **shall** be delivered in accordance with the CDRL.
IMAR671	9.5.0-3	Performance Verification procedures **shall** contain details such as instrumentation monitoring, facility control sequences, and device under test functions, test parameters, pass/fail criteria, quality control checkpoints, data collection and reporting requirements.
IMAR672	9.5.0-4	The procedures also **shall** address safety and contamination control provisions.
IMAR673	9.6	**9.6 Verification Reports**
IMAR674	9.6.0-1	After each unit or instrument environmental test activity has been completed, a report **shall** be submitted to GSFC.
IMAR675	9.6.0-2	For each analysis activity, the report **shall** describe the degree to which the objectives were accomplished, how well the mathematical model was validated by related test data, and other such significant results.
IMAR676	9.6.0-3	In addition, as-run verification procedures and all test and analysis data **shall** be retained for review.
IMAR677	9.6.0-4	Verification Reports **shall** be delivered in accordance with the CDRL.
IMAR678	9.7	**9.7 System Performance Verification Report**
IMAR679	9.7.0-1	At the conclusion of the performance verification program, a final System Performance Verification Report **shall** be delivered that compares the hardware/software specifications with the final verified values (whether measured or computed).
IMAR680	9.7.0-2	The System Performance Verification Report **shall** be maintained "real-time" throughout the program summarizing the successful completion of verification activities, and showing that the applicable system performance specifications have been acceptably complied with prior to integration of hardware/software into the next higher level of assembly.
IMAR681	9.7.0-3	The System Performance Verification Report **shall** be delivered in accordance with the CDRL.
IMAR682	9.8	**9.8 Electrical Functional and Performance Test Requirements**
IMAR683	9.8.1	**9.8.1 General**
IMAR684	9.8.1.0-1	The following paragraphs describe the required electrical functional and performance tests that verify the instrument operation before, during, and after performance and environmental testing. These tests along with all other calibrations, functional/performance tests, measurements/alignments (and alignment verifications), etc., that are part of the overall verification program **shall** be described in the System Performance Environmental Verification Plan.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR685	9.8.2	**9.8.2 Electrical Interface Tests**
IMAR686	9.8.2.0-1	Before the integration of an assembly, unit or subsystem into the next higher hardware assembly, electrical interface tests **shall** be performed to verify that all interface signals are within acceptable limits of applicable performance specifications.
IMAR687	9.8.2.0-2	Prior to mating with other hardware, electrical harnessing **shall** be tested to verify proper characteristics; such as routing of electrical signals, impedance, isolation, and overall workmanship.
IMAR688	9.8.3	**9.8.3 Comprehensive Performance Tests**
IMAR689	9.8.3.0-1	The comprehensive performance test (CPT) **shall** be a detailed demonstration that the hardware and software meet their performance requirements within allowable tolerances.
IMAR690	9.8.3.0-2	The test **shall** demonstrate operation of all redundant and cross-strapped circuitry and satisfactory performance in all operational modes.
IMAR691	9.8.3.0-3	The initial CPT at ambient temperature prior to the start of the environmental test program **shall** serve as a baseline against which the results of all later CPTs can be readily compared.
IMAR693	9.8.3.0-4	CPT's **shall** be repeated at the conclusion of major environmental tests of each level of assembly.
IMAR694	9.8.3.0-5	At the instrument system level, the CPT **shall** demonstrate that, with the application of known stimuli, the instrument will produce the expected response.
IMAR695	9.8.3.0-6	At lower levels of assembly, the test **shall** demonstrate that, when provided with appropriate inputs, internal performance is satisfactory and outputs are within acceptable limits.
IMAR697	9.8.4	**9.8.4 Limited Performance Tests**
IMAR698	9.8.4.0-1	A Limited Performance Test (LPT) is a subset of the CPT. It demonstrates the aliveness, addressability, and response of all units including primary and redundant sides. The instrument response during LPT **shall** be recorded for comparison and tracking of critical parameters and for insight and characterizing instrument health.
IMAR701	9.8.5	**9.8.5 Performance Operating Time and Trouble-Free Performance Testing**
IMAR702	9.8.5.0-1	A minimum of one-thousand (1000) hours of operating/powered-on time **shall** be accumulated on all flight electronic hardware prior to shipping the instrument.
IMAR1086	9.8.5.0-2	Powered on time **shall** be divided between primary and redundant electronics.
IMAR703	9.8.5.0-3	At the conclusion of the performance verification program, instruments **shall** have demonstrated trouble-free performance testing for at least the last 350 hours of operation prior to instrument shipment.
IMAR1102	9.8.5.0-4	Trouble-free performance testing time **shall** be divided between primary and redundant electronics.
IMAR704	9.8.5.0-5	Trouble-free operation **shall** include 200 hours during the thermal-vacuum test with 100 hours being logged at the hot-dwell temperature and 100 hours being logged at the cold-dwell temperature.
IMAR1087	9.8.5.0-6	Trouble-free operation during thermal vacuum test **shall** be divided between primary and redundant electronics.

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IMAR706	9.8.6	**9.8.6 Limited-Life Electrical Parts**
IMAR707	9.8.6.0-1	A life test program **shall** be conducted for electrical parts that have limited lifetimes.
IMAR708	9.8.6.0-2	The Life Test Plan **shall** address the life test program, identifying the electrical and electromechanical parts that require such testing, describing the test hardware that will be used, and the test methods that will be employed.
IMAR709	9.9	**9.9 Structural and Mechanical Verification Requirements**
IMAR710	9.9.1	**9.9.1 General Requirements**
IMAR711	9.9.1.0-1	The contractor **shall** demonstrate compliance with structural and mechanical requirements with a series of interdependent tests and analysis activities.
IMAR712	9.9.1.0-2	The demonstrations **shall** qualify the design and demonstrate margins using specified factors of safety, ensure interface compatibility, acceptable workmanship, and compliance with both Atlas V and Delta IV interface and safety requirements.
IMAR1152	9.9.2	**9.9.2 Mechanical Test Factors and Duration**
IMAR1153	9.9.2.0-1	The project **shall** employ the mechanical test factors and durations in accordance with Section 2.2.4 of GSFC-STD-7000. For pressurized glass elements, the qualification test factor is 2.0, and the acceptance test factor is 1.25.
IMAR1155	9.9.3	**9.9.3 Minimum Workmanship**
IMAR1156	9.9.3.0-1	All electrical, electronic, and electro-mechanical components **shall** be subjected to minimum workmanship test levels as specified in GSFC-STD-7000 Section 2.4.2.6.
IMAR1157	9.9.4	**9.9.4 Testing in Flight Configuration**
IMAR1158	9.9.4.0-1	Mechanical environmental testing of flight hardware **shall** be performed with the test article in its appropriate configuration.
IMAR1159	9.9.4.0-2	Hardware powered on for launch **shall** be powered on for testing.
IMAR1160	9.9.5	**9.9.5 Structural Proof Testing**
IMAR1161	9.9.5.0-1	Primary and secondary structures fabricated from nonmetallic composites, beryllium, or containing bonded joints or bonded inserts **shall** be proof tested in accordance with GSFC-STD-7000 Section 2.4.1.4.1.
IMAR1162	9.9.6	**9.9.6 Model Survey Characterization**
IMAR1163	9.9.6.0-1	Modes up to 75 Hz and with more than 5% predicted modal mass participation **shall** have frequencies verified by test. *(CCR 00218)*
IMAR1187	9.9.6.0-2	Predicted frequencies of these modes **shall** correlate to test frequencies within 5%. *(CCR 00218)*
IMAR1188	9.9.6.0-3	Modes below 50 Hz and with more than 5% predicted modal mass participation **shall** be verified by modal survey. *(CCR 00218)*
IMAR1189	9.9.6.0-4	Cross-orthogonality checks of these test and analytical mode shapes, with respect to the analytical mass matrix, **shall** be performed with the requirement of obtaining at least 0.9 on diagonal terms and no greater than 0.1 off-diagonal. *(CCR 00218)*

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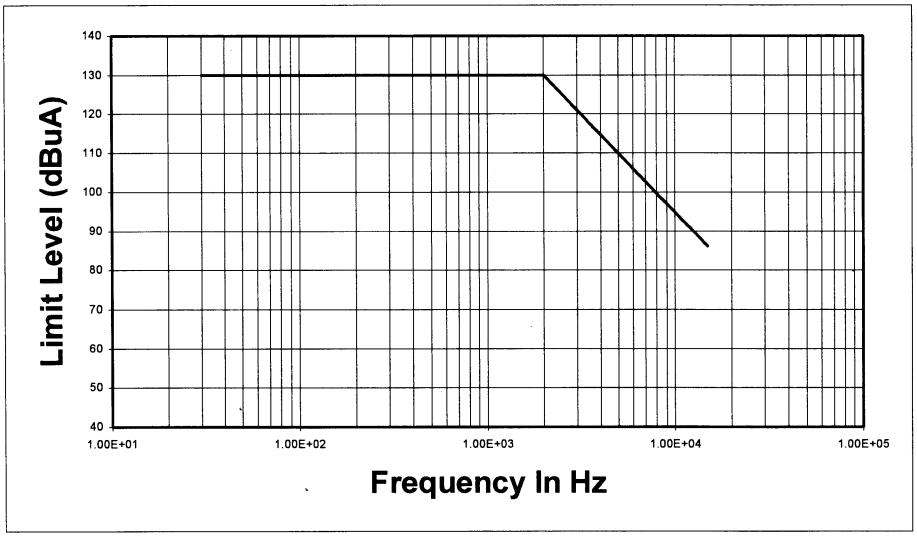
IMAR1164	9.9.6.0-5	The instrument contractor **shall** determine by loads and jitter analysis the critical modal parameters.
IMAR1165	9.9.6.0-6	The instrument contractor **shall** measure by test the critical modal parameters of the structure.
IMAR1166	9.9.6.0-7	The measured modal parameters **shall** be used to verify and update the loads and jitter performance.
IMAR1167	9.9.7	**9.9.7 Structural Qualification**
IMAR1168	9.9.7.0-1	Structural tests that demonstrate that flight hardware is compatible with expected mission environments **shall** be conducted in compliance with GSFC-STD-7000 Section 2.4.
IMAR1169	9.9.7.0-2	Any glass elements with bonds **shall** be qualified with a non-flight prototype.
IMAR1170	9.9.7.0-3	The number of qualification tests on a non-flight prototype **shall** be greater than or equal to the planned number of acceptance tests performed on any flight unit.
IMAR1171	9.9.7.0-4	The test durations **shall** have a tolerance of plus 5 seconds and minus zero.
IMAR1172	9.9.7.0-5	The qualification tests **shall** reduce the input levels as necessary to prevent the unit interface forces from exceeding the yield limits defined in the instrument ICD.
IMAR1173	9.9.7.0-6	The acceptance tests **shall** reduce the input levels as necessary to prevent the interface forces from exceeding the flight limits defined in the instrument ICD.
IMAR1174	9.9.7.0-7	Vibration tests **shall** be performed to provide test data sufficient to update structural models, to compute responses to launch loads using updated models, and to verify margins against yield and ultimate strength requirements in the 50.1 to 100 Hz frequency range. *(CCR 00082A)*
IMAR1175	9.9.7.0-8	For shock isolated units, the lower frequency limit of the input shock spectrum **shall** be less than 0.7 times the frequency of the first natural mode of the isolated unit.
IMAR1176	9.9.8	**9.9.8 Deployment and Articulation Verification**
IMAR1177	9.9.8.0-1	All flight deployables, movable appendages, and mechanisms **shall** demonstrate full range of motion and articulation under worst-case conditions prior to flight.
IMAR1178	9.9.9	**9.9.9 Life Test**
IMAR1179	9.9.9.0-1	Except for active cryogenic cooling systems, a life test **shall** be conducted, within representative operational environments, to at least 2x expected life for all repetitive motion devices with a goal of completing 1x expected life by CDR.
IMAR1180	9.9.9.0-2	For active cryogenic cooling systems, the total operating time or number of operational cycles without failure **shall** be at least 1.0 times mission life with 0.5 times mission life completed prior to the scheduled launch date of the first flight model.
IMAR1181	9.9.10	**9.9.10 Mechanical Clearance Verification**
IMAR1182	9.9.10.0-1	Verification of mechanical clearances and margins including potential reduced clearances after blanket expansion **shall** be performed on the final as-built hardware.
IMAR795	9.10	**9.10 Electromagnetic Compatibility Requirements**
IMAR796	9.10.1	**9.10.1 General**

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR797	9.10.1.0-1	The instrument and its units **shall** not generate electromagnetic interference that could adversely affect its own performance or the performance and operation of other units on the spacecraft, or the launch vehicle and launch site.
IMAR798	9.10.1.0-2	An EMC/EMI Compatibility Plan **shall** be prepared and delivered in accordance with the CDRL.
IMAR799	9.10.1.0-3	The instrument **shall** not be susceptible to emissions that could adversely affect its performance and safety. This applies whether the emissions are intentional or non-intentional.
IMAR800	9.10.1.0-4	The qualification and flight acceptance tests for the EMC program are the same. The EMC test program is intended to uncover workmanship defects and unit-to-unit variation in electromagnetic characteristics, as well as design flaws. Performance of the qualification and acceptance test programs will provide a margin of hardware reliability. The EMC requirements described below also apply to all previously qualified hardware.
IMAR801	9.10.2	**9.10.2 Safety and Controls**
IMAR802	9.10.2.0-1	Spurious signals that lie above specified testing limits **shall** be eliminated.
IMAR803	9.10.2.0-2	Spurious signals (i.e. Any unintentional out of band signals that are a direct or indirect product of one or more oscillators) that are below specified limits **shall** be analyzed to determine if a subsequent change in frequency or amplitude is possible; if it is possible, the spurious signals should be eliminated to protect the spacecraft and instruments from the possibility of interference. *(CCR 00232)*
IMAR804	9.10.2.0-3	Retest **shall** be performed to verify that intended solutions are effective.
IMAR805	9.10.3	**9.10.3 Conducted Emission Requirements**
IMAR806	9.10.3.0-1	Conducted emission limits on power leads **shall** be applied to instrument hardware as defined below.
IMAR807	9.10.3.1	**9.10.3.1 Power Leads Conducted Emissions *(CCR 00078A) (CCR 00146B)***
IMAR808	9.10.3.1.0-1	Narrowband conducted emission on power and power-return leads **shall** be limited to the levels specified in the Conducted Emissions on Instrument Power Leads Figures (IMAR1128 /IMAR811). *(CCR 00078A)*
IMAR1125	9.10.3.1.1	**9.10.3.1.1 Conducted Emissions (30Hz to 9.999kHz) *(CCR 00078A) (CCR 00146B)***
IMAR1126	9.10.3.1.1.0-1	Testing for the control of electromagnetic interference characteristics of subsystems and equipment in the 30Hz to 9.999kHz frequency range **shall** be in accordance with MIL-STD-461E, section 5.4.3 (CE101 test procedure). *(CCR 00078A) (CCR 00146B)*
IMAR1127	9.10.3.1.1.0-2	The test bandwidth **shall** be as indicated in MIL-STD-461E, Table II. *(CCR 00078A) (CCR 00146B)*
IMAR1128	9.10.3.1.1.0-3	

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR1128 9.10.3.1.1.0-3 **Conducted Emissions on Instrument Power Leads Figure (30Hz to 9.999kHz)** ***(CCR 00078A) (CCR 00146B)***

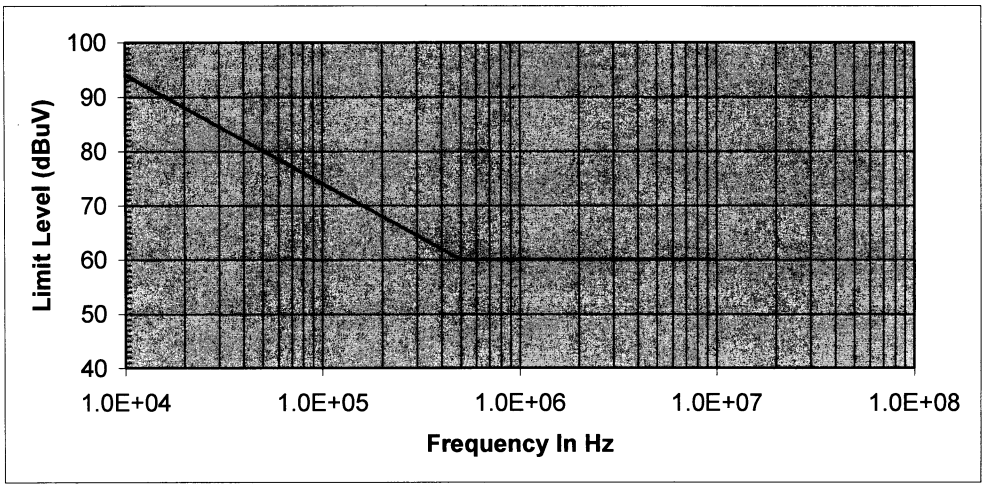


IMAR1130 9.10.3.1.2 **9.10.3.1.2 Conducted Emissions (CE102)** *(CCR 00078A)*

IMAR809 9.10.3.1.2.0-1 Testing **shall** be in accordance with MIL-STD-461E, Requirements for the control of electromagnetic Interference Characteristics of Subsystems and Equipment, test number CE102 (10 KHz to 50 MHz). *(CCR 00078A)*

IMAR810 9.10.3.1.2.0-2 The measurement bandwidth **shall** be as indicated in Table II in MIL-STD-461E. *(CCR 0078A)*

IMAR811 9.10.3.1.2.0-3 Conducted Emissions on Instrument Power Leads Figure (CE102) *(CCR 00006) (CCR 00078A)*

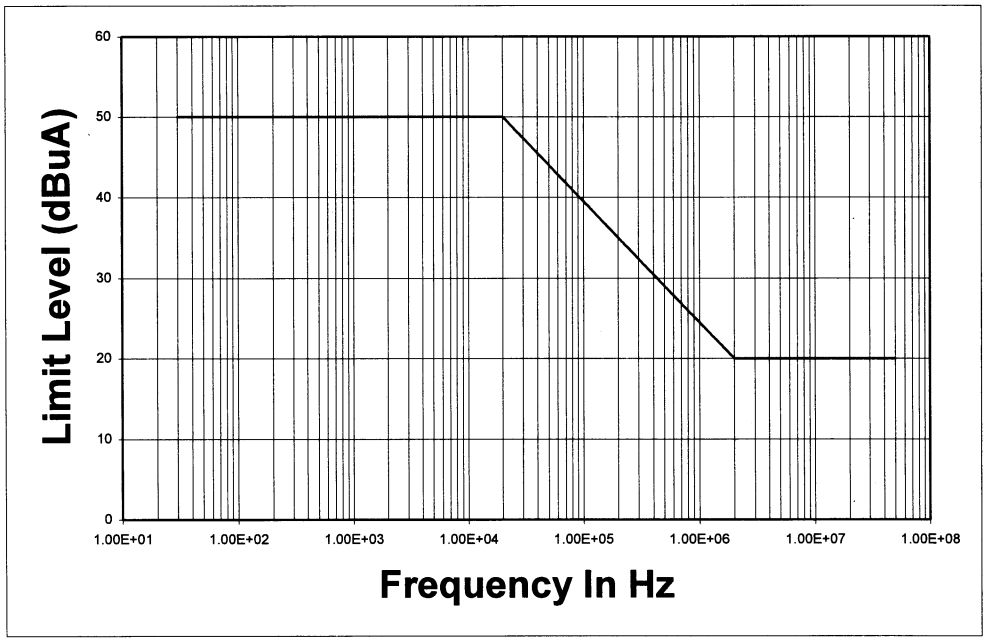


IMAR812 9.10.4 **9.10.4 Common Mode Noise**

IMAR816 9.10.4.1 **9.10.4.1 Common Mode Noise (Frequency Domain)**

IMAR817 9.10.4.1.0-1 Conducted emission common mode noise in the frequency domain **shall** be limited to the levels specified in the Power Lead Common Mode Noise Figure (IMAR820).

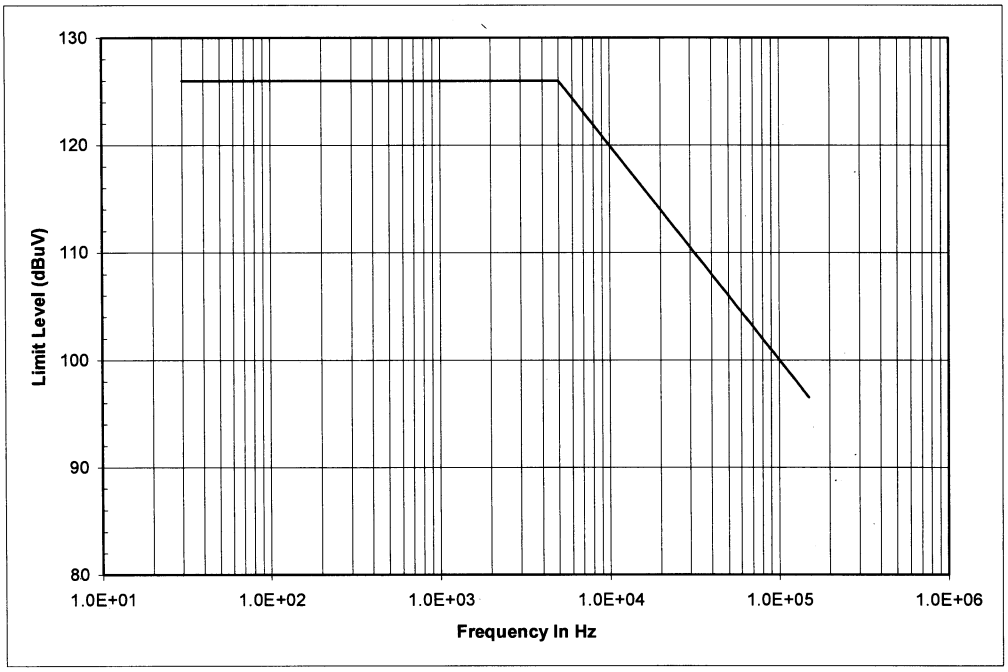
ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR818	9.10.4.1.0-2	The test procedure used for this test **shall** be in accordance with MIL-STD-461 test number CE101.
IMAR819	9.10.4.1.0-3	In the test required by IMAR818, the probe **shall** be placed around both the positive and return leads.
IMAR820	9.10.4.1.0-4	Power Lead Common Mode Noise Figure



IMAR821	9.10.5	**9.10.5 Conducted Susceptibility, Power Leads (CS101 30 Hz to 150 KHz)**
IMAR822	9.10.5.0-1	The instrument **shall** not exhibit any malfunction, degradation of performance, or deviations from instrument specifications beyond the allowable tolerances, when subjected to an injection probe drive level which has been pre-calibrated to the appropriate current limit shown in the Conducted Susceptibility for Power Leads Figure (IMAR824).
IMAR823	9.10.5.0-2	The test procedure used for this test **shall** be in accordance with MIL-STD-461, CS101.
IMAR824	9.10.5.0-3	Conducted Susceptibility for Power Leads Figure

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR824 9.10.5.0-3



IMAR825 9.10.6

9.10.6 Conducted Susceptibility, Bulk Cable Injection (CS114 10 KHz to 200 MHz)

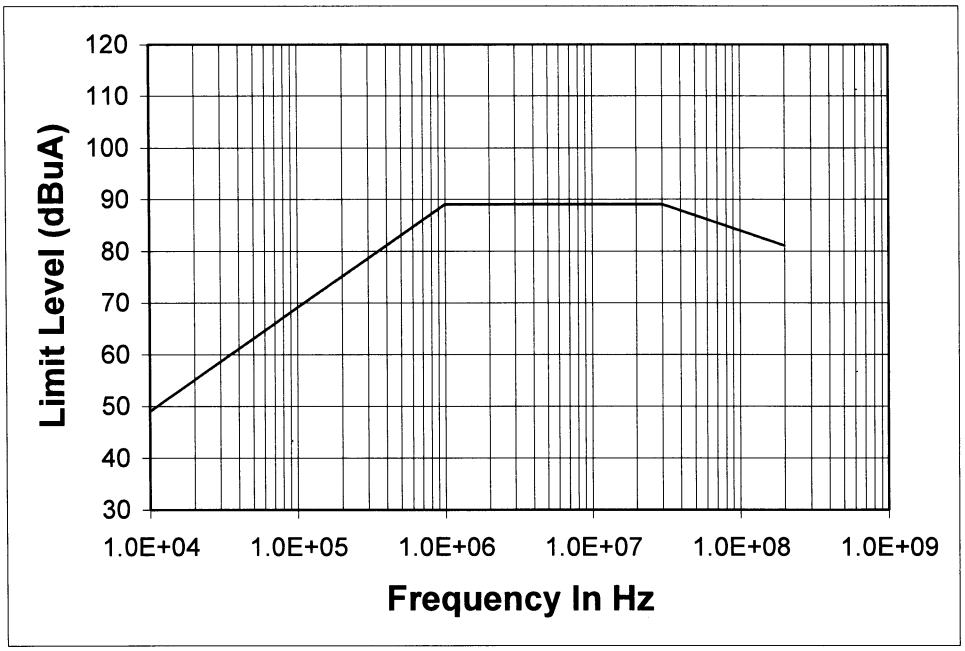
IMAR826 9.10.6.0-1 The instrument **shall** not exhibit any malfunction, degradation of performance, or deviation from instrument specifications beyond allowable tolerances, when subjected to an injection probe drive level onto the power leads which has been pre-calibrated to the appropriate current limit shown in the Conducted Susceptibility for Power Leads, Bulk Current Injection Figure (IMAR831).

IMAR828 9.10.6.0-2 The test procedures used for these tests **shall** be accordance with MIL-STD-461 Rev E, CS114. *(CCR 00004)*

IMAR831 9.10.6.0-3 Conducted Susceptibility for Power Leads, Bulk Current Injection Figure

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR831 9.10.6.0-3



IMAR830 9.10.7

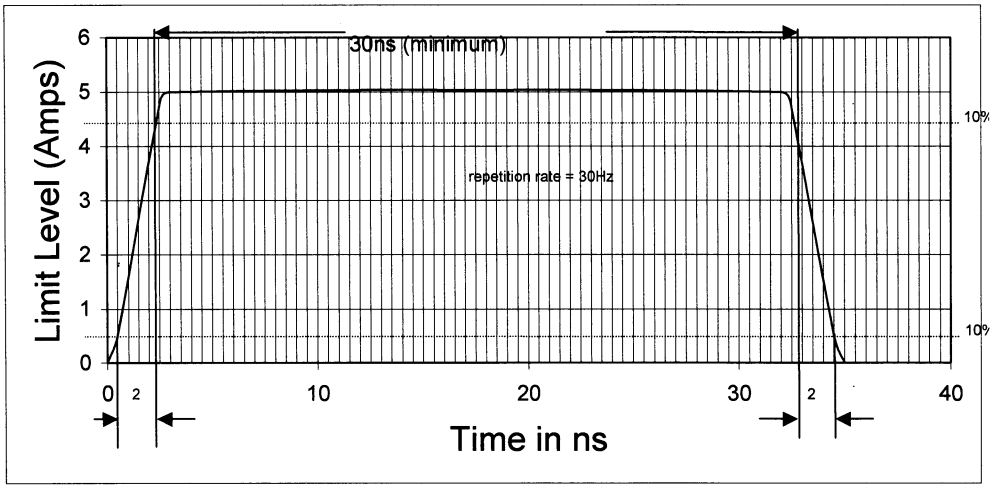
9.10.7 Conducted Susceptibility, Bulk Injection, Impulse Excitation (CS 115)

IMAR832 9.10.7.0-1 The instrument **shall** not exhibit any malfunction, degradation of performance, or deviation from instrument specifications beyond allowable tolerances, when subjected to a pre-calibrated signal having rise and fall times, pulse width, and amplitude as specified in the Conducted Susceptibility, Current Test, Impulse Excitation Figure (IMAR836) at a 30 Hz rate for one minute.

IMAR833 9.10.7.0-2 This test signal **shall** be injected onto the power leads of the instrument.

IMAR835 9.10.7.0-3 The test procedure used for this test **shall** be in accordance with MIL-STD-461 Rev E, CS 115. *(CCR 00004)*

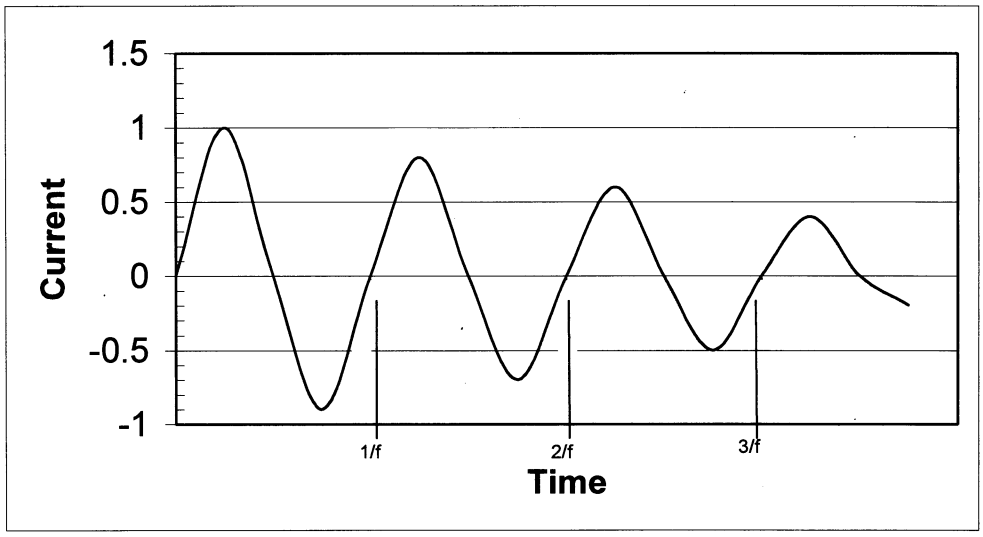
IMAR836 9.10.7.0-4 Conducted Susceptibility, Current Test, Impulse Excitation Figure



ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR837	9.10.8	**9.10.8 Conducted Susceptibility, Damped Sinusoidal Transients, Cable and Power Leads (CS116 10 KHz to 100 MHz)**
IMAR838	9.10.8.0-1	The instrument **shall** not exhibit any malfunction, degradation of performance, or deviation from instrument specifications beyond allowable tolerances, when subjected to a signal having the waveform shown in the Power Lead Conducted Susceptibility, Damped Sinusoidal Transient Figure and having a maximum current as specified in the Maximum Current for the Damped Sinusoidal Transient Figure. The criteria for this test is described below: a) The test signal will be injected onto the power leads of the instrument. b) The indicated test limit is applicable across the entire specified frequency range. c) As a minimum, compliance will be demonstrated at the following frequencies: 0.01, 0.1, 1.0, 10.0, 30.0 and 100 MHz. d) The test procedure used for this test will be accordance with MIL-STD-461 Rev E, CS116 *(CCR 00004)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR846 9.10.8.0-2 Power Lead Conducted Susceptibility, Damped Sinusoidal Transient Figure



Notes for the Power Lead Conducted Susceptibility, Damped Sinusoidal Transient Figure.

a) Normalized waveform: $e^{-(\pi ft)/Q}\text{Sin}\,(2\pi ft)$

Where: f= Frequency (Hz)
t= Time (sec)
Q= Damping factor, 15 ± 5

b) Damping factor (Q) will be determined as follows: $Q= \pi\,(N-1)/\ln\,(IP/IN)$

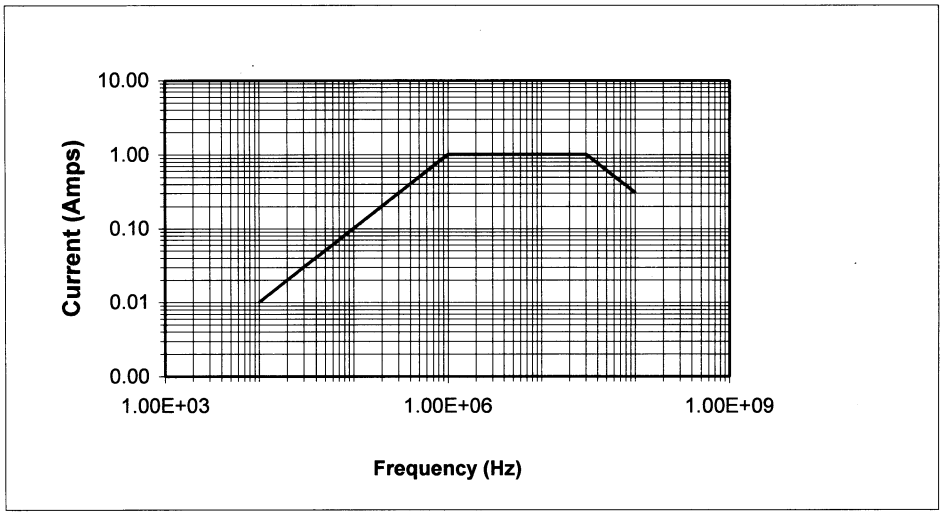
Where: Q= Damping factor
N= Cycle number (i.e., N= 2,3,4,5,….)
IP= Peak, current at the first cycle
IN=Peak current at cycle closest to 50 % decay
ln= Natural log

c) IP is as specified in the Maximum Current for the Damped Sinusoidal Transient Figure (IMAR847).

IMAR847 9.10.8.0-3 Maximum Current for the Damped Sinusoidal Transient Figure

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR847 9.10.8.0-3



IMAR848 9.10.9

9.10.9 Radiated Emissions

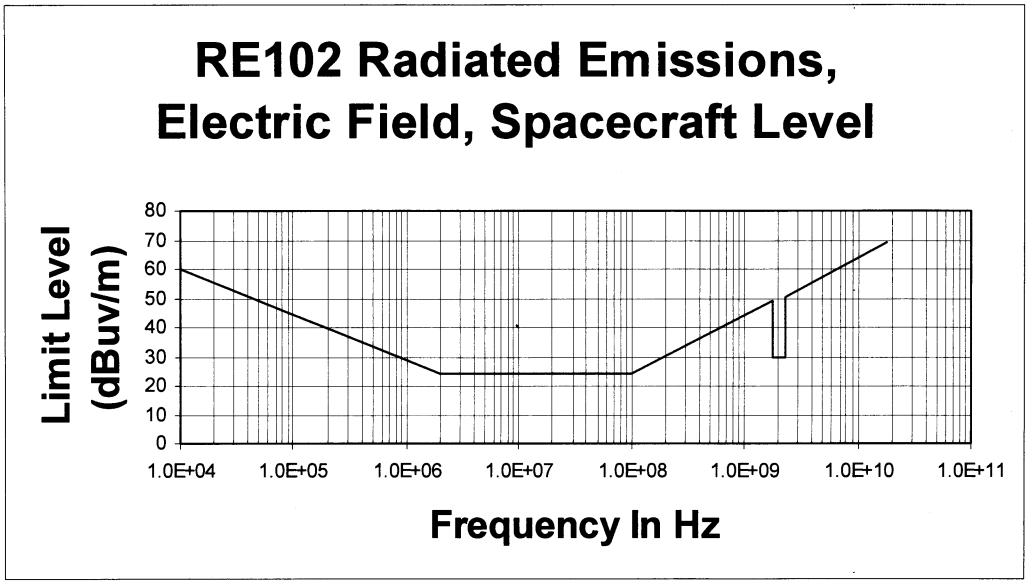
IMAR850 9.10.9.1

9.10.9.1 Radiated Emissions, Electric Field (RE 102)

IMAR851 9.10.9.1.0-1

Radiated narrow band electric field levels generated by the instrument **shall** not exceed the levels specified in the Radiated Emissions, Electric Field Figure below except for the SAR and DCS Receiver bands specified in IMAR860. *(CCR 00337)*

Radiated Emission, Electric Field Figure



(CCR 00337)

IMAR852 9.10.9.1.0-2

The test procedure used for this test **shall** be in accordance with MIL-STD-461, RE102.

IMAR854 9.10.10

9.10.10 Radiated Emissions in SAR and DCS Receiver Bands

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR855	9.10.10.0-1	Radiated emission measurements in the SAR and DCS receiver bands **shall** be made in accordance with MIL-STD-461, RE102 with the EMI meter replaced by a spectrum analyzer preceded by a low noise pre-amplifier such that the test system noise figure is equal to or less than 3 dB, e.g., an HP-8566 spectrum analyzer preceded by a MITEQ AU-2A-0550 pre-amplifier or equivalent. *(CCR 00337)*
IMAR856	9.10.10.0-2	The spectrum analyzer levels and the difference in the levels **shall** be recorded for both white noise and spurious signals before and after power is applied to the instrument clock and control signals.
IMAR857	9.10.10.0-3	The test antenna **shall** be tuned to the center of each of the two frequency bands specified in the SAR and DCS EMC Test Parameters Table (IMAR862).
IMAR858	9.10.10.0-4	Prior to making the actual measurements, the test antenna **shall** be de-mated and the cable terminated with 50 ohms.
IMAR859	9.10.10.0-5	The noise floor of the measuring equipment **shall** be verified to be lower than the specified maximum signal level in a 100 Hz resolution bandwidth.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR860 9.10.10.0-6 Radiated emission levels generated by the instrument **shall** not exceed the maximum signal levels specified in the SAR and DCS EMC Test Parameters Table below.

SAR (406.000 to 406.100 MHz) and DCS (401.700 to 402.400 -140 MHz) EMC Test Parameters Table

Unit Name	Designated Frequency Band	Measurement Bandwidth (Hz)	Dwell Time (Seconds)	Minimum Measurement Time Analog Measurement Receiver (sec/kHz)	Max. Field Intensity (dBuV/m)
Instrument Electronics Boxes	SAR/DCS	100	.015	0.15	10 (each box)
Magnetosphere Particle Sensor (MPS)	SAR/DCS	100	.015	0.15	-24 (+Z) (per sensor) 10 (-Z)
Geostationary Lightning Mapper (GLM)	SAR/DCS	100	.015	0.15	-24
Solar Galatic Particle Sensor (SGPS)	SAR/DCS	100	.015	0.15	-12.8 (per sensor)
Energetic Heavy Ion Sensor (EHIS)	SAR/DCS	100	.015	0.15	-24 (+Z) 10 (-Z)
Solar Ultraviolet Imager (SUVI)	SAR/DCS	100	.015	0.15	-12.8
EUVS XRS Irradiance Sensors (EXIS)	SAR/DCS	100	.015	0.15	-12.8

(CCR 00337)

IMAR861 9.10.10.0-7 The results of this test **shall** be provided with sufficient sensitivity and resolution to demonstrate that these requirements are met.

IMAR863 9.10.11 **9.10.11 Radiated Susceptibility**

IMAR864 9.10.11.1 **9.10.11.1 Reserved *(CCR 00156)***

IMAR865 9.10.11.1-1 Reserved *(CCR 00156)*

IMAR866 9.10.11.2 **9.10.11.2 Radiated Susceptibility, Launch Environment**

IMAR867 9.10.11.2.0-1 The instrument **shall** be exposed to external electromagnetic field strengths in accordance with MIL-STD-461.

IMAR868 9.10.11.2.0-2 The test **shall** simulate launch environment levels as stated in Table VII of MIL-STD-461.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR869	9.10.12	**9.10.12 Electrostatic Arc-Discharge Susceptibility**
IMAR870	9.10.12.0-1	The instrument **shall** be designed to preclude or minimize the impact of ESD events.
IMAR871	9.10.12.0-2	The instrument **shall** be designed to withstand both a radiated and direct arc as shown in the ESD Characteristics Table (IMAR879) without sustaining permanent damage.
IMAR872	9.10.12.1	**9.10.12.1 External Surface-to-Surface direct discharge**
IMAR873	9.10.12.1.0-1	The direct arc-discharge can occur on any of the exposed surfaces of the instrument. The instrument **shall** not be impaired by differential charging between it's external surfaces.
IMAR875	9.10.12.2	**9.10.12.2 Deep Dielectric Charging**
IMAR876	9.10.12.2.0-1	The instrument **shall** withstand all direct discharges caused by deep dielectric charging (Internal Electrostatic Discharge, IESD). Terminating all unused wires within a harness and terminating all unused pins within connectors will minimize the magnitude of charge build up.
IMAR877	9.10.12.3	**9.10.12.3 ESD Characteristics**
IMAR878	9.10.12.3.0-1	Test or analysis **shall** be used to show that the instrument operation will not be impaired after an arc discharge with the characteristics listed in the ESD Characteristics Table (IMAR879).
IMAR879	9.10.12.3.0-2	ESD Characteristics Table

Item	Description	Characteristics
1	Discharge Voltage	10 kv
2	Discharge Energy	3 millijoules, maximum
3	Peak Current	1 amp
4	Time Constant	600 nsec
5	Repetition Rate	1 sec
6	Quantity of Discharges per Surface	≥ 30
7	Distance of Radiated Discharge from Instrument Surface	30 cm

IMAR880	9.11	**9.11 Radiation Environment**
IMAR881	9.11.1	**9.11.1 General**
IMAR882	9.11.1.0-1	The radiation environment requirements **shall** be as described in 417-R-RPT-0027.
IMAR1090	9.11.1.0-2	The contractor **shall** prepare a Radiation Shielding and Dose Analysis Report in accordance with the CDRL.
IMAR883	9.11.2	**9.11.2 Single Event Effects**
IMAR884	9.11.2.0-1	A Single Event Effects Control Plan **shall** be prepared and delivered in accordance with the CDRL.
IMAR885	9.11.3	**9.11.3 In-Orbit Electro-Static Discharge Control Plan**

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR886	9.11.3.0-1	An In-Orbit Electro-Static Discharge Control Plan **shall** be prepared and delivered in accordance with the CDRL.
IMAR887	9.12	**9.12 Magnetic Properties**
IMAR888	9.12.1	**9.12.1 General**
IMAR889	9.12.1.0-1	The magnetic field test **shall** measure the peak-to-peak change in magnetic field produced by each unit for all instrument operating modes. *(CCR 00042B)*
IMAR892	9.12.1.0-2	Measurements **shall** be made in the X, Y and Z-axis of all units for both primary and redundant configurations. *(CCR 00042B)*
IMAR894	9.12.1.0-3	The measured change in the magnetic field strength will be the difference between the ambient background level of the instrument and the maximum magnetic field induced by the change in the instrument's state.
IMAR895	9.12.1.0-4	A reference probe **shall** be used to exclude anomalous data caused by external events such as opening and closing of doors.
IMAR896	9.12.1.0-5	A Magnetic Control Plan **shall** be prepared and delivered in accordance with the CDRL.
IMAR1190	9.12.1.0-6	The magnetic field test **shall** measure the permanent magnetic field produced by each unit. *(CCR 00330)*
IMAR897	9.13	**9.13 Thermal Requirements**
IMAR898	9.13.1	**9.13.1 General Requirements**
IMAR899	9.13.1.0-1	The thermal vacuum, thermal balance, and humidity requirements herein apply to GOES-R instruments.
IMAR900	9.13.1.0-2	An appropriate set of tests and analyses **shall** be performed to demonstrate IMAR901, IMAR902, IMAR903, IMAR904, IMAR906.
IMAR901	9.13.1.0-3	The instrument **shall** meet performance requirements while operating under vacuum and within test temperature limits including during hot and cold plateaus and transitions
IMAR902	9.13.1.0-4	Instrument thermal design and thermal control system **shall** maintain the affected hardware within the established survival temperatures during non-operating mission phases including launch and ascent.
IMAR903	9.13.1.0-5	Instrument thermal design and thermal control system **shall** maintain the affected hardware within the established Mission Allowable Temperature (MAT) during planned operating mission phases.
IMAR904	9.13.1.0-6	The flight hardware **shall** withstand, the temperature and humidity conditions of integration, transportation, storage, and pre-launch activities as well as launch and flight.
IMAR906	9.13.1.0-7	The quality of workmanship and materials of the hardware **shall** be sufficient to pass thermal cycle test screening in vacuum.
IMAR908	9.13.1.1	**9.13.1.1 Summary of Requirements**
IMAR909	9.13.1.1.0-1	The Thermal Test Verification Methodology Table (IMAR910) summarizes the tests and analyses that collectively will fulfill the General Requirements. Tests noted in the table may require supporting analyses.

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IMAR910 9.13.1.1.0-2 Thermal Test Verification Methodology Table

Requirement	Instrument	Unit
Thermal Vacuum	T	T
Thermal Balance	T and A	T and A
Leakage	L	L
Venting	V	V

T = Test required
A = Analysis, correlate model to TB test
L = Leakage measured during vacuum testing
V = Venting test at performed during chamber pump-down

IMAR911 9.13.1.2 **9.13.1.2 Applicability**

IMAR912 9.13.1.2.0-1 All instrument flight hardware **shall** be subjected to thermal-vacuum testing in order to demonstrate satisfactory operation in modes representative of mission functions at temperatures in excess of the extremes predicted for the mission.

IMAR913 9.13.1.2.0-2 The tests **shall** exercise flight hardware to produce the maximum and minimum dissipation in components including operation over the range of possible applied voltages.

IMAR914 9.13.1.2.0-3 These tests **shall** demonstrate survival mode and survival heater margin, as well as operational heaters and their margin.

IMAR915 9.13.1.3 **9.13.1.3 Test Chronology**

IMAR916 9.13.1.3.0-1 For the testing program to emulate the chronology of mission stresses, the order of tests will generally follow the chronology of mission event stresses.

IMAR917 9.13.1.3.0-2 Instrument-level thermal testing **shall** follow instrument-level mechanical testing.

IMAR918 9.13.1.4 **9.13.1.4 Thermal Test Chronology**

IMAR919 9.13.1.4.0-1 Thermal Balance (TB) and Thermal Vacuum (TV) testing may occur as individual or combined tests. Combined tests must, however, satisfy the requirements of both tests.

IMAR920 9.13.1.4.0-2 Regardless of whether TB is a combined or separate test, TB **shall** precede TV, thereby allowing the TB results to refine the TV plateau temperatures if appropriate. The permissible exception to this is that the first hot plateau may be combined with bake-out prior to TB.

IMAR921 9.13.1.5 **9.13.1.5 Pressure**

IMAR922 9.13.1.5.0-1 The chamber pressure during TB and TV **shall** be maintained at less than 1.33 X 10-3 Pa. (1 X 10-5 torr).

IMAR923 9.13.1.6 **9.13.1.6 Temperature Monitoring and Alarms**

IMAR924 9.13.1.6.0-1 Test article and test equipment temperatures **shall** be monitored throughout the test and have "temperature alarms".

IMAR925 9.13.1.7 **9.13.1.7 Contamination Control**

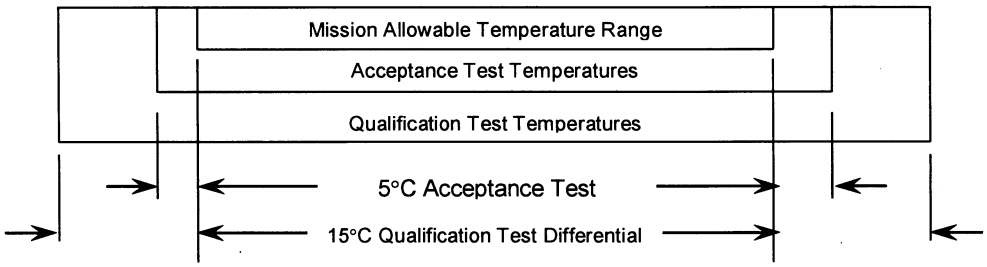
IMAR926 9.13.1.7.0-1 The test(s) **shall** be configured and conducted to be compliant with the contamination control

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR927	9.13.1.8	**9.13.1.8 Unrealistic Failure Modes**
IMAR928	9.13.1.8.0-1	The test program **shall** avoid unrealistically overstressing environmental conditions that could induce test failure modes such as exceeding acceptable rates of temperature change.
IMAR929	9.13.2	**9.13.2 Thermal Vacuum**
IMAR930	9.13.2.1	**9.13.2.1 Transition Rates**
IMAR932	9.13.2.1.0-1	The temperature rate of changes **shall** be at least at the expected orbital temperature transition rate.
IMAR933	9.13.2.2	**9.13.2.2 Corona Operation**
IMAR934	9.13.2.2.0-1	Any unit that is electrically powered during launch **shall** be operated through chamber pump down to demonstrate that they will not sustain damage though the corona voltage breakdown regime. This applies at unit, instrument and spacecraft testing levels.
IMAR937	9.13.2.3	**9.13.2.3 Hot and Cold Start Demonstrations**
IMAR938	9.13.2.3.0-1	Start-up capability **shall** be demonstrated to verify that the unit under test will turn on after exposure to the extreme temperatures that may occur in orbit.
IMAR939	9.13.2.3.0-2	Cold start **shall** be demonstrated from non-operational temperatures (unit level or lower) or from temperatures maintained by survival heaters (unit level or higher).
IMAR940	9.13.2.3.0-3	Cold start **shall** be demonstrated during the cold plateau and minimum input voltage.
IMAR941	9.13.2.3.0-4	Hot restart **shall** be demonstrated during hot plateau and maximum input voltage.
IMAR942	9.13.2.4	**9.13.2.4 Heater Verification**
IMAR943	9.13.2.4.0-1	TV testing **shall** demonstrate the ability of survival heaters to maintain units within Non-Operating Temperature Limits during worst cold environments, minimum voltage and while the instrument is off.
IMAR944	9.13.2.4.0-2	Cold plateau testing **shall** demonstrate that operational heaters maintain applicable components within the MAT.
IMAR945	9.13.2.4.0-3	Both operational and survival heater set points and heater control (including primary and redundant circuits) **shall** be independently verified.
IMAR946	9.13.2.5	**9.13.2.5 Flight Temperature Sensor Verification**
IMAR947	9.13.2.5.0-1	Instrument level TV testing **shall** corroborate flight temperature sensors against test temperature sensors in at least the hot and cold bounding operating conditions.
IMAR948	9.13.3	**9.13.3 Thermal Cycling**
IMAR949	9.13.3.0-1	Thermal Cycling consists of cycling between temperature extremes for the purpose of checking operability over broad temperature ranges while inducing stress to uncover workmanship defects and other flaws.
IMAR950	9.13.3.1	**9.13.3.1 Spacecraft Level TV Test**
IMAR951	9.13.3.1.0-1	Four TV cycles are planned during spacecraft thermal testing. The instrument **shall** be operating during spacecraft level thermal vacuum testing.
IMAR952	9.13.3.2	**9.13.3.2 Cumulative Cycles**

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR953	9.13.3.2.0-1	Every unit **shall** undergo 12 TV cycles prior to launch, this applies to flight spares as well as to repaired units.
IMAR955	9.13.3.3	**9.13.3.3 Instrument Level TVCycling**
IMAR957	9.13.3.3.0-1	There **shall** be a minimum of (4) four thermal-vacuum cycles at the instrument level of testing.
IMAR958	9.13.3.3.0-2	The thermal plateaus **shall** be of sufficient duration to conduct functional testing.
IMAR960	9.13.3.3.0-3	Operational time **shall** be divided between primary and redundant sides.
IMAR961	9.13.3.3.0-4	The instrument **shall** be operated and its performance **shall** be monitored, during hot and cold plateaus as well as during hot and cold transitions.
IMAR963	9.13.3.3.0-5	At least two cold starts **shall** be demonstrated.
IMAR964	9.13.3.3.0-6	In redundant units as well as internally redundant single units, each unit or side **shall** demonstrate at least one cold start.
IMAR965	9.13.3.4	**9.13.3.4 Unit Level TV Cycling**
IMAR966	9.13.3.4.0-1	Unit level level plateaus **shall** be of sufficient duration to conduct functional testing.
IMAR967	9.13.3.4.0-2	During the unit level plateaus and temperature transitions, the unit **shall** be operating and performance **shall** be monitored.
IMAR969	9.13.3.4.0-3	Operational time **shall** be divided between primary and redundant sides.
IMAR970	9.13.3.4.0-4	Two cold starts **shall** be demonstrated.
IMAR971	9.13.3.4.0-5	In internally redundant and cross-strapped units, each side **shall** demonstrate cold start.
IMAR972	9.13.3.5	**9.13.3.5 Ambient Pressure Thermal Cycling Substitution**
IMAR973	9.13.3.5.0-1	Substituting ambient pressure thermal cycling for thermal vacuum testing is not permitted at the unit level of assembly, or the instrument level of assembly.
IMAR1150	9.13.3.5.0-2	The chamber pressure **shall** be monitored and provide a "pressure alarm" for loss of vacuum.
IMAR1151	9.13.3.5.0-3	In the event of a pressure alarm, appropriate action **shall** be taken automatically to safe the instruments.
IMAR974	9.13.3.6	**9.13.3.6 Test Temperatures**

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR975	9.13.3.6.0-1	The test temperature description is provided below in the Test Temperature Description Figure.

Test Temperature Description Figure



IMAR976	9.13.3.6.1	**9.13.3.6.1 Mission Allowable Temperatures**
IMAR977	9.13.3.6.1.0-1	Mission Allowable Temperatures (MAT) are the established range of temperatures that units are permitted to experience while operating in orbit. Mission allowable temperatures are established based upon analytical temperature predictions and upon the temperature range over which the hardware can operate. MAT encompasses worst case operating temperature predictions, uncertainty, and any contractor desired temperature margin.
IMAR979	9.13.3.6.2	**9.13.3.6.2 Qualification, Protoflight and Acceptance Temperatures**
IMAR980	9.13.3.6.2.0-1	Qualification, proto-flight and acceptance verification tests are the same except for adjustments in test temperature differentials.
IMAR981	9.13.3.6.2.0-2	The qualification temperature is 15°C warmer than the maximum MAT and 15°C colder than the minimum MAT.
IMAR1091	9.13.3.6.2.0-3	Proto-flight temperature is 10°C warmer than the maximum MAT and 10°C colder than the minimum MAT.
IMAR1092	9.13.3.6.2.0-4	Acceptance temperature is 5°C warmer than the maximum MAT and 5°C colder than the minimum MAT.
IMAR984	9.13.3.6.3	**9.13.3.6.3 Non-operational Temperatures**
IMAR985	9.13.3.6.3.0-1	Non-operational Temperatures (NOT) are the established range of temperatures that components are permitted to experience while dormant, not operating and not powered. NOT temperatures represent the permissible range while the hardware is off. During flight, survival heaters maintain hardware at or above the cold NOT limit and passive design maintains hardware below the upper NOT limit.
IMAR988	9.13.3.7	**9.13.3.7 Temperature test tolerances**
IMAR989	9.13.3.7.0-1	In lieu of more specific instructions or requirements, TV test tolerances **shall** be ±2° C.
IMAR990	9.13.3.8	**9.13.3.8 Plateau Criteria**
IMAR991	9.13.3.8.0-1	Thermal vacuum soak **shall** be based upon representative temperature sensor(s) or an average of such sensors.
IMAR992	9.13.3.8.0-2	These **shall** be representative of unit or critical parts of the payload.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR993	9.13.3.8.0-3	Temperature soaks **shall** begin when the "control" temperature is: within ±2° C of the proposed test temperature and the temperature rate of change is less than 1° C/hour per hour.
IMAR994	9.13.4	**9.13.4 Thermal Balance (TB)**
IMAR995	9.13.4.0-1	The Thermal Balance (TB) test directly validates the adequacy of the thermal design and as built thermal hardware. TB testing demonstrates the thermal control system performance by operating in (simulated) worst hot and cold case thermal environment.
IMAR996	9.13.4.1	**9.13.4.1 TB Applicability**
IMAR997	9.13.4.1.0-1	All of the GOES-R instruments **shall** be subject to TB testing.
IMAR998	9.13.4.2	**9.13.4.2 Balance Points**
IMAR999	9.13.4.2.0-1	The two compulsory balance points **shall** directly simulate operation during the hot environment and cold environment.
IMAR1000	9.13.4.2.0-2	A third compulsory balance point **shall** directly verify survival heater margins at worst cold environment with the instrument non-operational.
IMAR1001	9.13.4.2.0-3	Additional balance point(s) **shall** be required for case(s) that challenge the thermal control system in ways not demonstrated during the compulsory balance points.
IMAR1002	9.13.4.3	**9.13.4.3 TB-Instrument Configuration**
IMAR1003	9.13.4.3.0-1	For TB, the test units **shall** be in flight-like configuration including: a) Coatings and finishes b) MLI c) Mounting hardware and isolators
IMAR1004	9.13.4.4	**9.13.4.4 TB Accuracy and Knowledge**
IMAR1005	9.13.4.4.0-1	For TB simulations, the simulated environment **shall** replicate at least 95% of the overall instrument heat transfer.
IMAR1006	9.13.4.4.0-2	The hot and cold simulated environment **shall** be measured, characterized and understood to ±2%.
IMAR1007	9.13.4.4.0-3	During or prior to TB testing, unit dissipation (in all relevant modes) **shall** be measured and characterized to 1% accuracy.
IMAR1008	9.13.4.4.0-4	Prior to TB testing, the test harness losses (voltage drops) **shall** be measured and characterized.
IMAR1009	9.13.4.4.0-5	Conductive heat losses due to test harnesses **shall** be less than 5% of the instrument heat balance, and the conductive loss knowledge uncertainty **shall** be less than 2% of the instrument heat balance.
IMAR1011	9.13.4.5	**9.13.4.5 TB Steady State Criteria**
IMAR1012	9.13.4.5.0-1	TB conditions are stable when each control temperature sensor's variation is less than 0.10° C/hour for 6 hours and to a rate representing energy balance to within 3%.
IMAR1015	9.13.4.6	**9.13.4.6 Thermal Analytical Model Correlation**
IMAR1016	9.13.4.6.0-1	In the course of the instrument development program, analytical thermal models **shall** be developed of the instrument in orbit.

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IMAR1017	9.13.4.6.0-2	The instrument orbital thermal model **shall** be modified to reflect the test chamber configuration, boundary conditions and Beginning of Life (BOL) surface properties to predict instrument thermal performance under test conditions, this model is the thermal balance model.
IMAR1018	9.13.4.6.0-3	The TB model **shall** be correlated against the TB results.
IMAR1019	9.13.4.6.0-4	Correlation modifications to the TB model **shall** be tracked and propagated into updated flight predictions.
IMAR1020	9.13.4.7	**9.13.4.7 Correlation Accuracy**
IMAR1021	9.13.4.7.0-1	The post TB correlation **shall** meet the following accuracy requirements: a) 95.4% of the measured nodes will be within ±3° C. b) 99.7% of the measured nodes will be within ±5° C for the bounding TB cases. c) Standard deviation of correlated model nodal temperatures against balance temperatures less than 3° d) Model energy balance agreement within 3 %.
IMAR1027	9.14	**9.14 Testing of Spare Hardware**
IMAR1028	9.14.1	**9.14.1 General**
IMAR1029	9.14.1.0-1	As a minimum, spares **shall** undergo a verification program equal to that required for follow-on hardware. Therefore, special consideration must be given to spares as indicated below.
IMAR1030	9.14.1.1	**9.14.1.1 Extent of Testing**
IMAR1031	9.14.1.1.0-1	The extent and type of testing **shall** be determined as part of the flight hardware test program.
IMAR1032	9.14.1.1.0-2	A spare unit may be used for qualification of the hardware by subjecting it to protoflight testing, and testing flight hardware to acceptance levels.
IMAR1033	9.14.1.2	**9.14.1.2 Spares Testing**
IMAR1034	9.14.1.2.0-1	If a flight item is replaced for reasons of failure and is then repaired and re-designated as a spare, appropriate re-testing **shall** be conducted.
IMAR1035	9.14.1.3	**9.14.1.3 Caution on the Use of Spares**
IMAR1036	9.14.1.3.0-1	When the need for a spare arises, immediate analysis and review of the failed hardware **shall** be made. If failure occurs in a hardware item of which there are others of identical design, the fault may prove to be generic and may thus affect all hardware of that design. Hardware modifications and/or additional testing of the replacement spare hardware should be carefully considered, as well as for any redundant hardware in the instrument.
IMAR1037	9.14.1.4	**9.14.1.4 "One-Shot" Items**
IMAR1038	9.14.1.4.0-1	Some items may be degraded or expended during the integration and test period and replaced by spares.
IMAR1039	9.14.1.4.0-2	The spare that is used **shall** have met the required quality control standards or auxiliary tests.
IMAR1040	9.14.1.4.0-3	Units **shall** be of qualified design.
IMAR1041	9.14.1.4.0-4	Examples are pyrotechnic devices, and elements that absorb impact energy by plastic yielding.

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IMAR1042	9.14.1.4.0-5	When the replacement entails procedures that could jeopardize mission success, the replacement procedure **shall** be successfully demonstrated with the hardware in the same configuration that it will be in when final replacement is to be accomplished.
IMAR1043	9.15	**9.15 Test Facilities**
IMAR1044	9.15.1	**9.15.1 General**
IMAR1045	9.15.1.0-1	The facilities and fixtures used in conducting tests **shall** be capable of producing and maintaining the test conditions prescribed with the test specimen installed and operating or not operating, as required.
IMAR1046	9.15.1.0-2	In any major test, facility performance **shall** be verified prior to the test either by a review of its performance during a test that occurred a short time earlier or by conducting a test with a substitute test item.
IMAR1047	9.15.2	**9.15.2 Test Facilities Calibration**
IMAR1112	9.15.2.0-1	All equipment used for tests **shall** be in current calibration and so noted by tags and stickers. *(CCR*
IMAR1049	9.16	**9.16 Test Condition Tolerances**
IMAR1050	9.16.1	**9.16.1 General**
IMAR1103	9.16.1.0-1	In the absence of a rationale for other test condition tolerances, the following **shall** be used; the values include measurement uncertainties.

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IMAR1103 9.16.1.0-1

Acoustics		
	≤ 1 dB	
Overall Level:	Frequency (Hz)	Tolerance (dB)
	f £ 40	+3, -6
1/3 Octave Band Tolerance:	40< F < 3150	± 3
	f ≥ 3150	+3, -6
Antenna Pattern Determination	± 2 dB	
Electromagnetic Compatibility		
Voltage Magnitude:	± 5% of the peak value	
Current Magnitude:	± 5% of the peak value	
RF Amplitudes:	± 2 dB	
Frequency:	± 2%	
Distance:	± 5% of specified distance or ± 5 cm, whichever is greater	
Humidity	± 5% RH	
Loads		
Steady-State (Acceleration):	± 5%	
Static:	± 5%	

ID	Object Number
IMAR1103	9.16.1.0-1

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Magnetic Properties	
Mapping Distance Measurement:	± 1 cm
Displacement of assembly center of gravity (cg) from rotation axis:	± 5 cm
Vertical displacement of single probe centerline from cg of assembly:	± 5 cm
Mapping turntable angular displacement:	± 3 degrees
Magnetic Field Strength:	± 1 nT
Repeatability of magnetic measurements (short term):	± 5% or ± 2 nT, whichever is greater
Demagnetizing and Magnetizing Field Level:	± 5% of nominal
Mass Properties	
Weight:	± 0.2%
Center of Gravity:	± 0.15cm (± 0.06 in.)
Moments of Inertia:	± 1.5%
Mechanical Shock	
Response Spectrum:	+25%, -10%
Time History:	± 10%

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IMAR1103 9.16.1.0-1

Pressure		
	Greater than 1.3 X 10^4 Pa (Greater than 100 mm Hg):	± 5%
	1.3 X 10^4 to 1.3 X 10^2 Pa (100 mm Hg to 1 mm Hg):	± 10%
	1.3 X 10^2 to 1.3 X 10^1 Pa (1 mm Hg to 1 micron):	± 25%
	Less than 1.3 X 10^1 Pa (less than 1 micron):	± 80%
Temperature		± 2°C
Vibration		
	Sinusoidal:	
	Amplitude	± 10%
	Frequency	± 2%
	Random:	
	RMS level	± 10%
	Accel. Spectral Density	± 3 dB

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1052	10	**10** Electrostatic Discharge (ESD) Control
IMAR1055	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.
IMAR1056	10.1	**10.1 Electrostatic Discharge Control Requirements**
IMAR1057	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.
IMAR1058	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.
IMAR1059	10.1.0-3	The ESD Control Plan **shall** be submitted and approved in accordance with the CDRL.
IMAR1060	10.1.0-4	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.
IMAR1061	10.1.0-5	Electronic hardware **shall** be manufactured, inspected, tested, or otherwise processed only at designated ESD protective work areas.
IMAR1062	10.1.0-6	These work areas **shall** be verified on a regular schedule as identified in the contractor's ESD Control Program.
IMAR1063	10.1.0-7	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-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1064	11	# 11 GIDEP Alerts and Problem Advisories
IMAR1065	11.1	## 11.1 GIDEP Participation
IMAR1066	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-01 Government Industry Data Exchange Program Requirements Guide, available from the GIDEP Operations Center, PO Box 8000, Corona, California 91718-8000. *(CCR 00039)*
IMAR1067	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.
IMAR1068	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. *(CCR 00039)*
IMAR1069	11.1.0-4	The contractor **shall** review, document and submit results of GIDEP reports and NASA advisories in accordance with the CDRL. *(CCR 00037A)*
IMAR1070	11.1.0-5	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.
IMAR1071	11.1.0-6	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-01 whenever failed or nonconforming items, available to other buyers, are discovered during the course of the contract.
IMAR1131	11.1.0-7	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. *(CCR 00037A)*

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IMAR1072	12	**12** Applicable Documents List
IMAR1105	12.1	**12.1 Applicable Documents**
IMAR1106	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. *(CCR 00112)*

(CCR 00112)

NPR 8621.1A, NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping, February 11, 2004. *(CCR 00112)*

Section 4

MIL-HDBK-217 Rev. F, Change Notice 2, Reliability Prediction of Electronic Equipment, February, 1995. *(CCR 00112)*

Section 5

NASA-STD-8719.13B w/Change 1, Software Safety Standard, July 8, 2004. *(CCR 00051B)*

Section 6

NASA-STD-8739.1, Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies, August 6, 1999. *(CCR 00112)*

NASA-STD-8739.2, NASA Workmanship Standard for Surface Mount Technology, August 31, 1999. *(CCR 00112)*

NASA-STD-8739.3, w/Change 2, Soldered Electrical Connections, January 18, 2001. *(CCR 00112)*

NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring, February 9, 1998. *(CCR 00112)*

NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation, February 9, 1998.*(CCR 00112)*

NPR 6000.1G, Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment and Associated Components, March 28, 2005. *(CCR 00064) (CCR 00112)*

IPC-2221 Rev A, Generic Standard on Printed Board Design, May 2003. *(CCR 00112)*

IPC-2222, Sectional Design Standard for Rigid Organic Printed Boards, February 1998, *(CCR 00112)*

IPC-2223, Sectional Design Standard for Flexible Printed Boards, November 1998. *(CCR 00112)*

IPC-6011, Generic Performance Specification for Printed Boards, July 1996. *(CCR 00112)*

IPC-6012B, Qualification and Performance Specification for Rigid Printed Boards, August 1, 2004. *(CCR 00112)*

IPC-6013 Rev A, Qualification and Performance Specification for Flexible Printed Boards, November 2003. *(CCR 00112)*

MIL-STD-981 Rev B(4), Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications *(CCR 00112)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document

IMAR1106 12.1.0-1

Section 7

GSFC EEE-INST-002, Instructions for EEE Parts Selecting Screening, Qualification, and Derating, May 2003. *(CCR 00112)*

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. *(CCR 00112)*

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, 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, May 22, 2000. *(CCR 00112)*

ASTM E-595 Rev 1993, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment

(CCR 00112)

MIL-STD-889 Rev. B (VN2), Dissimilar Metals

541-PG-8072.1.2, Goddard Space Flight Center Fastener Integrity Requirements, March 5, 2001. *(CCR 00074A) (CCR 00112)*

Air Force Space Command Manual 91-710 (AFSPCMAN 91-710), Range Safety Requirements, July 1, 2004. *(CCR 00074A) (CCR 00112)*

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)

Section 11

S0300-BT-PRO-010, GIDEP Operations Manual

S0300-BU-GYD-01, Government-Industry Data Exchange Program Requirements Guide, November 1994. *(CCR 00112)*

IMAR1107 12.2

12.2 Reference Documents

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1108	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-7000, General Environmental Verification Standard (GEVS) for GSFC Flight Programs and Projects GSFC-STD-1000, Goddard Space Flight Center Rules for the Design, Development, Verification, and Operation of Flight Systems *(CCR 00099A)*

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1075	13	**13** Acronyms and Glossary
IMAR1077	13.1	**13.1 Acronyms** *(CCR 00112)*
IMAR1110	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
FMECA	Failure Modes Effect and Criticality Analysis
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
INST	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
MCM	Multi-Chip Module
MEB	Materials Engineering Branch
MIL	Military
MITEQ	Microwave Information Transmission Equipment

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document	
IMAR1110	13.1.0-1	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
		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
		OSHA	Occupational Safety & Health Administration
		PAPL	Project Approved Parts List
		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
		SMA	Space & Military Avionics
		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

IMAR1110	13.1.0-1	TV	Thermal Vacuum
		VTL	Verification Tracking Log
		V&V	Verification and Validation

IMAR1078 13.2

13.2 Definitions

IMAR1079 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 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.

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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 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.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1079	13.2.0-1	**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: a) **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. b) **Subassembly:** A subdivision of an assembly. Examples are wire harness and loaded printed circuit boards. c) **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. d) **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. e) **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. f) **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). **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, nonconformances fall into two categories--discrepancies and failures. A discrepancy is a departure from specification that is detected during inspection or process control testing, etc., 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.

ID	Object Number	417-R-IMAR-0039, RM Version, Instrument Mission Assurance Requirements (IMAR) Document
IMAR1079	13.2.0-1	**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. **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. *(CCR 00215)* **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. *(CCR 00215)* **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).

417-R-IMAR-0039 DCR

CCR #: 00001 Rev
CCB Status: **Approved**
CCB Date: 12/7/2004

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12/7/2004

Title: Combining of System and Environmental Verification Plans
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABICDRL-0018, 417-R-ABIMAR-0012, 417-R-ABISOW-0016
Doc Section #: CDRL: Table 2-1, DID 65, DID 66; MAR: 9.2, 9.4, 9.8; SOW:
DOORS Version: ABICDRL N/A,
DOORS ID #: CDRL: N/A; MAR: ABIMAR624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 636, 637, 638, 652, 653, 654, 655, 656, 658, 659, 660, 661, 662, 663, 664, 696, 700; SOW:

CCR #: 00004 Rev
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3/15/2005

Title: Cleanup of MAR Section 9.10 EMC - Conducted Susceptibility Levels
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR: 9.10.6, 9.10.7, 9.10.8
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR827, 828, 834, 835, 844, 845

CCR #: 00006 Rev

CCB Status: **Approved**
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3/15/2005

Title: Cleanup of MAR Section 9.10 EMC - Conducted Emissions on Instrument Power Leads
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR: 9.10.3.1 Figure
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR811 (9.10.3.1-4)

CCR #: 00007 Rev
CCB Status: **Approved**
CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

Title: Cleanup of MAR Section 9.10 EMC - Common Mode Noise
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 9.10.4.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR814 (9.10.4.1-1), 815 (9.10.4.1-2)

CCR #: 00031 Rev

CCB Status: **Approved**
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Doc Change Date:
3/15/2005

Title: ABI MAR (MAID 118) Delete NASA Electronic Parts Database Rqmt & Define ADPL Format
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.8.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR509 (7.8.3-2)

CCR #: 00032 Rev
CCB Status: **Approved**
CCB Date: 2/18/2005

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3/15/2005

Title: ABI MAR (MAID 119) Clarify EEE Parts Traceability Requirements
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.7.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR477 (7.7.3-3), ABI MAR(TBD) (7.7.3-5)

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CCB Status: **Approved**
CCB Date: 2/18/2005

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3/15/2005

Title: ABI MAR (MAID 121) PIND Screening Requirement Clarification
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.5.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR431 (7.5.1-1)

CCR #: 00035 Rev
CCB Status: **Approved**
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Doc Change Date:
3/15/2005

Title: ABI MAR (MAID 122) Deletion of Duplicate Parts Derating
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.4.6
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR416 (7.4.6-3)

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Doc Change Date:
7/8/2005

Title: ABI MAR (MAID 126) Clarification of GIDEP and NASA Advisories Handling by Contractors
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 11.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR1067 (11.1-2), ABIMAR1069 (11.1-4), ABIMAR(TBD)

CCR #: 00038 Rev

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3/15/2005

Title: ABI MAR (MAID 124) Clarify "Custom or Advanced Technology Devices" Design Review Requirements
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.4.4
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR404 (7.4.4-2)

CCR #: 00039 Rev
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CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

Title: ABI MAR (MAID 127) GIDEP Requirements Clarification.
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 11.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR1066 (11.1-1), ABIMAR1068 (11.1-3)

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8/12/2005

Title: Modification of Magnetic Field Testing Requirements for Magnetometer Goal Requirements.
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07, Info 4HZ48, 4HZ49, 4HZ50, 4HZ65
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 9.12
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR889 (9.12.1-1), ABIMAR891 (9.12.1-2) (was -3), ABIMAR892 (9.12.1-3), ABIMAR893 (9.12.1-4)

CCR #: 00050 Rev **B**
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Doc Change Date:
6/13/2005

Title: ABI MAR (MAID 96) System Safety Requirements Update
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR TOC, ABIMAR 3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR70 (3.1-3), ABIMAR71 (3.1-4), ABIMAR72 (3.1-5), ABIMAR74 (3.2-1), ABIMAR78 (3.3), ABIMAR79 (3.3-1), ABIMAR80 (3.3-2), ABIMAR81 (3.3-3), ABIMAR85 (3.4), ABIMAR87 (3.4-1), ABIMAR88 (3.4-2), ABIMAR89 (3.4-3), ABIMAR90 (3.4-4), ABIMAR91 (3.5), ABIMAR92 (3.1), ABIMAR93 (3.5-2), ABIMAR94 (3.5-3), ABIMAR95 (3.5-4), ABIMAR97 (3.6-1), ABIMAR99 (3.6-2), ABIMAR100 (3.6-3), ABIMAR103 (3.7-1), ABIMAR107 (3.8), ABIMAR108 (3.8-1), ABIMAR109 (3.8-2), ABIMAR111 (3.9-1), ABIMAR112 (3.10), ABIMAR113 (3.10-1), ABIMAR114 (3.10-2), ABIMAR115 (3.10-3), ABIMAR118 (3.11-1), ABIMAR121 (3.11-4), ABIMAR126 (3.11-1-9), ABIMAR127 (3.11-10), ABIMAR130 (3.11-12), ABIMAR137 (3.13-2), ABIMAR153 (3.15.1), ABIMAR154 (3.15.1-1), ABIMAR155 (3.15.1-2), ABIMAR156 (3.15.1-3), ABIMAR157 (3.15.1-4), ABIMAR156 (3.15.3-2), ABIMAR169 (3.15.4), ABIMAR170 (3.15.4-1), ABIMAR171 (3.15.4-2), ABIMAR172 (3.15.4-3), ABIMAR173 (3.15.4-5), ABIMAR174

CCR #: 00051 Rev **B**
CCB Status: **Approved**
CCB Date: 5/24/2005
Doc Change Date:
6/13/2005

Title: ABI MAR (MAID 96) Section change for Software Safety
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - NNG04HZ07C
Doc #: 417-R-ABIMAR-0012, 417-R-IMAR-0039
Doc Section #: MAR 3.14, 5.1.2, 12.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR140 (3.14-1), 141 (3.14-2),142 (3.14-3),143 (3.14-4),144 (3.14-5),145 (3.14-6),146 (3.14-7),147 (3.14-8),148 (3.14-9),149 (3.14-10),150 (3.14-11), 151 (3.14-12), ABIMAR278 (5.1.2-1), ABIMAR(TBD) (5.1.2-2), ABIMAR(TBD) (5.1.2-3), ABIMAR(TBD) (5.1.2-4), ABIMAR(TBD) (5.1.2-5), ABIMAR(TBD) (5.1.2-6), ABIMAR(TBD) (5.1.2-7), ABIMAR(TBD) (5.1.2-7), ABIMAR(TBD) (5.1.2-8), ABIMAR(TBD) (5.1.2-9), ABIMAR(TBD)

CCR #: 00053 Rev

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

Title: ABI MAR (MAID 115) Change Surveillance of the Contractor to a Shall Requirement
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 1.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR12 (1.3.1)

CCR #: 00055 Rev **A**

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

Title: ABI MAR (MAID 129 and 131) Delete Duplicate Record Retention Requirement
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.9.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR532 (7.9.3-4)

CCR #: 00056 Rev

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

Title: ABI MAR (MAID 130) Change Unit/Subsystem to Instrument & Clarify End Item Acceptance Data Package Rqmts

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.9.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR529 (7.9.3-1), 530 (7.9.3-2), 531 (7.9.3-3)

CCR #: 00057 Rev

CCB Status: **Approved**
CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

Title: ABI MAR (MAID 132) Correct Typo in Parts List Rqmts

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.8
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR499 (7.8-3)

CCR #: 00058 Rev

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

Title: ABI MAR (MAID 134) Correct Derating Policy Guidelines Reference

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.7.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR469 (7.7.2-2)

CCR #: 00059 Rev

CCB Status: **Approved**
CCB Date: 4/26/2005

Doc Change Date:
4/26/2005

Title: ABI MAR (MAID 135) Delete Redundant Parts Age and Storage Control Rqmt

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.7.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR466 (7.7.1-4)

CCR #: 00060 Rev

CCB Status: **Approved**
CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

Title: ABI MAR (MAID 136 and 138) Capacitor Surge Current Screening Requirement Correction

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.5.2.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR436 (7.5.2.1-2), 437 (7.5.2.1-3)

CCR #: 00061 Rev

CCB Status: **Approved**
CCB Date: 4/26/2005

Doc Change Date:
4/26/2005

Title: ABI MAR (MAID 137) Addition of Sample Size to DPA Requirement

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.5.2.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR441 (7.5.2.2-3)

CCR #: 00062 Rev

Title: ABI MAR (MAID 140) Add Contractor RE & PPE Approvals to SEL Susceptible Parts Usage

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.4.3.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR399 (7.4.3.3-4)

CCR #: 00063 Rev **A**

Title: ABI MAR (MAID 142) Deletes an Unnecessary Contractor PMCB Membership Rqmt

CCB Status: **Approved**
CCB Date: 7/8/2005

Doc Change Date:
7/8/2005

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 7.3.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR379 (7.3.3-6)

CCR #: 00064 Rev

Title: ABI MAR (MAID 117) Clarify Packaging Requirements in Workmanship Standards Section

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 6.7
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR338 (6.7-1)

CCR #: 00066 Rev

Title: ABI MAR (MAID 157) Corrects Materials Selection Reference Document and Document Use

CCB Status: **Approved**
CCB Date: 4/1/2005

Doc Change Date:
4/1/2005

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 8.2.1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR558 (8.2.1-4)

CCR #: 00067 Rev

Title: ABI MAR (MAID 159) Clarification of Shelf-Life-Controlled Materials

CCB Status: **Approved**
CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: MAR 8.2.4.3
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR576 (8.2.4.3-3), 577 (8.2.4.3-4), 578 (8.2.4.3-5)

CCR #: 00069 Rev **A**

Title: ABI MAR Conversion to Instrument MAR (IMAR)

CCB Status: **Approved**
CCB Date: 7/8/2005

Doc Change Date:
1/5/2006

GOES S/C: R Effectivity: Instruments
Contract # NNG0 - NNG04HZ07C
Doc #: 417-R-ABIMAR-0012, 417-R-IMAR-0039
Doc Section #: ALL
DOORS Version: ABIMAR 1.0,
DOORS ID #: ALL

CCR #: 00074 Rev **A**

Title: Clarification of Materials Requirements

CCB Status: **Approved**

GOES S/C: R Effectivity: Instruments

CCB Date: 4/26/2005
Doc Change Date: 4/26/2005

Contract # NNG0 - NNG04HZ07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 8.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR556 (8.2.1-2), 568 (8.2.4.1-1), 572 (8.2.4.2-2), 582 (8.2.5-3), 583 (8.2.5-4), 589 (8.2.5.1-4), 604 (8.2.6-1), 605 (8.2.6-2), 606 (8.2.6-3), 607 (8.2.6-4), 1106 (12.1-1)

CCR #: 00075 Rev
CCB Status: **Approved**
CCB Date: 7/25/2005

Doc Change Date: 7/25/2005

Title: Clarification of Workmanship Requirements
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 6.1, 6.6
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR318 (6.1-3), 336 (6.6-3)

CCR #: 00078 Rev **A**
CCB Status: **Approved**
CCB Date: 6/8/2005

Doc Change Date: 6/13/2005

Title: Addition of Test Number CE01
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 9.10.3.1, 9.10.3.1.1(add), 9.10.3.1.2(add)
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR808 (9.10.3.1-1), ABIMAR(TBD) (9.10.3.1.1-1), ABIMAR(TBD) (9.10.3.1.1-2), ABIMAR(TBD) (9.10.3.1.1-3), ABIMAR809 (9.10.3.1-2), ABIMAR809 (9.10.3.1-3), ABIMAR809 (9.10.3.1-4)

CCR #: 00079 Rev

CCB Status: **Approved**
CCB Date: 4/26/2005

Doc Change Date: 4/26/2005

Title: ABI MAR (MAID 120) Change Screening requirements for Magnetic Components to Exempt Planar Devices
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 6.4-5(add), 7.5.3-1
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR(TBD) (6.4-5), ABIMAR444 (7.5.3-1)

CCR #: 00080 Rev

CCB Status: **Approved**
CCB Date: 7/25/2005

Doc Change Date: 7/25/2005

Title: ABI MAR (MAID 123) Clarification of Procurement Specification Requirements for Custom or Advanced Technology Devices
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 7.4.4
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR407 (7.4.4-6), ABIMAR1099 (7.4.4-7), ABIMAR408 (7.4.4-8), ABIMAR409 (7.4.4-9), ABIMAR(TBD) (7.4.4-10)

CCR #: 00082 Rev **A**
CCB Status: **Approved**
CCB Date: 5/24/2005
Doc Change Date: 6/13/2005

Title: Sinusoidal Testing Frequency Limit (MAID 38)
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - NNG04HZ07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 9.9.5
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR742 (9.9.5-1), ABIMAR747 (9.9.5-6), ABIMAR(TBD) (9.9.5-12)

CCR #: 00093 Rev
CCB Status: **Approved**
CCB Date: 4/26/2005

Doc Change Date:
4/26/2005

Title: Simplification of MAR Section 9 Re-Test Requirements (MAID 49, 160)
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012, 417-R-ABICDRL-0018
Doc Section #: ABIMAR :9.8.5, 9.9.4, 9.9.5, 9.9.6, 9.13.3.2; ABI CDRL DID 94
DOORS Version: ABIMAR 1.0,
DOORS ID #: ABIMAR705 (9.8.5-8), ABIMAR729 (9.9.4-3), ABIMAR744 (9.9.5-3), ABIMAR759 (9.9.6-6), ABIMAR954 (9.13.3.2-2); CDRL

CCR #: 00094 Rev
CCB Status: **Approved**
CCB Date: 4/26/2005

Doc Change Date:
4/26/2005

Title: Deletion of Heater Cycling Requirements for Thermal Balance (MAID
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 9.13.4.5
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR1013 (9.13.4.5-2) and ABIMAR1014 (9.13.4.5-3).

CCR #: 00099 Rev **A**

CCB Status: **Approved**
CCB Date: 7/25/2005

Doc Change Date:
7/25/2005

Title: Add GSFC-STD-1000 to MAR Reference Document List and Change the GEVS-SE Reference to the Current GSFC Document
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 12.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR1108

CCR #: 00103 Rev
CCB Status: **Approved**
CCB Date: 7/25/2005

Doc Change Date:
7/25/2005

Title: MAR Section 7.4.2 Cleanup (MAID 141)
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 7.4.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR386

CCR #: 00104 Rev
CCB Status: **Approved**
CCB Date: 7/25/2005

Doc Change Date:
7/25/2005

Title: MAR Section 9.15.2 Cleanup (MAID 150)
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 9.15.2
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR1048 (9.15.2-1), (9.15.2-2), (9.15.2-3)

CCR #: 00112 Rev
CCB Status: **Approved**
CCB Date: 10/11/200

Doc Change Date:
11/16/2005

Title: MAR Applicable Documents List Update
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: ABIMAR 1.4, 12, 13
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR18 (1.4-1), ABIMAR19 (1.4-2), ABIMAR1106 (12.1-1), ABIMAR1110 (13.1-1)

CCR #: 00142 Rev
CCB Status: **Approved**
CCB Date: 11/16/200

Doc Change Date:
11/16/2005

Title: ABIMAR Reliability and Workmanship Updates
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, GLM RFP. SEISS RFP
Doc #: 417-R-ABIMAR-0012
Doc Section #: 4.3.1, 6.0, 6.2, 6.4
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR196 (4.3.1-5), 307 (6.0-2), 308 (6.0-3), 311 (6.0-5), 312 (6.0-6), 320 (6.2-1), 327 (6.4-1)

CCR #: 00134 Rev

CCB Status: **Approved**
CCB Date: 6/2/2006

Doc Change Date:
6/14/2006

Title: Revised RE102 Radiated Emissions, Electric Field, Spacecraft Level Figure
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
Doc #: 417-R-ABIMAR-0012
Doc Section #: 9.10.9
DOORS Version: ABIMAR 1.0
DOORS ID #: ABIMAR853

CCR #: 00156 Rev

CCB Status: **Approved**
CCB Date: 4/13/2006

Doc Change Date:
6/14/2006

Title: Delete the Magnetic Field Radiated Susceptibility RS101 Testing Requirement
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-ABIMAR-0012, 417-R-IMAR-0039
Doc Section #: 9.10.11.1
DOORS Version: ABIMAR 1.0,
DOORS ID #: ABIMAR864, IMAR864, ABIMAR865, IMAR865

CCR #: 00217 Rev
CCB Status: **Approved**
CCB Date: 6/2/2006

Doc Change Date:
6/14/2006

Title: IMAR Test Tolerances
GOES S/C: R Effectivity: Instruments (- ABI)
Contract # NNG0 - Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039
Doc Section #: 9.9.2
DOORS Version: IMAR 2.0
DOORS ID #: IMAR1154 (9.9.2.0-2)

CCR #: 00218 Rev
CCB Status: **Approved**
CCB Date: 6/2/2006

Doc Change Date:
6/14/2006

Title: IMAR Modal Survey
GOES S/C: R Effectivity: Instruments (- ABI)
Contract # NNG0 - Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039
Doc Section #: 9.9.6
DOORS Version: IMAR 2.0
DOORS ID #: IMAR1163 (9.9.6.0-1)

CCR #: 00231 Rev
CCB Status: **Approved**
CCB Date: 6/14/2006

Doc Change Date:
6/14/2006

Title: IMAR Clarification
GOES S/C: R Effectivity: Instruments (- ABI)
Contract # NNG0 - Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039
Doc Section #: 3.12.1
DOORS Version: IMAR 2.0
DOORS ID #: IMAR163 (3.12.1.0-5)

CCR #: 00232 Rev
CCB Status: **Approved**
CCB Date: 6/14/2006

Doc Change Date:
6/14/2006

Title: IMAR Spurious Signals Definition Clarification
GOES S/C: R Effectivity: Instruments (- ABI)
Contract # NNG0 - Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039
Doc Section #: 9.10.2
DOORS Version: IMAR 2.0
DOORS ID #: IMAR803 (9.10.2.0-2)

CCR #: 00215 Rev
CCB Status: **Approved**
CCB Date: 8/1/2006

Doc Change Date:
8/1/2006

Title: Change and Addition of Definitions to ABIMAR and IMAR
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039, 417-R-ABIMAR-0012
Doc Section #: 13.2
DOORS Version: IMAR 2.0,
DOORS ID #: IMAR1079 (13.2.0-1), ABIMAR1079 (13.2)

CCR #: 00146 Rev **B**

CCB Status: **Approved**
CCB Date: 6/2/2006

Doc Change Date:
8/2/2006

Title: Clarification of Requirements for Control of Electromagnetic Interference Characteristics
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
Doc #: 417-R-IMAR-0039, 417-R-ABIMAR-0012
Doc Section #: 9.10.3.1
DOORS Version: IMAR 2.0,
DOORS ID #: IMAR807 (9.10.3.1), IMAR1125 (9.10.3.1.1), IMAR1126 (9.10.3.1.1.0-1), IMAR1127 (9.10.3.1.1.0-2), IMAR1128 (9.10.3.1.1.0-3), ABIMAR807 (9.10.3.1), ABIMAR1125 (9.10.3.1.1), ABIMAR1126 (9.10.3.1.1-1), ABIMAR1127 (9.10.3.1.1-2), ABIMAR1128 (9.10.3.1.1-3)

CCR #: 00330 Rev
CCB Status: **Approved**
CCB Date: 11/27/200

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11/27/2006

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Version 2.14

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

General Interface Requirements Document (GIRD)

February 22, 2007

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

General Interface Requirements Document (GIRD)

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/Systems Engineering

GIRD

417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)

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ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD1	1	# 1 SCOPE
GIRD2	1.1	## 1.1 Introduction
GIRD3	1.1.0-1	This General Interface Requirements Document (GIRD) sets forth the general, mechanical, thermal, electrical power, command and data handling and contamination control interface requirements imposed on both the instruments and spacecraft for the Geosynchronous Operational Environmental Satellite (GOES) -R Series System. It also defines the general environments to which the satellite will be subjected. The spacecraft contractor and the instrument contractor shall each meet their respective interface requirements defined in this document. The Unique Instrument Interface Document (UIID) for an instrument defines the specific resource allocations, documents exceptions to the GIRD requirements and constraints, and defines the special requirements not specifically covered in the GIRD. The instrument contractor will create and maintain, with government approval, an Instrument Descriptive Document (IDD) which describe the detail instrument design and unique interface requirements. The GIRD, in conjunction with the UIID and the IDD establishes the instrument-to-spacecraft interface requirements. Interface Control Documents (ICDs) will define the specific details of the complete spacecraft to instrument interface information (i.e., mechanical, electrical power, command and data handling, and thermal interfaces). These will be developed by the spacecraft contractor to document the Instrument-Spacecraft interface. The spacecraft contractor will control the ICDs and the ICDs will replace the related IDDs.
GIRD4	1.2	## 1.2 Requirements Terminology *(CCR 00098)*
GIRD1154	1.2.0-1	The following requirements terminology is used throughout this document: *(CCR 00098)*
GIRD1146	1.2.0-2	The term *"shall"* designates a requirement that must me achieved and is synonymous with the term *"threshold."* The term *"should"* designates a desired level of performance the government would like the contractor to strive towards achieving and is synonymous with the term *"goal."* All other terms, including *"will"*, only designate statements of fact or intentions of the government and are not to be interpreted as contractor requirements. *(CCR 00098)*
GIRD1147	1.2.0-3	The term "TBD" means, "to be determined." This is applied to requirements or values that have not been defined. The contractor **shall** propose a requirement or value and provide a rationale for all TBD requirements. *(CCR 00098)*
GIRD1148	1.2.0-4	TBD requirement proposals **shall** be made in coordination with the government and may involve other contractors. *(CCR 00098)*
GIRD1149	1.2.0-5	The contractor **shall** request approval from the government before proceeding with its proposed TBD requirement or value. *(CCR 00098)*
GIRD1150	1.2.0-6	The term "TBR" means, "to be reviewed." This is applied to requirements or values that are subject to review by the government and the contractor. The contractor **shall** review and suggest a modified value and rationale for all TBR requirements. The "TBR" provides an indication that the value may change upon review. *(CCR 00098)*
GIRD1151	1.2.0-7	TBR requirement proposals **shall** be made in coordination with the government and may involve other contractors. *(CCR 00098)*

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GIRD1152	1.2.0-8	The contractor **shall** request approval from the government before proceeding with its proposed TBR requirement or value. *(CCR 00098)*
GIRD1153	1.2.0-9	The term "TBS" means, "to be supplied." The government will supply TBS requirements. The government will provide a date or milestone at which each TBS requirement will be supplied. *(CCR 00098)*
GIRD5	1.2.0-10	An instrument may comprise more than one physical assembly, or unit. "Sensor unit" refers to the unit that contains the optics. "Instrument unit" means the sensor unit, electronics box (if applicable), or other units of the instrument. *(CCR 00098)*
GIRD6	1.3	**1.3 Order of Precedence**
GIRD7	1.3.0-1	The order of precedence of interface requirements documents is the UIID at the highest level, followed in order by the GIRD, ICD, and IDD.

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2 Documents

2.1 Applicable Documents

GIRD10 2

GIRD1060 2.1

GIRD11 2.1.0-1

The following documents of the exact issue shown form a part of this GIRD to the extent specified herein. In the event of conflict between the documents referenced and the contents of this GIRD the latter **shall** be the superseding requirement.

MIL-STD-461E Aug 99 - Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

ECSS-E-50-12A - Space Wire - Links, Nodes, Routers and Networks, 24 January 2003 European Cooperation for Space Standardization (ECSS)

ISO/DIS 14644-1 - Cleanrooms and Associated Controlled Environments, May 1, 1999 *(CCR 00158)*

CCSDS 133.0-B-1 Space Packet Protocol, Blue Book, Issue 1, September 2003 *(CCR 00158)*

IEEE/ASTM SI-10 - American National Standard for Use of the International System of Units (SI): The Modern Metric System, December 2002 *(CCR 00158)*

417-R-RPT-0027 - The Radiation Evironment for Electronic Devices on GOES-R Series Satellites, August 14, 2006 *(CCR 00274)*

CCSDS 301.0-B-3 - Time Code Formats. Blue Book. Issue 3, January 2002

NASA/TM-2001-211221 - Guideline for the Selection of Near-Earth Thermal Environment Parameters for Spacecraft Design, October 2001

417-R-RPT-0050 - GOES-R Reliable Data Delivery Protocol Version 2.0 January 30, 2007 *(CCR 00109) (CCR 00213) (CCR 00274) (CCR 00372)*

ISO/DIS 14644-3 Cleanrooms and associated controlled environments - Part 3: Metrology and test methods, 9/26/02 *(CCR 00115)*

SN-C-0005 Revision D, Contamination Control Requirements, July 20,1998 *(CCR 00115)*

2.2 Reference Documents

GIRD1061 2.2

GIRD1062 2.2.0-1

Spacecraft Attitude Determination and Control, edited by James R. Wertz (Boston: Reidel, 1978), pp. 268-270.

Farrenkopf, R. L., "Analytic Steady-State Accuracy Solutions for Two Common Spacecraft Attitude Estimators," Journal of Guidance and Control (Reston, VA: American Institute of Aeronautics and Astronautics), July-August, 1978, Vol. 1, No. 4, pp. 282-284.

Markley, F. Landis, and R. G. Reynolds, "Analytic Steady-State Accuracy of a Spacecraft Attitude Estimator," Journal of Guidance, Control, and Dynamics (Reston, VA: American Institute of Aeronautics and Astronautics), November-December, 2000, Vol. 23, No.6, pp. 1065-1067.

CCSDS 701.0-B-3 - Recommendations for Advanced Orbiting Systems, Networks and Data Links, Architectural Specification, June 1, 2001 *(CCR 00158)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD12	3	# 3 Requirements
GIRD13	3.1	## 3.1 General Requirements
GIRD14	3.1.1	### 3.1.1 Instrument Modes
GIRD18	3.1.1.1	#### 3.1.1.1 Mode Changes External Harm
GIRD19	3.1.1.1.0-1	The instrument **shall** transition from its current mode to any other mode without harming any other instrument or spacecraft bus component.
GIRD20	3.1.1.2	#### 3.1.1.2 Power Off Mode
GIRD21	3.1.1.2.0-1	The Instrument Power OFF Mode **shall** not draw operational power.
GIRD26	3.1.1.3	#### 3.1.1.3 Instrument Safe Mode
GIRD28	3.1.1.3.1	##### 3.1.1.3.1 Instrument Safe Mode Command
GIRD29	3.1.1.3.1.0-1	The instrument **shall** enter Instrument Safe Mode upon receipt of a safeing command from the spacecraft.
GIRD30	3.1.1.3.2	##### 3.1.1.3.2 Instrument Safe Mode Timeout
GIRD31	3.1.1.3.2.0-1	The instrument **shall** enter Instrument Safe Mode upon the detection of 10 consecutive missing time messages.
GIRD34	3.1.1.4	#### 3.1.1.4 Survival and Storage Modes
GIRD35	3.1.1.4.0-1	The spacecraft **shall** provide survival heater power in Survival and Storage modes.
GIRD1134	3.1.1.4.0-2	The instrument **shall** not draw operational power while in Survival and Storage modes.
GIRD38	3.1.2	### 3.1.2 Operational Concepts
GIRD39	3.1.2.1	#### 3.1.2.1 Pre-Launch
GIRD40	3.1.2.1.0-1	The satellite will be transported to the launch site where final vehicle preparations and checkout will be accomplished.
GIRD838	3.1.2.1.0-2	Final inter-segment and system verification tests will be accomplished prior to launch.
GIRD839	3.1.2.1.0-3	Instrument testing and inspection to be accomplished at the launch site will be documented in the ICD.
GIRD41	3.1.2.2	#### 3.1.2.2 Launch and Orbit Raising
GIRD42	3.1.2.2.0-1	During launch the various spacecraft subsystems may be powered on or turned off in order to provide protection from the launch and injection environments or to comply with other specified requirements. Spacecraft telemetry to monitor vehicle status may be provided during launch. Transmission of launch vehicle telemetry may satisfy this requirement during the launch phase. During the Orbit Raising and after insertion into its operational orbit, appropriate deployments would be initiated by command. Spacecraft telemetry transmission to ground monitoring stations would be used to the extent practicable.
GIRD1076	3.1.2.2.0-2	The instrument will be in Survival Mode during launch.

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GIRD840	3.1.2.2.0-3	The instrument contractor will identify in the IDD the required configuration of the instrument for the launch environment, and the power required, in the event the mode is to be anything other than OFF, and also to document required sequences leading up to the pre-launch OFF mode.
GIRD43	3.1.2.3	**3.1.2.3 On-Orbit Concept**
GIRD44	3.1.2.3.0-1	The satellite will operate in a geosynchronous orbit (Semi-major axis of approximately 42,164 Km) located at either 75° or 135° west longitude. Normal on-orbit operations entail periodic station keeping maneuvers that keep the satellite within a 0.5° inclination about the equator and within ±0.5° of the on-station longitude.
GIRD841	3.1.2.3.0-2	The spacecraft will be 3-axis stabilized.
GIRD842	3.1.2.3.0-3	Instruments **shall** survive an anomaly resulting in a static instrument line-of-sight (LOS) such that the sun passes through the LOS at orbit rate.
GIRD45	3.1.2.3.0-4	Instruments **shall** survive a spacecraft attitude anomaly resulting in the sun being at an arbitrary fixed location within the instrument field of regard (FOR).
GIRD46	3.1.2.3.0-5	Instruments **shall** survive a spacecraft attitude anomaly resulting in the sun sweeping through the field-of-view (FOV) of the instrument radiator from "horizon to horizon" at a rate of 6^{O}/minute, passing through radiator normal.
GIRD47	3.1.3	**3.1.3 Dimension Standard**
GIRD48	3.1.3.0-1	For all documents related to instrument interfaces, the spacecraft and instrument contractors **shall** use the International System of Units (SI) for all measurement units in accordance with IEEE/ASTM SI-10. The contractor may include English units in parenthesis for clarification.
GIRD51	3.1.4	**3.1.4 Coordinates**
GIRD52	3.1.4.0-1	The orbit reference frame (ORF) **shall** be defined as follows: *(CCR 00005)* The ORF is orthogonal and right-handed. The ORF origin is at the spacecraft center of mass. The ORF +z axis points toward the center of the Earth. The ORF +y axis points along the negative orbit normal. The ORF +x axis completes the triad.
GIRD53	3.1.4.0-2	The body reference frame (BRF) **shall** be defined as follows: *(CCR 00005)* The BRF is orthogonal and right-handed. The BRF is fixed to the body of the spacecraft. The location of the BRF origin will be specified by the spacecraft contractor. The BRF axes are nominally parallel to the ORF axes when spacecraft attitude is in its nominal Earth-pointing, upright yaw attitude with zero attitude error. The roll, pitch, and yaw axes are defined to be parallel to the BRF x, y, and z axes, respectively.
GIRD54	3.1.4.0-3	If there is a yaw-flip, the spacecraft will be flown upright (+Y BRF pointed in the +Y ORF direction) during northern hemisphere winter and inverted (+Y BRF pointed in the -Y ORF direction) during northern hemisphere summer. i.e., the +Y BRF axis is generally in the same hemisphere as the Sun.
GIRD55	3.1.4.0-4	If there is no yaw-flip, the spacecraft will be flown upright all year.

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GIRD1063	3.1.4.0-5	At the option of the government, the spacecraft may be flown such that the BRF is offset from the ORF so that the BRF x-axis is always parallel to the Earth's equator and/or the BRF z-axis always points to the nominal subsatellite point.
GIRD870	3.1.4.0-6	The reference coordinate system of each instrument unit **shall** be nominally parallel to the spacecraft BRF coordinate system, with the exception of solar-pointing instruments.
GIRD871	3.1.4.0-7	The origin of the coordinate system of each instrument unit **shall** be located and defined inside the mechanical envelope of the instrument unit.
GIRD1135	3.1.5	**3.1.5 Yaw Flip**
GIRD1136	3.1.5.0-1	For an instrument with passive cryogenic detector cooling, the GOES spacecraft will be rotated 180^{O} about the Z-axis (yaw) twice per year to keep the -Y axis side of the spacecraft shaded, within ±4 days of the Sun crossing the orbit plane.
GIRD1137	3.1.5.0-2	The rotation will be performed any time during the 8-day window and will be carried out such that neither the Sun nor Earth illuminates the cooler during the maneuver. The maneuver is expected to last less than 1 hour. The net effect reverses the sign of the roll and pitch axes while maintaining yaw pointing at nadir.
GIRD56	3.2	**3.2 Interface Requirements**
GIRD931	3.2.0-1	All instrument-to-spacecraft interfaces **shall** be single fault tolerant.
GIRD57	3.2.1	**3.2.1 Mechanical**
GIRD58	3.2.1.1	**3.2.1.1 Instrument Envelopes**
GIRD59	3.2.1.1.0-1	The instrument units **shall** meet the dimensional envelope constraints defined in the UIID under conditions encountered during launch, deployment, and on-orbit operations.
GIRD60	3.2.1.1.1	**3.2.1.1.1 Envelope Documentation**
GIRD61	3.2.1.1.1.0-1	The instrument contractor will document the instrument unit envelopes in the IDD by engineering drawings with a set of "not to exceed" dimensions. The instrument envelopes will be inclusive of the thermal blankets.
GIRD62	3.2.1.1.1.0-2	The instrument contractor will ensure that the swept or deployed volume includes tolerances, distortions and misalignments.
GIRD63	3.2.1.1.2	**3.2.1.1.2 Critical Clearances**
GIRD65	3.2.1.1.2.0-1	The satellite **shall** fit within the dynamic envelope of the launch vehicle fairing as described in the satellite-to-launch vehicle ICD.
GIRD66	3.2.1.1.2.0-2	The spacecraft contractor will position the instrument units on the spacecraft to ensure that the stowed, deploying, and final deployed positions of the instrument units clear all obstacles including obstacles on the spacecraft, other instruments, and the launch vehicle.
GIRD67	3.2.1.1.2.0-3	A minimum of 2.5 cm clearance **shall** be maintained between the instrument units and surrounding structure.
GIRD69	3.2.1.1.2.0-4	The spacecraft contractor will implement a critical clearance analysis to ensure that the clearance rule is not violated.
GIRD70	3.2.1.1.2.0-5	The instrument thermal blankets **shall** not impede any deployment or mechanism motion.
GIRD72	3.2.1.2	**3.2.1.2 Fields of View**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD73	3.2.1.2.0-1	The spacecraft **shall** provide the instrument fields-of-view defined in the UIID.
GIRD74	3.2.1.2.0-2	The instrument contractor will document the instrument field-of-view requirements in the IDD.
GIRD77	3.2.1.2.0-3	Instruments **shall** meet all performance requirements whether or not the spacecraft performs a yaw flip, except for instruments with cryogenic detectors cooled by a passive radiator.
GIRD78	3.2.1.3	**3.2.1.3 Mass Properties**
GIRD79	3.2.1.3.0-1	The instrument mass **shall** be less than or equal to that allocated in the UIID.
GIRD80	3.2.1.3.0-2	The mass of the instrument units will be measured with an accuracy of ±0.5 kg.
GIRD81	3.2.1.3.0-3	The instrument mass **shall** be constant unless mass expulsion rates and substances are allocated by the UIID.
GIRD83	3.2.1.3.0-4	The nominal launch mass with tolerances of each instrument unit will be provided to the spacecraft contractor for documentation in the ICD.
GIRD84	3.2.1.3.1	**3.2.1.3.1 Center of Mass**
GIRD87	3.2.1.3.1.0-1	The instrument contractor will determine the centers of mass for each flight instrument unit relative to the instrument unit coordinate system with an accuracy of ± 5 mm including launch and deployed configurations.
GIRD88	3.2.1.3.1.0-2	The launch and deployed centers of mass with tolerances of each instrument unit will be provided to the spacecraft contractor for documentation in the ICD, referenced to the instrument coordinate axes.
GIRD90	3.2.1.3.2	**3.2.1.3.2 Inertia Properties**
GIRD91	3.2.1.3.2.0-1	The instrument unit moment of inertia will be defined using the instrument unit coordinate frame passing through the instrument center of mass.
GIRD92	3.2.1.3.2.0-2	The instrument contractor will determine the moments and products of inertia values with an accuracy of ± 5% of the maximum principal moment of inertia.
GIRD93	3.2.1.3.2.0-3	The launch and deployed moments and products of inertia with tolerances of each separately-mounted instrument unit, referenced to the instrument coordinate axes, will be provided to the spacecraft contractor for documentation in the ICD.
GIRD96	3.2.1.4	**3.2.1.4 Mounting**
GIRD97	3.2.1.4.1	**3.2.1.4.1 Hardware**
GIRD98	3.2.1.4.1.0-1	The spacecraft contractor will define and document all mounting hardware in the ICD and indicate the hardware provider.
GIRD99	3.2.1.4.1.0-2	Unless otherwise specified, the spacecraft contractor will provide all mounting hardware for the instrument units.
GIRD100	3.2.1.4.1.0-3	The instrument sensor unit **shall** mount to the spacecraft as described in the instrument UIID.
GIRD101	3.2.1.4.1.0-4	The instrument contractor will provide all kinematic mounts, plus vibration isolation and thermal isolation mounting hardware.
GIRD102	3.2.1.4.1.0-5	The instrument units will be delivered to the spacecraft contractor with flight mounts installed.
GIRD103	3.2.1.4.2	**3.2.1.4.2 Method**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD104	3.2.1.4.2.0-1	The spacecraft and instruments **shall** be designed using a mounting method that accommodates manufacturing tolerances, structural distortion, thermal distortions and alignment requirements. *(CCR 00096A)*
GIRD1155	3.2.1.4.2.0-2	Partitioning of the mounting method tolerances, distortions, and alignment requirements between the spacecraft and the instruments **shall** be defined in the ICD. *(CCR 00096A)*
GIRD105	3.2.1.4.2.0-3	The instrument units, excluding the sensor unit **shall** be capable of being mounted to the spacecraft with the spacecraft mounting surface in the vertical or in the horizontal position with the spacecraft mounting surface normal pointing up.
GIRD1070	3.2.1.4.2.0-4	The instrument sensor unit **shall** be capable of being mounted to the spacecraft with the spacecraft mounting surface in the horizontal position with the spacecraft mounting surface normal pointing up.
GIRD106	3.2.1.4.2.0-5	For instrument units with a mass greater than 15 kg, a minimum of three lifting points **shall** be provided.
GIRD107	3.2.1.4.2.0-6	The design of the lifting points **shall** allow handling with an overhead crane including when the unit is in its flight configuration.
GIRD1056	3.2.1.4.2.0-7	Each instrument unit design **shall** allow integration and de-integration to the spacecraft while using access constrained to the inside of the instrument dimensional envelope defined in the UIID with access penetrations into this envelope through the face of the envelope that is opposite to the mechanical interface plane.
GIRD109	3.2.1.4.2.0-8	Each instrument unit mounting method **shall** not require access from inside the spacecraft.
GIRD110	3.2.1.4.2.0-9	The method by which each instrument unit is mounted to the spacecraft will be defined in the ICD.
GIRD111	3.2.1.4.3	**3.2.1.4.3 Handling Fixtures**
GIRD112	3.2.1.4.3.0-1	The instrument contractor will provide proof tested handling fixtures for each unit with a mass greater than 15 kg.
GIRD113	3.2.1.4.3.0-2	Handling fixtures **shall** be designed to 5 times limit load for ultimate and 3 times limit load for yield.
GIRD114	3.2.1.4.3.0-3	Handling fixtures will be tested to 2 times working load.
GIRD115	3.2.1.4.4	**3.2.1.4.4 Interface**
GIRD116	3.2.1.4.4.0-1	The spacecraft mounting surface **shall** be flat to less than 0.83 mm per meter peak to peak.
GIRD117	3.2.1.4.4.0-2	The spacecraft contractor working with the instrument contractor will define the mechanical mounting interface requirements for each instrument unit in the ICD. Requirements include surface flatness, finish, mounting bolt size, number, material, and torque limits.
GIRD118	3.2.1.4.5	**3.2.1.4.5 Location**
GIRD119	3.2.1.4.5.0-1	The spacecraft contractor working with the instrument contractor will define and document the location and orientation of instrument units on the spacecraft in the ICD.
GIRD120	3.2.1.4.5.0-2	Coordinates and dimensions of the holes for mounting hardware will be specified at the mechanical interface and defined in the ICD.
GIRD121	3.2.1.4.6	**3.2.1.4.6 Drill Templates**

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GIRD122	3.2.1.4.6.0-1	The pattern of mounting holes in a unit **shall** allow like units to be interchanged.
GIRD123	3.2.1.4.6.0-2	Instrument unit, spacecraft, and test fixture interfaces **shall** be drilled using templates to correctly establish the pattern of the mounting holes.
GIRD124	3.2.1.4.6.0-3	The drill template **shall** include appropriate alignment, orientation and location reference information and alignment cubes if required.
GIRD125	3.2.1.4.6.0-4	The spacecraft contractor will document fabrication, functional requirements, and orientation information for the drill templates in the ICD.
GIRD126	3.2.1.4.6.0-5	The instrument contractor will provide an alignment drill template labeled with appropriate alignment, orientation, location reference information, and alignment cubes if necessary.
GIRD127	3.2.1.5	**3.2.1.5 Alignment**
GIRD135	3.2.1.5.0-1	The instrument contractor will measure the alignment between the sensor line-of-sight and the instrument alignment reference frame and deliver the results to the spacecraft contractor.
GIRD1065	3.2.1.5.0-2	The spacecraft contractor is responsible for the alignment knowledge of the input axes of the spacecraft IRU with respect to the IRU reference frame.
GIRD138	3.2.1.5.0-3	The spacecraft contractor will document all alignment measurements in an alignment report.
GIRD1066	3.2.1.5.0-4	The spacecraft and instrument contractors will negotiate and document in the ICD any relevant alignment requirements not specified in this document (GIRD).
GIRD128	3.2.1.5.1	**3.2.1.5.1 Nadir Pointed Instrument Alignment *(CCR 00332)***
GIRD1083	3.2.1.5.1.1	**3.2.1.5.1.1 References**
GIRD129	3.2.1.5.1.1.0-1	The instrument **shall** include a permanent alignment reference on the instrument sensor unit composed of a minimum 2.54 cm alignment cube and a mounting surface datum. The instrument alignment cube defines the instrument alignment reference frame.
GIRD131	3.2.1.5.1.1.0-2	The spacecraft inertial reference unit (IRU) **shall** include an alignment cube mounted on the IRU. This alignment cube defines the IRU reference frame. The IRU reference frame is the navigation reference frame of the spacecraft and is nominally parallel to the BRF.
GIRD132	3.2.1.5.1.1.0-3	The spacecraft IRU and instrument alignment cube pairs **shall** be viewable from two orthogonal directions.
GIRD133	3.2.1.5.1.1.0-4	The instrument contractor will document the location of all instrument optical alignment cubes in the IDD.
GIRD1064	3.2.1.5.1.1.0-5	The instrument mounting frame is an orthogonal reference frame defined by the locations of the spacecraft side of the instrument mounting points. A rigorous definition of this frame will be documented in the ICD. The instrument mounting frame is nominally parallel to the BRF.
GIRD1084	3.2.1.5.1.2	**3.2.1.5.1.2 Responsibilities**
GIRD136	3.2.1.5.1.2.0-1	The spacecraft contractor will align the instrument alignment reference frame to the spacecraft IRU reference frame.
GIRD137	3.2.1.5.1.2.0-2	The spacecraft contractor will measure the alignment between the instrument alignment reference frame and the spacecraft IRU reference frame.
GIRD1085	3.2.1.5.1.3	**3.2.1.5.1.3 Placement**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD140	3.2.1.5.1.3.0-1	The placement of the instrument alignment reference frame with respect to the spacecraft IRU reference frame **shall** be to within 0.25 degrees per axis (TBR), including variation over all launch and on-orbit environments
GIRD1086	3.2.1.5.1.4	**3.2.1.5.1.4 Initial Alignment Knowledge**
GIRD142	3.2.1.5.1.4.0-1	The prelaunch alignment knowledge of the instrument alignment reference frame with respect to the spacecraft IRU input axes **shall** be 50 (TBR) microradians or better per axis.
GIRD1087	3.2.1.5.1.5	**3.2.1.5.1.5 On-Orbit Alignment Knowledge**
GIRD1088	3.2.1.5.1.5.0-1	The on-orbit alignment knowledge of the instrument mounting frame with respect to the spacecraft IRU input axes **shall** be 50 (TBR) microradians or better, per axis. This requirement includes launch shift, on-orbit calibration uncertainty, on-orbit environments, and spacecraft structural and thermal stability.
GIRD1089	3.2.1.5.1.5.0-2	Contractor-specified operations for on-orbit calibration **shall** be consistent with the GOES-R operational concept, particularly as related to operational outages, as documented in **TBS**.
GIRD1090	3.2.1.5.1.6	**3.2.1.5.1.6 Alignment Rate of Change**
GIRD144	3.2.1.5.1.6.0-1	The rate of change of the alignment of the instrument mounting frame with respect to the spacecraft IRU input axes **shall** not exceed 100 (TBR) microradians per hour per axis. This requirement includes on-orbit environments and spacecraft structural and thermal stability.
GIRD1091	3.2.1.5.2	**3.2.1.5.2 Reserved *(CCR 00095)***
GIRD1092	3.2.1.5.2.1	**3.2.1.5.2.1 Reserved *(CCR 00095)***
GIRD1093	3.2.1.5.2.1.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1094	3.2.1.5.2.1.0-2	Reserved *(CCR 00077) (CCR 00095)*
GIRD1095	3.2.1.5.2.1.0-3	Reserved *(CCR 00077) (CCR 00095)*
GIRD1096	3.2.1.5.2.1.0-4	Reserved *(CCR 00095)*
GIRD1097	3.2.1.5.2.1.0-5	Reserved *(CCR 00077) (CCR 00095)*
GIRD1098	3.2.1.5.2.2	**3.2.1.5.2.2 Reserved *(CCR 00095)***
GIRD1099	3.2.1.5.2.2.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1100	3.2.1.5.2.2.0-2	Reserved *(CCR 00077) (CCR 00095)*
GIRD1101	3.2.1.5.2.2.0-3	Reserved *(CCR 00077) (CCR 00095)*
GIRD1102	3.2.1.5.2.2.0-4	Reserved *(CCR 00077) (CCR 00095)*
GIRD1103	3.2.1.5.2.3	**3.2.1.5.2.3 Reserved *(CCR 00095)***
GIRD1104	3.2.1.5.2.3.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1105	3.2.1.5.2.4	**3.2.1.5.2.4 Reserved *(CCR 00095)***
GIRD1106	3.2.1.5.2.4.0-1	Reserved *(CCR 00095)*
GIRD1107	3.2.1.5.2.5	**3.2.1.5.2.5 Reserved *(CCR 00095)***

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GIRD1108	3.2.1.5.2.5.0-1	Reserved *(CCR 00095)*
GIRD145	3.2.1.6	**3.2.1.6 Access**
GIRD146	3.2.1.6.0-1	The position of the instrument units on the spacecraft **shall** leave adequate clearance between the instrument and surrounding structures to provide access to instrument mounting hardware, access to instrument connectors, and space for instrument interfacing harness service loops.
GIRD147	3.2.1.6.0-2	Instrument access requirements will be documented in the ICD.
GIRD148	3.2.1.6.0-3	All instrument units to be installed, removed or replaced at the satellite level **shall** be accessible without disassembly of the unit.
GIRD149	3.2.1.7	**3.2.1.7 Attitude and Disturbances for Nadir Pointed Instruments *(CCR 00332)***
GIRD150	3.2.1.7.0-1	The requirements in this section apply to nadir-pointing instruments while the instrument is on orbit and operating and also to body-mounted space environment instruments.
GIRD151	3.2.1.7.1	**3.2.1.7.1 Spacecraft Attitude and Disturbances**
GIRD1109	3.2.1.7.1.0-1	The interface attitude error and disturbance limits include government-held reserve and all spacecraft errors, including orbit and attitude knowledge, attitude command error, and attitude control error with all instruments operating in normal operational mode.
GIRD152	3.2.1.7.1.1	**3.2.1.7.1.1 Attitude Error**
GIRD153	3.2.1.7.1.1.0-1	The attitude error of the instrument mounting frame relative to the desired ORF-referenced attitude **shall** not exceed ± 360 **(TBR)** microradians, 3-sigma, per axis. Attitude error is defined as the difference between the desired attitude and the actual, or true, attitude of the instrument mounting frame.
GIRD1067	3.2.1.7.1.1.0-2	The instrument mounting frame attitude **shall** be stable to within 500 microradians, peak-to-peak, 3-sigma, per axis, over any 60-second period of time.
GIRD154	3.2.1.7.1.2	**3.2.1.7.1.2 Attitude Error Rate**
GIRD155	3.2.1.7.1.2.0-1	For a given total spacecraft gyro signal phase delay, the instrument mounting frame attitude error rate relative to the desired ORF-referenced attitude **shall** not exceed ± the corresponding limit from the Total Spacecraft Gyro Signal Phase Delay and Rate Error Trade Space Figure provided below, per axis, when the rate is filtered by a fourth order Butterworth low pass filter with a -3dB frequency of 15 Hz.

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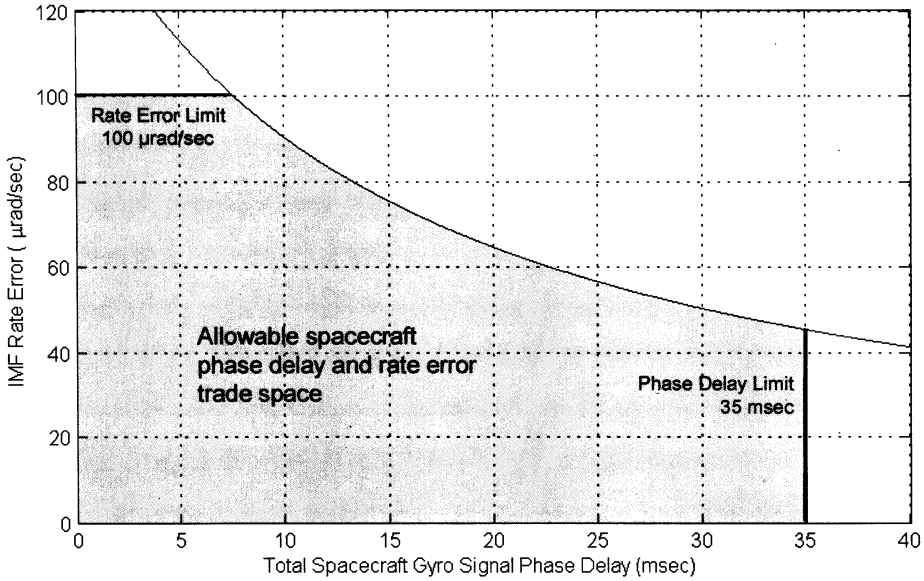
GIRD155 3.2.1.7.1.2.0-1



Total Spacecraft Gyro Signal Phase Delay and Rate Error Trade Space Figure

GIRD156 3.2.1.7.1.3

3.2.1.7.1.3 Spacecraft Translation Acceleration Limits

GIRD157 3.2.1.7.1.3.0-1

The translational accelerations at the spacecraft side of each instrument sensor unit mount **shall** not exceed the limits specified in the Translational Acceleration Limits for Spacecraft to Instrument Table below. The limits apply to each orthogonal axis after the acceleration is bandpass-filtered using at least a fourth-order band-pass Butterworth filter with -3dB frequencies of f_1 and f_2. Note that the filter has fourth-order rolloff on both sides of the response. The accelerations can be present at any combination of the instrument sensor unit mounts and along any combination of the three orthogonal axes at each mount. *(CCR 00163)*

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GIRD157 3.2.1.7.1.3.0-1

Translational Acceleration Limits for Spacecraft to Instrument Table

f_1 (Hz)	f_2 (Hz)	Peak Limit (mg)	f_1 (Hz)	f_2 (Hz)	Peak Limit (mg)	f_1 (Hz)	f_2 (Hz)	Peak Limit (mg)
0.0	512.0	18.44	26.9	30.2	0.40	114.0	128.0	2.40
0.9	10.1	1.50	28.5	32.0	0.40	120.8	135.6	2.40
6.3	32.0	1.00	30.2	33.9	1.40	128.0	143.7	2.40
20.2	101.6	4.29	32.0	35.9	1.40	135.6	152.2	1.40
64.0	322.5	10.55	33.9	38.1	1.40	143.7	161.3	1.40
203.2	512.0	15.16	35.9	40.3	1.40	152.2	170.9	1.40
9.0	10.1	0.40	38.1	42.7	1.40	161.3	181.0	3.02
9.5	10.7	0.40	40.3	45.3	1.40	170.9	191.8	3.02
10.1	11.3	0.40	42.7	47.9	1.40	181.0	203.2	3.02
10.7	12.0	0.40	45.3	50.8	1.40	191.8	215.3	3.02
11.3	12.7	0.40	47.9	53.8	1.40	203.2	228.1	2.56
12.0	13.5	0.40	50.8	57.0	3.18	215.3	241.6	2.56
12.7	14.3	0.40	53.8	60.4	3.18	228.1	256.0	2.56
13.5	15.1	0.40	57.0	64.0	3.18	241.6	271.2	2.56
14.3	16.0	0.40	60.4	67.8	3.18	256.0	287.4	2.56
15.1	17.0	0.40	64.0	71.8	3.18	271.2	304.4	2.56
16.0	18.0	0.40	67.8	76.1	3.18	287.4	322.5	2.56
17.0	19.0	0.40	71.8	80.6	1.40	304.4	341.7	2.56
18.0	20.2	0.40	76.1	85.4	1.40	322.5	362.0	2.56
19.0	21.4	0.40	80.6	90.5	1.40	341.7	383.6	2.56
20.2	22.6	0.40	85.4	95.9	1.40	362.0	406.4	2.56
21.4	24.0	0.40	90.5	101.6	1.40	383.6	430.5	2.56
22.6	25.4	0.40	95.9	107.6	1.40	406.4	456.1	2.56
24.0	26.9	0.40	101.6	114.0	1.40	430.5	483.3	2.56
25.4	28.5	0.40	107.6	120.8	2.40	456.1	512.0	2.56

(CCR 00163)

GIRD1110 3.2.1.7.1.3.0-2

The translational accelerations at the spacecraft side of each instrument sensor unit mount **shall** produce an absolute peak acceleration Shock Response Spectra (SRS) less than the limits set in the On Orbit Operational SRS Acceleration Limits Table below. The limits apply to each orthogonal axis for SRS natural frequencies when using a quality factor, Q, of 50. The SRS is computed after the acceleration is high pass filtered with a fourth order Butterworth filter with a -3dB cut off at 1.0 Hz. Use a logarithmic interpolation for both frequency and acceleration terms in the On Orbit Operational SRS Acceleration Limits Table. *(CCR 00163)*

GIRD1110 3.2.1.7.1.3.0-2 **On Orbit Operational SRS Acceleration Limits Table**

f (Hz)	SRS Limit (mg)	SRS Limit/ Q (mg)	f (Hz)	SRS Limit (mg)	SRS Limit/ Q (mg)
10	10.0	0.20	138	45.0	0.90
30	10.0	0.20	165	45.0	0.90
30	30.0	0.60	177	140.7	2.81
52	30.0	0.60	198	140.7	2.81
59	135.2	2.70	210	45.0	0.90
66	135.2	2.70	225	45.0	0.90
73	30.0	0.60	236	103.9	2.08
90	30.0	0.60	264	103.9	2.08
90	45.0	0.90	275	45.0	0.90
112	45.0	0.90	285	45.0	0.90
118	102.3	2.05	295	82.2	1.64
132	102.3	2.05	300	82.2	1.64

(CCR 00163)

GIRD158 3.2.1.7.2 **3.2.1.7.2 Instrument-to-Spacecraft Disturbances**

GIRD159 3.2.1.7.2.1 **3.2.1.7.2.1 Instrument Disturbance Torque Limits**

GIRD160 3.2.1.7.2.1.0-1 At any time during the operational mode of the spacecraft, the sum of the magnitude of the instrument sensor unit's uncompensated torques and the magnitude of its uncompensated linear forces multiplied by a lever arm of 2 meters **shall** not exceed 1.0 N-m.

GIRD161 3.2.1.7.2.2 **3.2.1.7.2.2 Instrument Allowable Angular Momentum**

GIRD162 3.2.1.7.2.2.0-1 The magnitude of the instrument unit's uncompensated angular momentum **shall** not exceed 1.0 N-m-sec.

GIRD163 3.2.1.7.2.2.0-2 The instrument contractor will document the angular momentum produced by the instrument in the IDD.

GIRD164 3.2.1.7.2.3 **3.2.1.7.2.3 Instrument Disturbances Allocation**

GIRD165 3.2.1.7.2.3.0-1 The instrument **shall** not exceed disturbances defined in the UIID given a spacecraft characterized by Laplace domain transfer functions $H_{\theta T}(s)$, $sH_{\theta T}(s)$ and $as^2H_{\theta T}(s)$ with the parameters in the tables named Parameters for Roll Torques and Rotations about the X Axis, Parameters for Pitch Torques and Rotations about the Y Axis, and Parameters for Yaw Torques and Rotations about the Z Axis.

Filtering the instrument sensor unit torque time history in Newton-meter units with $H_{\theta T}(s)$ estimates the spacecraft pointing error displacement in radian units. Filtering with $sH_{\theta T}(s)$ estimates the spacecraft pointing error rate in radians per second units. Filtering with $as^2H_{\theta T}(s)$ estimates the spacecraft linear acceleration at a mount in meters per second per second units. When filtering roll axis torques with $H_{\theta T}(s)$, $sH_{\theta T}(s)$ and $as^2H_{\theta T}(s)$, use table Parameters for Roll Torques and Rotations about the X Axis. When filtering pitch, use table Parameters for Pitch Torques and Rotations about the Y Axis. When filtering yaw, use table Parameters for Yaw Torques and Rotations about the Z Axis. Transfer function $H_{\theta T}(s)$ is

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GIRD165	3.2.1.7.2.3.0-1	plotted in Figure Torque to Spacecraft Pointing Error Transfer Functions for roll, pitch and yaw.

Torque to Angular Displacement Transfer Function

$$\frac{\theta(s)}{T(s)} = H_{\theta T}(s)$$

Torque to Angular Rate Transfer Function

$$\frac{\dot{\theta}(s)}{T(s)} = sH_{\theta T}(s)$$

Torque to Translational Acceleration Transfer Function

$$\frac{\ddot{x}(s)}{T(s)} = as^2 H_{\theta T}(s)$$

where

$$H_{\theta T}(s) = \sum_{i=1}^{n} \frac{1/J_i}{s^2 + 2\zeta_i \omega_i s + \omega_i^2} \quad \text{and} \quad \omega_i = 2\pi f_i .$$

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GIRD165	3.2.1.7.2.3.0-1	

Parameters for Roll Torques and Rotations about the X Axis

a (m)	n	i	f_i (Hz)	ζ_i (%)	J_i (kg-m^2)
1.5	12	1	0.01	30.0	4721
		2	0.40	2.0	10733
		3	1.34	0.1	59081
		4	1.92	0.1	34514
		5	13.24	0.1	972
		6	16.54	0.1	732
		7	23.56	0.1	3468
		8	30.55	0.1	5017
		9	30.91	0.1	2975
		10	31.00	0.1	1313
		11	31.17	0.1	1204
		12	39.36	0.1	25821

Parameters for Pitch Torques and Rotations about the Y Axis

a (m)	n	i	f_i (Hz)	ζ_i (%)	J_i (kg-m^2)
1.5	9	1	0.01	30.0	3203
		2	1.35	0.1	89061
		3	13.24	0.1	820
		4	16.54	0.1	1620
		5	23.56	0.1	985
		6	30.55	0.1	55722
		7	30.91	0.1	8377
		8	31.00	0.1	3897
		9	31.17	0.1	6104

Parameters for Yaw Torques and Rotations about the Z Axis

a (m)	n	i	f_i (Hz)	ζ_i (%)	J_i (kg-m^2)
1.5	5	1	0.01	30.0	4873
		2	0.64	2.0	10001
		3	1.35	0.1	76471
		4	31.00	0.1	45578
		5	39.36	0.1	73013

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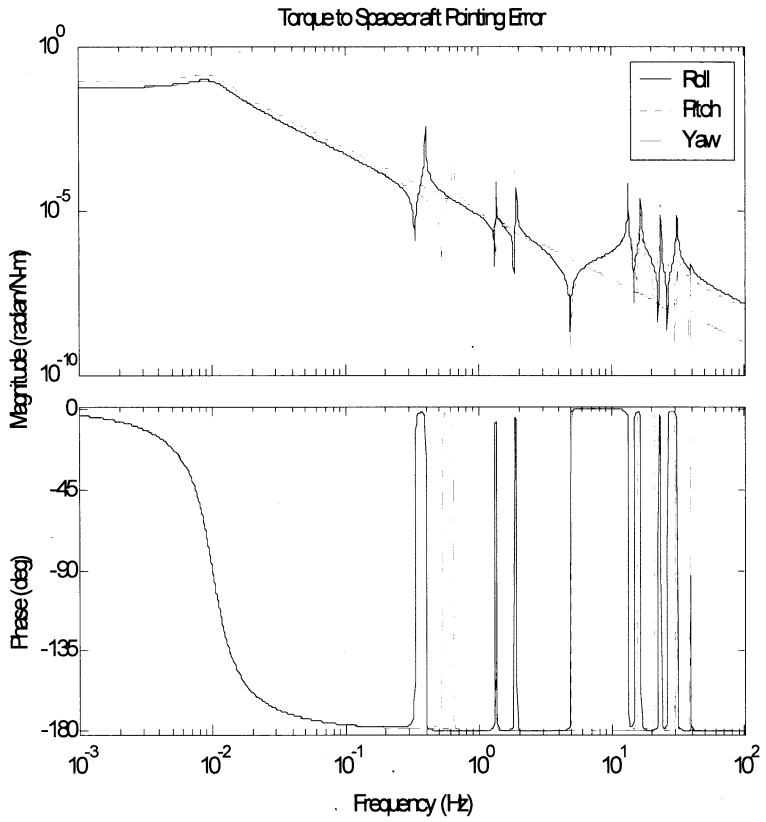
GIRD165	3.2.1.7.2.3.0-1	

Torque to Spacecraft Pointing Error Transfer Functions



GIRD166	3.2.1.8	**3.2.1.8 Reserved *(CCR 00095)***
GIRD1112	3.2.1.8.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1113	3.2.1.8.0-2	Reserved *(CCR 00077) (CCR 00095)*
GIRD1114	3.2.1.8.1	**3.2.1.8.1 Reserved *(CCR 00095)***
GIRD1115	3.2.1.8.1.1	**3.2.1.8.1.1 Reserved *(CCR 00095)***
GIRD1116	3.2.1.8.1.1.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1138	3.2.1.8.1.1.0-2	Reserved *(CCR 00077) (CCR 00095)*
GIRD1117	3.2.1.8.1.1.0-3	Reserved *(CCR 00077) (CCR 00095)*
GIRD1118	3.2.1.8.1.1.0-4	Reserved *(CCR 00077) (CCR 00095)*
GIRD1142	3.2.1.8.1.1.0-5	Reserved *(CCR 00077) (CCR 00095)*
GIRD1143	3.2.1.8.1.1.0-6	Reserved *(CCR 00077) (CCR 00095)*

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GIRD1144	3.2.1.8.1.1.0-7	Reserved *(CCR 00077) (CCR 00095)*
GIRD1145	3.2.1.8.1.1.0-8	Reserved *(CCR 00077) (CCR 00095)*
GIRD1119	3.2.1.8.1.2	**3.2.1.8.1.2 Reserved *(CCR 00077) (CCR 00095)***
GIRD1120	3.2.1.8.1.2.0-1	Reserved *(CCR 00077) (CCR 00095)*
GIRD1121	3.2.1.8.1.3	**3.2.1.8.1.3 Reserved *(CCR 00095)***
GIRD1122	3.2.1.8.1.3.0-1	Reserved *(CCR 00095)*
GIRD1123	3.2.1.8.1.4	**3.2.1.8.1.4 Reserved *(CCR 00095)***
GIRD1124	3.2.1.8.1.4.0-1	Reserved *(CCR 00095)*
GIRD1125	3.2.1.8.1.4.0-2	Reserved *(CCR 00095)*
GIRD1126	3.2.1.8.1.4.0-3	Reserved *(CCR 00095)*
GIRD1127	3.2.1.8.2	**3.2.1.8.2 Reserved *(CCR 00095)***
GIRD1128	3.2.1.8.2.1	**3.2.1.8.2.1 Reserved *(CCR 00095)***
GIRD1129	3.2.1.8.2.1.0-1	Reserved *(CCR 00095)*
GIRD1130	3.2.1.8.2.1.0-2	Reserved *(CCR 00095)*
GIRD1131	3.2.1.8.2.2	**3.2.1.8.2.2 Reserved *(CCR 00095)***
GIRD1132	3.2.1.8.2.2.0-1	Reserved *(CCR 00095)*
GIRD1133	3.2.1.8.2.2.0-2	Reserved *(CCR 00095)*
GIRD1111	3.2.1.9	**3.2.1.9 Flight and Non-Flight Equipment**
GIRD167	3.2.1.9.0-1	The instrument contractor will provide information on all items to be installed or removed prior to flight for identification in the IDD.
GIRD168	3.2.1.9.0-2	The instrument contractor will tag all non-flight items to be removed prior to flight with a red tag stating, "**Remove Before Flight**".
GIRD169	3.2.1.9.0-3	The instrument contractor will tag all flight items to be installed prior to flight with a green tag stating, "**Install Before Flight**".
GIRD170	3.2.2	**3.2.2 Thermal**
GIRD171	3.2.2.1	**3.2.2.1 Thermal Control Concept**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD172	3.2.2.1.0-1	The instrument units installed on the spacecraft bus fall under one of the following categories: a) Thermally-independent units are conductively and radiatively decoupled from the spacecraft and reject their heat directly to space. b) Thermally-coupled units dissipate their heat to the spacecraft. In general: • Instrument electronic units are thermally-coupled. • Instrument sensor units are thermally-independent. The instrument contractor will document the thermal control concept in the IDD. *(CCR 00250)*
GIRD844	3.2.2.1.0-2	The spacecraft **shall** maintain the instrument units mounting surface temperature within instrument Mission Allowable Temperatures (MAT) during instrument operation.
GIRD845	3.2.2.1.0-3	The spacecraft **shall** maintain the instrument units mounting surface temperature within non-operational limits when the instrument is non-operating.
GIRD173	3.2.2.1.1	**3.2.2.1.1 Independent Thermal Control Design**
GIRD1059	3.2.2.1.1.0-1	The instrument contractor is responsible for independent thermal unit thermal design.
GIRD1141	3.2.2.1.1.0-2	Thermally-independent instrument units **shall** restrict heater power consumption within overall power limitations.
GIRD178	3.2.2.1.2	**3.2.2.1.2 Coupled Thermal Control Design**
GIRD179	3.2.2.1.2.0-1	The instrument contractor is responsible for thermally coupled unit internal thermal design. For coupled units, the instrument contractor will provide unit internal design information including internal dissipation, couplings, and interface heat flow so the spacecraft contractor can appropriately interface with the unit.
GIRD180	3.2.2.2	**3.2.2.2 Heat Transfer**
GIRD182	3.2.2.2.0-1	The net heat transfer (conducted and radiated) is the total amount of heat transferred between the instrument units and the spacecraft.
GIRD181	3.2.2.2.1	**3.2.2.2.1 Independent Unit - Heat Transfer**
GIRD183	3.2.2.2.1.0-1	The net heat transfer between the independent unit and spacecraft includes radiation between adjacent instrument and spacecraft surfaces, conduction via the mechanical interface and conduction via the instrument harness.
GIRD184	3.2.2.2.2	**3.2.2.2.2 Independent Unit - Net Heat Transfer**
GIRD185	3.2.2.2.2.0-1	For Independent Units, the net heat transfer averaged over the instrument independent unit interface plane area **shall** be less than 15.5 watts/m^2.
GIRD186	3.2.2.2.3	**3.2.2.2.3 Coupled Unit Heat Transfer**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD187	3.2.2.2.3.0-1	The spacecraft **shall** provide a heat rejection path for thermally coupled units. Units with less than 5 watts dissipation may rely on radiative rather than conductive heat rejection subject to agreement of the instrument and spacecraft contractors. Where conduction is the principal heat transfer mechanism, the interface temperature is the spacecraft side of the mechanical interface. For radiatively-coupled units (accommodated within the spacecraft) the interface temperature is the average local environment surrounding unit external surfaces.
GIRD188	3.2.2.2.4	**3.2.2.2.4 Coupled Unit - Net Heat Transfer**
GIRD189	3.2.2.2.4.0-1	The net heat transfer collectively from the instrument's coupled units to the spacecraft **shall** not exceed the values dictated by the UIID.
GIRD190	3.2.2.2.5	**3.2.2.2.5 Coupled Unit - Heat Transfer Flux Density**
GIRD191	3.2.2.2.5.0-1	For conductively-coupled units, peak local heat transfer fluxes conducted to the spacecraft in excess of 0.25 watts per square centimeter **shall** be coordinated with the spacecraft contractor and subject to NASA concurrence.
GIRD192	3.2.2.2.5.0-2	Where this watt density is exceeded, the spacecraft contractor will provide a detailed description of the heat transport features and SINDA model of the spacecraft side interface.
GIRD193	3.2.2.3	**3.2.2.3 Interface Temperatures**
GIRD201	3.2.2.3.0-1	For planning and preliminary design purposes, the interface temperature (spacecraft side) for Earth-viewing instruments **shall** be: a) 0°C to 40°C during operation b) -30°C to 50°C during non-operation
GIRD203	3.2.2.4	**3.2.2.4 Temperature Monitoring**
GIRD204	3.2.2.4.1	**3.2.2.4.1 Mechanical Interface Temperature Monitoring**
GIRD205	3.2.2.4.1.0-1	The instrument contractor will select a unit attachment point and identify it on the IDD.
GIRD206	3.2.2.4.1.0-2	The spacecraft **shall** have a temperature sensor adjacent to this attachment point (on the spacecraft side) to serve as the interface temperature sensor.
GIRD207	3.2.2.4.2	**3.2.2.4.2 Instrument Critical Temperatures**
GIRD208	3.2.2.4.2.0-1	The spacecraft **shall** convey instrument critical temperatures via the spacecraft telemetry stream.
GIRD209	3.2.2.4.2.0-2	The type(s) of temperature sensor and excitation will be collectively selected by the instrument contractor and spacecraft contractor and is subject to NASA concurrence.
GIRD210	3.2.2.4.2.0-3	The instrument contractor will procure and install the critical temperature sensors.
GIRD211	3.2.2.4.2.0-4	The instrument contractor will furnish temperature calibration coefficients for the critical temperature sensors and document them in the IDD.
GIRD212	3.2.2.4.3	**3.2.2.4.3 Instrument Non-Critical Temperatures**
GIRD213	3.2.2.4.3.0-1	The instrument **shall** report instrument non-critical temperatures in telemetry.
GIRD216	3.2.2.5	**3.2.2.5 Heater Power and Heater Control**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD217	3.2.2.5.0-1	The two categories of instrument heaters are: • Operational heaters controlled by the instrument • Non-operational (survival) heaters powered by the spacecraft When the instrument is OFF, the instrument survival heaters **shall** consume no more than 35% of nominal operational power (of the independent units) averaged over every 72 minute period.
GIRD219	3.2.2.6	**3.2.2.6 Thermal Interfaces**
GIRD220	3.2.2.6.1	**3.2.2.6.1 Mounting Details**
GIRD221	3.2.2.6.1.0-1	The spacecraft contractor will document in the ICD properties of any thermally conductive or isolating materials used at the interface of the instrument unit. *(CCR 00021)*
GIRD223	3.2.2.6.2	**3.2.2.6.2 Contact Area**
GIRD224	3.2.2.6.2.0-1	Unit mounting contact area on the instrument and spacecraft **shall** be unpainted.
GIRD225	3.2.2.6.3	**3.2.2.6.3 Interstitial Materials**
GIRD226	3.2.2.6.3.0-1	The spacecraft contractor will integrate the instrument units onto the spacecraft including application of any interstitial materials as conductive enhancements. Selection and application of any interface materials require the concurrence of the instrument contractor and spacecraft contractor.
GIRD1079	3.2.2.7	**3.2.2.7 Multi-layer Insulation**
GIRD1080	3.2.2.7.0-1	Multi-layer insulation (MLI) **shall** have provisions for electrical grounding to prevent ESD.
GIRD1081	3.2.2.7.0-2	MLI vents **shall** be located and oriented consistent with observatory contamination requirements.
GIRD227	3.2.3	**3.2.3 Instrument Electrical Power**
GIRD1171	3.2.3.0-1	All instrument electrical power interface requirements **shall** be specified at the instrument input power connectors. *(CCR 00161B)*
GIRD1172	3.2.3.1	**3.2.3.1 Electrical Power Interfaces**
GIRD230	3.2.3.1.0-1	The spacecraft **shall** supply functionally independent, redundant operational power buses to each instrument for normal instrument operation. *(CCR 00161B)*
GIRD1173	3.2.3.1.0-2	The instrument **shall** utilize only one side of the operational power bus at a time. *(CCR 00161B)*
GIRD1174	3.2.3.1.0-3	Inadvertent simultaneous application of both primary and redundant Instrument Operational Power by the spacecraft **shall** not cause damage to the instrument. *(CCR 00161B)*
GIRD1175	3.2.3.1.0-4	The spacecraft **shall** supply functionally independent, redundant survival power buses to each instrument to power the instrument survival heaters. *(CCR 00161B)*
GIRD1176	3.2.3.1.0-5	The instrument **shall** only utilize survival heater power for heaters and associated passive control circuitry which maintains the instrument at its minimum turn-on temperature. *(CCR 00161B)*
GIRD1177	3.2.3.1.0-6	Following initial activation both sides of the instrument survival bus **shall** be powered at all times by the spacecraft. *(CCR 00161B)*
GIRD1178	3.2.3.1.0-7	The spacecraft power system **shall** accommodate instrument operational bus turn on and peak survival bus loading simultaneously for each instrument. *(CCR 00161B)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD1179	3.2.3.1.0-8	The spacecraft power system **shall** accommodate the sequential turn on/activation of all instruments in any order from any combination of operating and survival modes. *(CCR 00161B)*
GIRD1180	3.2.3.1.0-9	Following the initial thermal transition from survival mode following instrument turn-on, the instrument design **shall** not depend on the use of the survival heater buses when operational power is active. *(CCR 00161B)*
GIRD1181	3.2.3.2	**3.2.3.2 Power Specifications *(CCR 00161B)***
GIRD1182	3.2.3.2.1	**3.2.3.2.1 Power Definitions *(CCR 00161B)***
GIRD1183	3.2.3.2.1.0-1	The following definitions **shall** be used when calculating average power, maximum power, and peak current values. Average Power (Operational) - The total power into an instrument averaged over any 5 minute period. Average Power (Survival) - The total power into an instrument averaged over any 72 minute period. Maximum Power (Operational or Survival) - The total power into an instrument averaged over any 20ms period. Peak Current (Operational) - The maximum (never to be exceeded) current drawn by the instrument. Peak current is typically calculated as 1.5 times the maximum power at worst case nominal voltage (26 Vdc). *(CCR 00161B)*
GIRD1184	3.2.3.2.2	**3.2.3.2.2 Power Characteristics *(CCR 00161B)***
GIRD1185	3.2.3.2.2.1	**3.2.3.2.2.1 Voltage *(CCR 00161B)***
GIRD1186	3.2.3.2.2.1.1	**3.2.3.2.2.1.1 Instrument Voltage *(CCR 00161B)***
GIRD242	3.2.3.2.2.1.1.0-1	The spacecraft **shall** supply a DC voltage at the instrument operational power input connector. *(CCR 00161B)*
GIRD1187	3.2.3.2.2.1.1.0-2	At any time after the initial turn on of the instrument, the spacecraft **shall** control the voltage at the instrument operational power input connector to 28 volts ± 2 volts for any condition of instrument load current (including transients). *(CCR 00161B)*
GIRD243	3.2.3.2.2.1.1.0-3	The instrument **shall** operate in accordance with the instrument performance specification within the range of 28 volts Vdc ± 2 volts at the instrument operational power input connector. *(CCR 00161B)*
GIRD356	3.2.3.2.2.1.1.0-4	The spacecraft **shall** supply a steady-state dc voltage of TBD Vdc ± TBD Vdc at the instrument survival heater power input connector. *(CCR 00161B)*
GIRD357	3.2.3.2.2.1.1.0-5	The instrument **shall** operate the instrument survival heaters and associated passive control circuitry to maintain minimum turn-on temperatures with a steady-state dc voltage of TBD Vdc ± TBD Vdc applied at the instrument survival heater power input connector. *(CCR 00161B)*
GIRD1188	3.2.3.2.2.1.2	**3.2.3.2.2.1.2 Voltage Transients *(CCR 00161B)***
GIRD1207	3.2.3.2.2.1.2.0-1	The spacecraft **shall** limit the voltage rate of rise to less than 0.01 V/μsec when powering on instrument operational power interfaces. *(CCR 00161B)*
GIRD1208	3.2.3.2.2.1.2.0-2	During the initial ramp voltage power up of the instrument (0.01 V/μsec) the input voltage to the instrument **shall** not drop more than 0.5 volts. *(CCR 00161B)*

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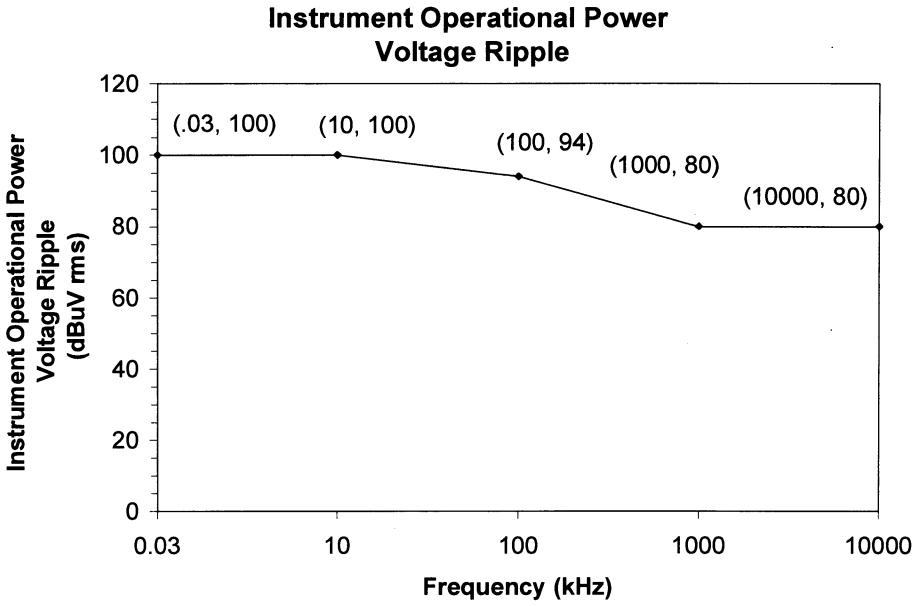
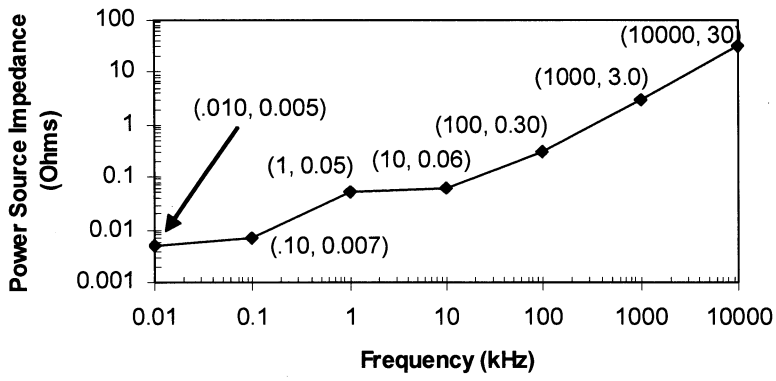
GIRD265	3.2.3.2.2.1.3	**3.2.3.2.2.1.3 Operational Power Voltage Ripple**
GIRD266	3.2.3.2.2.1.3.0-1	The spacecraft **shall** control the instrument operational power voltage ripple to levels that are less than or equal to levels specified in the Instrument Operational Power Voltage Ripple Figure below for all operating modes with all spacecraft power system buses loaded at their maximum steady-state on-orbit load. *(CCR 00161B)*



GIRD270	3.2.3.2.2.1.3.0-2	The test equipment used for the voltage ripple test measurements **shall** comply with sections 4.3.10, 4.3.10.1, 4.3.10.2, and 4.3.10.3.1 of MIL-STD-461 E. *(CCR 00161B)*
GIRD1189	3.2.3.2.2.1.3.0-3	The voltage ripple test measurements **shall** comply with the frequency ranges and corresponding bandwidths, dwell times, and minimum measurement times for the analog measurement receiver as defined in section 4.3.10.3.1 of MIL-STD-461 E. *(CCR 00161B)*
GIRD1190	3.2.3.2.2.1.3.0-4	Emission identification **shall** be in accordance with section 4.3.10.3.2 of MIL-STD-461 E.. *(CCR 00161B)*
GIRD1191	3.2.3.2.2.1.3.0-5	The frequency scanning for the voltage ripple measurements **shall** comply with section 4.3.10.3.3 of MIL-STD-461 E. *(CCR 00161B)*
GIRD1192	3.2.3.2.2.1.3.0-6	Voltage ripple test measurement data **shall** be presented in accordance with section 4.3.10.3.4 of MIL-STD-461 E. *(CCR 00161B)*
GIRD1193	3.2.3.2.2.1.4	**3.2.3.2.2.1.4 Abnormal Operation Voltage Limits *(CCR 00161B)***
GIRD1194	3.2.3.2.2.1.4.0-1	Under abnormal failure mode conditions the spacecraft **shall** limit the maximum operational power supply voltage to 50 Vdc with maximum durations of 10 ms. *(CCR 00161B)*
GIRD262	3.2.3.2.2.1.4.0-2	Under abnormal failure mode conditions the spacecraft **shall** limit the steady state operational power supply voltage to 40 V indefinitely. *(CCR 00161B)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD264	3.2.3.2.2.1.4.0-3	The instrument **shall** survive without damage following exposure to the abnormal operational voltage limits cited in GIRD1194 [3.2.3.2.2.1.4.0-1] and GIRD262 [3.2.3.2.2.1.4.0-2]. *(CCR 00161B)*
GIRD943	3.2.3.2.2.1.5	**3.2.3.2.2.1.5 Voltage Power Source Impedance *(CCR 00161B)***
GIRD944	3.2.3.2.2.1.5.0-1	The spacecraft **shall** control its instrument operational power source impedance to the levels specified in the Spacecraft's Instrument Operational Power Source Impedance Figure below.

Spacecraft's Instrument Operational Power Source Impedance Figure

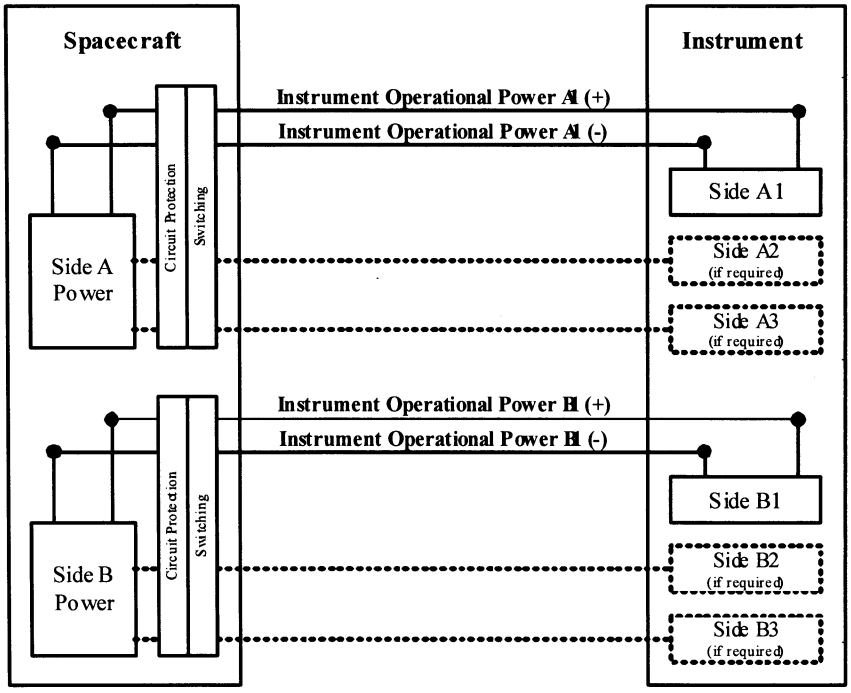


The actual source impedance the instrument will see at the instrument/spacecraft interface will be the source impedance in the figure above modified by the additional impedance of the spacecraft power distribution hardware and the additional impedance of the harness unique to each instrument. These instrument unique spacecraft source impedance values will be documented in the spacecraft to instrument ICDs. *(CCR 00161B)*

GIRD1195	3.2.3.2.2.1.5.0-2	The input impedance of the instrument will be coordinated with the spacecraft provider and documented in the spacecraft to instrument ICD. The instrument supplier should consider input filter design, DI/DT requirements, and negative impedance loading of the instrument power conditioning hardware to mitigate potential stability concerns. *(CCR 00161B)*
GIRD1196	3.2.3.2.2.2	**3.2.3.2.2.2 Current *(CCR 00161B)***
GIRD277	3.2.3.2.2.2.1	**3.2.3.2.2.2.1 Operational Power Transients *(CCR 00161B)***
GIRD1209	3.2.3.2.2.2.1.0-1	The amplitude of any instrument operational power current transient **shall** not exceed the peak current value allocated in the UIIDs. *(CCR 00161B)*
GIRD1197	3.2.3.2.2.2.1.0-2	The instrument **shall** limit any change in operational power current at any time (including initial power turn-on) to no more than 0.2A/μs. *(CCR 00161B)*
GIRD1198	3.2.3.2.2.2.1.0-3	The instrument **shall** control the maximum delta change in operational current at any time to 50% of the peak current allocated in the UIID. *(CCR 00161B)*
GIRD1199	3.2.3.2.3	**3.2.3.2.3 Power Distribution, Control, and Status *(CCR 00161B)***
GIRD232	3.2.3.2.3.1	**3.2.3.2.3.1 Operational Power Lines *(CCR 00161B)***

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD233	3.2.3.2.3.1.0-1	The spacecraft **shall** supply single fault tolerant operational power distribution to the instrument for primary and redundant instrument operational power sources as specified in the Operational Power Lines Figure below.

Operational Power Lines Figure

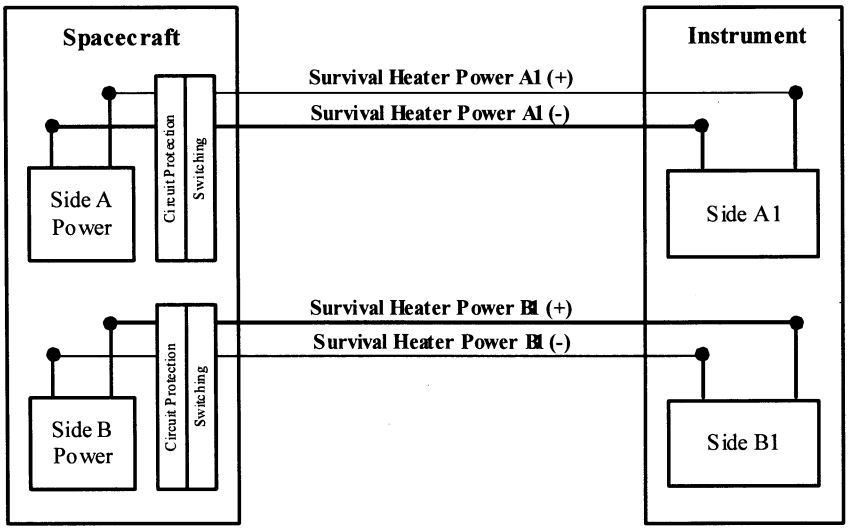


Note: Single-Sided (non-redundant) instruments are required to accommodate both primary and redundant spacecraft operational power at the spacecraft-instrument interface and should provide any associated internal power distribution circuitry required to utilize either spacecraft source. *(CCR 00161B)*

GIRD1200	3.2.3.2.3.1.0-2	The spacecraft **shall** provide each instrument with a maximum of three instrument operational power sources. *(CCR 00161B)*
GIRD926	3.2.3.2.3.1.0-3	The spacecraft **shall** independently sense and telemeter the instrument operational power current being supplied to each primary instrument operational power source. *(CCR 00161B)*
GIRD936	3.2.3.2.3.1.0-4	The spacecraft **shall** independently sense and telemeter the instrument operational power current being supplied to each redundant instrument operational power source. *(CCR 00161B)*
GIRD1156	3.2.3.2.3.1.0-5	The spacecraft and instruments **shall** have independent wire harnesses and connectors for the primary and redundant power cables. *(CCR 00108)*
GIRD234	3.2.3.2.3.2	**3.2.3.2.3.2 Operational Power On/Off Functionality *(CCR 00161B)***
GIRD235	3.2.3.2.3.2.0-1	The spacecraft **shall** provide redundant commanding to switch instrument operational power on and off to the instrument operational power input connector.
GIRD236	3.2.3.2.3.2.0-2	The spacecraft **shall** provide redundant instrument operational power on and off status telemetry.
GIRD237	3.2.3.2.3.2.0-3	The spacecraft **shall** supply redundant switching of instrument operational power to the instrument operational power input connector.

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD238	3.2.3.2.3.2.0-4	The instrument **shall** accept switched power at the instrument operational power input
GIRD239	3.2.3.2.3.3	**3.2.3.2.3.3 Operational Power Overcurrent Protection *(CCR 00161B)***
GIRD1201	3.2.3.2.3.3.0-1	The spacecraft **shall** provide protection of the spacecraft power system by providing overcurrent protection on each instrument operational power connection. *(CCR 00161B)*
GIRD1202	3.2.3.2.3.3.0-2	The size of the spacecraft provided operational power overcurrent devices for each instrument **shall** be documented in the ICD. *(CCR 00161B)*
GIRD240	3.2.3.2.3.3.0-3	Operational Power harness wire sizes **shall** be consistent with overcurrent protection device sizes. *(CCR 00161B)*
GIRD345	3.2.3.2.3.4	**3.2.3.2.3.4 Survival Heater Power Lines *(CCR 00161B)***
GIRD346	3.2.3.2.3.4.0-1	The spacecraft **shall** supply single fault tolerant survival heater power distribution to the instrument for primary and redundant instrument survival heater power sources as specified in the Survival Heater Power Lines Figure below.

Survival Heater Power Lines Figure



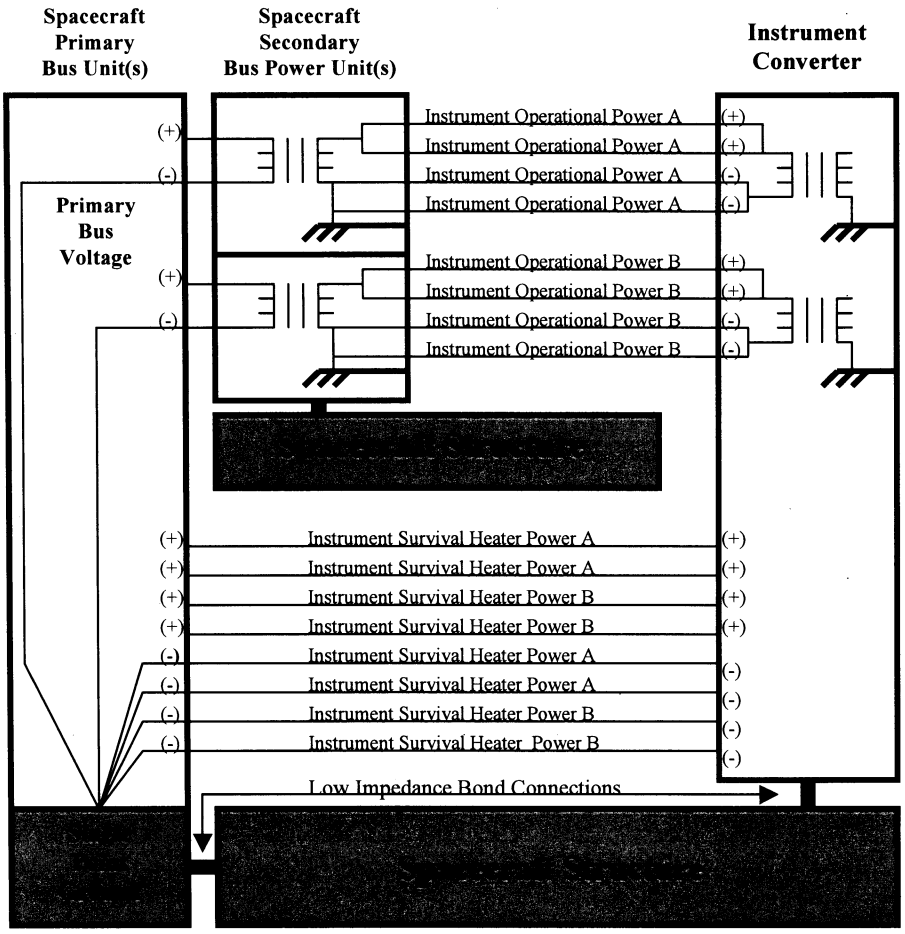
(CCR 00161B)

GIRD1203	3.2.3.2.3.4.0-2	The spacecraft **shall** independently sense and telemeter the instrument survival heater power current being supplied to each primary survival heater power source. *(CCR 00161B)*
GIRD1204	3.2.3.2.3.4.0-3	The spacecraft **shall** independently sense and telemeter the instrument survival heater power current being supplied to each redundant instrument survival heater power source. *(CCR 00161B)*
GIRD348	3.2.3.2.3.5	**3.2.3.2.3.5 Survival Heater Power On/Off Functionality *(CCR 00161B)***
GIRD349	3.2.3.2.3.5.0-1	The spacecraft **shall** provide redundant commanding to switch instrument survival heater power on and off to the instrument survival heater power input connector. *(CCR 00161B)*
GIRD350	3.2.3.2.3.5.0-2	The spacecraft **shall** provide redundant instrument survival heater power on and off status telemetry. *(CCR 00161B)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD351	3.2.3.2.3.5.0-3	The spacecraft **shall** supply redundant switching of instrument survival heater power to the instrument survival heater power input connector.
GIRD352	3.2.3.2.3.5.0-4	The instrument **shall** accept switched power at the instrument survival heater power input connector.
GIRD353	3.2.3.2.3.6	**3.2.3.2.3.6 Survival Heater Power Overcurrent Protection *(CCR 00161B)***
GIRD1205	3.2.3.2.3.6.0-1	The spacecraft **shall** provide protection of the spacecraft power system by providing overcurrent protection on each instrument survival heater power connection. *(CCR 00161B)*
GIRD1206	3.2.3.2.3.6.0-2	The size of the spacecraft provided survival heater power overcurrent devices for each instrument **shall** be documented in the ICD. *(CCR 00161B)*
GIRD354	3.2.3.2.3.6.0-3	Survival Heater Power harness wire sizes **shall** be consistent with overcurrent protection device sizes. *(CCR 00161B).*
GIRD400	3.2.4	**3.2.4 Instrument Electrical Power Grounding**
GIRD401	3.2.4.1	**3.2.4.1 Instrument Operational Power Grounding**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD402	3.2.4.1.0-1	The instrument electrical power grounding **shall** be in accordance with the Electrical Grounding Figure.

Electrical Grounding Figure

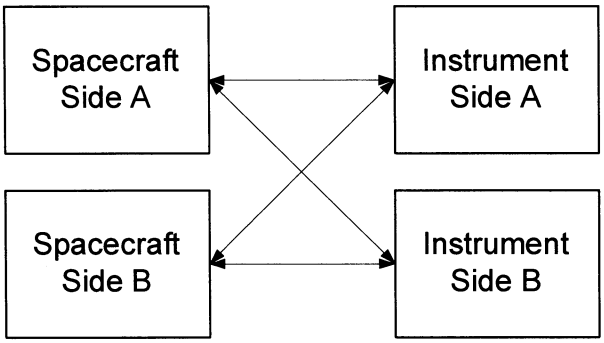


GIRD403	3.2.4.1.0-2	The spacecraft **shall** connect each instrument operational power return to the chassis of the spacecraft secondary bus power unit.
GIRD947	3.2.4.1.0-3	The spacecraft **shall** connect the spacecraft primary bus return(s) to the spacecraft single point ground.
GIRD1058	3.2.4.1.0-4	The spacecraft **shall** control the dc resistance of each primary bus return connection to the single point ground to less than 2.5 milliohms. *(CCR 00008A)*
GIRD404	3.2.4.1.0-5	The spacecraft **shall** control the dc resistance between the spacecraft's instrument operational power return at the spacecraft's secondary power bus unit connector and the spacecraft secondary bus power unit chassis to less than 2.5 milliohms. *(CCR 00008A)*
GIRD972	3.2.4.1.0-6	The spacecraft **shall** supply a low impedance bond connection with a dc resistance of less than 2.5 milliohms between the spacecraft secondary power unit chassis and the spacecraft structure. *(CCR 00008A)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD405	3.2.4.1.0-7	The instrument **shall** isolate the instrument operational power returns from the instrument chassis with a dc resistance greater than 1 megohm.
GIRD410	3.2.4.2	**3.2.4.2 Instrument Survival Heater Power Grounding**
GIRD411	3.2.4.2.0-1	The spacecraft **shall** connect each instrument survival heater power return at spacecraft's primary bus unit connector to the spacecraft's primary bus return with a dc resistance of less than 2.5 milliohms. *(CCR 00008A)*
GIRD412	3.2.4.2.0-2	Reserved *(CCR 00008A)*
GIRD948	3.2.4.2.0-3	The spacecraft **shall** supply a low impedance bond connection with a dc resistance of less than 2.5 milliohms between the single point ground and the spacecraft structure. *(CCR 00008A)*
GIRD413	3.2.4.2.0-4	The instrument **shall** isolate the instrument survival heater power returns from the instrument chassis with a dc resistance greater than 1 megohm.
GIRD414	3.2.4.3	**3.2.4.3 Instrument Secondary Power Grounding**
GIRD415	3.2.4.3.0-1	The instrument **shall** isolate the instrument secondary power returns from the instrument operational power and instrument survival heater power returns with a dc resistance greater than 1 megohm.
GIRD416	3.2.4.3.0-2	The spacecraft **shall** supply a low impedance bond connection with a dc resistance of less than 2.5 milliohm between the spacecraft structure and instrument chassis mounted directly to the spacecraft structure.
GIRD417	3.2.4.3.0-3	The spacecraft **shall** supply a low impedance electrical connection with a dc resistance of less than 25 milliohms between the spacecraft structure and instrument chassis mounted on other surfaces than the spacecraft structure. Examples of mounting surfaces other than the spacecraft structure are the solar array yoke and an optical bench. *(CCR 00008A)*
GIRD949	3.2.4.4	**3.2.4.4 Instrument Electrical Signal Grounding**
GIRD950	3.2.4.4.1	**3.2.4.4.1 Instrument Command Grounding**
GIRD951	3.2.4.4.1.1	**3.2.4.4.1.1 Instrument Pulse Command Grounding**
GIRD952	3.2.4.4.1.1.0-1	The instrument **shall** isolate the instrument pulse command returns from the instrument operational power returns, instrument survival heater power returns, instrument secondary power returns and instrument serial command returns with a dc resistance greater than 1 megohm.
GIRD954	3.2.4.4.1.2	**3.2.4.4.1.2 Instrument Serial Command Grounding**
GIRD955	3.2.4.4.1.2.0-1	The instrument **shall** isolate the instrument serial command returns in accordance with the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.
GIRD956	3.2.4.4.1.3	**3.2.4.4.1.3 Instrument Electro-Explosive Device (EED) Command Grounding**
GIRD957	3.2.4.4.1.3.0-1	The instrument **shall** isolate the instrument EED command returns from the instrument pulse command returns, instrument serial command returns, and instrument secondary power returns with a dc resistance greater than 1 megohm.
GIRD958	3.2.4.4.2	**3.2.4.4.2 Instrument Telemetry Grounding**
GIRD959	3.2.4.4.2.1	**3.2.4.4.2.1 Instrument Analog Telemetry Grounding**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD960	3.2.4.4.2.1.0-1	The instrument **shall** isolate low frequency analog telemetry returns with signal frequency characteristics below 1 MHz from the instrument operational power returns, instrument survival heater power returns, instrument pulse command returns, instrument serial command returns, instrument EED command returns, and serial telemetry returns with a dc resistance greater than 1 megohm.
GIRD961	3.2.4.4.2.2	**3.2.4.4.2.2 Instrument Serial Telemetry Grounding**
GIRD962	3.2.4.4.2.2.0-1	The instrument **shall** isolate the serial telemetry returns in accordance with the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.
GIRD963	3.2.4.5	**3.2.4.5 Instrument Electrical Accommodations**
GIRD964	3.2.4.5.1	**3.2.4.5.1 Spacecraft/Instrument Interface Harnessing**
GIRD965	3.2.4.5.1.0-1	The spacecraft **shall** supply the required flight harnesses between the instrument and spacecraft. The harness is considered to include the required harness interface connectors, harness wire, harness shielding, insulation wrap, fixing plates, grommets, edge protectors, connector savers, and thermal insulation to make a reliable electrical connection for the entire mission life.
GIRD967	3.2.4.5.2	**3.2.4.5.2 Spacecraft/Instrument Power Interface Harnessing**
GIRD968	3.2.4.5.2.0-1	Reserved *(CCR 00041A)*
GIRD969	3.2.4.5.3	**3.2.4.5.3 Spacecraft/Instrument Telemetry & Command Interface Harnessing**
GIRD970	3.2.4.5.3.0-1	The spacecraft **shall** construct spacecraft/instrument telemetry & command interface harnesses which comply with the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.
GIRD971	3.2.4.5.3.0-2	The instrument **shall** supply the mating connectors to the spacecraft/instrument telemetry & command interface harnesses which comply with the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.
GIRD1157	3.2.4.5.3.0-3	The spacecraft and instrument **shall** have independent wire harnesses and connectors for the primary and redundant critical telemetry, discrete, and monitor signal wires. *(CCR 00108)*
GIRD421	3.2.5	**3.2.5 Command and Data Handling**
GIRD422	3.2.5.1	**3.2.5.1 Data Transfer Between the Instrument and Spacecraft**
GIRD423	3.2.5.1.0-1	All data transferred between the instrument and spacecraft **shall** use the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.
GIRD424	3.2.5.2	**3.2.5.2 SpaceWire Layer Support**
GIRD425	3.2.5.2.0-1	All data transferred between the instrument and the spacecraft **shall** use the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard through the packet layer as a minimum.
GIRD932	3.2.5.2.1	**3.2.5.2.1 Guaranteed Delivery**
GIRD933	3.2.5.2.1.0-1	All data transferred between the instrument and the spacecraft **shall** provide guaranteed data delivery as defined in GOES R Reliable Data Delivery Protocol document. *(CCR 00109)*
GIRD426	3.2.5.3	**3.2.5.3 SpaceWire Data Bus**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD427	3.2.5.3.0-1	The SpaceWire Data Bus **shall** be a point-to point communications path.
GIRD977	3.2.5.3.1	**3.2.5.3.1 SpaceWire Redundancy**
GIRD978	3.2.5.3.1.0-1	The SpaceWire bus **shall** be dual redundant cross-strapped between the instrument and spacecraft as shown in the illustration below.



GIRD428	3.2.5.4	**3.2.5.4 Source Packet Format**
GIRD429	3.2.5.4.0-1	All data transferred over the SpaceWire **shall** use the CCSDS 133.0-B-1 Section 4.1Protocol Data Unit definition shown in the Source Packet Definition Figure. *(CCR 00158)*

Source Packet Definition Figure

PRIMARY HEADER							SECONDARY HEADER	DATA VARIABLE
PACKET IDENTIFICATION				PACKET SEQUENCE CONTROL				
VERSION NUMBER	TYPE	SEC. HDR FLAG	APPLICATION PROCESS ID	SEQUENCE FLAGS	PACKET SEQUENCE COUNT	PACKET LENGTH	TIME CODE AND ANCILLARY DATA	
3 bits	1 bit	1 bit	11 bits	2 bits	14 bits	16 bits	104 bits	
							13 – 8K octets	

GIRD430	3.2.5.4.1	**3.2.5.4.1 Source Packet Length**
GIRD431	3.2.5.4.1.0-1	Source packets **shall** be variable length with a maximum data zone of 8192 octets including Secondary Header.
GIRD432	3.2.5.4.2	**3.2.5.4.2 Secondary Header Flag**
GIRD433	3.2.5.4.2.0-1	The Secondary Header Flag **shall** be set to the value 1. *(CCR 00372)*
GIRD434	3.2.5.4.3	**3.2.5.4.3 Source Packet Secondary Header**
GIRD435	3.2.5.4.3.0-1	The Source Packet Secondary Header **shall** be as defined in the Secondary Header Figure.

Secondary Header Figure

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)

GIRD435 3.2.5.4.3.0-1

SECONDARY HEADER	
TIME CODE	USER FLAGS
72 bits	32 bits

GIRD436 3.2.5.4.4 **3.2.5.4.4 Sequence Flags**

GIRD437 3.2.5.4.4.0-1 The Sequence Flags **shall** be set to the value of 11.
Note: Segmentation services are not permitted.

GIRD438 3.2.5.4.5 **3.2.5.4.5 User Defined Flags**

GIRD439 3.2.5.4.5.0-1 The instrument contractor will define Secondary Header User-Defined Flags in the ICD.

GIRD440 3.2.5.5 **3.2.5.5 SpaceWire Data Rate**

GIRD441 3.2.5.5.0-1 Data transferred over the SpaceWire data bus **shall** be clocked at 132Mhz. *(CCR 00229)*

Note: This clock rate allows for a 106Mbps data rate accounting for SpaceWire overhead. *(CCR 00229)*

GIRD442 3.2.5.6 **3.2.5.6 Instrument to Spacecraft Data Volume**

GIRD443 3.2.5.6.0-1 The volume of instrument data transmitted to the spacecraft **shall** not exceed the values allocated by the UIID.

GIRD444 3.2.5.7 **3.2.5.7 Pulse Per Second (PPS)**

GIRD445 3.2.5.7.0-1 The spacecraft **shall** provide the instrument a 1 PPS time code sequence accurate to ±10 microseconds relative to UTC.

GIRD446 3.2.5.7.1 **3.2.5.7.1 SpaceWire Time Code Support**

GIRD447 3.2.5.7.1.0-1 The 1 PPS time code sequence **shall** comply with the European Cooperation For Space Standardization (ECSS) ECSS-E50-12A (Space Wire) standard.

GIRD448 3.2.5.7.2 **3.2.5.7.2 PPS Signal Drift**

GIRD449 3.2.5.7.2.0-1 The 1 PPS signal **shall** not drift more than ± 1μsec over 100 seconds.

GIRD450 3.2.5.7.3 **3.2.5.7.3 Time Message**

GIRD451 3.2.5.7.3.0-1 The spacecraft **shall** transmit a source packet containing the time code to be synchronized by the 1 PPS sequence.

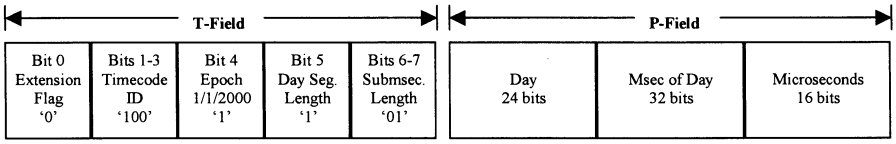
GIRD452 3.2.5.7.4 **3.2.5.7.4 Time Code Format**

GIRD453 3.2.5.7.4.0-1 The time code **shall** comply with the CCSDS 301.B-3 Time Code Formats, Day Segmented format in the Time Code Format Figure.

Time Code Format Figure

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)

GIRD453 3.2.5.7.4.0-1



Note: The T-Field is implied and not included in the actual time message.

GIRD454 3.2.5.7.5

3.2.5.7.5 Epoch

GIRD455 3.2.5.7.5.0-1 The time code epoch **shall** be January 1, 2000.

GIRD456 3.2.5.7.6

3.2.5.7.6 Distribution Timing

GIRD457 3.2.5.7.6.0-1 The time message **shall** be issued between 500 ms and 800 ms before reception of the SpaceWire time code sequence.

GIRD458 3.2.5.8

3.2.5.8 Ancillary Data

GIRD459 3.2.5.8.0-1 The spacecraft **shall** provide the instruments an ancillary data packet defined in the ICD.

GIRD460 3.2.5.8.1

3.2.5.8.1 Ancillary Packet Rate

GIRD461 3.2.5.8.1.0-1 The Ancillary Packet **shall** be transmitted at 100 packets per second.

GIRD462 3.2.5.9

3.2.5.9 Control and Monitoring

GIRD463 3.2.5.9.0-1 The spacecraft **shall** provide remote access to all critical telemetry and control. *(CCR 00096A)*

Critical telemetry is defined as telemetry points that are required to monitor the instrument in powered off state.

Non-critical telemetry is defined as telemetry points that are required to monitor the instrument in powered on state.

Engineering telemetry are data required to process instrument sensor data to higher level products.

Housekeeping telemetry are data required to monitor instrument operation, health, and safety.

GIRD464 3.2.5.9.1

3.2.5.9.1 Critical Telemetry

GIRD465 3.2.5.9.1.0-1 All temperature and status telemetry required to monitor the health of the instrument will be defined in the ICD.

GIRD469 3.2.5.9.2

3.2.5.9.2 Critical Telemetry Analog Signals

GIRD470 3.2.5.9.2.0-1 The spacecraft **shall** provide up to 16 analog signals to monitor critical temperature points to each instrument.

GIRD471 3.2.5.9.3

3.2.5.9.3 Critical Telemetry Analog Signal Resolution

GIRD472 3.2.5.9.3.0-1 The Critical Telemetry Analog signal resolution **shall** be 12 bits ± 0.5 LSB.

GIRD473 3.2.5.9.4

3.2.5.9.4 Discrete Control Signals

GIRD474 3.2.5.9.4.0-1 The spacecraft **shall** provide up to 16 discrete pulse or level control signals to the instrument. Note: The actual combination of control signals will be documented in the IDD. *(CCR 00165)*

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD475	3.2.5.9.5	**3.2.5.9.5 Discrete Monitor Signals**
GIRD920	3.2.5.9.5.0-1	The spacecraft **shall** provide up to 16 discrete instrument monitor lines to each instrument.
GIRD981	3.2.5.9.6	**3.2.5.9.6 Critical Telemetry Signal Characteristics**
GIRD982	3.2.5.9.6.0-1	Critical telemetry sensors **shall** be sourced, from the spacecraft a current from 0.1 to 10ma programmable in 0.1ma steps.
GIRD983	3.2.5.9.7	**3.2.5.9.7 Discrete Pulse Control Signal Characteristics *(CCR 00165)***
GIRD984	3.2.5.9.7.0-1	The spacecraft provided discrete pulse command ON signal **shall** source 500ma maximum at 28V +/- 3V with 150 msec +/- 50 msec pulse widths. *(CCR 00165)*
GIRD1167	3.2.5.9.8	**3.2.5.9.8 Discrete Level Control Signal Definition *(CCR 00165)***
GIRD1166	3.2.5.9.8.0-1	The spacecraft provided level control signal **shall** consider 0 Volts as an OFF condition and +28 Volts +/- 3 Volts as an ON condition. *(CCR 00165)*
GIRD985	3.2.5.9.9	**3.2.5.9.9 Discrete Monitor Signal Sink Current**
GIRD986	3.2.5.9.9.0-1	Discrete telemetry points monitored by the spacecraft **shall** sink 1ma +/-1%.
GIRD987	3.2.5.9.10	**3.2.5.9.10 Discrete Monitor ON Status**
GIRD988	3.2.5.9.10.0-1	A Telemetry Discrete Monitor point with a current of 0.8ma or greater **shall** be considered in the ON state.
GIRD989	3.2.5.9.11	**3.2.5.9.11 Discrete Monitor OFF Status**
GIRD990	3.2.5.9.11.0-1	A Telemetry Discrete Monitor point with a current of 0.2ma or less **shall** be considered in the OFF state.
GIRD491	3.2.5.9.12	**3.2.5.9.12 Instrument Configuration Commands**
GIRD492	3.2.5.9.12.0-1	The instrument **shall** be configurable by spacecraft issued commands. Note: The instrument may also internally configure itself, reporting its configuration via telemetry.
GIRD493	3.2.5.9.12.1	**3.2.5.9.12.1 Configuration Command Definition**
GIRD494	3.2.5.9.12.1.0-1	The instrument contractor will document instrument configuration commands in the IDD.
GIRD979	3.2.5.9.13	**3.2.5.9.13 Stored Command Processing**
GIRD980	3.2.5.9.13.0-1	All stored command processing services **shall** be provided by the spacecraft.
GIRD558	3.2.6	**3.2.6 Environmental Conditions**
GIRD559	3.2.6.1	**3.2.6.1 On-Orbit Radiation Environment**
GIRD935	3.2.6.1.0-1	The instruments and spacecraft **shall** comply with the on-orbit radiation requirements that are described in the GSFC document 417-R-RPT-0027 titled "The Radiation Environment for Electronic Devices on the GOES-R Series Satellites." *(CCR 00096A)*
GIRD576	3.2.6.2	**3.2.6.2 Launch Environment**

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD577	3.2.6.2.0-1	The instruments and spacecraft **shall** be designed to meet the launch environment described herein. The baseline launch vehicle is planned to be an expendable Delta IV or Atlas V. *(CCR 00096A)*
GIRD578	3.2.6.2.1	**3.2.6.2.1 Thermal Environment During Launch**
GIRD580	3.2.6.2.1.0-1	The fairing inner surface temperatures **shall** not exceed 150°C for 300 (TBR) seconds.
GIRD581	3.2.6.2.1.0-2	The fairing inner surface **shall** radiate to the instrument no more than 1240 W/m^2 to the instrument for 300 seconds.
GIRD582	3.2.6.2.1.0-3	The instantaneous free molecular heating on instrument surfaces in the velocity vector at the time of fairing separation **shall** not exceed 1135 W/m^2, 3 sigma.
GIRD583	3.2.6.2.1.0-4	The duration of free molecular heating **shall** be limited to 20 (TBR) seconds after fairing separation
GIRD584	3.2.6.2.2	**3.2.6.2.2 Pressure Profile**
GIRD585	3.2.6.2.2.0-1	The spacecraft contractor will document in the ICD the predicted launch pressure decay time history obtained from the launch vehicle contractor. Inside the launch vehicle fairing, the pressure decays from a maximum of 110 kPa to an orbital minimum of 13 nPa over a period of 100 seconds.
GIRD586	3.2.6.2.2.0-2	The depressurization rate **shall** be less than 2.8 kPa/sec except for a maximum 5 second excursion to 6.2 kPa/sec.
GIRD587	3.2.6.2.3	**3.2.6.2.3 Flight Acceleration**
GIRD588	3.2.6.2.3.0-1	Flight limit loads for each instrument unit **shall** be defined by the spacecraft contractor and recorded in the ICD.
GIRD589	3.2.6.2.3.0-2	The instrument unit interface forces **shall** not exceed those induced by a static acceleration load factor times 9.81 m/s/s in any direction. The acceleration load factor is defined as a logarithmic scale linear interpolation of the values in the Mass Acceleration Curve Table with an absolute limit of 55 g's. The Mass Acceleration Curve Table is plotted in the Mass Acceleration Curve Figure. *(CCR 00081A)*

Mass Acceleration Curve Table

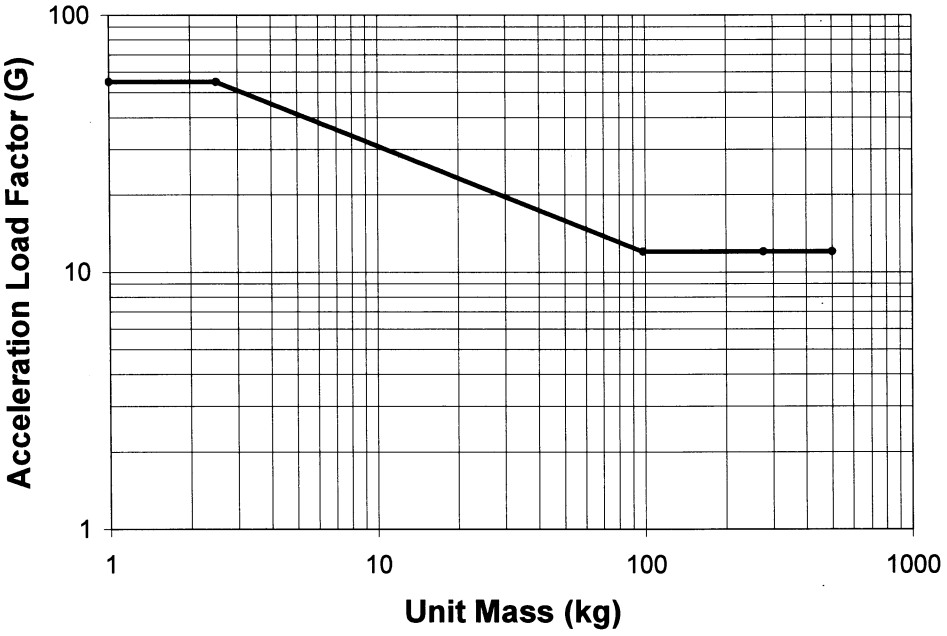
Mass (kg)	Load (G)
≤ 2.5	55
98	12
500	12

(CCR 00081A) (CCR 00196)

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)

GIRD589 3.2.6.2.3.0-2

Mass Acceleration Curve Figure ***(CCR 00196)***

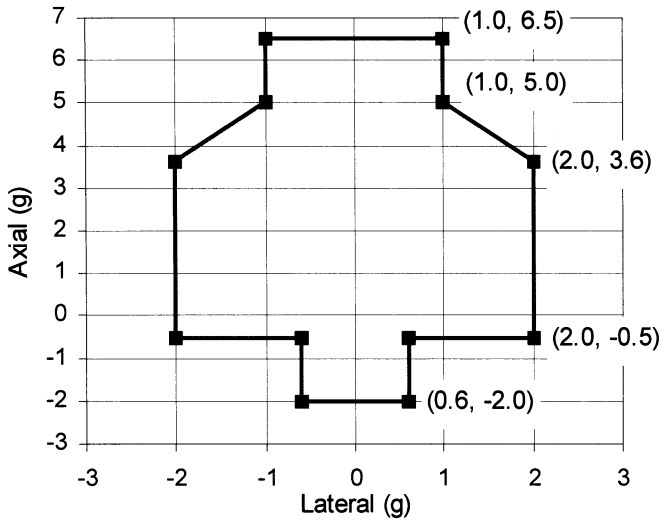


(CCR 00196)

GIRD590 3.2.6.2.3.0-3

The quasi-static acceleration limit loads for the center of mass of the spacecraft will not exceed the limits plotted in Quasi-Static Spacecraft Center of Mass Limit Loads Figure.

Quasi-Static Spacecraft Center of Mass Limit Loads Figure



GIRD591 3.2.6.2.4

3.2.6.2.4 Flight Random Vibration

GIRD592 3.2.6.2.4.0-1

Based on the structural vibrations produced by the vibration and acoustic launch environments, the spacecraft contractor will document in the ICD measured or predicted maximum expected flight level random vibration environments for each of the instrument units. Flight levels are equivalent to acceptance levels.

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD874	3.2.6.2.4.0-2	The ASD levels **shall** not exceed the limits set in **GIRD588** and **GIRD589** Flight Acceleration.
GIRD593	3.2.6.2.4.0-3	The maximum expected flight random vibration Acceleration Spectral Density (ASD) for each instrument unit with a mass less than 22.7 kg **shall** not exceed the limit levels shown in the Flight Limit Acceleration Spectral Densities (ADS) figure in **GIRD596**.
GIRD594	3.2.6.2.4.0-4	For each instrument unit with a mass greater than 22.7 kg and less than 59 kg, the limit ASD levels **shall** be reduced by a factor of 22.7 kg divided by the mass of the unit in kilograms while maintaining the slope magnitudes at 6 dB per octave.
GIRD595	3.2.6.2.4.0-5	For each instrument unit with a mass greater than 59 kg and less than 182 kg, the limit ASD levels for the 50 to 800 Hz band **shall** be reduced by a factor of 22.7 kg divided by the mass of the unit in kilograms while maintaining the 20 and 2000 Hz levels at 0.005 g^2/Hz.
GIRD596	3.2.6.2.4.0-6	For each instrument unit with a mass greater than 182 kg, the flight ASD levels **shall** not exceed the limit ASD levels for a 182 kg unit. The Flight Limit Acceleration Spectral Densities (ASD) Figure plots the limit acceleration spectral densities for units with a mass of 22.7, 59 and 182 kg.

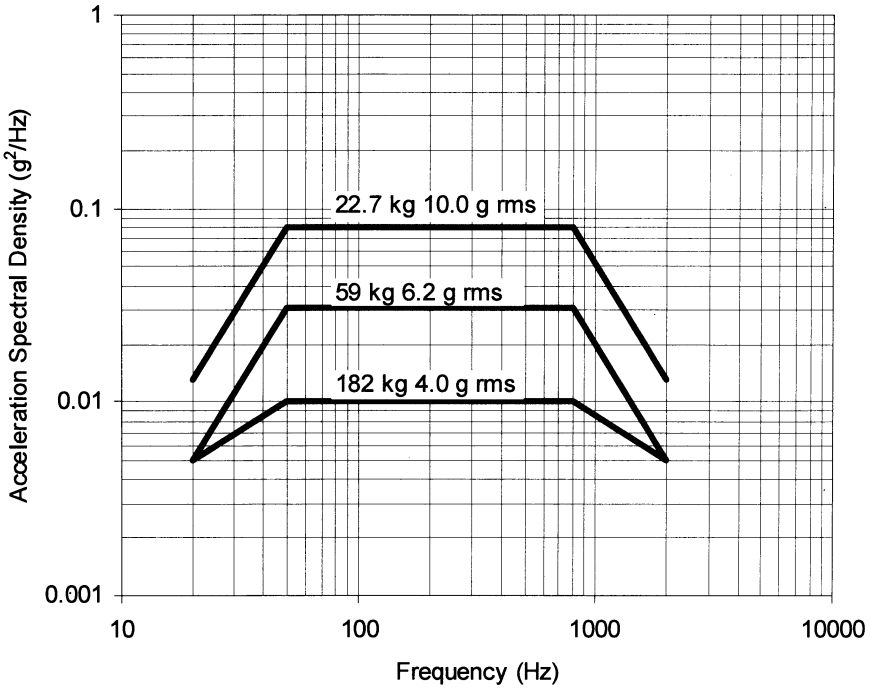
ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)

GIRD596 3.2.6.2.4.0-6

Flight Random Vibration Table

Frequency (Hz)	Units kg	Component Mass 22.7	59	182
20	g^2/Hz	0.013	0.005	0.005
20-50	dB/oct	+6.0	+6.0	+2.3
50-800	g^2/Hz	0.080	0.031	0.010
800-2000	dB/oct	-6.0	-6.0	-2.3
2000	g^2/Hz	0.013	0.005	0.005
Overall	g rms	10.0	6.2	4.0

Flight Limit Acceleration Spectral Densities (ASD) Figure



GIRD597 3.2.6.2.5

3.2.6.2.5 Flight Sinusoidal Vibration

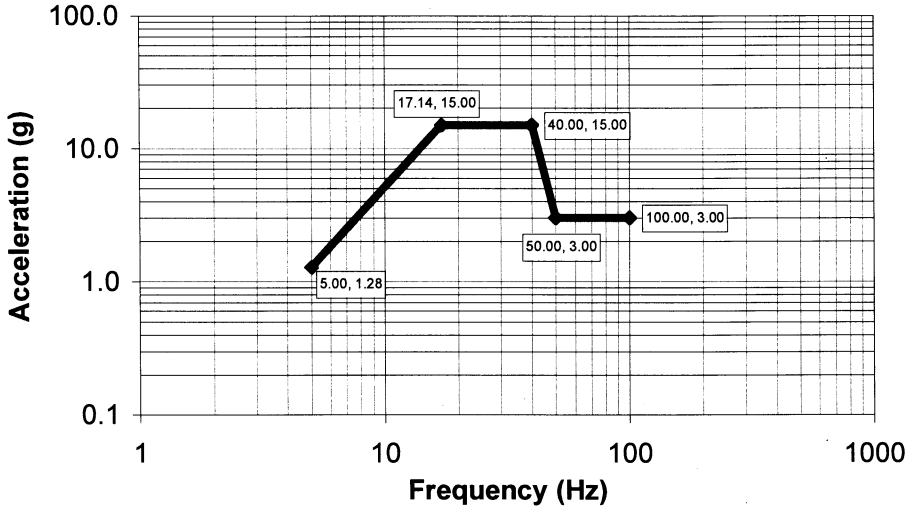
GIRD598 3.2.6.2.5.0-1

Based on the structural response of the spacecraft produced by the maximum expected launch vehicle interface sinusoidal acceleration, the spacecraft contractor will document in the ICD the predicted maximum sinusoidal acceleration response at the interfaces for each of the instrument units.

GIRD599 3.2.6.2.5.0-2

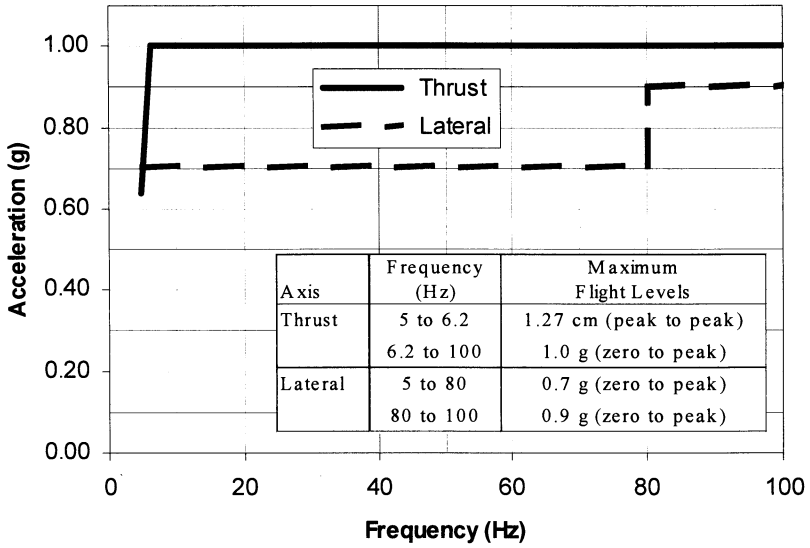
The maximum flight sinusoidal acceleration limit loads at the interfaces for each of the instrument units **shall** not exceed the limits in the Flight Limit Instrument Unit Sinusoidal Accelerations Figure and the limits set in GIRD588 and GIRD589 Flight Acceleration.

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD599	3.2.6.2.5.0-2	**Flight Limit Instrument Unit Sinusoidal Accelerations Figure (*CCR 00023*)**



GIRD600 3.2.6.2.5.0-3 The maximum flight sinusoidal acceleration limit loads at the interface between the spacecraft and the launch vehicle **shall** not exceed the limits plotted in Limit Spacecraft to Launch Vehicle Sinusoidal Accelerations Figure.

Limit Spacecraft to Launch Vehicle Sinusoidal Accelerations Figure



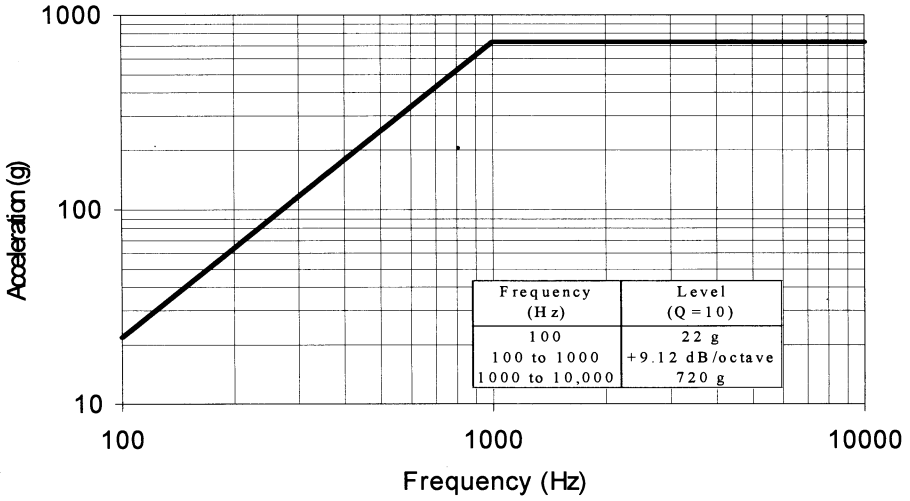
Axis	Frequency (Hz)	Maximum Flight Levels
Thrust	5 to 6.2	1.27 cm (peak to peak)
	6.2 to 100	1.0 g (zero to peak)
Lateral	5 to 80	0.7 g (zero to peak)
	80 to 100	0.9 g (zero to peak)

GIRD601 3.2.6.2.6 **3.2.6.2.6 Shock**

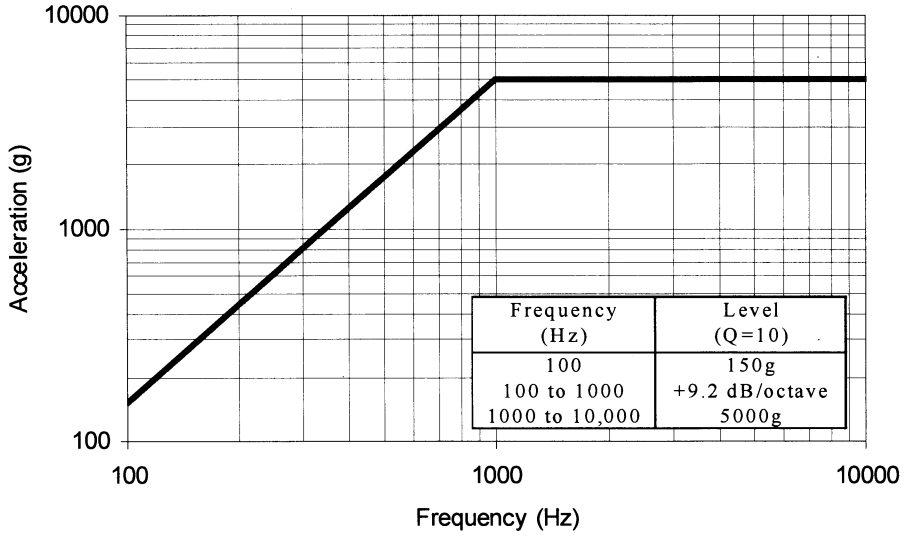
GIRD602 3.2.6.2.6.0-1 Based on launch vehicle and spacecraft shock inputs transmitted through spacecraft structure, the spacecraft contractor will document in the ICD the expected shock levels at the interfaces of the instrument units.

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD885	3.2.6.2.6.0-2	For each instrument unit and for each axis, the flight shock accelerations on the spacecraft side of the instrument to spacecraft interface **shall** produce a peak acceleration response spectra less than the limits set in the Flight Shock Limit Acceleration Response Spectra from the Spacecraft to Instrument Unit Figure when using a quality factor, Q, of 10.

Flight Shock Limit Acceleration Response Spectra from the Spacecraft to Instrument Unit Figure



GIRD886	3.2.6.2.6.0-3	The flight shock accelerations on the launch vehicle side of the interface between the spacecraft and the launch vehicle **shall** produce a peak acceleration response spectra less than the limits set in the Flight Shock Limit Acceleration Response Spectra from the Launch Vehicle to Spacecraft Figure in **GIRD919** when using a quality factor, Q, of 10.
GIRD919	3.2.6.2.6.0-4	**Flight Shock Limit Acceleration Response Spectra from the Launch Vehicle to Spacecraft Figure**



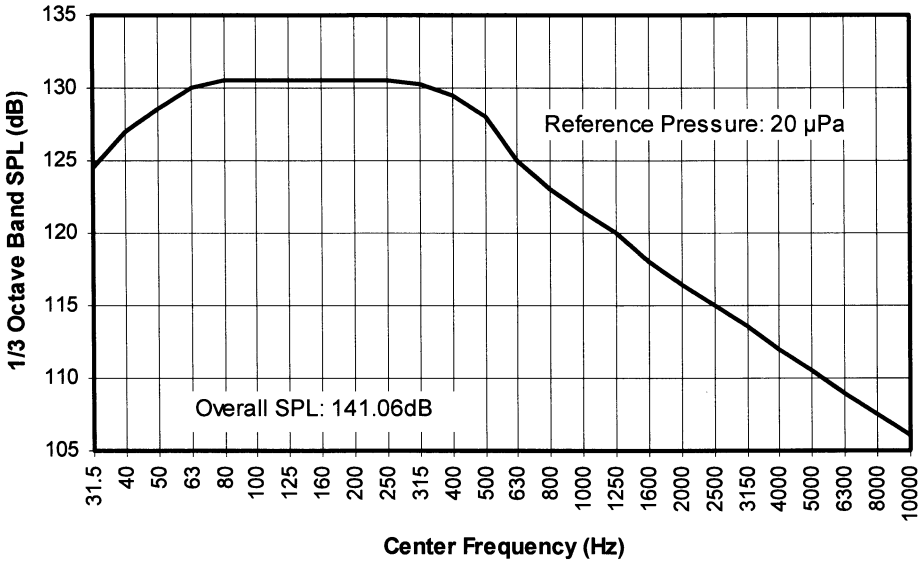
ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD604	3.2.6.2.7	**3.2.6.2.7 Flight Acoustics**
GIRD605	3.2.6.2.7.0-1	The spacecraft contractor will document in the ICD the predicted Maximum Expected Flight Level (MEFL) for the acoustic environment with 95 percent probability and with 50 percent confidence.
GIRD606	3.2.6.2.7.0-2	The MEFL with a 95th percentile and 50 percent confidence **shall** not exceed the one third octave band limit Sound Pressure Levels (SPL) listed by their center frequencies in the Flight Limit Acoustic Sound Pressure Levels Table and plotted in the Flight Limit Acoustic Sound Pressure Levels Figure.

Flight Limit Acoustic Sound Pressure Levels Table

One-third Octave Bands			
Center Frequency (Hz)	SPL* (dB)	Center Frequency (Hz)	SPL* (dB)
31.5	124.5	630	125.0
40	127.0	800	123.0
50	128.5	1000	121.5
63	130.0	1250	120.0
80	130.5	1600	118.0
100	130.5	2000	116.5
125	130.5	2500	115.0
160	130.5	3150	113.5
200	130.5	4000	112.0
250	130.5	5000	110.5
315	130.2	6300	109.0
400	129.5	8000	107.5
500	128.0	10000	106.0
*Reference pressure is 20 μPa		QASPL	141.06

(CCR 00173)

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD606	3.2.6.2.7.0-2	**Flight Limit Acoustic Sound Pressure Levels Figure**



(CCR 00173)

GIRD607	3.2.6.3	**3.2.6.3 On-Orbit Environment**
GIRD608	3.2.6.3.1	**3.2.6.3.1 Acceleration**
GIRD609	3.2.6.3.1.0-1	Instrument flight hardware **shall** be designed to withstand a maximum acceleration of 0.040 (TBR) g on orbit without permanent degradation of performance.
GIRD612	3.2.6.3.2	**3.2.6.3.2 Orbital Heat Flux**
GIRD613	3.2.6.3.2.0-1	The following orbital heat flux magnitudes **shall** be assumed.
GIRD614	3.2.6.3.2.1	**3.2.6.3.2.1 Direct Solar Flux**
GIRD615	3.2.6.3.2.1.0-1	The maximum magnitude of direct solar flux to be used **shall** be 1414 $W/m^2 \pm 5$ W/m^2 uncertainty occurring at earth perihelion.
GIRD616	3.2.6.3.2.1.0-2	The minimum magnitude of direct solar flux to be used **shall** be 1322 $W/m^2 \pm 5$ W/m^2 uncertainty occurring at earth aphelion. Fluxes on specific dates may use a cosine interpolation between the perihelion and aphelion. *(CCR 00021)*
GIRD617	3.2.6.3.2.2	**3.2.6.3.2.2 Non-Cryogenic Systems**
GIRD618	3.2.6.3.2.2.0-1	For non-cryogenic instruments, only solar flux needs to be considered.
GIRD619	3.2.6.3.2.3	**3.2.6.3.2.3 Cryogenic Systems**
GIRD620	3.2.6.3.2.3.0-1	For cryogenic instruments, in addition to solar flux, earth reflected solar flux (albedo flux) and earth radiation **shall** be considered.
GIRD621	3.2.6.3.2.3.0-2	Earth reflected solar flux **shall** be modeled assuming a 0.26 albedo factor (Lambertian earth reflection assumed).

ID	Object Number	417-R-GIRD-0009, RM Version, GOES-R Series, General Interface Requirements Document (GIRD)
GIRD622	3.2.6.3.2.3.0-3	Earth IR **shall** be modeled assuming a 326 W/m^2 emitted radiance (at earth's surface), which is equivalent to a 2^O C black body earth temperature.
GIRD623	3.2.6.3.2.4	**3.2.6.3.2.4 Eclipse**
GIRD624	3.2.6.3.2.4.0-1	Solar Eclipse **shall** be considered as part of the environmental variation. The Solar Eclipse season occurs twice yearly, with each eclipse season lasting approximately 45 days. The maximum eclipse duration is 72 minutes.
GIRD625	3.2.6.3.2.5	**3.2.6.3.2.5 Lunar Eclipse**
GIRD626	3.2.6.3.2.5.0-1	Lunar Eclipses **shall** be considered for instrument survivability. Lunar eclipses of 105 minutes maximum duration are rare occurrences.
GIRD627	3.2.6.3.2.5.0-2	Lunar Eclipses **shall** not be considered as a nominal operation design case.
GIRD629	3.3	**3.3 Attitude and Orbit Data**
GIRD946	3.3.0-1	All attitude, rate and orbit data **shall** be included in the spacecraft ancillary data packet.
GIRD630	3.3.1	**3.3.1 Attitude Knowledge**
GIRD631	3.3.1.0-1	The spacecraft **shall** provide a periodic attitude estimate to the instrument.
GIRD632	3.3.1.1	**3.3.1.1 Representation**
GIRD633	3.3.1.1.0-1	The attitude estimate **shall** be a quaternion representation of the attitude of the instrument mounting frame relative to the J2000 inertial reference frame.
GIRD634	3.3.1.2	**3.3.1.2 Accuracy**
GIRD635	3.3.1.2.0-1	The attitude estimate **shall** be accurate to within ±100 microradians, per axis, 3-sigma. This requirement bounds the knowledge error, which is the difference between the estimated attitude and the true attitude.
GIRD636	3.3.1.3	**3.3.1.3 Update Rate**
GIRD637	3.3.1.3.0-1	The spacecraft **shall** update the attitude estimate at a rate no less than 1 Hz.
GIRD638	3.3.1.4	**3.3.1.4 Latency**
GIRD639	3.3.1.4.0-1	The attitude estimate latency **shall** not exceed 100 milliseconds.
GIRD640	3.3.2	**3.3.2 Spacecraft Angular Rate**
GIRD641	3.3.2.0-1	The spacecraft **shall** provide a periodic angular rate estimate to the instrument.
GIRD642	3.3.2.1	**3.3.2.1 Representation**
GIRD643	3.3.2.1.0-1	The spacecraft angular rate data **shall** be the inertial angular rate of the spacecraft, in units of microradians per second, resolved in the instrument mounting frame defined in **GIRD1064**.
GIRD644	3.3.2.2	**3.3.2.2 Accuracy**

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GIRD645	3.3.2.2.0-1	The accuracy of the spacecraft angular rate estimate is characterized by rate white noise, angle white noise, and the integral of the rate error over a specified time window. The rate error is defined as the difference between the estimated rates and the actual rates of the spacecraft. The integrated rate error includes all residual IRU errors after compensation by the spacecraft and also includes errors due to alignment knowledge error between the IRU input axes and the instrument mounting frame.
GIRD1068	3.3.2.2.0-2	The rate white noise component of the spacecraft angular rate estimate **shall** not exceed a power spectral density (PSD) level of $\sigma_v = 0.05\,\mu rad / s^{1/2}$
GIRD1069	3.3.2.2.0-3	The angle white noise component of the spacecraft angular rate estimate **shall** not exceed a power spectral density (PSD) level of $\sigma_e = 0.02\,\mu rad / Hz^{1/2}$
GIRD646	3.3.2.2.0-4	The integrated rate error of the spacecraft angular rate estimate **shall** not exceed ±0.6 microradians, 3-sigma, per axis, over any 1-second window.
GIRD647	3.3.2.2.0-5	In addition, the integrated rate error of the spacecraft angular rate estimate **shall** not exceed ±2 microradians, 3-sigma, per axis, over any 120-second window.
GIRD648	3.3.2.2.0-6	In addition, the integrated rate error of the spacecraft angular rate estimate **shall** not exceed ±5 microradians, 3-sigma, per axis, over any 300-second window.
GIRD649	3.3.2.3	**3.3.2.3 Bandwidth**
GIRD650	3.3.2.3.0-1	The spacecraft angular rate estimate **shall** have a minus 3dB bandwidth of greater than 25 Hz.
GIRD973	3.3.2.3.0-2	The spacecraft angular rate estimate **shall** have a second order frequency response.
GIRD974	3.3.2.3.0-3	The frequency response amplitude of the spacecraft angular rate estimate **shall** be stable to less than 1% (TBR) from 0.1 to 25 Hz.
GIRD975	3.3.2.3.0-4	The frequency response phase of the spacecraft angular rate estimate **shall** be stable to less than 1 degree (TBR) from 0.1 to 25 Hz.
GIRD976	3.3.2.3.0-5	The spacecraft contractor will document in the instrument ICD the gyro rate frequency response function from 0 Hz to at least ten times the -3dB gyro bandwidth .
GIRD651	3.3.2.4	**3.3.2.4 Update Rate**
GIRD652	3.3.2.4.0-1	The spacecraft **shall** update the angular rate estimate at a rate no less than 100 Hz.
GIRD654	3.3.2.4.0-2	Spacecraft angular rate sampling **shall** be uniform to within ±20 microseconds.
GIRD653	3.3.2.5	**3.3.2.5 Phase Delay**
GIRD655	3.3.2.5.0-1	For a given instrument mounting frame attitude error rate, the total spacecraft gyro signal phase delay **shall** not exceed the corresponding limit from the Total Spacecraft Gyro Signal Phase Delay and Rate Error Trade Space Figure (GIRD155 [3.2.1.7.1.2.0-1]) for sinusoidal excitations at 10 Hz or below. For sinusoidal system excitation, $\sin(\omega t)$, the phase delay, t_d, in the

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GIRD655	3.3.2.5.0-1	system output is defined as $\sin(\omega(t-t_d))$. Phase delay includes all delays from the time a physical event occurs through the time the data recording the event is received at the instrument. It includes sensor dynamics, sensor delay, spacecraft processor delays and SpaceWire delays.
GIRD656	3.3.2.5.0-2	Spacecraft angular rate latency **shall** be stable to within ±20 microseconds.
GIRD657	3.3.3	**3.3.3 Spacecraft Orbit**
GIRD658	3.3.3.0-1	The spacecraft **shall** provide a periodic spacecraft orbit estimate to the instrument via the ancillary data packet.
GIRD659	3.3.3.1	**3.3.3.1 Representation**
GIRD660	3.3.3.1.0-1	The spacecraft orbit estimate **shall** include Cartesian position and velocity vectors in the J2000 (TBR) frame, and a time tag corresponding to the orbit vectors. *(CCR 00020A)*
GIRD661	3.3.3.2	**3.3.3.2 Accuracy**
GIRD662	3.3.3.2.0-1	The spacecraft position estimate **shall** be accurate to 100 meters 3-sigma, in-track (ORF x-axis), cross-track (ORF y-axis) and radial (ORF z-axis) directions. *(CCR 00020A) (CCR00084)*
GIRD663	3.3.3.2.0-2	The spacecraft velocity estimate **shall** be accurate to within ±10 cm/sec , 3-sigma per axis. *(CCR 00040A)*
GIRD664	3.3.3.3	**3.3.3.3 Update Rate**
GIRD665	3.3.3.3.0-1	The spacecraft **shall** update the orbit estimate at a rate no less than 1 Hz. *(CCR 00096A)*
GIRD666	3.3.3.4	**3.3.3.4 Latency**
GIRD667	3.3.3.4.0-1	The spacecraft orbit estimate latency **shall** not exceed 1 second.
GIRD668	3.4	**3.4 Instrument GSE to Spacecraft I&T GSE Interface**
GIRD921	3.4.0-1	Instrument GSE **shall** receive instrument telemetry via the spacecraft electrical GSE.
GIRD922	3.4.0-2	Commanding of the instrument **shall** be from the spacecraft electrical GSE.
GIRD783	3.5	**3.5 Contamination Control**
GIRD784	3.5.1	**3.5.1 Instrument and Spacecraft Ground Processing**
GIRD785	3.5.1.1	**3.5.1.1 Facility Requirements**
GIRD793	3.5.1.1.0-1	During observatory level I&T and launch processing facility operations airborne particle fallout **shall** not exceed 0.022 percent area coverage (%AC) per month in an ISO 14644-1 Class 7 facility. *(CCR 00115)*
GIRD794	3.5.1.1.0-2	During observatory level I&T and launch processing facility operations airborne particle fallout **shall** not exceed 0.22 %AC per month in an ISO 14644-1 Class 8 facility. *(CCR 00115)*
GIRD795	3.5.1.1.0-3	During observatory level I&T and launch processing facility operations airborne molecular fallout **shall** not exceed 0.30 micrograms per square centimeter ($\mu g/cm^2$) per month in a cleanroom. *(CCR 00115)*

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GIRD788	3.5.1.1.0-4	During observatory level I&T and launch processing facility operations flight hardware **shall** be processed in an ISO 14644-1 Class 7 (TBR) cleanroom or better when contamination sensitive surfaces are exposed. *(CCR 00115)*
GIRD787	3.5.1.1.0-5	During observatory level I&T and launch processing facility operations flight hardware **shall** be processed in an ISO 14644-1 Class 8 (TBR) cleanroom or better when contamination sensitive surfaces are covered. Optical solar reflectors (OSRs) and solar panels are exceptions and may be exposed in an ISO 14644-1 Class 8 cleanroom. *(CCR 00115)*
GIRD789	3.5.1.1.0-6	The spacecraft contractor will be responsible for testing and monitoring ISO 14644-1 Class conformance during observatory I&T and launch processing facility operations. Conformance will be determined by monitoring both airborne particle counts larger than 0.5 μm and airborne particle counts larger than 5.0 μm per the measurement and test methods described in ISO 14644-3 (TBR). *(CCR 00115)*
GIRD792	3.5.1.1.0-7	During observatory level I&T and launch processing facility operations flight hardware **shall** be maintained in a relative humidity environment between 30 and 60%. *(CCR 00115)*
GIRD798	3.5.1.2	**3.5.1.2 Ground Support Equipment Requirements**
GIRD801	3.5.1.2.0-1	GSE hardware used in vacuum testing **shall** outgas less than $1x10^{-7}$ g/cm^2-hr (TBR) at 10°C above the maximum survival temperature of the flight hardware that they are tested with when measured with a QCM held at -65°C (208 K). *(CCR 00115)*
GIRD1158	3.5.1.2.0-2	Any GSE which must accompany the instrument or spacecraft into a cleanroom area **shall** be visibly clean per SN-C-0005 (JSC) (TBR). *(CCR 00115)*
GIRD1159	3.5.1.2.0-3	Any GSE which must contact flight hardware in a cleanroom area **shall** meet the same cleanliness requirement as the cleanest flight hardware it will contact once in the cleanroom. *(CCR 00115)*
GIRD802	3.5.1.3	**3.5.1.3 Purge Requirements**
GIRD803	3.5.1.3.0-1	Prior to instrument integration on the spacecraft and during any subsequent instrument deintegration periods the instrument contractor will be responsible for providing a gas purge to the instrument optical cavity during all storage, test, and transport operations if required by the instrument. *(CCR 00115)*
GIRD1160	3.5.1.3.0-2	Following instrument integration on the spacecraft the spacecraft contractor will be responsible for providing a gas purge to the instrument optical cavities during all storage, test, and transport operations if required by the instrument. *(CCR 00115)*
GIRD1161	3.5.1.3.0-3	During observatory level I&T and launch processing facility operations spacecraft provided purge gas properties **shall** be coordinated with the instrument providers and detailed in the ICD. *(CCR 00115)*
GIRD812	3.5.1.4	**3.5.1.4 Ground Storage/Transportation Requirements**
GIRD813	3.5.1.4.0-1	During extended inactivity, storage, and transportation periods, the instrument **shall** be bagged in an instrument provided ESD protective material. *(CCR 00115)*
GIRD1162	3.5.1.4.0-2	During storage and transportation periods the observatory **shall** be bagged in a spacecraft provided ESD protective material. Spacecraft provided observatory bagging will be used in addition to the instrument provided instrument bagging. *(CCR 00115)*
GIRD814	3.5.1.4.0-3	Storage and transport accommodations **shall** not transfer more than 0.02 %AC of particles during storage or transport periods. *(CCR 00115)*

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GIRD815	3.5.1.4.0-4	Storage and transport accommodations **shall** not transfer more 0.30 μg/cm^2 of molecular contamination during storage or transport periods. *(CCR 00115)*
GIRD1163	3.5.1.4.0-5	During storage and transportation periods the observatory **shall** be maintained in an ISO 14644-1 Class 8 controlled environment. *(CCR 00115)*
GIRD1164	3.5.1.4.0-6	During storage and transportation periods the observatory **shall be** maintained in a relative humidity environment between 30 and 60%. *(CCR 00115)*
GIRD820	3.5.2	**3.5.2 Mission Considerations**
GIRD821	3.5.2.1	**3.5.2.1 Design**
GIRD822	3.5.2.1.0-1	Multi Layer Insulation (MLI) venting and spacecraft vents **shall** be directed away from instrument optical ports, instrument thermal control surfaces, and spacecraft thermal control surfaces.
GIRD823	3.5.2.1.0-2	All MLI joints **shall** be sealed shut prior launch, so that only the planned vent paths allow outgassed molecular species to escape. This requirement will not supersede any requirement for thermal isolation. It is meant to reduce outgassing in an unplanned direction.
GIRD1165	3.5.2.1.0-3	The number, location, size, and orientation of all instrument and spacecraft vents **shall** be detailed in the ICD. *(CCR 00115)*
GIRD830	3.5.2.2	**3.5.2.2 Mission Performance**
GIRD831	3.5.2.2.1	**3.5.2.2.1 Particulate Contamination**
GIRD832	3.5.2.2.1.0-1	The combined spacecraft and instrument particulate contamination contribution **shall** produce no more than a 0.3% (TBR) area coverage of particles to any exposed sensitive surface at end of life. Spacecraft and instrument specific particulate contamination allocations will be detailed in the ICD. *(CCR 00115)*
GIRD833	3.5.2.2.2	**3.5.2.2.2 Molecular Contamination**
GIRD834	3.5.2.2.2.0-1	The combined spacecraft and instrument external molecular contamination contribution **shall** produce no more than 6 μg/cm^2 (TBR) of nonvolatile residue to instrument thermal control surface apertures, and the instrument optical aperture at end of life. Spacecraft and instrument specific molecular contamination allocations will be detailed in the ICD. Note - the following guidelines will be used for instrument analyses: The instrument contractor will use a density of 1.0 g/cm^3 for all molecular contaminants. The instrument contractor will use a transformation value of 0.01 solar absorptance units per 100 Angstroms of NVR on fused quartz optical solar reflectors (OSRs). *(CCR 00115)*
GIRD837	3.5.2.2.2.0-2	The BOL outgassing rates from the molecular contamination analysis for instruments, spacecraft main body, MLI, and the solar array **shall** be verified using a quartz crystal microbalance. BOL outgassing is the final outgassing rate determined during system-level thermal vacuum testing at the mission high temperature, plus 10^{0}C.
GIRD1139	3.6	**3.6 Acronyms**
GIRD1140	3.6.0-1	%AC percent area coverage A Ampere(s) ASD Acceleration Spectral Density BOL beginning of life

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GIRD1140	3.6.0-1	BRF	body reference frame
		bps	bits per seconds
		C	Celsius (Degrees)
		cm	centimeter
		db	decibel
		dc	Direct Current
		ECSS	European Cooperation for Space Standardization
		EED	Electro-Explosive Device
		EEE	Electrical, Electronic and Electromechanical
		ESD	electro static discharge
		FOR	field of regard
		FOV	field-of-view
		g	Earth's gravitational acceleration
		GIRD	General Interface Requirements Document
		GOES	Geosynchronous Operational Environmental Satellite
		GSE	Ground Support Equipment
		GSFC	Goddard Space Flight Center
		Hz	hertz
		ICD	Interface Control Document
		IDD	Instrument Description Document
		IRU	inertial reference unit
		ISO	International Office for Standardization
		K	kelvin
		kg	kilogram
		Km	kilometer
		kPa	Kilo Pascals
		LOS	line-of-sight
		LSB	Least Significant Bit
		m	meter
		ma	milli-ampere(s)
		Mbps	Mega bits per seconds
		MHz	Mega hertz
		mm	millimeter
		MAT	Mission Allowable Temperatures
		MEFL	Maximum Expected Flight Level
		m-g	milli-g (Earth's gravitational acceleration)
		MLI	Multi-layer insulation
		Ms	milli-seconds
		NASA	National Aeronautics and Space Administration
		N-m	Newton-meter
		N-m-sec	Newton-meter-second
		nPa	Nano Pascals
		NVR	Non-Volatile Residue
		ORF	Orbit reference frame
		OSR	Optical solar reflectors
		PPB	Parts Per Billion
		PPM	Parts Per Million
		PPS	Pulse Per Second
		PSD	power spectral density
		QCM	Quartz Crystal Microbalance
		RIU	Remote Interface Unit
		SCF	SPP Coordinate Frame
		SI	International System of Units
		SINDA	System Integrated Numerical Differential Analyzer
		SIS	Solar Imaging Suite
		SPP	Sun-Pointing Platform
		SRS	Shock Response Spectra
		TBD	to be determined

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GIRD1140	3.6.0-1	TBR	to be refined/reviewed
		THC	Total Hydrocarbons
		UIID	Unique Instrument Interface Document
		UTC	Universal Time Code
		µsec	mico-seconds
		V	Volts
		Vdc	Volts-Direct Current
		W	Watts

417-R-GIRD-0009 DCR

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Title: GIRD Orbit and Body Reference Frames (ORF/BRF)
GOES S/C: R Effectivity: S/C and Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Clarifies ORF and BRF definitions and makes BRF a
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.1.4 - 1, 3.1.4 - 2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD52, GIRD53

CCR #: 00009 Rev
CCB Status: **Approved**
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Title: Simplification of Survival Heater Power Interface
GOES S/C: R Effectivity: S/C and Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Simplifies survival heater power requirements.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD: 3.2.3.2.3, 3.2.3.2.4, 3.2.3.2.6, 3.2.3.2.7
DOORS Version: GIRD 2.0
DOORS ID #: GIRD360, 361, 362, 363, 365, 366, 367, 368, 370, 371, 373, 374, 376, 377, 378, 380, 381, 382, 383, 390, 392, 930, 397

CCR #: 00021 Rev
CCB Status: **Approved**
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12/7/2004

Title: GIRD Typos Cleanup
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Corrects typos in the GIRD
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.2.6.1, 3.2.6.3.2.1
DOORS Version: GIRD 2.0
DOORS ID #: GIRD221 (3.2.2.6.1-1), GIRD616 (3.2.6.3.2.1-2)

CCR #: 00023 Rev
CCB Status: **Approved**
CCB Date: 12/7/2004

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12/7/2004

Title: Flight Sinusoidal Vibration Limit Adjustment
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Adjusts the Flight Sinusoidal Vibration Limit.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.6.2.5
DOORS Version: GIRD 2.0
DOORS ID #: GIRD599 (3.2.6.2.5-2)

CCR #: 00008 Rev **A**
CCB Status: **Approved**
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Doc Change Date:
3/15/2005

Title: GIRD Grounding Section Clean-up
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Updates SC and instrument grounding requirements.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD: 3.2.4.1, 3.2.4.2, 3.2.4.3
DOORS Version: GIRD 2.0
DOORS ID #: GIRD1058 (3.2.4.1-4), 404 (3.2.4.1-5), 972 (3.2.4.1-6), 411 (3.2.4.2-1), 412 (3.2.4.2-2), 948 (3.2.4.2-3), 417 (3.2.4.3-3)

CCR #: 00020 Rev **A**
CCB Status: **Approved**
CCB Date: 2/18/2005

Doc Change Date:
3/15/2005

Title: GIRD Orbit Knowledge Clarifications
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Clarifies Orbit Knowledge.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.3.3.1, 3.3.3.2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD660 (3.3.3.1-1), GIRD662 (3.3.3.2-1)

CCR #: 00041 Rev **A**

Title: Delete GIRD968 - Duplicates ABIMAR795 Electromagnetic Compatibility Requirements

CCB Status: **Approved**
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3/15/2005

GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Deletes duplicate electromagnetic compatibility requirements.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.4.5.2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD968 (3.2.4.5.2-1)

CCR #: 00077 Rev
CCB Status: **Approved**
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Title: SIS Pointing Requirements Update
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Update of SIS pointing requirements
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.1.5.2, 3.2.1.8
DOORS Version: GIRD 2.0
DOORS ID #: GIRD1093 (3.2.1.5.2.1-1) 1094 (-2), 1095 (-3), 1097 (-5), 1099 (3.2.1.5.2.2-1), 1100 (-2), 1101 (-3), 1102 (-4), 1104 (3.2.1.5.2.3-1), 1112 (3.2.1.8-1), 1113 (3.2.1.8-2), 1116 (3.2.1.8.1.1-1), 1138 (-2), 1117 (-3), 1118 (-4), (TBD) (-5), 1120 (3.2.1.8.1.2-1)

CCR #: 00040 Rev **A**
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Doc Change Date:

4/1/2005

Title: Relaxation of Orbit Velocity Accuracy
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Relaxation of Orbit Velocity accuracy requirement and correction of DOORS object ID number.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.3.3.2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD663 (3.3.3.2-2)

CCR #: 00084 Rev
CCB Status: **Approved**
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Doc Change Date:

4/1/2005

Title: GIRD Orbit Position Accuracy Requirement
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Changes orbit position accuracy so it does not drive system performance.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.3.3.2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD662 (3.3.3.2-1)

CCR #: 00095 Rev
CCB Status: **Approved**
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6/13/2005

Title: Move SIS Pointing from GIRD to UIID
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary:
Doc #: 417-R-GIRD-0009, 417-R-SISUIID-0034
Doc Section #: GIRD: 3.2.1.5.2 and 3.2.1.8; SIS UIID: 5.3 and 5.4
DOORS Version: GIRD 2.0,
DOORS ID #: GIRD1091 - 1108, GIRD166, GIRD1112 - 1116, GIRD1138, GIRD1117, 1118, GIRD1142-1145, GIRD1119 - 1133,

CCR #: 00098 Rev
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7/8/2005

Title: Requirements terminology standardization
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Revises the document's requirements terminology.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 1.2
DOORS Version: GIRD 2.0
DOORS ID #: GIRD4, GIRD1154 (1.2-1), GIRD1146 (1.2-2), GIRD1147 (1.2-3), GIRD1148 (1.2-4), GIRD1149 (1.2-5), GIRD1150 (1.2-6),

CCR #: 00096 Rev **A**
CCB Status: **Approved**
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Doc Change Date:
8/1/2005

Title: GIRD Object Text Language Clean-Up
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.1.4.2, 3.2.5.9, 3.2.6.1, 3.2.6.2, 3.3.3.3
DOORS Version: GIRD 2.0
DOORS ID #: GIRD104 (3.2.1.4.2-1), -2, -3, -4, -5, -6, -7, -8, -9(add), GIRD463 (3.2.5.9-1), GIRD935 (3.2.6.1-1), GIRD577 (3.2.6.2-1), GIRD665 (3.3.3.3-1)

CCR #: 00109 Rev
CCB Status: **Approved**
CCB Date: 8/1/2005

Doc Change Date:
8/1/2005

Title: GIRD Reliable Delivery Protocol
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary: Updates GIRD with 417-R-RPT-0050 reference
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 2.1, 3.2.5.2.1
DOORS Version: GIRD 2.0
DOORS ID #: GIRD11 (2.1-1), GIRD933 (3.2.5.2.1-1)

CCR #: 00081 Rev **A**
CCB Status: **Approved**
CCB Date: 6/8/2005
Doc Change Date:
8/12/2005

Title: Mass Acceleration Curve Limit for Flight Accelerations
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - NNG04HZ07C
CCR Summary: Revision of flight acceleration requirements.
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.6.2.3
DOORS Version: GIRD 2.0
DOORS ID #: GIRD589 (3.2.6.2.3-2)

CCR #: 00108 Rev
CCB Status: **Approved**
CCB Date: 8/12/2005

Doc Change Date:
8/12/2005

Title: Redundant Power Cable Harnesses
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 5HY06C, 5HY07C
CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 3.2.3, 3.2.4
DOORS Version: GIRD 2.0
DOORS ID #: GIRD(TBD) (3.2.3.1.1.1-5), GIRD(TBD) (3.2.4.5.3-3)

CCR #: 00115 Rev
CCB Status: **Approved**
CCB Date: 2/23/2006

Doc Change Date:
2/23/2006

Title: GIRD Contamination Section Update
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: GIRD 2.1, 3.5
DOORS Version: GIRD 2.0
DOORS ID #: GIRD11 (2.1-1), GIRD793 (3.5.1.1.0-1), 794-2, 795-3, 796-4, 788-5(now 4), 787-6(5), 789-7(6), 792-8(7), 801 (3.5.1.2.0-1), 799-2, 800-3, tbd-2,-3, GIRD803 (3.5.1.3.0-1), tbd-2, 804-2, 805-3, 806-4, 809-5, 810-6, tbd (3.5.1.3.0-3), tbd (3.5.1.4.0-2), 814-2(3), 815-3(4), 816-4, tbd -5, -6, 817 (3.5.1.5) 818-1, 819-2, 824 (3.5.2.1.0-3), 825-4, 826-5, 827-6, 828-7, 829-8, tbd(3.5.2.1.0-3), 832 (3.5.7.2.1.0-1), 834 (3.5.2.2.2.0-1), 835-2, 836-3, 837-4 (2)

CCR #: 00173 Rev
CCB Status: **Approved**
CCB Date: 4/13/2006

Doc Change Date:

Title: Acoustic Levels Specification
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd
CCR Summary:

04/13/2006	Doc #: 417-R-GIRD-0009 Doc Section #: 3.2.6.2.7 DOORS Version: GIRD 2.3 DOORS ID #: GIRD606 (3.2.6.2.7.0-2)
CCR #: 00158 Rev CCB Status: **Approved** CCB Date: 5/4/2006 Doc Change Date: 5/4/2006	**Title: GIRD CCSDS Reference Document and Source Packet Update** GOES S/C: R Effectivity: SC & Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, GLM RFP. SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: 2.1, 3.2.5.4 DOORS Version: GIRD 2.3 DOORS ID #: GIRD11 (2.1.0-1), GIRD429 (3.2.5.4.0-1)
CCR #: 00165 Rev CCB Status: **Approved** CCB Date: 3/23/2006 Doc Change Date: 6/2/2006	**Title: GIRD Discrete Control Signals Update** GOES S/C: R Effectivity: S/C & Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C. SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: 3.2.5.9.4, 3.2.5.9.7 DOORS Version: GIRD 2.3 DOORS ID #: GIRD474 (3.2.5.9.4.0-1), GIRD984 (3.2.5.9.7.0-1), GIRD (TBD)
CCR #: 00196 Rev CCB Status: **Approved** CCB Date: 6/2/2006 Doc Change Date: 6/2/2006	**Title: GIRD Mass Acceleration Curve Update** GOES S/C: R Effectivity: Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: 3.2.6.2.3 DOORS Version: GIRD 2.3 DOORS ID #: GIRD589 (3.2.6.2.3.0-2)
CCR #: 00213 Rev CCB Status: **Approved** CCB Date: 6/2/2006 Doc Change Date: 7/7/2006	**Title: Change GIRD GRDDP Applicable Document Version** GOES S/C: R Effectivity: SC & Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: 2.1 DOORS Version: GIRD 2.4 DOORS ID #: GIRD11 (2.1.0-1)
CCR #: 00163 Rev CCB Status: **Approved** CCB Date: 5/4/2006 Doc Change Date: 7/8/2006	**Title: Change GIRD Mechanical Disturbance Requirements to Eliminate Spacecraft Model** GOES S/C: R Effectivity: Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, GLM RFP. SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: GIRD 3.2.1.7 DOORS Version: GIRD 2.3 DOORS ID #: GIRD 157, 1110
CCR #: 00229 Rev CCB Status: **Approved** CCB Date: 8/1/2006 Doc Change Date: 8/1/2006	**Title: Data Transfer Clock Rate Change** GOES S/C: R Effectivity: SC & Instruments Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd CCR Summary: Doc #: 417-R-GIRD-0009 Doc Section #: 3.2.5.5 DOORS Version: GIRD 2.5 DOORS ID #: GIRD441 (3.2.5.5.0-1)

CCR #: 00250 Rev
CCB Status: **Approved**
CCB Date: 8/1/2006

Doc Change Date:
8/1/2006

Title: GIRD SIS Thermal
GOES S/C: R Effectivity: SIS Instrument
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd

CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: 3.2.2.1
DOORS Version: GIRD 2.6
DOORS ID #: GIRD172 (3.2.2.1.0-1)

CCR #: 00236 Rev
CCB Status: **Approved**
CCB Date: 10/17/2006

Doc Change Date:
10/17/2006

Title: GIRD Spacecraft Attitude Error Rate and Gyro Phase Delay
GOES S/C: R Effectivity: SC & Instruments
Contract # NNG0 - Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd

CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: 3.2.1.7.1.2, 3.3.2.5
DOORS Version: GIRD 2.5
DOORS ID #: GIRD155 (3.2.1.7.1.2.0-1), GIRD655 (3.3.2.5.0-1)

CCR #: 00274 Rev
CCB Status: **Approved**
CCB Date: 8/31/2006

Doc Change Date:
10/18/2006

Title: Baseline Release or 417-R-RPT-0027 and GIRD Reference Update
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SEISS #tbd

CCR Summary:
Doc #: 417-R-RPT-0027, 417-R-GIRD-0009
Doc Section #: 2, RPT All
DOORS Version: GIRD 2.9, RPT N/A
DOORS ID #: GIRD11 (2.1.0-1), RPT N/A

CCR #: 00309 Rev
CCB Status: **Approved**
CCB Date: 10/10/2006

Doc Change Date:
11/27/2006

Title: Delete GIRD Nadir Temperature Controlled Platform
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, 6HX01C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SUVI/EXIS TBD

CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: 3.2.2.3
DOORS Version: GIRD 2.10
DOORS ID #: GIRD202 (3.2.2.3.0-2)

CCR #: 00332 Rev
CCB Status: **Approved**
CCB Date: 11/27/2006

Doc Change Date:
11/27/2006

Title: Alignment and Disturbance Related Requirement Clarification for
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, 6HX01C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, 6HX11C, 6HX12C, 6HX13C, SUVI/EXIS TBD

CCR Summary:
Doc #: 417-R-GIRD-0009, 417-R-SEISSUIID-0031
Doc Section #: GIRD 3.2.1.5.1, 3.2.1.7, SEISSUIID 5.1
DOORS Version: GIRD 2.10,
DOORS ID #: GIRD128 (3.2.1.5.1), 149 (3.2.1.7), SEISSUIID72 (5.1), 69 (5.1.0-1), 75 (5.1.0-2, chg to 3.3.5.0-2), tbd (3.3.5.0-3), 76 (5.1.0-3, chg to 3.3.5.0-4), 73 (5.2, chg to 5.1), 74 (5.2.0-1, chg to 5.1.0-1)

CCR #: 00161 Rev **B**
CCB Status: **Approved**
CCB Date: 10/23/2006

Doc Change Date:
2/22/2007

Title: GIRD Instrument Electrical Power Section Update
GOES S/C: R Effectivity: S/C & Instruments
Contract # NNG0 - 4HZ07C, Info 4HZ48C, 4HZ49C, 4HZ50C, 4HZ65C, GLM RFP. SEISS #tbd

CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: 3.2.3
DOORS Version: GIRD 2.7
DOORS ID #: ALL

CCR #: 00372 Rev
CCB Status: **Approved**
CCB Date: 2/27/2007

Title: Update GRDDP Reference in GIRD Applicable Documents List
GOES S/C: R Effectivity: Instruments
Contract # NNG0 - 4HZ07C, 6HX01C, Info 4HZ48C, 4HZ49C, 4HZ50C, 6HX11C, 6HX12C, 6HX13C, SUVI/EXIS TBD

Doc Change Date:
2/22/2007

CCR Summary:
Doc #: 417-R-GIRD-0009
Doc Section #: 2, 3.2.5.4.2
DOORS Version: GIRD 2.13
DOORS ID #: GIRD11 (2.1-1), GIRD433 (3.2.5.4.2.0-1)

LOCKHEED MARTIN SPACE SYSTEMS CO
SUBCONTRACTING PLAN FOR
SMALL BUSINESS & SMALL DISADVANTAGED BUSINESS CONCERNS
SUBMITTED IN SUPPORT OF:
GEOSTATIONARY LIGHTNING MAPPER (GLM) FOR THE GEOSTATIONARY OPERATIONAL ENVIRONMENT SATELLITE (GOES)
REQUEST FOR PROPOSAL: NNG05088738R

8/26/2005

A. In compliance with FAR 52.219-9, Small Business and Small Disadvantaged Business Subcontracting Plan, the following Subcontracting Plan is submitted by Lockheed Martin Space Systems Co - MSO in support of the above referenced requirement.

1. For National Aeronautics and Space Administration (NASA) prime contracts, HBCUs, MIs, and woman-owned small businesses are treated as Small Disadvantaged Business Concerns in accordance with NASA FAR Supplement clause 18-52.219-76, NASA Small Disadvantaged Business Goal.

B. This plan consists of:

1. The Lockheed Martin Space Systems Co - MSO, Master Subcontracting Plan for Small Business Concerns and Small Disadvantaged Business Concerns, which is incorporated herein by reference, and
2. The following goals and other variable data applicable to this specific plan, and
3. The following deviations, if any, from the Master Subcontracting Plan which are applicable to this specific plan.
4. Goals for subcontracting with Small Business Concerns and Small Disadvantaged Business (SB/SDB) Concerns are established as follows:

	% Goal	Dollar Goal
• Total Contract Dollars:		$2,000,000
• Total planned to be subcontracted:	16.5%	$380,000
• Total planned to be subcontracted with **Small Business** (including HBCUs/MIs for DoD and NASA prime contracts, and woman-owned small business for NASA prime contracts):	2.5%	$50,000
• Total planned to be subcontracted with **Small Disadvantaged Business** (including Small Disadvantaged Business and, for DoD and NASA prime contracts only, HBCUs/MIs):	2.5%	$50,000
• Total planned to be subcontracted with **Small Woman-owned Business** :	0%	0$
• Total planned to be subcontracted with **HBCU/MIs** :	0%	$0
• Total planned to be subcontracted with **HUB Zone Business :**	0%	$0
• Total planned to be subcontracted with **Veteran-owned Business** :	0%	$0