

SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL ITEM <i>OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, & 30</i>				1. REQUISITION NUMBER 4200312633		PAGE OF 1 31	
2. CONTRACT NO.		3. AWARD/EFFECTIVE DATE	4. ORDER NUMBER		5. SOLICITATION NUMBER NNS10312633R		6. SOLICITATION ISSUE DATE 11/20/2009
7. FOR SOLICITATION INFORMATION CALL:		a. NAME Gregory Fletcher			b. TELEPHONE NUMBER (No collect calls) 228-688-2223	8. OFFER DUE DATE/LOCAL TIME 12/04/2009 1500 LT	
9. ISSUED BY National Aeronautics & Space Admin Office of Procurement, Code DA10 Building 1100 Room 249 H John C. Stennis Space Center Stennis Space Center MS 39529-6000				10. THIS ACQUISITION IS <input checked="" type="checkbox"/> UNRESTRICTED OR <input type="checkbox"/> SET ASIDE % FOR: <input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> EMERGING SMALL BUSINESS <input type="checkbox"/> HUBZONE SMALL BUSINESS <input type="checkbox"/> Sole Source <input type="checkbox"/> SERVICE-DISABLED VETERAN-OWNED SMALL BUSINESS <input type="checkbox"/> 8(A) NAICS: 334513 SIZE STANDARD: 500			
11. DELIVERY FOR FOB DESTINATION UNLESS BLOCK IS MARKED <input type="checkbox"/> SEE SCHEDULE		12. DISCOUNT TERMS		13a. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) <input checked="" type="checkbox"/>		13b. RATING DO-C9	
15. DELIVER TO National Aeronautics & Space Admin Attn: Transportation Officer Building 2204 John C. Stennis Space Center Stennis Space Center MS 39529-6000				16. ADMINISTERED BY National Aeronautics & Space Admin Office of Procurement, Code DA10 Building 1100 Room 249 H John C. Stennis Space Center Stennis Space Center MS 39529-6000			
17a. CONTRACTOR/OFFEROR		17b. CHECK IF REMITTANCE IS DIFFERENT AND PUT SUCH ADDRESS IN OFFER		18a. PAYMENT WILL BE MADE BY			
TELEPHONE NO.		18b. SUBMIT INVOICES TO ADDRESS SHOWN IN BLOCK 18a UNLESS BLOCK BELOW IS CHECKED <input type="checkbox"/> SEE ADDENDUM					
19. ITEM NO.		20. SCHEDULE OF SUPPLIES/SERVICES		21. QUANTITY	22. UNIT	23. UNIT PRICE	24. AMOUNT
001		INCO TERMS 2: DESTINATION Large Test Stand Flow Meters in accordance with the specifications entitled, "LOX and LH Run Line Flow Meters, Specification Number 110GT-GM11, dated July 21, 2009," attached hereto and incorporated herein. Continued ... <i>(Use Reverse and/or Attach Additional Sheets as Necessary)</i>					
25. ACCOUNTING AND APPROPRIATION DATA					26. TOTAL AWARD AMOUNT (For Govt. Use Only)		
<input checked="" type="checkbox"/> 27a. SOLICITATION INCORPORATES BY REFERENCE FAR 52.212-1, 52.212-4, FAR 52.212-3 AND 52.212-5 ARE ATTACHED. ADDEND				<input checked="" type="checkbox"/> ARE <input type="checkbox"/> ARE NOT ATTACHED.			
<input type="checkbox"/> 27b. CONTRACT/PURCHASE ORDER INCORPORATES BY REFERENCE FAR 52.212-4. FAR 52.212-5 IS ATTACHED. ADDENDA				<input type="checkbox"/> ARE <input type="checkbox"/> ARE NOT ATTACHED.			
<input checked="" type="checkbox"/> 28. CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN <u>3</u> COPIES TO ISSUING OFFICE. CONTRACTOR AGREES TO FURNISH AND DELIVER ALL ITEMS SET FORTH OR OTHERWISE IDENTIFIED ABOVE AND ON ANY ADDITIONAL SHEETS SUBJECT TO THE TERMS AND CONDITIONS SPECIFIED HEREIN.				<input type="checkbox"/> 29. AWARD OF CONTRACT REF _____ OFFER DATED _____ YOUR OFFER ON SOLICITATION (BLOCK 5), INCLUDING ANY ADDITIONS OR CHANGES WHICH ARE SET FORTH HEREIN IS ACCEPTED AS TO ITEMS.			
30a. SIGNATURE OF OFFEROR/CONTRACTOR				31a. UNITED STATES OF AMERICA (SIGNATURE OF CONTRACTING OFFICER)			
30b. NAME AND TITLE OF SIGNER (Type or print)		30c. DATE SIGNED		31b. NAME OF CONTRACTING OFFICER (Type or print)		31c. DATE SIGNED	
				Carol West			

19. ITEM NO.	20. SCHEDULE OF SUPPLIES/SERVICES	21. QUANTITY	22. UNIT	23. UNIT PRICE	24. AMOUNT

32a. QUANTITY IN COLUMN 21 HAS BEEN RECEIVED INSPECTED NOTED: _____ ACCEPTED, AND CONFORMS TO THE CONTRACT, EXCEPT AS

32b. SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE _____ 32c. DATE _____ 32d. PRINTED NAME AND TITLE OF AUTHORIZED GOVERNMENT REPRESENTATIVE _____

32e. MAILING ADDRESS OF AUTHORIZED GOVERNMENT REPRESENTATIVE _____ 32f. TELEPHONE NUMBER OF AUTHORIZED GOVERNMENT REPRESENTATIVE _____
 32g. E-MAIL OF AUTHORIZED GOVERNMENT REPRESENTATIVE _____

33. SHIP NUMBER _____ 34. VOUCHER NUMBER _____ 35. AMOUNT VERIFIED CORRECT FOR _____ 36. PAYMENT COMPLETE PARTIAL FINAL 37. CHECK NUMBER _____
 PARTIAL FINAL

38. S/R ACCOUNT NUMBER _____ 39. S/R VOUCHER NUMBER _____ 40. PAID BY _____

41a. I CERTIFY THIS ACCOUNT IS CORRECT AND PROPER FOR PAYMENT _____ 41b. SIGNATURE AND TITLE OF CERTIFYING OFFICER _____ 41c. DATE _____
 42a. RECEIVED BY (Print) _____
 42b. RECEIVED AT (Location) _____
 42c. DATE REC'D (YY/MM/DD) _____ 42d. TOTAL CONTAINERS _____

SUPPLIES AND/OR SERVICES TO BE FURNISHED: The contractor shall provide all resources necessary to furnish the supplies/services in accordance with Specification Number 110GT-GM11, Revision 0, dated July 21, 2009, entitled, "LOX and LH Run Line Flow Meters," and the clauses of this contract.

Item No. 0001 Liquid Oxygen Flow Meter, in accordance with Specification No. 110GT-GM11

Quantity 3 Each

Unit Price \$ _____

Total Amount \$ _____

Item No. 0002 Liquid Hydrogen Flow Meter, in accordance with Specification No. 110GT-GM11

Quantity 3 Each

Unit Price \$ _____

Total Amount \$ _____

TOTAL FOR ALL ITEMS \$ _____

INVOICES

Invoices may be submitted to the following address:

NASA/Shared Services Center (NSSC)
Financial Management Division/Accounts Payable
Building 1111, Road C
Stennis Space Center, MS 39529
REFERENCE: Contract Number NNS10AA06C

Or may be submitted via email or facsimile to include the above information.

Email: NSSC-AccountsPayable@nasa.gov
Facsimile Number: (866) 209-5415

Note: A Taxpayers Identification Number (TIN) must be annotated on each invoice.

SHIP TO: NASA/John C. Stennis Space Center
Attn: Transportation Officer, Bldg. 2204
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000
REFERENCE: Contract Number NNS10AA06C

Offeror shall provide a breakdown of costs (labor, materials and transportation) and/or pricing elements.

Contract Completion: This contract shall be considered complete when all items have been delivered and accepted by designated SSC personnel.

52.211-9 Desired and Required Time of Delivery (Jun 1997)

(a) The Government desires delivery to be made according to the following schedule:

DESIRED DELIVERY SCHEDULE		
ITEM NO.	QUANTITY	WITHIN DAYS AFTER DATE OF CONTRACT
0001	3	60
0002	3	60

If the offeror is unable to meet the desired delivery schedule, it may, without prejudicing evaluation of its offer, propose a delivery schedule below. However, the offeror's proposed delivery schedule must not extend the delivery period beyond the time for delivery in the Government's required delivery schedule as follows:

REQUIRED DELIVERY SCHEDULE		
ITEM NO.	QUANTITY	WITHIN DAYS AFTER DATE OF CONTRACT
0001	3	90
0002	3	90

Offers that propose delivery of a quantity under such terms or conditions that delivery will not clearly fall within the applicable required delivery period specified above, will be considered nonresponsive and rejected. If the offeror proposes no other delivery schedule, the desired delivery schedule above will apply.

OFFEROR'S PROPOSED DELIVERY SCHEDULE		
ITEM NO.	QUANTITY	WITHIN DAYS AFTER DATE OF CONTRACT

(b) Attention is directed to the Contract Award provision of the solicitation that provides that a written award or acceptance of offer mailed or otherwise furnished to the successful offeror results in a binding contract. The Government will mail or otherwise furnish to the offeror an award or notice of award not later than the day the award is dated. Therefore, the offeror shall compute the time available for performance beginning with the actual date of award, rather than the date the written notice of award is received from the Contracting Officer through the ordinary mails.

However, the Government will evaluate an offer that proposes delivery based on the Contractor's date of receipt of the contract or notice of award by adding (1) five calendar days for delivery of the award through the ordinary mails, or (2) one working day if the solicitation states that the contract or notice of award will be transmitted electronically. (The term "working day" excludes weekends and U.S. Federal holidays.) If, as so computed, the offered delivery date is later than the required delivery date, the offer will be considered nonresponsive and rejected.

(End of Clause)

NOTE: Technical and Contractual questions **must be submitted in writing** to Gregory Fletcher at facsimile (228) 688-1141 or email: **gregory.fletcher-1@nasa.gov** not later than **November 27, 2009**. Telephone questions **will not** be accepted.

ADDENDUM TO 52.212-4, CONTRACT TERMS AND CONDITIONS - COMMERCIAL ITEMS

52.252-2 Clauses Incorporated by Reference. (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.acqnet.gov/far/>; NASA FAR Supplement (NFS) clauses: <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>

(End of clause)

52.204-7 Central Contractor Registration. (APR 2008)

52.204-9 Personal Identity Verification of Contractor Personnel. (SEP 2007)

52.209-6 Protecting the Government's Interest When Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment. (SEP 2006)

52.211-15 Defense Priority and Allocation Requirements. (APR 2008)

52.212-4 Contract Terms and Conditions - Commercial Items. (MAR 2009)

52.233-3 Protest after Award. (AUG 1996)

52.233-4 Applicable Law for Breach of Contract Claim. (OCT 2004)

52.237-2 Protection of Government Buildings, Equipment, and Vegetation. (APR 1984)

52.246-2 Inspection of Supplies - Fixed-Price. (AUG 1996)

52.247-34 F.o.b. Destination. (NOV 1991)

1852.204-76 Security Requirements for Unclassified Information Technology Resources. (MAY 2007)

1852.219-75 Small Business Subcontracting Reporting. (MAY 1999)

1852.219-76 NASA 8 Percent Goal. (JUL 1997)

1852.223-70 Safety and Health (APR 2002)

1852.223-72 Safety and Health (Short Form). (APR 2002)

1852.223-75 Major Breach of Safety or Security. (FEB 2002) -- Alternate I (FEB 2006)

1852.225-70 Export Licenses. (FEB 2000)

1852.237-72 Access to Sensitive Information. (JUN 2005)

1852.237-73 Release of Sensitive Information. (JUN 2005)

1852.215-84 Ombudsman. (OCT 2003) -- Alternate I (JUN 2000)

(a) An ombudsman has been appointed to hear and facilitate the resolution of concerns from offerors, potential offerors, and contractors during the preaward and postaward 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 must 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, Richard Gilbrech, Associate Director, John C. Stennis Space Center, MS 39529-6000, E-Mail: richard.gilbrech @nasa.gov, Phone (228) 688-1128, or Fax (228) 688-3240. 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.

(c) If this is a task or delivery order contract, the ombudsman shall review complaints from contractors and ensure they are afforded a fair opportunity to be considered, consistent with the procedures of the contract.

(End of clause)

ADDENDUM TO FAR 52.212-4, CONTRACT TERMS AND CONDITIONS - COMMERCIAL ITEMS

The following paragraphs of this clause are tailored as follows:

(a) Inspection/Acceptance. Add the following:

(a)(1) If the contractor fails to promptly perform the services again, or to take the necessary action to ensure future performance in conformity with contract requirements, the government may, by contract or otherwise, perform the services at contractor's cost.

(a)(2) Inspection and acceptance of the services will be performed at Stennis Space Center, MS, by the A3 Altitude Test Facility Project Office.

(c) Changes... Replace with the following: Changes. Changes in the terms and conditions of this contract may be made only by written agreement of the parties with the exception of administrative changes such as changes in the paying office, appropriations data, etc., which may be changed unilaterally by the Government.

(i)(1) Due to the potentially volatile market for materials required for this acquisition and long lead time for delivery, the Government realizes that payment upon completion and delivery may create undue hardship for small businesses. Therefore, milestone billing will be authorized in accordance with offeror's accepted milestone payment plan. Should circumstances result in the contractor's inability to deliver the final product or the contract being terminated, all materials billed and paid shall be immediately delivered to NASA or payments reimbursed.

(End of clause)

52.212-5 -- CONTRACT TERMS AND CONDITIONS REQUIRED TO IMPLEMENT STATUTES OR EXECUTIVE ORDERS -- COMMERCIAL ITEMS (Feb 2009)

(a) The Contractor shall comply with the following Federal Acquisition Regulation (FAR) clauses, which are incorporated in this contract by reference, to implement provisions of law or Executive orders applicable to acquisitions of commercial items:

(1) 52.222-50, Combating Trafficking in Persons (Feb 2009) (22 U.S.C. 7104(g)).

___ Alternate I (Aug 2007) of 52.222-50 (22 U.S.C. 7104(g)).

(2) 52.233-3, Protest After Award (Aug 1996) (31 U.S.C. 3553).

(3) 52.233-4, Applicable Law for Breach of Contract Claim (Oct 2004) (Pub. L. 108-77, 108-78).

(b) The Contractor shall comply with the FAR clauses in this paragraph (b) that the contracting officer has indicated as being incorporated in this contract by reference to implement provisions of law or Executive orders applicable to acquisitions of commercial items: [Contracting Officer shall check as appropriate.]

X (1) 52.203-6, Restrictions on Subcontractor Sales to the Government (Sep 2006), with Alternate I (Oct 1995)(41 U.S.C. 253g and 10 U.S.C. 2402).

___ (2) 52.203-13, Contractor Code of Business Ethics and Conduct (Dec 2008) (Pub. L. 110-252, Title VI, Chapter I (41 U.S.C. 251 note)).

___ (3) 52.219-3, Notice of Total HUBZone Set-Aside (Jan 1999)(15 U.S.C. 657a).

___ (4) 52.219-4, Notice of Price Evaluation Preference for HUBZone Small Business Concerns (Jul 2005) (if the offeror elects to waive the preference, it shall so indicate in its offer)(15 U.S.C. 657a).

___ (5) [Reserved]

(6) (i) 52.219-6, Notice of Total Small Business Aside (June 2003) (15 U.S.C. 644).

___ (ii) Alternate I (Oct 1995) of 52.219-6.

___ (iii) Alternate II (Mar 2004) of 52.219-6.

(7) (i) 52.219-7, Notice of Partial Small Business Set-Aside (June 2003)(15 U.S.C. 644).

___ (ii) Alternate I (Oct 1995) of 52.219-7.

___ (iii) Alternate II (Mar 2004) of 52.219-7.

X (8) 52.219-8, Utilization of Small Business Concerns (May 2004) (15 U.S.C. 637(d)(2) and (3)).

X (9) (i) 52.219-9, Small Business Subcontracting Plan (Apr 2008)(15 U.S.C. 637 (d)(4)).

___ (ii) Alternate I (Oct 2001) of 52.219-9.

X (iii) Alternate II (Oct 2001) of 52.219-9.

___ (10) 52.219-14, Limitations on Subcontracting (Dec 1996)(15 U.S.C. 637(a)(14)).

X (11) 52.219-16, Liquidated Damages - Subcontracting Plan (Jan 1999) (15 U.S.C. 637(d)(4)(F)(i)).

___ (12) (i) 52.219-23, Notice of Price Evaluation Adjustment for Small Disadvantaged Business Concerns (Oct 2008)(10 U.S.C. 2323) (if the offeror elects to waive the adjustment, it shall so indicate in its offer).

Fill In: (b)(1) XX%

___ (ii) Alternate I (June 2003) of 52.219-23.

___ (13) 52.219-25, Small Disadvantaged Business Participation Program Disadvantaged Status and Reporting (Apr 2008)(Pub. L. 103-355, section 7102, and 10 U.S.C. 2323).

___ (14) 52.219-26, Small Disadvantaged Business Participation Program Incentive Subcontracting (Oct 2000)(Pub. L. 103-355, section 7102, and 10 U.S.C. 2323). Fill In: (b) XX%

___ (15) 52.219-27, Notice of Total Service-Disabled Veteran-Owned Small Business Set-Aside (May 2004).

___ (16) 52.219-28, Post Award Small Business Program Representation (June 2007) (15 U.S.C.

632(a)(2)). Fill In: (g) The Contractor represents that it [] is, [] is not a small business concern under NAICS Code See SF1449 block 10 assigned to contract number TBD?.[Contractor to sign and date and insert authorized signer's name and title].

X (17) 52.222-3, Convict Labor (June 2003)(E.O. 11755).

X (18) 52.222-19, Child Labor-Cooperation with Authorities and Remedies (Feb 2008) (E.O. 13126).

- (19) 52.222-21, Prohibition of Segregated Facilities (Feb 1999).
- (20) 52.222-26, Equal Opportunity (Mar 2007)(E.O. 11246).
- (21) 52.222-35, Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans (Sept 2006)(38 U.S.C. 4212).
- (22) 52.222-36, Affirmative Action for Workers with Disabilities (Jun 1998)(29 U.S.C. 793).
- (23) 52.222-37, Employment Reports on Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans (Sept 2006)(38 U.S.C. 4212).
- (24) 52.222-39, Notification of Employee Rights Concerning Payment of Union Dues or Fees (Dec 2004) (E.O. 13201).
- (25) 52.222-54, Employment Eligibility Verification (Jan 2009). (Executive Order 12989). (Not applicable to the acquisition of commercially available off-the-shelf items or certain other types of commercial items as prescribed in 22.1803.).
- (26) (i) 52.223-9, Estimate of Percentage of Recovered Material Content for EPA-Designated Items (May 2008)(42 U.S.C. 6962(c)(3)(A)(ii)). Fill In: (b)(2) <<INSERT POC>>
- (ii) Alternate I (May 2008) of 52.223-9 (42 U.S.C. 6962(i)(2)(C)). Fill In: (b) See clause for cert to fill in
- (27) 52.223-15, Energy Efficiency in Energy- Consuming Products (Dec 2007) (42 U.S.C. 8259b).
- (28)(i) 52.223-16, IEEE 1680 Standard for the Environmental Assessment of Personal Computer Products (Dec 2007) (E.O. 13423).
- (ii) Alternate I (Dec 2007) of 52.223-16.
- (29) 52.225-1, Buy American Act--Supplies (Feb 2009)(41 U.S.C. 10a-10d).
- (30) (i) 52.225-3, Buy American Act-Free Trade Agreements-Israeli Trade Act (Feb 2009) (41 U.S.C. 10a-10d, 19 U.S.C. 3301 note, 19 U.S.C. 2112 note, Pub. L. 108-77, 108-78, 108-286, 109-53, and 109-169).
- (ii) Alternate I (Jan 2004) of 52.225-3.
- (iii) Alternate II (Jan 2004) of 52.225-3.
- (31) 52.225-5, Trade Agreements (Nov 2007)(19 U.S.C. 2501, et seq., 19 U.S.C. 3301 note).
- (32) 52.225-13, Restrictions on Certain Foreign Purchases (Jun 2008) (E.O.'s, proclamations, and statutes administered by the Office of Foreign Assets Control of the Department of the Treasury).
- (33) 52.226-4, Notice of Disaster or Emergency Area Set-Aside (Nov 2007) (42 U.S.C. 5150). Fill In: (a) <<identify geographic boundaries>>
- (34) 52.226-5, Restrictions on Subcontracting Outside Disaster or Emergency Area (Nov 2007) (42 U.S.C. 5150).
- (35) 52.232-29, Terms for Financing of Purchases of Commercial Items (Feb 2002)(41 U.S.C. 255(f), 10 U.S.C. 2307(f)).
- (36) 52.232.30, Installment Payments for Commercial Items (Oct 1995)(41 U.S.C. 255(f), 10 U.S.C. 2307(f)).
- (37) 52.232-33, Payment by Electronic Funds Transfer-Central Contractor Registration (Oct. 2003)(31 U.S.C. 3332).
- (38) 52.232-34, Payment by Electronic Funds Transfer-Other Than Central Contractor Registration (May 1999)(31 U.S.C. 3332). Fill In: (b)(1) <<insert terms>>
- (39) 52.232-36, Payment by Third Party (May 1999)(31 U.S.C. 3332).
- (40) 52.239-1, Privacy or Security Safeguards (Aug 1996)(5 U.S.C. 552a).
- (41) (i) 52.247-64, Preference for Privately Owned U.S.-Flag Commercial Vessels (Feb 2006)(46 U.S.C. Appx 1241(b) and 10 U.S.C. 2631).
- (ii) Alternate I (Apr 2003) of 52.247-64.
- (c) The Contractor shall comply with the FAR clauses in this paragraph (c), applicable to commercial services, that the Contracting Officer has indicated as being incorporated in this contract by reference to implement provisions of law or executive orders applicable to acquisitions of commercial items:
[Contracting Officer check as appropriate.]
- (1) 52.222-41, Service Contract Act of 1965 (Nov 2007)(41 U.S.C. 351, et seq.).
- (2) 52.222-42, Statement of Equivalent Rates for Federal Hires (May 1989)(29 U.S.C. 206 and 41

U.S.C. 351, et seq.). Fill In: See clause for table to fill in

____(3) 52.222-43, Fair Labor Standards Act and Service Contract Act -- Price Adjustment (Multiple Year and Option Contracts) (Nov 2006)(29 U.S.C.206 and 41 U.S.C. 351, et seq.).

____(4) 52.222-44, Fair Labor Standards Act and Service Contract Act -- Price Adjustment (Feb 2002)(29 U.S.C. 206 and 41 U.S.C. 351, et seq.).

____(5) 52.222-51, Exemption from Application of the Service Contract Act to Contracts for Maintenance, Calibration, or Repair of Certain Equipment-Requirements (Nov 2007) (41 U.S.C. 351, et seq.).

____(6) 52.222-53, Exemption from Application of the Service Contract Act to Contracts for Certain Services--Requirements (Feb 2009) (41 U.S.C. 351, et seq.).

____(7) 52.237-11, Accepting and Dispensing of \$1 Coin (Sept 2008)(31 U.S.C. 5112(p)(1)).

(d) Comptroller General Examination of Record. The Contractor shall comply with the provisions of this paragraph (d) if this contract was awarded using other than sealed bid, is in excess of the simplified acquisition threshold, and does not contain the clause at 52.215-2, Audit and Records -- Negotiation.

(1) The Comptroller General of the United States, or an authorized representative of the Comptroller General, shall have access to and right to examine any of the Contractor's directly pertinent records involving transactions related to this contract.

(2) The Contractor shall make available at its offices at all reasonable times the records, materials, and other evidence for examination, audit, or reproduction, until 3 years after final payment under this contract or for any shorter period specified in FAR Subpart 4.7, Contractor Records Retention, of the other clauses of this contract. If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement. Records relating to appeals under the disputes clause or to litigation or the settlement of claims arising under or relating to this contract shall be made available until such appeals, litigation, or claims are finally resolved.

(3) As used in this clause, records include books, documents, accounting procedures and practices, and other data, regardless of type and regardless of form. This does not require the Contractor to create or maintain any record that the Contractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e)

(1) Notwithstanding the requirements of the clauses in paragraphs (a), (b), (c) and (d) of this clause, the Contractor is not required to flow down any FAR clause, other than those in this paragraph (e)(1) in a subcontract for commercial items. Unless otherwise indicated below, the extent of the flow down shall be as required by the clause--

(i) 52.203-13, Contractor Code of Business Ethics and Conduct (Dec 2008) (Pub. L. 110-252, Title VI, Chapter 1 (41 U.S.C. 251 note)).

(ii) 52.219-8, Utilization of Small Business Concerns (May 2004)(15 U.S.C. 637(d)(2) and (3)), in all subcontracts that offer further subcontracting opportunities. If the subcontract (except subcontracts to small business concerns) exceeds \$550,000 (\$1,000,000 for construction of any public facility), the subcontractor must include 52.219-8 in lower tier subcontracts that offer subcontracting opportunities.

(iii) 52.222-26, Equal Opportunity (Mar 2007)(E.O. 11246).

(iv) 52.222-35, Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans (Sept 2006)(38 U.S.C. 4212).

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

(vi) 52.222-39, Notification of Employee rights Concerning Payment of Union Dues or Fees (Dec 2004) (E.O. 13201).

(vii) 52.222-41, Service Contract Act of 1965 (Nov 2007), flow down required for all subcontracts subject to the Service Contract Act of 1965 (41 U.S.C. 351, et seq.)

(viii) 52.222-50, Combating Trafficking in Persons (Feb 2009) (22 U.S.C. 7104(g)).

____ Alternate I (Aug 2007) of 52.222-50 (22 U.S.C. 7104(g)).

(ix) 52.222-51, Exemption from Application of the Service Contract Act to Contracts for Maintenance, Calibration, or Repair of Certain Equipment; Requirements (Nov 2007) (41 U.S.C. 351, et seq.).

(x) 52.222-53, Exemption from Application of the Service Contract Act to Contracts for Certain Services; Requirements (Feb 2009) (41 U.S.C. 351, et seq.).

(xi) 52.222-54, Employment Eligibility Verification (Jan 2009).

(xii) 52.247-64, Preference for Privately-Owned U.S. Flag Commercial Vessels (Feb 2006)(46 U.S.C.

- (xi) 52.222-54, Employment Eligibility Verification (Jan 2009).
- (xii) 52.247-64, Preference for Privately-Owned U.S. Flag Commercial Vessels (Feb 2006)(46 U.S.C.

Appx 1241(b) 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 include in its subcontracts for commercial items a minimal number of additional clauses necessary to satisfy its contractual obligations.

(End of clause)

ADDENDUM TO 52.212-1 INSTRUCTIONS TO OFFERORS - COMMERCIAL ITEMS

52.211-14 Notice of Priority Rating for National Defense, Emergency Preparedness, and Energy Program Use. (APR 2008)

Any contract awarded as a result of this solicitation will be [X] DO-C9 DX rated order; [] DO rated order certified for national defense, emergency preparedness, and energy program use under the Defense Priorities and Allocations System (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation.

(End of provision)

52.212-1 Instructions to Offerors - Commercial Items. (JUN 2008)

52.212-2 Evaluation - Commercial Items. (JAN 1999)

(a) The Government will award a contract resulting from this solicitation to the responsible offeror whose offer conforming to the solicitation will be most advantageous to the Government, price and other factors considered. The following factors shall be used to evaluate offers:

Technical compliance and experience	40%
Schedule	20%
Past performance	40%
Price	0%

(b) *Options.* The Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. The Government may determine that an offer is unacceptable if the option prices are significantly unbalanced. Evaluation of options shall not obligate the Government to exercise the option(s).

(c) A written notice of award or acceptance of an offer, mailed or otherwise furnished to the successful offeror within the time for acceptance specified in the offer, shall result in a binding contract without further action by either party. Before the offer's specified expiration time, the Government may accept an offer (or part of an offer), whether or not there are negotiations after its receipt, unless a written notice of withdrawal is received before award.

(End of provision)

INSTRUCTIONS REGARDING SUBMISSION OF OFFER:

The following information is to be provided with offeror's proposal. The information requested must be provided for the prime contractor, and, if applicable, significant subcontractors.

Failure to provide any item requested below may render offeror's proposal NON-RESPONSIVE and thereby ineligible for award

(A) TECHNICAL COMPLIANCE AND EXPERIENCE

1. Information provided shall include a discussion of the offeror's approach to meeting the requirements of the solicitation and should be specific, detailed, and complete enough to clearly and fully demonstrate an understanding of the requirements/specifications and any risks associated with the objectives of this procurement. It is inadequate to simply state that offeror understands and will comply with the requirements, or to paraphrase the requirements such as: standard procedures will be employed to and well-known techniques will be used for. The information provided shall comprehensively explain how offeror proposes to comply with the specification, as well as, the techniques and procedures offeror intends to utilize. At a minimum, supportive documentation shall address machining and other fabrication, quality control, welding, welding inspection, assembly, cleaning, and post delivery inspection.
2. Technical proposals should include, at a minimum:
 - a. Provide preliminary dimensional drawing(s) of flow meter configuration depicting size, type of fabrication, and support locations (if any).
 - b. Provide adequate documentation and technical references to support proposed material selection and configuration. At a minimum, supportive documentation shall address design temperature range, fabrication, cleaning, and post delivery inspection.
 - c. Provide adequate documentation and technical references to support proposed material selection and piping configuration. At a minimum, supportive documentation shall address design temperature range, fabrication, cleaning, and post delivery inspection.
 - d. Provide preliminary calculations for thickness, preliminary thermal analysis of design temperature range, and calculations and/or cut sheets for any long delivery items. Results of all preliminary calculations shall be summarized.
 - e. Provide identification of tests to be used to certify that proposed materials meet the requirements of the specifications and ensure ASME Code compliance.
 - f. Provide quality control manual(s) adequate to demonstrate that offeror has a quality management system in place sufficient to assure the end product provided meets the requirements of this procurement.
 - g. Provide representative sample cleaning procedure adequate to demonstrate items will be cleaned to NASA requirements.
 - h. Provide identification of all Manufacturers' ASME Certifications.

(B) SCHEDULE

1. Offeror shall provide a preliminary schedule depicting design, material procurement, fabrication, testing and delivery in calendar days or weeks after receipt of order with final delivery of each item identified.
2. Offeror shall provide documentation sufficient to demonstrate the ability to develop fabrication drawings, procure material, fabricate, test, clean, and ship the flow meters by the required delivery date. The number of shipping days and method should be included in the schedule.
3. Offerors are advised that proposals offering to meet the desired delivery schedule of this solicitation AND demonstrating the ability to do so will be given a higher score under this evaluation factor.

(C) PAST PERFORMANCE

1. Past Performance Information (PPI) and Relevant Experience Information shall include the name(s) and contact information for the three (3) most recent (within three years from the offer due date listed on page 1 in Block 8 of the SF1449) and relevant (as outlined in the Federal Acquisition Regulation) references

2. At a minimum, PPI provided shall include verifiable experience in designing and fabricating comparable stainless steel components and assemblies (more generic) medium pressure (100 - 300 psig) and size (4-12) vacuum jacketed pipe for liquid hydrogen service in accordance with ASME B31.3. Specifically note pressure, volume, wall thickness, service media, analysis programs for design, and a contact for experience verification (name, telephone number, and address).

3. Offeror shall provide documentation demonstrating years of experience by the manufacturer in design and manufacture of components and assemblies of similar design. Qualification name, phone number and address are required. Documentation shall include a list of components and assemblies fabricated, size, location of use, service, and date of manufacture. A minimum of three (3) years of experience is required.

(D) PRICE

1. This procurement is exempt from the requirements of submission or certification of cost or pricing data. However, offeror is to provide a general breakdown of pricing (i.e. labor, equipment, materials, subcontracts, transportation, etc.) sufficient to determine price realism and reasonableness. Should significant subcontractors be involved, the pricing breakdown shall identify the pricing associated with each subcontractor.

2. Offeror shall identify and document all (if any) assumptions, conditions, and/or exceptions upon which the price is based. Any assumptions, conditions, and/or exceptions considered by the Government to be unacceptable may result in elimination for an award.

(E) FORMAT

1. Proposals shall be clear and concise, and shall include sufficient detail for effective evaluation and substantiation of stated claims. The proposal shall not simply affirm, rephrase, or restate the Government's specifications/requirements, but rather shall provide convincing rationale to address how the offeror intends to meet the specifications/requirements. Offerors shall assume that the Government has no prior knowledge of their facilities and experience, and will base its evaluation only on the information presented in the offeror's proposal. Elaborate brochures or documentation, detailed artwork, or other superfluous embellishments are unnecessary and are not desired.

2. If a joint venture, subcontracting arrangement, or any other type of contractual arrangement is proposed, proposal shall clearly delineate the approach for overall management and integration of this teaming arrangement. Offeror shall describe the operational and management interfaces (including all levels of supervision and management) for interacting with subcontractors, other contractors, NASA, and other resident agencies and why they will be effective in accomplishing the requirement.

3. Offer(s) shall be signed and may be submitted in hard copy only. An original and 3 complete copies are required. For ease of evaluation, the breakout requested in paragraph (D) above (.xls compatible) may be submitted on CDROM so long as hard copies are also received.

4. All information and all copies of offer must be submitted no later than the date and time specified on Page 1 in Block 8 of the SF 1449. Proposals that arrive after the prescribed date and time specified for receipt of proposals will be considered late and treated in accordance with FAR 52.212-1(f)(2).

(G) AVAILABILITY OF DOCUMENTS - The Specifications and Drawings will be included in the solicitation. Requests for copies shall be made by e-mail to the Bid Distribution Office: gregory.fletcher-1@nasa.gov. Telephone or faxed requests will not be accepted. The list of offerors requesting CDROMs will become the Bidders Mailing List for small business subcontracting purposes.

(H) QUESTIONS - Questions regarding the solicitation and/or specifications are encouraged to ensure adequate understanding of the government's requirement. All offeror questions regarding subject solicitation must be submitted no later than 3pm local time (Central) on November 27, 2009. Questions submitted after this date/time **will not be accepted**. Questions will be accepted via e-mail or facsimile (228) 688-1141. In no event shall an offeror's failure to clarify the requirements of the solicitation constitute grounds for a protest before or after award or a claim after contract award.

(I) PAYMENTS

1. Offerors are advised that **advanced payments will not be authorized.**

(J) ALTERNATE PROPOSALS - Offerors are allowed submit an alternate proposal that departs from the stated requirements. Such proposals shall clearly identify why the acceptance of the proposal would be advantageous to the government. Any deviations from the specifications and/or terms and conditions of the solicitation, with the comparative advantage to the government, shall be clearly identified and explicitly defined. The offeror shall also provide an assessment of the risks associated with the offeror's approach, including the identification of impacts and mitigation recommendations in the applicable section of the proposal. The government reserves the right to amend the solicitation to allow all offerors an opportunity to submit revised proposals based on the revised requirements. If an alternate proposal is submitted, offerors are required to submit a separate, independent, and complete proposal that conforms to the solicitation to ensure consideration.

(I) If a small business set-aside involving manufacturing, add: **SMALL BUSINESSES** - Small business offerors shall address the non manufacturer and ostensible relationship rules in their proposal and demonstrate compliance with the performance requirements inherent therein.

(K) PROPOSAL COSTS - The Government will not pay any offeror for preparation of their proposal.

(L) TECHNICAL EVALUATION CONTRACTOR SUPPORT

1. Offerors are hereby informed that the John C. Stennis Space Center (SSC) onsite Test Operations Contractor will be providing technical assistance to the NASA proposal evaluation team, and, as such, will require access to offeror's proposal. The onsite SSC Test Operations Contractor will not be evaluating proposals, but will play an integral supporting role in the technical evaluation by providing technical input to be used by the NASA evaluation team. The final technical evaluation results shall be the responsibility of the NASA Technical Evaluation Team.

2. **Any offer received in response to the subject solicitation whereby written acknowledgement of approval and acceptance, below, has not been properly executed may be determined NON-RESPONSIVE and may not be evaluated.**

3. ACKNOWLEDGEMENT AND ACCEPTANCE:

Offeror agrees that NASA may release to it's service providers, their subcontractors, and their individual employees, sensitive information submitted during the course of this procurement.

BY: _____
(Printed Name) (Signature)

(End of Addendum)

The following **ADDENDUM TO FAR 52.212-2** is incorporated:

(A) COMPETITIVE NEGOTIATED PROCUREMENT USING QUALITATIVE CRITERIA

This procurement is being conducted utilizing Best Value Selection (BVS), which seeks to make an award based on the best combination of price and qualitative merit (including Technical Compliance, past performance, schedule, and price) of the proposals submitted and reduce the administrative burden on Offerors and the Government. BVS predefines the value characteristics which will serve as discriminators among proposals. BVS evaluation is based on the premise that, if all proposals are of approximately equal qualitative merit, award will be made to the Offeror with the lowest evaluated price (fixed-price contracts) or the lowest most probable cost (cost type contracts). However, the Government may consider awarding to an Offeror with higher qualitative merit if the difference in price is commensurate with added value. Conversely, the Government may consider making award to an Offeror whose quote has lower qualitative merit if the price (or cost) differential between it and other offers warrants doing so.

The following **ADDENDUM TO FAR 52.212-2** is incorporated:

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(B) EVALUATION CRITERIA

a. The award will be made where the offeror is determined to be responsible, and the proposal is responsive and offers the best value to the government. Best value will be determined based on an integrated assessment of each proposal in terms of Technical Compliance, Schedule, Past Performance, and Price. Therefore, subjective judgment by the government is implicit in the evaluation process. Technical Compliance, Schedule, and Past Performance, when combined, are significantly more important than Price.

If offeror does not have relevant past performance history, the offeror may not be evaluated favorably or unfavorably on past performance and will be given a neutral rating as detailed in this plan. In addition, award may be made without conducting discussions.

b. Once all responses have been gathered, proposals will be qualitatively evaluated by team members using the below value characteristics. These value characteristics are performance-based and permit evaluation of the proposal, which provides better results for a reasonable marginal increase in price. All proposals will be judged against these value characteristics.

(C) EVALUATION PROCESS

The Government will evaluate proposals in two general steps:

Step One -- An initial evaluation will be performed to determine if all required information has been provided and the Offeror has presented a responsive proposal. Offeror may be contacted only for clarification purposes during the initial evaluation. Should a proposal be determined nonresponsive, the offeror shall be notified that their proposal has been rejected and the reasons therefore, and the proposal shall be excluded from further consideration.

Otherwise responsive proposals containing a significant variance in price from the government's estimate may be immediately removed from further consideration if there is no expectation that an award can be made at a fair and reasonable price, as it would be detrimental to the public interest to pay more than fair market price.

Step Two -- All responsive proposals will be evaluated against the specifications/statement of work and the value characteristics identified herein. Based on this evaluation, the Government has the option, depending on the specific circumstances of the proposals received, to utilize one of the following methods: (1) Make selection and award without discussions, or (2) after establishment of the competitive range, hold discussions with all finalists and afford each Offeror an opportunity to revise its proposal, and then make selection based upon an evaluation of the revised proposals.

Offerors are cautioned that omissions or an inaccurate or inadequate response to these evaluation factors may have a negative effect on your overall evaluation.

References other than those provided by the offeror may be contacted and their comments considered during the evaluation process. The information submitted may be verified by the Government through discussions with the references provided. While the Government may elect to consider data obtained from other sources, the burden of providing relevant references that the Government can readily contact rests with the Offeror.

during the evaluation process. The information submitted may be verified by the Government through discussions with the references provided. While the Government may elect to consider data obtained from other sources, the burden of providing relevant references that the Government can readily contact rests with the Offeror.

(D) VALUE CHARACTERISTICS

Listed below are the value characteristics that will be utilized in the evaluation of each proposal. Each value characteristic is further defined to explain the rating that each offeror will receive. Documentation insufficient to make a definitive determination regarding these characteristics may negatively impact the score received.

- a) Technical Compliance and Experience 40% - The government will evaluate the information provided by the offeror in response to this solicitation as well as to what extent proposal is in compliance with required Statement of Work/Specifications/Drawings and the reasonableness of the proposed approach.
- b) Schedule 20% - The government will evaluate to what extent proposed schedule meets the government's needs as specified in the solicitation as well as the reasonableness of the schedule proposed.
- c) Past Performance 40% - The government will evaluate past and present performance, giving consideration to the relevance of the work performed and the quality of performance indicated, to anticipate the likelihood of successful performance.
- d) Price - The government will evaluate offeror's proposed price for reasonableness and realism and for determining best value to the Government.

(End of provision)

REPRESENTATIONS, CERTIFICATION AND OTHER STATEMENTS

52.212-3 Offeror Representations and Certifications-Commercial Items. (AUG 2009) -- Alternate I (APR 2002)

An offeror shall complete only paragraphs (b) of this provision if the offeror has completed the annual representations and certificates electronically at <http://orca.bpn.gov> . If an offeror has not completed the annual representations and certifications electronically at the ORCA website, the offeror shall complete only paragraphs (c) through (m) of this provision.

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

“Emerging small business” means a small business concern whose size is no greater than 50 percent of the numerical size standard for the NAICS code designated.

“Forced or indentured child labor” means all work or service—

- (1) Exacted from any person under the age of 18 under the menace of any penalty for its nonperformance and for which the worker does not offer himself voluntarily; or
- (2) Performed by any person under the age of 18 pursuant to a contract the enforcement of which can be accomplished by process or penalties.

“Inverted domestic corporation” means a foreign incorporated entity which is treated as an inverted domestic corporation under 6 U.S.C. 395(b), *i.e.*, a corporation that used to be incorporated in the United States, or used to be a partnership in the United States, but now is incorporated in a foreign country, or is a subsidiary whose parent corporation is incorporated in a foreign country, that meets the criteria specified in 6 U.S.C. 395(b), applied in accordance with the rules and definitions of 6 U.S.C. 395(c).

“Manufactured end product” means any end product in Federal Supply Classes (FSC) 1000-9999, except—

- (1) FSC 5510, Lumber and Related Basic Wood Materials;
- (2) Federal Supply Group (FSG) 87, Agricultural Supplies;
- (3) FSG 88, Live Animals;
- (4) FSG 89, Food and Related Consumables;
- (5) FSC 9410, Crude Grades of Plant Materials;
- (6) FSC 9430, Miscellaneous Crude Animal Products, Inedible;
- (7) FSC 9440, Miscellaneous Crude Agricultural and Forestry Products;
- (8) FSC 9610, Ores;
- (9) FSC 9620, Minerals, Natural and Synthetic; and
- (10) FSC 9630, Additive Metal Materials.

“Place of manufacture” means the place where an end product is assembled out of components, or otherwise made or processed from raw materials into the finished product that is to be provided to the Government. If a product is disassembled and reassembled, the place of reassembly is not the place of manufacture.

“Restricted business operations” means business operations in Sudan that include power production activities, mineral extraction activities, oil-related activities, or the production of military equipment, as those terms are defined in the Sudan Accountability and Divestment Act of 2007 (Pub. L. 110-174). Restricted business operations do not include business operations that the person (as that term is defined in Section 2 of the Sudan Accountability and Divestment Act of 2007) conducting the business can demonstrate—

- (1) Are conducted under contract directly and exclusively with the regional government of southern Sudan;
- (2) Are conducted pursuant to specific authorization from the Office of Foreign Assets Control in the Department of the Treasury, or are expressly exempted under Federal law from the requirement to be conducted under such authorization;
- (3) Consist of providing goods or services to marginalized populations of Sudan;
- (4) Consist of providing goods or services to an internationally recognized peacekeeping force or humanitarian organization;
- (5) Consist of providing goods or services that are used only to promote health or education; or
- (6) Have been voluntarily suspended.

“Service-disabled veteran-owned small business concern”—

- (1) Means a small business concern—
 - (i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and
 - (ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.
- (2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

“Small business concern” means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and size standards in this solicitation.

“Veteran-owned small business concern” means a small business concern—

- (1) Not less than 51 percent of which is owned by one or more veterans(as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and
- (2) The management and daily business operations of which are controlled by one or more veterans.

“Women-owned business concern” means a concern 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 its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

“Women-owned small business concern” means a small business concern --

(1) That 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) (1) *Annual Representations and Certifications.* Any changes provided by the offeror in paragraph (b)(2) of this provision do not automatically change the representations and certifications posted on the Online Representations and Certifications Application (ORCA) website.

(2) The offeror has completed the annual representations and certifications electronically via the ORCA website at <http://orca.bpn.gov>. After reviewing the ORCA database information, the offeror verifies by submission of this offer that the representation and certifications currently posted electronically at FAR 52.212-3, Offeror Representations and Certifications—Commercial Items, have been entered or updated in the last 12 months, are current, accurate, complete, and applicable to this solicitation (including the business size standard applicable to the NAICS code referenced for this solicitation), as of the date of this offer and are incorporated in this offer by reference (see FAR 4.1201), except for paragraphs _____. [Offeror to identify the applicable paragraphs at (c) through (n) of this provision that the offeror has completed for the purposes of this solicitation only, if any. These amended representation(s) and/or certification(s) are also incorporated in this offer and are current, accurate, and complete as of the date of this offer. Any changes provided by the offeror are applicable to this solicitation only, and do not result in an update to the representations and certifications posted on ORCA.]

(c) Offerors must complete the following representations when the resulting contract is to be performed in the United States or its outlying areas. Check all that apply.

(1) *Small business concern.* The offeror represents as part of its offer that it is, is not a small business concern.

(2) *Veteran-owned small business concern.* [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents as part of its offer that it is, is not a veteran-owned small business concern.

(3) *Service-disabled veteran-owned small business concern.* [Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (c)(2) of this provision.] The offeror represents as part of its offer that it is, is not a service-disabled veteran-owned small business concern.

(4) *Small disadvantaged business concern.* [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents, for general statistical purposes, that it is, is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(5) *Women-owned small business concern.* [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents that it is, is not a women-owned small business concern.

Note: Complete paragraphs (c)(6) and (c)(7) only if this solicitation is expected to exceed the simplified acquisition threshold.

(6) *Women-owned business concern (other than small business concern).* [Complete only if the offeror is a women-owned business concern and did not represent itself as a small business concern in paragraph (c)(1) of this provision.]. The offeror represents that it is, a women-owned business concern.

(7) *Tie bid priority for labor surplus area concerns.* If this is an invitation for bid, small business offerors may identify the labor surplus areas in which costs to be incurred on account of manufacturing or production (by offeror or first-tier subcontractors) amount to more than 50 percent of the contract price:

(8) **Small Business Size for the Small Business Competitiveness Demonstration Program and for the Targeted Industry Categories under the Small Business Competitiveness Demonstration Program.**
[Complete only if the offeror has represented itself to be a small business concern under the size standards for this solicitation.]

(i) *[Complete only for solicitations indicated in an addendum as being set-aside for emerging small businesses in one of the designated industry groups (DIGs).]* The offeror represents as part of its offer that it is, is not an emerging small business.

(ii) *[Complete only for solicitations indicated in an addendum as being for one of the targeted industry categories (TICs) or designated industry groups (DIGs).]* Offeror represents as follows:

(A) Offeror's number of employees for the past 12 months (check the Employees column if size standard stated in the solicitation is expressed in terms of number of employees);
 or

(B) Offeror's average annual gross revenue for the last 3 fiscal years (check the Average Annual Gross Number of Revenues column if size standard stated in the solicitation is expressed in terms of annual receipts).

(Check one of the following):

<u>Number of Employees</u>	<u>Average Annual Gross Revenues</u>
50 or fewer	\$1 million or less
51-100	\$1,000,001-\$2 million
101-250	\$2,000,001-\$3.5 million
251-500	\$3,500,001-\$5 million
501-750	\$5,000,001-\$10 million
751-1,000	\$10,000,001-\$17 million
Over 1,000	Over \$17 million

(9) *[Complete only if the solicitation contains the clause at FAR 52.219-23, Notice of Price Evaluation Adjustment for Small Disadvantaged Business Concerns, or FAR 52.219-25, Small Disadvantaged Business Participation Program—Disadvantaged Status and Reporting, and the offeror desires a benefit based on its disadvantaged status.]*

(i) *General.* The offeror represents that either—

(A) It is, is not certified by the Small Business Administration as a small disadvantaged business concern and identified, on the date of this representation, as a certified small disadvantaged business concern in the database maintained by the Small Business Administration (PRO-Net), and that no material change in disadvantaged ownership and control has occurred since its certification, and, where the concern is owned by one or more individuals claiming disadvantaged status, 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); or

(B) It has, has not 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.

(ii) *Joint Ventures under the Price Evaluation Adjustment for Small Disadvantaged Business Concerns.* The offeror represents, as part of its offer, that it is a joint venture that complies with the requirements in 13 CFR 124.1002(f) and that the representation in paragraph (c)(9)(i) of this provision is accurate for the small disadvantaged business concern that is participating in the joint venture. [*The offeror shall enter the name of the small disadvantaged business concern that is participating in the joint venture: _____.*]

(10) HUBZone small business concern. [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents, as part of its offer, that--

(i) It is, is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR part 126; and

(ii) It is, not a joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (c)(10)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. [*The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture: _____.*] Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(d) Representations required to implement provisions of Executive Order 11246 --

(1) Previous contracts and compliance. The offeror represents that --

(i) It has, has not, participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation; and

(ii) It has, has not, filed all required compliance reports.

(2) *Affirmative Action Compliance.* The offeror represents that --

(i) It has developed and has on file, has not developed and does not have on file, at each establishment, affirmative action programs required by rules and regulations of the Secretary of Labor (41 CFR parts 60-1 and 60-2), or

(ii) It has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(e) *Certification Regarding Payments to Influence Federal Transactions* (31 U.S.C. 1352). (Applies only if the contract is expected to exceed \$100,000.) By submission of its offer, the offeror certifies to the best of its knowledge and belief that no Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress or an employee of a Member of Congress on his or her behalf in connection with the award of any resultant contract. If any registrants under the Lobbying Disclosure Act of 1995 have made a lobbying contact on behalf of the offeror with respect to this contract, the offeror shall complete and submit, with its offer, OMB Standard Form LLL, Disclosure of Lobbying Activities, to provide the name of the registrants. The offeror need not report regularly employed officers or employees of the offeror to whom payments of reasonable compensation were made.

(f) *Buy American Act Certificate.* (Applies only if the clause at Federal Acquisition Regulation (FAR) 52.225-1, Buy American Act – Supplies, is included in this solicitation.)

(1) The offeror certifies that each end product, except those listed in paragraph (f)(2) of this provision, is a domestic end product and that for other than COTS items, the offeror has considered components of unknown origin to have been mined, produced, or manufactured outside the United States. The offeror shall

list as foreign end products those end products manufactured in the United States that do not qualify as domestic end products, *i.e.*, an end product that is not a COTS item and does not meet the component test in paragraph (2) of the definition of “domestic end product.” The terms “commercially available off-the-shelf (COTS) item,” “component,” “domestic end product,” “end product,” “foreign end product,” and “United States” are defined in the clause of this solicitation entitled “Buy American Act—Supplies.”

(2) Foreign End Products:

LINE ITEM NO.	COUNTRY OF ORIGIN

[List as necessary]

(3) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25.

(g)(1) *Buy American Act -- Free Trade Agreements -- Israeli Trade Act Certificate.* (Applies only if the clause at FAR 52.225-3, Buy American Act -- Free Trade Agreements -- Israeli Trade Act, is included in this solicitation.)

(i) The offeror certifies that each end product, except those listed in paragraph (g)(1)(ii) or (g)(1)(iii) of this provision, is a domestic end product and that for other than COTS items, the offeror has considered components of unknown origin to have been mined, produced, or manufactured outside the United States. The terms “Bahrainian, Moroccan, Omani, or Peruvian end product,” “commercially available off-the-shelf (COTS) item,” “component,” “domestic end product,” “end product,” “foreign end product,” “Free Trade Agreement country,” “Free Trade Agreement country end product,” “Israeli end product,” and “United States” are defined in the clause of this solicitation entitled “Buy American Act--Free Trade Agreements--Israeli Trade Act.”

(ii) The offeror certifies that the following supplies are Free Trade Agreement country end products (other than Bahrainian, Moroccan, Omani, or Peruvian end products) or Israeli end products as defined in the clause of this solicitation entitled “Buy American Act—Free Trade Agreements—Israeli Trade Act”:

Free Trade Agreement Country End Products (Other than Bahrainian or Moroccan End Products) or Israeli End Products:

LINE ITEM NO.	COUNTRY OF ORIGIN

[List as necessary]

(iii) The offeror shall list those supplies that are foreign end products (other than those listed in paragraph (g)(1)(ii) or this provision) as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act." The offeror shall list as other foreign end products those end products manufactured in the United States that do not qualify as domestic end products, *i.e.*, an end product that is not a COTS item and does not meet the component test in paragraph (2) of the definition of "domestic end product."

Other Foreign End Products:

LINE ITEM NO.	COUNTRY OF ORIGIN

[List as necessary]

(iv) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25.

(2) *Buy American Act—Free Trade Agreements—Israeli Trade Act Certificate, Alternate I.* If Alternate I to the clause at FAR 52.225-3 is included in this solicitation, substitute the following paragraph (g)(1)(ii) for paragraph (g)(1)(ii) of the basic provision:

(g)(1)(ii) The offeror certifies that the following supplies are Canadian end products as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act":

Canadian End Products:

Line Item No.:

(3) *Buy American Act—Free Trade Agreements—Israeli Trade Act Certificate, Alternate II.* If Alternate II to the clause at FAR 52.225-3 is included in this solicitation, substitute the following paragraph (g)(1)(ii) for paragraph (g)(1)(ii) of the basic provision:

(g)(1)(ii) The offeror certifies that the following supplies are Canadian end products or Israeli end products as defined in the clause of this solicitation entitled "Buy American Act--Free Trade Agreements--Israeli Trade Act":

Canadian or Israeli End Products:

Line Item No.:	Country of Origin:

[List as necessary]

(4) *Trade Agreements Certificate.* (Applies only if the clause at FAR 52.225-5, Trade Agreements, is included in this solicitation.)

(i) The offeror certifies that each end product, except those listed in paragraph (g)(4)(ii) of this provision, is a U.S.-made or designated country end product as defined in the clause of this solicitation entitled "Trade Agreements."

(ii) The offeror shall list as other end products those end products that are not U.S.-made or designated country end products.

Other End Products

Line Item No.:	Country of Origin:

[List as necessary]

(iii) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25. For line items covered by the WTO GPA, the Government will evaluate offers of U.S.-made or designated country end products without regard to the restrictions of the Buy American Act. The Government will consider for award only offers of U.S.-made or designated country end products unless the Contracting Officer determines that there are no offers for such products or that the offers for such products are insufficient to fulfill the requirements of the solicitation.

(h) *Certification Regarding Responsibility Matters (Executive Order 12689)*. (Applies only if the contract value is expected to exceed the simplified acquisition threshold.) The offeror certifies, to the best of its knowledge and belief, that the offeror and/or any of its principals--

- (1) Are, are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;
- (2) Have, have not, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a Federal, state or local government contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, violating Federal criminal tax laws, or receiving stolen property; and
- (3) Are, are not presently indicted for, or otherwise criminally or civilly charged by a Government entity with, commission of any of these offenses enumerated in paragraph (h)(2) of this clause; and
- (4) Have, have not, within a three-year period preceding this offer, been notified of any delinquent Federal taxes in an amount that exceeds \$3,000 for which the liability remains unsatisfied.

(i) Taxes are considered delinquent if both of the following criteria apply:

(A) *The tax liability is finally determined.* The liability is finally determined if it has been assessed. A liability is not finally determined if there is a pending administrative or judicial challenge. In the case of a judicial challenge to the liability, the liability is not finally determined until all judicial appeal rights have been exhausted.

(B) *The taxpayer is delinquent in making payment.* A taxpayer is delinquent if the taxpayer has failed to pay the tax liability when full payment was due and required. A taxpayer is not delinquent in cases where enforced collection action is precluded.

(ii) Examples.

(A) The taxpayer has received a statutory notice of deficiency, under I.R.C. §6212, which entitles the taxpayer to seek Tax Court review of a proposed tax deficiency. This is not a delinquent tax because it is not a final tax liability. Should the taxpayer seek Tax Court review, this will not be a final tax liability until the taxpayer has exercised all judicial appeal rights.

(B) The IRS has filed a notice of Federal tax lien with respect to an assessed tax liability, and the taxpayer has been issued a notice under I.R.C. §6320 entitling the taxpayer to request a hearing with the IRS Office of Appeals Contesting the lien filing, and to further appeal to the Tax Court if the IRS determines to sustain the lien filing. In the course of the hearing, the taxpayer is entitled to contest the underlying tax liability because the taxpayer has had no prior opportunity to contest the liability. This is not a delinquent tax because it is not a final tax liability. Should the taxpayer seek tax court review, this will not be a final tax liability until the taxpayer has exercised all judicial appeal rights.

(C) The taxpayer has entered into an installment agreement pursuant to I.R.C. §6159. The taxpayer is making timely payments and is in full compliance with the agreement terms. The taxpayer is not delinquent because the taxpayer is not currently required to make full payment.

(D) The taxpayer has filed for bankruptcy protection. The taxpayer is not delinquent because enforced collection action is stayed under 11 U.S.C. §362 (the Bankruptcy Code).

(i) Certification Regarding Knowledge of Child Labor for Listed End Products (Executive Order 13126). [The Contracting Officer must list in paragraph (i)(1) any end products being acquired under this solicitation that are included in the List of Products Requiring Contractor Certification as to Forced or Indentured Child Labor, unless excluded at 22.1503(b).]

(1) Listed End Product

Listed End Product:	Listed Countries of Origin:

(2) Certification. [If the Contracting Officer has identified end products and countries of origin in paragraph (i)(1) of this provision, then the offeror must certify to either (i)(2)(i) or (i)(2)(ii) by checking the appropriate block.]

(i) The offeror will not supply any end product listed in paragraph (i)(1) of this provision that was mined, produced, or manufactured in the corresponding country as listed for that product.

(ii) The offeror may supply an end product listed in paragraph (i)(1) of this provision that was mined, produced, or manufactured in the corresponding country as listed for that product. The offeror certifies that it has made a good faith effort to determine whether forced or indentured child labor was used to mine, produce, or manufacture any such end product furnished under this contract. On the basis of those efforts, the offeror certifies that it is not aware of any such use of child labor.

(j) *Place of manufacture.* (Does not apply unless the solicitation is predominantly for the acquisition of manufactured end products.) For statistical purposes only, the offeror shall indicate whether the place of manufacture of the end products it expects to provide in response to this solicitation is predominantly—

(1) In the United States (Check this box if the total anticipated price of offered end products manufactured in the United States exceeds the total anticipated price of offered end products manufactured outside the United States); or

(2) Outside the United States.

(k) Certificates regarding exemptions from the application of the Service Contract Act. (Certification by the offeror as to its compliance with respect to the contract also constitutes its certification as to compliance by its subcontractor if it subcontracts out the exempt services.) [The contracting officer is to check a box to indicate if paragraph (k)(1) or (k)(2) applies.]

(1) Maintenance, calibration, or repair of certain equipment as described in FAR 22.1003-4(c)(1). The offeror does does not certify that—

(i) The items of equipment to be serviced under this contract are used regularly for other than Governmental purposes and are sold or traded by the offeror (or subcontractor in the case of an exempt subcontract) in substantial quantities to the general public in the course of normal business operations;

(ii) The services will be furnished at prices which are, or are based on, established catalog or market prices (see FAR 22.1003-4(c)(2)(ii)) for the maintenance, calibration, or repair of such equipment; and

(iii) The compensation (wage and fringe benefits) plan for all service employees performing work under the contract will be the same as that used for these employees and equivalent employees servicing the same equipment of commercial customers.

(2) Certain services as described in FAR 22.1003-4(d)(1). The offeror does does not certify that—

(i) The services under the contract are offered and sold regularly to non-Governmental customers, and are provided by the offeror (or subcontractor in the case of an exempt subcontract) to the general public in substantial quantities in the course of normal business operations;

(ii) The contract services will be furnished at prices that are, or are based on, established catalog or market prices (see FAR 22.1003-4(d)(2)(iii));

(iii) Each service employee who will perform the services under the contract will spend only a small portion of his or her time (a monthly average of less than 20 percent of the available hours on an annualized basis, or less than 20 percent of available hours during the contract period if the contract period is less than a month) servicing the Government contract; and

(iv) The compensation (wage and fringe benefits) plan for all service employees performing work under the contract is the same as that used for these employees and equivalent employees servicing commercial customers.

(3) If paragraph (k)(1) or (k)(2) of this clause applies—

(i) If the offeror does not certify to the conditions in paragraph (k)(1) or (k)(2) and the Contracting Officer did not attach a Service Contract Act wage determination to the solicitation, the offeror shall notify the Contracting Officer as soon as possible; and

(ii) The Contracting Officer may not make an award to the offeror if the offeror fails to execute the certification in paragraph (k)(1) or (k)(2) of this clause or to contact the Contracting Officer as required in paragraph (k)(3)(i) of this clause.

l) *Taxpayer identification number (TIN)* (26 U.S.C. 6109, 31 U.S.C. 7701). (Not applicable if the offeror is required to provide this information to a central contractor registration database to be eligible for award.)

(1) All offerors must submit the information required in paragraphs (l)(3) through (l)(5) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the Internal Revenue Service (IRS).

(2) The TIN may be used by the government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.]

(3) Taxpayer Identification Number (TIN).

TIN: _____.

TIN has been applied for.

TIN is not required because:

Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

Offeror is an agency or instrumentality of a foreign government;

Offeror is an agency or instrumentality of the Federal Government;

(4) Type of organization.

Sole proprietorship;

Partnership;

Corporate entity (not tax-exempt);

Corporate entity (tax-exempt);

Government entity (Federal, State, or local);

Foreign government;

International organization per 26 CFR 1.6049-4;

Other _____.

(5) Common parent

Offeror is not owned or controlled by a common parent:

Name and TIN of common parent:

Name _____

TIN _____

(m) *Restricted business operations in Sudan.* By submission of its offer, the offeror certifies that the offeror does not conduct any restricted business operations in Sudan.

(n) Prohibition on Contracting with Inverted Domestic Corporations.

(1) *Relation to Internal Revenue Code.* A foreign entity that is treated as an inverted domestic corporation for purposes of the Internal Revenue Code at 26 U.S.C. 7874 (or would be except that the inversion transactions were completed on or before March 4, 2003), is also an inverted domestic corporation for purposes of 6 U.S.C. 395 and for this solicitation provision (see FAR 9.108).

(2) *Representation.* By submission of its offer, the offeror represents that it is not an inverted domestic corporation and is not a subsidiary of one.

(End of Provision)

Alternate I (Apr 2002). As prescribed in 12.301(b)(2), add the following paragraph (c)(11) to the basic provision:

(11) (Complete if the offeror has represented itself as disadvantaged in paragraph (c)(4) or (c)(9) of this provision.)

[The offeror shall check the category in which its ownership falls]:

___ Black American.

___ Hispanic American.

___ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

___ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory or the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

___ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

___ Individual/concern, other than one of the preceding.

Alternate II (Oct 2000). As prescribed in 12.301(b)(2), add the following paragraph (c)(9)(iii) to the basic provision:

(iii) Address. The offeror represents that its address is, is not in a region for which a small disadvantaged business procurement mechanism is authorized and its address has not changed since its certification as a small disadvantaged business concern or submission of its application for certification. The list of authorized small disadvantaged business procurement mechanisms and

regions is posted at <http://www.arnet.gov/References/sdbadjustments.htm>. The offeror shall use the list in effect on the date of this solicitation. "Address," as used in this provision, means the address of the offeror as listed on the Small Business Administration's register of small disadvantaged business concerns or the address on the completed application that the concern has submitted to the Small Business Administration or a Private Certifier in accordance with 13 CFR part 124, subpart B. For joint ventures, "address" refers to the address of the small disadvantaged business concern that is participating in the joint venture.

DOCUMENTS, EXHIBITS OR ATTACHMENTS

LIST OF ATTACHMENTS

The following documents are attached hereto and made a part of this contract:

Attachment No. A

Description/Title:

LOX and LH Run Line Flow Meters, Specification Number 110GT-GM11

Date: July 21, 2009

Pages: 33

ORIGINAL

A3 Altitude Test Facility
at
NASA Stennis Space Center

**LOX AND LH RUN LINE
FLOW METERS**

Specification Number 110GT-GM11

Prepared by:
ISSUED/CEF 1 JUL 20 2009

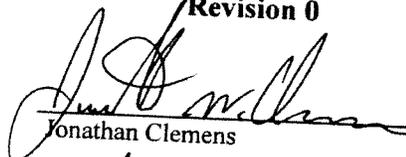
Pratt & Whitney Rocketdyne
A-3 Test Stand Mechanical Systems Engineering Team

July 21, 2009

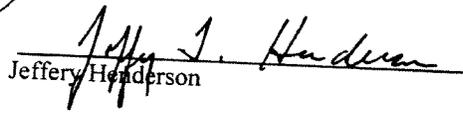
Revision 0

Approved:

Originator:

 7/22/2009
Jonathan Clemens

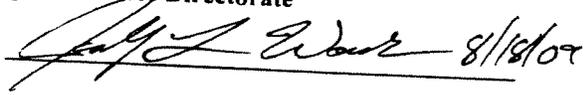
Approver:

 8/3/09
Jeffery Henderson

NASA Construction Manager:

 8/20/09

NASA Engineering and Science Directorate

 8/18/09

NASA A3 Safety

 8/18/09

Revision No. 0

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

This specification contains the requirements for turbine flowmeters to be used to measure liquid oxygen (LOX) and liquid hydrogen (LH) flow rates for J-2X rocket engine testing at Stennis Space Center. This basic specification describes units which will be mounted in low-pressure piping. Requirements herein shall govern design, material, fabrication, assembly, inspection, examination, testing, cleaning, packaging and delivery of the specified components. The government reserves the right to inspect any aspect of the fabrication and testing of this component. There shall be no exceptions to any requirements of this engineering standard unless specifically defined in the proposal. When a vendor's particular product is judged acceptable for use within the requirements of this specification, a specific specification will be issued listing the models and sizes so qualified. Six (6) flowmeters will be purchased under this specification: Three (3) for Liquid Oxygen and three (3) for Liquid Hydrogen.

1.2 REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation. Refer to Section 01420, "Sources for Reference Publications", for information on obtaining publications.

AMERICAN SOCIETY OF NON DESTRUCTIVE TESTING (ASNT)

ASNT-TC-1A – Manual of Recommended Practice

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AS5202

Bosses, Fluid Connector – Internal
Straight Thread

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
BOILER AND PRESSURE VESSEL CODE

ASME B16.5

Pipe Flanges and Flanged Fittings

ASME B16.9

Factory Made Wrought Steel Butt
Welding Fittings

PROCESS FLOWMETER PROCUREMENTS

110GT-GM11 Rev.0

ASME A182	Specification for Forged or rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Flowmeters and Parts for High-Temperature Service
ASME A312	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASME B31.3	Process Piping
ASME MFC-4M	Measurement of Gas Flow by Turbine Meter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105	Standard specification for carbon steel forgings for piping applications
ASTM A 193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 266	Standard specification for carbon steel forgings for pressure vessel components
ASTM G86	Standard Test Method for Determining Ignition Sensitivity of Materials to Mechanical Impact in Pressurized Oxygen Environments

NASA & SSC STANDARDS AND SPECIFICATIONS (SSC)

SSC-STD- 8070-0089 - FLUIDS	Surface Cleanliness Requirements for SSC Fluid Systems
SSC-DWG NO. 54000-GM30	Specifications for materials used in LOX or GOX service exempt from batch test requirements

SSC-STD-79-002	Sampling Requirements and Maximum Allowable Impurities for SSC Fluids and Fluid Systems
SSC-STD-79-010	Requirements for Materials Used in LOX/GOX Service
SSC-DWG NO. 54000-GP11	Packaging and Preservation of Cleaned Components
NASA-STD-5008A	Protective coating of carbon steel, stainless steel, and aluminum on launch structures, facilities and ground support equipment.
MSFC-HDBK-527	Materials Selection List for Space Hardware Systems
NHB-8060.1	Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

One (1) e-mail.pdf version along with four black line prints of each drawing shall be submitted. One print, marked with the review notations by the Contracting Officer, will be returned.

SD-01 Data

The Contractor shall furnish design calculations covering performance features of the flowmeters. Design calculations shall be submitted with the shop drawings. One (1) e-mail.pdf version along with four black line prints are due six weeks after award of the contract. Design calculations shall be stamped by a Professional Engineer and shall include:

1. Calculations confirming compliance with key specification requirements
2. Engineering drawings
3. Critical clearance ("stackup") analysis
4. Stress analysis

5. Analysis or experience with similar designs to verify that electrical discharge from the rotor that could have detrimental effects on any flowmeter hardware or pose an ignition hazard in LOX will not occur
6. Material selection
7. Manufacturing process selection
8. Status of long-lead procurements
9. Acceptance test plan, including details on approach to proving repeatability and non-linearity Paragraphs 2.3.3 and 2.5.3.5.
10. Schedule status
11. Plan for satisfying dynamic balance requirements

SD-01 Data

The Contractor shall submit One (1) e-mail.pdf version along with four black line prints of the Loading, Transportation and Lift Plan six weeks prior to flowmeter shipment.

SD-04 Drawings

Shop Fabrication Drawings shall be submitted of each flowmeter and of each shop assembly component as needed for the assembly of the flowmeter. The drawings shall be checked and shall be in AutoCAD Ver. 2007 format. Six copies are due six weeks after award of the contract. Shop drawings shall show the location and details of:

- all dimensions and details of construction
- lifting points
- center of gravity (of complete assembly)
- support design requirements (as needed)
- bill of Materials

SD-07 Schedules

One (1) e-mail.pdf version along with four black line prints of Fabrication time and test and inspection schedules shall be submitted in Microsoft Project 2003 three weeks after award of contract.

SD-08 Statements

The Contractor shall submit six copies of the following items within three weeks after award of contract:

- Quality Control Manual
- NDT Procedures and Inspection Procedures
- Hydrostatic Leak Check Procedures

Cleaning and Certification Procedures
Painting Specifications and Procedures
Functional Test Procedures

SD-09 Reports

Material reports shall be furnished for the materials used in each flowmeter. In addition to the specification for the base material, the report shall include the specification for the weld material. One (1) e-mail.pdf version along with four black line prints are due six weeks after award of the contract. The following information shall be shown in the report:

Contract number
System
Pipe Specification or Use Material Specification (Base Material)
Material Specification of Weld or Bond
Material Specification of all non-metallic materials.
Heat Treatment charts and records – as applicable

SD-09 Reports

Prior to commencement of fabrication, the Contractor shall submit One (1) e-mail.pdf version along with four black line prints of the following items:

Certified Material Test Reports for plate, forging and welding materials
Heat Treatment Procedure (as applicable)

SD-09 Reports

One (1) e-mail.pdf version along with four black line prints of the following shall be submitted at the time the flowmeter is ready for shipment:

Mill Test Reports
Facsimile of Nameplate Stamping
Manufacturer's Data Report
Hydrostatic Test Report including test set-up configuration and log of time versus pressure
All Reports for Non-Destructive Examinations
Records of all shop repairs
Complete listing of all materials and soft goods (including certifications for spare parts as applicable)

SD-18 Records

At the time the flowmeter is ready for shipment, four copies of the following shall be submitted:

Heat Treatment Charts and Records
Spare Parts Recommendation List

1.4 GENERAL REQUIREMENTS

Each flowmeter shall be designed, fabricated, tested, cleaned and delivered in accordance with the detailed requirements of this specification. The requirements specified herein are minimum requirements. The Contractor shall take whatever additional measures are necessary in his design, fabrication, inspection and testing to produce a flowmeter, which will satisfactorily pass the tests specified herein without damage. Where specific requirements are set forth, and where such specific requirements depart from requirements or alternatives contained in any documents referenced herein, the specific requirements contained herein shall govern and take precedence. The general requirements for each type of flowmeter are provided within the body of this specification with specific requirements for each flowmeter type.

1.5 QUALIFICATION OF FLOWMETER MANUFACTURER

The Contractor shall furnish with his bid, certification attesting to a minimum of 5 years experience by the manufacturer in design and manufacture of flowmeters of similar design with the specific service media identified. Qualification name, phone number and address of reference are required. The experience listing shall include a list of flowmeters fabricated, size, location of use, service, and date of manufacture.

1.6 DRAWINGS AND REPORTS

This section specifies the requirements for capacity and performance. Nothing shown on the drawings or contained in the design data shall relieve the Contractor from his responsibility to furnish a flowmeter meeting the requirements of this section.

1.7 QUALITY ASSURANCE

The Contract Administrator and Government reserve the right to inspect all work at all times during and upon completion of fabrication and to witness any or all tests. The Contractor shall cooperate fully to enable the SSC COTR or Government designated representative to be present at the performance of any or all tests and any other activity as specifically requested. The Contractor shall furnish all equipment and materials for all tests except where specially stated otherwise. The Contractor shall notify the COTR fourteen calendar (14) calendar days prior to performance of any and all tests.

As a minimum, the following hold points shall apply:

Item No.	Surveillance	Type
1	Government review and approval of welding procedures, qualification records, and welder certifications, prior to commencement of any welding.	Verification
2	Government review of calculations	Verification
3	Packaging of flowmeter for shipment	Witness
4	Functional Test	Witness
	*Final Buy-offs of x-rays to be performed by SSC NDE	

1.8 WELDING PROCEDURE AND WELDING OPERATOR QUALIFICATIONS

1.8.1 General

Welding procedure and welders qualifications shall be performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

1.8.2 Welding Procedure

Prior to flowmeter fabrication, welding procedures shall be submitted to the COTR for approval.

1.8.3 Qualifications of Welders

The determination of the qualification of welders, and the requirements for welding shall be in accordance with the applicable portions of the above referenced code and shall be submitted to COTR for approval prior to any welding.

1.8.4 Weld Rods

Weld rods shall be suitable for the type of welding to be performed. Rods shall be stored to prevent contamination and deterioration by moisture. A drying oven or heater shall be used in accordance with recommendations and instructions of the manufacturer.

1.9 GUARANTEE

All equipment to be furnished under this specification shall be guaranteed against defective materials, design, and workmanship for a period of one year from receipt of the flowmeter. Upon receipt of notice of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no additional cost. The Contractor shall acknowledge his



responsibility under these guarantee provisions by letter, stating the inclusive dates of the guarantee period for which the equipment and materials referred herein are guaranteed.

PART 2 REQUIREMENTS

2.1 GENERAL

Each of the dash numbers listed under this specification applies to a certain flow rate and fluid.

FLOW PARAMETER	-01 LIQUID OXYGEN			-02 LIQUID HYDROGEN		
	MINIMIUM	MAXIMIUM	NOMINAL	MINIMIUM	MAXIMIUM	NOMINAL
PRESSURE (PSIG)	27	275	30.3	15	275	22.3
TEMPERATURE R	162	170	164.5	36	42	37.2
DENSITY (lb/ft ³)	70	71.25	70.90	4.2	4.42	4.39
FLOW RATE (GPM)	450	4500	3478	1300	13000	10282

2.1.1 FLOW RANGE

The fluid and operating volumetric flow rate change for each dash number are shown in Table 1.

2.1.2 PRESSURE AND TEMPERATURE

Operating temperature and pressure for each dash number is shown in Table 1.

2.1.3 OVER-RANGE FLOW

The flowmeter shall withstand bursts of liquid flow rate to 150% of Q_{max} (Table 1) for ten (10) seconds, with no change in structural integrity, calibration, or flowmeter performance.

2.1.4 GAS FLOW

The flowmeter shall withstand gas flow up to 30% of Q_{max} (Table 1) for ten (10) minutes without damage to the bearings, and no change in calibration or flowmeter performance. "Gas Flow" is construed to mean vapor phase of the service fluid (Table 1).

2.1.5 VIBRATION

When installed in its piping section, the flowmeter shall withstand vibration of the following levels (any axis):

- 20 Hz to 70 Hz ----- .012 G² (rms)/Hz
- 70 Hz to 100 Hz ----- +18 db/octave rise
- 100 Hz to 318 Hz ----- .120 G² (rms)/Hz
- 318 Hz to 400 Hz ----- +12 db/octave rise
- 400 Hz to 2000 Hz ----- .3 G² (rms)/Hz
- Composite reference level = 22.9 G (rms)

There shall be no significant resonance points below 200 Hz

2.1.6 THERMAL SHOCK

The flowmeter shall withstand sudden chill from ambient to the operating temperature (Table 1) corresponding to complete quench in the service liquid, with no change in structural integrity, calibration or performance.

2.1.7 TRANSIENT FLOW

The flowmeter shall withstand flow rate increase from 0 to maximum (Q_{max} - Table 1) in 300 milliseconds.

2.1.8 INTERFACES

1. The flowmeter will be installed in 12 inch Schedule 5 pipe
2. The flowmeter shall attach to the piping system by ANSI 150 lb. raised-face flanges.
3. Figure 1 shows the length of the flowmeter between flanges, the inlet diameter and the exit diameter with tolerances.
4. Figure 2 shows the clocking of the pick up coil boss and dimensions for the boss
5. The flowmeter body shall be capable of withstanding the following forces and moments, which may be transmitted to it by the piping system, without damage and without change of calibration.
 - a. Torsion 5,000 lb-ft
 - b. Bending moment 500 lb-ft
 - c. Vertical force 750 lb
6. Lifting lugs or other suitable means of lifting the flowmeter shall be provided.

2.1.9 ORIENTATION

The flowmeter shall function according to this specification when installed in any orientation.

2.2 MATERIALS AND FABRICATION

2.2 GENERAL

All materials shall be new and shall conform to the latest applicable specifications and standards.

2.2.1 ACCEPTABLE MATERIALS

The following materials are preferred; all other materials need to be evaluated and approved. All materials used are to be certified. All materials in contact with the working fluid must be compatible with water, liquid oxygen and liquid hydrogen.

Supports -----	weldments - 304L, 316L, 321, 347 stainless steels non-welded - 300 series stainless steel
Bearings -----	Balls - Silicon Nitride; Cage & Race Material - Per vendors recommendation.
Retainers -----	300 series stainless steel
Rotor -----	nickel 200

2.2.2 WELDMENTS

All welds must be 100% penetration, void-free and fully stress relieved. Vendor must include weld design information with proposed design. X-ray inspection of housing welds required. Lifting lug and coil boss welds excluded from 100% requirement and X-ray inspection.

2.2.3 ROTORS

Preference is for a rotor machined entirely from a single piece of material. Special care must be exercised to prevent stress concentration, especially at blade roots. If a shroud is employed, design must be approved by the Government.

2.2.4 BEARINGS

Primary rotor bearings shall be radial retainer ball type, for both radial and axial loads. Secondary bearings shall be employed and must use AMPCO 18. These shall support the rotor in the event of a primary bearing failure.

2.2.5 ASSEMBLY AND DISASSEMBLY

All wear points shall be capable of easy replacement. All fasteners shall be locked with deformed expendable locks, except that lock wiring shall not be employed. No special tools shall be required for disassembly for replacement of worn parts. The rotor shall be marked to show flow direction.

2.2.6 DYNAMIC BALANCE

The rotor shall be dynamically balanced per International Standard ISO 1940 to balance grade of G6.3.

2.2.7 SPECIAL STRESS SITUATIONS

The following stress situations are examples of special concern:

1. Axial support stresses due to drag, including transient flow effects.
2. Bearing loads due to drag, transient flow and vibration.
3. Rotor blade stresses due to drag, transient flow and vibration.
4. Rotor shroud (if used) stresses from drag, centrifugal force and vibration.
5. Housing loads due to mechanical interfaces.

The vendor shall submit as a minimum an engineering analysis of these stress concerns with the design evaluation drawings, Paragraph 4.

2.2.8 PICKUP COILS

The flowmeter shall be designed to operate with two pickup coils mounted 180 degrees apart in the same plane. Pickup coils shall be located as shown in Figure 1. Coils will be GFE and shall be delivered to the vendor for flowmeter testing.

2.2.9 IDENTIFICATION

The flowmeter shall be permanently identified on the outside of the assembly with the following information:

- Manufacturer
- Specification and dash number
- Serial number
- Liquid service
- Maximum flow rate (GPM)
- Flow direction
- Test pressure

2.2.10 ENVIRONMENT

The flowmeter shall function according to this specification under exposure to the following exterior environments:

- Temperature - 10° F to 120° F
- Humidity - 10% to 100%
- Heavy rain
- Sand and dust

2.3 PERFORMANCE

2.3.1 OPERATING SPEED

At the maximum flow rate (Q_{\max} - Table 1) the rotational speed of the flow meter rotor shall be at least 500 RPM.

2.3.2 OUTPUT FREQUENCY

At the maximum flow rate (Q_{\max} - Table 1) output frequency shall be at least 400 Hz.

2.3.3 OUTPUT VOLTAGE

At the minimum flow rate (Q_{\min} - Table 1) output signal amplitude shall be at least 100 millivolts peak-to-peak across a 10,000 ohm resistive load. At all flow rates within the operating range (Table 1); the output waveform must be uniform, with no secondary peaks, and with positive portion above 10 percent greater in duration than 1/3 of the pulse repetition period. These requirements shall be met when the flowmeter is equipped with supplied pickup coils. Reference Figure A below.

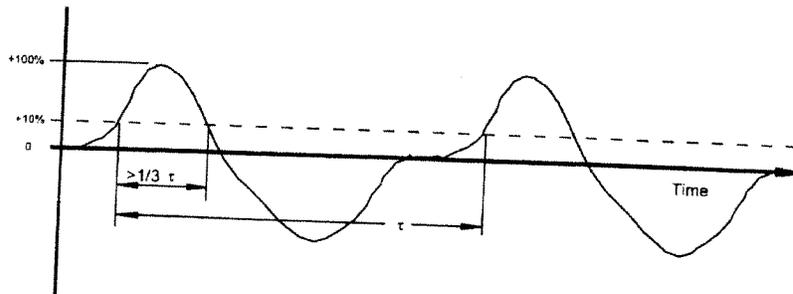


Figure A

2.3.4 NON-LINEARITY

Non-linearity is defined as deviation of calibration factor from the mean over the operating range (Table 1). Non-linearity shall be less than $\pm 0.5\%$.

2.3.5 REPEATABILITY

The repeatability error shall be less than $\pm 0.1\%$ (95% confidence level) at the minimum flow rate (Table 1). This shall be demonstrated by the vendor, utilizing the correlation technique presented herein. The flowmeter shall be installed in series with another flowmeter in a water calibration facility. Ten (10) repeat runs at the minimum flow rate shall be made. The simultaneous totaled counts (cycles) for each flowmeter, together with the time increment, temperature of the liquid, and its volume, shall be recorded for each run. If the deviations of the simultaneous flowmeter factors are correlated in both

direction and magnitude, then the deviations are due to the calibration facility. If they are not correlated, then the deviations are due to each flowmeter's respective repeatability.

By computing the statistical correlation coefficient r and the standard deviation σ for the ten repeats, the respective contributions of facility and flowmeter to σ can be estimated. The following computations shall be made:

Compute the factor K for each run for each flowmeter:

$$K_{xi} = \frac{X_i}{V_i} \quad K_{yi} = \frac{Y_i}{V_i}$$

Where X_i and Y_i are the totaled counts (cycles) for the i_{th} run of Flowmeter X (the flowmeter undergoing acceptance test per paragraph 4.3) and Flowmeter Y (the comparison flowmeter), respectively. V_i is the corresponding water volume.

Compute the correlation coefficient r :

$$r = \frac{\sum_{i=1}^n (K_{xi} \cdot K_{yi}) - \left(\frac{\sum_{i=1}^n K_{xi}}{n} \right) \cdot \left(\frac{\sum_{i=1}^n K_{yi}}{n} \right)}{\sqrt{\left[\sum_{i=1}^n (K_{xi})^2 - \frac{\left(\sum_{i=1}^n K_{xi} \right)^2}{n} \right] \cdot \left[\sum_{i=1}^n (K_{yi})^2 - \frac{\left(\sum_{i=1}^n K_{yi} \right)^2}{n} \right]}}$$

Where n is the number of runs.

Compute the mean factors K_x and K_y :

$$K_x = \frac{\sum_{i=1}^n K_{xi}}{n} \quad K_y = \frac{\sum_{i=1}^n K_{yi}}{n}$$

Compute the standard deviation σ :

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^n (K_{ix})^2 - \left(\frac{\sum_{i=1}^n K_{ix}}{n}\right)^2}{n-1}}$$

$$\sigma_y = \sqrt{\frac{\sum_{i=1}^n (K_{iy})^2 - \left(\frac{\sum_{i=1}^n K_{iy}}{n}\right)^2}{n-1}}$$

Compute the experimental repeatability (*tCV*) in percent at 95% confidence level:

$$tCV_x = \frac{2.26\sigma_x \cdot 100}{K_x} \qquad tCV_y = \frac{2.26\sigma_y \cdot 100}{K_y}$$

Finally, calculate the flowmeter repeatability (*tCV_m*):

$$tCV_{mx} = (tCV_x) \cdot \sqrt{1-r^2}; \text{ repeatability of Flowmeter } X \text{ (the flowmeter per this specification)}$$

$$tCV_{my} = (tCV_y) \cdot \sqrt{1-r^2}; \text{ repeatability of Flowmeter } Y \text{ (the comparison flowmeter)}$$

The quantity (*tCV_m*) shall be less than 0.1% for compliance with the specification. If *r* is negative and *tCV* is greater than 0.1%, then the test is not entirely conclusive. Additional tests may be required in that instance.

Alternatively, the vendor may demonstrate individual flowmeter repeatability by calibration against a volumetric standard, but the Government must evaluate the standards prior to testing. Standards used and facility error, must have a demonstrated combined uncertainty of 0.03% reading or less. Standards must be NIST traceable.

2.3.6 BACK PRESSURE

Operation of the flowmeter without degradation of performance due to cavitation effects shall required back pressure no greater than 20 psi above the liquid's vapor pressure at inlet conditions.

2.3.7 PRESSURE LOSS

At the maximum flow rate (Table 1) the overall pressure loss shall not exceed 2 psi, using water at 70° F.

2.3.8 ELECTRICAL DISCHARGE

The use of Silicon Nitride Ceramic bearings allows the flowmeter rotor to remain electrically isolated from the housing. At the flow ranges specified in Table 1 electrical

discharge from the rotor that could have detrimental effects on flowmeter hardware or pose an ignition hazard in LOX will not occur.

2.4 Not Used

2.5.0 ACCEPTANCE TESTS

2.5.1 DEFINITION

Certain acceptance tests are to be performed on each flowmeter upon receipt. These shall include:

- Workmanship (2.5.3.1)
- Installation dimensions (2.5.3.3)

Other tests shall be performed by the vendor at any facility mutually acceptable to the Government and the vendor. These include:

- Output signal (2.5.3.2)
- Vibration (2.5.3.4) (single flowmeter shall be chosen to represent all)
- Repeatability (2.5.3.5)
- Non-linearity (2.4)

Test fixtures shall be furnished by the vendor.

2.5.2 WITNESS

The Government's representatives shall be allowed to witness the Repeatability and Vibration tests. Fourteen (14) days notice shall be given prior to each test.

2.5.3 TESTS

2.5.3.1 WORKMANSHIP

The flowmeter shall be examined for good workmanship and adherence to design drawings. Of particular interest are welds, surface condition, and elimination of burrs.

2.5.3.2 OUTPUT SIGNAL

The flowmeter shall be mounted in a test fixture with two (2) pickup coils located in accordance with Figure 2. One coil shall be loaded with 10,000 ohms. Rotor shall be spun with gas for a total cumulative time of 60 seconds. The output signal characteristics shall be in accordance with Paragraph 2.3.3.

2.5.3.3 INSTALLATION DIMENSIONS

The flowmeter shall be measured to verify envelope dimensions in accordance with Figure 1.

2.5.3.4 VIBRATION

2.5.3.4.1 RESONANCE SEARCH

The flowmeter shall be mounted in a steel test fixture. The assembly shall be subjected to sinusoidal vibration along three (3) mutually perpendicular axes, one of which is the spin axis of the flowmeter. Sweeps shall be from 5 Hz to 200 Hz, at one (1) octave per minute. Using an accelerometer mounted on the fixture, coaxial with the vibrator axis, determine that there are no significant resonances. One (1) sweep shall be made on each axis.

2.5.4.3.2 RANDOM VIBRATION TEST

The flowmeter shall be subjected to random vibration with the spectral distribution shown in Paragraph 2.1.5, for one (1) hour on each of three (3) mutually perpendicular axes, one (1) of which shall be the spin axis. There shall be no evidence of structural failure, such as cracking or galling. Dye penetrant inspection shall be used to check for cracks. After the test, the flowmeter shall be examined for damage.

2.5.3.5 REPEATABILITY

The flowmeter shall be tested in accordance with Paragraph 2.3.5.

2.5.3.6 TEST RESULTS

All data and analysis results generated during the acceptance testing of the flowmeter shall be documented and provided to the Customer upon delivery of the flowmeter

PART 3 EXECUTION

3.0 CLEANING

Each flowmeter shall be cleaned in accordance with SSTD-8070-0089-FLUIDS. Individual cleanliness certification cards identifying the component serial number and clean level are required for each component. The manufacturer shall submit a cleaning and verification procedure subject to approval by the Government before any work is performed. All Liquid Oxygen flowmeters shall be cleaned to SSTD-8070-0089-FLUIDS Level 1XX. All Liquid Hydrogen flowmeters shall be cleaned to SSTD-8070-0089-FLUIDS Level 2X.

All components shall be packaged after final cleaning and testing in accordance with SSC-DWG NO. 54000-GP11. Precision cleaning is not required for spare parts.

3.1 TRANSPORTATION

After the cleaning, inspecting and sealing of the flowmeters has been completed, the cleanliness level shall be maintained for delivery to Stennis Space Center using a double-plastic wrapped enclosure. The vendor shall assure the proper securing and bracing required to safely transport each flowmeter to its final destination. The manufacturer shall deliver the flowmeters complete and ready for safe installation on site at test facilities at Stennis Space Center.

3.1.1 Loading, Transportation and Lift Plan

The vendor is responsible for the safe loading, securing and transportation of each flowmeter from his point of fabrication to Stennis Space Center. The safe transportation of each flowmeter shall comply with all Federal, state and local codes and regulations. Total weight of the loaded transporter shall be provided to the Contracting Officer prior to transportation in order to assure safe transportation of the flowmeters once they arrive at Stennis Space Center to their final destination.

The vendor shall provide a lift plan that includes the net weight of the load, and gross weight of load "under the hook". A list of all required lifting slings, spreader bars and attachment devices required shall be provided for use to off-load each flowmeter. Each attachment/lift point on the flowmeter shall be properly identified to allow proper rigging for off-loading the flowmeter and assuring the proper configuration requirements are followed during the lifting and placing of the flowmeter from the transporter to the final vertical position. The vendor shall include a drawing providing the center of gravity of the load and all other pertinent information that could affect the safe off-loading of the flowmeter. Lift plan to be reviewed and approved by SSC Lifting Device and Equipment (LDE) Manager. Plan to be issued to SSC 15 calendar days prior to flowmeter delivery.

3.1.2 Unloading Phase

Unloading of the flowmeters will be performed by others based upon the Lifting Plan, information and documentation provided by the vendor as specified in 3.1.1. Any additional information concerning the load weight, center of gravity, configuration changes or any other information that may affect the safe off-loading and placement in the vertical position must be provided prior to the off-loading of each flowmeter.

The flowmeter manufacturer shall provide any special lifting structure (i.e. spreader bars) as part of the flowmeter delivery.

-- End of Section --

SECTION 01330

SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

A standard transmittal form provided by the Government, SSC Form 581, shall be used to transmit each submittal.

One (1) e-mail .pdf version alone with four black line prints of each submittal shall be submitted. One print, marked with review notations by the Contracting Officer, will be returned.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-19, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

SD-01 Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-02 Manufacturer's Catalog Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

SD-03 Not used

SD-04 Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-05 to 06 Not used

SD-07 Schedules

Tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-08 Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

SD-09 Reports

Reports of inspections and laboratory tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-10 to 17 Not used

SD-18 Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism.

SD-19 Not used

1.3 PREPARATION

1.3.1 Marking

Permanent marking shall be provided on each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Contracting officer.

1.3.2 Drawing Format

Drawing submittals shall be prepared in AutoCad 2007 version format and submitted on bond (20 lb. bond minimum) paper, not less than 8-1/2 by 11 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproduces shall be suitable for microfilming and reproduction and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

- a. Job name, which shall be the general title of the contract drawings.
- b. Date of the drawings and revisions.
- c. Name of Contractor.
 - a. Name of Subcontractor.
 - e. Name of the item, material, or equipment detailed thereon.
- f. Number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.
- g. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 4 X 4 inches shall be reserved on the right hand side of each sheet for the Government disposition stamp.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.3.4 Samples

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or

product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Schedules

Within 14 calendar days of notice to proceed, the Contractor shall provide, for approval by the Contracting Officer, the following schedule of submittals, Schedules shall be in Microsoft Project 2003 as well as a .pdf version:

- a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Schedule shall indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.
- b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).
- c. Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include it in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".
- d. Copies of both schedules shall be re-submitted monthly annotated by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

1.4.2 Drawings Submittals

One (1) e-mail .pdf version along with four (4) blackline prints of each drawing shall be submitted. One print, marked with review notations by the Contracting officer, will be returned to the Contractor.

1.4.3 Data Submittals

One (1) e-mail .pdf version along with four (4) complete sets of indexed and bound product data shall be submitted. One set, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.5 GOVERNMENT'S REVIEW

1.5.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "Approved as Submitted." authorize the Contractor to proceed with the work covered.
- b. Submittals marked "Approved, Except as Noted, Resubmission Not Required." authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.
- c. Submittals marked "Approved, Except as Noted, Resubmission Required." require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.
- d. Submittals marked "Will Be Returned By Separate Correspondence" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before prior to proceeding with any of the work depicted by the submittal.
- e. Submittals marked "Disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of work requiring a submittal shall be accomplished until the submittals are approved or approved as noted.
- f. Submittals marked "Receipt Acknowledged" confirm receipt only.
- g. Submittals marked "Other (Specify)" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes in Contract Documentation" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.6 PROGRESS SCHEDULE

1.6.1 Bar Chart

Contractor shall:

- a. Submit the progress chart, for approval by the Contracting officer, within 21 calendar days of Notice to Proceed, in one reproducible and 4 copies.
- b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.
- c. Include no less than the following information on the progress chart:
 - (1) Break out by major headings for primary work activity.
 - (2) A line item break out under each major heading sufficient to track the progress of the work.
 - (3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.
 - (4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

- (5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.
- (6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)
- d. Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

1.7 STATUS REPORT ON MATERIALS ORDERS

Within 21 calendar days after notice to proceed, the Contractor shall submit, for approval by the Contracting officer, an initial status report on materials orders. This report will be updated and re-submitted every 28 calendar days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

- a. Material name, supplier, and invoice number.
- b. Bar chart line item or CPM activity number affected by the order.
- c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.
- d. Current delivery date agreed on by supplier.
- e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.
- f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section -

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
Internet: www.astm.org

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: www.asme.org

NASA & SSC STANDARDS AND SPECIFICATIONS (SSC)

Central Engineering Files
Building 2104
Stennis Space Center, MS 39529
Ph: 228-688-3043
Fax: 228-688-3503

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

400 Commonwealth Drive
Warrendale, PA 15096-0001
Ph: 412-776-4841
Fax: 412-776-5760
Internet: <http://www.sae.org>
e-mail: publications@sae.org

PROCESS FLOWMETER PROCUREMENTS

110GT-GM11 Rev.0

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

1711 Arlingate Lane
P.O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899

-- End of Section --

APPENDIX A1

SSC-STD-8070-0089 – FLUIDS

SURFACE CLEANLINESS REQUIREMENTS FOR SSC FLUID SYSTEMS

SSTD-8070-0089-FLUIDS
Revision B
July 2004

**John C. Stennis Space Center
Surface Cleanliness Requirements
For SSC Fluid Systems**

Original signed by

W. Kirk Miller
NASA SSC Center Operations
Project Management Division

Richard T. Rauch
NASA SSC Propulsion Test
Engineering Division

John Stealey
NASA SSC Safety & Mission Assurance

Issued by

Issued CEF 07/14/04
Central Engineering Files



National Aeronautics and
Space Administration
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

Stennis Standard	SSTD-8070-0089-FLUIDS	B
	Number	Rev.
	Effective Date: July 13, 2004	
	Review Date: July 13, 2009	Page 1 of 111
Responsible Office: NASA SSC Center Operations, Project Management Division		
SUBJECT: Surface Cleanliness Requirements for SSC Fluid Systems		

Document History Log

Revision Change	Date	Originator Phone	Description
Basic	07/03/02	M. Yentzen x87252	Initial release – supersedes SSC STD 79-001 Rev. K, with the following changes: New document number and format per SPG 1400.1; Change Center Ops signature title per NASA reorg.; 1.3.1 delete ref to SLP-05; 2.0 change refs per text mods, add SCD 54000-GM11; 5.1.1 Add Material and Process Control Team option; 5.2 change “can” to “may” throughout; 5.2.2 delete prohibition of HCFC-225g (AK-225g) on titanium alloys; 5.2.9 add new for <i>normal</i> -Propyl Bromide; 6.3 add note excluding level 2 and level 4; 10.0 change SLP-16 ref to new SSLP number; Appendix B: delete terms not used in the standard.
A	8/25/03	Doug Dike Ext 8-2803	2.0 deleted ASTM D1193 per text change in 5.4.1, 5.4.2 and 5.4.3; 5.4.1, 5.4.2 and 5.4.3 revised DI water requirements, including delete of reference to ASTM D1193, add of volume/area ratio limits and (in 5.4.2, particulate) qualifiers for complex configurations and surfactants; Table 1 new note * in “systems” block and footer listing for field dewpoint verification – subsequent notes renumbered; 6.5 revised for field dewpoint verification of assembled dump/vent systems open to the atmosphere. Note: mod to 6.5 and Table 1 incorporates changes per Variance NA63.
B	7/13/04	Dale Sewell Ext 8-2642	Added sentence to 5.2.9 that stipulates not to use <i>normal</i> -Propyl Bromide for NVR and/or particulate analysis of any type of Reflange Seal Rings. 6.5 was revised for weld prepared piping.

Stennis Standard	SSTD-8970-0089-FLUIDS	B
	Number	Rev
	Effective Date: July 13, 2004	
	Review Date: July 13, 2009	
Responsible Office: NASA SSC Center Operations, Project Management Division		Page 11 of 111
SUBJECT: Surface Cleanliness Requirements for SSC Fluid Systems		

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1.0 INTRODUCTION

1.1 PURPOSE

This standard (STD) establishes the surface cleanliness requirements for fluid systems, components, and inspection, measuring and test equipment (IM&TE) at Stennis Space Center (SSC).

1.2 APPLICABILITY

This STD applies to site-wide facility components and systems that require cleanliness certification.

1.3 RESPONSIBILITIES

1.3.1 SSC Activities

NASA and Contractor personnel responsible for engineering design, manufacture/fabrication, analysis, inspection or test operations shall implement this STD. NASA and the Contractor shall ensure compliance with requirements of this STD through surveillance, auditing and process verification. Design specifications and drawings shall identify cleanliness levels by the alphanumeric or numeric designations defined in this STD. Revision or cancellation of this STD shall be reviewed and approved in accordance with SSC standard SSTD-8070-0005-CONFIG.

1.3.2 Quality Control

NASA and/or Contractor QA shall verify that the surface cleanliness requirements for SSC fluid systems are satisfied.

2.0 REFERENCED DOCUMENTS

The referenced documents form an integral part of this standard and their latest issues shall apply unless otherwise specified.

A-A-59150	Federal Specification: Cleaning Compound, Solvent, Hydrofluoroether (HFE)
AMS 3649	SAE Industry Standard: Film, PCTFE Unplasticized
ASTM D4080	Standard Specification for Trichloroethylene, Technical and Vapor Degreasing Grade
ASTM D4376	Standard Specification for Vapor-Degreasing Grade Perchloroethylene (vapor degreasing use only)

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ASTM D5501	Standard Test Method for Determination of Ethanol Content of Denatured Fuel Ethanol by Gas Chromatography
ASTM D6368	normal-Propyl Bromide (Ensolv®)
JSC SE-S-0073	Space Shuttle Specification Fluid Procurement and Use Control
MIL-C-81302	Cleaning Compound Trichlorotrifluoroethane (Freon)
MIL-T-81533	Trichloroethane 1,1,1, (Methyl Chloroform) Inhibited, Vapor Degreasing
NASA STD 6001	Flammability, Odor, Offgassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion
O-E-760	Federal Specification: Ethyl Alcohol (Ethanol); Denatured Alcohol; Proprietary/Industrial Solvents
SCW1-8500-0004-ENV	Hazardous Materials, Hazardous Waste and Solid Waste Procedures & Guidelines
SPG 1400.1	Document Preparation, Numbering and Management Guidelines
SPG 8715.1	SSC Safety and Health Procedures and Guidelines
SSC SCD 54000-GM10	Procurement of Solvent, Cleaning and Verification, Vertrel MCA 1,1,1,2,3,4,4,5,5,5 - Decafluoropentane (62 wt%) and Trans-1,2 - Dichloroethylene (38 wt%)
SSC SCD 54000-GM11	Procurement of Solvent, Cleaning, 1,3-Dichloro-1,1,2,2,3, - Pentafluoropropane, HCFC-225G
SSC SCD 54000-GP11	Packaging & Preservation of Cleaned Components
SSC STD 79-002	Sampling Requirements and Maximum Allowable Impurities for SSC Fluids and Fluid Systems
SSLP-1440-0001	SSC Records Management Program and Control of Quality Records
SSTD-8070-0005-CONFIG	Preparation, Review, Approval and Release of SSC Standards
TT-I-735	Federal Specification: Isopropyl Alcohol

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3.0 GENERAL REQUIREMENTS

3.1 SAFETY

All procedures in this STD shall be performed in accordance with the applicable requirements of SPG 8715.1.

3.2 SYSTEM DESIGN

3.2.1 Breaks and Check Valves

When fluid systems are designed or modified, cleanliness breaks shall be established to enable connecting of systems that have different cleanliness levels.

- a. Use dual check valves for the following cleanliness breaks: 1, 1X, 1XX or 1XXX (upstream) and 2, 2X, 2XX or 3 (downstream). Add filter if downstream particulate requirements are more stringent than upstream requirements.
- b. Use single check valve for the following cleanliness breaks: 1, 1X, 1XX or 1XXX (upstream) and 2A (downstream).
- c. Use filter for the following cleanliness breaks: any combination of 1, 1X, 1XX or 1XXX (upstream or downstream).
- d. Use filter for the following cleanliness breaks: any combination of 2, 2X, 2XX or 3 (upstream or downstream).

3.2.2 Component Removal

Designs for systems and system components should enable the removal of all valves and components from the system. In cases where it is not practical to use removable components (e.g., V-J valves with buttweld end connections), component design shall enable removal of all internal piece parts of the component while it is connected to its respective system.

3.2.3 Component Disassembly

Complete disassembly is required prior to cleaning or verifying all components except for IM&TE and for components being field cleaned or verified by an approved procedure. Therefore, use of components that cannot be completely disassembled shall be avoided.

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3.2.4 Bottles and Vessels

Designs of bottles and vessels shall incorporate adequate provisions for cleaning. These provisions shall include, but are not limited to, manway or "jet-mole" access (to inspect and flush/spray all significant surfaces wetted by service media) and low-point drains (to collect flush samples).

3.3 CLEANING

Cleaning is comprised of two categories: gross and precision. Gross cleaning may be accomplished by using one or more of the following processes or materials: mechanical cleaning, halogenated degreasers, alkaline or acid cleaners, detergents and tap or deionized (DI) water flushes. Precision cleaning is performed after gross cleaning and may be accomplished by employing methods such as solvent flushing.

Certification of a cleaned system, component and/or packaging material is required prior to packaging or securing the component or system.

3.4 ACIDITY AND ALKALINITY

Surfaces of components that have been cleaned and are rinsed with deionized water shall register a pH between 5.5 and 8.0 while the component is wet from the last rinse or after wetting the surface with deionized water.

3.5 DRYING AND TESTING GAS

Gas for drying and testing of items cleaned per this standard shall conform to SSC STD 79-002. When the cleanliness level particulate requirements are more stringent than those specified by SSC STD 79-002, the gas shall be pre-filtered through an appropriately sized filter prior to use or entry into a system or component to be dried or tested.

4.0 SPECIFIC REQUIREMENTS BY CLEAN LEVEL

The cleanliness level requirements imposed by this standard are specified in Table 1. Each cleanliness level in Table 1 requires visual inspection according to Section 6.2.

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TABLE I. CLEANLINESS LEVELS/REQUIREMENTS

CLEANLINESS LEVEL	PARTICULATE		NVR/HYDROCARBON mg/0.1m ² (mg/ft ²) <input type="checkbox"/> <input checked="" type="checkbox"/>		DEWPOINT/MOISTURE CONTENT	
	SIZE (MICRONS)	NUMBER (PARTICLES) no./0.1m ² (no./ft ²) †	TANKS/ VESSELS	LINES/ COMPONENTS	COMPONENTS	SYSTEMS *
1	>2500	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	700-X<2500	1				
	175-X<700	5				
1X	>800	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	175-X<800	5				
	>400	0				
1XX	175-X<400	5	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	>100	0				
	50-X<100	1				
1XXX	25-X<50	11	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	15-X<25	75				
	<15	280				
	N/A	N/A				
2	N/A	N/A	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
2A	N/A	N/A	<input type="checkbox"/>	<input type="checkbox"/>	N/A	N/A
2X	>400	0	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	175-X<400	5				
2XX	>100	0	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	50-X<100	5				
	25-X<50	68				
	0-X<25	■				
3	N/A	N/A	N/A	N/A	N/A	N/A
4 (HYDRAULIC CLEAN)	>100	10	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	50-X<100	60				
	25-X<50	530				
	10-X<25	2150				
	0-X<10	■				

† Test sample volumes for particulate and NVR analyses are specified in section 6.1.
 * For the purposes of this standard, NVR may be determined by using any analytical method that accurately measures the hydrocarbon content of a particular solvent, e.g., gravimetric, TOC and FTIR.
 • The requirement for field dewpoint verification of an existing assembled dump/vent line shall be determined by the end user. Field dewpoint verification is required on all newly installed dump/vent lines. Prior to or following installation, all newly installed components shall be properly processed and verified dry in accordance with the system cleanliness level requirement for both existing and newly installed dump/vent lines.
 Hydrocarbon residue as detected by fluorescence of the type and UV spectrum specified in the definition of "Black Light" from Appendix B shall be cause for rejection.
 • One nonmetallic particle above the maximum is permitted.
 ■ Particles in the specified range are not counted; however, a concentration of such particles sufficient to obscure membrane grid lines (silt) shall be cause for rejection.
 * Commercial clean is equivalent to cleanliness level 3.

5.0 CLEANING FLUIDS, VERIFICATION FLUIDS AND RINSING AGENTS
 5.1 GENERAL

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Cleaning fluids, verification fluids and rinsing agents that can be used are specified in sections 5.2, 5.3 and 5.4.

The requirements of SCWI-8500-0004-ENV *Hazardous Materials, Hazardous Waste, and Solid Waste Procedures and Guidelines* shall be met when using verification fluids, cleaning fluids and rinsing agents at SSC.

Traceability of cleaning fluids, verification fluids and rinsing agents must be maintained throughout the cleaning and verification process. Traceability documentation shall include, at a minimum, fluid cleanliness certifications and product composition reports.

5.1.1 Compatibility of Cleaning Fluids, Verification Fluids and Rinsing Agents

Cleaning fluids, verification fluids and rinsing agents must be compatible with the item being cleaned, verified or rinsed and shall not cause immediate or latent degradation (e.g., leaching of plasticizers, swelling of softgoods or hardware corrosion).

The performing organization must verify that the cleaning fluids, verification fluids and rinsing agents selected for use are compatible with the item being processed. The SSC Material and Process Control Team may be used as a resource to ensure compatibility of cleaning fluids, verification fluids and rinsing agents prior to their use on new materials.

The performing organization must also ensure that cleaning, verification and rinsing processes employing multiple fluids do not degrade hardware (e.g., some mixtures of halogenated solvents and water are corrosive to some metals). Parts and components shall be dried or rinsed between operations as required to prevent the formation of corrosive mixtures.

5.1.2 Control Samples

Verification fluids and rinsing agents shall be sampled prior to use on hardware with cleanliness levels requiring an NVR or particulate analysis. Verification fluids and rinsing agents shall meet the cleanliness requirements of the item being verified or rinsed. The control sample for all fluids used to sample or rinse tanks and vessels shall have no more than 25 mg NVR per 500 ml of fluid. The control sample for all other hardware shall have no more than 1 mg NVR per 200 ml of fluid.

The control sample NVR may be subtracted from the test sample NVR to determine compliance with this standard; however, the control sample particulate results may not be subtracted from the test sample particle count.

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When the control sample of a fluid does not meet the appropriate NVR requirement, the fluid cannot be used. The fluid must be distilled and resampled to verify that the NVR requirement is met. When the control sample of a fluid does not meet the appropriate particulate requirement, the fluid cannot be used. The fluid must be filtered with a clean, wire mesh filter and resampled to verify that the particulate requirement is met.

5.2 HALOGENATED SOLVENTS

When used for testing, halogenated solvents shall comply with the latest revision of the applicable procurement specifications referenced in subsections 5.2.1 through 5.2.8. In addition, the solvent shall meet the cleanliness requirements of the cleaned item or system. When the required NVR level of the solvent is less than the procurement specification, the solvent shall be distilled or cleaned to obtain the required NVR level.

Following use of any halogenated solvent (except for CFC-113, HFE-7100® and HCFC-225g) on items or systems with NVR requirements, verification is required to ensure that the solvent has been thoroughly removed from the item or system. Verification of solvent removal from significant surfaces shall be done in accordance with a NASA approved procedure. This verification must be supported with data that demonstrate removal of the solvent for the affected item or system. After removal of the solvent, the item or system must be purged with gas to dry it. Finally a gas sample shall be taken and analyzed to verify that the total gaseous hydrocarbon content is less than 5 ppm expressed as Methane.

5.2.1 Trichlorotrifluoroethane (CFC-113), MIL-C-81302, Type 1

CFC-113 may be used to perform NVR and/or particulate analysis, but it shall **not** be used on titanium alloys or for flushing hydraulic components or systems.

5.2.2 HCFC-225g (AK-225g), SSC DWG 54000-GM11

HCFC-225g may be used to perform NVR and/or particulate analysis, but it shall **not** be used for flushing hydraulic components or systems.

5.2.3 1,1,1 Trichloroethane (Methyl Chloroform), MIL-T-81533

1,1,1 Trichloroethane may be used to perform NVR and/or particulate analysis, but it shall **not** be used on titanium alloys or for flushing hydraulic components or systems.

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5.2.4 Tetrachloroethylene (Perchloroethylene), ASTM D4376 (for vapor degreasing only) or ACS Spectrometric Grade (for cleaning and verification)

Tetrachloroethylene may be used to perform NVR and/or particulate analysis, but it shall not be used for titanium alloys, softgoods or hydraulic components/systems. When used for cleanliness verification, tetrachloroethylene shall not be used on items that contain enclosed or entrapped areas.

5.2.5 Trichloroethylene, MIL-T-27602 or ASTM D4080

Trichloroethylene may be used to perform NVR and/or particulate analysis, but it shall not be used on titanium alloys or for flushing hydraulic components or systems.

5.2.6 Methoxynonafluorobutane (Hydrofluoroether-7100)(HFE-7100®), A-A-59150 or JSC SE-S-0073

HFE-7100® may be used to perform particulate analysis or as a rinsing agent to remove Vertrel MCA® from items with an NVR requirement. HFE-7100® shall not be used as a test fluid for NVR analysis or for flushing hydraulic components or systems.

5.2.7 Decafluoropentane 62% & Trans-1,2-Dichloroethylene 38% (Vertrel MCA®), JSC SE-S-0073 or SSC DWG 54000-GM10

Vertrel MCA® may be used to perform NVR and/or particulate analysis, but it shall not be used for softgoods that have an NVR requirement, titanium alloys or hydraulic components or systems. Items or systems with NVR requirements shall be pre-dried in accordance with section 6.5; flushed with HFE-7100®; and verified to ensure solvent removal in accordance with section 5.2.

5.2.8 Decafluoropentane (HFC-4310 mee or Vertrel XF®), SSC DWG 54000-GM10

Vertrel XF® may be used to perform particulate analysis, but it shall not be used as a test fluid for NVR analysis or for flushing hydraulic components or systems.

5.2.9 normal-Propyl Bromide (Ensolv®), ASTM D6368

normal-Propyl Bromide may be used for NVR and/or particulate analysis for tanks and vessels. It shall not be used for NVR and/or particulate analysis for components. It may be used for NVR and/or particulate analysis for piping only if the solvent meets the NVR level of the systems being verified.

It shall not be used for NVR and/or particulate analysis of any type Reflange Seal Rings.

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5.3 ALCOHOL SOLVENTS

All alcohol solvents used for testing shall comply with the latest procurement specifications listed in paragraphs 5.3.1 and 5.3.2. In addition, the alcohol control solvent shall meet the cleanliness requirements of the item being cleaned. Alcohol solvents shall **not** be used for cleaning, verifying or rinsing oxidizer systems (hardware and softgoods) or on any system that feeds into an oxidizer system.

5.3.1 Isopropyl Alcohol, TT-I-735, Grade A or ACS Reagent Grade

Isopropyl alcohol (isopropanol) may be used to perform particulate analysis; but it shall **not** be used as a test fluid for NVR analysis.

5.3.2 Ethyl Alcohol, 0-E-760

Ethyl alcohol (ethanol) may be used to perform particulate analysis, but it shall **not** be used as a test fluid for NVR analysis or for items that contain Teflon®.

5.4 DI BASED FLUIDS

NOTE

Dry film lubricated surfaces shall not undergo any DI water process for NVR and/or particulate verification.

5.4.1 DI Water Process for NVR Verification

When used for NVR verification, DI water shall conform to a resistivity of greater than 1 meg-ohm-cm or a conductivity of less than 1 micro-siemen-cm. DI water shall meet NVR and/or particulate requirements of the cleaned item. In addition, DI water shall require use of mechanical energy (e.g. high velocity impingement, sonication and heat); therefore, it should not be used on items of complex configuration. Verification and analysis methods must conform to a procedure that is approved by NASA PTD and supported with test data that demonstrate the efficacy of the process for the affected item or assembly.

To reliably detect an NVR level of 1 mg/0.1m², the DI water volume to hardware surface area ratio used for ultrasonic extraction and Total Organic Carbon (TOC) analyses shall not exceed 3 liters/0.1m².

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5.4.2 DI Water Process for Particulate Analysis

When used for particulate verification, DI water shall conform to a resistivity of greater than 1 meg-ohm-cm or a conductivity of less than 1 micro-siemen-cm. The DI water shall meet the particulate requirements of the cleaned item. In addition, DI water shall require use of mechanical energy (e.g. high velocity impingement, sonication and heat); therefore, it should not be used on items of complex configuration. Use of a surfactant in the DI water final clean level test/verification flush solvent is acceptable but shall be limited to clean levels that do not require NVR analysis. Particulate analysis methods, including types and concentrations of surfactants used, solvent temperature controls, and application of mechanical energy, must conform to a procedure that is approved by NASA SSC PTD. Furthermore, the particulate analysis methods shall be supported with test data demonstrating the effectiveness of the process in removal of residual particle contaminants from all significant surfaces of the affected item or assembly.

5.4.3 DI Water/Rinsing Agent

When used for rinsing operations, the DI water shall conform to the resistivity of greater than 50,000 ohms-cm or a conductivity of less than 20 micro-siemen-cm.

6.0 CERTIFICATION TESTS

6.1 TEST SAMPLES

Test samples can be obtained by flushing or spraying significant surfaces with a solvent. For internal significant surface areas of 0.5 square meter or less (approximately 5 square feet), a 200-milliliter (minimum) sample shall represent approximately 0.1 square meter (approximately 1 square foot) of significant surface area. For internal significant surface areas greater than 0.5 square meter, a 100-milliliter (minimum) sample shall represent approximately 0.1 square meter of significant surface.

6.2 VISUAL INSPECTION

All significant surfaces that contact service fluids require visual inspection unless the surface is "inaccessible" as defined in Appendix B. The presence of gross contamination is not allowed. If visual evidence of contamination is found in a component or system, the foreign material shall be analyzed to determine its identity, source and compatibility with the service fluid.

NOTE

Scale-free discoloration due to welding, etching, heat treating, and passivation of lines, components or surfaces is permitted.

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6.2.1 Flash Rust

Visible, scale-free surface oxidation (flash rust) is allowed on significant surfaces; however, it shall not exceed five percent of the internal significant surface area of systems or components. Furthermore, flash rust is not acceptable if it prevents the system or component from meeting cleanliness requirements.

6.2.2 Inspection Aids

Inspection aids such as lights, borescopes, mirrors and ultraviolet (UV) lamps (black lights) must meet the cleanliness requirements of the system or component that they inspect.

6.3 PARTICULATE ANALYSIS

NOTE

If silt is discovered during particulate analysis, investigate the system or component, determine the cause and correct the problem. Silting is unacceptable.

A test sample, as described in section 6.1, shall be analyzed for particle population and size. When a test sample meets Level 1 NVR requirements but fails particulate requirements, a gas purge of 3 meters per second or more can be used for particulate analysis in lieu of an additional fluid flush. This analysis must conform to a procedure that is approved by NASA PTD.

NOTE

This is not applicable to Level 2 or Level 4 verification processes.

6.4 NONVOLATILE RESIDUE (NVR) ANALYSIS

A test sample, as described in section 6.1, shall be used for NVR analysis. If the test sample NVR level is less than the control sample NVR level, the NVR analysis shall be considered invalid and the verification process shall be repeated.

If the spray or flush method of obtaining a test sample is not practical, a swab or wipe sampling technique may be used (with customer approval) for NVR analysis. This sampling method is performed by wiping a representative area of up to one square foot with a certified clean, solvent-soaked, lint-free swab or wipe. After wiping the area to be verified, each swab or wipe shall be flushed with approximately 200 ml of solvent and analyzed for NVR. Larger surfaces may require several random wipe tests to ensure that a representative portion of the surface area is sampled.

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6.5 DRYNESS (DEWPOINT) ANALYSIS

Dewpoint Analysis certification is mandatory for all systems, components and IM&TE with a dewpoint requirement specified in Table 1, with the exception of:

- excepted components per stipulations in section 8.0;
- pipe, fittings, and pipe spools/sections with at least one weld-prepared end; and
- assembled dump/vent systems that are open to the atmosphere and are field verified for cleanliness level.

Whether or not this certification is required, proper processing and dryness verification in accordance with this standard is required for all IM&TE, components, fittings, pipe, tubing, and pipe sections/spools used in dump/vent systems and for all pipe sections/spools with at least one weld joint preparations.

- a. Components and IM&TE assembled in a clean room do not require dewpoint testing if their disassembled parts are oven dried for 30 minutes at 66 degrees C (150 degrees F).
- b. IM&TE with open configuration shall be purged with nitrogen for a minimum of 30 minutes. IM&TE with entrapped areas or closed configurations shall be vacuum dried at or below 20 in. of Hg for a minimum of 30 minutes. This will serve as certification that the item is dried.
- c. If dryness certification cannot be obtained by the methods outlined in section 6.5(a) or (b), a dewpoint test shall be performed. Prior to performing a dewpoint test on the effluent gas from a system or component, heated gas at 135 degrees C shall be used to purge the system or component for a minimum of 30 minutes, or the gas shall be locked within the system or component for a minimum of 30 minutes. Prior to performing a dewpoint test on the effluent gas from a vessel, gas shall be heated to 135 degrees C to purge the vessel. The gas shall be locked within the vessel for a minimum of 8 hours prior to performing a sample. The gas is not required to maintain the 135 degrees C minimum requirement while locked up within the vessel.

NOTE

To certify dryness for cleanliness level 2 components (not 2A, 2X, 2XX), a system dewpoint analysis may be performed in lieu of performing individual dewpoint analyses on each component in the system.

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7.0 FIELD PROCEDURES

CAUTION

Components containing softgoods incompatible with the test fluid in use shall be replaced with a temporary spool piece and/or a flange to prevent softgood degradation that could result from field cleaning/ verification operations.

7.1 FIELD CLEANING

Field cleaning is permissible for systems or components that are required to be cleaned to level 3 or level 2 (not 2A, 2X or 2XX). For all other systems or components, the provisions of section 7.2 must be satisfied before field cleaning is allowed.

7.2 CLEANING/VERIFICATION

- a. Field cleaning/verification shall be performed only when all of the following apply, unless otherwise approved by the NASA Propulsion Test Directorate.
 1. The item is part of a fixed installation and cannot be moved to a remote and controlled cleaning facility.
 2. Cleaned replacements are not available.
 3. System components having moving parts, close tolerance fluid passages, or zero flow velocity zones are replaced by pipe spool pieces or have all internal piece parts removed.
 4. All pressure gages and other instrumentation are removed.
- b. The flushing process for field cleaning/verification shall be performed by system flow-through at 1.2 meters per second or more, pressurized spraying, or by other methods approved by the NASA Propulsion Test Directorate.
- c. Sampling methods shall comply with section 6.0.

7.3 FIELD CERTIFICATION

The certification of system or component cleanliness levels may be performed in the field; however, verification processes that precede certification, such as sample analysis, are best performed in a laboratory. Verification by flushing shall be performed in a clean room or other controlled environment unless it is performed in accordance with section 7.2.

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7.4 CONTAMINATION CONTROL

Provide shelters, enclosures or a positive purge of sufficient quantity to prevent contamination of systems opened in the field. These preventive measures shall comply with NASA approved procedures.

7.4.1 Post-Verification Operations

Assembly, installation and removal of precision cleaned components shall be done with utmost care to prevent contamination. Certified clean gloves and tooling shall be used when handling cleaned significant surfaces.

7.4.2 Post-Verification Cleaning

Field hardware that meet cleanliness requirements do not need to be re-verified when contamination associated with field activities is completely accessible and can be removed by handwiping or purging.

NOTE

The certified clean, lint-free cloth used for handwiping shall be dry or moistened with a verification fluid that meets the requirements of this standard. Handwiping shall be performed in such a manner that the fluid does not flow into or become entrapped in the hardware.

7.4.3 Post-Verification Inspection

Surfaces of all cleaned components that will contact the service fluid shall be visually inspected for the presence of gross contaminants.

8.0 CERTIFICATION OF EXCEPTED COMPONENTS/SYSTEMS & SOFT GOODS

NOTE

When excepted components contain softgoods that must be removed prior to the certification process, the softgoods must be removed and precision cleaned as individual piece parts.

Components that cannot be certified using normal procedures or facilities (because of their size, construction, incompatibility with flushing solvent, or method of assembly) may be certified as excepted components. All excepted components, other than softgoods processed as excepted components due to solvent incompatibility, require approval by the NASA Propulsion Test Directorate Configuration Control Board.

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Excepted components shall be certified by the tests described in section 6.0. When acceptable results are obtained, these components will be identified by notation "EXC." on the certification tag, which shall also indicate the required cleanliness level and certification test results. The "EXC." notation will identify that the component has been certified in accordance with this standard.

9.0 PROTECTION OF CLEANED SURFACES

All protective materials shall be compatible with the system or component surface in contact with the protective material. Protective materials shall also be designed to withstand the specified environment for the storage period and mode of delivery including impact protection of significant surfaces.

9.1 PACKAGING

- a. Packaging requirements are specified in SSC drawing 54000-GP11. Before cleaning, prepare detailed instructions showing materials, methods and quality requirements for the packaging to ensure that cleanliness levels are maintained during periods of shipping and/or storage. These instructions shall be approved as specified by contract.
- b. Cleaned and certified components shall be packaged within a controlled environment equal to or cleaner than the environment in which they were cleaned and certified. Outer protective wrap (e.g., dimple wrap) may be applied outside the controlled area. This procedure shall be approved by the Quality Assurance Representative and in accordance with the requirements of section 9.2.

9.2 PACKAGING FILMS

NOTE

Stainless steel threaded plugs, blind hubs and flanges can be used for the primary packaging inner barrier that isolates clean surfaces from ambient environments. Prior to use, these plugs, hubs and flanges (and their respective seals) shall be cleaned to the same cleanliness level as the cleaned item.

- a. Packaging films used for packaging precision clean items must conform to the requirements of section 9.1. The cleanliness level of the inner wrap shall be at least equivalent to that of the exposed clean surfaces of the item packaged. The outer wrap shall be visibly clean.
- b. Selection of a specific film shall be dictated by compatibility with the specified service medium.

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- c. Items that come in contact with liquid oxygen (LOX) and gaseous oxygen (GOX) fluids or systems shall be protected with an inner bag or layer of film such as fluorohalocarbon film (e.g., Aclar 22A and 33C) conforming to AMS 3649.
- d. Removal of packaging film prior to installation of hardware into a system shall be performed such that all material is completely removed (i.e., no shreds, strips or pieces of material shall remain after packaging is removed).

10.0 RECORDS AND FORMS

Records and forms required by this standard shall be maintained as specified in SSLP-1440-0001. For Quality Records, refer to the SSC Master Records Index. Forms shall be the latest edition unless otherwise specified and may be obtained from the SSC Electronic Forms repository or the NASA SSC Forms Management Officer.

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APPENDIX A DEFINITIONS

Black Light - a high intensity, long-wave, low-energy, ultraviolet (UV) light (UV spectrum 3200-3800 angstroms).

Blanket Purge - the use of pressurized gas in an enclosed environment for protecting components, piping or vessels from contamination.

Certification - a written record demonstrating that requirements have been verified and achieved.

Cleaning - the removal of incompatible materials from the significant surfaces of components and systems within the scope of this standard.

Clean Room - a room in which precautions are employed to reduce contaminants in the air, producing a controlled environment for verification, assembly and packing of cleaned items.

Commercial Clean - without gross contamination.

Component - an item that is normally a combination of parts, subassemblies or assemblies and that is self-contained within a fluid system.

Contaminant - any material that could chemically react or mechanically interfere with a cleaned component, system or end item.

Control Sample - a specific volume of flushing solvent that is analyzed to determine a baseline contamination level before a test sample is attained.

Dewpoint - the temperature at which a gas becomes saturated with water vapor and condensation begins (usually atmospheric pressure).

Drying - reducing moisture/dewpoint levels by vacuum, purge, flush or oven-heated methods.

Excepted Component/System/Soft Good - an item or system that cannot be cleaned and certified using normal procedures or facilities because of their size, construction or method of assembly.

Field Certification - the process of certifying components in the field.

Field Cleaning - cleaning performed outside a shop or clean room environment.

Field Verification - process of obtaining samples in the field for subsequent laboratory analysis to certify cleanliness levels.

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Fluid – a gas or liquid used in an SSC system or used to clean, test, dry or preserve test systems, subsystems, assemblies, components, IM&TE and support equipment.

Flushing Solvent - the solvent used to obtain the control sample and the test sample.

Gross Cleaning - the removal of gross contaminants.

Gross Contaminants - visible contaminants, such as moisture, corrosion, loose slag, oil, grease, scale, rust, soil, sludge and grit.

Hydrocarbon - any compound containing carbon and hydrogen bonds.

Inaccessible - unable to be viewed due to physical configuration.

Inspection – the verification method performed by visual observation under ambient or black light.

Inspection, Measuring and Test Equipment (IM&TE) - items used to perform measurements where distinct values are required for system performance or to demonstrate conformance to specified requirements.

Item - anything smaller than or contained within a system (e.g., assembly, component, IM&TE, piece part).

Method - a technique or process used to test, inspect or collect samples.

Micron – dimension of length equal to 0.001 millimeter (0.0000394 inch).

Moisture - the residual water (liquid/gas) in components or systems, measured in parts per million (ppm) or dewpoint.

Nonvolatile Residue (NVR) - the residue remaining after filtration and controlled evaporation of the final flushing solvent. NVR is specified in milligrams (mg) per square meter or square foot of significant surface. Since the predominant constituents of NVR are hydrocarbons, NVR and total hydrocarbon content are considered equivalent; therefore, analytical methods that determine total hydrocarbon (e.g., gravimetrics, FTIR and TOC) may be used to determine NVR.

Particle – a unit of matter with observable length, width, and thickness; usually measured in microns.

Particulate - multiple particles.

pH - a unit of measure on a scale of 0 to 14 that describes the acidity or alkalinity of a solution, (with 7 indicating neutrality, values below 7 indicating acidity level, and values above 7 indicating alkalinity level).

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Precision Clean - a high level of cleanliness (i.e., cannot be verified with unaided eye) positively confirmed by a test for particle size/count and documented.

Sample - a selected portion or quantity of fluid collected to determine the cleanliness level of a system or component.

Significant Surfaces – those surfaces of components, piece parts, assemblies, subsystems, systems and ground support equipment that come in contact with test fluids or service fluids.

Silting - a background of particles below the size ranges counted and in such a quantity as to interfere with sample analysis.

Test - the process used to determine the cleanliness level of a system, component or packing material.

Test Sample - a specific volume of flushing solvent used for particulate and/or NVR analysis.

Ultraviolet (UV) Lamp – a lamp that produces “black light”.

Verification - the process whereby one or more of the following methods is used for the purpose of certification: performing visual inspections, obtaining samples, analyzing/testing samples and reviewing inspection/test data.

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**APPENDIX B
ACRONYMS AND ABBREVIATIONS**

AMS	Aerospace Materials Specification
ASTM	American Society for Testing and Material
CFC-113	Trichlorotrifluoroethane (Freon)
DI	Deionized
FTIR	Fourier Transform Infrared
GOX	Gaseous Oxygen
IM&TE	Inspection Measuring and Test Equipment
JSC	Johnson Space Center
LOX	Liquid Oxygen
MIL	Military
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NVR	Nonvolatile Residue
PCTFE	Polychlorotrifluoroethylene
PTD	Propulsion Test Directorate
SAE	Society of Automotive Engineers
SCD	Specification Control Drawing
SPG	SSC Procedures and Guidelines
SSC	Stennis Space Center
SSLP	Stennis System Level Procedure
STD	Standard
SSTD	Stennis Standard
TOC	Total Organic Carbon
UV	Ultraviolet

RELEASED - Printed documents may be obsolete; validate prior to use.

APPENDIX A2

SSC DWG NO. 54000-GM30

SPECIFICATIONS FOR MATERIALS USED IN LOX OR GOX SERVICE EXEMPT
FROM BATCH TEST REQUIREMENTS

- 1.0 SERVICE CONDITIONS
LIQUID OXYGEN AND GASEOUS OXYGEN
- 2.0 SCOPE
THIS SPECIFICATION LISTS THE MATERIALS USED IN LIQUID AND GASEOUS OXYGEN SERVICE THAT ARE EXEMPT FROM THE BATCH TEST REQUIREMENTS IN NASA-STD-6001 AND SPECIFICS THE USE PARAMETERS UNDER WHICH THE EXEMPTION APPLIES.
- 3.0 DOCUMENTATION
- 3.1 REFERENCED DOCUMENTS
THE LATEST ISSUE OF THE FOLLOWING DOCUMENTS FORM A PART OF THIS DRAWING TO THE EXTENT SPECIFIED HEREIN.
- A-A-58092 TAPE, AMTSEIZE, POLYTETRAFLUOROETHYLENE
- ASTM D1430 STANDARD SPECIFICATION FOR POLYCHLOROTRIFLUOROETHYLENE (PCTFE) PLASTICS
- ASTM D2116 STANDARD SPECIFICATION FOR PTFE - FLUOROCARBON MOLDING AND EXTRUSION MATERIALS
- ASTM D3294 STANDARD SPECIFICATION FOR PTFE RESIN MOLDDED SHEET (REPLACES D1283)
- ASTM D3308 STANDARD SPECIFICATION FOR PTFE RESIN SKINNED TAPE
- ASTM D3369 STANDARD SPECIFICATION FOR POLYTETRAFLUOROETHYLENE (PTFE) RESIN CAST FILM
- ASTM D4894 STANDARD SPECIFICATION FOR POLYTETRAFLUOROETHYLENE (PTFE) GRANULAR MOLDING AND RAM EXTRUSION MATERIALS
- ASTM D4895 STANDARD SPECIFICATION FOR POLYTETRAFLUOROETHYLENE (PTFE) RESIN PRODUCED FROM DISPERSION
- MIL-I-27730 TAPE, AMTSEIZE, POLYTETRAFLUOROETHYLENE, WITH DISPENSER (SUPERSEDED BY A-A-58092)
- NASA-STD-6001 FLAMMABILITY, OORR, OFFGASSING, AND COMPATIBILITY REQUIREMENTS AND TEST PROCEDURES FOR MATERIALS IN ENVIRONMENTS THAT SUPPORT COMBUSTION (PREVIOUSLY NHB 8060.1C)
- SAE AMS 3645 POLYCHLOROTRIFLUOROETHYLENE (PCTFE), COMPRESSION MOLDDED, HEAVY SECTIONS, UNPLASTICIZED
- SAE AMS 3647 POLYTETRAFLUOROETHYLENE-PROPYLENE FILM AND SHEET (FEP)
- 3.2 APPLICABLE DOCUMENTS
ALTHOUGH NOT REFERENCED IN THIS DRAWING, THE FOLLOWING DOCUMENTS CONTAIN OXYGEN COMPATIBILITY REQUIREMENTS, TEST METHODS AND TEST RESULTS THAT ARE APPLICABLE TO THIS DRAWING.
- SSC STD 79-010 SSC REQUIREMENTS FOR MATERIALS USED IN LOX/COX SERVICE
- NSS 1740.15 SAFETY STANDARD FOR OXYGEN AND OXYGEN SYSTEMS, GUIDELINES FOR OXYGEN SYSTEM DESIGN, MATERIALS SELECTION, OPERATIONS, STORAGE, AND TRANSPORTATION, NASA, OFFICE OF SAFETY AND MISSION ASSURANCE, WASHINGTON, DC 20546.
- MSFC-HDRK-527 MATERIALS SELECTION LIST FOR SPACE HARDWARE SYSTEMS
- ASTM D2512 STANDARD TEST METHOD FOR COMPATIBILITY OF MATERIALS WITH LIQUID OXYGEN (IMPACT SENSITIVITY THRESHOLD AND PASS-FAIL TECHNIQUES)
- ASTM G 63 GUIDE FOR EVALUATING NONMETALLIC MATERIALS FOR OXYGEN SERVICE
- ASTM G 74 STANDARD TEST METHOD FOR IGNITION SENSITIVITY OF MATERIALS TO GASEOUS FLUID IMPACT
- ASTM G 86 TEST METHOD FOR DETERMINING IGNITION SENSITIVITY OF MATERIALS TO MECHANICAL IMPACT IN PRESSURIZED OXYGEN ENVIRONMENTS
- ASTM G 88 GUIDE FOR DESIGNING SYSTEMS FOR OXYGEN SERVICE
- ASTM G 94 GUIDE FOR EVALUATING METALS FOR OXYGEN SERVICE
- ASTM G 126 TERMINOLOGY RELATING TO THE COMPATIBILITY AND SENSITIVITY OF MATERIALS IN OXYGEN ENRICHED ATMOSPHERES
- ASTM G 128 GUIDE FOR CONTROL OF HAZARDS AND RISKS IN OXYGEN ENRICHED SYSTEMS
- SAE AMS 3659 POLYTETRAFLUOROETHYLENE EXTRUSIONS, PREMIUM STRENGTH, SINTERED AND STRESS-RELIEVED
- SAE AMS 3668 POLYTETRAFLUOROETHYLENE (PTFE) MOLDINGS, PREMIUM GRADE, AS SINTERED
- SAE AMS 3669 POLYTETRAFLUOROETHYLENE SHEET, MOLDDED, PREMIUM GRADE, AS SINTERED
- SSC PTD-01-E22 MATERIAL AND PROCESS CONTROL OF CRITICAL PROPULSION FACILITIES AND SYSTEMS
- SSC 54000-GM08 SPECIFICATION FOR PROCUREMENT OF VIRGIN FEP TEFLON BAGGING AND PACKAGING MATERIAL
- SSC 54000-GM09 SPECIFICATION FOR PROCUREMENT OF POLYCHLOROTRIFLUOROETHYLENE (ACQUA Z24) BAGGING AND PACKAGING MATERIAL

3.3 HISTORICAL DOCUMENTS

THE INFORMATION CONTAINED IN SECTION 6.0 OF DRAWING 54000-GM30 REV. 3 WAS BASED ON REVISION 2 AND THE FOLLOWING KENNEDY SPACE CENTER MATERIAL SELECTION LISTS:

79K09560 MATERIAL SELECTION LIST FOR LIQUID OXYGEN SERVICE
79K09561 MATERIAL SELECTION LIST FOR GASEOUS OXYGEN AND AIR SERVICE

DOCUMENTATION TO SUPPORT SUBSEQUENT CHANGES IS MAINTAINED BY THE MATERIALS AND PROCESSES CONTROL TEAM IN ACCORDANCE WITH SSC PTD 01-622.

4.0 REQUIREMENTS

4.1 MATERIAL RATING, SECTION 6.0 LISTS THOSE MATERIALS THAT HAVE BEEN DETERMINED TO BE COMPATIBLE WITH LOX AND/OR GOX USING NASA-STD-6001 CRITERIA. RATINGS INDICATE THE FOLLOWING:

4.1.1 "A" RATING.
MATERIALS RATED "A" FOR LOX ARE EXEMPT FROM BATCH TESTING WHEN USED IN LOX SYSTEMS AT PRESSURES NOT EXCEEDING THAT SHOWN AND TEMPERATURES NOT EXCEEDING -275F (-171C). MATERIALS RATED "A" FOR GOX ARE EXEMPT FROM BATCH TESTING WHEN USED IN GOX SYSTEMS AT PRESSURES NOT EXCEEDING THAT SHOWN AND TEMPERATURES NOT EXCEEDING 180F (71C). BATCH TESTING IS REQUIRED FOR ANY "A" RATED MATERIAL WHEN USED AT A PRESSURE HIGHER THAN SHOWN IN SECTION 6.0 OR TEMPERATURES EXCEEDING 180F (71C) FOR GOX OR -275F (-171C) FOR LOX.

MATERIALS LISTED BY TRADE NAME, WHEN AN "A" RATED MATERIAL IS IDENTIFIED BY TRADE NAME (E.G., HALOCARBON GREASE), THE LISTED TRADE NAME MATERIAL IS EXEMPT FROM THE REQUIREMENTS FOR BATCH TESTING FOR PRESSURES NOT EXCEEDING THAT SHOWN. IF A SPECIFIC MATERIAL IS LISTED (E.G., HALOCARBON 25-55 GREASE) ONLY THAT SPECIFIC MATERIAL IS EXEMPT. UNLISTED TRADE NAME MATERIALS WITH THE SAME COMPOSITION AS LISTED TRADE NAME MATERIALS MUST BE QUALIFIED BY BATCH TESTING UNLESS PURCHASED TO A LISTED SPECIFICATION.

MATERIALS LISTED BY SPECIFICATION, WHEN ONE OR MORE APPLICABLE SPECIFICATIONS ARE LISTED UNDER THE "REMARKS" HEADING OF THE TABLE MATERIALS FURNISHED AND CERTIFIED TO MEET THE REQUIREMENTS OF ONE OF THE SPECIFICATIONS LISTED ARE EXEMPT FROM BATCH TESTING FOR PRESSURES NOT EXCEEDING THAT SHOWN.

4.1.2 "B1" RATING.
MATERIALS RATED "B1" (BATCH TEST) ARE APPROVED FOR USE IN OXYGEN SYSTEMS PROVIDED THAT EACH BATCH FOR LOT OF THE PRODUCT IS INDIVIDUALLY TESTED AND MEETS THE ACCEPTANCE CRITERIA OF NASA-STD-6001, TESTS 13A (LOX) AND/OR TEST 13B (GOX AND LOX) AS APPROPRIATE.

4.1.3 "C" RATING.

MATERIALS RATED "C" ARE NOT NORMALLY USED IN OXYGEN SYSTEMS AND/OR HAVE NOT BEEN EVALUATED FOR USE IN OXYGEN.

4.2 MATERIAL CERTIFICATION. MATERIAL ORDERED FOR USE IN OXYGEN SERVICE SHALL BE CERTIFIED BY THE VENDOR FOR USE IN OXYGEN SYSTEMS BY ONE OF THE FOLLOWING METHODS:

4.2.1 CERTIFICATE OF CONFORMANCE FOR "A" RATED MATERIAL.
THE SUPPLIER OF ANY MATERIAL ORDERED FOR USE IN OXYGEN SERVICE THAT IS EXEMPT FROM BATCH TESTING MUST PROVIDE A CERTIFICATE OF CONFORMANCE WITH THE MATERIAL.

MATERIALS LISTED BY TRADE NAME FOR "A" RATED MATERIALS LISTED BY TRADE NAME. THE SUPPLIER'S CERTIFICATE OF CONFORMANCE SHALL INCLUDE A DESCRIPTION OF THE MATERIAL WITH P.O. NUMBER REFERENCE, PLUS THE MATERIAL'S TRADE NAME AND CHEMICAL NAME. WHEN THE MATERIAL CONSISTS OF TWO OR MORE COMPONENTS, THE CHEMICAL NAME AND PERCENTAGE BY WEIGHT (OR VOLUME) OF EACH OF THE COMPONENTS MUST BE PROVIDED. FOR EXAMPLE, "WE CERTIFY THE MATERIAL OF THE SEAT INSERTS (P/N XXXXX) FURNISHED PER P.O. XXXXX IS HOSIARON TPA 4215, A CARBON FILLED POLYTETRAFLUORETHYLENE (PTFE), 25% CARBON BY WEIGHT."

MATERIALS LISTED BY SPECIFICATION, WHEN AN "A" RATED MATERIAL IS ORDERED PER APPLICABLE SPECIFICATION(S), THE SUPPLIER'S CERTIFICATE OF CONFORMANCE SHALL INCLUDE A DESCRIPTION OF THE MATERIAL WITH P.O. NUMBER REFERENCE, PLUS THE MATERIAL'S CHEMICAL NAME AND THE LISTED SPECIFICATION(S). SPECIFIC DETAILS (TYPE, GRADE, CONDITION, ETC.) OF THE MATERIAL MUST ALSO BE PROVIDED WHEN THE LISTED SPECIFICATION COVERS MORE THAN ONE TYPE OF MATERIAL. FOR EXAMPLE, "WE CERTIFY THE MATERIAL OF THE 1/2" ROD FURNISHED PER P.O. XXXXX IS POLYCHLORODIFLUOROETHYLENE (PCTFE), MEETING THE REQUIREMENTS OF ASTM D1430 TYPE 1 GRADE 3 HOMOPOLYMER AND THE REQUIREMENTS OF SAE AMS-3645."

4.2.2 PACKING SLIP AND MSDS.
FOR MATERIALS RATED "B1" THE VENDOR SHALL INDICATE ON THE SHIPPING DOCUMENTATION THE FOLLOWING INFORMATION (AS APPLICABLE): TRADE NAME, CHEMICAL NAME, PERCENTAGE BY WEIGHT OR VOLUME OF EACH COMPONENT, SPECIFICATION, LOT AND/OR BATCH NUMBER, SIZE AND FORM, AND QUANTITY. MATERIAL SAFETY DATA SHEETS (MSDS) SHALL BE PROVIDED FOR ALL MATERIALS TO BE BATCH TESTED.

4.3 VARIANCES. MATERIALS NOT LISTED MAY BE USED PROVIDED THEY HAVE BEEN EVALUATED IN ACCORDANCE WITH NASA-STD-6001, TEST 13 [MECHANICAL IMPACT FOR MATERIALS IN AMBIENT PRESSURE LOX (TEST 13A) AND MECHANICAL IMPACT FOR MATERIALS IN VARIABLE PRESSURE GOX AND LOX (TEST 13B)]. VARIANCES FROM THE CRITERIA OF THIS DOCUMENT AND NASA-STD-6001 SHALL BE APPROVED IN ACCORDANCE WITH SSC PTD-01-622. THE MATERIAL'S USAGE AGREEMENT FORM FROM PTD-01-622 SHALL BE USED TO DOCUMENT VARIANCES AND USAGE OF MATERIALS NOT LISTED.

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- 4.4 IDENTIFICATION. THE VENDOR SHALL ATTACH THE FOLLOWING INFORMATION TO MATERIAL ORDERED PER THIS SPECIFICATION FOR USE IN OXYGEN SERVICE.
 - A. PURCHASE ORDER NUMBER
 - B. MATERIAL CERTIFICATION (PER SECTION 4.2)
 - C. MANUFACTURER OF DELIVERED PRODUCT
 - D. VENDOR PART NUMBER (OR PART DESCRIPTION IF VENDOR P/N IS NOT AVAILABLE)
 - E. SSC PART NUMBER (IF APPLICABLE)
 - F. LOT AND/OR BATCH NUMBER FOR:
 - RAW MATERIAL (POWDER, PELLETS, ETC.)
 - MOLDED MATERIAL (SHEETS, RODS, CYLINDERS, ETC.)
 - FINISHED PRODUCTS (PIECE PARTS) WHEN REQUESTED BY PURCHASE ORDER
 - G. DATE OF MANUFACTURE (CURE DATE)
- 4.5 QUALITY REQUIREMENTS FOR ELASTOMERS AND PLASTICS
- 4.5.1 NO INK OR DYE STAMPING OR COLORING PIGMENTS WILL BE PERMITTED IN OR ON THE MATERIAL OR FINISHED PART.
- 4.5.2 LOCALIZED SURFACE SCRATCHES, IMPERFECTIONS, OR FOREIGN BODIES FOUND IN MATERIAL WILL BE CAUSE FOR REJECTION. MATERIAL SHALL BE FREE OF VOIDS, FISSURES, FOREIGN INCLUSIONS OR BUBBLES. RAW MATERIAL SHALL CONTAIN NO DEFECTS THAT WILL PREVENT FABRICATION OF A VOID-FREE PART.
- 4.5.3 MATERIALS THAT FAIL TO MEET THE REQUIREMENTS OF THIS SPECIFICATION SHALL BE RETURNED TO THE VENDOR AT NO COST TO THE GOVERNMENT.
- 5.0 QUALITY ASSURANCE (SSC ONLY)
- 5.1 UPON RECEIPT OF MATERIALS THAT MEET THE REQUIREMENTS OF THIS SPECIFICATION, QUALITY ASSURANCE SHALL INITIATE A CERTIFICATION/TRACABILITY INSPECTION RECORD (CTR) FOR EACH ITEM AND SHALL INSURE THAT EACH ITEM IS PACKAGED INDIVIDUALLY WITH ITS RESPECTIVE CTR.
- 5.2 FOR ALL "A1" RATED MATERIALS AND FOR THOSE "A" RATED MATERIALS WITH USE PRESSURES OR TEMPERATURES EXCEEDING THE LIMITATIONS OF THIS SPECIFICATION, TEST SAMPLES MUST BE PROCURED AND PROCESSED FOR OXYGEN COMPATIBILITY IMPACT TESTING IN ACCORDANCE WITH TP-0132A.

NOTICE: THE GOVERNMENT DRAWINGS, SPECIFICATIONS, AND/OR DATA ARE PREPARED FOR THE EXCLUSIVE USE BY OR ON THE BEHALF OF THE UNITED STATES GOVERNMENT. THE GOVERNMENT NEITHER WARRANTS THESE DRAWINGS, SPECIFICATIONS, OR OTHER DATA, NOR ASSUMES ANY RESPONSIBILITY OR OBLIGATION, FOR THEIR USE FOR PURPOSES OTHER THAN THE GOVERNMENT PROJECT FOR WHICH THEY WERE PREPARED AND/OR PROVIDED BY THE GOVERNMENT, OR AN AGENT DIRECTLY RELATED THERETO. THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY APPLICATION OR OTHERWISE, AS LICENSING IN ANY MANNER THE HOLDER OR ANY OTHER PERSON OR CORPORATION, NOR CONVEYING THE RIGHT OR PERMISSION, TO MANUFACTURE, USE, OR SELL PATENTED INVENTION THAT MAY RELATE THERETO.

6.0 MATERIAL SELECTION LIST FOR OXYGEN SYSTEMS

CODE	MATERIAL CLASS OR CHEMICAL NAME	TRADE NAME	MANUFACTURER	LOX RATING (PSIG)	COX RATING (PSIG)	REMARKS AND APPLICABLE SPECIFICATIONS
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ELASTOMERS

E01	FLUOROELASTOMER	VITON	E.I. DUPONT	C	A51650	
E08	PERFLUOROELASTOMER	FLUOREL KALREZ CHEMRAZ	E.I. DUPONT 3M COMPANY GREENE, TWEED & CO.	C	A51650	

LUBRICANTS

L06	PERFLUOROPOLYALKYLETHETHER (PFPAE) OIL	KRYtox 143AC FOULIN 706 FOULIN 716 BRAYCOE 615Z OIL	E.I. DUPONT AUSIMONT, INC. AUSIMONT, INC. CASTROL NORTH AMERICA	A51500	A56700	ALSO CALLED PERFLUOROPOLYETHER (PFPE) PERFLUOROPOLYALKYLETHETHER (PFPAE)
L01.1	PFPAE OIL WITH PTFE THICKENER	KRYtox 240AC GREASE BRAYCOE 640AC GREASE	E.I. DUPONT CASTROL NORTH AMERICA	A510000	A510000 (TO +550° F)	
L01.1	PERFLUOROPOLYALKYLETHETHER (PFPAE) GREASE (PTFE THICKENER)	BRAYCOIE 600F TRIBOLUBE 76 BRAYCOIE 601F	CASTROL NORTH AMERICA AEROSPACE LUBRICANTS, INC. CASTROL NORTH AMERICA	A51500	A56700	
L01.2	PERFLUOROPOLYALKYLETHETHER (PFPAE) GREASE	TRIBOLUBE 10C CHRISTO-LUBE BRAYCOIE 806	AEROSPACE LUBRICANTS, INC. LUBRICATION TECHNOLOGY, INC. CASTROL NORTH AMERICA	B.T.	A51650	
L05	LOX PUMP OIL	HALOCARBON FLUOROLUBE	KSC BLINDED HALOCARBON PRODUCTS CO. OCCIDENTAL CHEMICAL CORP.	A51500	B.T.	KSC SPECIFICATION 79K22280
L09	POLYCHLOROPRENE/FLUORETHYLENE (PCPFE) OIL			A51500	A51650	

CODE	MATERIAL CLASS OR CHEMICAL NAME	TRADE NAME	MANUFACTURER	LOX RATING (PSIG)	GOX RATING (PSIG)	REMARKS AND APPLICABLE SPECIFICATIONS
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LUBRICANTS

L08	PCFTE/SILICA THICKENED OR PCFTE/PCFTE POLYMER THICKENED GREASE	HALOCARBON FLUOROLUBE	HALOCARBON PRODUCTS CO. OCCIDENTAL CHEMICAL CORP.	B.T.	AS1650	
L08.1	PCFTE/SILICA THICKENED GREASE	HALOCARBON 25-55 GREASE	HALOCARBON PRODUCTS CO.	AS400	AS1650	
L10		DRILUBE 701, DRILUBE 703, DRILUBE 831, DRILUBE 842	DRILUBE COMPANY	B.T.	AS1650	
L11	SOLID FILM LUBRICANT	EXERLUBE 812	E/M CORPORATION	AS1500	AS6700	
L12	SOLID DRY FILM LUBRICANT WITH MOLYBDENUM DISULFIDE	TOLUBE 1175	TROUZE CO.	AS1500	AS1650	
L13	DRY FILM LUBRICANT	DOW CORNING LUBRICANT 321	DOW CORNING CORP.	AS1500	AS1050	DISPERSION OF MoS ₂ , GRAPHITE AND RESIN IN A SOLVENT (CURES TO A DRY LUBRICATING FILM)
L14	PERFLUOROPOLYETHER (PFPE) OIL WITH SOLUBLE ADDITIVES	KRYTOX KP147 OIL	E.I. DUPONT	AS500	AS500	LIMITED TO INDIRECT (NON-WETTED) LOX SERVICE APPLICATIONS (i.e. LOX PUMP COUPLING)
L15	PERFLUOROPOLYETHER (PFPE) OIL	KRYTOX GPL-103 OIL	E.I. DUPONT	AS10000	AS10000	TEMPERATURE RATING IS 5180°F

MISCELLANEOUS

M01	CARBON SEALS		ALL MANUFACTURERS	B.T.	AS1650	
M25	PFTE/ELECTROLESS NICKEL COATING	NIFLOR	DRESSER INDUSTRIES, CAL. TECH. PLATING	AS6700	AS6700	
M26		FLUOROLON 325 COATING (0.001" THICKNESS)	SOUTHWEST IMPREGON, INC.	AS500	AS500	
M27	DYE PENETRANTS		ALL MANUFACTURERS	B.T.	B.T.	
M31	LEAK DETECTOR FLUID	SHERLOCK	WINTON PRODUCTS	AS1500	AS6700	
M40	BEARING MATERIAL (PFTE/Pb/TIN-BRONZE MATRIX)	DU-B OR DU(B)	GLACER GARLOCK BEARINGS INC.	AS1720	AS1720	LIMITED TO USE AS LINEAR, RADIAL OR THRUST BEARING AT RUNNING SPEEDS 5.05 FT/SEC. (MFG. SPEC. GMS-10Z REV. E)

CODE	MATERIAL CLASS OR CHEMICAL NAME	TRADE NAME	MANUFACTURER	LOX RATING (PSIG)	COX RATING (PSIG)	REMARKS AND APPLICABLE SPECIFICATIONS
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PLASTICS

P01	POLYTETRAFLUOROETHYLENE (VIRGIN PTFE)	TEFLON THE TEFALON VIRGIN TEFALON HALON ALGELON TOSTALON FLUON	E.I. DUPONT TETRAFLUOR INC. AUSMONT INC. AUSMONT INC. HOECHST AG HOECHST AG	AS6700	A56700	ASTM D4894, ASTM D4895 ASTM D3294, AMS 3668, AMS 3669 A-A-58092 OR MIL-T-27730 ASTM D3308 ASTM D3369
	FOR RESINS, APPLICABLE SPECIFICATIONS ARE..... FOR MOLDED PRODUCTS, APPLICABLE SPECIFICATIONS ARE..... FOR ANTISEIZE TAPE, APPLICABLE SPECIFICATION IS..... FOR RESIN SAVED TAPE, APPLICABLE SPECIFICATION IS..... FOR CAST FILM, APPLICABLE SPECIFICATION IS.....					
P03	PTFE GLASS FILLED	FLUOROCOLD CARLOCK 857J	PIRION CO. CARLOCK, INC.	AS6700	AS6700	MAXIMUM FILL 50% BY WEIGHT
P06	PTFE GLASS FILLED	ALGORON HALON CHEMFLUOR RT/QUORON TETRAFLUOR TETRALON POLYCOMP HOSTAFLOM CARLOCK 9405	AUSMONT, INC. AUSMONT, INC. NORBON PERFORMANCE PLASTICS ROGERS CORP. TETRAFLUOR, INC. TETRAFLUOR, INC. KI AMERICAS, INC. HOECHST AG CARLOCK, INC.	AS1650	AS1650	MAXIMUM FILL 50% BY WEIGHT
P29	PTFE, CARBON OR GRAPHITE-FILLED	HALON CHEMFLUOR TETRAFLUOR HOSTAFLOM	AUSMONT, INC. NORBON PERFORMANCE PLASTICS TETRAFLUOR, INC. HOECHST AG	AS1650	AS1650	MAXIMUM FILL 50% BY WEIGHT

PLASTICS

CODE	MATERIAL CLASS OR CHEMICAL NAME	TRADE NAME	MANUFACTURER	LOX RATING (PSIG)	GOX RATING (PSIG)	REMARKS AND APPLICABLE SPECIFICATIONS
P12	PTE. MINERAL FILLED	RULON A	DIXON CORP	A56700	A56700	
P32	PTE. CRYSTALLINE SILICA FILLED	HYPERLOX	SPECIALTY BALL VALVE			
M30	PTE. BRONZE FILLED	GYLON 3502	GARLOCK, INC.	A51650	A51650	MAXIMUM FILL 50% BY WEIGHT
		HALON	AUSIMONT, INC.	B.T.	A51650	
		HOCHSTON	HOECHST AG			
		FLUOROCOMP	ICI AMERICAS, INC.			
		CHEMFLUOR	NORTON PERFORMANCE PLASTICS			
		TETRAFLUOR	TETRAFLUOR, INC.			
		TETRALON	TETRAFLUOR, INC.			
M28	PTE. COMBINED GRAPHITE AND GLASS FILLED	HALON	AUSIMONT, INC.	B.T.	A51650	MAXIMUM FILL 50% BY WEIGHT
		TETRAFLUOR	TETRAFLUOR, INC.			
P13	PTE. CARBON, GLASS AND GRAPHITE FILLED	MULTIFIL 427	GARLOCK, INC.	A51650	A51650	
		FOG-FIL	WORCESTER CONTROLS			
M29	PTE. COMBINED GLASS AND MOLYBDATE FILLED	HALON	AUSIMONT, INC.	B.T.	A51650	MAXIMUM FILL 50% BY WEIGHT
		TETRAFLUOR	TETRAFLUOR, INC.			
		RT/DURIDIO	ROGERS CORP.			
P04	PTE. GLASS & CR OXIDE FILLED	FLUOROGREEN E-800	THE AMICON GROUP	A56700	A56700	
		FLUOROGREEN E-800	W. L. GORE ASSOCIATES			
P33	EXPANDED PTE. GASKET MATERIAL	GORE-TEX JOINT SEALANT	THE AMICON GROUP	A56700	A56700	
P02	PERFLUORO (ETHYLENE PROPYLENE) COPOLYMER (MORIN FEP)	TETRON TEP	E. I. DUPONT	A51650	A51650	
		NEOTON FEP	DAMIN INDUSTRIES	A56700	A56700	
		FLUOROMELT	ICI AMERICAS, INC.			
	FOR MOLDED AND EXTRUDED PRODUCTS, APPLICABLE SPECIFICATION IS:.....					ASTM D2116
	FOR FILM AND SHEET PRODUCTS, APPLICABLE SPECIFICATION IS:.....					AMS 3647
	FOR BAGGING AND PACKAGING MATERIAL, SEE:.....					SSC 54000-GM08
P07	PERFLUOROPOLYETHER	TETRON PFA	EI DUPONT	B.T.	A51650	
		NEOTON PFA	DAMIN INDUSTRIES			
		FLUOROMELT	ICI AMERICAS, INC.			

CODE	MATERIAL CLASS OR CHEMICAL NAME	TRADE NAME	MANUFACTURER	LOX RATING (PSIG)	GDX RATING (PSIG)	REMARKS AND APPLICABLE SPECIFICATIONS
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PLASTICS

P09	POLYCHLOROTRIFLUOROETHYLENE (PCTFE) FOR RAW MATERIAL (POWDER OR PELLET), THE APPLICABLE SPECIFICATION IS: FOR COMPRESSION MOLDED MATERIAL (SHEET, ROD, HEAVY WALL TUBING, PIECE PARTS, ETC.), APPLICABLE SPECIFICATIONS ARE: FOR BAGGING AND PACKAGING MATERIAL, SEE:			A51650	A51650	ASTM D1430 (TYPE 1 GRADE 3 ONLY) AND AMS 3645 SSC 54000-GM09
P09.1	POLYCHLOROTRIFLUOROETHYLENE (PCTFE)	KEL-F 81	JM COMPANY	A51650	A51650	NO LONGER MANUFACTURED
P14	POLYIMIDE		ALL MANUFACTURERS	B1	B1	
P14.1	POLYIMIDE GRAPHITE FILLED	VESEL SP-21	EL DUPONT	B1	A51650	NOMINAL FILL 15% BY WEIGHT
P14.2	POLYIMIDE GRAPHITE FILLED	VESEL SP-22	EL DUPONT	B1	A510000	NOMINAL FILL 40% BY WEIGHT
P34	AMORPHOUS FLUOROPOLYMERS	TEFLON AF	EL DUPONT	B1	B1	

PLASTIC HOSE LINERS AND PLASTIC COATINGS

P01	HOSE LINER - POLYTETRAFLUOROETHYLENE		RESISTOFLEX AERODUP TETRELEX	B1	A51650	SEE "POLYTETRAFLUOROETHYLENE (VIRCON PIPE)" FOR LINER MATERIAL TRADE NAMES.
P02	HOSE LINER - POLYTETRAFLUOROETHYLENE WITH CARBON ADDITIVE		RESISTOFLEX AERODUP TETRELEX	B1	A51650	SEE "PCTFE-CARBON OR GRAPHITE-FILLED" FOR LINER MATERIAL TRADE NAMES.
P01	POLYTETRAFLUOROETHYLENE COATED 300 SERIES STAINLESS STEEL			A51650	A51650	SEE "POLYTETRAFLUOROETHYLENE (VIRCON PIPE)" FOR COATING MATERIAL TRADE NAMES AND SPECIFICATIONS.
P02	PERFLUORO (ETHYLENE PROPYLENE) COPOLYMER COATED 300 SERIES STAINLESS STEEL			A51650	A51650	SEE "PERFLUORO (ETHYLENE PROPYLENE) (VIRCON FEP)" FOR COATING MATERIAL TRADE NAMES AND SPECIFICATIONS.

PROCESS FLOWMETER PROCUREMENTS

I10GT-GM11 Rev.0

APPENDIX B
DIMENSIONAL DRAWINGS

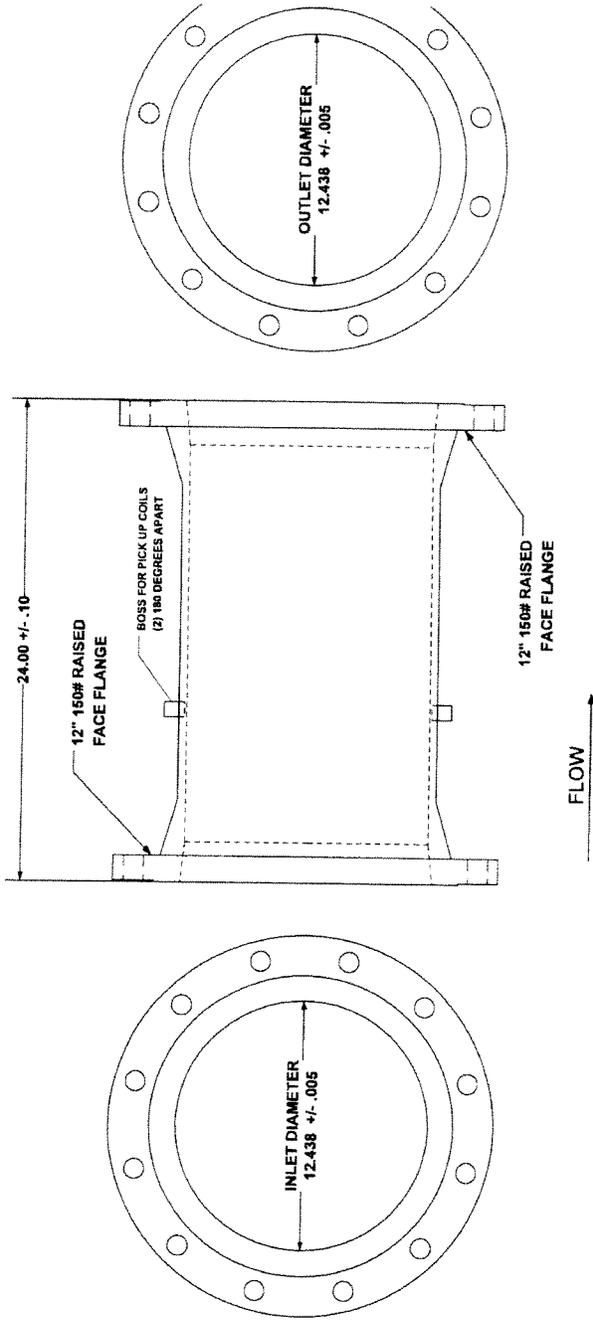


FIGURE 1

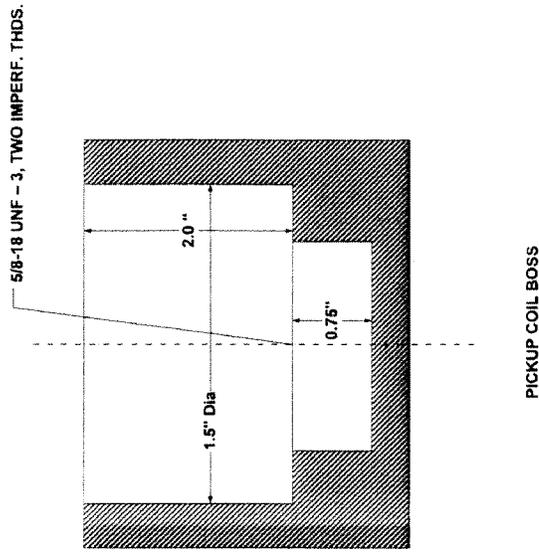
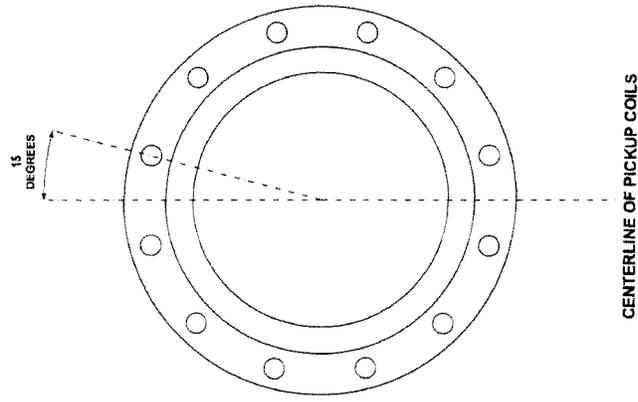


FIGURE 2