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GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

P0878

SCIENCE PROBE GAS INLET MANIFOLD CLEANLINESS VERIFICATION

(GYRO / P1A INLETS TO INTERMEDIATE ISOLATION VALVE ASSEMBLY MANIFOLD)

GP-B VERIFICATION of FLIGHT HARDWARE PROCEDURE

THIS PROCEDURE CONTAINS HAZARDOUS OPERATIONS

OCTOBER 3, 2001

PREPARED _____ _____
Chris Gray, GMA REE Date

APPROVED _____ _____
Ken Bower, Deputy GMA RE Date

APPROVED _____ _____
D. Ross, Quality Assurance Date

APPROVED _____ _____
Rob Brumley, Hardware Manager Date

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1. GENERAL DESCRIPTION

This procedure will verify the manifolds fabricated to supply gas from the GMA to the Flight Science Probe inlets are consistent with the GP-B program standards for He gas cleanliness. The same process used to verify the integrity from the Flight Probe Top hat to the gyro inlets shall basically be used throughout this procedure.

1.1 Proper care should be taken in its handling. and cleanliness must be preserved.

1.1.1 Temperature: 15-30 º C

1.1.2 Humidity: not critical

2.2 Cleanliness

2.2.1 Class 10 Clean room

2.2.2 Class 10 Clean room policies and techniques should be followed through out this procedure.

2.3 ESD precautions

2.3.1 None required.

ONR representative, and QA to be notified prior to beginning this procedure

2.4 Procedure Pass-Fail Criteria

2.4.1 The leak rate of the manifolds shall be verified @ ≤ 1 X 10^{-8} atm scc/sec or better for He.

2.4.2 The particulate measurement verifies that the ID of the inlet manifolds under test will be consistent with the Science Probe Gyro Inlet manifolds verified using P0427.

2.5 Personnel, QA, and Documentation

2.5.1 Personnel Integration and Test Director

2.5.2 Test Director shall be Chris Gray or an alternate that he shall designate. The TD has overall responsibility for the implementation of this procedure and shall sign off the completed procedure and relevant sections within it. The Integration Manager shall also sign off the completed “As-Built” procedure.

2.5.3 Test Engineers and other personnel. All engineers and technicians participating in this procedure shall work under the direction of the TD who shall determine personnel that are qualified to participate in this procedure. Participants in this procedure are to be Rick Stephenson, Ken Bower, Tom Walsh, and/or Chris Gray. ***The Test Director will perform Pre-Test and Post-Test briefings in accordance with P0875 GP-B Maintenance and Testing at all Facilities". Checklists will be used as directed by P0875.***

2.5.4 The test shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified of the start of this procedure. A Quality Assurance Representative, designated by D. Ross shall be present during the procedure (if deemed necessary) and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Manager, D. Ross or her designate, shall certify their concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document. Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108. If a re-test of any or all of the hardware is necessary, the TD will determine the appropriate changes in the procedure, with the QA and Integration Manager's approval.

2.6 Red-line Authority

2.6.1 Authority to red-line (make minor changes during execution) this procedure is given solely to the TD or his designate, or the GMA Manager, and shall be approved by QA. Additionally, approval by the Hardware Manager shall be required, if in the judgment of the TD or QA Representative, experiment functionality may be affected.

3. DOCUMENTS AND EQUIPMENT

3.1 Applicable Documents

3.2 P0427

3.2 Test Equipment

Equipment	Model and Serial Number	Calibration
Helium Leak Detector	ASM 180 T	G142
Particle Detector		

3.3 Flight Part

3.3.1 Withdraw the following parts from Bonded Stores:

GMA to Science Probe Gas Inlet Manifold Parts List

Description	Part No.	Inlet #	Comments
GMA Manifold	25780-104	**Gyro 1**	
GMA Manifold	25780-105	**Gyro 2**	
GMA Manifold	25780-106	**Gyro 3**	
GMA Manifold	25780-107	**Gyro 4**	
GMA Manifold	25780-108	**P1A**	

WARNING

HELIUM USED IN THE SMD REPRESENTS A HAZARDOUS MATERIAL FOR THE PERSONEL AND HARDWARE INVOLVED IN THE OPERATIONS. EXTREME CARE SHOULD BE USED WHEN WORKING AROUND OR WITH HELIUM GASES.

4 LEAK TEST OF SCIENCE PROBE HELIUM GAS INLET MANIFOLDS (Optional)

Started on: _____

4.1 Verification Setup

4.1.1 QA Representative to attend testing on a spot check basis.

4.1.2 Testing will be done at Stanford. Test will be performed in the Class 10 clean room.

4.1.3 Attach a Gamah to VCR connector saver to the manifold using a non-flight Gamah gasket and only slightly torque the Gamah interface connection to prevent the connector saver from rotating.

4.1.4 Cap the opposite end of the manifold with the appropriate Gamah cap and non-flight gasket and torque the fittings .

4.1.5 Connect a clean 1/4" flex tube from the GSE manifold connecting the Alcatel 180t leak detector and the clean He gas supply through a 2u filtered line to be verified at the 4VCR fitting connector saver.

2.4.3 Pump down the manifold and record the background sensitivity of the test set-up in Table 1.

4.1.7 Bag manifold and backfill with He gas and record results of leak data in Table 1 after a sufficient period of time has elapsed.

4.1.8 Repeat steps 4.1.3 through 4.1.7 on the remaining Inlet manifolds.

4.1.9 If any manifold has a verified leak rate ≥ 1 X 10^{-}8 atm scc/s, the manifold should be rejected and either reworked or replaced per MRB review.

STEP 4.1 COMPLETE. *QUALITY WITNESS*_____

Table 1.
Probe Inlet Manifold Leak Rate Verification Results

	Gyro 1	Gyro 2	Gyro 3	Gyro 4	P 9 Inlet
Sensitivity	**Leak Rate (sccs)**	**Leak Rate (sccs)**	**Leak Rate (sccs)**	**Leak Rate (sccs)**	**Leak Rate (sccs)**
Background	× 10^{-}	× 10^{-}	×10^{-}	× 10^{-}	× 10^{-}
Verification	× 10^{-}	× 10^{-}	×10^{-}	× 10^{-}	× 10^{-}

5 INITIAL SETUP AND TEST OF INLET GAS MANIFOLD

5.1 Initial Preparations

Record Start Time and Date: _____

5.1.1 Gas Inlet Manifolds should be the Class 10 facility. Clear off a suitable table and ensure the table is clean of particulates. Remove any Gamah caps on the manifold if necessary so gas can flow freely though the manifold for test.

5.1.2 Set up a He supply source with a manifold that has a regulator, filter, pumping system / leak detector, pressure gage and clean flexible manifold. This He gas supply will be used to verify the cleanliness of the manifolds under test. Verify the He gas is He and 99.9999% pure and has traceablity. Record helium cylinder serial number_____.

1.1.3 Place the HHPC-6 (or equivalent) particle detector on the table and turn it on. Begin to take background samples of the ambient air within the Class 10 facility. Record data in Table 1.

Table 1. Ambient PC Particle Counts ≥ 0.5 µm per SCFM

Sample 1	
Sample 2	
Sample 3	
Sample 4	
Sample 5	
Average	

5.1.4 Open up the supply source of the He gas to start a purge of the gas source to be verified by the particle detector.

STEP 5.1 COMPLETE. QUALITY WITNESS_____

5.2 Measure Cleanliness of the Supply Gas Manifold (GSE)

5.2.1 Fashion clean bag of approximately one liter volume, and with small openings at opposite ends. These will be later attached, as described below, to the gas source tube and the inlet to the particle counter respectively, The bag serves as a gas conduit maintained at pressure ≅ 1 ATM. This is important because the pressure in the bag should be just above ambient, but not so high that it interferes with the operation of the particle counter. This ensures that the particle counter which samples at ~ 2.8 l/m senses gas representative of the source. In practice, this requires adjustment of the gas flow to a value typically about 4.2 l/m.

5.2.2 Set up and turn on the particle counter in the vicinity of where this test will take place. Do not attach the particle counter to the hole at the other end of the bag at this time. The particle counter should be operating and integrating particles ≥ 0.5 µm for one minute increments. Confirm that it is reading the expected ambient counts, i.e. < 10 counts/SCFM, consistent with Class 10 cleanroom standards when sampling uncontaminated cleanroom air. Record the data in Table 1 below. The particle counter should typically read ≤ 3 count per SCFM if no particulates are generated upstream in the vicinity of the device. Otherwise check operation and repeat.

5.2.3 Now insert the tubing attached to the exit line from the 0–10 psid pressure gauge directly into the clean bag. Tape the bag with cleanroom tape so that it is well sealed above the Gamah fitting. Set the flow controller/meter to approximately 4.2 l/m by adjusting the flow controller/meter and its input pressure as necessary.

5.2.4 Carefully insert the sampling tube of the particle counter, as shown in Figure 1, into the exit hole of the bag and tape in place. Do not seal this opening. Verify that the bag is loosely inflated which ensures that the pressure in the bag is approx. at ambient pressure. If inflated too tightly, decrease the flow or let more gas escape from the bag at/near the attachment point to the sampling tube of the PC and vice versa if the bag does not inflate sufficiently. Record data in Table 2. after 2 min have elapsed. Take five 1 minute samples with the PC.

Data should average ≤ 1 count/SCFM. indicating a source gas of sufficient cleanliness that will be put into the GMA line. If this is not true, disconnect, clean and flush the system and repeat this test, recording the data in Table 2A. Otherwise do not enter data into Table 2A.

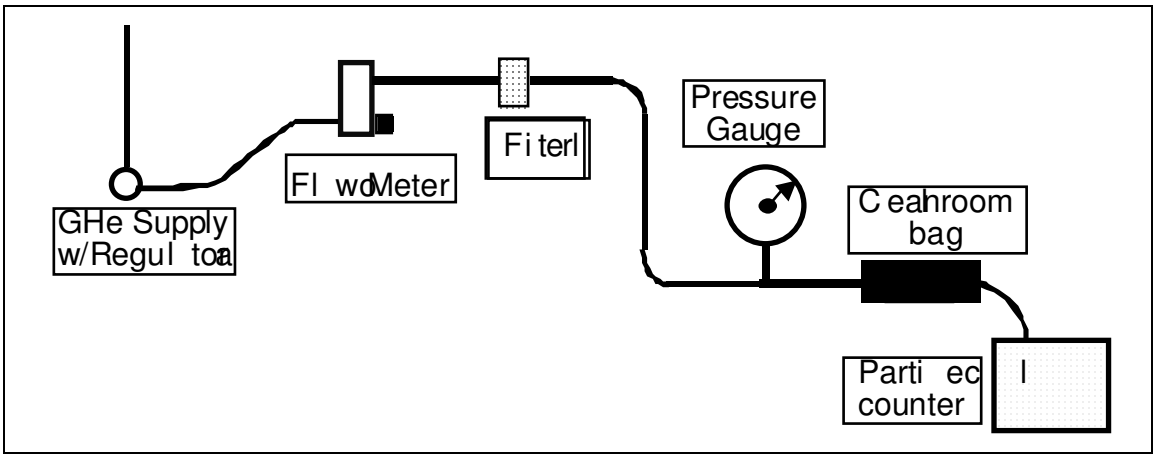

Figure 1. Gas Cleanliness Measurement Set-up

5.2.5 Remove the bag from the particle counter while gas is still flowing. Remove the bag from the Gamah fitting end of the GMA manifold .

5.2.6 Do not shut off the He gas flow, i.e. let the line continue to purge to preserve cleanliness.

Table 2. Source Gas Cleanliness before connection to Gas Inlet Manifold

1 min Sample Sequence Number	Flow Rate (l/m)	Integrated Number Of Particles per ≥ 0.5 µm SCFM
1		
2		
3		
4		
5		
Average		

Table 2A. Source Gas Cleanliness before connection to Gas Inlet Manifold *

1 min Sample Sequence Number	FLOW RATE (l/m)	Integrated Number Of Particles per ≥ 0.5 µm SCFM
1		
2		
3		
4		
5		
Average		

* Table 2A only applicable if Section 5.2.4 applies. Otherwise leave blank

6 MEASURE PARTICULATE COUNTS OF THE GMA MANIFOLD INTERFACING FROM THE INTERMEDIATE VALVE ASSEMBLY TO THE TOP HAT INLETS

This section is to be repeated for each of the five inlet lines. Data from the test on "S1" manifold should be recorded in the table marked " S1" Manifold Data", Data from the test on "S2" manifold should be recorded in the table marked " S2" Manifold Data" and so forth.

6.1 Ambient Particulate Count Rate Adjacent to "S1" GMA Inlet Manifold

6.1.1 Set up the particle counter so that the funnel can be held adjacent to the "S1" manifold to monitor the He gas purge outlet. Begin integration in 1 minute increments, for a total of 2 minutes, for particle sizes ≥ 0.5 µm

6.1.2 Without placing the GMA Inlet manifold into the funnel, take five, one minute, PC integration readings of the ambient cleanroom air. The results should be ≤ 10 counts per SCFM, (with typical readings ≤ 3) consistent with the Class 10 cleanroom. Record the data in the Table 3A.

Table 3A. Ambient Air Adjacent to the GMA Inlet Manifold
PC Particle Counts ≥ 0.5 µm per SCFM

Sample 1	
Sample 2	
Sample 3	
Sample 4	
Sample 5	
Average	

STEP 6.1 COMPLETE. QUALITY_____

6.2 Particulate Measurements thru (S1) GMA Inlet Manifold

6.2.1 With the gas still flowing from the supply line (Section 5.2.6), connect the gas supply to the "female Gamah" GMA fitting installed on the supply line.

6.2.6 Make sure that the PC is auto-counting for 1 minute increments and is set to show integrated particle counts for sizes ≥ 0.5µm. Wait 2 minutes but note if count rate is ≥ 3 during this period.

6.2.7 Take 1 minute increment PC data for 5 minutes and record the data in Table 3B below for the appropriate manifold under test.

6.2.8 Repeat test starting at 6.2.1 for all the manifolds S2, S3, S4, and P1A.

STEP 6.2 COMPLETE. QUALITY WITNESS_____

Table 3B. GMA to Probe Inlet Manifold "S1"

1 min. Sample Sequence Number	ACTUAL PRESSURE (psid)	NUMBER OF PARTICLES per SCFM ≥ 0.5 µm
1		
2		
3		
4		
5		
Average		

Table 3B. GMA to Probe Inlet Manifold "S2"

1 min. Sample Sequence Number	ACTUAL PRESSURE (psid)	NUMBER OF PARTICLES per SCFM ≥ 0.5 µm
1		
2		
3		
4		
5		
Average		

Table 3B. GMA to Probe Inlet Manifold "S3"

1 min. Sample Sequence Number	ACTUAL PRESSURE (psid)	NUMBER OF PARTICLES per SCFM ≥ 0.5 µm
1		
2		
3		
4		
5		
Average		

Table 3B. GMA to Probe Inlet Manifold "S4"

1 min. Sample Sequence Number	ACTUAL PRESSURE (psid)	NUMBER OF PARTICLES per SCFM ≥ 0.5 µm
1		
2		
3		
4		
5		
Average		

Table 3B. GMA to Probe Inlet Manifold "P1A"

1 min. Sample Sequence Number	ACTUAL PRESSURE (psid)	NUMBER OF PARTICLES per SCFM ≥ 0.5 µm
1		
2		
3		
4		
5		
Average		

_____ date: _____
GMA Engineer

Discrepancies if any:

Approved: _____ date: _____
GMA Manager

Approved: _____ date: _____
Payload Hardware Manager

Approved: _____ date: _____
QA Representative

6. DATA BASE ENTRY

The following data shall be entered into the GP-B Data Base:

- Name, number and revision of this procedure
- Date of successful completion of procedure.
- Part numbers and serial numbers of manifold components