



STANFORD UNIVERSITY
W.W. HANSEN EXPERIMENTAL PHYSICS LABORATORY
GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

GDS OPERATING PROCEDURE

Caution: This procedure contains hazardous operations

P0886 Rev A

13 September, 2002

PREPARED _____
S. Buchholz, Prepared by _____ Date _____

APPROVED _____
K. Bower, GMA Engineer _____ Date _____

APPROVED _____
C. Gray, GMA REE _____ Date _____

APPROVED _____
Harv Moskowitz, LMSSC Safety Engineer _____ Date _____

APPROVED _____
D. Ross, Quality Assurance _____ Date _____

APPROVED _____
R. Brumley, Hardware Manager _____ Date _____

REVISION HISTORY

Rev	Date	Comments
-	09/04/02	
A	09/013/02	Multiple changes to procedure to include manual valve torques, correct GMA launch configuration and other minor corrections. (ECO # 1385)

TABLE OF CONTENTS

A	SCOPE	4
B	SAFETY	4
C.	QUALITY ASSURANCE	4
	C.1 QA Notification	4
	C.2 Red-line Authority	4
	C.3 Discrepancies	4
D	TEST PERSONNEL	5
E	REQUIREMENTS	5
	E.1. Electrostatic Discharge Requirements	5
	E.2. Lifting Operation Requirements	5
	E.3. Hardware/Software Requirements	5
	E.4. Instrument Pretest Requirements	5
	E.5. Configuration Requirements	5
	E.6. Optional Non-flight Configurations	5
	E.7. Verification/ Success Criteria	6
	E.8. Constraints and Restrictions	6
F.	REFERENCE DOCUMENTS	6
	F.1. Drawings	6
	F.2. Supporting documentation	6
	F.3. Additional Procedures	6
G.	OPERATIONS	6
	G.1. Verify Appropriate QA Notification	6
	G.2 Setup of GDS	6
	G.3 Particle and Leak Check of GDS Manifold to GMA	7
	G.4 GMA Gas Fill Preparations (Gas Purity Test)	8
	G.5 GMA Regulator Lock-Up	9
	G.6 GMA Gas Fill	12
	G.7 Disconnect GDS	13
	G.8 Diagrams	15
	Figure #1	15
	Figure #2	16
	Figure #3	17
H	PROCEDURE COMPLETION	18
	H.1 Completion Table	18
	H.2 Pressure Sensor Record	19
	H.3 Procedure Sign Off	20

A SCOPE

This procedure defines how to operate the Gas Delivery System (GDS) for use with flight and flight-like Gas Management Assembly (GMA). It will cover the setting of pressures, valve operations for filling external systems and gas sample checks. All precautions will be made to insure that the GDS and GMA gas paths stays as clean as possible. Upon completion of this operation, the GMA will be in configuration for launch.

B SAFETY

The GDS has multiple gas pressure vessels. Under normal operations, GDS requires no safety measures or equipment beyond those required for the use of a supply gas cylinder. The GDS is a high-pressure gas delivery system. When any of the system is pressurized and connected to the vacuum system and/or leak detector, be cautious not to vent high pressure through the pumping portions of either system. Only allow high pressure to vent through approved ports (such as leak detector vent) and make sure that these are open at time of venting. The table below defines the pressure limits for each zone of the GDS.

GDS Operating Pressure Limitations (psig)

Zone	System MEOP	Rated MEOP	Relief Pressure	Proof Pressure
Red	2640	3500	3775	3960
Orange	2000	3000	2200/3300	3000
Yellow	300	650	330	450
Green	300	1000	330	450
Blue	<10	150	<10	N/A

Note: Observe caution with pressure units, psia and psig.
(psia = psig+ 14.7)

C QUALITY ASSURANCE

C.1 QA Notification

This operation will be conducted on a formal basis to approved and released procedures. **The QA program office and ONR representative shall be notified 24 hours prior to the start of this procedure.** A Quality Assurance Representative, designated by D. Ross shall be present during the procedure and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Program Engineer, D. Ross or her designate, will certify her 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.

C.2 Red-line Authority

Authority to redline (make minor changes during execution) this procedure is given solely to the Test Engineer or his designate and shall be approved by the QA Representative.

C.3 Discrepancies

Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108.

D TEST PERSONNEL

The Test Engineer shall be Ken Bower or an alternate that he shall designate. The Engineer has overall responsibility for the implementation of this procedure and shall sign off the completed procedure and relevant sections within it.

E REQUIREMENTS

E.1 Electrostatic Discharge Requirements

N/A

E.2 Lifting Operation Requirements

N/A

E.3 Hardware/Software Requirements

GDS

ECU Flight Equivalent, Flight ECU, or Manual Latch Valve Control Box

(Note: The procedures will always call for an 'ECU command' to open GMA valves but it can be replaced by any of the above equivalents.)

Interface cables from ECU to GMA/ Gas Flow Mock GMA (G-Mock)

Research Grade Helium Supply: four bottles on the GDS cart and one for leak detection spraying. GMA or G-Mock

High and Low Pressure Manifold Hardware to connect GMA/G-Mock to GDS

Mensor High Resolution Pressure Transducers attached to manifold

3500 psia digital pressure sensor

Calibration Date: _____ S/N: _____ Model #: _____

500psia digital pressure sensor

Calibration Date: _____ S/N: _____ Model #: _____

Leak detector, Alcatel (or alternate), internally calibrated

Hand held particle counter (sensitive to 0.50 microns or better)

Calibration Date: _____ S/N: _____ Model #: _____

Clean room bags

Alcatel Dry Pump / Turbo Pump Cart (or equivalent)

E.4 Instrument Pretest Requirements

All test equipment used to verify test data is required to be "in calibration."

E.5 Configuration Requirements

The GDS has passed the Acceptance Test and 'Initial Gas Purity Tests' (99.9995% He).

E.6 Optional Non-flight Configurations

N/A

E.7 Verification/ Success Criteria

Individual quantities should be able to be within tolerances set out in individual procedure sections.

E.8 Constraints and Restrictions

N/A

F REFERENCE DOCUMENTS

F.1 Drawings

GDS Drawing – Advanced Micropolish Inc (AMI) Dwg # STN-103-ASM
GDS Schematic, GP-B Dwg. Number 26278
G-Mock Drawing
GMA Schematic, GP-B Dwg. Number 26273

F.2 Supporting documentation

N/A

F.3 Additional Procedures

ECU operations as applicable.

G OPERATIONS

G.1 Verify Appropriate QA Notification

QA Notified _____ ONR Notified _____
(Date & Time) (Date & Time)

G.2 Setup of GDS

Started on: _____

WARNING

HELIUM USED IN THE GRAVITY PROBE-B PROGRAM REPRESENTS A HAZARDOUS MATERIAL FOR THE PERSONNEL INVOLVED IN THE TESTING AND CRYOGENIC SYSTEM OPERATIONS.

EXTREME CARE SHOULD BE USED WHEN WORKING AROUND OR WITH HELIUM

- G.2.1 Verify pressure relief systems are installed and all associated cutoff valves are open.
- G.2.2 Verify GDS supply cylinders have sufficient Helium to complete required operations. (Minimum of two full Air Products (AP) BIP's 2640 psig cylinders are required to fill the GMA to 2000psia)
- G.2.3 Verify that all GDS valves (except those noted in G2.1) and He supply valves are closed and all GDS ports are sealed. Open the GDS sample bottle valves. The sample bottle valves remain open at all times unless stated otherwise.
- G.2.4 Verify that the GDS is at a positive pressure of Helium. Record PT-2_____ PT-3 _____
- G.2.5 Connect the ECU (or equivalent control device) to the GMA and start it up.

G.2.6 Start Null Script software to control the GMA solenoid valves. The GMA valves will then be in "launch", "sleep", or "unchanged" configuration, determined by the Test Director. Record configuration here: _____ (If "unchanged" is the configuration chosen, attach a configuration description). Make note of all problems in a Discrepancy Log.

G.2.7 Record the starting pressure of the He supply bottles:

#1 _____ #2 _____ #3 _____ #4 _____

G.3 Particle and Leak Check of GDS Manifold to GMA

Started on: _____

Note: Mark off each step of this section as it is completed.

G.3.1 Open one He supply bottle (bottle # _____), the corresponding GDS supply valve (V-1, V-2, V-3 or V-4) and V-6. **(Fig. 2)**

G.3.2 Open GDS valves V-13, V-14, V-17, and V-24. Set pressure regulator PR-1 to a low-pressure (<150 psig) then open valve V-8. Uncap high-pressure outlet. Set flow between 5-10 lpm (about 0.25 scfm).

G.3.3 Connect high-pressure manifold hardware to GDS high -pressure outlet. **(Fig. 1)**

G.3.4 Close GDS valve V-24 and open valve V-25. Set pressure regulator PR-2 to a low-pressure (<150 psig) then open valve V-26. Uncap low-pressure outlet. Set flow between 5-10 lpm (about 0.25 scfm).

G.3.5 Connect low pressure manifold hardware to GDS low -pressure outlet.

G.3.6 Close GDS valve V-25.

G.3.7 Open valve V-24. Fashion a clean room bag into an air trap with small openings at either end.

G.3.8 Affix the clean room bag to the high-pressure outlet of the manifold. Gas should slightly inflate the air trap.

G.3.9 Insert particle counter inlet loosely into other end of bag.

G.3.10 Allow gas to flow for at least 5 minutes to purge line.

G.3.11 Take five one-minute samples. Average number of 0.5 micron or greater particles should be less than 5 per cubic foot. Samples @ MV1) : #1 ___ #2 ___ #3 ___ #4 ___ #5 ___

G.3.12 Remove particle counter and gas trap and do not shut off the gas flow.

G.3.13 Initial here to verify test pass for the high-pressure outlet _____.

G.3.14 Open GDS valve V-25 and repeat steps G.3.7 to G3.12 for the low-pressure outlets.

Samples - @ MV2): #1 ___ #2 ___ #3 ___ #4 ___ #5 ___ ; @MV3 :#1 ___ #2 ___ #3 ___ #4 ___ #5 ___ ; @ MV4 : #1 ___ #2 ___ #3 ___ #4 ___ #5 ___

Note: If there is insufficient flow, close valve V-24 during low-pressure outlet particle check.

G.3.15 Initial here to verify test pass for the three low-pressure outlets _____.

G.3.16 Connect manifold to GMA. Use a conical seal in each connection (part #C33934-004). Verify that positive flow is maintained during mating. (Open valve V-24 if required).

Connections torqued to 120 ± 10 in-lbs and recorded in valve cycle log sheet.

TORQUE @: MV1 _____, MV2 _____, MV3 _____, MV4 _____

QUALITY _____

- G.3.17 Vent pressure through CV-1 by doing the following: Close GDS supply valve (V-1, V-2, V-3 or V-4). Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open valve V-29 (CCW to open) and slowly release pressure to a nominal 10 psig. Close valve V-29.
- G.3.18 Connect leak detector to the GDS RGA connection. Ensure the leak detector has been tuned and calibrated. Calibration Date _____ Calibration Value _____
- G.3.19 Start leak detector. Open GDS valves V-9 and V-11, wait for the GDS pump to evacuate the GDS ($<5 \times 10^{-3}$ torr), close V-10, then open GDS valve V-22. Verify that all GDS pressure sensors read 0 psia once leak detector goes into test mode. Record background leak rate _____.
- G.3.20 Using a small flow from the leak test supply bottle, spray helium around the GDS to GMA manifold hardware. Watch for leak rate spikes that would indicate leaks.
- G.3.21 Fix any leaks that are found and repeat step G.3.17 as necessary. Record any discrepancies in a discrepancy log.
- G.3.22 Close GDS valves V-9, V-11 and V-22. Shut down leak detector.
- G.3.23 Record completion of leak test on line 1 of Section H.1. **QUALITY** _____

G.4 GMA Gas Fill Preparations (Gas Purity Test)

Started on: _____

Note: Mark off each step of this section as it is completed.

- G.4.1 Open/verify open GDS valves V-8, V-13, V-14, V-15, V-16, V-17, V-21, V-23, V-24, V-25 and V-26. Close/verify closed GDS valves V-1, V-2, V-3, V-4, V-5, V-6, V-7, V-9, V-10, V-11, V-12, V-18, V-19, V-20, V-22, V-27, V-28, V-29 and V-30.
- G.4.2 Verify that GDS pressure sensors PT-2 and PT-3 all are <10 psig. Start GDS vacuum pump, open valves V-9, V-10 and V-11 and evacuate GDS.
- G.4.3 Verify that GDS and supply manifold are under vacuum ($< 5 \times 10^{-3}$ torr @ VT-1) before pressurizing.
- G.4.4 Close GDS valves V-8, V-9, V-10, V-11, V-13 and V-26.
- G.4.5 Open one He supply bottle (bottle # _____), the corresponding GDS supply valve (V-1, V-2, V-3 or V-4) and V-6.
- G.4.6 Set regulator PR-1 to ≥ 700 psig and crack open valve V-8 to allow the pressure to rise slowly.
- G.4.7 Close the valves on GDS sample bottle #1.
- G.4.8 Close the helium supply bottle and the corresponding GDS valve (V-1, V-2, V-3 or V-4).
- G.4.9 Vent pressure through CV-1 by doing the following: Open GDS valve V-13. Set PR-1 and PR-2 (CW to open) to minimum flows. Open valve V-29. Crack open valve V-26 (CCW to open) and slowly release pressure then close valve V-29.
- G.4.10 Close and lock GDS valves V-15 and V-16. Remove sample bottle #1, cap the ends of the bottle and ports. Send sample to vendor for analysis. (If gas sample does not require vendor

analysis, do not remove.) Turn off GDS vacuum pump if desired.

QUALITY _____

Note: If any configuration of the GDS manifold has been opened to atmosphere or Helium Supply bottles have been changed, sample results must be verified by a qualified gas analysis vendor before proceeding.

Helium gas composite shall be 99.9995% or better.

G.5 GMA Regulator Lock-Up

Started on: _____

Note: Mark off each step of this section as it is completed.

- G.5.1 Verify section G.2 is complete, the ECU (or equivalent control device) is ready and the GMA valves are in a launch configuration.
- G.5.2 Measure GMA system pressures and record values in Section **H.2**.
- G.5.3 Verify all GDS valves and regulators are closed, except the relief cutoff valves (V-21, V-23, RV-1 and RV-3).
- G.5.4 Connect the Alcatel Turbo Pump Cart and valve manifold to the GMA non-propulsive vent port. Verify valves VV-1 and VV-2 are closed.
- G.5.5 If GMA Zones II, III, IV or V (**Figure #3**) are all at a vacuum ($< 5 \times 10^{-3}$ torr) then go to step **G.5.10**.
- G.5.6 If GMA Zones II, III, IV or V is > 50 psig then the pressure must be vented by doing the following: Enter ECU command to open GMA valves V3, V4, V-5, V-6 and V29. Open VV-1 and vent until GMA pressure is < 50 psig. Close VV-1.
- G.5.7 Turn on Alcatel Turbo Pump and then open valve VV-2 to evacuate.
- G.5.8 Close VV-2. Turn off Alcatel Turbo pump if desired.
- G.5.9 Enter ECU command to close GMA valves V3, V4, V5, V6 and V29.
- G.5.10 Record all GMA pressure sensors and enter values in Section **H.2**.
- G.5.11 Enter ECU command to open GMA valves V1 and V2.
- G.5.12 If GMA sensor P1 indicates < 270 psia then go to step **G.5.20**.
- G.5.13 If GMA sensor P1 indicates 300 psia (± 30) then go to step **G.5.30**
- G.5.14 If GMA sensor P1 indicates > 330 psia then continue. (Excess pressure must be bled through the GMA vent.)
- G.5.15 Enter ECU command to open GMA valves V3, V4, V5, V6 and V29.
- G.5.16 Open VV-1 and slowly bleed gas until desire pressure is obtained then close VV-1.
- G.5.17 Enter ECU command to close GMA valves V1, V2, V3, V4, V5, V6 and V29.
- G.5.18 Record all GMA pressure sensors and enter values in Section **H.2**.
- G.5.19 Go to step **G.5.30**.
- G.5.20 If the GDS is at a positive pressure (> 20 psig) then it must be vented through CV-1 by doing the following: Verify GDS valve V-6 is closed. Open GDS valves V-8, V-13 and V-26. Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open valve V-29 (CCW to open) and slowly release pressure. Close GDS valve V-29.
- G.5.21 Start GDS vacuum pump, open GDS valves V-9, V-10 and V-11 and evacuate GDS.
- G.5.22 Open GDS valves V-24 and V-25.
- G.5.23 Verify the GDS and supply manifold are under vacuum ($< 5 \times 10^{-3}$ torr @VT-1).
- G.5.24 Close GDS valves V-8, V-9, V-10, V-11, V-13 and V-25.

- G.5.25 Open one He supply bottle (bottle #_____), the corresponding GDS supply valve (V-1, V-2, V-3 or V-4) and V-6. Set regulator PR-1 to 300 psia (285 psig). Crack open valve V-8 and allow the pressure to rise slowly.
- G.5.26 Slowly open GMA valves MV1 (record in valve cycle log sheet) and enter ECU command to open GMA valves V1 and V2. There might be some settling time required (15 minutes) before verification of the final pressure.
- G.5.27 Enter ECU command to close GMA valves V1 and V2.
- G.5.28 Close GMA valve MV1 (Torqued to 40 ±5 in-lbs and recorded in valve cycle log sheet) and GDS valve V-24. **TORQUE:**_____ **QUALITY**_____
- G.5.29 Record all GMA pressure sensors and enter values in Section **H.2**.
- G.5.30 On lines **2** and **3** of Section **H.1** record completion of gas fill and final pressures
- G.5.31 If the GDS is at a positive pressure (> 20 psig) then it must be vented through CV-1 by doing the following: Close GDS valve V-6. Open GDS valve V-13. Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open GDS valve V-29 (CCW to open) and slowly release pressure. Close GDS valve V-29.
- G.5.32 Start GDS vacuum pump, open GDS valves V-9, V-10, V-11, V-25 and V-26 (if not already open) and evacuate.
- G.5.33 Verify the GDS and supply manifold are under vacuum (< 5x10⁻³ torr @ VT-1).
- G.5.34 Close GDS valves V-8, V-9, V-10, V-11 and V-26.
- G.5.35 Open one He supply bottle (bottle #_____), the corresponding GDS supply valve (V-1, V-2, V-3 or V-4) and V-6. Open GDS valve V-6 and set regulator PR-1 to 500 psig and crack open valve V-8 to allow the pressure to rise slowly.
- G.5.36 Set regulator PR-2 to 50 psig (± 10) and crack open valve V-26 and allow the pressure to rise slowly to 50 psig.
- G.5.37 Slowly open GMA valves MV3 and MV4 (record each in valve cycle log sheet).
- G.5.38 Increase PR-2 setting to 285 psig (300 psia) (± 30) but limit increase to ≤100 psi/minute. Verify final pressure with the Mensor.
- G.5.39 Close GMA valves MV3 and MV4 (Torqued to 40 ± 5 in-lbs and recorded in valve cycle log sheet).

TORQUE:_____ **QUALITY**_____

On lines **4** and **5** of Section **H.1** record completion of gas fill and final pressures. Record all GMA pressure sensors and enter values in Section **H.2**

- G.5.40 Vent pressure through CV-1 by doing the following: Close GDS valve V-6. Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open valve V-29 (CCW to open) and slowly release pressure. Close GDS valve V-29.
- G.5.41 Open GDS valves V-9, V-10 and V-11 and evacuate GDS.
- G.5.42 Verify the GDS and supply manifold are under vacuum (< 10⁻³ torr @ VT-1) before pressurizing.
- G.5.43 Close GDS valves V-8, V-9, V-10, V-11 and V-26.

- G.5.44 Open GDS valve V-6 and set regulator PR-1 to 500 psig and crack open valve V-8 to allow the pressure to rise slowly.
- G.5.45 Set regulator PR-2 to 50 psig and crack open valve V-26 and allow the pressure to rise slowly to 50 psig.
- G.5.46 Open GMA valve MV2 (record in valve cycle log sheet).
- G.5.47 Enter ECU command to open GMA valves V3, V4, V5 and V6.
- G.5.48 Increase PR-2 setting to 285 psig (300 psia) (± 30) but limit increase to <100 psi/minute. Verify final pressure with the Mensors.
- G.5.49 Enter ECU command to close GMA valves V3, V4, V5, V6 and close the GMA valve MV2 (Torqued to 40 ± 5 in-lbs and recorded in valve cycle log sheet). On lines **12 to 14** of Section **H.1** record completion of gas fill and final pressures.
- G.5.50 Record all GMA pressure sensors and enter values in Section **H.2**.
- G.5.51 Vent pressure through CV-1 by doing the following: Close GDS valve V-6. Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open valve V-29 (CCW to open) and slowly release pressure. Close GDS valve and V-29.

Note: The following procedures (G5.52 to G5.58) are optional depending if GMA Zone V requires evacuation.

- G.5.52 Enter ECU command to open GMA valve V29.
- G.5.53 Open VV-1 and release the pressure in Zone V. Close VV-1
- G.5.54 Turn on Alcatel Turbo Pump and then open valve VV-2.
- G.5.55 Verify the GMA Zone V is under vacuum (read GMA sensor P6).
- G.5.56 Enter ECU command to close GMA valve V29 and close VV-2.
- G.5.57 On line**14** of Section **H.1** record completion of gas fill and final pressures.
- G.5.58 Record all GMA pressure sensors and enter values in Section **H.2**.

Note: The following procedures (G5.59 to G5.66) are optional depending if GMA Zone VI requires evacuation.

- G.5.59 Connect GMA outlets S1, S2, S3, S4 and P1A to a vacuum source and start pump.
- G.5.60 Enter ECU command to close GMA valves V7, V8, V11, V12, V15, V16, V19, V20, V23, and V24.
- G.5.61 Enter ECU command to open GMA valves V9, V10, V13, V14, V17, V18, V19, V21, V22, and V26.
- G.5.62 Evacuate GMA outlets.
- G.5.63 Verify the GMA is under vacuum ($< 10^{-3}$ torr @ vacuum source)
- G.5.64 Enter ECU command to close GMA valves V9, V10, V13, V14, V17, V18, V21, V22, V25 and V26.
- G.5.65 On lines **6 to 11** of Section **H.1** record completion of gas fill and final pressures.
- G.5.66 Record all GMA pressure sensors and enter values in Section H.3. **QUALITY**_____

G.6 GMA Pressure Vessel Fill

Started on: _____

Note: Mark off each step of this section as it is completed.

- G.6.1 Verify section G.2 is complete, the ECU (or equivalent control device) is ready and the GMA valves are in a launch configuration.
- G.6.2 Verify that GDS valves V-13, V-14, V-17, V-18, V-19, V-21, V-23 and V-24 are open.
- G.6.3 Open one He supply bottle (bottle #____), the corresponding GDS supply valve (V-1, V-2, V-3 or V-4) and V-6.
- G.6.4 If the GDS is at a positive pressure (> 20 psig) then it must be vented through CV-1 by doing the following: Open GDS valves V-8 and V-26. Set PR-1 and PR-2 (CW to open) to minimum flows. Crack open valve V-29 (CCW to open) and slowly release pressure. Close GDS valve and V-29.
- G.6.5 Open GDS valves V-9, V-10 and V-11. Evacuate GDS and supply manifold.
- G.6.6 Verify that GDS and supply manifold are under vacuum ($< 5 \times 10^{-3}$ torr @ VT-1) before pressurizing.
- G.6.7 Close GDS valve V-9, V-10 and V-11
- G.6.8 Set regulator PR-1 to 285 psig (± 30) and crack open valve V-8 to allow the pressure to rise slowly.
- Note: If the GMA tank pressures are known to not equal 285 psig (± 30), the Test Director shall designate a different starting pressure. _____
- G.6.9 Slowly open GMA valve MV1 (record in valve cycle log sheet). Close GDS valve V-21.
- G.6.10 Increase pressure at PR-1 up to a nominal expected 2200 psig but limit increase to <100 psi/minute (Actual fill pressure to be determined by Test Director _____). There might be some settling time required (15 minutes) before verification of the final pressure. Verify final pressure with the Mensor. (Note: If the GMA bottle temperature increases more than 10° C, stop fill process and wait for the temperature to decrease below the 10° delta.)
- G.6.11 Close GMA valve MV1 (Torqued to 40 ± 5 in-lbs and recorded in valve cycle log sheet).
- TORQUE:** _____ **QUALITY** _____
- G.6.12 Vent pressure through GDS CV-1 by doing the following: Close GDS valve V-6. Set PR-1 and PR-2 (CW to open) to minimum flows. Open valves V-29. Crack open valve V-26 (CCW to open) and slowly release pressure. Close GDS valves V-8, V-26 and V-29.
- G.6.13 Open valves V-9, V-10 and V-11 and evacuate GDS.
- G.6.14 Verify the GDS and supply manifold are under vacuum ($< 5 \times 10^{-3}$ torr @ VT-1) before pressurizing.
- G.6.15 Close GDS valves V-8, V-9, V-10, V-11, V-13 and V-26. Turn off GDS vacuum pump if desired. Wait period – Approval from Test Director required before continuing _____.
- G.6.16 Slowly open GMA valve MV1 (record in valve cycle log sheet) and back fill GDS sample bottle #2 to equilibrium (approximately 1880 psia, actual final pressure to be determined by Test Director _____). Verify pressure with the 3500 psi Mensor. If pressure is greater than

desired final pressure, carefully vent surplus pressure through the following sequence of GDS valves as required: V-14, V-13, PR-2 (set to <50 psig), V-26, V-29, and CV-1. Record final pressure _____.

- G.6.17 Close GMA valve MV1 (Torqued to 40 ± 5 in-lbs and recorded in valve cycle log sheet) and GDS sample bottle #2 valves. **TORQUE:** _____ **QUALITY** _____
- G.6.18 Vent pressure through CV-1 by doing the following: Set PR-1 and PR-2 (CW to open) to minimum flows. Open valves V-13 and V-29. Crack open valve V-26 (CCW to open) and slowly release pressure. Close GDS valves V-26 and V-29.
- G.6.19 Close and lock GDS valves V-18 and V-19.
- G.6.20 Remove sample bottle #2, cap the ends of the bottle and ports. Send to vendor for analysis. (If gas sample does not require vendor analysis, do not remove.)
- G.6.21 On line **15** of Section **H.1** record completion of gas fill and final pressure. **QUALITY** _____

G.7 Disconnect GDS

Started on: _____

Note: Mark off each step of procedure as it is completed.

- G.7.1 Verify all GMA valves MV1, MV2, MV3 and MV4 are closed and torqued (Torqued to 40 ± 5 in-lbs and recorded in valve cycle log sheet). **TORQUE:** MV1 _____, MV2 _____, MV3 _____, MV4 _____ **QUALITY** _____
- G.7.2 Verify GDS valves V-1, V-2, V-3, V-4, V-6, V-13, V-14, V-17, V-21, V-23, V-24, V-25 and V-26 are open. All other GDS valves are closed.
- G.7.3 Record the final pressure of the He supply bottles:
#1 _____ #2 _____ #3 _____ #4 _____
- G.7.4 Set regulator PR-1 and PR-2 to a low-pressure (<150 psig) then open valve V-8 to set flow between 5-10 lpm (about 0.25 scfm).
- G.7.5 Disconnect manifold from GMA.
- G.7.6 Cap and seal all GMA fill and drain valve ports. Use a conical seal in each port. (part #C33934-004). (Caps torqued to 120 ± 10 in-lbs and recorded in valve cycle log sheet)
TORQUE @: MV1 _____, MV2 _____, MV3 _____, MV4 _____
QUALITY _____
- G.7.7 Disconnect manifold from GDS.
- G.7.8 Verify that all GDS purge gas connections are capped and all relief/check valves are enabled.
- G.7.9 Close GDS valves V-24, V-25 and V-26.
- G.7.10 Close He supply bottle(s).
- G.7.11 Set regulator PR-1 and PR-2 to minimum flows.
- G.7.12 Vent GDS to 5 psig (± 2 psig): Open GDS valve V-26 and crack open valve V-29 (CCW to open) and slowly release pressure to 5 psig. Close GDS valve V-29.
- G.7.13 Close all GDS valves.
- G.7.14 Removed any Ground Support Hardware (GSE) hardware as required.

G.7.15 Sign off on line **16** of Section **H.1** to verify that the GDS is safe and back-filled with Helium to 5 psig.

G.8. Diagrams

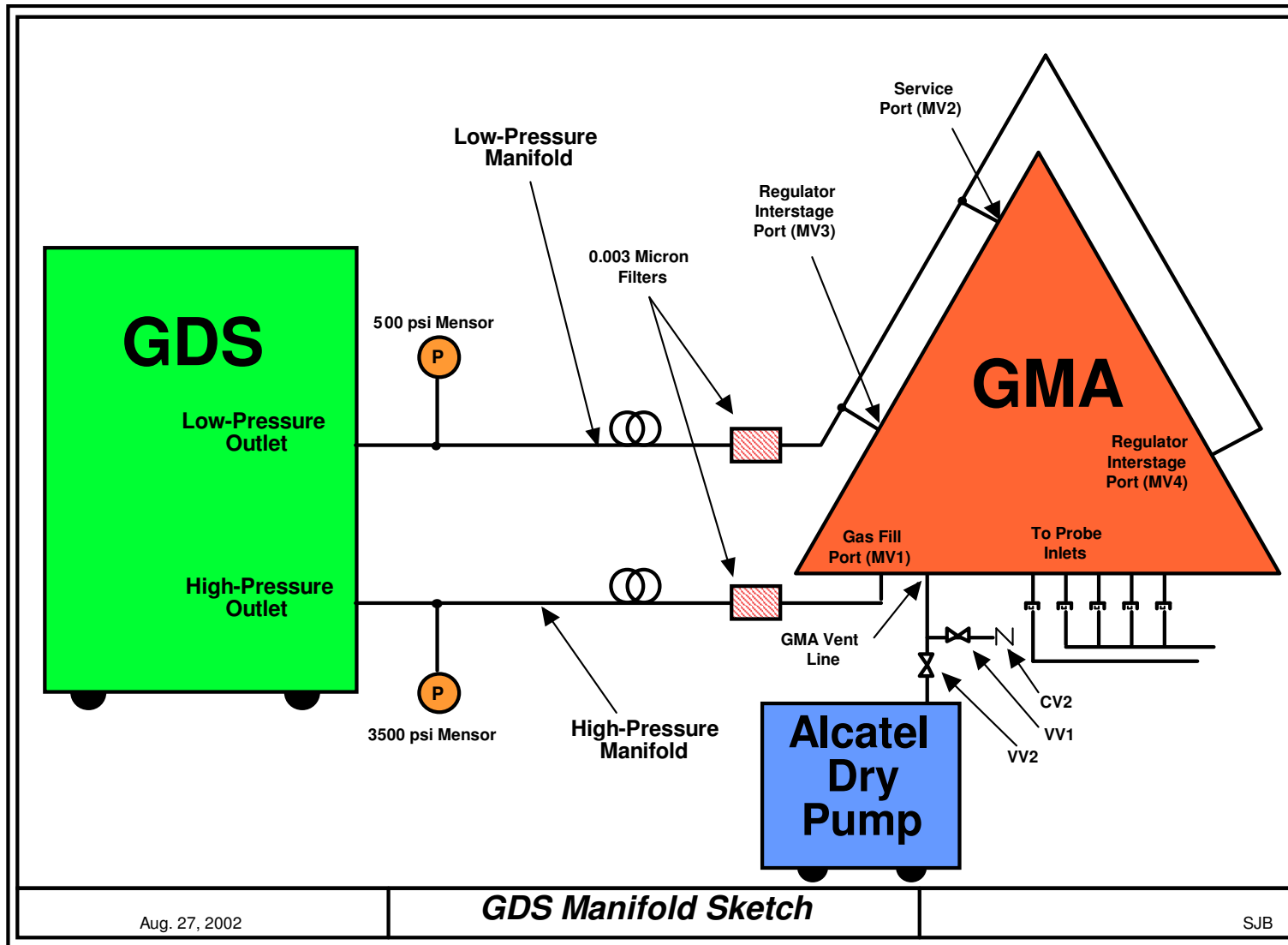


Figure 1

G.8. Diagrams

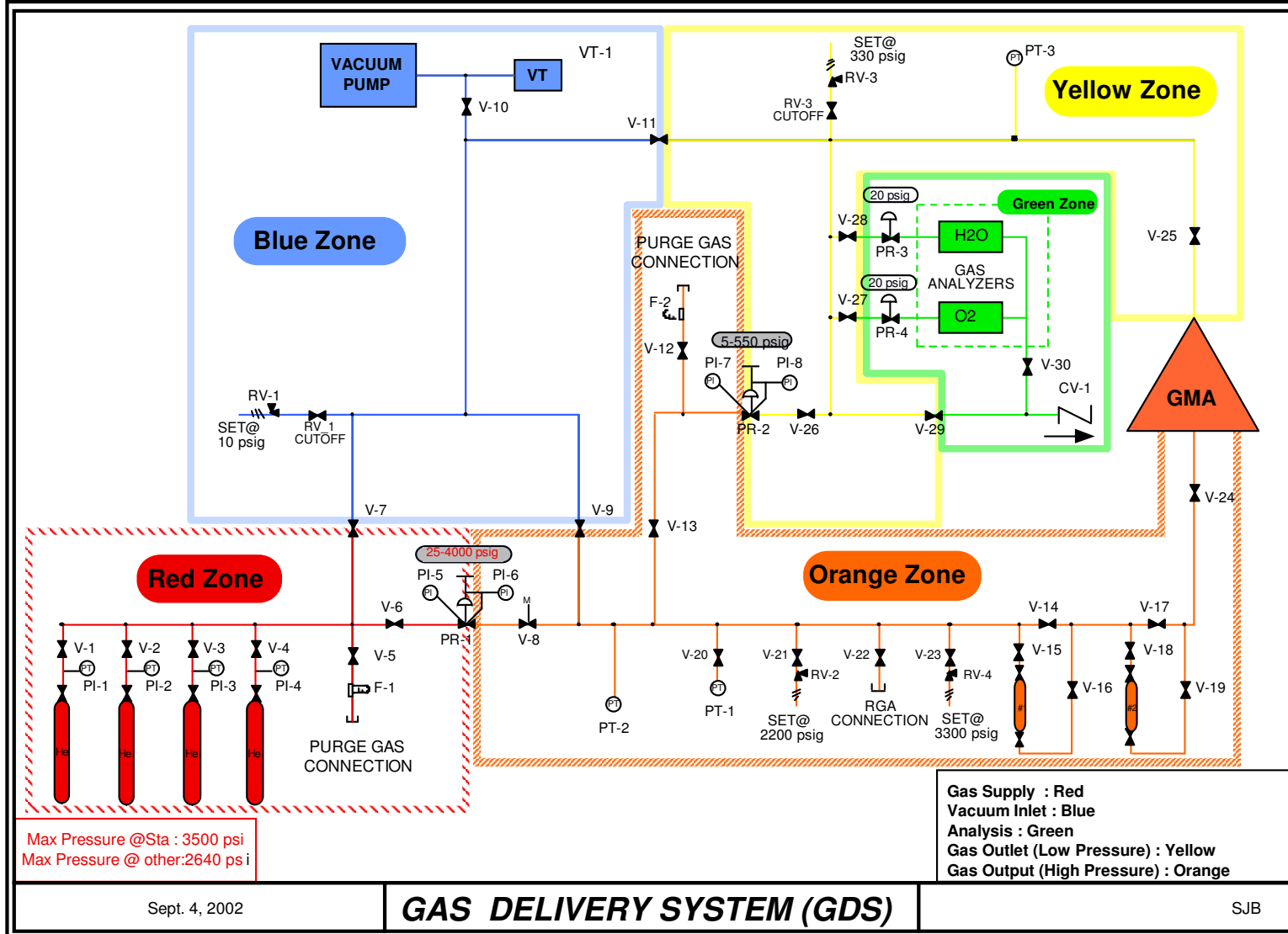
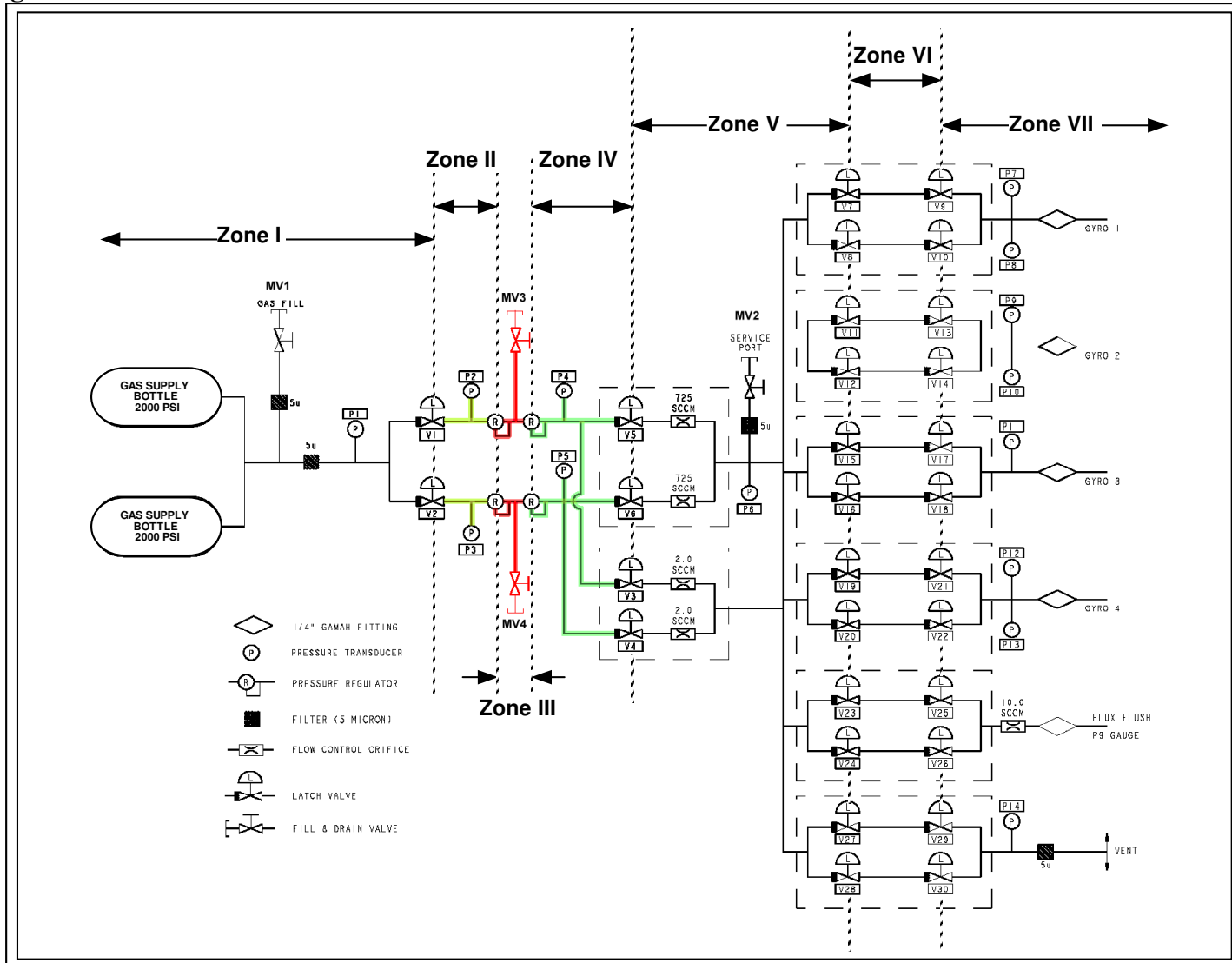


Figure 2

G.8. Diagrams



GMA Schematic
Figure 3

H

H.1 PROCEDURE COMPLETION

No.	Section	Task	Details	Final Pressure	Completed		QA Approval	Comments
					Date	Initial		
1	G.3	GDS leak test passed	Better than 1×10^{-8} sccs external leak rate					
2	G.5	GDS fill of GMA between V1 and R1 (Zone II)	Pressure @300 psia (-0/+50psi)					
3	G.5	GDS fill of GMA between V2 and R2 (Zone II)	Pressure @300 psia (-0/+50psi)					
4	G.5	GDS fill of GMA between R1 regulators (Zone III)	Pressure @300 psia (-0/+30psi)					
5	G.5	GDS fill of GMA between R2 regulators (Zone III)	Pressure @300 psia (-0/+30psi)					
6	G.5	GDS fill of GMA between V7/V8 and S1	Pressure @0 psia					
7	G.5	GDS fill of GMA between V11/V12 and S2	Pressure @0 psia					
8	G.5	GDS fill of GMA between V15/V16 and S3	Pressure @0 psia					
9	G.5	GDS fill of GMA between V19/V20 and S4	Pressure @0 psia					
10	G.5	GDS fill of GMA between V23/V24 and Probe	Pressure @0 psia					
11	G.5	GDS fill of GMA between V27/V28 and Vent	Pressure @0 psia					
12	G.5	GDS fill of GMA between R1 and V3/V5 (Zone IV)	Pressure @300 psia (-0/+30psi)					
13	G.5	GDS fill of GMA between R2 and V4/V6 (Zone IV)	Pressure @300 psia (-0/+30psi)					
14	G.5	GDS fill of GMA between V3 to V6 and V9/V10, V13/ V14..etc (Zone V)	Pressure @300 psia (-0/+30psi)					
15	G.6	GDS fill of GMA between gas supply bottles and V1/V2 (Zone I)	Pressure @1880 or designated _____ psia (-0/ +100psi)					
16	G.7	GDS backfilled with Helium	To 5 psig (-0/+5psi)					

H.2 Pressure Sensor Log

Sect: Step	Time	GMA Sensors Counts														Manifold Mensors		GDS		
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	500 psi	3500 psi	PT1	PT2	PT3

H.3 Procedure Sign Off

The results obtained in the performance of this procedure are acceptable:

_____ date: _____
Test Director/GMA Engineer

Discrepancies if any:

Approved: _____ date: _____
C. Gray, GMA REE

Approved: _____ date: _____
QA Representative

Approved: _____ date: _____
D. Ross, QA