W. W. Hansen Experimental Physics Laboratory

STANFORD UNIVERSITY

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Gravity Probe B Relativity Mission

Vibration/leak Test
2.5" and 6" Vatterfly Valves (3179 and 3223) spare units

GP-B Engineering Procedure
P0761 Rev.-

February 14, 2001

_____

Prepared by: C. Warren ,Test Director Date

Approved : L. Sokolsky LMMS Engineer Date

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Approved : R. Singley,Vatterfly REE Date

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Approved : D.Ross., Quality Assurance Date

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Approved : B. Muhlfelder, Program Technical Manager Date

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1 GENERAL DESCRIPTION

This Vibration/leak test will be done to prove no leak during lift off. The test will be done in Z axis for the 2.5" valve and the X axis for the 6.0" valve as shown in figure 2, the 2.5"valve showed some rattling during Previous vibration test. The test will be done with the valve covers on for maintaining cleanliness, keeping the probe side under vacuum and connected to a helium leak detector. The GSE side is back filled with 1 atmosphere of helium gas.

2 APPLICABLE DOCUMENTS

Document number	Rev	Title
3179	G	Drawing, Valve, Vacuum, 2.5"
3223	G	Drawing, Valve, Vacuum, 6.0
210127-01	-	Drawing, Random Vibration Fixture 2.5"
210126-01	-	Drawing, Random Vibration Fixture 6.0"
210121-01	B	Drawing, 2.5" Valve Cover, Upper
210122-01	C	Drawing, 2.5" Valve Cover, Lower
210123-01	B	Drawing, 6.0" Valve Cover, Upper
210124-01	C	Drawing, 6.0" Valve Cover, Lower

3 GENERAL INSTRUCTIONS

3.1.1 The Test Director (TD) shall be Chuck Warren 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 Vatterfly Valve REE shall also sign off the completed "As-Built" procedure.

3.1.2 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 C. Warren and /or R. Stephenson and L. Sokolsky.

3.1.3 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 retest of any or all of the hardware is necessary, the TD will determine the appropriate changes in the procedure, with the QA Manager's approval.

Do not break test configuration if a failure occurs. Notify QA

.

ONR representative, and QA to be notified 24 hours prior to beginning this procedure **SU QA_____time & date ONR_____time & date**

3.2 Red-line Authority

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

4 PARTS

4.1 Take Delivery of Parts from Bonded Stores

4.1.1 Accept the following parts from Stores:

Description	Part Number	Serial Number
2.5" Vatterfly valve (back up engineering unit)	3179	0001
6.0" Vatterfly valve (back up engineering unit)	3223	0002

4.2 Test Equipment

Item #	Qty.	Equipment	Model and Sn, or Part Number	Cal due date
1.	1 Ea.	Alcatel leak detector	ASM 180T ,	NA
2.	1 Ea.	Varian helium calibrated leak	F8473302, EBBC6015	1/25/02
3.	1 Ea.	Vatterfly Valve Test Manifold	NA	NA

4.3 Hardware

Item #	Qty.	Description	P/N / Size
1.	2 Ea.	Viton O-ring, 2.5	2-234
2.	2 Ea.	Viton O-ring, 6.0”	2-259
3.	12Ea.	Stainless steel washers	#10
4.	12 Ea.	Stainless steel socket head screws	10-32x1”lg
5.	4 Ea.	Stainless steel hex head bolts	¼-20x3.5”lg
6.	12 Ea.	Stainless steel washers	¼”
7.	8 Ea.	Stainless steel socket head bolts	¼-28x5/8”lg
8.	8 Ea.	Special stainless socket head bolts with 5/16 allen head	¼-20x 6” lg
9.	8 Ea.	Brass washers	1/2”
10.	6 Ea.	Stainless steel socket head bolts	10mm x 30mm lg
11.	6 Ea.	Stainless steel washers	3/8”
12.	2 Ea.	¼” stainless bellows	24” lg
13.	2 Ea.	1/2” stainless bellows	24” lg
14.	AR	¼” VCR gaskets	SS-4-VCR-2-GR
15.	AR	1/2” VCR gaskets	SS-8-VCR-2-GR
16.	1 Ea.	1/2” VCR male union	SS-8-VCR-6-DM
17.	1 Ea.	Adapter ½” male VCR to KF25	K100-VCR50
18.	1 Ea.	KF-25 centering ring	K100-CR
19.	1 Ea.	KF-25 clamp	K100-C
20.	16 Ea.	Stainless steel socket head bolts	3/8-16x1.5” lg.
21.	16 Ea.	Stainless steel washers	3/8”
22.	16 Ea.	Stainless steel lock washers	3/8”

4.4 Tools

Description	Size
Combination wrench	¾”
Combination wrench	5/8”
Combination wrench	7/16”
Allen wrench	3/16”
Allen wench	5/16”
Adjustable wrench	6”
Torque wrench	0 to 150 inch lbs., 3/8” drive
Socket	7/16”, 3/8” drive

5 RANDOM VIBRATION TEST OF VATTERFLY VALVES, 2.5" 3179 AND 6.0" 3223

5.1 Testing will be done either at Bell Technologies or at LMMS bldg. 181. Accelerations in the shake axis will be recorded at the fixture. See Figure 2 for sketch of test set-up.

5.2 Initial set-up and leak check of 2.5" and 6.0" valves for vibe/leak test.
(See figure 1)

5.2.1 Installation of 2.5" valve into upper and lower covers.

5.2.1.1 Install o-ring into groove in lower cover.

5.2.1.2 Place Vatterfly valve seal side down onto lower cover with motor housing opposite shutoff valve (V-2)

5.2.1.3 Secure Vatterfly valve to lower cover using 8 ea. ¼-28 x5/8" long stainless socket head bolts.

5.2.1.4 Install o-ring into groove in upper cover.

5.2.1.5 Place Vatterfly valve and lower cover assembly into upper cover with motor housing in cutout opposite shutoff valve (V-1).

5.2.1.6 Secure whole assembly with 6 ea. 10-32x1" long stainless socket head screws and washers.

5.2.2 Installation of 6.0" valve into upper and lower covers.

5.2.2.1 Install o-ring into groove in upper cover.

5.2.2.2 Place Vatterfly valve into upper cover with motor housing in cutout opposite shutoff valve(V-1).

5.2.2.3 Secure Vatterfly valve to upper cover using 6 ea. 8mm x 30mm long stainless bolts with washers.

5.2.2.4 Install o-ring into groove in lower cover.

5.2.2.5 Place Vatterfly valve and upper cover assembly onto lower cover with motor housing opposite shutoff valve (V-2).

5.2.2.6 Secure whole assembly with 6 ea. 10-32x1" long stainless socket head screws and washers.

5.2.3 Leak check and helium backfill of 2.5".

(See figure 1)

5.2.3.1 Start-up leak detector and calibrate as per manufacturer's instructions. After cal. record leak rate in table below.

Date/Time	Calibrated leak SN / leak rate (mbar l/sec) of helium	Calibrated leak cal. due date	Leak rate after cal. (mbar l/sec) of helium
/	EBBC6015/4.52E^{-8}	1-25-02	

5.2.3.2 Vent leak detector by pressing cycle switch and attach Vatterfly valve test manifold to leak detector using KF-25 centering ring and clamp.

5.2.3.3 Connect V-1and V-2 from Vatterfly valve to Vatterfly valve test manifold using 2 ea.¼"x24" lg. Bellows and 4 ea. ¼" VCR gaskets.

5.2.3.4 Attach helium gas supply to MV-3 on Vatterfly valve test manifold using ¼" polyflow tubing as required..

5.2.3.5 Close verify closed all valves.

5.2.3.6 Open valves MV-1, MV-2, V-1 and V-2 and start leak detector pumping by pressing the cycle button on leak detector.

5.2.3.7 When leak detector crosses over into fine leak test and leak rate is< 1E^{-7} mbar l/sec leak test all connections using helium spray method. When all connections are leak tight to <1E-7 mbar .l/sec close V-2, MV-3 and MV-2.

5.2.3.8 Open MV-3 and vent GSE side of Vatterfly valve to ~1/2 psi of helium gas and close MV-3.

5.2.3.9 Open MV-1 and MV-2 vent up to air by pushing cycle button on leak detector.

5.2.3.10 Disconnect Vatterfly valve test manifold from leak detector and Vatterfly valve

5.2.4 Leak check and helium backfill of 6.0".

(See figure 1)

5.2.4.1 Start-up leak detector and calibrate as per manufacturer's instructions. After cal. record leak rate in table below.

Date/Time	Calibrated leak SN / leak rate (mbar l/sec) of helium	Calibrated leak cal. due date	Leak rate after cal. mbar l/sec of helium
/	EBBC6015/4.52E^{-8}	1-25-02	

5.2.4.2 Vent leak detector by pressing cycle button and attach Vatterfly valve test manifold to leak detector using KF-25 centering and clamp.

5.2.4.3 Connect V-1and V-2 from Vatterfly valve to Vatterfly valve test manifold using 2 ea.¼"x24" lg. Bellows and 4 ea. ¼" VCR gaskets.

5.2.4.4 Close verify closed all valves.

5.2.4.5 Open valves MV-1, MV-2, V-1 and V-2 and start leak detector pumping by pressing the cycle button on leak detector.

5.2.4.5.1 When leak detector crosses over into fine leak test and leak rate is< 1E^{-7} mbar l/sec leak test all connections using helium spray method. When all connections are leak tight to <1E-7 mbar .l/sec close V-2, MV-2 and MV-1.

5.2.4.6 Open MV-3 and vent GSE side of Vatterfly valve to ~1/2 psi of helium gas and close MV-3.

5.2.4.7 Open MV-1 and MV-2 vent up to air by pushing cycle button on leak detector.

5.2.4.8 Disconnect Vatterfly valve test manifold and Vatterfly valve leak from leak detector.

QA (D. Ross or appointee) to attend testing _____

5.3 Z Axis Shake of 2.5" Vatterfly valve

(See figure 2)

5.3.1 Bolt 2.5" Vatterfly valve to fixture 210127-01 using 4 Ea. ¼-20 x 3.5" lg. Stainless steel hex head bolts and Torque to 90 in-lbs.
Date_____ Torque value _____in lbs.

5.3.2 Bolt 2.5" Vatterfly valve and fixture 210127-01 to shake table using 8 Ea. 3/8-16-1.5" lg. Stainless steel socket head bolts, and Torque to 25 ft-lbs.
Date_____ Torque value _____ft lbs.

5.3.3 Bond Z axis and redundant accelerometers to fixture.

5.3.4 Start-up leak detector and calibrate as per manufacturer's instructions. After cal. record leak rate in table below.

Date/Time	Calibrated leak SN / leak rate mbar l/sec of helium	Calibrated leak cal. due date	Leak rate after cal. (mbar l/sec) of helium
/	EBBC6015 / $3.38E^{-8}$	1-25-02	

5.3.5 Vent leak detector by pushing cycle button

5.3.6 Connect leak detector to V-2 with ½"x24"lg bellows and 2 ea. 1/2" VCR gaskets as shown in figure 2.

5.3.7 Open V-2 and start leak detector pumping by pushing cycle button on leak detector. When leak detector goes into fine leak test mode and stabilizes record leak rate _____mbar l/sec of helium.

5.3.8 Check leak rate at the probe side and record _____ mbar l/sec of helium.

5.3.9 Vibrate valve in Z direction to the required levels as shown in table below.

Z axis Random Vibration Spectrum

Frequency (Hz)	**Shake level (g^2/hz)**
20	0.008
50	0.05
800	0.05
2000	0.008
Composite (grms)	**7.9**

Duration: 60 seconds
Spec: ±3 dB, 20 hz to 2000 hz
RMS: ± 10%

5.3.10 Record leak rate every 20 sec in table below.

Time in seconds				
Leak Rate (mbar l/sec) of He				

5.3.11 The test failed only if there was a major leak that saturated the leak detector (> $1E^{-2}$ mbar l/sec of He). Spikes of leaks are O.K.

5.3.12 Remove valve from fixture.

5.3.13 Attach all plots and pictures of test set-up to back of procedure.

5.4 X Axis Shake of 6.0" Vatterfly valve

(See figure 2)

5.4.1 Bolt shake fixture 210126-01 to shake table using 16 Ea. 3/8-16-1.5" lg. Stainless steel hex head bolts, and Torque to 25 ft-lbs.
Date_____ Torque value _____ft lbs.

5.4.2 Bolt 6.0" Vatterfly valve to shake fixture 210127-01 using 4 Ea. ¼-20 x 3.5" lg. Stainless steel hex head bolts, and Torque to 90 in-lbs.
Date_____ Torque value _____in lbs.

5.4.3 Bond Z axis and redundant accelerometers to fixture.

5.4.4 Start-up leak detector and calibrate as per manufacturer's instructions. After cal. record leak rate in table below.

Date/Time	Calibrated leak SN / leak rate (mbar l/sec) of helium	Calibrated leak cal. due date	Leak rate after cal. (mbar l/sec) of helium
/	EBBC6015 / $3.38E^{-8}$	1-25-02	

5.4.5 Vent leak detector by pushing cycle button

5.4.6 Connect leak detector to V-2 with ½"x24"lg bellows and 2 ea. 1/2" VCR gaskets as shown in figure 2.

5.4.7 Open V-2 and start leak detector pumping by pushing cycle button on leak detector. When leak detector goes into fine leak test mode and stabilizes record leak rate _____mbar l/sec of helium.

5.4.8 Check leak rate at the probe side and record _____ mbar l/sec of helium.

5.4.9 Vibrate Vatterfly valve in X-axis to the required levels as shown in table below.

X axis Random Vibration Spectrum

Frequency (Hz)	Shake level (g^2/Hz)
20	0.008
50	0.05
800	0.05
2000	0.008
Composite (grms)	**7.9**

Duration: 60 seconds
Spec: ±3 dB, 20 Hz to 2000 Hz
RMS: ± 10%

5.4.10 Record leak rate every 20 sec in table below.

Time in seconds				
Leak Rate (mbar l/sec) He				

5.4.11 The test failed only if there was a major leak that saturated the leak detector (>$1E^{-2}$ mbar l/sec of He) Spikes of leaks are O.K.

5.4.12 Remove valve from fixture

5.4.13 Attach all plots and pictures of test set-up to back of procedure.

Figure 1
Vatterfly vibe/leak test setup

6.0" or 2.5" Valve

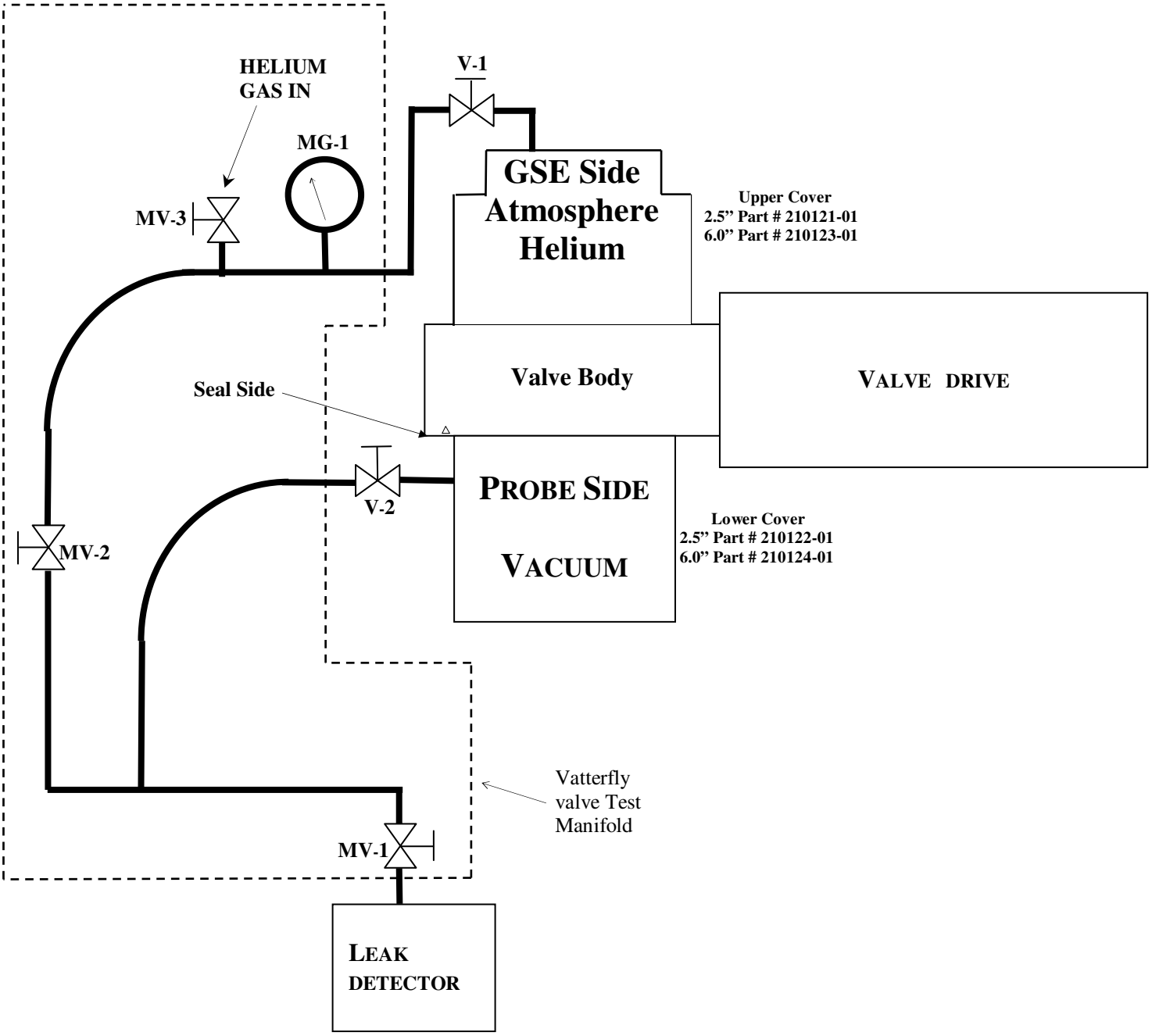
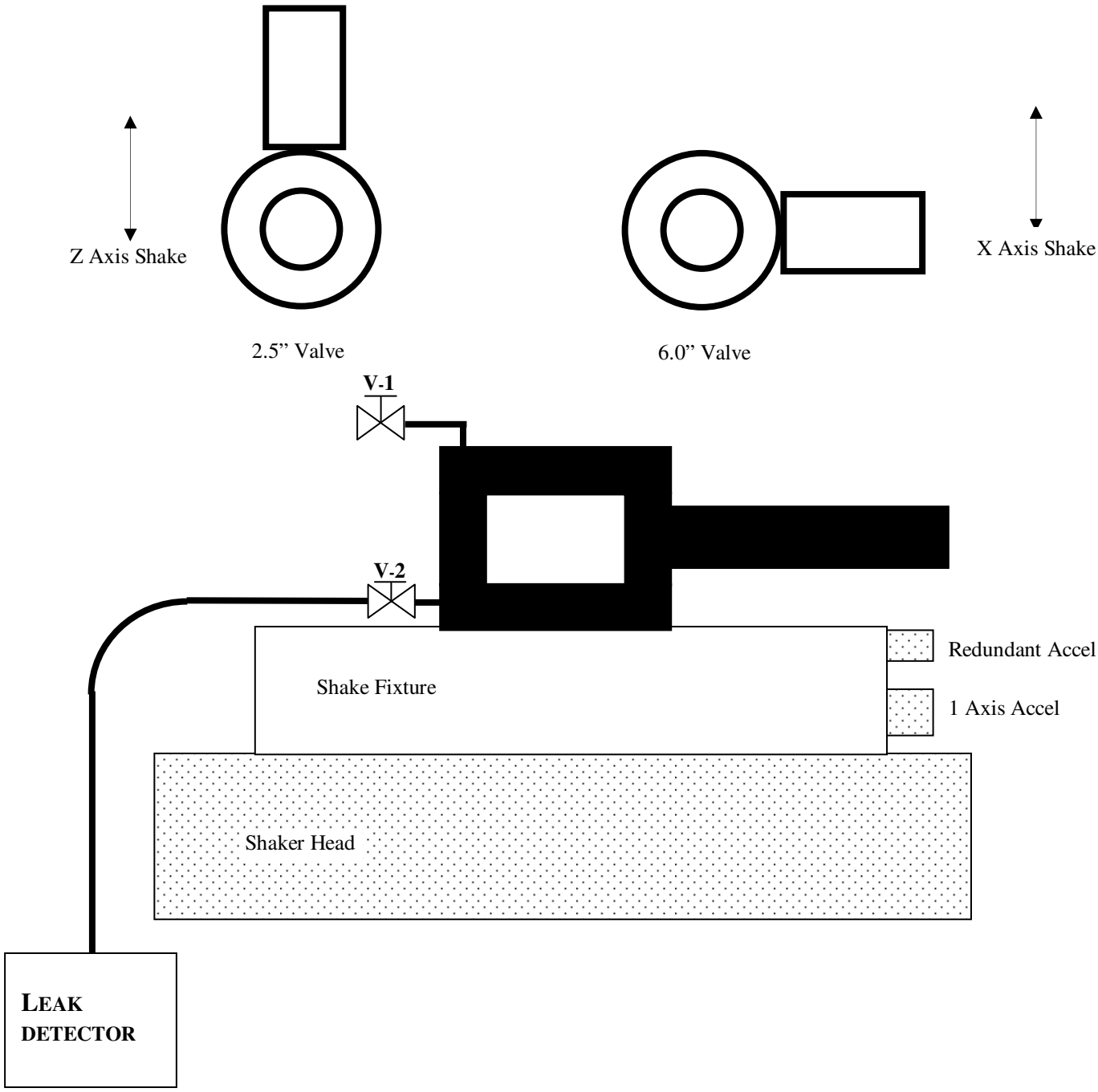


Figure 2
2.5” \ 6.0” Valve Shake test setup



6 PROCEDURE COMPLETION

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

Operation completed.

_____ Date: _____
Completed by

_____ Date: _____
Q.A representative

Time: _____

Discrepancies if any:

Approved: _____ Date: _____
R. Singley Vatterfly REE

Approved: _____ Date: _____
D. Ross, QA Manager

7 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 Vatterfly valve and their components