GRAVITY PROBE-B

TEST PROCEDURE

POST PROBE REMOVAL FROM SCIENCE MISSION DEWAR

January 6, 2000

Originator:
D. Murray

Approval:

Mike Taber GP-B Payload Test Director	Date	Dave Murray Cryogenic Test Director	Date
Dorrene Ross GP-B Quality Assurance	Date	John Janicki Lockheed Safety Engineer	Date
Sasha Buchman GP-B Program Manager	Date		

REVISION	PAGES	DATE/ APPROVALS
Original	All	30 JAN 1995

ABBREVIATIONS

xxP	Kit number xx of P type kits (ref. SU GP-B P0141)
ALSP	Airlock Support Plate
ALSPV	Airlock Support Plate Valve
ATC	Advanced Technology Center (at LMMS)
AWG	American Wire Gauge
Cryoperm	Trade name for cryogenic magnetic shielding
CT	Cooling Tube
CTE	Cryogenic Test Engineer
DAS	Data Acquisition System
DEV-xx	Dewar Exhaust Valve number xx
DVM	Digital Volt Meter
EEBA	Emergency Evacuation Breathing Apparatus
EG-xx	Gas Module Exhaust Gauge number xx
EVRx	Gas Module Relief Valve number x
GHe	Gaseous Helium
GP-B	Gravity Probe-B program (also, Relativity Mission)
GRT	Germanium Resistance Thermometer
GSE	Ground Support Equipment
GTU-2	Ground Test Unit number 2
L.D.	Leak Detector
LLS	Liquid Level Sensor
LMMS	Lockheed Martin Missiles and Space
LN_2	Liquid Nitrogen
mG	milli Gauss
MHZ	Megahertz
NPB	Normal Boiling Point
Ozsi	Ounces per square inch
PPS	Programmable Power Supply
PWx	Well Pressure gauge x
QD	Quick Disconnect - O-ring seal under screw down cap
RCM	Rotating Coil Magnetometer
sccs	Standard cubic centimeters per second
SMD	Science Mission Dewar (of GP-B , Relativity Mission program)
SU	Stanford University
TAO	Thermal Acoustic Oscillation
TM xx	Task Module number xx.
VMA	Valve of Mini-Airlock
UTS	Utility Turbo pumping Station
VSx	Valve number x on Shutter
VW-1	Valve on Dewar Adapter connecting Well to outside

Table of Contents

1 SCOPE

This procedure describes the steps necessary to effect the removal of Probe-C from the Assembly Stand and the preparation and moving of the Probe to the GP-B HEPL clean room.

See Figure 1 for the Post Probe Removal Flow Diagram.

2 REFERENCE DOCUMENTS

2.1 Procedures:

Procedure No.	Title
P0136	Probe-B Removal from Dewar
P0141	FIST Emergency Procedures

2.2 Drawings:

Lockheed Dwg No.	Title
None	

3 Figures

Fig. 1 Test Flow for Probe Insertion

3.1 Supporting documentation

3.1.1 GP-B Magnetic Control Plan, LMMS-5835031

3.1.2 SMD Safety Compliance Assessment, LMMS GPB-100153C

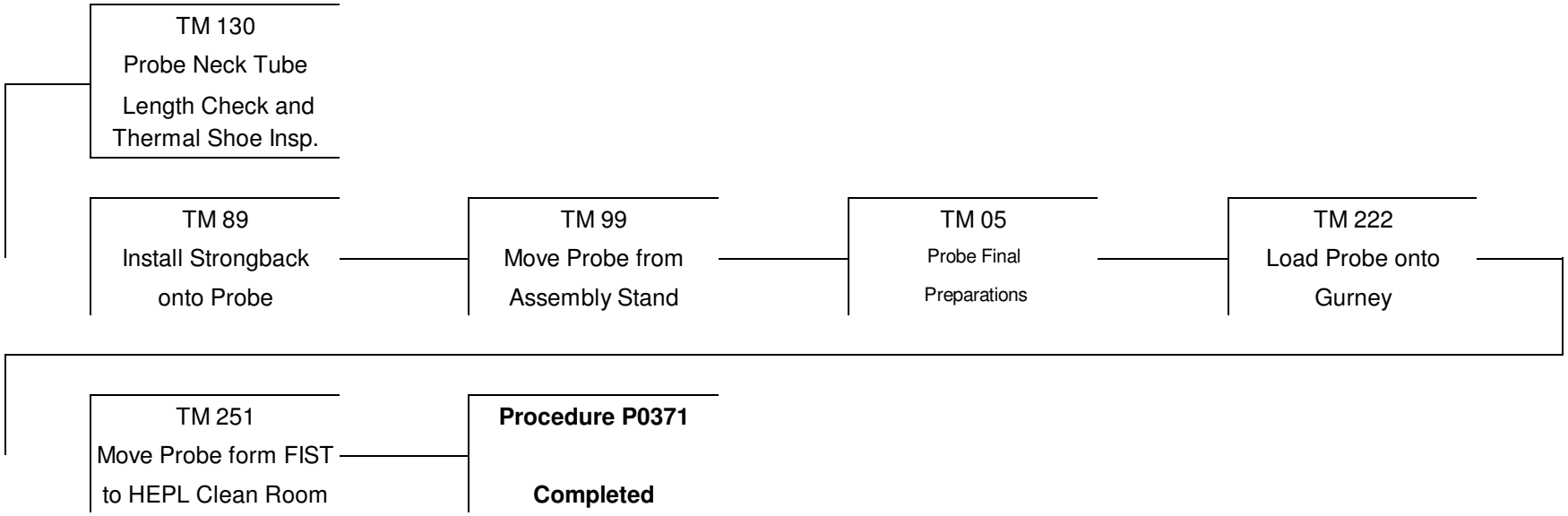
3.1.4 SM Dewar FMECA, LMMS GPB-100333

3.1.5 FIST Emergency Procedures SU/GP-B P0141

3.1.6 Probe/Dewar Hardware Kit List, SU/GP-B P0144

3.1.7 SMD Final Assembly, LMMS 5833500

TEST FLOW CHART
PROBE-B REMOVAL FROM SMD - P0371



3 SAFETY

3.1 General

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware (e.g. positioning of Dewar in tilt stand; integration of probe into airlock; integration of airlock/probe onto Dewar; removal of airlock from Dewar; removal of probe from Dewar); and during positioning of support equipment (e.g. pressurized gas cylinders; supply dewars).

Undesired events associated with these operations include: (1) Personnel or other objects are struck (e.g. by forklift or crane load) when hardware is being moved . (2) Personnel who are positioning hardware get their hands or feet caught between objects as hardware is moved into place. (3) Suspended hardware is dropped. (4) Personnel who are present during hardware movements (e.g. by forklift; crane) are caught between objects (e.g. forklifts and walls; loads and building support columns).

3.2 Lifting operations

The following Paras. apply to lifting operations.

3.2.1 The following equipment shall be available to and used by personnel working around elevated working platforms:
- a) Hardhats.
- b) Safety glasses.

3.2.2 Hoisting equipment operators shall be trained and qualified in the safe operation of all lifting equipment employed. They shall be competent in rigging lifting hardware. It is the responsibility of these individuals to ensure proper lifting configuration, based upon a review of procedures, drawings, training and experience.

3.2.3 Movements shall be verbally rehearsed before performing them.

3.2.4 All personnel in the area of hoisting operations shall wear hard hats.

3.2.5 Spotters shall be used as required. The crane operator and spotters shall agree upon and use a standard safety signal system prior to the start of any lifting operation.

3.2.6 Personnel who are positioning hardware shall use extreme caution so that they don't get their fingers pinched between the load and other objects.

3.2.7 Standard rigging fittings and lifting devices specially designed for the specific task shall be used at all times for hoisting material and equipment. The use of C-clamps, mild steel bolts and non-shouldered eye bolts are prohibited for use as rigging fittings.

3.2.8 Safety hoist ring bolts shall be tightened to the torque value indicated on the safety hoist rings. Safety hoist rings shall not be modified in any manner. The use of substitute parts is expressly prohibited. Only those replacement or exchange parts recommended by the manufacturer are authorized.

3.2.9 The hoist operator shall visually inspect accessory hoisting equipment for damage or defects prior to each use. Particular attention shall be paid to the condition of slings (e.g. broken wires, fraying, excessive wear, abrasions, kinks, deformation, cracks, etc.). Equipment found to be defective shall be immediately removed from service and reported to the supervisor.

3.2.10 The hoist operator shall inspect cranes, hoists and all other primary lifting equipment each day before the initial use and before any critical lifting operation as specified by procedure. He shall perform a hoist checkout, or verify one has been performed that day.

3.2.11 The hoist operator shall be responsible for the rigging of each lifting operation called out in each procedure. The lifting sling, attachment, etc., shall be selected from P0144, Probe/Dewar Hardware Kit List.

3.2.12 The hoist operator shall be responsible for the safety of all lifting operations.

3.3 Injuries

In case of any injuries adhere to the following:

3.3.1 Obtain medical treatment. **Call 9-911**

3.3.2 Notify Test Director, Mike Taber, telephone **54136** or beeper **(9) 599-8033**

3.4 Liquid Helium Dump

Certain failure modes of the SMD can lead to a rapid dump of liquid/gaseous helium into the room. The following precautions will minimize possibly injury to personnel.

3.4.1 Non-flight diverters (90-deg elbows) are to be attached to the outboard flange of the two Main Tank and two Vacuum Enclosure burst disk assemblies. These diverters shall be positioned to direct the potential helium flow to the floor (or other designated safe dump area).

3.4.2 When the diverters are directed to the floor, drip pans shall be placed under them to prevent liquid oxygen collection on the floor.

3.4.3 In the case of a fast helium dump the oxygen concentration may be lowered below a safe level (19.5%). In this case an oxygen concentration sensor mounted on the west wall will sound an alarm. All personnel shall immediately exit the FIST Operations room.

3.5 Genie Operations

Work at the top of the Airlock after it has been integrated with the SMD requires the use of Genie personnel lifts. The following steps shall be used whenever the Genie lifts are employed.

3.5.1 Before raising the Genie ensure the four outriggers (or floor anchors) have been installed and locked and the leveling jacks have been adjusted to firmly touch the floor and the base is level.

3.5.2 Do not adjust outriggers or reposition the machine while the platform is raised.

3.5.3 No work should be performed by leaning out over the rails.

3.5.4 Only two persons shall work at the top of the Airlock at a time.

3.5.5 One of the two Genie lifts will be left at the top of the scaffolding at all times and used only if a need for rapid exiting of personnel working top side. This would be the occasion if a fast liquid helium dump whether or not the oxygen concentration alarm has started or not.

3.5.6 Those working at the top of the Airlock shall each have ready access to an EEBA (Emergency Evacuation Breathing Apparatus) to be used for evacuating the room in case of a sudden dump of the helium cryogen and resultant depletion in oxygen concentration in the room.

3.5.7 Those working at the top of the Airlock shall have been certified trained to use an EEBA and been medically OKed to use an EEBA.

3.6 Safety

The SMD Safety Compliance Assessment, LMMS GP-B 1000153C, discusses the safety design, operating and maintenance requirements of the SMD. This document should be reviewed for applicability at any facility where the hardware is operated.

3.7 Hazards Analysis

The GP-B SMD FMECA, LMMS GP-B 100333, discusses hazards inherent in ACT-developed SMD hardware in detail.

3.8 Emergency Procedures

The FIST Emergency Procedures, SU/GP-B P0141, sets forth the procedures to be taken in case of facility power loss, arming and disarming the FIST alarm system and safeing of equipment in case of a sudden loss of liquid helium from the Dewar.

4 TEST PERSONNEL

4.1 Personnel Qualifications:

The test director is the designated signer for the "witnessed by" sign offs located at the end of each procedure/task module. The CTE who performs the operation is to sign the "completed by" sign off.

4.2 Qualification of Personnel:

The Test Director must have a detailed understanding of all procedures and facility operations and experience in all of the Probe insertion operations.

The Cryogenic Test Engineers must have Probe/FIST operations experience and an understanding of the operations and procedures used for the cryogenic servicing/maintenance of the Dewar.

At present (November 1997) the personnel who qualify for the above categories are:

Test Director:	Mike Taber	Stanford University
	Dave Murray[1]	Lockheed
Cryogenic Test Engineer:	Tom Welsh[1]	Lockheed
	Jim Maddock	Stanford University
	Dean Read	Lockheed
	Chuck Warren	Stanford University
	Mike Taber	Stanford University
	Dave Murray[1]	Lockheed
	Chris Gray	Stanford University
Responsible Safety Eng.		
	John Janicki	Lockheed
	Mike Jeung-Wesoloski	Lockheed

4.3 Critical Operations Review

At the start of this procedure and before any test procedures have been initiated an operations review meeting will be held with all personnel in attendance who have been assigned or who could be assigned (on a replacement basis) responsibilities. This meeting will cover the following:

3) Crane main breaker switch

4) Review the ground rules for Genie personnel lift operations per Para. 3.3

5) Open discussion to cover all suggestions/concerns of test personnel.

5 Quality Assurance

A Quality Assurance Representative, designated by D. Ross shall be present during the procedure and shall review any discrepancies noted and approve their disposition. Any redlines made to this procedure shall be initialed by a program RQE prior to his/her final sign off. All discrepancies, nonconformance or test anomaly, will be recorded in a D-log or as a DR per Quality Plan P0108.

Notification shall be given to RQE and the ONR representative 24 hours before start of this procedure.

6 Redline Authority

The persons authorized to create and sign-off on redline modifications of the procedure as it is performed are the test directors, M. Taber and D. Murray. The redlines will be reviewed and approved by the RQE and ,as appropraiate, the RSE during or after the performance of the redline.

7 Operations

7.1 Test Director for this Procedure is: _____ .

Starting Date & Time: _____ .

7.2 Verify that the Critical Operations Review meeting of Para. 4.3 has been completed and that all applicable personnel have attended or been briefed of the results.

7.3 Verify RQE and RSE have been notified 24 hours before start of this procedure.

7.4 Verify Completion of procedure P0135, Remove Probe from Dewar.

7.5 Disconnect and remove/verify removed all Suspension, SQUID readout, and electronics from Probe.

7.6 Perform, in sequence, the following Task Modules:

Task Modules for Post Probe Insertion						
Para. No.	Task Module	Op. No.	Started		Completed	
			Date	Time	Date	Time
7.6.1	Task Module 130: Probe Neck Tube Length Check and Thermal Shoe Inspection					
7.6.2	Task Module 89: Install Strongback onto Probe in Assembly Stand					
7.6.3	Task Module 99: Move Probe from Assembly Stand					
7.6.4	Task Module 06 Probe Final Preparations - Case 3					
7.6.5	Task Module 222: Loading Probe onto Gurney					
7.6.6	Task Module 251: Moving Probe from FIST to Clean Room					

8 Probe removal from Dewar complete.

Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

APPENDIX A

TASK MODULES

FOR

PROCEDURE P0371

Task Module 130: Probe Neck Tube Length Check and Thermal Shoe Inspection

Operations Number
Date Initiated
Time Initiated

A SCOPE

A.1 This module effects the removal of the Probe Strongback and the setting and spacing verification of the three BPS (Bellville Pre-load System) mounted on the Probe Flange. It also effects the verification of the installation/alignment of the thermal shoes.

B GENERAL REQUIREMENTS

B.1 Magnetic screened tools, obtained from non-magnetic tool box are used for all components which will be integrated into the SMD Well.

B.2 All O-rings installed shall be visually inspected, cleaned with alcohol as required and installed dry.

C CONFIGURATION REQUIREMENTS

C.1 The successful completion of the Task Module 86: Connect Cables and Balance Probe/Piston.

D HARDWARE REQUIRED

D.1 Hardware installed/used:

a) BeCu Hinged Collar
b) BPS Adjustment Tool (Dwg. SK022895)

D.2 Hardware removed:

a) Strongback
b) Strongback screws, Kits 22Ga, 22Gb, 22Gc and 22Gd

D.3 Tools required
a) General hand tools
b) 7/16 nonmagnetic allen wrench (nonmagnetic)
c) 3/16 allen wrench (nonmagnetic)
d) 3/8 end wrench (nonmagnetic)
e) 36-in vernier caliper
f) bubble level with magnetic base
g) 6-in dial caliper
h) Thermal Shoe gauging tool (Tool #526B, per SK-338)

E REFERENCES:

1. GP-B Magnetic Control Plan, LMMS 5835031
2. LMMS Drawing 5813395, SMD External plumbing
3. LMMS Drawing 5813396, SMD Plumbing Schematic
4. LMMS 5813353, Helium Airlock Assembly
5. LMMS 5823341, Helium Airlock Installation
6. LMMS Dwg. SK-338
7. LMMS Dwg. SK-022895
8. LMMS Engineering Memo SMS258

F OPERATIONS

1 Aligning Probe Vertical:

1.1 Remove/verify removed the Vacuum Shell Brace.

1.2 Use a machinist level held on vacuum shell to check Probe vertical alignment and record:

x-axis _____ deg; y-axis _____ deg

1.3 **If alignment is more than 1-deg from vertical then correct as follows:**

1.3.1 ❒ Alignment is better than 1-deg; skip this section.

1.3.2 Back off vertical jack screws.

1.3.3 Adjust four Spherical nuts to make Probe vertical.

1.3.4 Snug vertical Jacking Screws on their seats.

1.3.5 Final alignment:

x-axis _____ y-axis

1.3.6 Snug Vertical Jack Screws.

2 Measuring the Probe Neck Tube Length:

2.1. Install/verify installed the BeCu collar ring on probe Axial Lock dog slots as shown in Fig. TM130-1.

2.2 Remove/verify removed the Vacuum Shell Restrainer.

2.3 Remove/verify removed any plastic clean room covering from the vacuum shell.

2.4 Install Load Stop Adjustment Tool (Dwg. SK032898) onto the indium coated probe Station 200 surface using three 3-in C-clamps between the Tool and the BeCu collar. See Fig. TM130-1. Locate the C-clamps at the axial lock dogging positions (to minimize the possibility of contacting the Probe with the C-clamps), and use only light clamping pressure so as to not distort the tool.

2.5 Record the measurements made at three locations as measurement No. 1 in the table below (the number of the BPS is the same as the closest axial lock location).

NOTE

This measurement is best accomplished with a 36-in vernier caliper:

a) Attach a magnetic bubble level to the side of the caliper.

b) The upper inside caliper jaw is fully inserted below the top of the Top Hat Flange (at the azimuthal location of one of the BPSs) and the tip of the bottom inside jaw is engaged with the top surface of the BPS Adjustment Tool.

c) Ensure that the caliper is vertical and parallel to the probe axis when making a measurement.

d) The vernier movable jaw should be locked with the set screw before removing for a reading as the jaw will not stay correctly aligned when not locked.

	Location No. 1		Location No. 2		Location No. 3	
Description of Location	Between -X & -Y		Near +X		Near +Y	
Present Caliper meas.						
Caliper meas. from P0133						
Requirement.(1)	-	34.833	-	34.833	-	34.833
Difference between meas.						

1. Ref 8; LMMS EMO SMS258. Dimension was increased by .006-in. relative to Probe-C fit check to compensate for added weight (~80 lb.) of the Quartz Block.

3 Adjusting BPS:

3.1 Indicate if BPSs are to be adjusted:
- ❒ Yes, adjust BPS
- ❒ No adjustment: record BPS load cell readings in Table TM130-1 and go to para. 3

3.1.1 Record BPS load cell readings in Table TM130-1 as the adjustments proceed.

3.1.2 Adjust caliper to desired setting.

3.1.3 If the spacing is currently too short, adjust all BPS adjustment nuts uniformly (½-turn at a time) to give a too large spacing (i.e., to make the Probe slightly longer than the desired length).

3.1.4 While one person holds the caliper vertical (using a magnetic bubble level) and in the measurement position a second person adjusts the nut such that the flanges just touch the caliper jaws.

3.1.5 Repeat for other two BPS adjustment nuts.

3.1.6 Repeat measurements of Para. 3.2 and record the results in the Table TM130-1.

3.1.7 If necessary, make fine adjustments on the BPS adjusting nuts to bring spacing into tolerance and repeat the measurements of Para. 3.2. Record the final results in the table.

Table TM130-1 Load Cell Readings

Location	No. 1 Between -X & -Y		No. 2 Near +X		No. 3 Near +Y		Comment
Time	Load Cell	Cal. meas.	Load Cell	Cal. meas	Load Cell	Cal. meas.	

	(lbs)	(in.)	(lbs)	(in.)	(lbs)	(in.)	

4 Measure load stop settings:

4.1 Using a pin or feeler gauge of nominal 0.050-in determine the correct spacing of the lower Load Stop nut (3 places).

4.2 Record values found in Table below.

4.3 Using a 6" dial caliper, measure the spacing of each of the lower Load Stop tabs and Top Hat flange and record:

	Location No. 1		Location No. 2		Location No. 3	
Description. of Location	Between -X* & -Y*		Near +X*		Near +Y*	
	Pin Gauge	Caliper	Pin Gauge	Caliper	Pin Gauge	Caliper
Previously meas. values (See P0133)						
Present measured value						

4.4 Inspect the BPS and load cell wiring for all BPS units to insure that the wires have not been damaged during probe insertion and removal or by the Belleville washers.

4.5 Inspect wiring at the top of the vacuum Shell to ensure that it has not been damage. Record observations: _____

_____ .

5 Remove the Load Stop adjustment tooling installed in Para. 2

CAUTION

Care must be exercised in the following step to avoid damaging the electrical leads to thermometers located on the bottom side of the Thermal Shoe Rings in the vicinity of the -X axis.

5.1 Remove/verify removed the Vacuum Shell Restrainer.

5.2 Loosen the three C-clamps holding the tool to Station 200.

5.3 Remove the C-clamps and carefully remove the tool down and off the vacuum shell.

5.4 Install the Vacuum Shell Brace.

6 Verifying the Thermal Shoe settings:

6.1 Inspect each thermal Shoe and verify the flexure pivot mechanism is free to move and not damaged. Record results in TM130-2.

6.2 No adjustment is to be made of the Thermal Shoes at this time.

7 Task Module 34 completed.

Completed by:
Witnessed by:
Date:
Time:
RQE sign off :

Table TM130-2 Thermal Shoe Adjustment

Position(1)	Flex Pivot Check	Comments
HEX-1 1		
2		
3		
4		

5		
6		
HEX-2 1		
2		
3		
4		
5		
6		
HEX-3 1		
2		
3		
4		
5		
6		
HEX-4 1		
2		
3		
4		
5		
6		

1. Thermal shoe 1 is closest to +X axis in CCW (+Z rotation) direction and 2 is next CCW shoe, etc.

Figure TM130-1 Probe Length Adjustment Schematic

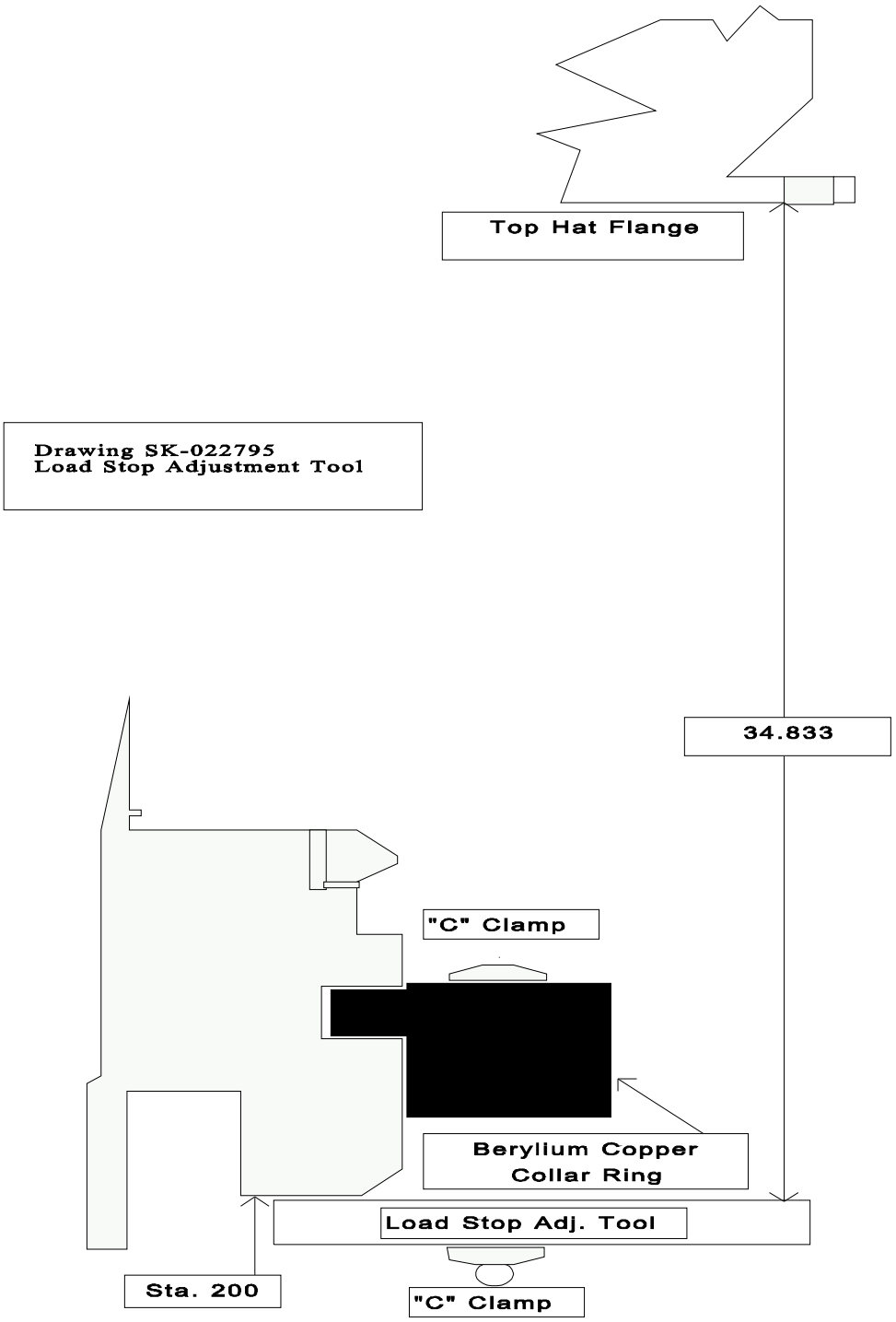


Figure TM130-2 Thermal Shoe Nominal Dimensions

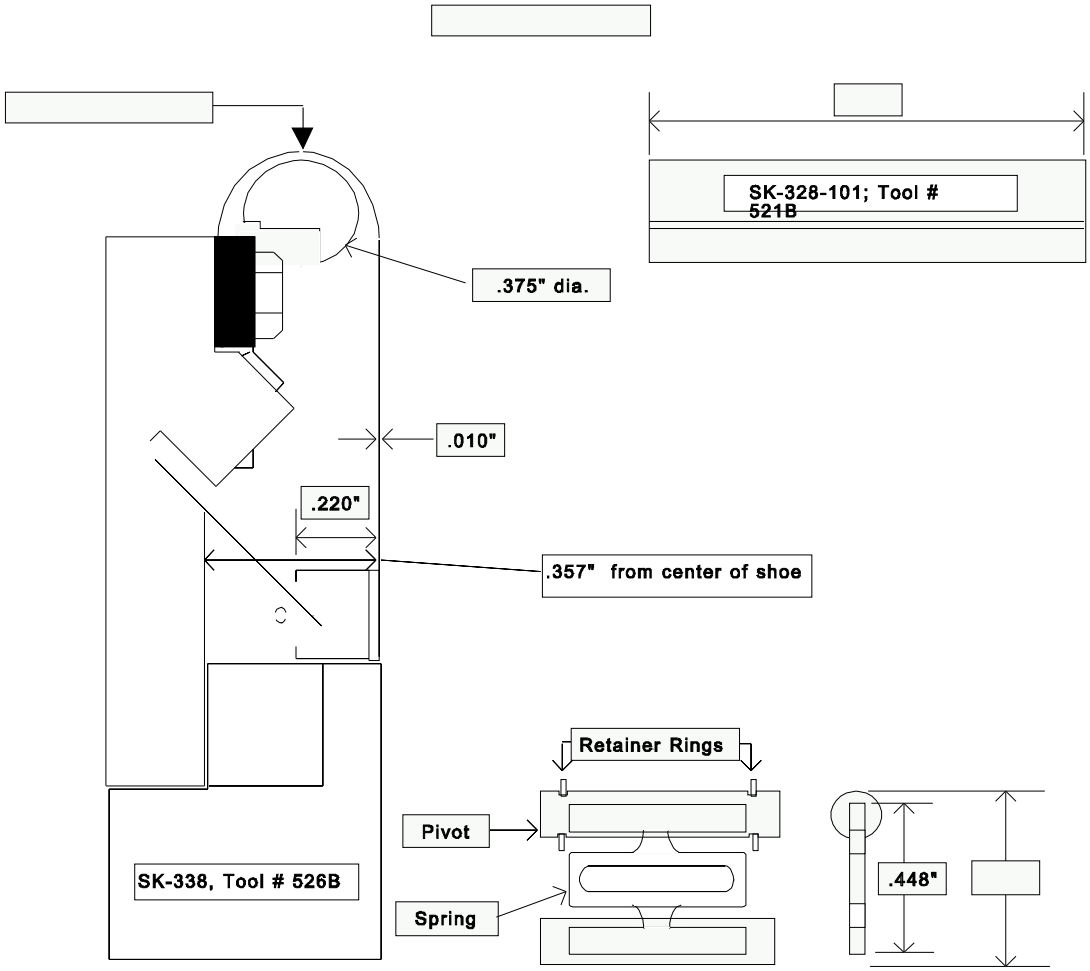


Fig TM130-3 BPS/Probe/Load Stop Schematic

Operations Number
Date Initiated
Time Initiated

H SCOPE

H.1 This module effects the installing of the Strongback and the securing of the Probe into the Yoke.

I GENERAL REQUIREMENTS

I.1 Magnetic screened tools, obtained from non-magnetic tool box are used for all open-well operations. Magnetic Zone SP, black marking (shrink tubing), is to be assumed,

I.2 All O-rings installed shall be visually inspected, cleaned with alcohol as required and installed dry.

J CONFIGURATION REQUIREMENTS

J.1 Probe installed on Assembly Stand.

J.2 The Genie has the Probe support Yoke installed.

K HARDWARE REQUIRED

K.1 Hardware installed/used:

a) Kits installed: 6G, 7G

b) Kits Removed: 4G, 5G, 10G, and 16G

c) Strongback fasteners:

Kit	Description	No.	Use
22G a	1/4-28x.875 Hex head CRES bolts, washers & nuts	14	Strongback longitudinal fasteners, type 1
22G b	1/4-28x.875 socket head CRES bolts, washers & nuts	2	Strongback longitudinal fasteners, type 2
22Gc	1/4-28x0.5 CRES bolts & washers	15	Strongback top axial fasteners
22G d	1/4-28x1 Hex head CRES bolts, washers & spherical nuts	15	Strongback bottom axial fasteners

K.2 Tools required
a) 7/16-in wrench
b) 5/16 and 7/16 open end wrench
c) 9/16-in open end wrench
d) Torque wrench

L Operations

1 Preparing the Probe Strongback:

1.1 Remove/verify removed the 16 each nuts, bolts and washers from the Strongback Assembly two longitudinal flanges. (Hold this hardware in bag marked kit no.6G for further use.)

1.2 Back out as far as possible the bottom axial bolts, Kit 22Gd, (see Fig. 1) to position the spherical nuts against the strongback flange and with approximately 1/4-in of bolt showing above the spherical nut.

1.3 At the bottom end of the Strongback there are 12 radial bolts which serve to move and hold 12 V-blocks against a circular V-way on the Station 200 Ring of the Probe. Back all of these radial bolts outward until the V-blocks will not follow the bolts.

1.4 Verify that each V-block is oriented so that they are in line with the Probe V-way.

1.5 Record the BPS load cell values:

Load Cell	No. 1	No. 2	No. 3
Location	Between -X & -Y	Near +X	Near +Y
Load Cell (lbs)			

2 Installing the Probe Strongback:

2.1 Position one half of the Strongback directly around the Composite Neck Tube with the axial bolt spherical nuts against the Top Hat flange.

2.2 Install loosely two of the 0.5-in axial bolts to the spherical nuts to support the Strongback half.

NOTE:
Ensure the Strongback mating dowel pins are lined up when doing the following steps.

2.3 While holding the first Strongback half in place, mate the other half shell and support by loosely installing two of the axial support bolt mechanisms.

2.4 Engage the Strongback mating dowel pins and insert and hand tighten four each bolts, nuts, and washers of Kit 22Ga through each Strongback longitudinal flange to hold Strongback Assembly together.

2.5 Loosely assemble all 15 axial support bolt and nut combinations to the Top Hat flange.

2.6 Engage the Radial V-blocks with the V-way on Station 200.

2.7 Hand tighten the 12 radial bolts evenly and sequentially.

2.8 Insert the 10 remaining, nuts, and washers of Kit 22Ga which serve to fasten the Strongback halves together.

2.9 Insert and hand tighten the 2 longitudinal support bolts of Kit 22Gb.

2.10 Torque all longitudinal bolts to 7 ft-lbs.

CAUTION

Verify all axial bolt combinations are loose and not putting any force on the Strongback in the following steps.

2.11 While maintaining concentricity, tighten the 12 radial bolts and torque to 3 ft-lbs. (tighten in steps of 1.5 ft-lb and in sequential order, 180 degrees apart)

2.12 Using an open end wrench run the spherical nuts up the support bolt until they all seat in the through holes in the Top Hat flange.

2.13 Install all the 1/4-28x0.5 axial bolts of Kit 22Gc

2.14 Torque all the axial bolt top bolts to 5 ft-lbs.

2.15 Record the BPS load cell values:

Load Cell	No. 1	No. 2	No. 3
Location	Between -X & -Y	Near +X	Near +Y
Load Cell (lbs)			

3 Task Module 89 Complete.

Completed by:

Witnessed by:

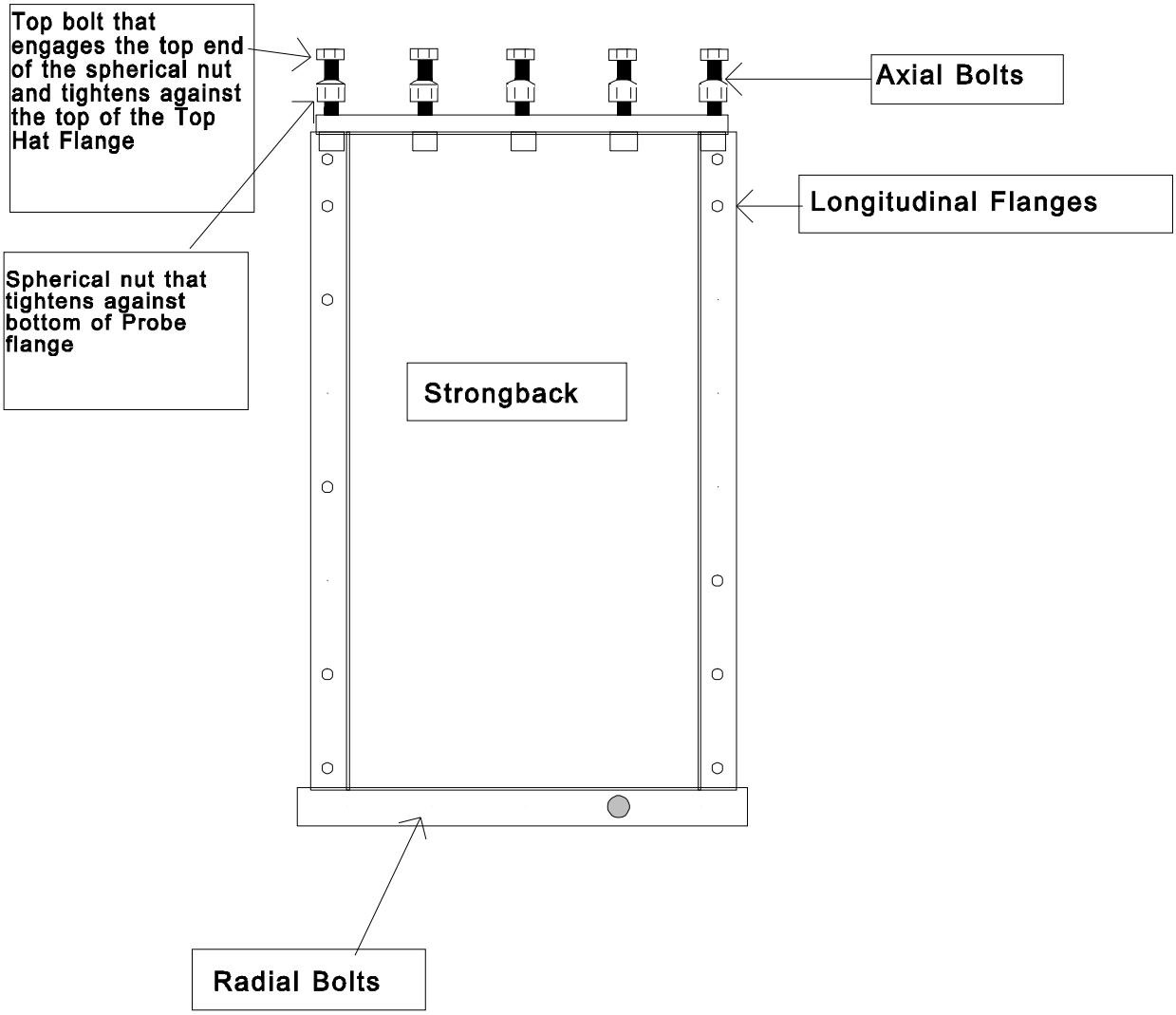
RQE Witness:

RSE Witness:

Date:

Time:

Fig. 1 Strongback Schematic



Operations Number
Date Initiated
Time Initiated

A SCOPE

A.1 This module effects the removal of the probe from the Assembly Stand and installation on the Genie Stand.

B GENERAL REQUIREMENTS

B.1 Magnetic screened tools, obtained from non-magnetic tool box are used for all open-well operations. Magnetic Zone SP, black marking (shrink tubing), is to be assumed,

B.2 All O-rings installed shall be visually inspected, cleaned with alcohol as required and installed dry.

C CONFIGURATION REQUIREMENTS:

C.1 **Probe installed in Assembly stand and Strongback installed on Probe.**

D HARDWARE REQUIRED

D.1 Hardware installed/used:

a) Genie Stand with Station 200 Yoke installed
b) Overhead Crane

D.2 Hardware removed:

a) Kits installed: 2G, 9G, 16G, 4G, 17G.

D.3 Tools required

a) Miscellaneous hand tools

E Operations

1 Preparing the Assembly Stand:

1.1 Verify Probe strongback has been installed per TM 89.

1.2 Position Assembly Stand/Probe under crane with the open side to the south.

1.3 Lock the four Assembly Stand casters. Turn the casters locking wings to the inside of the Stand and parallel to the A-frame sides.

1.4 Set the outrigger feet and verify the four casters are on the ground.

1.5 Remove/verify removed the work platform toward the open (south) side of the Assembly Stand.

1.6 Verify the Guide Rod Spacer Blocks have been removed and the top end Guide Rod Pins installed

1.7 Verify Yoke is mounted to Genie, if not, mount it per engineering instructions.

1.8 Remove/verify removed all cabling/wiring between Piston and Probe.

2 Preparing Genie and Yoke:

2.1 Position Genie in front of Assembly Stand and lower Yoke to lowest position above the floor.

2.2 Remove two bottom Guide Rod retainer locking pins.

2.3 Remove BeCu Collar from Yoke

2.4 Remove Probe Restraining Collar from Probe and from Assembly Stand.

3 Preparing Probe/Assembly Stand:

3.1 Using crane raise Probe sufficient to allow Yoke /Genie to be driven under Probe.\

CAUTION

Ensure top Guide Rod Pins are in place.

3.2 Position Genie so that Yoke is centered on Probe axis.

3.3 Lower Probe back into the Assembly Stand.

3.4 Install BeCu Collar onto Probe Station 200.

3.5 Remove/verify removed the four Collar Retainer Plates from the Yoke.

3.6 Using a ½-in wrench, remove the two 5/16 x 1-in bolts holding the Clocking Assy Guide to Probe..

4 Transferring Probe to Genie:

4.1 Use Genie to raise Yoke to within about 2-in of Probe Station 200 interface.

4.2 Adjust Genie hydraulic shutoff valve partially closed to give fine control over the Genie movement when completing Probe/Genie engagement.

CAUTION

Proceed carefully or damage to the Probe interface may occur

4.3 Verify 4 Collar Retainer Plates are removed from the Yoke.

4.4 Inspect for adequate clearances.

4.5 Raise Yoke to mate with Probe.

4.6 Using eight 1/4-28 x 3/4-in screws, install the four Probe Collar Retainer Plates. Hand tighten the screws with a wrench.

4.7 Using a 7/16 socket and wrench, back off the four Vertical Jack Screws (~1.2-in).

4.8 Pulse the Genie lift to gradually lift the Yoke/Probe until Probe weight is transferred to the Genie.

4.9 Remove the four Spherical nuts from the Probe Suspension Studs.

CAUTION

Station one person to watch the Probe to floor clearance to prevent Probe from hitting floor.

4.10 With one person holding the Top Hat of the Probe back towards the Genie mast to prevent Probe from tilting, lower Probe until disengaged from the Assembly Stand.

4.11 Pull Probe/Genie away from Assembly Stand.

5 Securing the Probe:

5.1 If the Probe is to be left in the vertical orientation install the Genie outriggers.

5.2 If the Probe is to be left in a horizontal orientation:

5.2.1 Unlock large bevel gear brakes of Yoke assembly.

5.2.2 Use small crank to rotate Probe such that Gate Valve will be lowermost when the steps below are performed.

5.2.3 Install crank and rotate Probe until horizontal.

5.2.4 Lock Yoke brakes.

5.2.5 Use Genie and lower Yoke assembly to ~ 3 feet from the floor.

5.2.6 Lower the Probe to a height that will allow the clean booth to be moved around the Probe Top Hat.

5.2.7 Set the Jack screws on the Genie Lift.

5.2.8 Close the hydraulic valve on the Genie Lift to prevent any possible lowering of the Probe.

6 Install in Clean Booth:

6.1 If Section 5.0 has been completed and clean both operations are to be performed, perform the following steps.

6.2 Set up clean booth near Probe and activate fans.

6.3 Roll clean booth over Top Hat portion of Probe.

6.4 Verify clean booth fan is on and particle counter shows <100 Class clean room.

7 Finishing the Assembly Stand:

7.1 Using a pliers and 7/16 wrench, remove from each of the four studs from the Probe Flange:

a) Spherical Nut.
b) Spherical Washer.

7.2 Bag and stow the above hardware.

8 Task Module 99 completed: Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

Operations Number
Date Initiated
Time Initiated
Case No.

A SCOPE

A.1 This module effects the installation of the Probe Flange and/or Pumpout Plate and/or Holding Spool onto the Top Hat of the Probe.

Case 1: Installation of Pumpout Plate onto the Top Hat.

Case 2: Installation of Probe Flange onto the Top Hat with Probe on Genie stand.

Case 3: Installation of Holding Spool onto the Top Hat.

Case 4: Installation of the Probe Flange onto Top Hat with Probe in Dewar:

B GENERAL REQUIREMENTS

B.1 Magnetic screened tools, obtained from non-magnetic tool box are used for all open-well operations. Magnetic Zone SP, black marking (shrink tubing), is to be assumed,

B.2 All O-rings installed shall be visually inspected, cleaned with alcohol as required and installed dry.

C CONFIGURATION REQUIREMENTS

C.1 Probe on Genie stand or installed in Dewar and the clean room booth installed over Probe Top Hat area.

D HARDWARE REQUIRED

a) None

D.1 Hardware installed/used:

a) Kits Installed: 11P, 12P and 21P

D.2 Hardware removed:

a) Kits Removed: 12P
b) 12-M10x1.50 X ?? bolts

D.3 Tools required

a) Portable Clean Room booth
b) Clean room particle counter
c) Leak detector and special plumbing
d) Miscellaneous hand tools

E OPERATIONS

1 Installing Probe Top Hat Area into Clean Booth:

1.1 Lower the Probe to a height that will allow the clean booth to be moved around the Probe Top Hat.

1.2 Set the Jack screws on the Genie Lift.

1.3 Close the hydraulic valve on the Genie Lift to prevent any possible lowering of the Probe.

1.4 Roll Clean booth over the Probe Top Hat area and fold hanging slats to minimize suck-by from the outside.

1.5 Start up the clean booth fans.

1.6 Place the Atcor particle monitor inside the clean booth approximately 10-in from the floor.

1.7 Verify the particle monitor reading is better than Class 100.

1.8 For all operations inside the clean booth a complete clean room suit must be worn.

1.9 Proceed to the para. appropriate for the Case number.

2 Case 1: Installing the Pumpout Plate onto Top Hat:

2.1 Locate the Pumpout Plate and install/verify installed an isolation valve on the KF-50 flange.

2.2 Verify that the Gate Valve is closed.

2.3 If the space between the hardware currently installed on the Gate Valve and the Gate Valve is known to be at one atmosphere pressure skip the steps of this Para.

☐ complete the following ☐ skip the steps of this para

2.3.1 Connect a pumping line between the isolation valve on the current closeout hardware installed on the Gate Valve and AUX-1.

2.3.2 Close, verify closed, AV-1.

2.3.3 Verify that AV-9 is set for He, the Helium supply shutoff valve is open and the Helium pressure regulator is set to approximately 5 psig.

2.3.4 Open AV-8 and AV-3 to evacuate the pumping line to 20 mtorr.

2.3.5 Close AV-8.

2.3.6 Slowly crack open the isolation valve on the current closeout hardware and monitor the pressure on AG-1. If the pressure does not rise above 1 torr, skip the next two steps.

2.3.7 Open AV-8, and continue to slowly open the isolation valve until AG-1 reads 20 mtorr.

2.3.8 Re-close AV-8.

2.3.9 Slowly crack open AV-1 to vent the system at a rate not to exceed 30 torr/min. Record data below.

Time	Press -Torr	Time	Press -Torr	Time	Press -Torr

2.3.10 When AG-1-CAP reads one atmosphere, close AV-1 and the closeout isolation valve.

2.4 Remove from the Top Hat, as applicable, stow hardware into Kit No. 12P:

2.4.1 The Holding Spool, or
2.4.2 The Probe Flange.

CAUTION

Be careful not to damage the Dowel Pins when removing Probe Flange.

2.5 Remove, inspect, clean and re-grease O-Ring No. 1, then replace onto the Top Hat.

2.6 Using the 12 bolts, spacers, washers, and lock washers from Kit No. 12P, install the Pumpout Plate.

2.7 Task Module 5 Case 1 completed.

Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

3 Case 2: Installing the Probe Flange onto top Hat:

3.1 Install/verify installed the Probe Guide onto the Probe Flange using 10 screws, washers, and lock washers from Kit No. 11P. Torque to 90-110 in-lbs (7.5 to 9 ft-lbs).

3.2 Remove/verify removed the Probe Flange valve and rubber seal from the Probe Flange.

3.3 Clean Probe Flange Assembly: Interior Surfaces to Level 100; exterior surfaces to Level 200.

3.4 Clean Probe Adapter Flange (LMMS _____): Interior Surfaces to Level 100; exterior surfaces to Level 200.

3.5 Solvent clean the Probe Flange Valve and reinstall.

3.6 Solvent clean the relief valve (<3 psid cracking pressure) and install in the second Probe Flange port.

3.7 Inspect the two Probe Flange Dowel Pins.

3.8 Remove the Holding Spool from the Top Hat and stow hardware into Kit No. 12P.

3.9 If O-ring is in Holding Spool flange, remove, inspect, and clean (no grease) O-Ring No. 1b.

3.10 Install clean, no grease O-ring No. 1b into Probe Adapter Flange.

NOTE:
Ensure clocking is correct for Probe Adapter Flange, +X mark should be 90-deg CW from Top Hat Flange -Y mark.

3.11 Bolt Probe Adapter Flange to Top Hat flange with 16 10-32x1.0 screws, with washers.

3.12 Install/verify installed the Dowel Pins to orient the Probe Flange.

NOTE:
Ensure clocking is correct for Probe Flange, +X mark should line up with Probe Adapter Flange +X mark.

3.13 Install the Probe Flange using the 12 3/8x1.0 bolts and washers from Kit No. 12b and using 3 0.06-in thick washers to give a effective bolt length of .82-in.

3.14 Torque the bolts to 240 in-lbs (20 ft-lb).

3.15 Backfilling Probe Flange/Gate Valve Volume:

3.15.1 Connect a pumping line between the Probe Flange Valve and Access-1 of the Gas Module.

3.15.2 Close, verify closed, EV-__.

3.15.3 Verify that AV-9 is open and the Helium pressure regulator is set to approximately 2 psig.

3.15.4 Open AV-___ and AV-___ to evacuate the pumping line to 20 mtorr.

3.15.5 Slowly crack open the isolation valve on the Probe Flange while monitoring the pressure on AG-1 and continue until full open.

3.15.6 Close AV- __.

3.15.7 Slowly crack open AV-1 to vent the system at a rate not to exceed 30 torr/min.

Time	Press -Torr	Time	Press -Torr	Time	Press -Torr

3.15.8 When AG-1-CAP reads one atmosphere, close AV-1 and the Probe Flange isolation valve.

3.15.9 Remove the pumping line to Access-1.

3.15.10 Install a relief valve on the Probe Flange Valve and open the valve.

3.16 Task Module 5, Case 2 completed.

Completed by:
Witnessed by:
Date:
Time:

4 Case 3: Installing Holding Spool onto Top Hat:

4.1 Verify that the Vaterfly valve is closed.

4.2 Verify Probe Top Hat area is installed in the clean booth and the particle count is <100 Class clean room.

4.3 Remove any plastic wrap from Top Hat area.

CAUTION

Be careful to not damage the Dowel Pins when removing Probe Flange in the following step.

4.4 Remove from the Top Hat the Probe Flange and stow hardware into Kit No. 12P.

4.5 Remove Probe-B interface adapter plate and stow hardware.

4.6 Using the 12 bolts, ISO half-clamps, and washers from Kit No. 12P, install the Holding Spool onto the Top Hat.

4.7 Task Module 5, Case 3 completed.

Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

5 Case 4: Installation of the Probe Flange onto Top Hat with the Probe in Dewar:

5.1 Install/verify installed the Probe Guide onto the Probe Flange using 10 screws, double washers from Kit No. 11P. Torque to 90-110 in-lbs (7.5 to 9 ft-lbs).

5.2 Install/verify installed the Probe Flange valve on the Probe Flange.

5.3 Clean Probe Flange Assembly to Level 100.

5.4 Inspect the two Dowel Pins.

5.5 Verify that the Gate Valve is closed.

5.6 Remove Top Hat Hardware:

5.6.1 Disconnect two 4-in roughing lines from two Exhaust Gas turbo pumps. Perform disconnect at lower joint of flex line and cover all ports with clean aluminum foil.

5.6.2 Remove 10 ISO bolts and clamps from Gate Valve/Bellows flange. Place the O-ring and centering ring in plastic bag.

5.6.3 Slide the Exhaust Gas Platform away from the Probe until against stops.

5.7 Install Probe Flange:

5.7.1 Open cleaned Probe Flange inside the clean booth and install lightly greased O-ring. Use heavy grease in four spots such that O-ring will not fall out when the Probe Flange is inverted.

5.7.2 Install/verify installed the Dowel Pins to orient the Probe Flange.

5.7.3 Install Probe Flange with +Y scribe marking aligned with the +Y axis of the Dewar.

5.7.4 Install the Probe Flange using the 12-M10x1.25 X 60 bolts and washers from Kit No. 12P.

5.7.5 Torque the bolts to 300 in-lbs (25 ft-lb).

5.8 Close out Exhaust Gas System

5.8.1 Remove ISO clamps and bolts from Bellows/Exhaust Gas System flange and place bellows in plastic bag with the O-ring and O-ring centering ring.

5.8.2 Cover Exhaust Gas System inlet port with clean aluminum foil.

5.9 Remove, inspect, clean and **lightly** re-grease O-Ring No. 1, then replace onto the Probe Flange.

5.10 Install/verify installed the Dowel Pins to orient the Probe Flange.

5.11 Install the Probe Flange using the 12 M10x1.25 X 60 bolts and washers from Kit no. 12P.

5.12 Torque the bolts to 300 in-lbs (25 ft-lb).

5.13 Backfill Probe Flange with Helium:

5.13.1 Connect a pumping line between the isolation valve on the Probe Flange and Access-1.

5.13.2 Close, verify closed, AV-1.

5.13.3 Verify that AV-9 is set for He, the Helium supply shutoff valve is open and the Helium pressure regulator is set to approximately 5 psig.

5.13.4 Open AV-8 and AV-3 and the Probe Flange Isolation Valve and evacuate to 20 mtorr.

5.13.5 Close AV-8.

5.13.6 Open AV-1 to vent the system at a rate not to exceed 30 torr/min.

5.13.7 When AG-1-CAP reads one atmosphere, close AV-1 and the Probe Flange Isolation Valve.

5.13.8 Remove the pumping line to Access-1 and cap off the Probe Flange isolation valve.

5.14 Install/verify installed the Probe Flange heater on the circumference of the Probe Flange.

6 Task Module 5, Case 4 completed. Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

GRAVITY PROBE-B

OPERATIONS ORDER FOR

SCIENCE MISSION DEWAR

Task Module 222: Load Probe onto Gurney

May 7, 1998

Task Module 222: Load Probe onto Gurney

Operations Number
Date Initiated
Time Initiated

A Scope

This module effects the loading of the Probe onto the transportation Gurney.

B General Requirements

B.1 Magnetic screened tools, obtained from non-magnetic tool box are used for all operations. Magnetic Zone SP, black marking (shrink tubing), is to be assumed unless Zone 2, yellow marking, is specifically called out.

B.2 All O-rings installed shall be visually inspected, cleaned with alcohol as required and installed dry.

C Configuration Requirements

C.1 Completion of Task Module 208

D Hardware Required

D.1 Hardware installed/used:

a) Misc. hand tools

b)

D.2 Hardware removed:

a)

E References:

1. GP-B Magnetic Control Plan, LMMS 5835031
2. LMMS 5813353, Helium Airlock Assembly
3. LMMS 5823341, Helium Airlock Installation
4. Probe Hardware Kit List SU/GP-B P0144

F Operations

1 Remove the Probe Flange and Install Spool Piece:

1.1 Record Probe pressure on convectron: _____ torr.

1.2 Unbolt and remove Probe Flange.

1.3 Record Probe pressure on convectron: _____ torr.

1.4 Install and bolt Spool piece torquing bolts to 30 in-lb

1.5 Record Probe pressure on convectron: _____ torr.

1.6 Time/Date

2 Preparing Gurney for Genie Lift:

2.1 Position Gurney to allow Genie Lift Carrier to access Interface Block.

2.2 Set the four Gurney Jack screws.

2.3 Tighten fully the Yoke Brakes.

2.4 Plug in power cord to the Genie hydraulic lift motor.

2.5 Remove the Spool support clamp.

2.6 Move the Genie Lift/Probe up high enough to clear the Gurney.

3 Mating Probe to Gurney:

3.1 Position the Gurney under the Genie Lift/Probe.

3.2 Slowly lower Genie Lift/Probe until it is resting in the Gurney.

3.3 Insert the Gurney/Yoke locking pin.

3.4 Remove the two 8-in Mast Carrier Bolts.

3.5 Lower the Mast Carrier out of the Interface Block.

3.6 Install the Spool Support Clamp.

3.7 Back away the Genie Lift from the Gurney

Task Module 222 completed.

Completed by:

Witnessed by:

RQE Witness:

RSE Witness:

Date:

Time:

GRAVITY PROBE-B

OPERATIONS ORDER FOR

SCIENCE MISSION DEWAR

Task Module 251
Moving Probe-C from FIST Lab to HEPL Clean Room

October 23, 1998

Operations Number
Date Initiated
Time Initiated

A SCOPE

This module effects the moving a Probe-C mounted on the Gurney from the FIST Lab to the GP-B HEPL Class 1000 clean room.

B GENERAL REQUIREMENTS

B.1 None.

C CONFIGURATION REQUIREMENTS

C.1 Probe-C is secured in Gurney and double bagged inside of FIST Lab.

D HARDWARE REQUIRED

D.1 Hardware installed/used:

a) Probe-C mounted on the Gurney and bagged.
b) Fork lift
c) Worm Gear Assembly
d) Impactograph or equivalent
e) Large C-clamps (4)
f) Miscellaneous wood blocks

D.2 Hardware removed:

a) None.

E REFERENCES:

None

F PERSONNEL:

Personnel qualified to perform the various functions in this procedure are:

Test Director:	Mike Taber
	Dave Murray
Fork lift Operator:	J. Perales
	P. Cruz
Technicians:	T. Welsh
	K. Bower
	C. Gray
	C. Warren
RSE	J. Janicki
	M. Jeung-Wesoloski
RQE	D. Ross
	R. Leese
ONR	E. Igraham

NOTE: The ONR, RQE and RSE shall be notified 24 hours prior to beginning this procedure.

G OPERATIONS

1 Prepare to move Probe:

1.1 Verify the ONR, RQE and RSE have been notified 24 hours prior to beginning this procedure.

1.2 This procedure requires one Test Director, one qualified fork lift operator and two technicians and the program Safety Engineer (RSE). The qualified personnel are listed in the front of this procedure.

1.3 The Test Director is in charge of controlling and executing all steps of this procedure;

Record Test Director: _____ .

1.4 Verify ONR, RSE and RQE have been notified of move (24 hours prior). Date/Time:

1.5 Verify Probe-C is installed on the Gurney in the GP-B FIST Ops clean room and is securely fastened to the Gurney and the yoke worm gear is locked in place.

1.6 Install/verify installed an recording accelerometer (Impactograph or equivalent) on the Gurney frame with one of the two sensing directions in the vertical and the other crosswise of the frame.

Record: Vertical sensing _____ axis

Record: Cross axis sensing _____ axis

1.7 Install/verify installed a double wrap of clean room plastic over the Probe.

1.8 Verify Fork Lift is available for use.

1.9 Clear all equipment from the End Station I lower floor area between the FIST roll up door and the outside roll up door.

1.10 Clear all equipment from around the Weld Shop roll up door.

2 Moving Probe:

CAUTION

In the following take care to not jar the Probe when rolling the Gurney across the floor or when moving the Gurney/Probe with the fork lift as damage to the Probe could result.

2.1 Turn on the Impactograph.

2.2 Roll the Gurney with Probe-C out of GP-B FIST Ops clean room to just outside the End Station I roll up door.

2.3 Use the fork lift to raise the Gurney and Probe approximately 2-in off the ground.

2.4 Secure the Gurney frame to the forklift forks with four C-clamps (use wood blocks for clamping as required).

CAUTION

In the following step use spotters on both ends of Gurney to prevent any interferences occurring.

2.5 Use the fork lift to raise the Gurney/Probe clear of the pavement and move the hardware to just outside the roll up door at the Weld Shop roll up door

2.6 Set Gurney on pavement and remove C-clamps and back Fork Lift away

CAUTION

Use extreme care in rolling Gurney over rough spots of floor.

2.7 Roll Gurney into GP-B HEPL Class 1000 clean room.

2.8 Turn off Impactograph recording and record:

Maximum vertical axis acceleration: _____ g.

Maximum cross axis acceleration: _____ g.

2.9 If an electronic impactograph was used, attach read-out report for this operation.

2.10 Remove Impactograph from Gurney.

3 Completed.

Completed by:

Witnessed By:

RSE :

Date:

Time:

RQE :