

ASSEMBLY AND IN-PROCESS TESTS OF SCIENCE MISSION CAGING UNITS

GP-B SCIENCE MISSION PROCEDURE

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1. SCOPE

This document contains procedures for assembly and in-process testing of the Science Mission caging units. The procedure takes place at Stanford HEPL for most assembly and test, and at Directed Light, Inc in San Jose, CA for laser welding.

This procedure is subdivided into Task Modules as follows:

- A. Assembly, Weld, and Test of Diaphragm Subassembly (P/N 22793-302), first 5 welds
- B. Assembly and Test of Tubing Assembly, Caging (P/N 22822-201)
- C. Assembly, Weld, and Test of Diaphragm Assembly (P/N 22793-301), welds 6 and 7
- D. Assembly and Dimensional Measurements of Actuator Assembly (P/N 22794-301)
- E. Match Machining the Housing (P/N 22802-101) and Rod (P/N 22798-101) to the Actuator Assembly
- F. Assembly and Test of Housing/Actuator Assembly (P/N 22805-301)
- G. Assembly and Measurements of Mechanism Assembly (P/N 22809-301)
- H. Assembly of Caging Subassembly (P/N 23190-301)
- I. Assembly and Test of Tubing Assembly, Caging Jumper Line (P/N 23188-205)
- J. Assembly of Caging Assembly (P/N 23172-301)

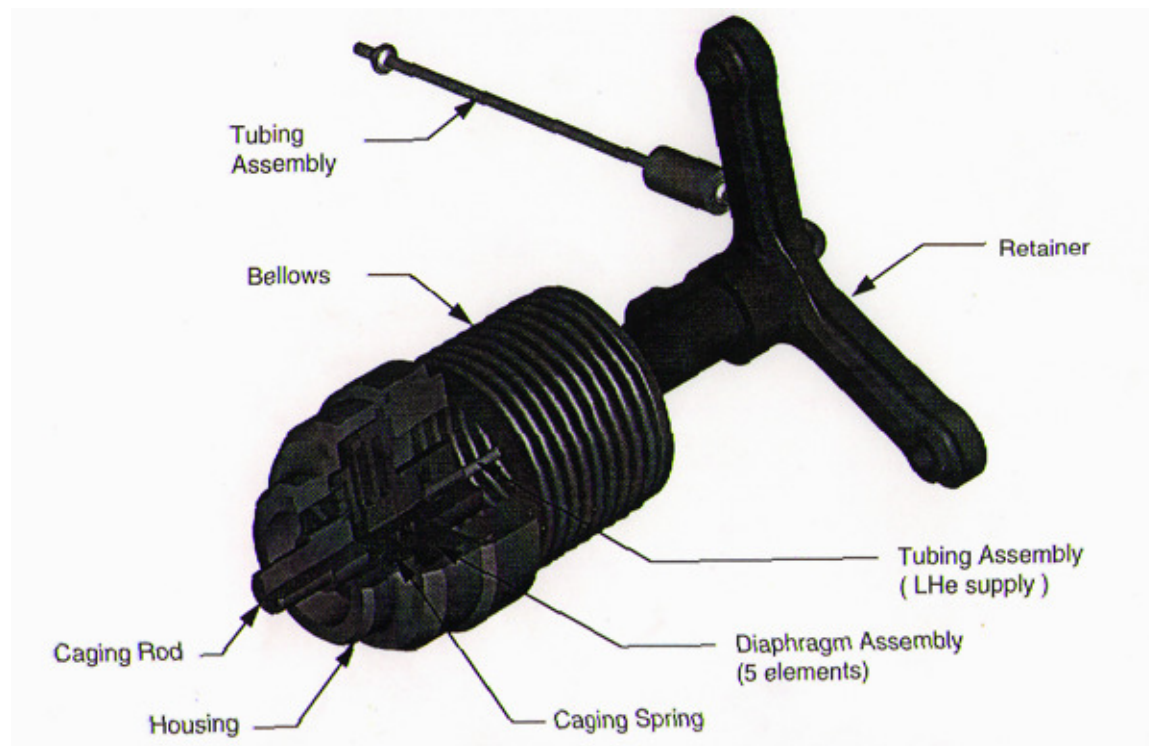


Figure 1. Caging Assembly Isometric

2. REFERENCES

P0059	GPB Contamination Control Plan
P0057-A	Stanford Magnetic Control Plan
P0054	Vacuum Leak Test Procedure
P0063	Cryogenic Dip Procedure
5833741	GPB Procedure for Mating and Demating the Caging and Spinup Solder Joints
P0355	Epoxy Bond Procedure
F277277 v4.0	Payload Specification, PLSE-12

3. GENERAL REQUIREMENTS

3.1 Environmental Requirements

3.1.1. Cleanliness

Assembly of the weld parts at Directed Light, Inc are conducted on a clean room HEPA flow bench with laminar flow. This bench shall be maintained at cleanliness level 100 per Federal Standard 209D. The Laser Weld machine is provided with a laminar downflow hood, which flows clean filtered air over the weld parts. Most of the Stanford activity is conducted in the HEPL Class 1000 Cleanroom.

3.1.2. Particulate Contamination

All parts and tools shall be cleaned using methods consistent with achieving Mil Standard 1246B Level 100 cleanliness. In addition, all parts shall be maintained at level 100 cleanliness per Procedure P0059.

3.1.3. Magnetic Contamination

Parts to be handled are in Zones 1 and 2. All parts shall be screened per Procedure P0057A. Take all necessary precautions to keep tooling and handling free of magnetic contamination. Tools that come in contact with these components must be of Beryllium Copper, Phosphor Bronze, ceramic, copper, brass, titanium, or appropriate plastics.

3.2 Personnel

3.2.1 Responsible Assembly and Test Engineer

The Responsible Assembly and Test Engineer shall be John Stamets. He has overall responsibility for the implementation of this procedure and shall sign off the completed task modules.

3.2.2 Personnel

All engineers and technicians participating in this procedure shall work under the direction of John Turneure, who shall determine whether the person is qualified to participate in this procedure. The laser welds are conducted by certified personnel at Directed Light, Inc in San Jose, CA , phone number 1-800-HOT-BEAM.

3.3 Safety

3.3.1. General

The responsible engineer shall ensure that all personnel are aware of the specific personnel and hardware safety concerns indicated in the safety requirements, cautions and warnings in the procedure.

3.3.2. Protective Garments

Minimum protective garments for personnel working in the clean rooms shall be the standard Tyvek clean room apparel for room classes from 10,000 to 1000.

3.4. Quality Assurance

All assembly and testing shall be conducted on a formal basis to approved and released assembly and test procedures.. A Quality Assurance representative shall review and document any discrepancy noted during integration or test, and approve its disposition. Upon completion of this procedure, the QA representative will certify his concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval line at the end of the procedure.

3.5. Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the responsible engineer. Approval by the Hardware Director shall be required, if in the judgment of the REE or QA representative, experiment functionality may be affected.

4. REQUIRED EQUIPMENT

Flight Hardware

Hardware	Part Number	Quantity
Diaphragm Subassembly	22793-302	18 (4 flight)
Body, Diaphragm	22791-101	1/subassembly
Diaphragm, Outer	22800-101	1/subassembly
Diaphragm, Middle, female	23537-101	1/subassembly
Diaphragm, Inner	22792-201	1/subassembly
Diaphragm, Middle, male	23538-101	2/subassembly
Ring, Transfer	22795-201	1/subassembly
Tubing Assembly, Caging	22822-201	16 (4 flight)
Diaphragm Assembly	22793-301	16 (4 flight)
Spring	22796-101	1/actuator assembly
Actuator Assembly	22794-301	up to 16 (4 flight)
Housing	22802-101	1/housing/actuator assembly
Keeper	22797-101	1/housing/actuator assembly
Rod	22798-101	1/housing/actuator assembly
Housing/Actuator Assembly	22805-301	up to 16 (4 flight)
Pusher	22804-101	1/mechanism assembly
Bellows	22810-101	1/mechanism assembly
Mechanism Assembly	22809-301	up to 16 (4 flight)
Retainer	22897-101	1/caging subassembly
Caging Subassembly	23190-301	up to 16 (4 flight)
Tubing Assembly, Caging Jumper Line	23188-201, 23188-202, 23188-203, 23188-204	8 (4 flight)

Note: Serial Numbers and/or Lot Date Code of Flight Hardware are listed in the various tables as the assembly occurs in Section 5.

Ground Support Equipment

DIRECTED LIGHT, INC Laser Weld Machine

 RAYTHEON Model SS550, 400 W Pulsed NdYag at $\lambda = 1.06 \mu\text{m}$

 ANORAD Anomatic 2 Controller (Computer Numerically Controlled (CNC))

Downflow HEPA flow bench to attach to Laser Weld Machine

Aluminum Spring Loaded Fixture to bolt onto SS550 Laser Weld Machine to support Diaphragm weld parts
(Welding Fixture 01)

Plastic compartments (clean) for storing weldments

Braze torch

CUSIL 20 mil brazing alloy

Inert gas (Argon) for use during brazing

Plastic Gyro Caging Simulator Tube

 Dial Indicator Adapter for Gyro Simulator Tube

 Load Cell Unit for Gyro Simulator Tube

GSE for Diaphragm Assembly Travel Test

Housing (modified P/N 22802-101)
 Keeper (modified P/N 22797-101)
 Rod (modified P/N 22798-101)
 Pusher (modified P/N 22804-101)
 Bellows (modified P/N 22810-101)
 Caging Retainer (modified P/N 22897-101)
 Capillary tube adapter
 one-inch Hex nuts for retainer bolts (3)

1/8 inch stainless steel tube with female VCR fittings on both end - approx 6' long

1/4 inch flexible vacuum hose with female VCR fittings on both ends - approx 6' long

POPE Scientific, Inc 1 liter vacuum flask

Fixture for holding Actuator Assembly for measurements

Mitutoyo 70040 Stand

Aluminum Cylinder for holding Actuator Assembly on Mitutoyo 70040 Stand

Caging Control Unit (CCU), and associated plumbing

Caging Line Adapter for connecting Caging tube to CCU

Plunger type dial indicator

V-block

Measurement GSE

<u>Item</u>	<u>Model Number</u>	<u>Serial Number</u>	<u>Calibration Date</u>
Mitutoyo Dial Indicator	IDC-112E	300650	4/29/97
Starrett Dial Indicator	25-231		
CCU Pressure Transducer			
Load Cell Force Meter	Omega DP41-V		
Varian Leak Detector	Turbo Auto-test 960		

Tools and Miscellaneous

Tetrafluorethane (TF) Solvent - .05 μ m filtered Freon

Chemtronics Freez-It 2000 can of Tetrafluorethane 1,1,1,2 (-51 °C)

Chemtronics Ultra-jet Duster can of Tetrafluorethane 1,1,1,2 (-51 °C)

Bottle of Ethyl alcohol

Monofilament nylon line

5. ASSEMBLY, WELD, AND TEST OF THE DIAPHRAGM SUBASSEMBLY, P/N 22793-302

5.1 Assembly and Weld of Diaphragm Subassembly (Weldments 1 - 5)

This task module takes place at Directed Light, Inc in San Jose. It assumes (1) the diaphragm subassembly parts have been cleaned, magnetically screened, and released.

(2) the weld parameters for the SS550 Laser Welder have been determined and set;

(3) the laminar flow bench for assembly and the downflow bench for welding are in place and ready for use; (4) the Turbo Leak Detector (LD) is at the vendor and has been prepped (rough pumped and calibrated).

The exploded rear view of the Caging Diaphragm Subassembly, 22793-202, is shown in Figure 2. The rear view better illustrates the welds. Welds 1-5, as numbered in Figure 2, are welded and leak tested under vacuum, sequentially. Weld 6 is a mechanical weld, and is done later. The total number of candidate parts are welded at each level prior to going on to the next weldment; i.e., Weldment #1 is completed for all candidate units (in this case 18) and leak tested prior to going to Weldment #2, etc. The odd numbered welds are of diameter 0.788", while the even numbered welds are of diameter 0.125".

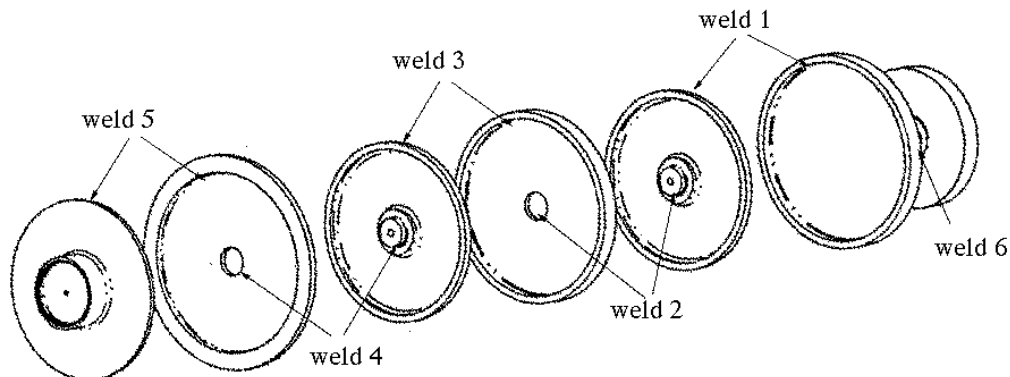


Figure 2. Exploded Rear View Diaphragm Subassembly P/N 22793

Record Start Date and Time _____

- 5.1.1 Set up the room at Directed Light, Inc with a Stanford supplied downflow laminar bench attached to the SS550 Laser Welder. A Stanford supplied aluminum spring loaded fixture (Welding Fixture 01) will hold the diaphragm weld parts in compression while in the machine.

The laser weld uses a pulsed NdYag laser, at wavelength 1.06 μm . The laser is CNC controlled to yield a circular weld.

For these 5 welds, the test unit does not move during the welding process. Weld penetration to be .007 - .015".

The parameters used on the SS550 are:

pulse width : 3.1 ms
pulse frequency: 20 pulses/sec
average power: 288 W
input power: 10.8 kW
focus: sharp focus, focal length 6 inches
nozzle size 0.25"
assist gas: Argon
assist gas pressure: 40 scfh (standard cubic feet per hour)
feed rate, using X-Y interpolator (determines run time) :
F30, Large weldments (odd numbers)
F20, Small weldments (even numbers)

5.1.2 Weldment #1 : Weld P/N 22792-201 to P/N 23538-101

- 5.1.2.1 On the clean room bench, clean P/N 23538-101 and P/N 22792-201 by thoroughly spraying with Freon spray. Shrink-fit P/N 23538-101 inside the P/N 22792-201 outer flange by cooling to a minimum temperature differential of 30 °C by spraying with tetrafluorethane spray. Fit surfaces of mating welded parts to be flush.
- 5.1.2.2 Weld this mating diameter (Weldment#1) per vendor weld procedure, using above parameters.
- 5.1.2.3 Put the weldment on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Document leak rate in Table 1 below. If leak rate is = 10^{-8} sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 5.1.2.2. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory. Store accepted weldments in clean, plastic, numbered compartments.
- 5.1.2.4 Using next P/N 23538-101 and P/N 22792-201, repeat steps 5.1.2.1 through 5.1.2.3 until all candidate units completed. Record leak rates in Table 1.

5.1.3 Weldment #2 : Weld completed Weldment #1 to P/N 23537-101

- 5.1.3.1 Take the completed Weldment #1, and a P/N 23537-101 on the clean room bench, clean parts to be welded by thoroughly spraying with TF spray. Insert the inner flange of Weldment #1 into the inner hole of P/N 23537-101. Shrink-fit not required. Fit surfaces of mating welded parts to be flush.
- 5.1.3.2 Weld this mating diameter (Weldment#2) per vendor weld procedure, using above parameters.
- 5.1.3.3 Put the weldment on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Document leak rate in Table 1 below. If leak rate is = 10^{-8} sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 5.1.3.2. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory. Store accepted weldments in clean, plastic, numbered compartments.
- 5.1.3.4 Using next Weldment #2 and P/N 23537-101, repeat steps 5.1.3.1 through 5.1.3.3 until all candidate units completed. Record leak rates in Table 1.

5.1.4 Weldment #3 : Weld completed Weldment #2 part to new P/N 23538-101

- 5.1.4.1 Take the completed Weldment #2, and a new P/N 23538-101 on the clean room bench, clean parts to be welded by thoroughly spraying with TF spray. Shrink-fit P/N 23538-101 inside the weldment P/N 23537-101 outer flange by cooling to a minimum temperature differential of 30 °C by spraying with tetrafluorethane spray. Fit surfaces of mating welded parts to be flush.
- 5.1.4.2 Weld this mating diameter (Weldment#3) per vendor weld procedure, using above parameters.
- 5.1.4.3 Put the weldment on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Document leak rate in Table 1 below. If leak rate is = 10^{-8} sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 5.1.4.2. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory. Store accepted weldments in clean, plastic, numbered compartments.
- 5.1.4.4 Using next Weldment #3 and P/N 23538-101, repeat steps 5.1.4.1 through 5.1.4.3 until all candidate units completed. Record leak rates in Table 1.
- 5.1.5 Weldment #4 : Weld completed Weldment #3 part to new P/N 22800-101
- 5.1.5.1 Take the completed Weldment #3, and a P/N 22800-101 on the clean room bench, clean parts to be welded by thoroughly spraying with TF spray. Insert the inner flange of Weldment #3 into the inner hole of P/N 22800-101. Shrink-fit not required. Fit surfaces of mating welded parts to be flush.
- 5.1.5.2 Weld this mating diameter (Weldment#4) per vendor weld procedure, using above parameters.
- 5.1.5.3 Put the weldment on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Document leak rate in Table 1 below. If leak rate is = 10^{-8} sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 5.1.5.2. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory. Store accepted weldments in clean, plastic, numbered compartments.
- 5.1.5.4 Using next Weldment #3 and P/N 22800-101, repeat steps 5.1.5.1 through 5.1.5.3 until all candidate units completed. Record leak rates in Table 1.
- 5.1.6 Weldment #5 : Weld completed Weldment #4 part to new P/N 22791-101
- 5.1.6.1 Take the completed Weldment #4, and a new P/N 22791-101 on the clean room bench, clean parts to be welded by thoroughly spraying with TF spray. Shrink-fit P/N 22791-101 inside the weldment P/N 22800-101 outer flange by cooling to a minimum temperature differential of 30 °C by spraying with tetrafluorethane spray. Fit surfaces of mating welded parts to be flush.
- 5.1.6.2 Weld this mating diameter (Weldment#5) per vendor weld procedure, using above parameters.

- 5.1.6.3 Put the weldment on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Document leak rate in Table 1 below. If leak rate is $= 10^{-8}$ sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 5.1.6.2. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory. Store accepted weldments in clean, plastic, numbered compartments.
- 5.1.6.4 Using next Weldment #4 and P/N 22791-101, repeat steps 5.1.6.1 through 5.1.6.3 until all candidate units completed. Record leak rates in Table 1.

Leak Rate Requirement per PLSE-12, section 3.7.1.4.7.6 is $= 10^{-8}$ sccs He

Storage #	Weldment #1	Weldment #2	Weldment #3	Weldment #4	Weldment #5	After Cryo-Dip Weldment #5	Weldment #7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

Table 1. Diaphragm Subassembly Leak Rates (sccs He)
(Background 1×10^{-9} sccs He)

- 5.1.6.5 Section a failed unit to verify weld penetration

Weld Depth _____ Date _____

- 5.1.6.6 Transport all Diaphragm Subassemblies which passed leak tests to Stanford for Cryogenic Cycling, Leak Test, and Magnetic Screening.

Completed: _____ date: _____
Responsible Engineer

Discrepancies if any:

5.2 LN₂ Dip, Leak Test and Mag Test of Diaphragm Subassembly

The LN₂ dip procedure takes place at Stanford HEPL, Room 22. The Leak Test will be done in the Class 1000 Clean Room, and the Magnetic Test will be done in the HEPL Magnetics Lab.

Record Start Date and Time _____

- 5.2.1 Prepare a standard 15" LN₂ dewar flask and fill to a depth of approximately 6 inches with Liquid Nitrogen.
- 5.2.2 Prepare a monofilament nylon tie line to support the Diaphragm Subassembly such that there are markers which indicate the subassembly is (a) in the liquid, (b) in the cold vapor, or (c) in the warm vapor.
- 5.2.3 Thermal cycle the unit according to Cryo Dip Procedure P0063.
- 5.2.4 After thermal cycling, store in clean numbered storage compartments. Repeat cryo-dip procedure for all candidate units, and store in numbered compartments.
- 5.2.5 After thermal cycling all candidate units, carry the units to the Class 1000 Clean room where the Leak Detector is set up. Perform vacuum leak test of each unit according to P0054. Record leak rate in Table 1.
- 5.2.6 After leak test, clean subassembly with TF spray according to P0059, bag, and store in numbered compartment.
- 5.2.7 Send to Stanford Magnetics Lab for magnetic testing, according to P0057A.

Completed: _____ date:
 Responsible Engineer

Discrepancies if any:

6. ASSEMBLY, BRAZE, AND TEST OF TUBING ASSEMBLY, CAGING, P/N 22822-201

6.1 Assembly and Braze of Tubing Assembly, Caging

This task module takes place in Stanford's HEPL building Tube Shop, Rm 141. It assumes the Tubing Assembly parts have been cleaned, magnetically screened, and released.

The Tubing Assembly, Caging, 22822-201, is shown in Figure 3. The Tubing Collar, P/N 22823-101, and Ferrule, P/N 23385-201 are brazed onto the tube, while the two Supports, P/N 22877-201, are epoxy bonded onto the tube after brazing is completed.

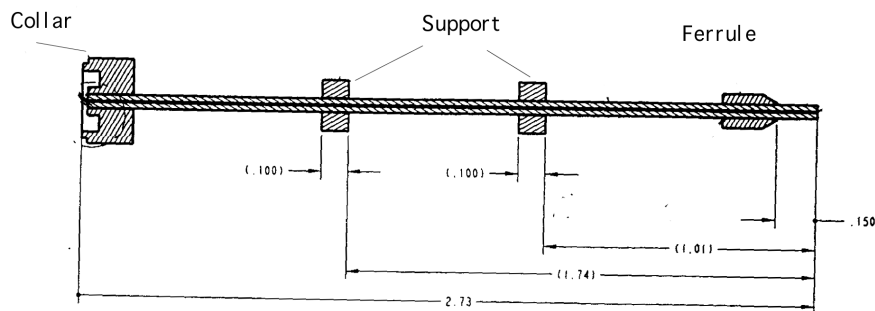


Figure 3. Tubing Assembly, Caging

Record Start Date and Time _____

- 6.1.1 Clear off the bench area where the brazing is to be done. Put the brazing tools, braze material, inert gas, in a readily accessible place.
- 6.1.2 Connect the inert gas (Argon) supply tube onto the bare tube. This end will become the Collar end of the Tube.
- 6.1.3 Position the Ferrule, P/N 23385-201 onto the other end of the Tube, in accordance with drawing 22822.
- 6.1.4 Hand braze the Ferrule onto the Tube, using CUSIL 20 mil brazing alloy, according to Tube Shop procedures. The inert gas will be flowing through the tube during the actual brazing. Leak test braze according to Tube Shop procedure. Brazing is to be performed by Manuel Ortega of Stanford, or his designate.
- 6.1.5 Remove the inlet gas from the Tube, and slip on two Supports, P/N 22877-201 over the Tube, and slide down to the Ferrule end.
- 6.1.6 Connect the inert gas supply tube onto the bare tube protruding from the Ferrule end.

- 6.1.7 Position the Collar, P/N 22823-101 on the other end of the Tube, in accordance with drawing 22822.
- 6.1.8 Hand braze the Collar onto the Tube, using CUSIL 20 mil brazing alloy, according to Tube Shop procedures. The inert gas will be flowing through the tube during the actual brazing. Leak test braze according to Tube Shop procedure. Brazing is to be performed by Manuel Ortega of Stanford, or his designate.
- 6.1.9 After leak test, clean subassembly with TF spray according to procedure P0059, bag, and store in numbered compartment.
- 6.1.10 With new parts, repeat 6.1.1 through 6.1.9 until 16 assemblies are completed.

6.2 LN₂ Dip, Leak Test, Epoxy Bond, and Mag Test of Tubing Assembly

The LN₂ dip procedure takes place at Stanford HEPL, Class 1000 Clean Room bench. The Leak Test will be done in the Class 1000 Clean Room.

Record Start Date and Time _____

- 6.2.1 Prepare a LN₂ dewar flask of height sufficient to hold the entire assembly in the liquid, cold vapor, and warm vapor, and fill to a depth of approximately 6 inches with Liquid Nitrogen.
- 6.2.2 Prepare a pulley arrangement above the bench, such that a line can be plumbed into the dewar flask.
- 6.2.3 Prepare a monofilament nylon tie line to support the Tubing Assembly such that there are markers visible above the flask, which indicate the assembly is (a) in the liquid, (b) in the cold vapor, or (c) in the warm vapor.
- 6.2.4 Thermal cycle the unit according to Cryo Dip Procedure P0063.
- 6.2.5 After thermal cycling, store in clean numbered storage compartments. Repeat cryo-dip procedure for all candidate units, and store in numbered compartments.
- 6.2.6 After thermal cycling all candidate units, perform vacuum leak test of each unit according to P0054. Record leak rate in Table 2.
- 6.2.7 After leak test, epoxy bond the two Supports per tube according to Bonding Procedure P0355.
- 6.2.8 Clean subassembly with TF spray according to P0059, bag, and store in numbered compartment.
- 6.2.9 Send to Stanford Magnetics Lab for magnetic testing, according to P0057A.

Tubing Assembly Unit Number	Leak Rate (scs He) Reqmt: 1×10^{-8} scs He		Accepted (Y or N)
	Collar	Ferrule	

Table 2. Leak Rate of Tubing Assembly After Braze

Completed: _____ date:
Responsible Engineer

Discrepancies if any:

7. ASSEMBLY, WELD, AND TEST OF DIAPHRAGM ASSEMBLY, P/N 22793-301

7.1 Assembly and Weld of Diaphragm Assembly (Weldments 6 & 7)

This task module takes place at Directed Light, Inc in San Jose, CA. It assumes (1) the diaphragm subassembly weldments 1-5 have been completed, thermal cycled, leak tested, cleaned, magnetically screened, and released. (2) the tubing assemblies, P/N 22822-201, have been assembled, cleaned, magnetically screened, and released. (3) the weld parameters for the SS550 Laser Welder have been determined and set.

Record Start Date and Time _____

- 7.1.1 Set up the room at Directed Light, Inc with a Stanford supplied downflow laminar bench attached to the SS550 Laser Welder. A Stanford supplied aluminum spring loaded fixture will hold the diaphragm weld parts in compression while in the machine.

For Weldment #6, the test unit does not move during the welding process. For Weldment #7, the test unit rotates, while the laser is held in place. Weld penetration to be .007 - .015".

Weldment #6 of the Caging Diaphragm Subassembly, 22793-302, is shown in Figure 2. This weld is mechanical only, and not leak tested under vacuum. Weldment #7 is shown in Figure 4 below.

The parameters used on the SS550 are:

*pulse width : 3.1 ms
 pulse frequency: 20 pulses/sec
 average power: 288 W
 input power: 10.8 kW
 focus: sharp focus, focal length 6 inches
 nozzle size 0.25"
 assist gas: Argon
 assist gas pressure: 40 scfh (standard cubic feet per hour)
 feed rate, using X-Y interpolator (determines run time) :
 F20, Small weldments (even numbers)*

- 7.1.2 Weldment #6 : Weld completed Weldment #5 part to new P/N 22795-201
- 7.1.2.1 Take the completed Weldment #5, and a P/N 22795-201 on the clean room bench, clean parts to be welded by thoroughly spraying with TF spray. Insert the inner flange of Weldment #5 into the inner hole of P/N 22800-101. Shrink-fit not required. Fit surfaces of mating welded parts to be flush.
- 7.1.2.2 Weld this mating diameter (Weldment#6) per vendor weld procedure, using Stanford approved parameters.
- 7.1.2.3 Using new Weldment #5 and P/N 22795-201, repeat steps 7.1.2.1 through 7.1.2.2 until all candidate units completed.

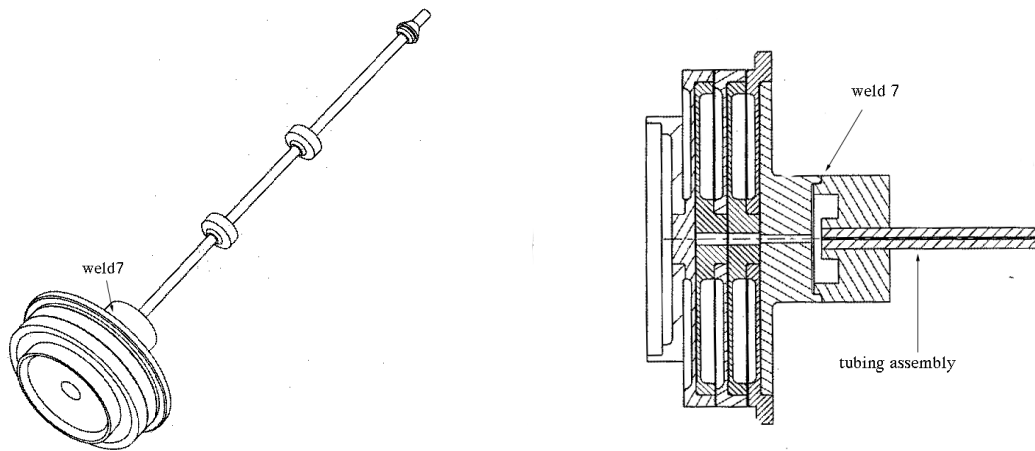


Figure 4. Weldment #7 of Diaphragm Assembly

7.1.3 Weldment #7 : Weld completed Weldment #6 part to new P/N 22822-201

Weldment #7 of the Caging Diaphragm Assembly, P/N 22793-301, is shown in Figure 4. This weld is of the Tubing Assembly, P/N 22822-201, to the Diaphragm Subassembly P/N 22793-302 (Weldment #6).

For Weldment #7, the test unit is placed in a Rotator fixture so that the unit rotates during the welding process. Weld penetration to be .007 - .015”.

The parameters used on the SS550 are:

*pulse width : 1.9 ms
 pulse frequency: 20 pulses/sec
 (average power: 150.8 W)
 focus: sharp
 feed rate: F100 (determines run time)*

- 7.1.3.1 Take the completed Weldment #6, and a Tubing Assembly, P/N 22822-201, on the clean room bench, clean parts to be welded by thoroughly spraying with Freon. To verify flow through the Tubing Assembly, insert the end of the Tubing Assembly tube to the plastic tube which attaches to the can of prefiltered Freon. The Tubing Assembly tube will just fit into the Freon tube. Spray the Freon and visually check that flow is coming through the Tubing Assembly tube.
- 7.1.3.2 Insert P/N 22822-201 into the inner flange of P/N 22791-101 of Weldment #6. Shrink-fit not required. Fit surfaces of mating welded parts to be flush.
- 7.1.3.3 Weld this mating diameter (Weldment#7) per vendor weld procedure, using Stanford approved parameters.

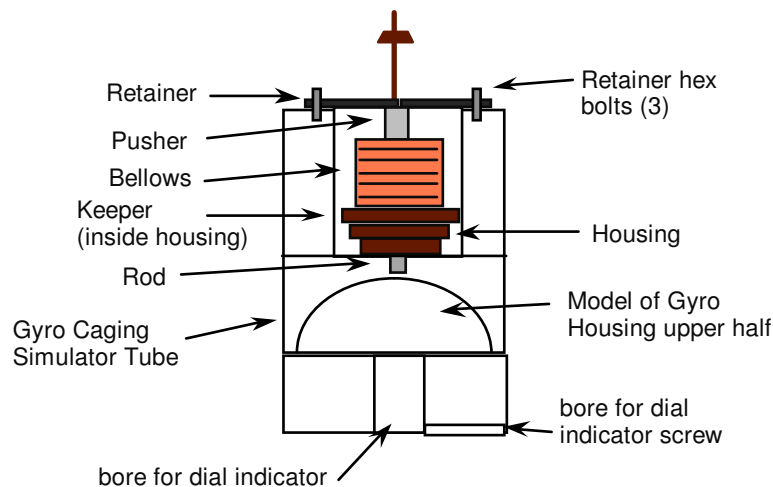
- 7.1.3.4 Using next Weldment #6 and P/N 22822-201, repeat steps 7.1.3.1 through 7.1.3.3 until all candidate units completed.
- 7.1.3.5 Put the Weldment #7 on the adapter unit of the Leak Detector. Leak test this part per Procedure P0054. Enter leak rate in Table 1. If leak rate is $< 10^{-8}$ sccs He, accept this part; if leak rate is $> 10^{-8}$ sccs He, repeat 7.1.3.3. If leak rate is $> 10^{-8}$ sccs He, after second weld, remove this unit from flight inventory.
- 7.1.3.6 Upon completion of leak test of all Weldment #7s, return to Stanford.

7.2 Pressure Test of Diaphragm Assembly

The candidate Weldment #7s, the Caging Diaphragm Assembly, P/N 22793-301, which passed leak test in the previous step, are brought back to Stanford HEPL to test for free movement of the diaphragm. The test is done in the Class 1000 MGP Clean Room. Hereafter, buildup of the Caging Subassembly will not leave the Class 1000 Room, prior to completion.

The plastic Gyro Caging Simulator Tube depicts the gyro cavity and housing for the purpose of testing the caging unit.

- 7.2.1 Place the completed Weldment #7 into the GSE Housing (modified P/N 22802-101). The housing will prevent over-travel during pressurization, and will be removed after test. Screw the GSE Keeper (modified P/N 22797-101) into the Housing. Holding the Housing Unit vertical, place the GSE Pusher (modified P/N 22804-101) / Bellows (modified P/N 22810-101) / Rod (modified P/N 22798-101) assembly on the keeper, held in place by gravity.
- 7.2.2 Place the GSE Caging Retainer (modified P/N 22897-101), and capillary tubing adapter on the assembly.
- 7.2.3 Place the unit into the bore of the plastic Gyro Caging Simulator Tube, Fixture #10, such that the 3 holes in the Retainer go over the bolts of the Simulator Tube. Hand tighten the 3 one-inch Hex nuts onto the bolts.



NOTE: Everything GSE except Diaphragm Assembly. Drawing not to scale

Figure 5. Caging Assembly in Gyro Caging Simulator Tube

- 7.2.4 Install the Mitutoyo Model IDC-112E Dial Indicator in the Simulator Tube. Place the Simulator on a V-block, with the Dial Indicator in place.
- 7.2.5 Connect the tubing assembly ferrule to the compression fitting adapter which adapts to the VCR fitting. Connect to the VCR fitting on the 1/8 inch stainless steel tube. Connect the VCR on the other end of the tube to the CCU as shown in Figure 6 below.

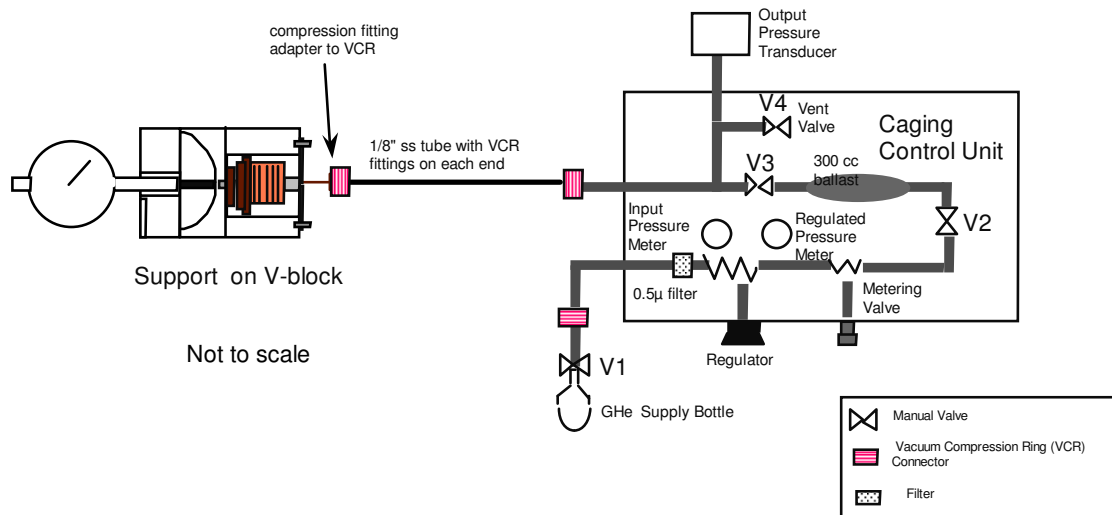


Figure 6. Set-up of Pressure Test of Diaphragm Subassembly (not to scale)

- 7.2.6 Configure the manual valves to their nominal conditions as follows: V1 open, V2 open, V3 open, V4 closed, Metering Valve closed. The metering valve shall be used to control the rate of rise.
- 7.2.7 Slowly build up pressure at a rate of approximately 1 psid per second, using the metering valve. Note the pressure at which travel is detected, and record in Table 2. If no travel is detected by 65 psid, relax the pressure, and bring it up again.
- 7.2.8 Continue building pressure at a rate of approximately 1 psid per second, not to exceed 160 psid. Record travel vs pressure at 10 psid increments in Table 3. Approximately 28 mils of travel at 160 psid, with near linear travel is desired. Limit travel to 32 mils.

NOTE: Verify that at 20 psid, travel is = .008 inch. This verifies Requirement # 3.7.1.4.7.8 of the Payload Spec, F277277.

- 7.2.9 After completing pressure test of unit, close off pressure at V2 and open V4 to vent to one atmosphere.
- 7.2.10 Disconnect the 1/8 inch ss tube from the caging unit at the adapter end of the tube.

- 7.2.11 Unscrew the 3 Hex nuts holding the Caging Retainer onto the Simulator. Remove the Caging Unit out of the Simulator.
- 7.2.12 Remove the Diaphragm Assembly out of the Housing Unit, by reversing the order of assembly in 7.2.1.
- 7.2.13 Assign serial number to this assembly if the unit is accepted at this stage, and record in Table 3. Diamond scribe the serial number into the back outer surface (tube side) of the Diaphragm Assembly. Place the Diaphragm Assembly into a clean marked container.
- 7.2.14 Repeat steps 7.2.1 through 7.2.13 until all Diaphragm Assemblies are tested.

Pressure	Unit Number (Entries are travel in mils)																	
psid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
10																		
20																		
30																		
40																		
50																		
60																		
70																		
80																		
90																		
100																		
110																		
120																		
130																		
140																		
150																		
160																		
Serial #																		

Table 3. Diaphragm Travel vs Pressure Test Results

7.3 LN₂ Dip of Serialized Units

The Serialized Caging Diaphragm Assembly, P/N 22793-301, which pass pressure test in the previous step, are thermal cycled in liquid nitrogen, and leak tested in the Class 1000 MGP Clean Room.

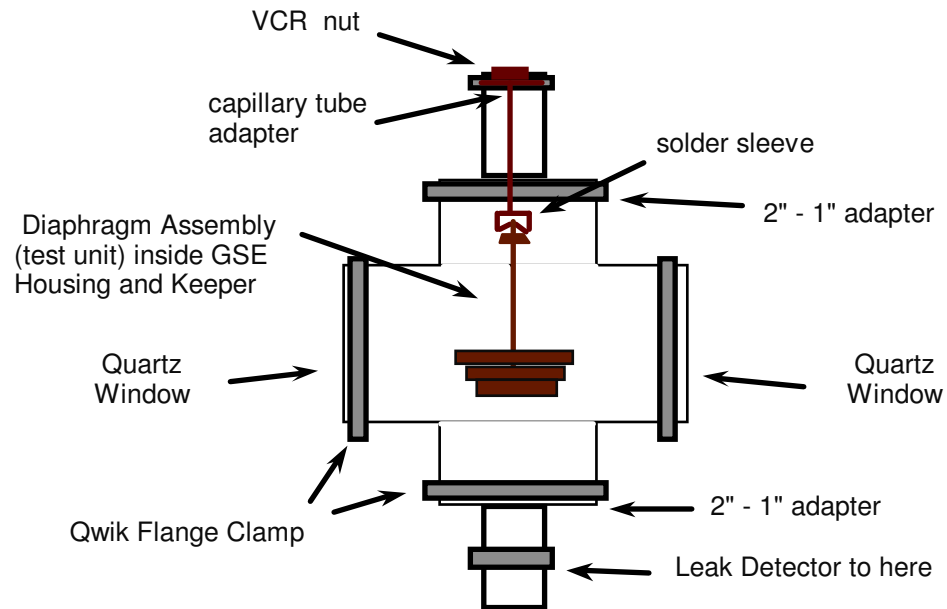
Record Start Date and Time _____

- 7.3.1 Prepare a LN₂ dewar flask of height sufficient to hold the entire assembly in the liquid, cold vapor, and warm vapor, and fill to a depth of approximately 6 inches with Liquid Nitrogen.
- 7.3.2 Prepare a tack pulley arrangement above the bench, such that a line can be plumbed into the dewar flask.
- 7.3.3 Prepare a monofilament nylon tie line to support the Diaphragm Assembly such that there are markers visible above the flask, which indicate the assembly is (a) in the liquid, (b) in the cold vapor, and (c) in the warm vapor.
- 7.3.4 Thermal cycle the unit according to Cryo Dip Procedure P0063.
- 7.3.5 After thermal cycling, store in clean numbered storage compartments.
- 7.3.6 Repeat cryo-dip procedure for all candidate units, and store in numbered compartments.

7.4 Leak Test of Serialized Units

For leak testing, the assembly is placed in GSE Housing and Keeper units as before to prevent over travel, then placed in a 2 inch diameter T-shaped Chamber. The chamber is evacuated using the Leak Detector, while the Diaphragm Assembly is pressurized with the Caging Control Unit.

The chamber has two quartz window flanges, and two 1 inch to 2 inch adapter flanges. One of the 1 inch adapters connects to the Leak Detector, and the other flange holds an adapter for holding the Diaphragm Assembly. Each 2 inch flange is clamped to the chamber with a 2 inch Qwik-flange clamp. The 1 inch adapter consists of a 1 inch plate with a capillary tube welded on. One end of the tube has a solder sleeve for soldering to the ferrule of the Diaphragm Assembly. The other end of the tube connects to a VCR nut. See Figure 7 below.



Vacuum Chamber with Diaphragm Assembly (not to scale)

Figure 7. Vacuum Chamber for Leak Testing Diaphragm Assembly

Record Start Date and Time _____

- 7.4.1 Connect the the bottom flange of chamber onto the leak detector. Clamp with a 1 inch Qwik Flange.
- 7.4.2 Connect the VCR female adapter on one end of the flexible 1/4 inch vacuum line to the VCR nut on the CCU, as shown in Figure 8 below. Be sure that V2 is closed.
- 7.4.3 Connect the VCR nut on the top flange to the VCR female on the 1/4 inch flexible vacuum hose.
- 7.4.4 Remove the capillary adapter unit from the chamber at the 2 inch flange, by loosening the 2 inch clamp.
- 7.4.5 Solder the ferrule of the Diaphragm Assembly tube onto the solder sleeve of the capillary adapter, according to soldering procedure 5833741.
- 7.4.6 Replace the flange with the Diaphragm Assembly in GSE Housing and Keeper, into the Chamber. Clamp down the 2 inch Qwik Flange clamp.

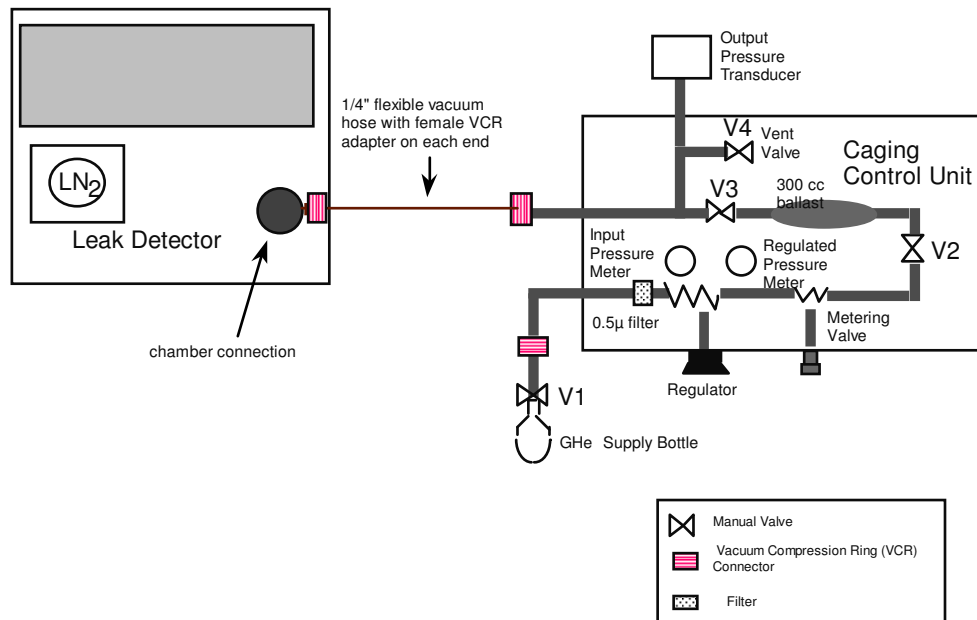


Figure 8. Leak Test Setup of Diaphragm Assembly

- 7.4.7 Pump down chamber to approximately 1×10^{-9} sccs He. Record background leak rate in Table 4 below.
- 7.4.8 Pressurize the Diaphragm Assembly to a maximum of 165 psid, at a rate of approximately 1 psid/sec, using the Metering Valve for control, and V2 open. If a leak greater than 1×10^{-8} sccs He is observed, stop and reject unit. Record leak rate and pressure in Table 4 below. If 165 psid is reached with leak rate $< 1 \times 10^{-8}$ sccs He, record leak rate and pressure in Table 4 below.
- 7.4.9 To de-pressurize the test unit, close V2, then open V4 to vent to one atmosphere.
- 7.4.10 Loosen the 2 inch Qwik Flange clamp holding the Diaphragm Assembly adapter. Lift out the the Diaphragm Assembly from the chamber.
- 7.4.11 De-solder the Diaphragm Assembly ferrule from the sleeve on the adapter, according to the Caging Soldering Procedure 5833741.
- 7.4.12 Clean Diaphragm Assembly and place in the clean marked container.
- 7.4.13 Repeat steps 7.4.5 through 7.4.12 for each candidate Diaphragm Assembly.

Leak Rate Requirement per PLSE-12, section 3.7.1.4.7.6 is $= 10^{-8}$ sccs He

Serial Number	Background (sccsHe)	Leak Rate (sccsHe)	Pressure for Leak Rate (psid)	Accepted (Y or N)

Table 4. Leak Test Results of Diaphragm Subassemblies

Completed: _____ date:
 Responsible Engineer

Discrepancies if any:

8. ASSEMBLY AND MEASUREMENTS OF ACTUATOR ASSEMBLY P/N 22794-301

This task module assumes (1) the Diaphragm Assembly Weldments 1-7 have been completed, cleaned, magnetically screened, and released. (2) the Caging Springs, P/N 22796-101 are cleaned, magnetically screened, and released.

8.1 Assembly of Actuator Assembly

Record Start Date and Time _____

This assembly procedure bonds the Caging Spring P/N 22796-101, to the Diaphragm Assembly, P/N 22793-301, to form the Actuator Assembly, P/N 22794-301, shown in Figure 9 below. The procedure is conducted on the laminar flow bench in the Class 1000 Room in HEPL.

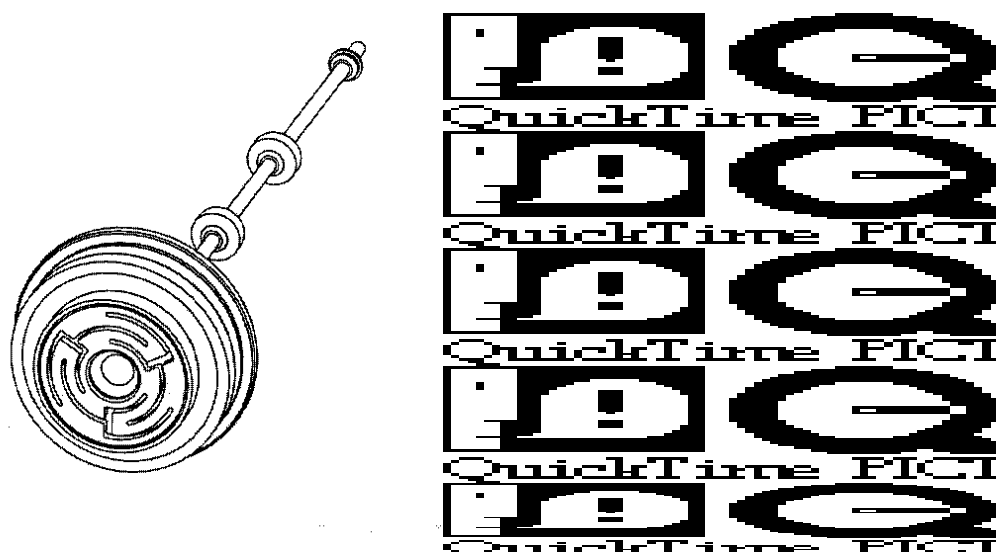


Figure 9. Actuator Assembly, P/N 22794-301

- 8.1.1 Remove a serialized Diaphragm Assembly from its container, and Epoxy bond, according to P0355, a Caging Spring P/N 22796-101 to the Diaphragm Assembly. Record the Lot Date Code of the Spring in Table 5 below. Repeat until all good Diaphragm Assembly parts are used.

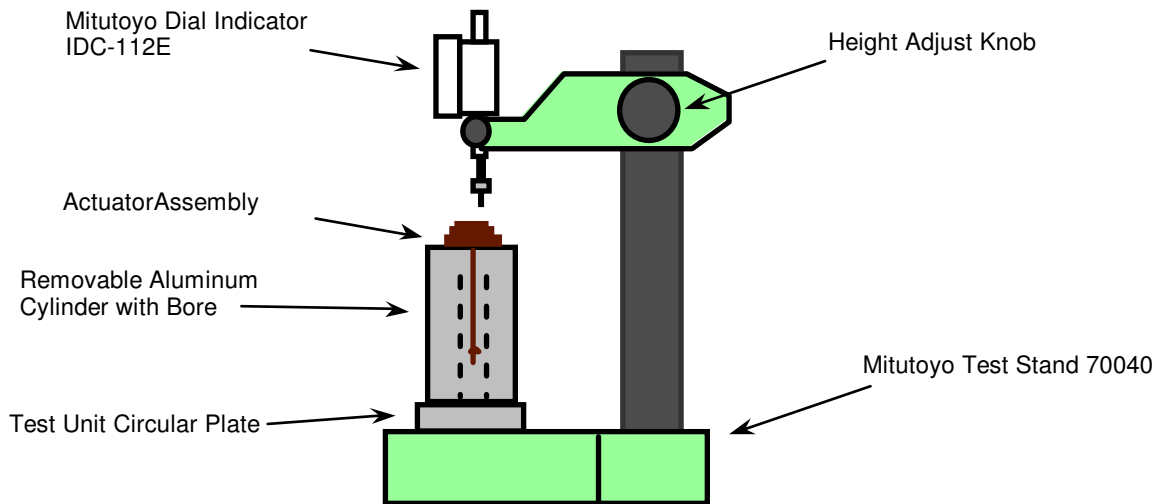


Figure 10. Test Setup for Dimensional Measurement of Actuator Assembly

- 8.2.2 The Actuator Assembly is placed in the cylindrical aluminum fixture with bore, specialized for this purpose. The tube of the Actuator Assembly is placed into the bore, and the tube-side surface of the Actuator Assembly rests on the aluminum cylinder, as shown in Fig 10.
- 8.2.3 Place the aluminum cylinder with Actuator Assembly on the circular plate on the stand.
- 8.2.4 Set the zero point of the indicator to the common surface shown in Figure 9. Place the spring loaded tip of the dial indicator on the highest part of the top surface (caging spring or transfer ring), within 0.05 inch of the edge of the Actuator Assembly, and read the indicator reading. Repeat this measurement 3 times, by lifting up the tip off the surface, releasing, and reading. The 3 measurements should be repeatable within 0.5 mil. Record the average of these three readings in Table 6 below.
- 8.2.5 With the tip raised off the surface, rotate the aluminum cylinder with Actuator Assembly approximately 120 degrees, and repeat step 8.2.4 above.
- 8.2.6 Rotate the aluminum cylinder with Actuator Assembly once more by 120 degrees, and repeat step 8.2.4 above.
- 8.2.7 Record average of these 3 average measurements in Table 6 below, and in Table 7, column 2.
- 8.2.8 When completed with an Actuator Assembly, remove the aluminum cylinder from the test stand, remove the Actuator Assembly from the cylinder, and place in a marked container.
- 8.2.9 Repeat Steps 8.2.2 through 8.2.8 for each Actuator Assembly

Actuator Assembly Serial Number	Average of 3 measurements at Location 1 (mils)	Average of 3 measurements at Location 2 (mils)	Average of 3 measurements at Location 3 (mils)	Average of 3 Averages (mils) Reqmt: 0.270 ±.005 inch

Table 6. Actuator Assembly Dimensional Measurements

Completed: _____ date:
Responsible Engineer

Discrepancies if any:

9. MATCH MACHINING THE HOUSING (P/N 22802-101) AND ROD (P/N 22798-101) TO THE ACTUATOR ASSEMBLY

This task module assumes (1) the Actuator Assemblies, P/N 228794-301, have been completed, and dimensionally tested; (2) the Housings, P/N 22802-101, have been machined to their reference measurements; (3) the Caging Rod Blanks, P/N 22798-102, have been completed.

9.1 Match Machining Housing and Rod to Actuator Assembly

The desired travel of the diaphragm, .029 inch, is achieved by match machining the Housings, P/N 22802-101, to the Actuator Assemblies. The Caging Rods, P/N 22798-101, are match machined to the Housings to provide the proper gap between rod and gyro housing.

The critical dimension of the Housing is the difference between Dimension A (reference 0.478 inch), and Dimension B (reference 0.179 inch), in Figure 11. This difference is nominally 0.299 inch. This actual difference must match the Actuator Assembly surface measurement from Table 6 (reference 0.270 inch), plus the desired travel, .029 inch.

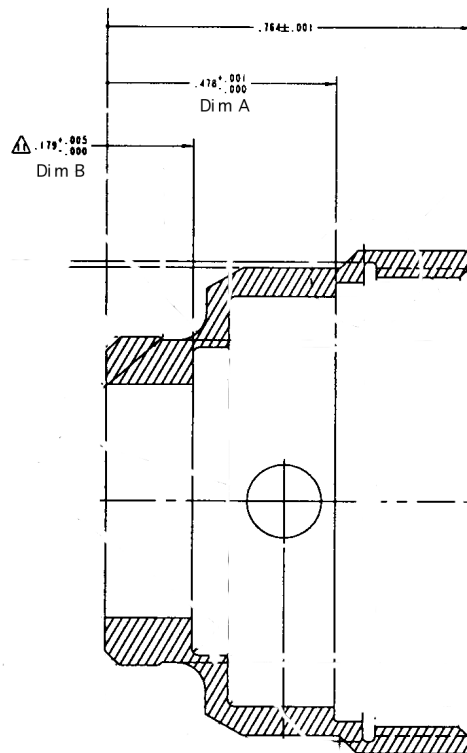


Figure 11. Housing, Caging

The Housings are first machined to their reference dimensions. These dimensions are measured, and if the actual difference matches the corresponding dimension of an Actuator Assembly, the Housing and Actuator Assembly are paired up. If an Actuator Assembly cannot be matched with a Housing without machining, a Housing will be match machined to it.

For machining, if the Housing difference measurement (Dim A minus Dim B) is greater than the Actuator Assembly dimension, then dimension A is machined down. If the Housing difference is smaller than the Actuator dimension, then dimension B is machined down. If the difference between Housing and Actuator dimensions is large, then both dimensions may require adjustment.

The Caging Rod length L, shown in Figure 12, is machined to equal the sum of 0.232 inch (the desired at-rest length from the top surface of the Housing to the top center of the Rod), Dimension B (ref .179 inch), and the desired travel, .029 inch. This rod length is nominally 0.440 inch.

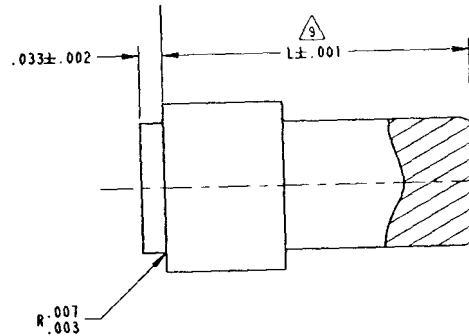


Figure 12. Rod, Caging

Table 7 gives the final after-machining dimensions of the Actuator Assembly, Housing, and Rod. The paired Serial Numbers of each are given.

Actuator Assembly Serial Number	Avg AA Surface Difference, inch (0.270)	Housing Serial Number	Housing Dim A, inch (.478)	Housing Dim B, inch (.179)	Dim A minus Dim B, inch (.299)	Rod Length, L (Dim B + .232 + .029), inch	Total Calculated Travel, inch (.029 ± .001)

Table 7. Final Dimensions of Housing/Actuator Units after Match Machining

10. ASSEMBLY AND TEST OF HOUSING/ACTUATOR ASSEMBLY, P/N 22805-301

This task module assumes (1) the Actuator Assemblies have been completed, cleaned, magnetically screened, and released. (2) the Housings, P/N 22802-101, have been match machined to the Actuator Assemblies, cleaned, magnetically screened, and released. (3) the Rods, P/N 22798-101, have been match machined to the Actuator Assemblies, cleaned, magnetically screened, and released.

10.1 Assembly of Housing/Actuator Assembly

Record Start Date and Time _____

This assembly integrates the Housing P/N 22802-101, Keeper, P/N 22797-101, and Rod, P/N 22798-101 to the Actuator Assembly, P/N 22794-301. The Housing /Actuator Assembly is shown in Figure 13 below.

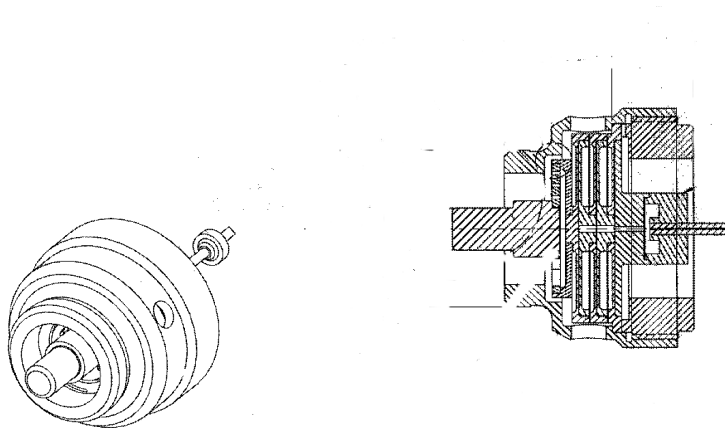


Figure 13. Housing Actuator Assembly, P/N 22805-301

- 10.1.1 Pair up the matched machined Caging Rod to an Actuator Assembly. Epoxy bond the Rod into the Caging Spring of the Actuator Assembly, following Epoxy Bond Procedure P0355. Let cure according to this procedure.
- 10.1.2 Pair up the matched machined Housing to an Actuator Assembly. Record Serial Numbers in Table 8.
- 10.1.3 Insert the Actuator Assembly with Rod into the Housing.
- 10.1.4 Holding the Actuator Assembly / Rod / Housing unit in one hand, slide a Keeper over the tube of the Tubing Assembly into the Housing. Screw the Keeper into the Housing. Record Lot Date Code of the Keeper in Table 8.

10.2.2 Maximum Travel Test

Note: This test uses the same set-up as the Diaphragm Assembly Pressure Test of Section 6.2

- 10.2.2.1 Holding the Housing / Actuator Assembly vertical, place the GSE Pusher (modified P/N 22804-101) / Bellows (modified P/N 22810-101) on the keeper, over the Tubing Assembly, held in place by gravity.
- 10.2.2.2 Thread a GSE Caging Retainer (modified P/N 22897-101) onto the Pusher threads.
- 10.2.2.3 Place the unit into the bore of the plastic Gyro Caging Simulator Tube, such that the 3 holes in the Retainer go over the bolts of the Simulator Tube. Hand tighten the 3 one-inch Hex nuts onto the bolts.
- 10.2.2.4 Install the Mitutoyo Digital Dial Indicator in the Simulator Tube. Place the Simulator on a V-block, with the Dial Indicator in place.
- 10.2.2.5 Connect to the CCU as indicated in Section 7.2.5, as shown in Figure 6.
- 10.2.2.6 Configure the manual valves to their nominal conditions as follows:
V1 open, V2 open, V3 open, V4 closed, Metering Valve closed. The metering valve shall be used to control the rate of rise.
- 10.2.2.7 Slowly build up pressure at a rate of approximately 1 psid per second, until the maximum travel is indicated. Record the maximum travel, and pressure at which it occurs, in Table 9 below. If the travel does not meet requirement, remachine housing.
- 10.2.2.8 After completing pressure test of unit, close off pressure at V2 and open V4 to vent to one atmosphere.
- 10.2.2.9 Replace the Housing / Actuator Assembly with a new one, by following the disconnect/connect steps described in Sections 7.2.10 through 7.2.12.
- 10.2.2.10 Repeat 10.2.2.5 through 10.2.2.9 until all Housing/Actuator Assemblies are tested for maximum travel.

Housing/ Actuator Assembly Serial No.	Maximum Travel (mils) Reqmt: 29±1 mils	Pressure at Max Travel (psid)	Maximum Force (lb) - Trial 1 Reqmt: 13±1 lb	Pressure at Max Force (psid)	Maximum Force (lb) - Trial 2 Reqmt: 13±1 lb	Pressure at Max Force (psid)	Accept (Y/N)

Table 9. Test Results of Travel and Force Tests, Housing/ Actuator Assembly

10.2.3 Maximum Force Test

Note: This test reconfigures the Gyro Simulator Tube to accept a gyro ball / load cell unit in place of the dial indicator unit. The load cell unit has a clear plastic simulation of the upper half of a gyro which is threaded to raise or lower the ball relative to the load cell itself.

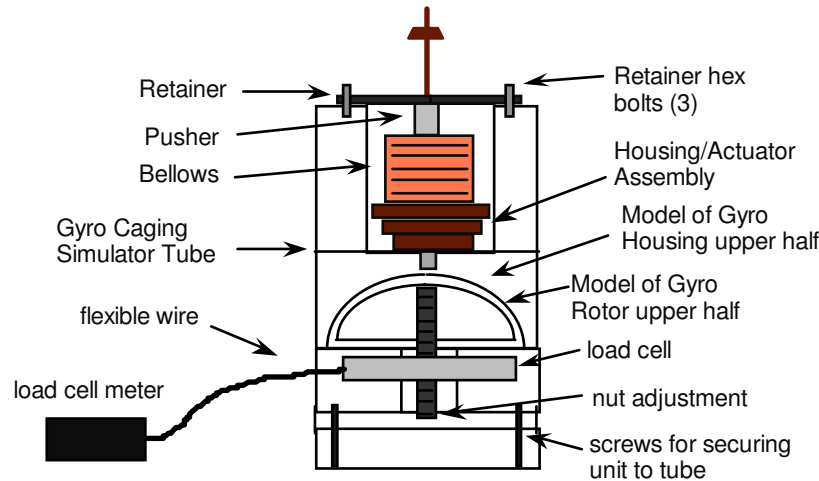


Figure 14. Gyro Simulator Tube with Load Cell

- 10.2.3.1 Remove the dial indicator cylindrical unit from the Gyro Simulator Tube, by unscrewing the 3 hex screws on the bottom, which hold the unit onto the rest of the Tube.
- 10.2.3.2 Adjust the gyro ball / load cell unit to the Tube by raising / lowering the threaded ball until it just contacts the housing. Screw the ball in by 15 deg from contact, to yield a 2 mil gap.
- 10.2.3.3 Attach the gyro ball / load cell unit to the Gyro Caging Simulator Tube, by screwing in the 3 hex screws from the bottom.
- 10.2.3.4 Place the Simulator Tube vertically on the table, with load cell meter connected.
- 10.2.3.5 Connect to the CCU as before, as indicated in Section 7.2.5, and shown in Figure 6.
- 10.2.3.6 Configure the manual valves to their nominal conditions as follows:
 V1 open, V2 open, V3 open, V4 closed, Metering Valve closed. The metering valve shall be used to control the rate of rise.
- 10.2.3.7 Slowly build up pressure at a rate of approximately 1 psid per second, until the pressure at which maximum travel was reached is achieved. The force indicator on the load cell meter should be rising.
- 10.2.3.8 Continue building up pressure at a rate of approximately 1 psid per second, until the peak force is reached on the load cell meter. Record peak force and pressure at peak force in Table 9.

- 10.2.3.9 After completing reading, close off pressure at V2 and open V4 to vent to one atmosphere.
- 10.2.3.10 Repeat the peak force reading by repeating steps 10.2.3.6 through 10.2.3.9.
If the force does not meet requirement, reject this unit at this point. Indicate in Table 9.
- 10.2.3.11 Replace the Housing / Actuator Assembly with a new one, by following the disconnect/connect steps described in Sections 7.2.10 through 7.2.12.
- 10.2.3.12 Repeat 10.2.3.6 through 10.2.3.11 until all Housing/Actuator Assemblies are tested for maximum force.
- 10.2.3.13 Upon completion of all pressure tests, epoxy bond the Keeper to the Housing, following Epoxy Bond Procedure P0355. Let cure according to this procedure.

Completed: _____ date:
Responsible Engineer

Discrepancies if any:

11. ASSEMBLY AND DIMENSIONAL MEASUREMENTS OF MECHANISM ASSEMBLY, P/N 22809-301

This task module assumes (1) the Housing/Actuator Assemblies, P/N 22805-301, have been completed, tested, cleaned, magnetically screened, and released; (2) the Pushers, P/N 22804-101, have been completed, tested, cleaned, magnetically screened, and released; (3) the Bellows, P/N 22810-101, have been completed, tested, cleaned, magnetically screened, and released.

11.1 Assembly of Mechanism Assembly

Record Start Date and Time

This assembly bonds the Pusher, P/N 22804-101, and Bellows, P/N 22810-101 to the Housing/Actuator Assembly P/N 22805-301. The Mechanism Assembly is shown in Figure 15 below.

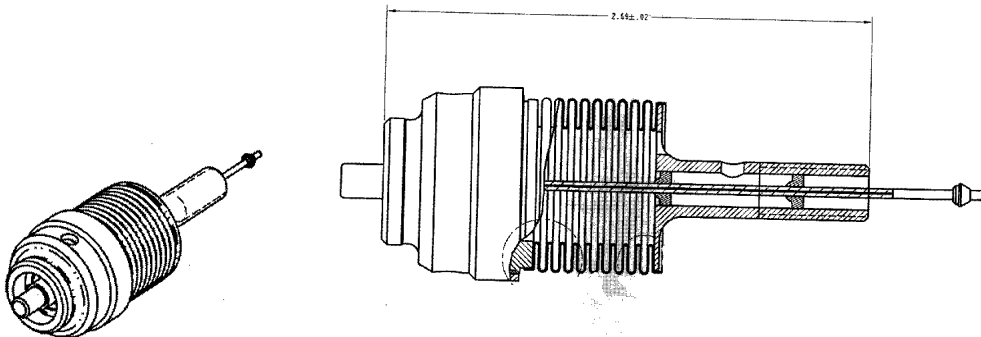


Figure 15. Mechanism Assembly

- 11.1.1 Epoxy bond the Pusher to the Bellows, following Epoxy Bond Procedure P0355. Let cure according to this procedure.
- 11.1.2 Place a Pusher / Bellows unit over the tube of the Housing/Actuator Assembly. Record Lot Date Codes in Table 10.
- 11.1.3 Epoxy bond the Bellows to the Keeper, following Epoxy Bond Procedure P0355. Let cure according to this procedure.

11.2 Dimensional Measurement and Magnetic Test of Mechanism Assembly

- 11.2.1 Verify the length of the Mechanism Assembly (note 12 in drawing 22809-301). Record length on Traveler. This length should be $2.69 \pm .02$ inch.
- 11.2.2 Send to Stanford Magnetism Lab for gradiometer testing, according to P0057A.

12. ASSEMBLY OF CAGING SUBASSEMBLY, P/N 23190-301

This task module assumes (1) the Mechanism Assemblies, P/N 22809-301, have been completed and tested; (2) the Retainers, P/N 22897-101, have been completed, cleaned, magnetically screened, etched, and released.

12.1 Assembly of Caging Subassembly

Record Start Date and Time

This assembly installs the Retainer, P/N 22897-101, to the Mechanism Assembly P/N 22809-301. The Caging Subassembly is shown in Figure 16 below.

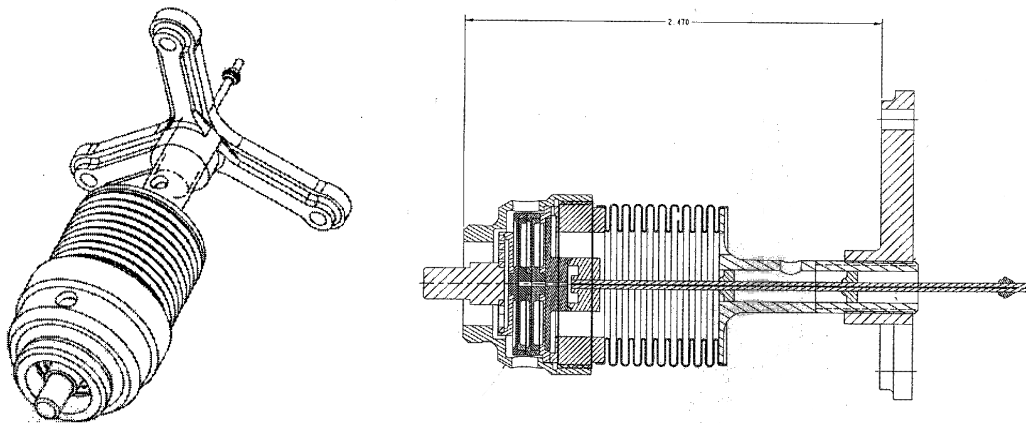


Figure 16. Caging Subassembly

12.1.1 Thread a Retainer unit onto the threads of the Pusher in a Mechanism Assembly.
Record Lot Date Code in Table 9.

12.2.1 Adjust the length of the Caging Subassembly (note 12 in drawing 23190-301) to $2.470 \pm .005$ inch.

NOTE: The Retainer is epoxy bonded during integration of the Caging Unit into the SIA, reference P0325

Completed: _____ date:
Responsible Engineer

Discrepancies if any:

13. ASSEMBLY AND TEST OF TUBING ASSEMBLY, CAGING JUMPER LINE, P/N 23188-201

13.1 Assembly of Tubing Assembly, Caging Jumper Line

This task module takes place in Stanford's HEPL building Tube Shop, Rm 141. It assumes the Tubing Assembly parts have been cleaned, magnetically screened, and released. The Tubing Assembly, Caging Jumper Line, P/N 23188, is shown in Figure 17.

- 13.1.1 The length L is determined by a fit check after the SIA is integrated with the probe, and the tubes are then cut to length. Record the length L for each line in Table 11.

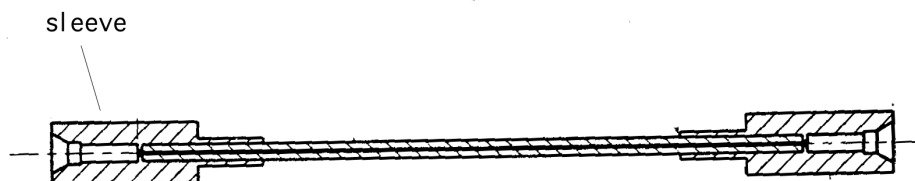


Figure 17. Tubing Assembly, Caging Jumper Line

- 13.1.2 Brazing the Sleeves, P/N 23384-201, Onto the Tube.

Record Start Date and Time _____

- 13.1.2.1 Clear off the bench area where brazing is to be done. Put the brazing tools, braze material, inert gas, in a readily accessible place.
- 13.1.2.2 Connect the inert gas (Argon) supply tube onto the bare tube.
- 13.1.2.3 Position a Sleeve, P/N 23384-201 onto the other end of the Tube, in accordance with drawing 23188.
- 13.1.2.4 Hand braze the Sleeve onto the Tube, using CUSIL 20 mil brazing alloy, according to Tube Shop procedures. The inert gas will be flowing through the tube during the actual brazing. Leak test braze according to Tube Shop procedure. Brazing is to be performed by Manuel Ortega of Stanford, or his designate.
- 13.1.2.5 Remove the supply gas from the Tube, and connect to the other end.
- 13.1.2.6 Position a Sleeve, P/N 23384-201 onto the other end of the Tube, in accordance with drawing 23188.
- 13.1.2.7 Hand braze the Sleeve onto the Tube, using CUSIL 20 mil brazing alloy, according to Tube Shop procedures. The inert gas will be flowing through the tube during the actual brazing. Leak test braze according to Tube Shop procedure. Brazing is to be performed by Manuel Ortega of Stanford, or his designate.

13.1.2.8 Clean subassembly with TF spray according to procedure P0059, bag, and store in numbered compartment.

13.1.2.9 Repeat 13.1.2.1 through 13.1.2.8 until 16 assemblies are completed.

13.2 LN₂ Dip, Leak Test, and Mag Test of Tubing Assembly, Caging Jumper Line

The LN₂ dip procedure takes place at Stanford HEPL, Class 1000 Clean Room bench. The Leak Test will be done in the Class 1000 Clean Room.

Record Start Date and Time _____

13.2.1 Prepare a LN₂ dewar flask of height sufficient to hold the entire assembly in the liquid, cold vapor, and warm vapor, and fill to a depth of approximately 10 inches with Liquid Nitrogen.

13.2.2 Prepare a tack pulley arrangement above the bench, such that a line can be plumbed into the dewar flask.

13.2.3 Prepare a monofilament nylon tie line to support the Tubing Assembly such that there are markers visible above the flask, which indicate the assembly is (a) in the liquid, (b) in the cold vapor, and (c) in the warm vapor, when the marker is at the pulley location. See P0063 for further details.

13.2.4 Thermal cycle the unit according to Cryo Dip Procedure P0063.

13.2.5 After thermal cycling, store in clean numbered storage compartments. Repeat cryo-dip procedure for all candidate units, and store in numbered compartments.

13.2.6 After thermal cycling all candidate units, perform vacuum leak test of each unit according to P0054. Record leak rate in Table 11.

13.2.7 Clean subassembly with TF spray according to P0059, bag, and store in numbered compartment.

13.2.8 Send to Stanford Magnetics Lab for magnetic testing, according to P0057A.

15. PROCEDURE COMPLETION

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

Responsible Engineer _____ Date _____

Hardware Manager: _____ Date _____

The information obtained under this assembly and test procedure is as represented and the documentation is complete and correct.

Quality Assurance _____ Date _____

16. DATA BASE ENTRY

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

- 1) Name, number and revision of this procedure
- 2) Date of successful completion of procedure.