CBI

IDENTIFICATION			
HMST3N LIGO-E950068-05-B			
REFERENCE NO. 953570 (930212)		SHT 1 OF 9	
OFFICE RSE		REVISION 5D	
MADE BY CNS	CHKD BY EEB	MADE BY PBS	CHKD BY WAC
DATE 3/15/94	DATE 5/1/94	DATE 1/30/97	DATE 2/4/97

TITLE
HELIUM MASS SPECTROMETER HOOD TEST OF PUMP PORTS WITH VALVE

PRODUCT
LIGO BEAM TUBE MODULES
CALIFORNIA INSTITUTE OF TECHNOLOGY

APPROVED — CBI: M. Tellalian, DATE 2-7-97 — CALTECH: DATE

1.0 SCOPE:

1.1 This procedure covers the final helium mass spectrometer hood test of each pump port flange to 10"Ø valve flange seal, the valve disk seal, the valve to type "H" pump port hardware seal and the seals in the type "H" hardware.

1.2 Perform the leak testing outlined in this procedure on the beam tube sections with pump ports after each of these applicable tube sections has:

1.2.1 Been successfully HMS leak tested in accordance with procedure HMST1N

1.2.2 Been final cleaned in accordance with procedure CL1N.

1.2.3 Had the 10"Ø UHV gate valve installed on the 10"Ø pump port.

1.2.4 Optionally, had the type "H" hardware installed on the 10"Ø UHV gate valve.

2.0 LEAK TESTING EQUIPMENT TO BE USED IN THIS PROCEDURE:

2.1 The helium mass spectrometer used to perform the leak testing outlined in this procedure shall be a Varian Model 960 T or equivalent with an optimum high sensitivity in the range of 10^{-11} atm. cc/sec of helium. All leak detectors shall be turbo pumped. Diffusion pumped units are not acceptable. See figure 1.

2.2 A disk shaped,pump port leak test plug. The pump port leak test plug shall have 1/2" NPT fittings for attachment of a helium supply line and helium vent and sampling connection. The plug is inserted into the pump port from inside of the beam tube. The plug is inserted into the port as far as possible with the tabs at 45° angle. The bolting is then tightened to compress the o-ring seal. The HMS is attached to the 40 mm valve on the type "H" hardware using a conflat to small ISO (KF or NW fitting) adapter and stainless steel flex hose. If the type "H" hardware is not going to be installed prior to the leak test, a test blind flange must be installed to the 10" valve. See drawings ER- 605 and ER-606.

2.3 A test blind flange to be installed to the 10" valve if the type "H" hardware has not been installed. See drawing ER- 605.

2.4 A standard helium calibrated leak in the range of 1 to 5 X 10^{-10} atm. cc/sec of helium

2.5 A plastic sheeting and duct tape helium hood bag. The hood is installed to cover all seals of the valve and pump port hardware.

2.6 An oxygen analyzer capable of detecting oxygen levels down to below 2.0%.

2.7 An optional external cold trap in the test line.

2.8 An optional Leybold Toss 50 or similar turbomolecular pumping station.

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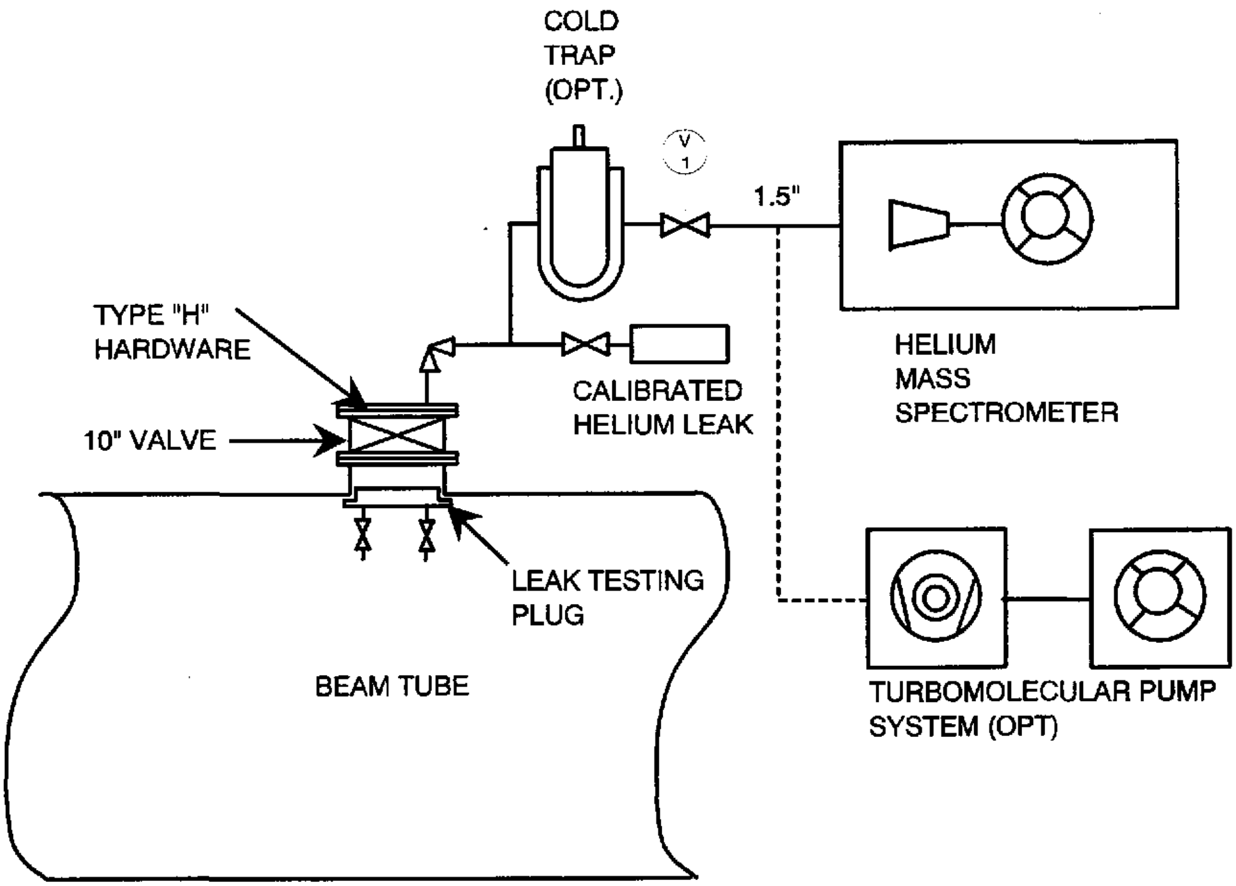

Figure 1

3.0 PROCEDURE:

3.1 Clean the interior of the port nozzle, the valve, and the type "H hardware. Install the valve and the pump port hardware (if the "H" hardware is being installed at this time).

3.2 Install the pump port leak test plug, the helium mass spectrometer and the calibrated leak as shown in figure 1.

3.3 Open the 10" ∅ valve (if it is not already in the open position).

3.4 Close the two valves in the pump port plug.

3.5 Start the HMS and calibrate as specified in the manufacturers instructions.

3.6 Vent the HMS and open the isolation valve (V1), the external calibrated leak valve, and the type "H" valve.

3.7 Evacuate the test volume with the HMS. Should the vacuum in the HMS test port stabilize at a high pressure indicating potential leakage, helium tracer probe test the port assembly to locate the leak . Repair any leaks found and repeat this procedure beginning at 3.1 above.

3.7(Alt.) Evacuate the test volume with the optional turbomolecular pumping system (TMP) and LN2 filled cold trap in lieu of the HMS described in 3.7 above. Having evacuated the system with the TMP, remove the TMP from the system, place the HMS on the system, and proceed with the test as described below.

3.8 Calibrate the test system against the 1 to 5 X 10^{-10} atm. cc/sec of helium calibrated leak:

3.8.1 Close the calibrated leak valve, and wait for at least 90 seconds before proceeding with the following steps.

3.8.2 Use the HMS zero function to "zero out" the system background.

3.8.3 Open the valve to the helium standard leak, and allow the helium signal to stabilize. Record the time required for the helium leak rate indication to reach a peak (not saturated) which is the response time.

3.8.4 Record the helium signal value (M_1) as a number of divisions on the instrument. A division shall be based on the smallest increment on the most sensitive scale of the leak rate indicator meter.

3.8.5 Close the standard leak valve and record the clean up time required for the helium leak signal to diminish to less than 33% of the M_1 signal value.

3.8.6 Record the background signal (M_2) as a number of divisions on the instrument after the background signal has stabilized. A division shall be based on the smallest increment on the most sensitive scale of the leak rate indicator meter.

3.8.7 Calculate the preliminary system sensitivity (S_1) in atm. cc/sec /div.
S_1 = (Std helium calibrated leak value) ÷ ($M_1 - M_2$)

3.8.8 If $S_1 \leq 1 \times 10^{-10}$ atm. cc/sec/div, proceed with the test. If $S_1 > 1 \times 10^{-10}$ atm. cc/sec/div, perform the necessary maintenance and corrective action to bring the system to the required sensitivity, and begin the test sequence again at step 3.8.1 above.

3.9 Leak Test Of The Port Flange To Valve CF Seal, Valve Bonnet, and (if installed) The "H" Hardware To Gate Valve CF Seal and type "H" hardware Seals

3.9.1 Install the helium hood (bag) if it is not already in place. This bag (or bags) must enclose the port to valve connection, valve body including bonnet, the valve to "H" hardware connection, and the "H" hardware seals.

3.9.2 Deflate the hood bag by hand or with a shop vacuum.

3.9.3 Backfill the hood bag with helium.

3.9.4 Sample the helium concentration in the hood bag.

3.9.5 Calculate the helium concentration sensitivity correction factor (C_{hc}) = 100 ÷ % Helium in hood.

3.9.6 Observe the HMS leak rate indicator meter for the larger of one (1) minute or three times the measured response time from section 3.8 above.

3.9.7 Upon completion of the observation time, record the test leak rate indicator signal (M_3) as a number of divisions on the instruments most sensitive scale.

3.9.8 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is equal to or greater than 4.9 x 10^{-10} atm cc/sec, go directly to section 5.0 Signal Verification and Leak Location.

If: $(M_3 - M_2) \times S_1 \times C_{hc} \geq 4.9 \times 10^{-10}$ atm cc/sec, go to section 5.0 Signal Verification and Leak Location, below.

3.9.9 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is less than 4.9 x 10^{-10} atm cc/sec, proceed with steps 3.12 and following.

If: $(M_3 - M_2) \times S_1 \times C_{hc} < 4.9 \times 10^{-10}$ atm cc/sec, proceed with steps 3.12 and following.

3.10 Leak Test of the 10" Gate Valve Seal

3.10.1 Close the 10" valve.

3.10.2 Using the valved inlet through the pump port test plug, fill the volume between the pump port test plug and the 10" gate valve with helium.

3.10.3 Sample the helium concentration in the volume between the plug and the valve through the vent valve in the pump port test plug and calculate the helium concentration sensitivity correction factor (C_{hc}) = 100 ÷ % Helium in port.

3.10.4 Observe the HMS leak rate indicator meter for at least three times the measured response time from section 3.8 above (but not less than 30 seconds).

______ 3.10.5 Upon completion of the observation time, record the test leak rate indicator signal (M_3) as a number of divisions on the instruments most sensitive scale.

______ 3.10.6 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is equal to or greater than 1×10^{-9} atm cc/sec, go directly to section 5.0 Signal Verification and Leak Location.

______ If: $(M_3 - M_2) \times S_1 \times C_{hc} \geq 1 \times 10^{-10}$ atm cc/sec, go to section 5.0 Signal Verification and Leak Location, below.

______ 3.10.7 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is less than 1×10^{-9} atm cc/sec, proceed with steps 3.12 and following.

______ If: $(M_3 - M_2) \times S_1 \times C_{hc} < 1 \times 10^{-10}$ atm cc/sec, proceed with steps 3.12 and following.

3.11 Leak Test of The "H" Hardware To Gate Valve CF Seal and "H" Ass'y CF Seals ONLY.

3.11.1 Delete steps 3.1 through 3.4 above.

3.11.2 Close the 10" valve if it is not already closed.

3.11.3 Perform steps 3.5 through 3.8.8 above.

3.11.4 Install the helium hood (bag) if it is not already in place. This bag (or bags) must enclose the valve to "H" hardware connection, and the "H" hardware seals.

______ 3.11.5 Deflate the hood bag by hand or with a shop vacuum.

______ 3.11.6 Backfill the hood bag with helium.

______ 3.11.7 Sample the helium concentration in the hood bag.

______ 3.11.8 Calculate the helium concentration sensitivity correction factor (C_{hc}) = 100 ÷ % Helium in hood.

______ 3.11.9 Observe the HMS leak rate indicator meter for the larger of one (1) minute or three times the measured response time.

______ 3.11.10 Upon completion of the observation time, record the test leak rate indicator signal (M_3) as a number of divisions on the instruments most sensitive scale.

______ 3.11.11 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is equal to or greater than 1×10^{-10} atm cc/sec, go directly to section 5.0 Signal Verification and Leak Location.

______ If: $(M_3 - M_2) \times S_1 \times C_{hc} \geq 1 \times 10^{-10}$ atm cc/sec, go to section 5.0 Signal Verification and Leak Location, below.

______ 3.11.12 If the test leak rate indicator signal (M_3), less the background signal (M_2), multiplied by the system sensitivity (S_1), corrected for helium concentration is less than 1×10^{-10} atm cc/sec, proceed with steps 3.12 and following.

______ If: $(M_3 - M_2) \times S_1 \times C_{hc} < 4.9 \times 10^{-10}$ atm cc/sec, proceed with steps 3.12 and following.

3.12 HMS Calibration Confirmation

3.12.1 Open the valve to the helium standard leak. Wait until the leak rate indication has stabilized, and record the leak rate indication signal (M_4) as a number of divisions on the instruments most sensitive scale.

______ 3.12.2 Calculate the final system sensitivity (S_2) in atm cc/sec/div.

$$S_2 = (\text{Std helium calibrated leak value}) \div (M_4 - M_3)$$

3.12.3 *There must be an agreement of 65% or more between S_1 and S_2. If there is not 65% or greater agreement, , perform the necessary maintenance and corrective action to bring the test system to the required sensitivity and begin the test sequence again at step 3.7 above. Percent agreement is equal to the lesser of S_1 or S_2 divided by the greater of S1 or S2.*

% Agreement = (Lesser of S1, S2 ÷ Greater of S1, S2) x 100

3.13 Calculate the final test sensitivity (S_F) corrected for tracer gas concentration .

$$S_F = S_2 \times C_{hc}$$

3.14 If $S_F \geq 1 \times 10^{-10}$ atm cc /sec /div, perform the necessary maintenance and corrective action to bring the system to the required sensitivity, remove the helium from the hood and begin the test sequence again at step 3.9 above.

3.15 Calculate the final observed leak rate (Q_F) corrected for helium concentration.

$$Q_F = (M_3 - M_2) \times S_F = \quad \text{atm cc/sec}$$

3.16 Assemblies which meet the following criteria for Q_F are acceptable:

Valve gate seal; $Q_f < 1 \times 10^{-9}$ atm cc/sec helium

Valve body and bonnet seal; $Q_f < 5 \times 10^{-10}$ atm cc/sec helium

Valve to port, valve to H hardware, and H hardware assembly; $Q_f < 1 \times 10^{-10}$ atm cc/sec.

Assemblies which do not meet the above listed acceptance criteria shall be repaired or replaced, and retested to this procedure.

3.17 With the 10" pump port valve remaining in the closed position, remove the pump port plug and clean the pump port and accessible areas of the valve with isopropyl alcohol and lint free cleaning towels.

3.18 Remove the HMS from the pump port hardware. Clean and replace the blank flange from the 40 mm valve outlet.

4.0 DOCUMENTATION:

4.1 Complete a Form WL233C, CBI LIGO PUMP PORT TO VALVE LEAK TEST REPORT, or a similar report generated by computer including all of the information required for Form WL233C. (A copy of Form WL233C is attached to this procedure.

4.2 Check for accuracy, sign and date the Form WL233C or the computer generated report.

4.3 Sign-off and date the beam tube module checklist for the pump port to valve leak test after it has been successfully completed.

4.4 In the comments section of the checklist, make entries of all noteworthy leak testing events, such as leaks repaired, or unusual difficulties in completing a leak test.

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CBI LIGO PUMP PORT TO VALVE TEST REPORT

______	______	______	953571	Hanford/Livingston
MODULE	PUMP PORT I.D.	VALVE TAG NO.	CONTRACT	LOCATION (Circle One)

Procedure and Rev. HMST3N Rev. _____	HMS Leak Detector (Mfg., Model and Serial Number)
System Standard Helium Leak ID	System Standard Leak Helium Leakage Rate _______ x 10^{-10} atm. cc/sec.
Basis for HMS Leak Indicator Division Unit of 2 on 10^{-11} Scale (50 divisions to a scale)	HMS Element Pressure During Test Torr

Test of (Check one)

● Port to valve only. ● Port to valve, valve to "H", and "H" seals. ● Valve gate seal.

● Valve to "H", and "H" seals

Observed Response time: ___________

M_1 (Initial Helium Signal) [_____ div on 10^{-10} scale, x 10] = _____ divisions on 10^{-11} scale

M_2 (Background Signal) [_____ div on 10^{-10} scale, x 10] = _____ divisions on 10^{-11} scale

Preliminalry system sensitivity $(S_1) = \frac{\text{Leakage Rate of Std. Leak}}{M_1 - M_2}$ = ________ x 10^{-} —— atm cc / sec / division

Helium concentration = ________ %

Helium concentration correction factor $(C_{hc}) = \frac{100}{\%\ \text{Helium}}$ = ________

M_3 (Test Helium Signal) [_____ div on 10^{-10} scale, x 10] = _____ divisions on 10^{-11} scale

M_4 (Final Calibration Signal) [_____ div on 10^{-10} scale, x 10] = _____ divisions on 10^{-11} scale

Final system sensitivity $(S_2) = \frac{\text{Leakage Rate of Std. Leak}}{M_4 - M_3}$ = ________ x 10^{-} —— atm cc / sec / division

Final Test Sensitivity (S_F)

$S_F = S_2 \times C_{hc}$ = ________ x 10^{-} —— atm cc / sec / division

Final Observed Leakage Rate $(Q_F) = (M_3 - M_2) \times S_F$ = ________ x 10—— atm cc / sec.

Check Applicable Box(es):

☐ Weld repairs were made during leak testing and have been visually inspe cted and re-tested and found acceptable. See VT Report No..

☐ No welded repairs made during leak testing.

Tests were performed and all leakage was evaluated in accordance with the referenced procedure.
Defects not repaired and retested during testing are recorded above as to location and disposition.
All other tested areas included in this report were found acceptable.

COMMENTS:____

_____________________________________ ______________
OPERATOR/EVALUATOR DATE

Results reviewed by:_____________________ ____________
DATE