E950069-00-B

CBI

IDENTIFICATION			
RGAPT			

TITLE	REFERENCE NO.		SHT _1_ OF _5_	
RGA PERFORMANCE TEST OF BEAM TUBE MODULES	930212			
	OFFICE		REVISION	
	RSE		0	
PRODUCT	MADE BY	CHKD BY	MADE BY	CHKD BY
LIGO BEAM TUBE MODULES	WAC	MLT		
CALIFORNIA INSTITUTE OF TECHNOLOGY	DATE	DATE	DATE	DATE
	5/22/94	7/1/94		

1.0 SCOPE:

1.1 This procedure covers the residual gas analyzer/helium mass spectrometer/performance test of each of the beam modules. Use this procedure in conjunction with the current revision of procedure LIGOTP.

1.2 Perform the sequence outlined in this procedure on the applicable beam tube module after :

1.2.1 All beam tube can sections in that module have been successfully HMS leak tested in accordance with procedure HMST1N, final cleaned and erected.

1.2.2 All closing weld joints in that module have been successfully HMS leak tested in accordance with procedure HMST2N and locally cleaned.

1.2.3 All pump port assemblies have been successfully HMS leak tested in accordance with procedure HMST3N and locally cleaned. A pump port asembly includes the pump port flange to 10"Ø valve flange seal, 10"Ø valve body and stem seal, 10"Ø valve flange to LN_2 pump flange seal, the LN_2 pump housing and internal cryogenic tubing, the LN_2 pump flange to the blind flange seal, the blind flange to the three 40 CF-F fittings and the RGA head and valved cold cathode gauge head and potential HMS test port attached to these fittings

1.2.4 The vacuum pump sets for the applicable beam tube module have been installed.

2.0 LEAK TESTING EQUIPMENT TO BE USED IN THIS PROCEDURE:

2.1 A turbo pumped helium mass spectrometer leak detector with ta sensitivity of 2×10^{-12} atm. cc/sec. of helium (8×10^{-13} atm. cc/sec. of air).

2.2 Flexible stainless steel hose with 40 KF (1 1/2"Ø) fittings for connecting the helium mass spectrometer to the test system.

2.3 Caltech supplied LN_2 pump at each module pump port.

2.4 Seven Caltech supplied RGA instruments at each module pump port with a minimum amu mass range of 1-100 and one calibrated air leak, one mid-module mounted.

2.5 Caltech supplied vacuum pump sets at both ends of each beam tube module. In a letter of 1/7/94 from Larry Jones, Caltech stated that each pump set shall consist of a 100 l/s mechanical pump backing a 2200 l/s turbomolecular pump. The pump sets shall be provided with valves to accomodate the helium mass spectrometer(s) for the beam tube module leak test.

2.6 Ultrasonic leak detector such as a model UF60 by Ultrasonics of Florida.

2.7 IBM compatable 486 PC with a DAS 1402 high speed board, STC-37 DAS 1400 terminal interface and Labtech Notebook 7.2 software data acquisition program with printer.

2.8 Seven (7) HPS or equivalent cold cathode gauge heads.

2.9 Three (3) HPS Model 937 or equivalent gauge tube controllers.

3.0 <u>PROCEDURE</u>:

3.1 All 10"∅ pump port isolation valves shall be in the open position.

3.2 Visually inspect the length of the beam tube module to be final tested.

3.3 Check-off each item on the checklist as it is inspected and found satisfactory during the walkdown.

3.4 Start and calibrate (peak tune) the helium mass spectrometer (HMS).

3.5 Conduct a blank-off and a HMS tracer probe test of the 100 l/s mechanical vacuum pump and 2200 l/s turbomolecular pump sets located at each end of each beam tube module. When both the blank-off and HMS tracer probe test results are satisfactory, begin evacuating the beam tube module.

3.6 Compare the system absolute pressure during pump down against a prepared theoretical pump down curve. Any time the actual pump down curve starts to vary significantly from the theoretical pump down curve, check all mechanical pump oil levels and condition of the oil for excess moisture and the blank-off pressures for the entire pump set systems. Continue to plot absolute pressure versus time on semi-log paper during the entire pump down and test.

3.7 When the absolute pressure in the beam tube module reaches approximately 100 millitorr, energize the beam tube module turbomolecular pumps.

3.8 Should the absolute pressure in the beam tube module stop decreasing before it reaches the level of 100 millitorr, indicating either gross leakage or overlooked internal contamination, repeat steps 3.2 and 3.3.

3.8.1 If any obvious problem item such as physical damage is discovered during the repeat walkdown checklist inspection of 3.2 and 3.3, scan the area with an ultrasonic leak detector. If leakage is indicated and pinpointed, isolate the vacuum pump sets, vent the system, repair and/or correct the problem and start over at step 3.5. System venting shall be controlled from the standpoint of particulate and condensation concerns.

3.8.2 If no leakage is detected, review all can section final test reports/logs/PC entries and all closing weld joint test reports/logs and PC entries for statements or data that reveals potential leakage problem areas or internal contamination previously overlooked. List all potential problem areas revealed by these logs or reports.

3.8.3 Walk the beam tube module in all these potential problem areas with an ultrasonic leak detector to attempt to detect and pinpoint the location of the gross leak. If leakage is detected and pinpointed, record the location. When all areas are ultrasonically leak tested, isolate the vacuum pumps, vent the system, repair and/or correct the problem(s) and start over at step 3.5. System venting shall be controlled from the standpoint of particulate and condensation concerns.

3.8.4 If gross leakage still exists, repeat all steps of item 3.8 using acetone while monitoring for rapid momentary pressure changes on the absolute pressure gauges.

3.8.5 Repeat these item 3.8 steps until gross leakage has been eliminated.

3.9 When the system absolute pressure reaches approximately 50 millitorr, open the valves between the turbomolecular pumps and the beam tube module. At the same time, close the valves in the roughing lines between the mechanical pump sets and the test system.

3.10 While continuing to evacuate the beam tube module, monitor with an RGA the following Caltech suggested system atomic mass numbers to obtain a signature analysis of the system gases. These amu values are 2, 12, 14, 15, 17, 18, 28, 32, 39, 40, 41, 42, 43, 44, 51, 52, 55 and 57. Provide this data to Caltech for air signature analysis results.

3.11 If at this step of the procedure the RGA signature analysis indicates unacceptable leakage of 1 x 10^{-5} atm. cc/sec. or larger, proceed as follows:

3.11.1 In accordance with the figures attached to reference 3.4 in procedure LIGOTF, conduct a pressure assessment of the beam tube module using the RGA readouts at each of the pump ports to attempt to localize the area of the leakage.

3.11.1.1 Record the absolute pressure and simultaneously readout each RGA with both pump sets pumping on the *beam tube module.*

3.11.1.2 Individually isolate the pump set at each end of the beam tube module. Record the absolute pressure and simultaneously readout each RGA.

3.11.1.3 Plot the ratio of the two pressure readings taken at each RGA against the distance in kilometers along the beam tube module from the leak. The highest ratio will be nearest the leak. The smaller the ratio, the further the distance from the leak.

3.11.1.4 With both pump sets again pumping on the system, record the absolute pressure simultaneously readout at each RGA every 1000 seconds and plot each of these readings in torr against distance in kilometers along the beam tube module. Continue recording and plotting until there is sufficient pressure change to reveal a meanful location pattern. Repeat this process with the pump set at the far end of the beam tube module isolated from the system..

3.11.1.5 Plot the pressure changes for the absolute pressure data in item 3.11.4 against the elapsed time in seconds during which those pressure changes occurred. Plot this for both conditions, i.e. first with both pump sets open to the system and second with one pump set open to the system and one pump set closed to the system.

3.11.1.6 If steps 3.11.1.1 through 3.11.1.4 reveals the approximate location of the leak, proceed to step 3.15.

3.12 If steps 3.11.2 through 3.11.5 do not reveal the approximate location of the leak, repeat the same steps using the readings of the cold cathode gauges located at each of the pump ports.

3.13 If step 3.12 also does not reveal the approximate location of the leak, connect the high speed data acquisition system to the cold cathode gauge controller units.

3.14 Isolate the pump sets at both ends of the beam tube module. At the same instant, energize the high speed data acquisition system. The timing of these three events must be closely co-ordinated due to the limited memory space of the PC. These high speed pressure change plots should reveal the location of the leak within a few meters. If that happens, proceed to step 3.15. Should this technique also fail to reveal the location of the leak, go to step 3.20.

3.15 Visually inspect the area of the approximate leak location to detect and pinpoint the exact source of the leakage.

3.15.1 If the leak is in a mechanical connection such as a flange seal which cannot be temporarily isolated from the system but may be repaired without entry into the beam tube module, vent the system with nitrogen gas, repair or replace the cause of the leak and re-evacuate the system. System venting shall be controlled from the standpoint of particulate and condensation concerns.

3.15.2 If the leak is a hole or crack in a weld which is not jeopradizing structural integrity, cover the leak area with a piece of plastic or aluminum foil and apply sealing compound around the edge of the plastic or foil to isolate the leak from the system.

3.15.3 If the leak is the result of a crack or damage which could be jeopradizing the structural integrity of the beam tube module and the beam tube would have to be entered to either make the repair or to locally test the repair, vent the system with air. After the cause of the leak has been repaired, re-evacuate the system. System venting shall be controlled from the standpoint of particulate and condensation concerns.

3.16 As long as the system absolute pressure continues to go down, continue to pump and monitor with the RGA to determine if the signature analysis still indicates no unacceptable inleakage.

3.17 Energize each of the LN_2 pumps with liquid nitrogen.

3.18 The leakage rate of the module shall be considered satisfactory and the module shall be considered ready for bake out:

3.18.1 When the beam tube module RGA air signature analysis indicates leakage less than $1x10^{-5}$ atm cc/s - air.

3.18.2 Even if the beam tube module will not readily evacuate to a sufficiently low absolute pressure level, provided the RGA signature analysis indicates the gas load is attributable to outgassing and not unacceptable inleakage.

3.19 The system would now be ready for bake out by Caltech.

3.20 If unacceptable leakage developes in the beam tube module during bake out which jeopardizes continuing the bake-out, repeat the applicable steps of this procedure. If necessary, proceed to procedure HMST5N.

3.21 If all procedure steps have been performed and the system will not evacuate to a sufficiently low absolute pressure level and the RGA signature analysis still indicates unacceptable inleakage of 1×10^{-9} atm. cc/sec. or larger, perform a HMS hood test of the beam tube module in accordance with procedure HMST5N.

4.0 <u>DOCUMENTATION</u>:

Document in accordance with item 5.0 of procedure LIGOTP.