LIGO-T940022-00-B

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Co. CALTECH	Co. CBI TS
Dept. LIGO	Phone # 815-439-6517
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October 4, 1994

To: Rai Weiss
LIGO Project - MIT

Fax No. (617)253-7014

From: M. L. Tellalian Phone (815)439-6517

Plainfield Engineering - PAE

RE: Section Leak Test
LIGO Design & Qualification Test - Caltech Contract C146

Rai,

Attached are the lab notes on our pump down and leak test today. As I discussed with Larry earlier, our background decreased to 2.3 X 10-9 based on a calibration with our 2.0 X 10-8 leak. The background was adjusted down to 2.6 X 10-10. The background was pumped down from this reading from 10:00 to 13:00 nearly zero on the 10-10 scale and then it was adjusted back up to 2.4 X 10-10. After another hour of pumping the background reading reduced to 1.0 X 10-10.

Helium was applied to an evacuated bag at 14:05 with the following conditions:

Chamber Pressure:	1.1 X 10-6
Helium Background :	1.1 X 10-10(Varying primarily between 1.0 & 1.5 X10-10)
Foreline Pressure:	2 millitorr
HMS Sensing Element Pressure:	6 X 10-5

At approximately 14:17, the background first exceeded the previously stable range with an oxygen content of 6.2 % inside the bag. As you can see, the helium background continued to rise. Approximately 1.75 bottles of helium were injected into the bag resulting in a low O2 of 5.5%. The O2 level started to increase when helium flow was stopped. The bag was well inflated and lifted off the tube. The background continued to rise even with the increase in the O2 content in the bag. Inspection of the bag revealed a couple of areas near the heads that had been pulled off during the evacuation and filling with helium. At 15:00, nitrogen was applied to the bag with a helium background of 2.0 X 10-9 and rising. The chamber pressure was constant through the test until 15:07 when the gage showed a decrease to 1.0 X 10-6. At 15:24 the bag was aired out to remove the nitrogen. Helium background continues to rise. Currently, the end seals are suspected of being the source of our background due to the holes in the bag around the end seals. The space between the end seal and the inflatable seal are being purged with N2.

We believe that the rise in helium pressure is due to permeation through the end seals or system seals. The isolation valve will be closed tonight and tomorrow some tests will be made with the intention of confirming our beliefs. The question is what was the sensitivity of our test during the first 12 minutes as helium was applied to the bag and the O2 content reached 6.2%. The calculated response time is about 10 seconds which was confirmed with the 4.7 X 10-10 leak. Your thoughts on the test would be greatly appreciated.

Regards,

Marty

M. L. Tellalian
Plainfield Engineering

cc: Larry Jones - LIGO Project
FAX # (818)304-9834

2.3×10^{-9} NOW $\rightarrow 2.6 \times 10^{-10}$

10:00 TO 10:05	1.5×10^{-6} t,	~~4.7×10^{-10} LEAK OPENED~~, BACKGROUND ROSE & STABILIZED AT 6.8×10^{-10}
10:10	1.5×10^{-6} t,	LEAK CLOSED, BACKGROUND, DECREASED TO 2.6×10^{-10}
10:20	1.4×10^{-6} t,	FORELINE 2m t, BACKGROUND 2.2×10^{-10}
1040	1.4×10^{-6} t,	DEGASSED GAGE
1050	1.3×10^{-6} t,	FORELINE 2m t, BACKGROUND 2.2×10^{-10}
5 TO 11 25	1.3×10^{-6} t	" 2 mtorr " 2.0×10^{-10}
35 11 45	1.2×10^{-6} t	FORELINE 3 m torr, BACKGROUND 1.0×10^{-10}
13:00	1.1×10^{-6} t	FORELINE 3m TORR, BACKGROUND DECREASED TO 0.0×10^{-10}, ADJUSTED UP TO 2.4×10^{-10}
NG IE 14:00	1.1×10^{-6} t	BACKGROUND PUMPED DOWN TO 1.0×10^{-10} TO 1.5×10^{-10}
		FORELINE P = 2 m. Hg torr
		HMS SORBING ELEMENT P = 6×10^{-5}

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BACKGROUND VARIATION MEASUREMENTS

READINGS TAKEN FROM 11:25 TO 11:35 EVERY 30 SECONDS
ALL READINGS WERE ON THE 10^{-10} SCALE. THE BACKGROUND WAS PREVIOUSLY ADJUSTED FROM 2.3×10^{-9} TO 2.6×10^{-10}.
BACKGROUND PUMPED DOWN TO 1.0×10^{-10} ⇒ START OF RUN
CHAMBER PRESSURE ⇒ 1.3×10^{-6}

0	1.0		5:00	.5
:30	.9		5:30	.4
1:00	.8		6:00	.6
1:30	.8		6:30	.5
2:00	.6		7:00	.5
2:30	.7	ELECTRICAL SPIKE	7:30	.6
3:00	1.1		8:00	.6
3:30	.9		8:30	.4
4:00	.8		9:00	.3
4:30	.4		9:30	.6
			10:00	.4

MEAN .61 $\times 10^{-9}$ STANDARD DEVIATION .26 $\times 10^{-10}$

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03	BAG ON FULL LENGTH OF TUBE EVACUATED. FITTINGS IN HEAD PURGED WITH N_2.			
2:05	BAG TIGHT TO VESSEL	1.1×10^{-10}	% Ne	HELIUM INPUT TO BAG.
2:08	BAG PUFFED AT ONE END.			1.2×10^{-10}
2:09	1.0×10^{-10}	35	15% O_2	
2:09:30	.8	44	13% O_2	
2:10	.9	47	12.3% O_2	
2:11	.7	57	9.9	BOTTLE HELIUM EMPTY
2:12	.8	59	9.4	
2:13	1.1×10^{-10}	57	9.9	
2:14	1.0×10^{-10}	63	8.7	2:13:40 NEW He BOTTLE
2:15	1.3×10^{-10}	66	7.9	
2:16	1.4×10^{-10}	72	6.5	
2:17	1.6×10^{-10}	73	6.2	
2:18	2.0×10^{-10}		5.7	
2:19	2.2×10^{-10}		5.5	- He BOTTLE SHUT OFF
2:20	2.5×10^{-10}		5.9	3/4 BOTTLE USED 300 psi
2:21	2.9×10^{-10}		6.3	DRAWING FROM 2300 psi
2:22	3.1×10^{-10}		7.3	
2:23	3.4×10^{-10}		8.0	
2:24	3.7×10^{-10}		8.2	
2:25	4.8×10^{-10}		8.6	
2:26	5.0×10^{-10}		9.1	
2:27	5.3×10^{-10}		9.6	NOTE: READINGS ON
2:28	6.0×10^{-10}		10.2	THIS PAGE ARE
2:29	6.4×10^{-10}		10.7	2:03 pm TO 2:39 pm
2:30	7.2×10^{-10}		11.1	OR
2:31	7.2×10^{-10}		11.5	14:03 TO 14:39
2:32	7.8×10^{-10}		12.1	
2:33	8.6×10^{-10}		14.0	
2:34	8.2×10^{-10}		14.3	
2:35	8.4×10^{-10}		14.5	
2:36	9.2×10^{-10}		14.7	
2:37	9.3×10^{-10}		15.0	
2:38	8.4×10^{-10}		15.1	
2:39	1.05×10^{-9}		15.3	

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N_2 75.5
O_2 23.2
Ar 1.3

$\left(1 - \frac{O_2}{23.2}\right) 100 = \%\ Ne$

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14:40	1.1×10^{-9}	15.3	* NOTE: HOLE WAS A UNTAPED LENGTH OF APPROX 6" inches
14:41	1.2×10^{-9}	15.2	
14:42	1.4×10^{-9}		BAG INSPECTION
14:42	1.4×10^{-9}		REVEALED HOLE* IN
14:43	1.5×10^{-9}	15.7	BAG AT EQUIPMENT END
14:44	1.3×10^{-9}		13.7 O_2 @ BAG HOLE,
14:45	1.3×10^{-9}		HOLE FIXED AT 14:43
14:46	1.4×10^{-9}	15.7	
14:47	1.3×10^{-9}	15.9	
14:48	1.4×10^{-9}	←	ADDITIONAL GAP FOUND IN
14:49	1.4×10^{-9}	16.1	EQUIPMENT END OF BAG
14:50	1.5×10^{-9}	16.3	* REPAIRED @ 14:51
14:51	1.7×10^{-9}	16.3	
14:52	1.7×10^{-9}		
14:53	1.5×10^{-9}	16.5 % O_2	
14:54	1.7×10^{-9}	16.8 %	
14:55	1.7×10^{-9}	16.7 %	
14:57	1.8×10^{-9}	16.9 %	
14:58	2.0×10^{-9}	16.9	BAG SUCKED OUT
14:59	1.9×10^{-9}		STARTING @ 14:58
15:00	2.1×10^{-9}		N_2 APPLIED TO BAG @ 15:00
15:01	1.9×10^{-9}		
15:02	2.1×10^{-9}		
15:03	1.9×10^{-9}		
15:04	2.0×10^{-9}		
15:05	2.2×10^{-9}		
15:06	2.4×10^{-9}		
15:07	2.3×10^{-9}	CHAMBER	1.0×10^{-6} @ 15:08
15:08	2.3×10^{-9}		
15:09	2.2×10^{-9}		
15:10	2.4×10^{-9}	15.4 % O_2	
15:11	2.4×10^{-9}		
15:12	2.5×10^{-9}		
15:13	2.5×10^{-9}		
15:14	2.6×10^{-9}		
15:15	2.6×10^{-9}		
15:16	2.5×10^{-9}		

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15:17	2.7×10^{-9}		15.7 % O_2 N_2 STILL BEING APPLIED TO BAG.
15:18	2.4×10^{-9}		
15:19	2.6×10^{-9}	19.6 %	BAG SUCKED OUT @ 15:18
15:20	2.8×10^{-9}		N_2 STILL ON
			~~1/4~~ TEAR IN BAG AT TOP OF GUIDED ~~FIXED~~ SUPPORT @ INSTRUMENT END.
15:25	2.5×10^{-9}		N_2 STOPPED @ 15:25
15:30	2.7×10^{-9}	15.1 %	MACHINE
15:35	3.0×10^{-9}		BAG CUT & BLOWN OUT @ AIR.
15:40	3.1×10^{-9}		STARTED PURGING END SEALS N_2

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