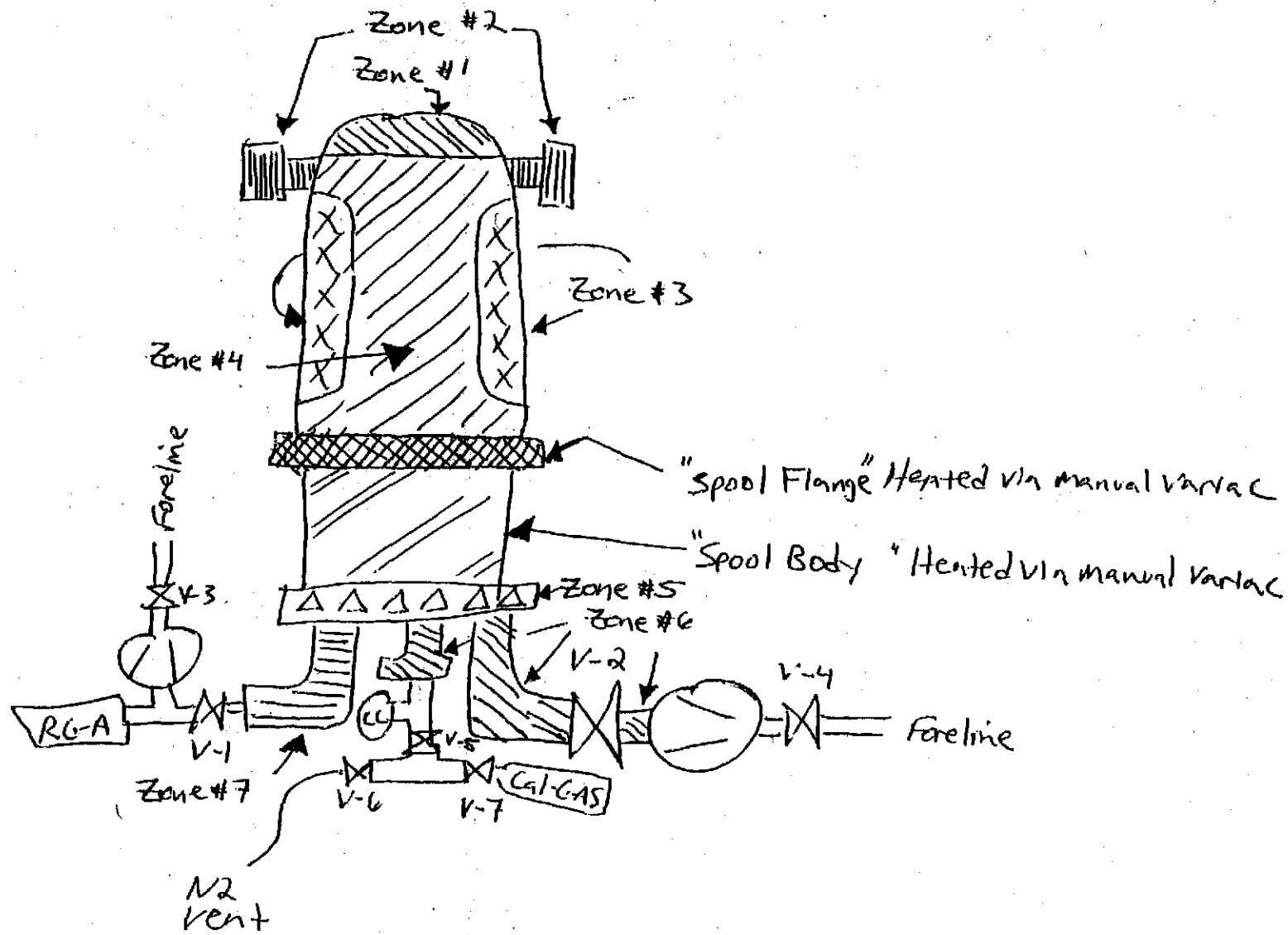# Summary of LHO Vacuum Bake Oven A RGA Data Generation

The individual parts which comprise a "load" are cleaned as per LIGO-E960022 or as allowed by waiver(s) and loaded into the bake oven. The oven is then pumped down through the main pump "arm" (through V-2, RGA arm is valved off at this point). A heating profile is programmed and baking of the system begins. A typical "heating profile" consists of ramping up to material type soak temperature, soaking for approximately 48 hours, ramping down to approximately 70C, soaking and then ramping down to near room temperature. While soaking at 70C, an RGA background scan is taken. V-1 is then opened and V-2 closed. Enough time is allowed for the system to come into pressure equilibrium and then an elevated load temperature RGA scan is taken. V-1 is then closed and V-2 opened. Following this elevated temperature scan, the load is ramped down to near room temperature and the baking portion of the process is complete. Throughout the baking, temperature data is taken to verify the actual temperatures in the various "heat zones" of the bake oven system.

Once at near room temperature, another RGA background (V-1 closed) scan is taken. Next, V-1 and the cal-gas are opened and V-2 closed. After a 30 minute pressure equilibration time, a "calibration" scan is taken. The calculated pressure of Argon (constituent of the "mixed" calibration gas) is determined using the leak rate of Argon and the pump speed of the RGA arm port as seen by the oven chamber and compared (ratio) to the maximum amp value measured for Argon in the calibration scan. This "torr/amp" ratio becomes the Calibration Factor for the given load, converting measured current to pressure.

Finally, the cal-gas is valved out and enough time is allotted to allow all traces of it to be pumped away. A "post-bake" scan is then taken. Approval of the post-bake scan is a collective "pass/fail" determination made by either Dennis Coyne (CalTech) or Stan Whitcomb (CalTech). The data collected during the "elevated temperature scan" is entered into a spreadsheet which then calculates what the outgassing rates of AMUs 41, 43, 53, 55 and 57 ought to be at room temperature. These calculations are used to determine the room temperature outgassing rates when the signals are below the RGA's sensitivity (noise floor).

Refer to the LHO Vacuum Bake Oven A logbook for the actual ordered events of the load # of interest.

Zone #2

Zone #1

Zone #3

Zone #4

"Spool Flange" Heated via manual Varlac

"Spool Body" Heated via manual Varlac

Zone #5

Zone #6

Foreline

V-3

RG-A

V-1

Zone #7

N2 Vent

V-6

CC

V-5

V-7

Cal-GAS

V-2

V-4

Foreline

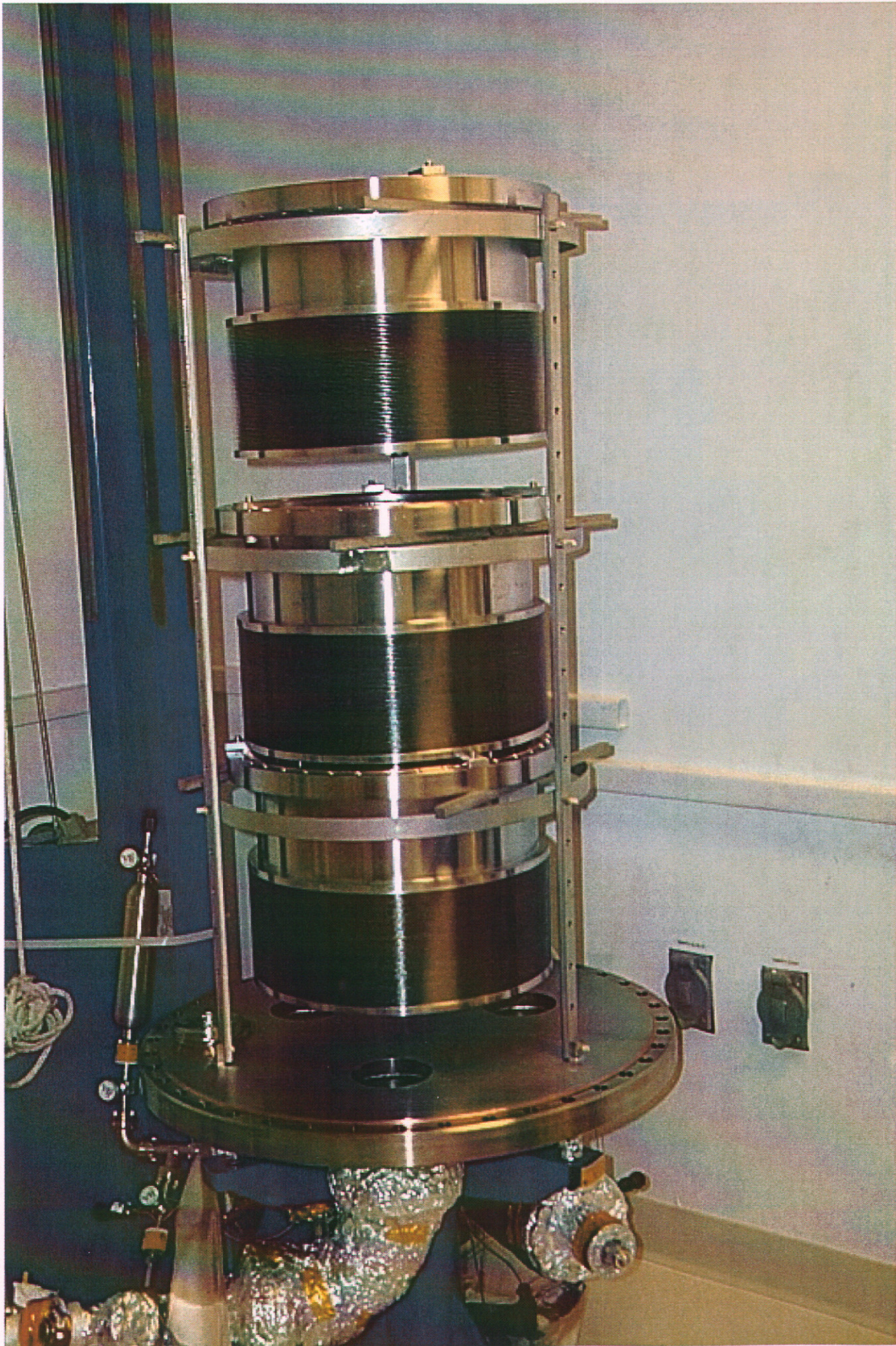# LHO VACUUM BAKE OVEN A: CONTENTS LOAD #53
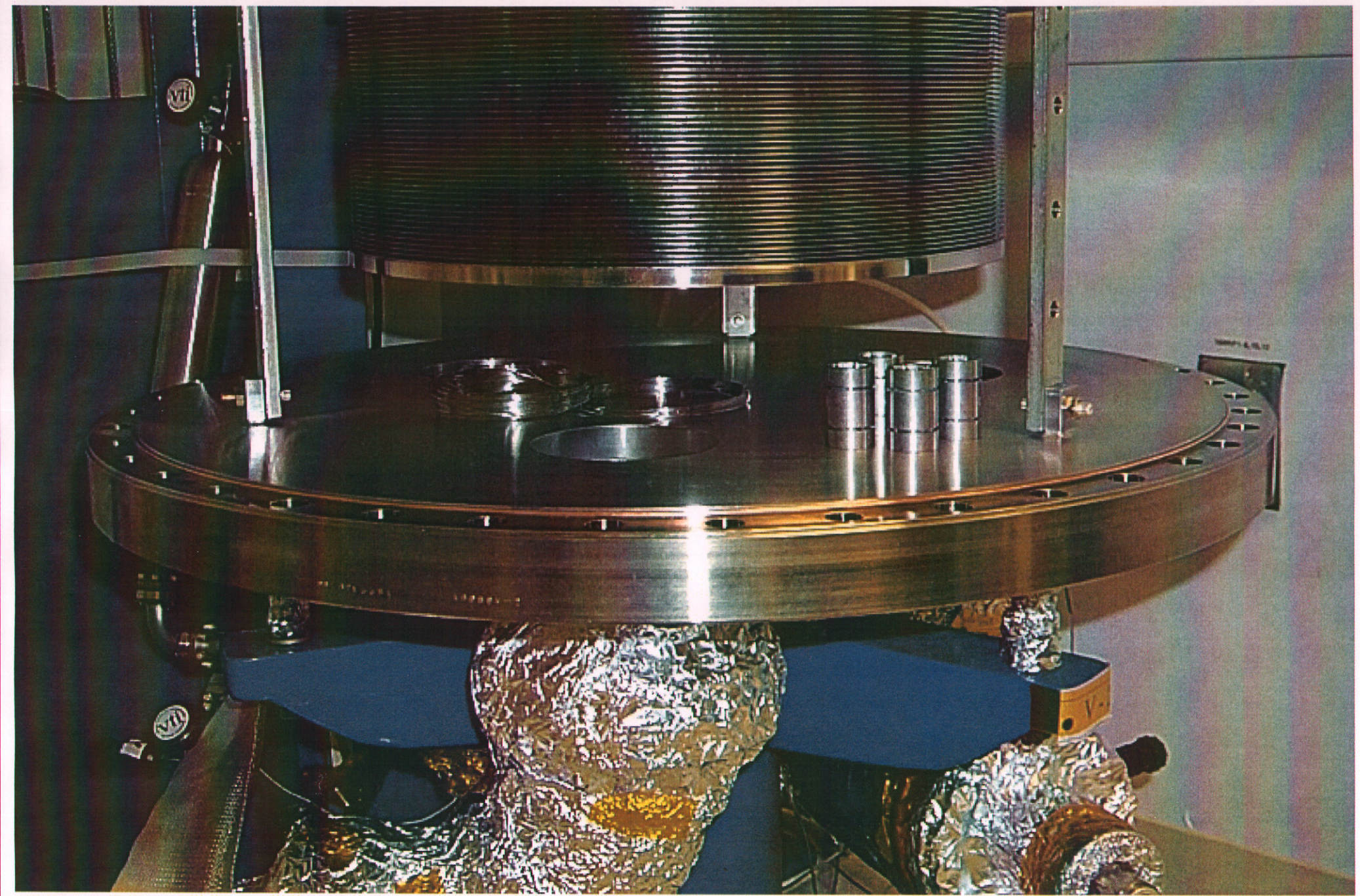
B.S.C. BELLOW SERIAL NUMBER-051

B.S.C. BELLOW SERIAL NUMBER-057

B.S.C. BELLOW SERIAL NUMBER-061

SAFETY WIRE SERIAL NUMBER N/A

E.T.M. TELESCOPE PIVOT HINGES SERIAL NUMBER

LIGO PROCESS TRAVELER

Originator	Cognizant Engineer	Ext./Phone#	Project	Account Number
Betsy Weaver	Janeen Hazel-Romie	(626) 395-8445	SUS	5F518

Dwg/Part Number	Rev	Part Description	Serial Number	Qty
		Stainless Steel Wire for tying OSEM cables to the LOS structures		~30 feet

Used In (next higher assembly):

Vendor Name	PO/Contract Number
	P

Data Package, Receiving/Inspection Remarks:

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/ Initials	Date Comp.

Process Flow:

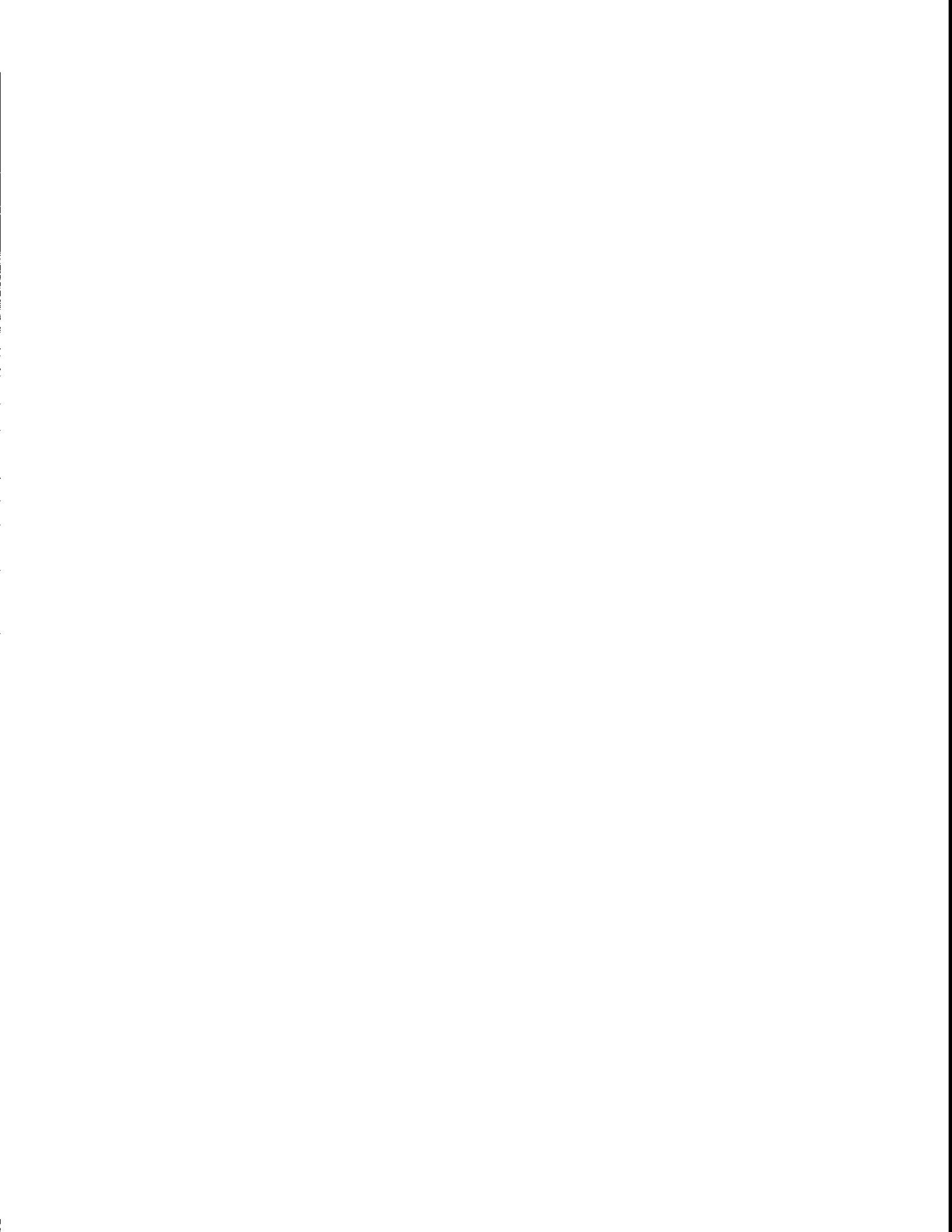| #	Operation	Start Date	Work Area	Instructions	Name/ Initials	Date Comp.
1	Clean & Vacuum Bake per LIGO Vacuum Prep. Form		LHO	Clean as Class A Hardware as per E960022.	B. Rivera *B.Rivera*	8-24-99
2	Control Point		NA	NA		
3	Wrap & Tag vacuum clean parts per E960022-A		LHO	VBO Load# **53** Scan# 082499 C. RCA *BW 9/14/99*	B. Rivera	
4			LHO	**Note: Copy this traveler and give to the DCC**	NA	
END: Go to Traveler associated with next higher assembly processing						

LIGO PROCESS TRAVELER

Special Instructions (Handling/Packaging Constraints, Remarks, etc.) or Notes:

DATE	NAME	DESCRIPTION

LIGO PROCESS TRAVELER

DCC Number: E98____-00-X

Date Prepared: 8·20·99

Originator	Cognizant Engineer	Ext/Phone#	Project	Account Number
B. RIVERA	MIKE FINE	626·395·3307	LIGO	5F311

Dwg/Part Number	Rev	Part Description	Serial Number	Qty
D972122		BSC BELLOWS	51, 57, 62	3

Used In (next higher assembly): BSC TOP ASSEMBLY

Vendor Name	PO/Contract Number
SENIOR FLEXONICS	P __ DC 299000

Data Package, Receiving/Inspection Remarks:

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/Initials	Date Comp.
YES	NO	NOTICED GREY "SMUDGES" AROUND OUTSIDE OF BELLOWS ATTEMPTED TO REMOVE WITH SOLVENTS DOES NOT COME OFF OK. /SM	B. RIVERA	8·20·99

Process Flow:

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
1	Clean & Vacuum Bake per LIGO Vacuum Prep. Form		CIT/LHO	per E960022-A	B. RIVERA	8·24·99
2	Control Point		NA	Review/approve RGA scan #082499C.RGA	/SM	9/14/99
3	Wrap & Tag vacuum clean parts per E960022-A	8·24·99	CIT/LHO	___1___ per package	B. RIVERA	8·25·99
4			CIT	**Note: Copy this traveler and give to the DCC**		

END: Go to Traveler associated with next higher assembly processing

---

N.B.: A copy of this traveler must be submitted to the DCC each time the original is shipped with the associated part(s) and when the traveler has been completed.

LIGO PROCESS TRAVELER

DCC Number: E98____-00-X

Special Instructions (Handling/Packaging Constraints, Remarks, etc.) or Notes:

(3 LAYERS)

BELLOWS SAT 1 DAY WRAPPED IN UHV FOIL BEFORE BEING WRAPPED IN AMERISTAT B.R VERA 8.29.99

JOHN WORDEN HAS UNWRAPPED INSPECTED AND "MASSAGED" INNER BELLOW KNIFE EDGES

WITH AN ARKANSAS STONE TU PREVENT LEAKS. B. RUZKA 9.1.99 HANDLING THE PARTS WITH UNGLOVED

HANDS VERBALLY OK'D BY DENNIS COYNE TO BE RE-BAKED AS A U.H.V. CLEAN PART

LIGO PROCESS TRAVELER

Originator	Cognizant Engineer	Ext./Phone#	Project	Account Number
Michael Smith	Michael Smith	2062	COS	5F515

Dwg/Part Number	Rev	Part Description	Serial Number	Qty	VBO Load 40	VBO Load 41	VBO Load 43	VBO Load 46	VBO Load 48	VBO Load 50	VBO Load 52	VBO Load 54
		Beam Dump Assemblies, WBSC2										
D980087	A	"glass retaining bracket, top left, cavity BD"	012-013	2			2				2	
D980088	A	"glass retaining bracket, top right, cavity BD"	012-013	2			2				2	
D980092	A	"glass plate 1, cavity BD"		2								
D980093	A	"glass plate 2, cavity BD"		2								
D980289	B	"glass mounting plate1, cavity BD"	012-013	2		2						
D980292	B	"glass mounting plate2, cavity BD"	010-011	2		2	2					
D980296	A	"glass retaining bracket, bottom left, cavity BD"	012-013	2			2				2	
D980297	A	"glass retaining bracket, bottom right cavity BD"	012-013	2			2				2	
D980348	B	"side plate, cavity BD"	025-028	4		4						
D980378	B	"Stiffener Block, cavity BD"	013-014	2		2						
D980685	A	"clamp, plate beam dump"		8								
D990028	A	Beam Dump Flex Hinge Tongue	011-014	4				4				
D990029	B	Beam Dump Flex Hinge Clevis	015-017, 019	4				4		1 (019)		
D990030	A	Beam Dump Flex Hinge Tee	013-016	4			3	4				
D990031	A	Beam Dump Flex Hinge Saddle	013-015, 010	4			4	3	1			
D990032	A	Beam Dump Flex Hinge Attach	014-017	4			4	4				
D990033	A	Beam Dump Flex Hinge Adapter	018, 015, 011	4			3					
D990140	D	Beam Dump Housing Plate	009, 010	2		2						
D990149	C	"Cavity Beam Dump, Mounting Bracket Angle "	010, 012, 014, 015	4			4	4				

N.B.: A copy of this traveler must be submitted to the DCC each time the original is shipped with the associated part(s) and when the traveler has been completed.

LIGO PROCESS TRAVELER

Dwg/Part Number	Rev	Part Description	Serial Number	Qty	VBO Load 40	VBO Load 41	VBO Load 43	VBO Load 46	VBO Load 48	VBO Load 50	VBO Load 52	VBO Load 54
D990150	B	"Cavity Beam Dump, Mounting Bracket Gusset "	013, 014, 016, 017	4			4		4			
D990151	B	"Cavity Beam Dump, Mounting Bracket Backplate 1"	009, 015, 019 016	4			4		4			
D990152	C	"Cavity Beam Dump, Mounting Bracket Backplate 2"	016, 017 010, 012	4			4		4			
D990198	B	Beam Dump Flex Hinge H_tube	008, 011, 006	4								3
D990199	A	Beam Dump Flex Hinge Low Strap	012, 014, 016, 017	4				4				
D990200	A	Beam Dump Flex Hinge Backup	007, 008, 025, 027, 035, 036 019, 032	8			8		8			
D990201	A	Beam Dump Flex Hinge Cap	030, 032, 038, 035, 018, 028, 031,037	8			8	8				
D990202	B	Beam Dump Flex Hinge Top Strap	011-014	4			4	4				
D990207	B	"rail, plate beam dump"	015-018	4			3		4			
D990218	B	"glass, plate beam dump"		2								
D990222	A	Beam Dump Housing Tube 2KBSAR3		0								
D990223	C	Beam Dump Housing Tube 2KFM		0								

Dwg/Part Number	Rev	Part Description	Serial Number	Qty	VBO Load 40	VBO Load 41	VBO Load 43	VBO Load 46	VBO Load 48	VBO Load 50	VBO Load 52	VBO Load 54
D990225	D	"Beam Dump Housing Tube 4KITMHR3, 4KITMHR4"		0								
D990236	B	"backplate_offset, plate beam dump"		0								
D990240	B	"backplate, plate beam dump"		0								
D990252	B	"Beam Dump Housing Tube ITMAR1,2KRMHR3"		2								
D990253	A	Extension Tube	004, 005	2			1		1(004)			1(005)
D990335	A	"Beam Dump Flex Hinge H_tube, 2KITMXAR4 "		0								
D990336	A	"Beam Dump Flex Hinge H_tube, 2KITMYAR4"		0								
WFV-10		#10 X 0.31 THK FLAT VENTED WASHER		32								40
93615A355		#10-24 X 0.75 LOW HD SCS		24	24							
92196A245		#10-24 X 0.75 SHCS		8	8							
WFV-06		#6 X 0.016 THK FLAT VENTED WASHER		8								40
92196A144		#6-32 X .25 SHCS		8	8							
WFV-08		#8 FLAT VENTED WASHER		68	48							20
92185A194		#8-32 X .50 SHCS		68	68							
91500A194		#8-32 X .500 FHPS		36	36							
91944A450		0.406ID X 0.88OD X 0.25 THK SPHER WASH		16	16							
92141A029		1/4 FLAT WASHER		32	32							
N-2520-A		1/4-20 HEX NUT		16	16							
93615A410		1/4-20 X .500 LOW HEAD SOCKET SCREW		16	16							
92196A540		1/4-20 X 0.75 SHCS		48	48							
92196A542		1/4-20 X 1.00 SHCS		32	32							
C-2016-NA		"1/4-20 X 1.00 SHCS, AG/SS"		40	20							20
92196A544		1/4-20 X 1.25 SHCS		16	16							
C-2820-NA		"1/4-28 X 1.25 SHCS, AG/SS"		24	24							
91950A031		3/8 X 0.063 FLAT WASHER		6	6							
WFV-38		3/8 X0.032 THK FLAT VENTED WASHER		42	42							
94804A320		3/8-16 HEX NUT		8	8							

LIGO PROCESS TRAVELER

Dwg/Part Number	Rev	Part Description	Serial Number	Qty	VBO Load 40	VBO Load 41	VBO Load 43	VBO Load 46	VBO Load 48	VBO Load 50	VBO Load 52
N-3816-A		"3/8-16 HEX NUT, AG/SS"		4	4						
TOP-1616-NA		3/8-16 X 1.00 SOCKT SET SCRW-OVL PT AG/SS		8	8						
90585A626		3/8-16 X 1.25 FLT HD CAP SCREW		8	8						
92186A626		3/8-16 X 1.25 HEX HD SCREW		16	16						
C-1620-NA		"3/8-16 X 1.25 SHCS, AG/SS"		8	8						
92186A630		3/8-16 X 1.75 HEX HD SCREW		4	4						
92196A630		3/8-16 X 1.75 SHCS		12	12						
92186A999		3/8-16 X 7.00 HEX HD SCREW		16	16						
099-966-12-20x		BERYLLIUM-CU GND STRP		8	8						
6032-400		Flex Pivot		8							4

Used In (next higher assembly): D990230, BSC Beam dump Installation, top assembly

Data Package, Receiving/Inspection Remarks:

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/Initials	Date Comp.
y		Inspect for breakage during shipment		

Process Flow:

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
1	Control Point	NA	NA		NA	NA
2	Clean	6/18	LHO	per LIGO-E960022, as applicable	B. Weaver	
3	Vacuum Bake	SEE NEXT PAGE	LHO	per LIGO-E960022 B.RYKER	K. Ryan	SEE NEXT PAGE
4	Wrap and Bag		LHO	per LIGO-E960022	B. Weaver	

N.B.: A copy of this traveler must be submitted to the DCC each time the original is shipped with the associated part(s) and when the traveler has been completed.

LIGO PROCESS TRAVELER

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
5	Control Point	6.24.99 6.28.99 07.06.99 07.20.99	LHO	Review/approve RGA: VBO Load#_40_ scan # 062899C.RGA VBO Load#_41_ scan # 070299C.RGA VBO Load#_43_ scan # REJECTED VBO Load#_46_ scan # 072699C.RGA VBO Load#_48_ scan # 080399C.RGA VBO Load#_50_ scan # 081699C.RGA VBO Load#_52_ scan # 082099C.RGA Note: attach RGA scan(s) to this traveler. VBO LOAD 54	K. Ryan BEW BEW BEW	7/28/99 8/10/99 8/10/99 9/14/99
	Box for shipment to LHO			Ship in LIGO-provided container. Coyne scan# 085099C.RGA VBO LOAD #53 scan# 082499C.RGA VBO LOAD #61 scan# 101899C.RGA	DCoyne 10/18/99	

No.	Qty per package	Part
ALL		BEAM DUMP PARTS

(see also qty. for each shipping destination below)

#	Operation
7	Ship

No.	Ship Qty.			Part Description
	LHO	LLO	Other	
	all			beam dump parts

LHO:	Attn: Betsy Weaver, COS LIGO Hanford Observatory (LHO) Specific Purpose: beam dump BSC8
LLO:	Attn: Jonathan Kern LIGO Livingston Observatory (LLO) Specific Purpose: beam dump BSC8

N.B.: A copy of this traveler must be submitted to the DCC each time the original is shipped with the completed hardware or when the travel has been completed.

Special Instructions (Handling/Packaging Constraints, Remarks, etc.) or Notes:

Attention: Betsy Weaver, Jonathan Kern, hold cleaned and baked parts for COS assembly

LIGO PROCESS TRAVELER

ACTION ITEMS:

Table 1:

DATE	NAME	DESCRIPTION
7/20	B. Weaver	S/N 012-013 of parts D980087, D980088, D980296, and D980297 were sent back to Spacecraft Spec. for rewotk, as we found that they had not been manufactured completely.
7/15	B. Weaver	VBOLoad#43 – Rejected due to bad scan. Dennis Coyne sent all parts from this load (plus some) to be electropolished or etched for better cleaning.
7/23	B. Weaver	Parts received back from polishing/etching companies. – Recleaned as per Dennis C.'s email (attached).
8/5/99	B. Weaver	Clevis D990029 s/n-019 was sent out for modification as per DCN#: E990273-B /D990029-B. Rec. back – 8/4.
9/10/99	B. Weaver	D980348 s/n 027 & 028 sent to Brockman Mfg. for rework – holes made into slots to compensate for low clearance.
10/11/99	B. Weaver	Giving D980348 s/n 027 & 028 to B. Rivers for vacuum rebake.

Table 1:

DATE	NAME	DESCRIPTION

X-POP3-Rcpt: bweaver@apex
Date: Thu, 22 Jul 1999 12:12:31 -0700
From: Dennis Coyne <coyne@ligo.caltech.edu>
Organization: Caltech/LIGO
X-Mailer: Mozilla 3.01Gold (Win95; I)
To: Betsy Weaver <weaver_b@ligo.caltech.edu>
CC: Stan Whitcomb <stan@acrux.ligo.caltech.edu>,
    Mike Smith <smith@acrux.ligo.caltech.edu>,
    Bartie Rivera <rivera_b@ligo-wa.caltech.edu>
Subject: Re: cleaning

NBO LOAD 48

Betsy,
You should clean as follows (E960022-05 except since the parts are too
large to ultrasonically clean, I've tailored the cleaning):

1) clean with Liquinox first (solution per E960022-05) and using a
rubbing/scrubbing action (i.e. not just rinsing the liquinox over the
surfaces). All holes must be cleaned with a brush (stainless steel,
phosphor-bronze preferred, but nylon is acceptable). It is ESSENTIAL
that the liquinox NOT dry before being rinsed with DI water.

2) Thoroughly rinse with DI water. All surfaces and holes must be rinsed
THOROUGHLY.

3) Rinse & rub (with gloved hand only) all surfaces with either methanol
or isopropal alcohol. Squirt the solvent into all holes.

4) Blow dry with clean, filtered air or N2, or allow to dry on a clean
bench. Do not leave exposed for longer than about 15 minutes, before
covering with UHV foil.

With regard to cleaning the lens, please see Stan for a confirmation,
but I believe the rule that we operate under is that if all surfaces are
polished, then an optics cleaning and wetting test is adequate and no
baking is required. However, if the sides of the optic are not polished
(as I suspect is the case for the ETM optics), then it should be cleaned
and baked and re-cleaned. However, please confirm this with Stan and he
may grant a waiver if he examines the surface condition of the optics.
    Dennis

Betsy Weaver wrote:
>
> Hi Dennis–
>
> Two cleaning questions for you:
>
> 1.   We just received the aluminum load (COS) from the etching company.
> How should we clean them here, before baking them? (They are

> obviously too large to put in the ultrasonic cleaner...)
>
> 2.   Mike has one large and two small lenses that are going to be
> used in the ETM Telescope Assembly. If they wet well during cleaning,
> do they really need to be baked? A while ago, Stan told me that the
> small steering mirrors for IO and COS did not need to be baked, as the oven
> would just make them dirtier, because they wetted so well during cleaning.
> Is this the same for the lenses? If they do need to be baked, can I put
> them in
> the next load with the one Large Optic?
>
> Thanks-
> Betsy

--

Dennis Coyne (Detector Installation Manager)
LIGO Laboratory, Caltech, Physics Department
626.395.2034 @CIT / 225.686.3168 @Livingston / 509.372.8166 @Hanford
cell 626.695.8350

LHO VACUUM BAKE OVEN A LOAD 53

Legend:
- SETPOINT
- LOOP ONE TEMP
- LOOP TWO TEMP
- LOOP THREE TEMP
- LOOP FOUR TEMP
- LOOP FIVE TEMP
- LOOP SIX TEMP
- LOOP SEVEN TEMP

Y-axis: 0, 50, 100, 150, 200, 250

X-axis: 17:02:10, 20:02:20, 23:02:30, 2:02:43, 5:02:56, 8:03:03, 11:03:13, 14:03:22, 17:03:36, 20:03:45, 23:04:02, 2:04:16, 5:04:29, 8:04:48, 11:04:57, 14:05:11, 17:05:29, 20:05:43, 23:05:51, 2:06:07, 5:06:18, 8:06:31, 11:06:42, 14:06:54, 17:07:12, 20:07:24, 23:07:36, 2:07:53, 5:08:08

LHO VACUUM BAKE OVEN A LOAD #53 ELEVATED TEMPERATURE BACKGROUND SCAN

V-1 Closed

No Elevated Temperature Background Data Available

LHO VACUUM BAKE OVEN A LOAD #53
ELEVATED TEMPERATURE SCAN

V-1 Open, Cal-Gas and V-2 Closed, 70°C

No Elevated Temperature Data Available

LHO Bake Oven A Load # 53

1st Order Desorption Outgassing Rate Estimates using $Q_{low} = SP_{low} = SP_{high}[e^{(E_s/kT_{high})}]/[e^{(E_s/kT_{low})}]$

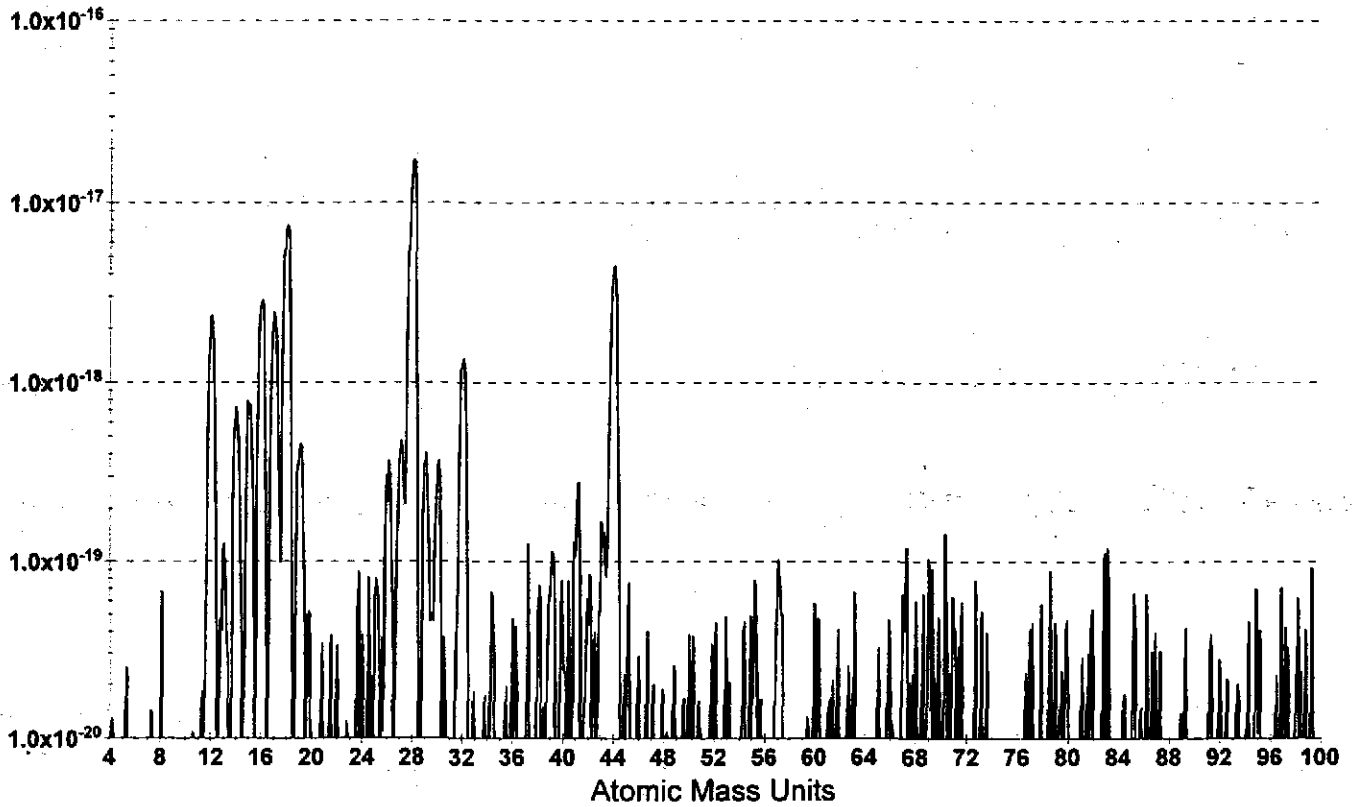| Number of units in bake load	Pump Speed (L/sec)	AMU	RGA background current (amps)	RGA current (amps) @ T_{high}	Calibration Factor CF (torr/amps)	T_{high} (K)	T_{low} (K)	Es/k	Extrapolated outgassing rate (torr*L/sec) @ T_{low}
1	5	41	No Data	No Data	2.00E+07	No Data	No Data	13000	No Data
1	5	43	No Data	No Data	2.00E+07	No Data	No Data	8000	No Data
1	5	53	No Data	No Data	2.00E+07	No Data	No Data	13000	No Data
1	5	55	No Data	No Data	2.00E+07	No Data	No Data	15000	No Data
1	5	57	No Data	No Data	2.00E+07	No Data	No Data	15000	No Data

LHO Vacuum Bake Oven A Load #53 RGA Background
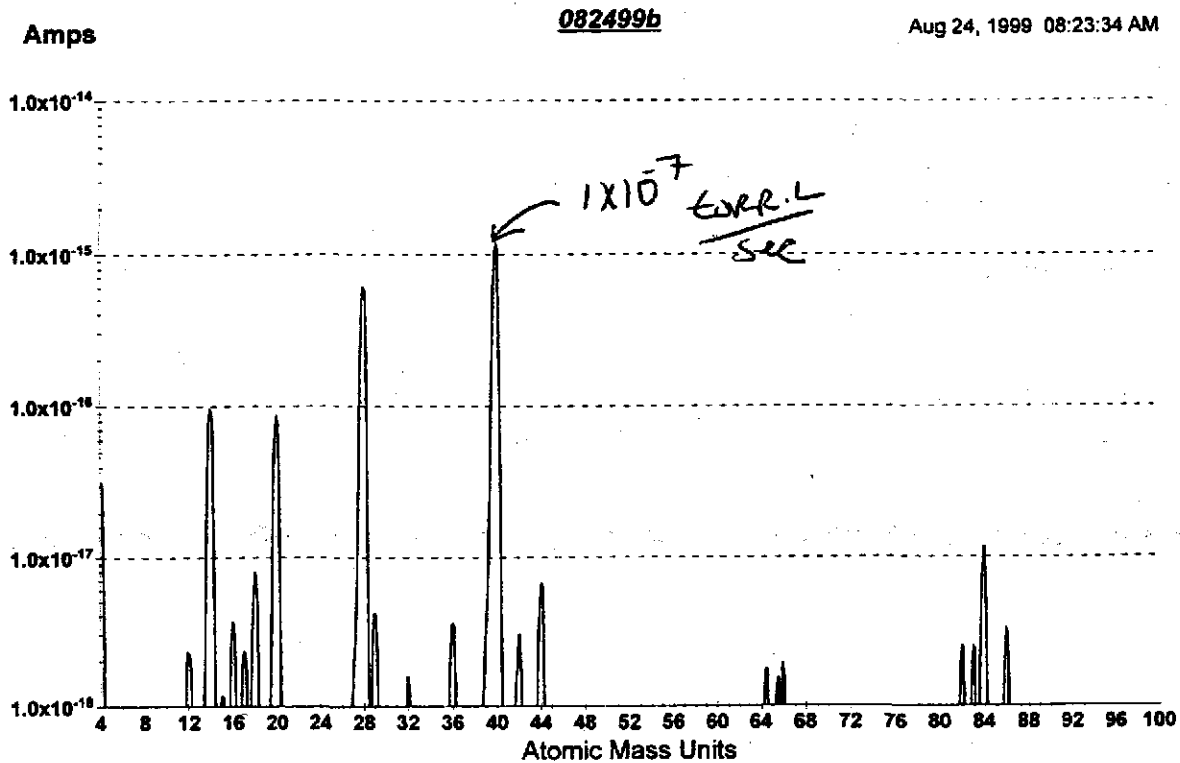
V-1 Closed, Room Temp

Amps

<u>**082499a**</u>

Aug 24, 1999 07:43:04 AM

LHO Vacuum Bake Oven A Load #53 Calibration

V-1 and cal-gas open, V-2 closed in pressure equilibrium at room temperature

082499b   Aug 24, 1999 08:23:34 AM

CF defined as $P_{(calc)} / I_{(meas)}$

$P_{calc(40)}$ = (leak rate) / (pump speed) = (1.1E-7 torr•L/sec)(0.86) / (5 L/sec) = 1.8E-8 torr

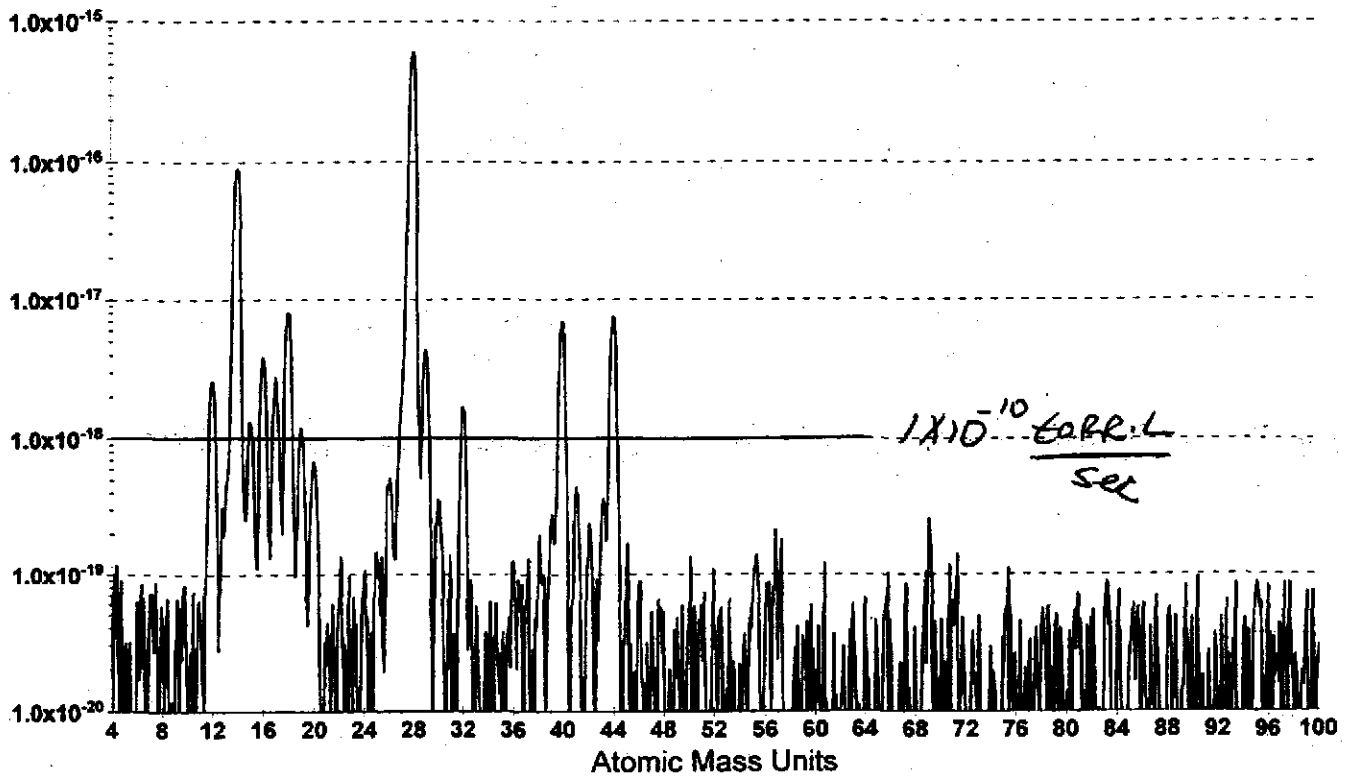$I_{(meas)}$ = 1E-15 amps

CF = (1.8E-8 torr) / (1E-15 amps) = 2E7 torr/amps

LHO Vacuum Bake Oven A Load #53 Post-Bake Scan Room Temp

V-1 Open, Cal-Gas and V-2 Closed

082499c

Aug 24, 1999 10:29:23 AM

Figure: Amps vs. Atomic Mass Units spectrum plot with handwritten annotation "1×10^{-10} ɕoɾɾ·L / sec"

X-POP3-Rcpt: brivera@apex
X-Sender: stan@127.0.0.1
X-Mailer: QUALCOMM Windows Eudora Light Version 3.0.5 (32)
Date: Wed, 01 Sep 1999 09:30:32 -0700
To: "Bartie J. Rivera" <rivera_b@ligo-wa.caltech.edu>
From: Stan Whitcomb <stan@ligo.caltech.edu>
Subject: Re: e-mail approval for previous scan

Bartie,

I approve tha scan for load 53.

stan

At 08:41 AM 9/1/99 -0700, you wrote:
>
>Hello Stan,
>
>Can I get you to e-mail me an approval for load
>53 (bsc bellows). You had approved them over the
>phone but the traveler has not been signed and they
>are about to be installed and I wanted to attach the
>approval to the back of the traveler. I will re-fax the
>scans to you at LLO.
>
>Thanks
>Bartie
>
>