

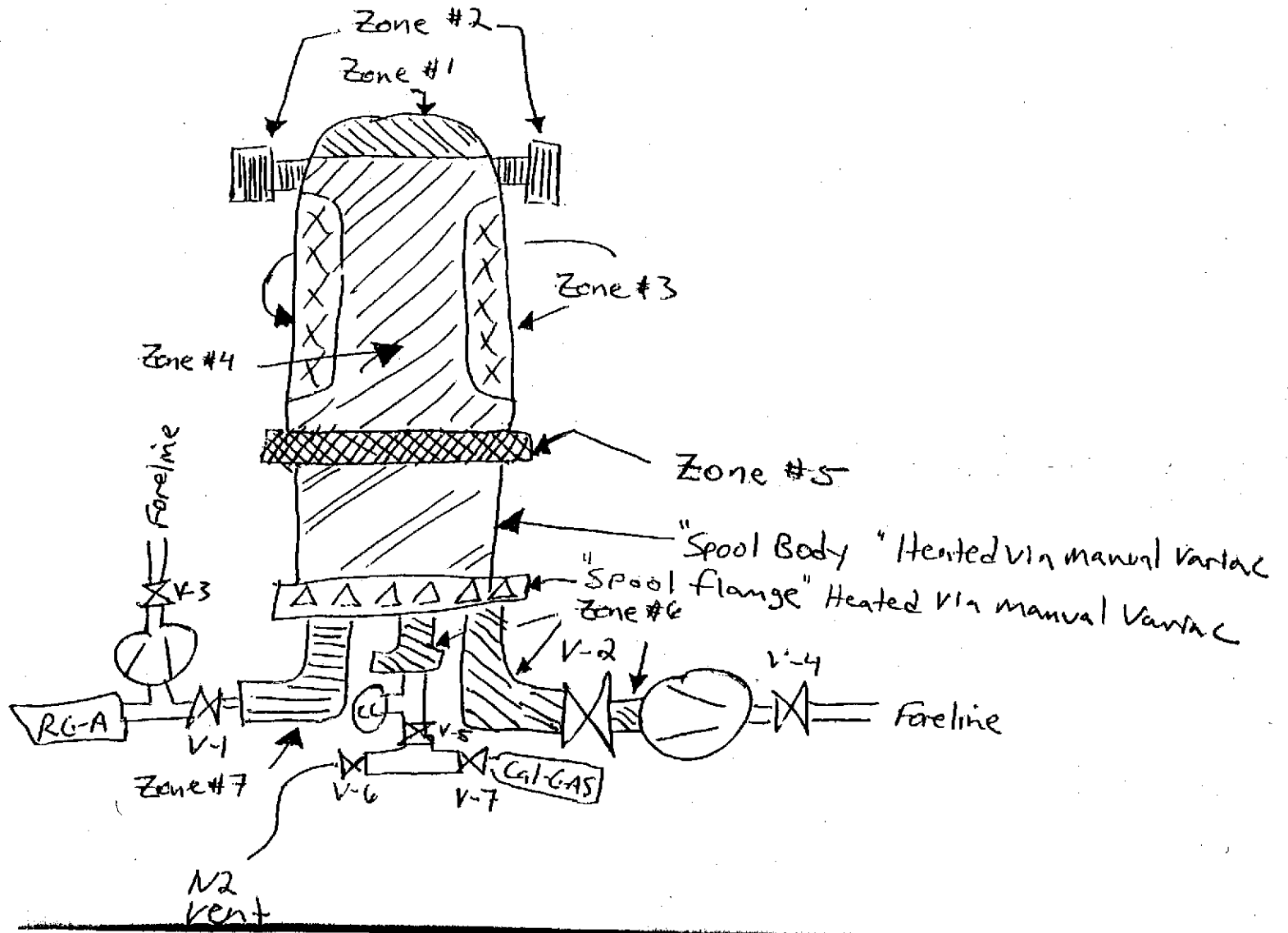
Summary of LHO Vacuum Bake Oven A RGA Data Generation

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.



LHO VACUUM BAKE OVEN A: CONTENTS LOAD #60

PSL REFERENCE CAVITY ASSEMBLY

REFERENCE CAVITY CHAMBER SERIAL NUMBER D980716 (2ea)

**REFERENCE CAVITY SUPPORT PLATES SERIAL NUMBER D980350-1-D
(3ea)**

**REFERENCE CAVITY SUPPORT PLATES SERIAL NUMBER D980350-2-D
(3ea)**

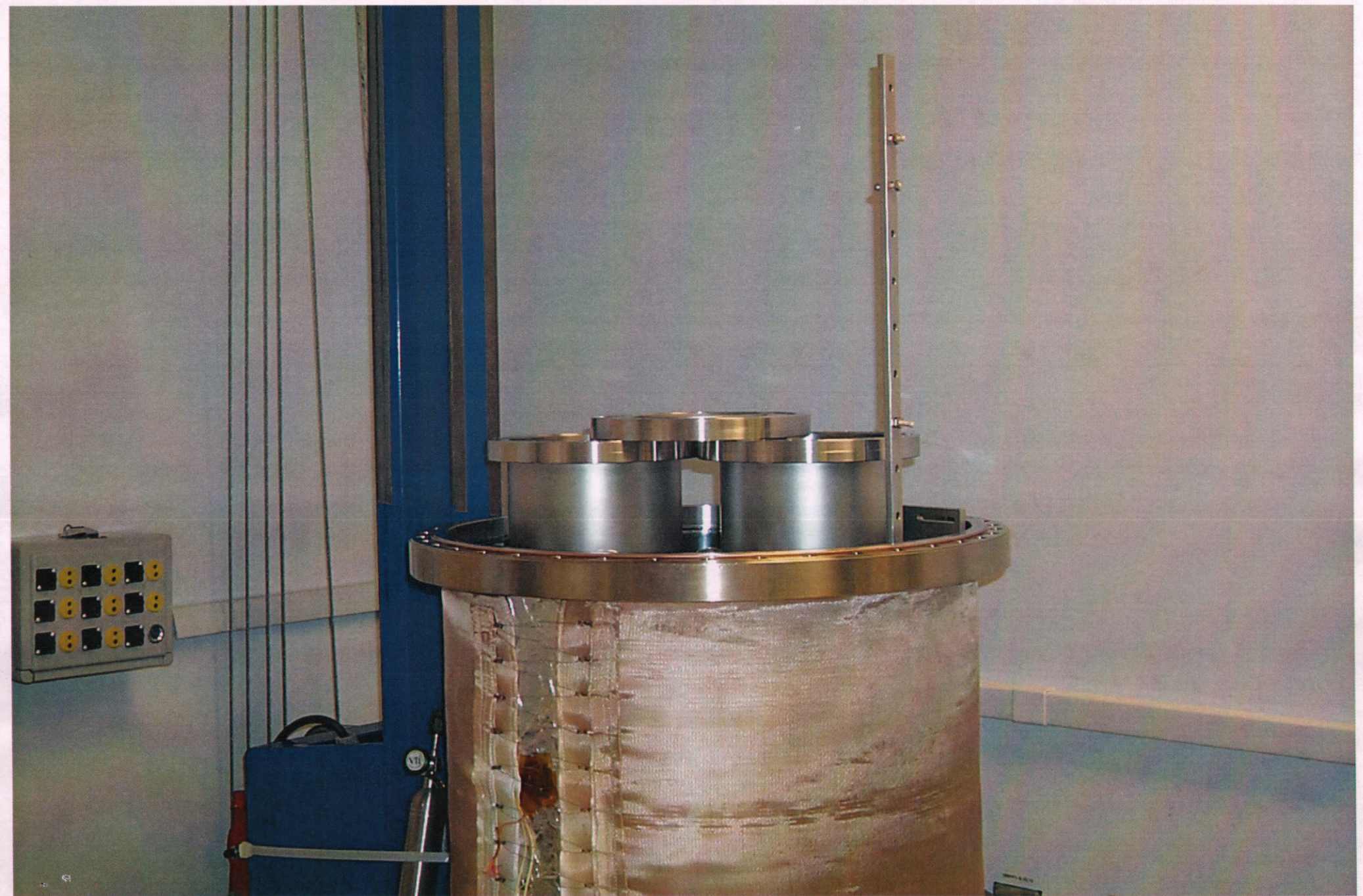
**REFERENCE CAVITY SUPPORT PLATES SERIAL NUMBER D980350-3-D
(3ea)**

**REFERENCE CAVITY AR COATED VIEWPORT SERIAL NUMBER ZV-800
(6ea)**

REFERENCE CAVITY POSTS S.S. S/N N/A (8ea)

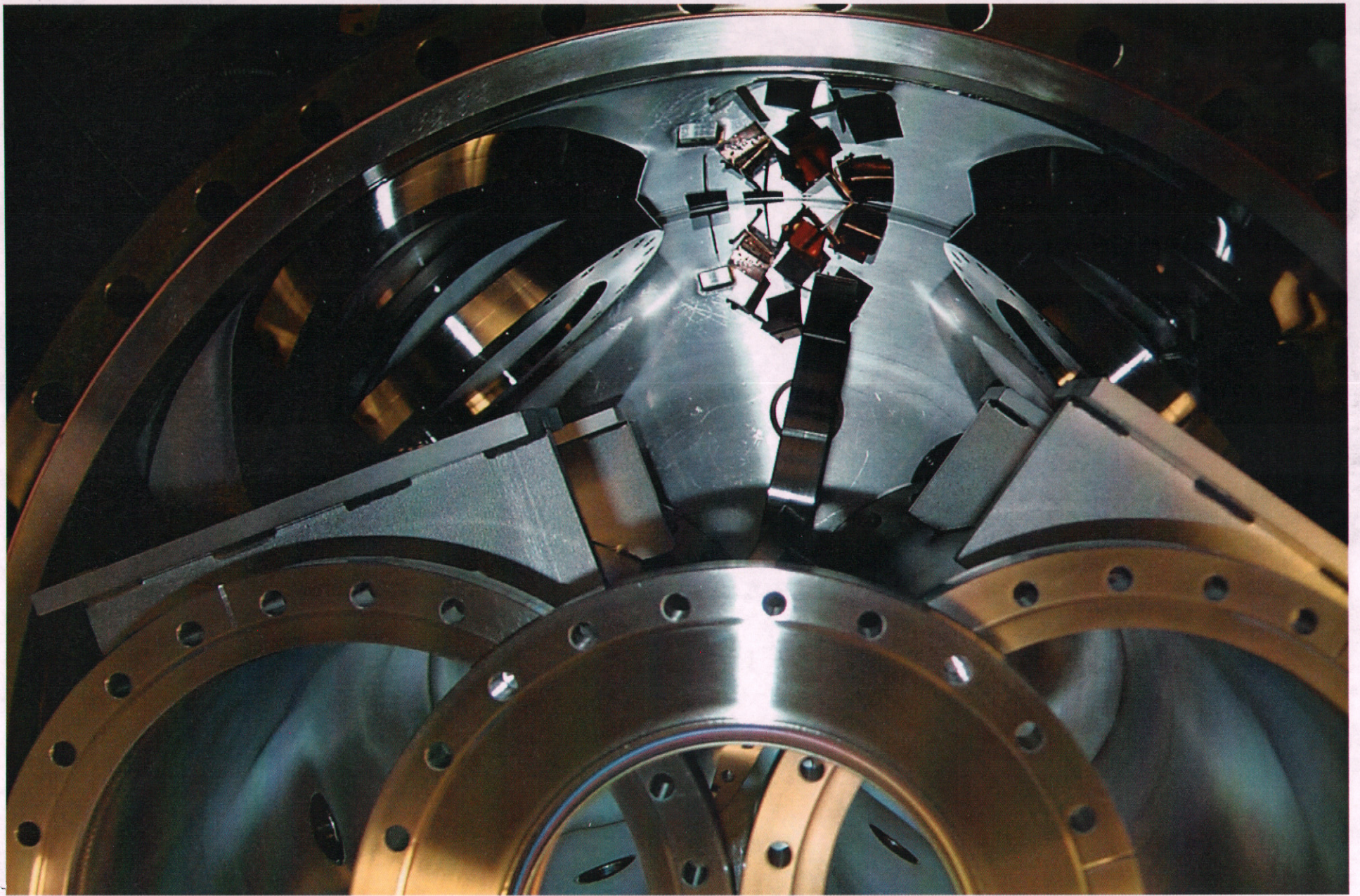
S.S. CHANNEL DAMPERS S/N N/A (6ea)

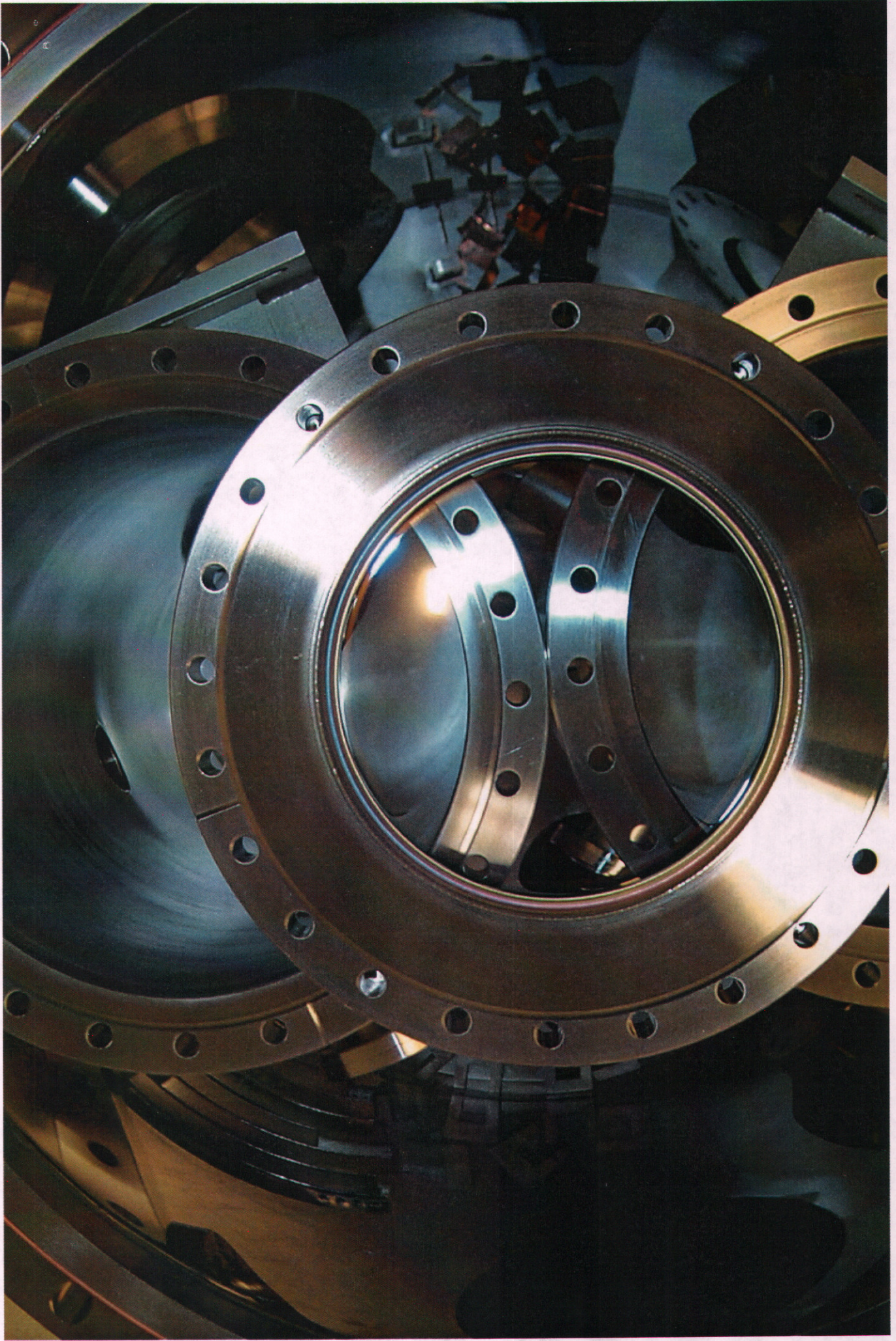
CU DAMPERS S/N N/A (14ea)



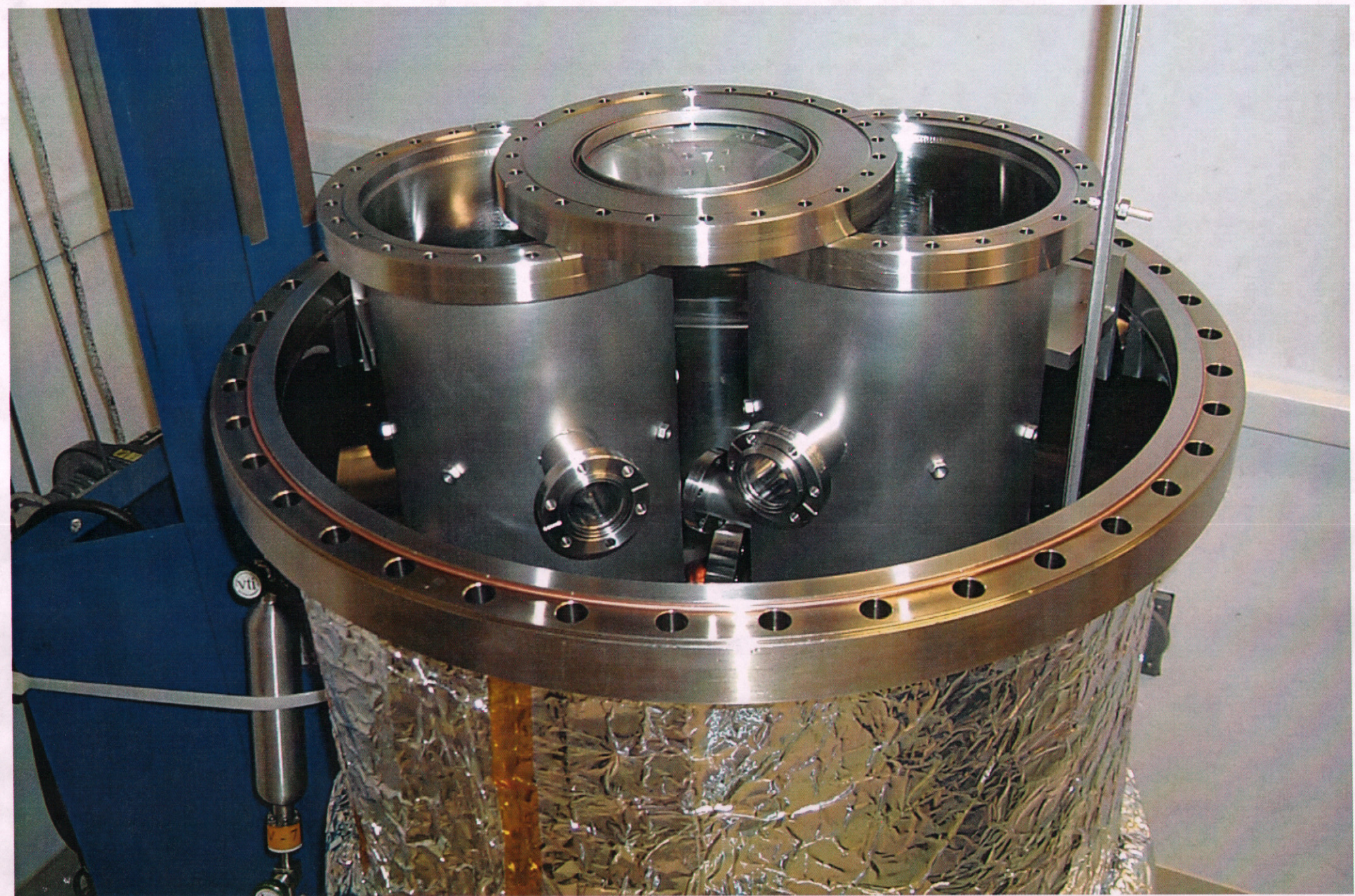




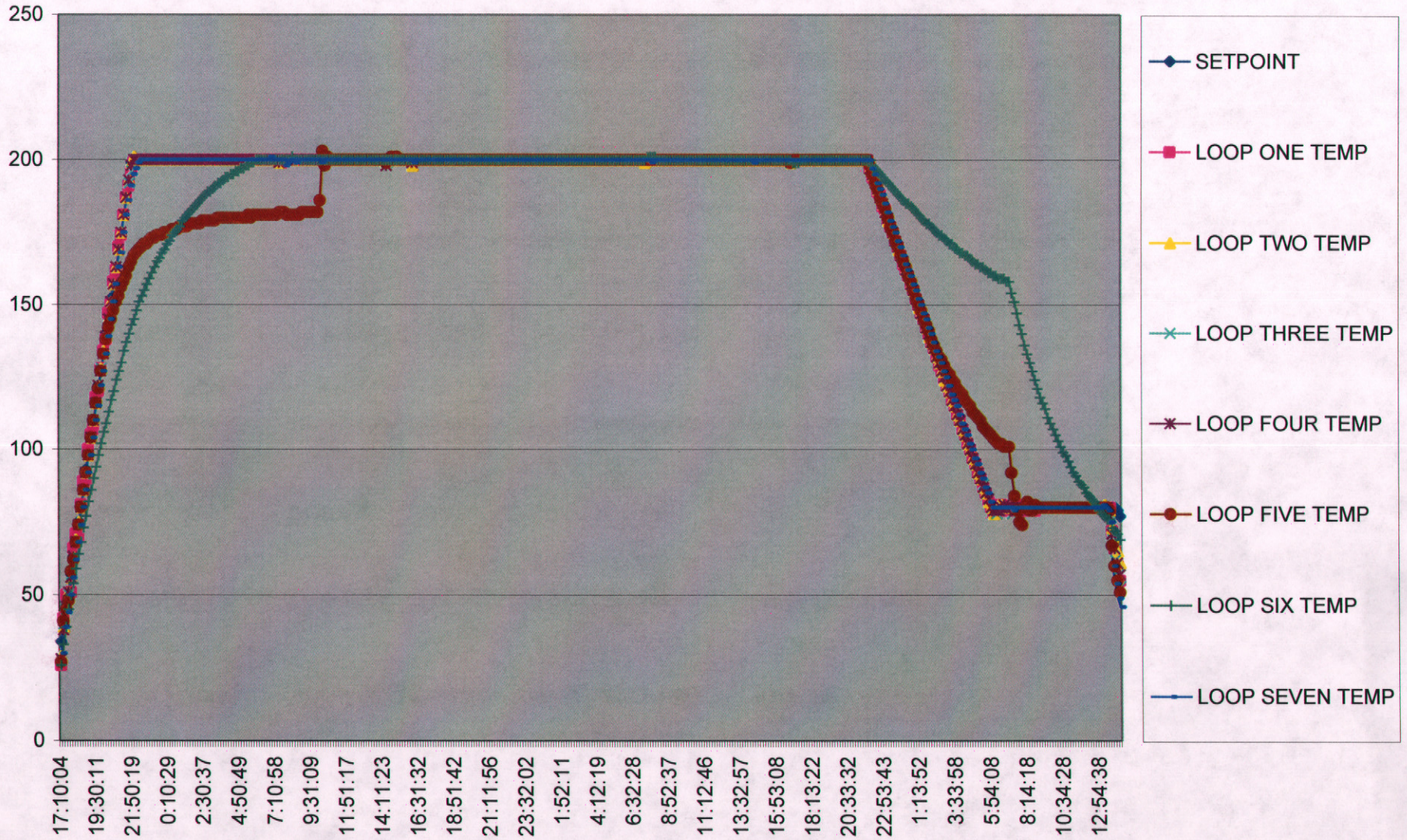








LHO VACUUM BAKE OVEN A LOAD 60



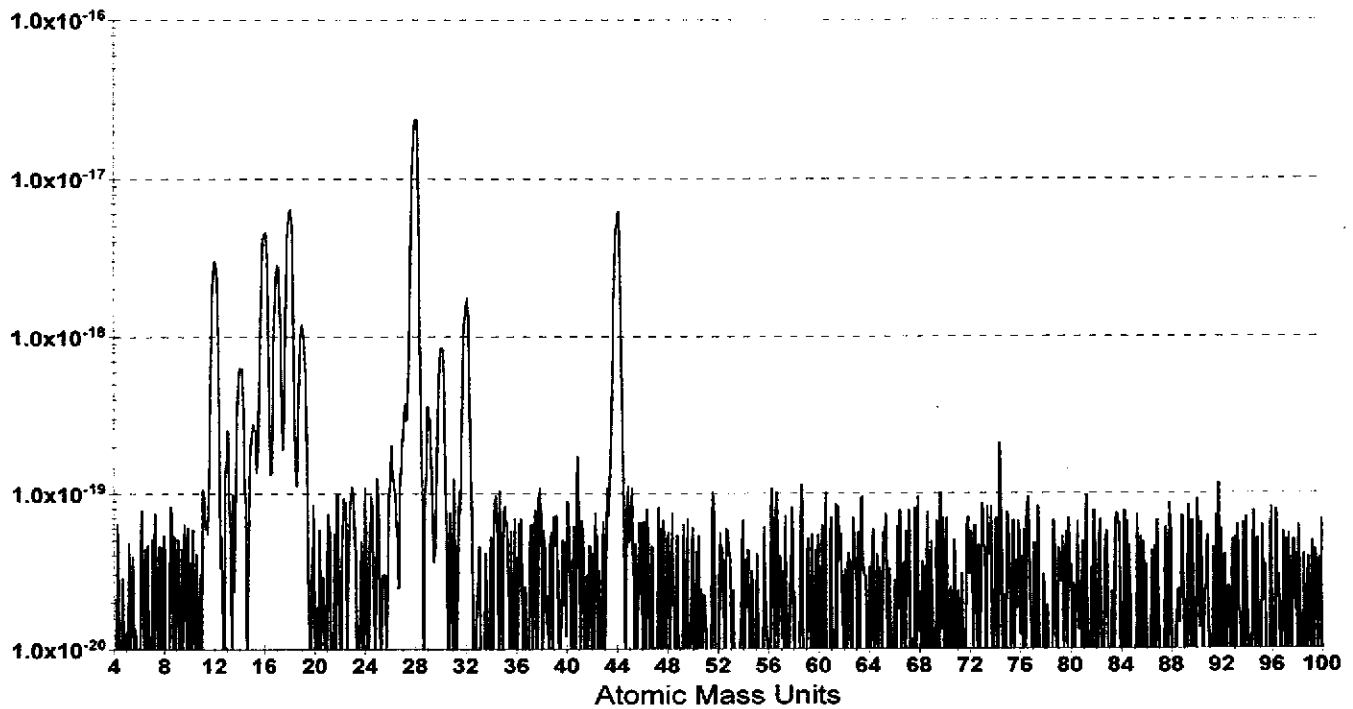
LHO VACUUM BAKE OVEN A LOAD #60 ELEVATED TEMPERATURE BACKGROUND SCAN

V-1 Closed

Amps

100899a

Oct 08, 1999 12:48:37 PM



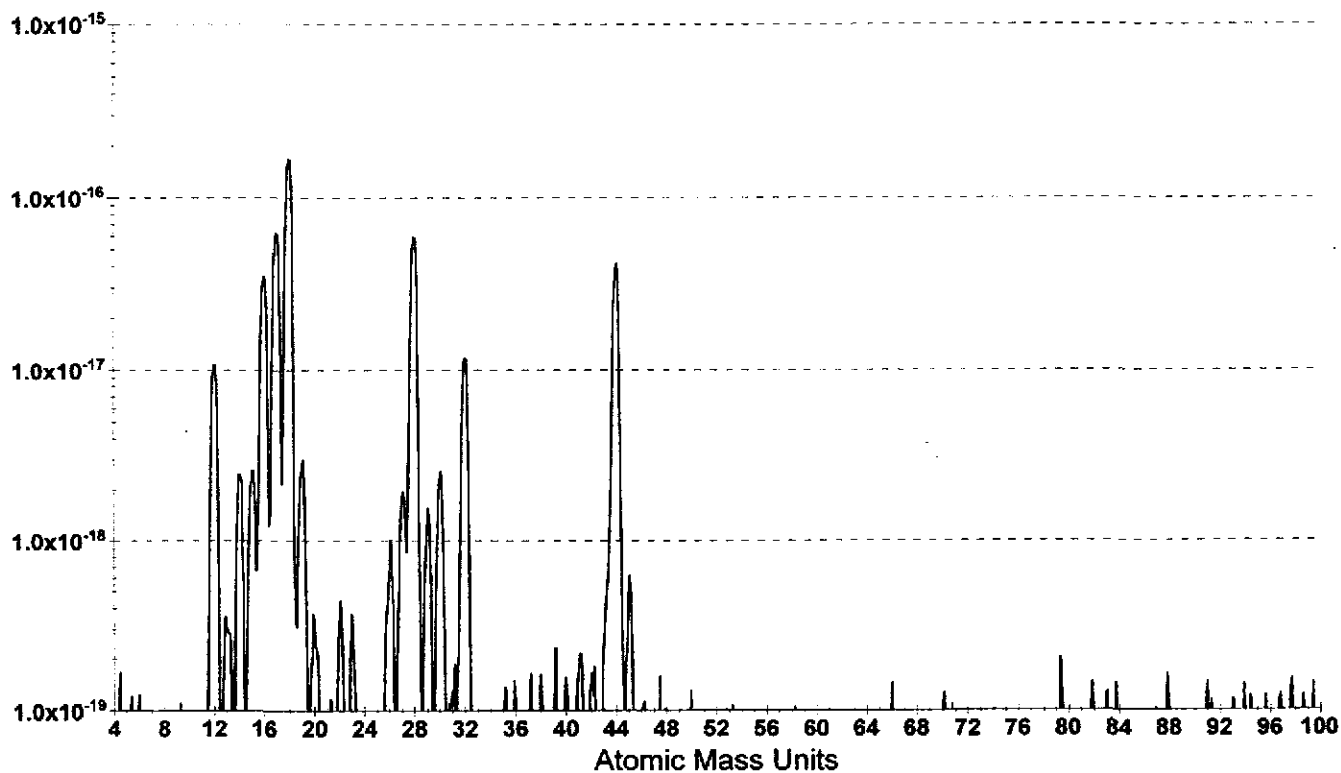
LHO VACUUM BAKE OVEN A LOAD #60 ELEVATED TEMPERATURE SCAN

V-1 Open, Cal-Gas and V-2 Closed, 80°C

Amps

100899b

Oct 08, 1999 01:36:25 PM



LHO Bake Oven A Load # 60

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	RGA current	Calibration Factor		High Temp (K)	Low Temp (K)	Es/k	Extrapolated
			background current (amps)	(amps) @ High Temp	CF (torr/amps)	T _{low}				
1	5	41	1.74E-19	2.16E-19	3.00E+07	not in equilibrium	2.96E+02	13000	#VALUE!	
1	5	43	3.97E-19	2.78E-18	3.00E+07	not in equilibrium	2.96E+02	8000	#VALUE!	
1	5	53	below noise	below noise	3.00E+07	not in equilibrium	2.96E+02	13000	#VALUE!	
1	5	55	below noise	9.97E-20	3.00E+07	not in equilibrium	2.96E+02	15000	#VALUE!	
1	5	57	below noise	9.74E-20	3.00E+07	not in equilibrium	2.96E+02	15000	#VALUE!	

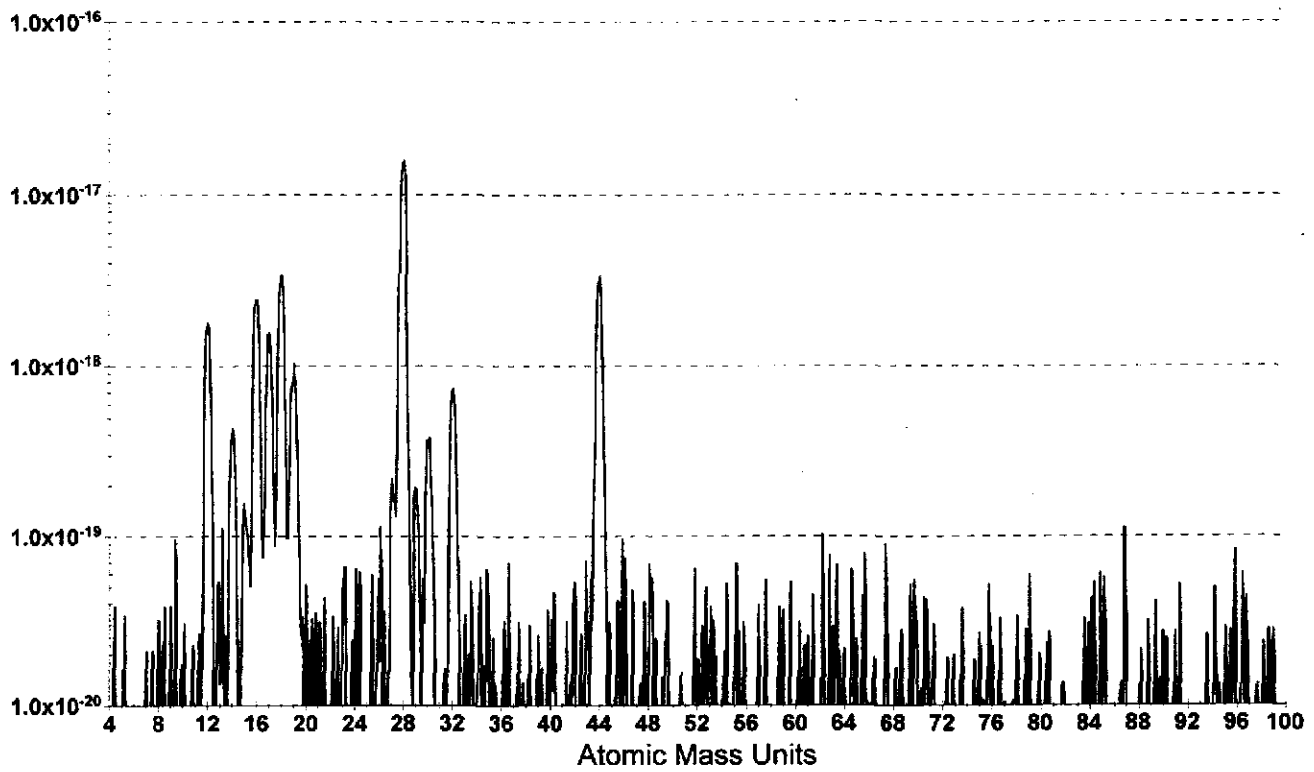
LHO Vacuum Bake Oven A Load #60 RGA Background

V-1 closed, room temperature

Amps

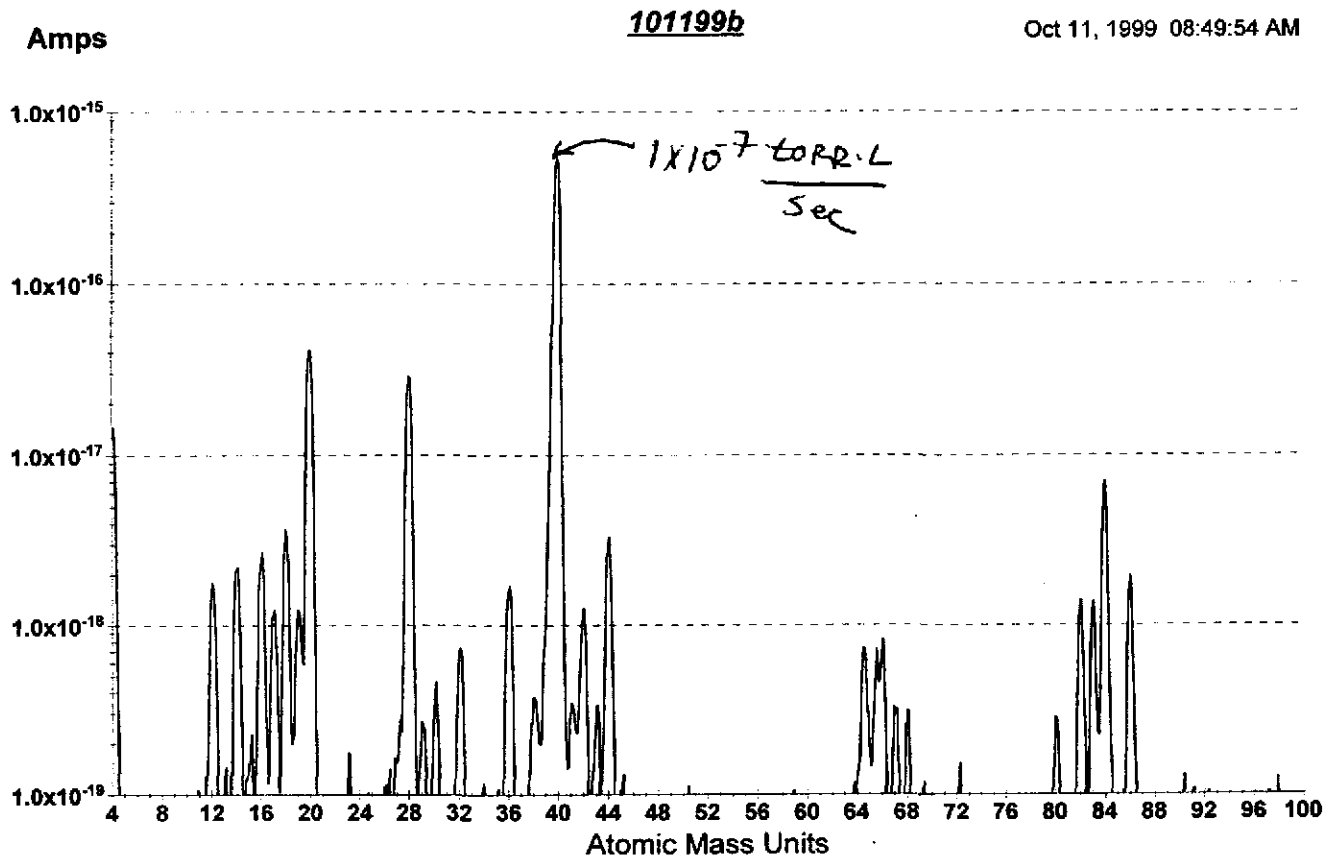
101199a

Oct 11, 1999 07:59:54 AM



LHO Vacuum Bake Oven A Load #60 Calibration

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



CF defined as $P_{(40)\text{calc}} / I_{(40)\text{meas}}$

$$P_{(40)\text{calc}} = (\text{leak rate}) / (\text{pump speed}) = (1.1 \times 10^{-7} \text{ torr} \cdot \text{L} / \text{sec})(0.86) / (5 \text{ L} / \text{sec}) = 1.8 \times 10^{-8} \text{ torr}$$

$$I_{(40)\text{meas}} = 5.3 \times 10^{-16} \text{ amps} \quad (\text{taken from } 101199\text{b.asc})$$

$$\text{CF} = (1.8 \times 10^{-8} \text{ torr}) / (5.3 \times 10^{-16} \text{ amps}) = 3.4 \times 10^7 \text{ torr/amps}$$

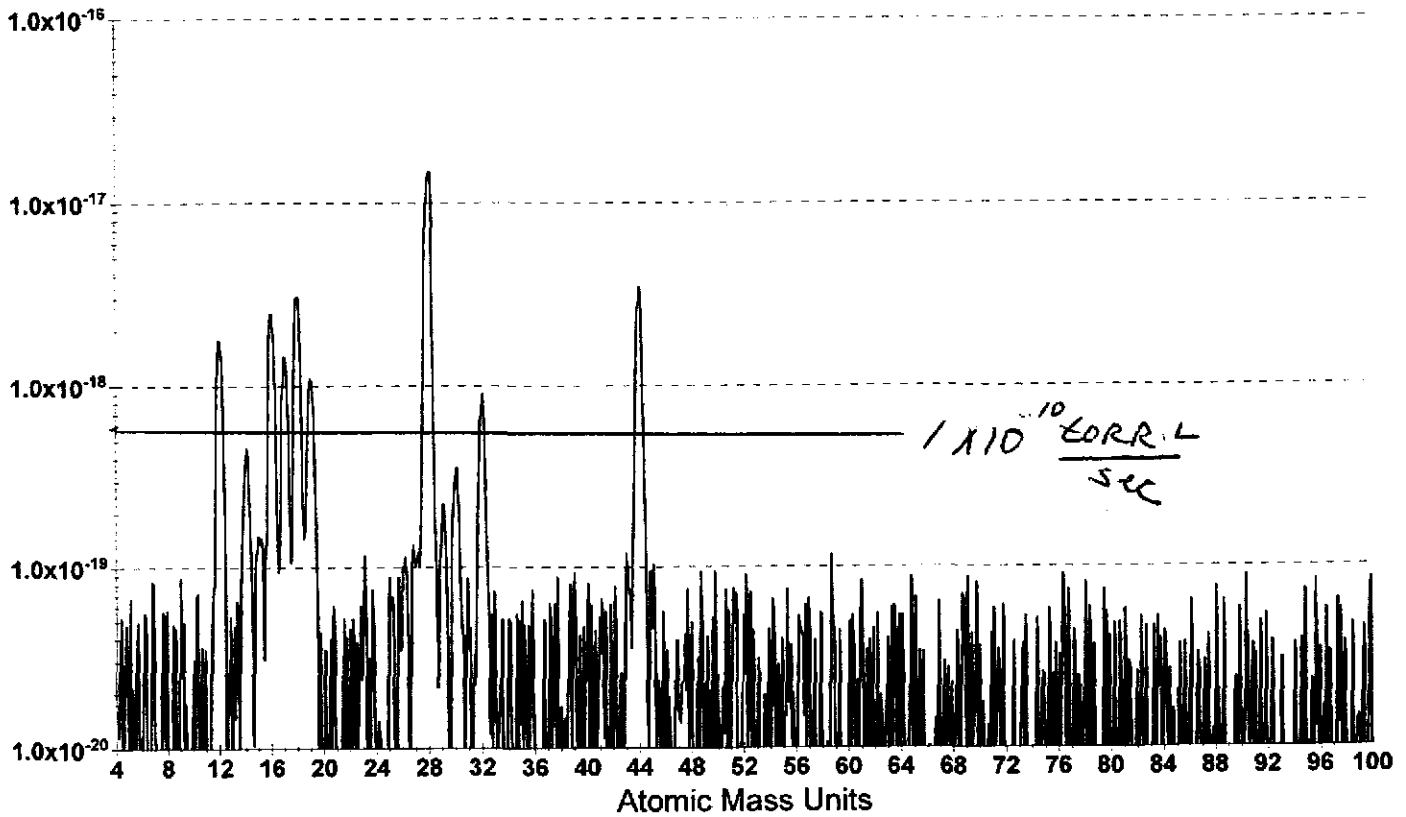
LHO Vacuum Bake Oven A Load #60 Post-Bake Scan Room Temp.

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

Amps

101199c

Oct 11, 1999 09:54:27 AM



LIGO PROCESS TRAVELER

Original
LHO/Cook

DCC Number: **E990358-00-X**

Date Prepared: **9-28-99**

Originator	Cognizant Engineer	Ext./Phone#	Account Number
J. Romie	Janeen Romie	#8445	5F518=LIGO.5F500 2.8, NSFLIGO.5F5000

Item	Dwg/Part Number	Rev	Part Description	Serial Number	Qty
1	D990484	02	ALUMINUM PARTS Rail, Little Beam Dumps	031 through 051	20

Used In (next higher assembly): Little Beam Dumps, D990490.

Vendor Name	PO/Contract Number
Spacecraft Specialist, Inc., Orange, CA	PO 1003714

Data Package, Receiving/Inspection Remarks:

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/Initials	Date Comp.
Y	Y		J. Romie/JHR	9-99

Process Flow:

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
1	Clean & Vacuum Bake per LIGO Vacuum Prep. Form		CIT	per E960022 for metal parts	Y. Kommemi S.E. J.C	10/1/99
2	Control Point		NA	Review/approve RGA scan # <i>354</i> <i>#65 SCAN 117790 RGA</i>	D. Coyne JC	10/5
3	Wrap & Tag vacuum clean parts per E960022-A		CIT	Wrap (UHV foil) and bag (CP Stat or equiv.) per E960022. Rails: 10 to LHO, 10 to LLO	Y. Kommemi Y.K.	10/5/99
4	Copy and File Traveler		N/A	Make 2 copies of the traveler File one copy with the DCC. Original goes with shipment to LHO, Attn: D. Cook. Send one copy with shipment to LLO, Attn: J. Kern.	Y. Kommemi Y.K.	10/5/99

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: E990358-00-X

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
5	Pack and Ship		CIT	Pack parts as appropriate to prevent contamination and damage in shipment. Ship to LHO, Attn: Doug Cook, to be used in IO assembly. <u>Note: Ship original traveler with these parts.</u> Ship to LLO, Attn: Jonathan Kern, to be used in IO assembly. <u>NOTE: Ship copy of traveler with these parts.</u>	Y. Kommemi Y.K.	10/5/99

END: Go to Traveler associated with next higher assembly processing

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

REMACHINED COMPONENTS. AND REBAKED @ LHO DCook

10/5/99

1.2E-07 DISP SPEC

A

SCAN SPEC

A

H

10/ 5/99 9:10

VSA # 357

CHANNEL	MASS	DMELL	HI LIMIT	LO LIMIT	CALIBRATE	PRESSURE
1	40.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	4.009E-11
2	44.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	6.050E-10
3	20.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.463E-09
4	18.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	4.884E-09
5	12.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.645E-10
6	2.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.583E-09
7	64.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.931E-10
8	41.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.223E-10
9	43.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	9.633E-11
10	53.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	3.749E-11
11	55.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	5.467E-11
12	57.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	5.311E-11

$$\frac{\Sigma = 3.63E-10}{30}$$

$$= \frac{1.21E-11}{20}$$

$$6.05E-13 \times 40$$

$$\left\{ \frac{2.4E-11 \text{ Tel}}{\text{Unit}} \right.$$

CHANNEL	12.	TAB HI	1.0E+00	ELEC CUR	2.26E-04	FIL RES	0.71
TAB MASS	57.	TAB LO	1.0E-15	EL ENERGY	-70.0	FIL VOLTS	2.2
TAB DMELL	4.0	TAB CALIB	1.0E+00	FOCUS	-20.0	FIL CUR	3.1
NO. SCANS	-1.	AUTO ZERO	ON	ELEC MULT	ON	FIL	ON

TOT PRES

1.2E-07 DISP SPEC

A

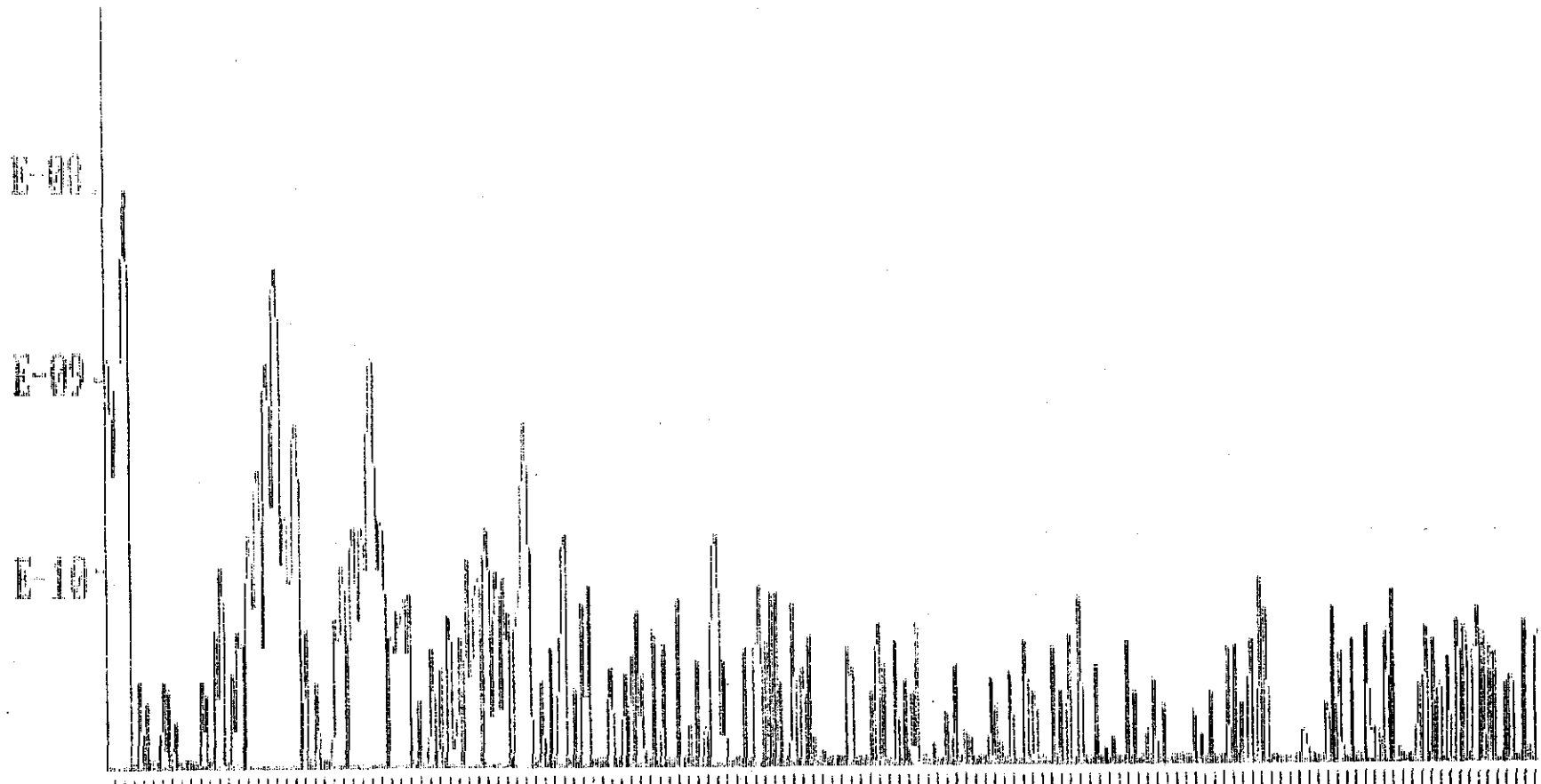
SCAN SPEC

A

10/ 5/99 8:52

1.0E-07

VSA #354



TO MASS	1. DWELL	2.0 SEC	ELEC CIR	9.986E-04	FIL RES	0.70	
HI MASS	150. SCALE	4 DEC	LOG	EL ENERGY	-70.0	FIL VOLTS	2.2
SAMP/AMU	4.			FOCUS	-20.0	FIL CIR	3.1
NO. SCANS	-1. AUTO ZERO	ON			ON	FIL	ON

TOT PIES

1.4E-07 DISP SPEC

A

SCAN SPEC

A

10/ 5/99 8:56

1.0E-07

'USA' #354

$$P_{calc} = \frac{2.0E-8}{\sqrt{40}} = 5.0E-10$$

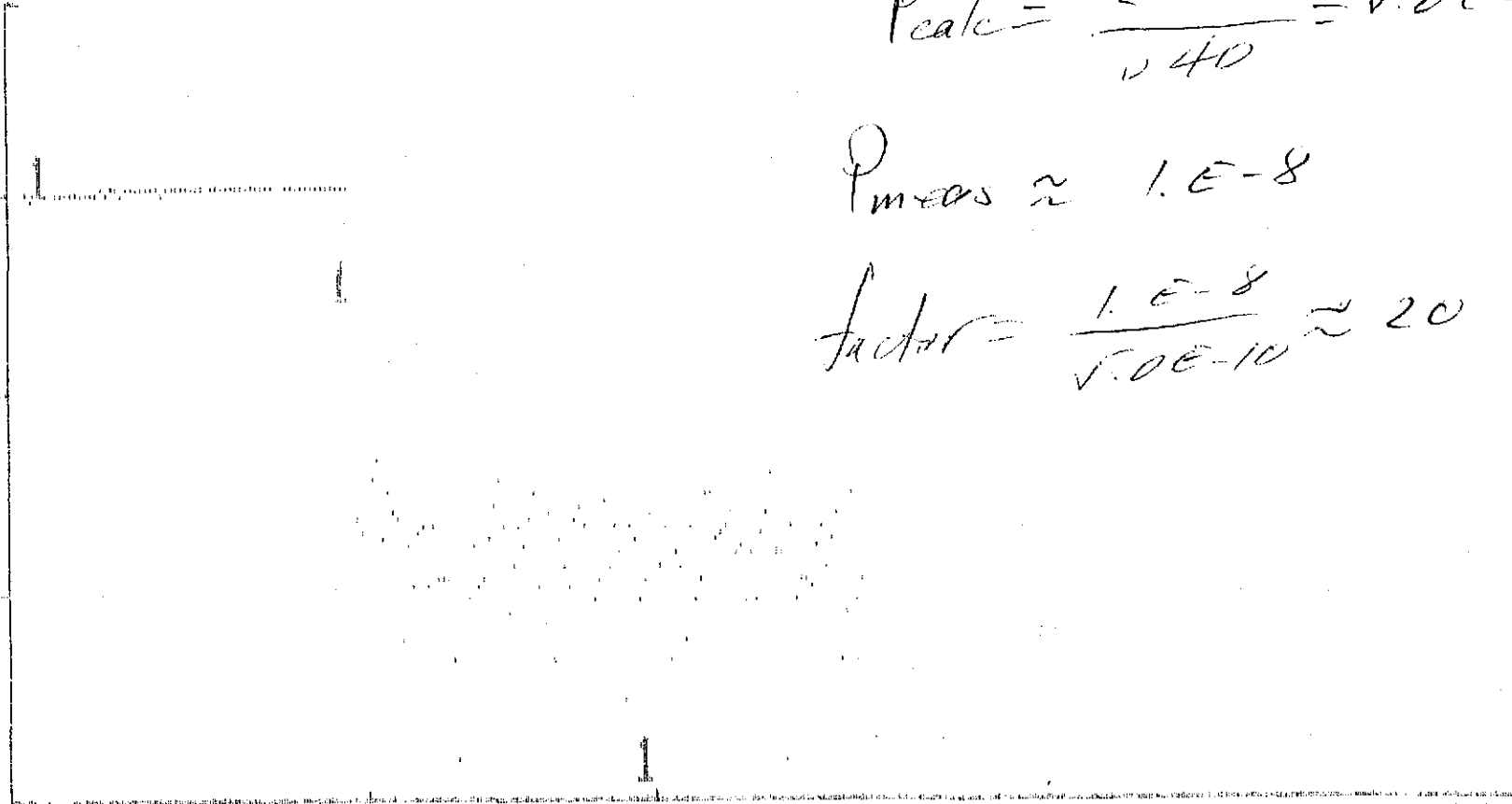
$$P_{meas} \approx 1.E-8$$

$$factor = \frac{1.E-8}{5.0E-10} \approx 20$$

E-08

E-09

E-10



0.0

100.0

200.0

300.0

400.0

500.0

CHANNEL

1. FREQUENCY

2. 2.50E+06

1. CAL MASS1

1. CAL MASS2

200.

TAB MASS

0. REF TIME

6.642 LO RES

4090. HI RES

2000.

TAB DWELL

120 NSEC EMISSION

1.0E+03 LO POS

0.50 HI POS

-3.00

TOT. SENS

20.0 AMP CAL

7.0E+03 LO SENS

6.00 HI SENS

8.00

LIGO VACUUM BAKE OVEN PROCEDURE AND CHECK LIST

Oven: A B C D VSA Load # 354 Date: 10/1/99

Load Contents: E990356, 358 (JMR) (24) stands CRD

Cap Torqued: _____ ft/lbs _____ ft/lbs 20 rails LBD _____ ft/lbs _____ ft/lbs

Metal vlv Open: Y N Vent vlv Closed: Y N TP on _____:_____ ; _____/_____
TP on _____:_____ ; _____/_____
TP on _____:_____ ; _____/_____
TP on _____:_____ ; _____/_____

Pressure: _____ Torr Date & Time: _____:_____
Pressure: _____ Torr Date & Time: _____:_____

NOTE: Do not turn heat on when pressure is above 5E-5 Torr.

AUTO/MANUAL; Heat on: _____:_____ ; _____/_____

RampTime: Oven: 3 Hrs, Pumpline: 3 Hrs
SoakTime: Oven: 48 Hrs, Pumpline: 48 Hrs

BAKE TEMPERATURE ('C');

Oven: 120 PumpLine: 200 TurboPump Heat On: Y N

TEMPERATURE: ('C');

	P-Line	End	Body	Cap	Date & Time	P(Torr)
1	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____

TP Heat Off: Y N Temp Cont. sw Off: Y N Reset PROG off: Y N

DEGAS;

Fil On? Y N W/Dycor# _____ Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___

PURGE; N2 AIR

Comments: _____

LIGO PROCESS TRAVELER

original
LHO / Cook

DCC Number: E990356-00-X

Date Prepared: 9-27-99

Originator	Cognizant Engineer	Ext./Phone#	Account Number
J. Romie	Janeen Romie	#8445	5F518=LIGO.5F500 2.8, NSFLIGO.5F5000

Item	Dwg/Part Number	Rev	Part Description	Serial Number	Qty
1	D990485	A	ALUMINUM PARTS Stand, Little Beam Dumps		24

Used In (next higher assembly): Little Beam Dumps, D990490.

Vendor Name	PO/Contract Number
Spacecraft Specialist, Inc., Orange, CA	PO 1003714

Data Package, Receiving/Inspection Remarks:

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/Initials	Date Comp.
Y	Y		J. Romie/JHR	9-27-99

Process Flow:

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
1	Clean & Vacuum Bake per LIGO Vacuum Prep. Form		CIT	per E960022 for metal parts	Y. Kommemi S.E. J.C.	10/1/99
2	Control Point		NA	Review/approve RGA scan # <i>354</i> <i>#65 1179C.RGA</i>	D. Coyne J.C.	10/5
3	Wrap & Tag vacuum clean parts per E960022-A		CIT	Wrap (UHV foil) and bag (CP Stat or equiv.) per E960022. Stands: 12 to LHO, 12 to LLO	Y. Kommemi V.K.	10/5/99
4	Copy and File Traveler		N/A	Make 2 copies of the traveler File one copy with the DCC. Original goes with shipment to LHO, Attn: D. Cook. Send one copy with shipment to LLO, Attn: J. Kern.	Y. Kommemi Y.K.	10/5/99

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: E990356-00-X

#	Operation	Start Date	Work Area	Instructions	Name/Initials	Date Comp.
5	Pack and Ship		CIT	Pack parts as appropriate to prevent contamination and damage in shipment. Ship to LHO, Attn: Doug Cook, to be used in IO assembly. <u>Note: Ship original traveler with these parts.</u> Ship to LLO, Attn: Jonathan Kern, to be used in IO assembly. <u>NOTE: Ship copy of traveler with these parts.</u>	Y. Kommemi J.P.	10/1/99

END: Go to Traveler associated with next higher assembly processing

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

RE MACHINED COMPONENTS AND RE BAKED @ LHO J.C.K.

NO. 123456789

1.2E-07 DISP SPEC

A

1 SCAN SPEC

A

1

10/ 5/99 9:10

VSA #27

CHANNEL	MASS	DWELL	HI LIMIT	LO LIMIT	CALIBRATE	PRESSURE
1	46.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	4.009E-11
2	44.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	6.050E-10
3	28.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.463E-09
4	18.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	4.884E-09
5	12.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.645E-10
6	2.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.583E-08
7	64.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.931E-10
8	41.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	1.223E-10
9	43.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	9.633E-11
10	53.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	3.749E-11
11	55.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	5.467E-11
12	57.	4.0 SEC	1.0E+00	1.0E-15	1.0E+00	5.311E-11

$$\frac{\sum = 3.63E-10}{30}$$

$$= \frac{1.21E-11}{20}$$

$$6.05E-13 \times 40$$

$$\left[\frac{2.42E-11 \text{ Tel}}{\text{Unit}} \right]$$

CHANNEL	12.	TAB HI	1.0E+00	ELEC CUR	9.96E-04	FIL RES	0.71
TAB MASS	57.	TAB LO	1.0E-15	EL ENERGY	-70.0	FIL VOLTS	2.2
TAB DWELL	4.0	SEC	1.0E+00	FOCUS	-20.0	FIL CUR	3.1
NO. SCANS	-1.	AUTO ZERO	ON	ELEC HIET	ON	FIL	ON

TOT PHS

1.2E-07 DISP SPEC

A

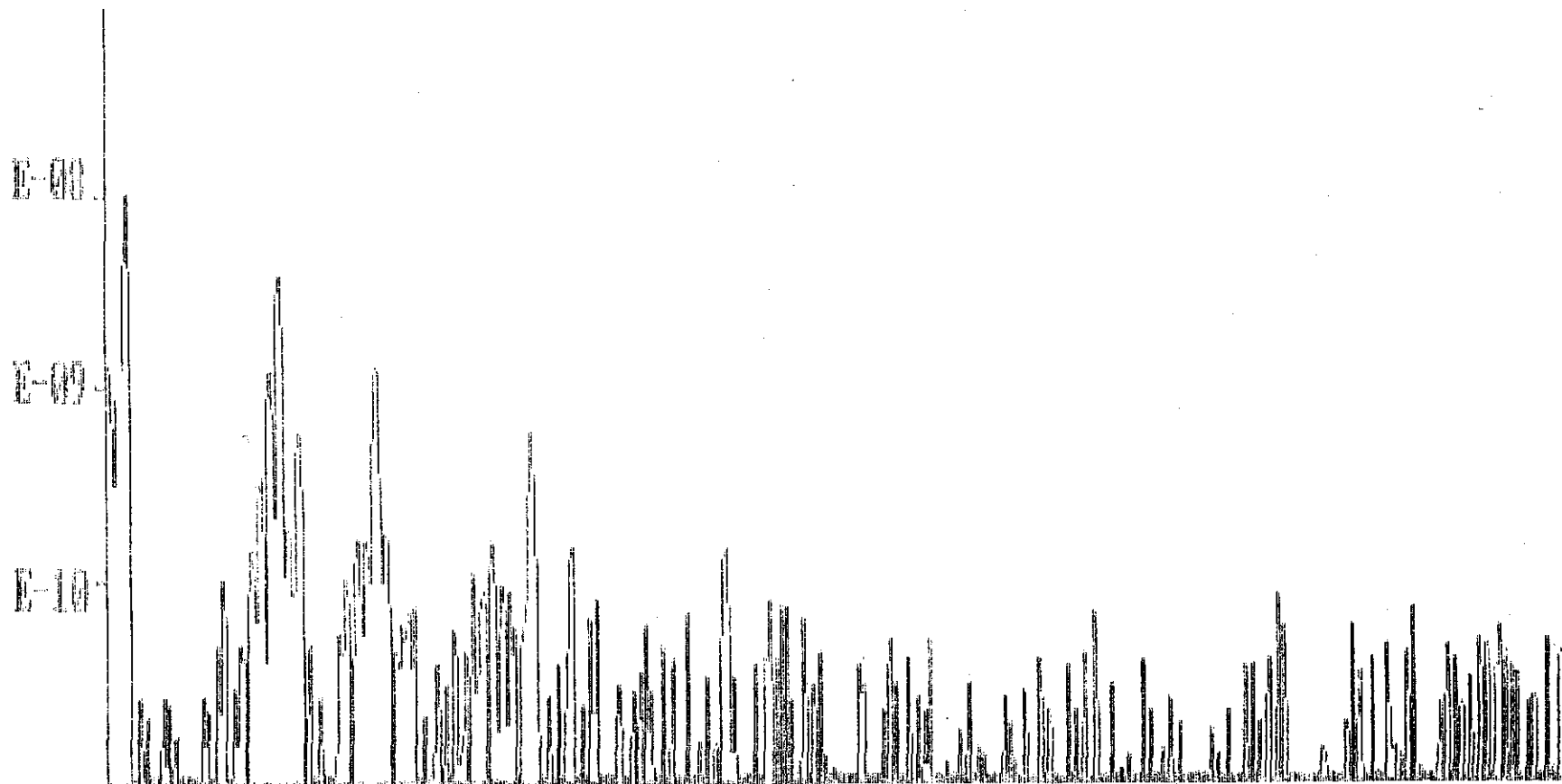
SCAN SPEC

A

10/ 5/99 8:52

1.0E-07

'VSA' 77354



10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

TO MASS	1. DWELL	2.0 SEC	ELEC CIR	9.986E-04	FIL RES	0.70	
HI MASS	150. SCALE	4 DEC	LOG	EL ENERGY	-20.0	FIL VOLTS	2.2
SAMP/AMU	1.		FOCUS	-20.0	FIL CIR	3.1	
NO. SCANS	-1. AUTO ZERO	ON	INTERMEDIATE	ON	FIL	ON	

TOT PRES

1.4E-07 DISP SPEC

A

SCAN SPEC

A

10/ 5/99 8:56

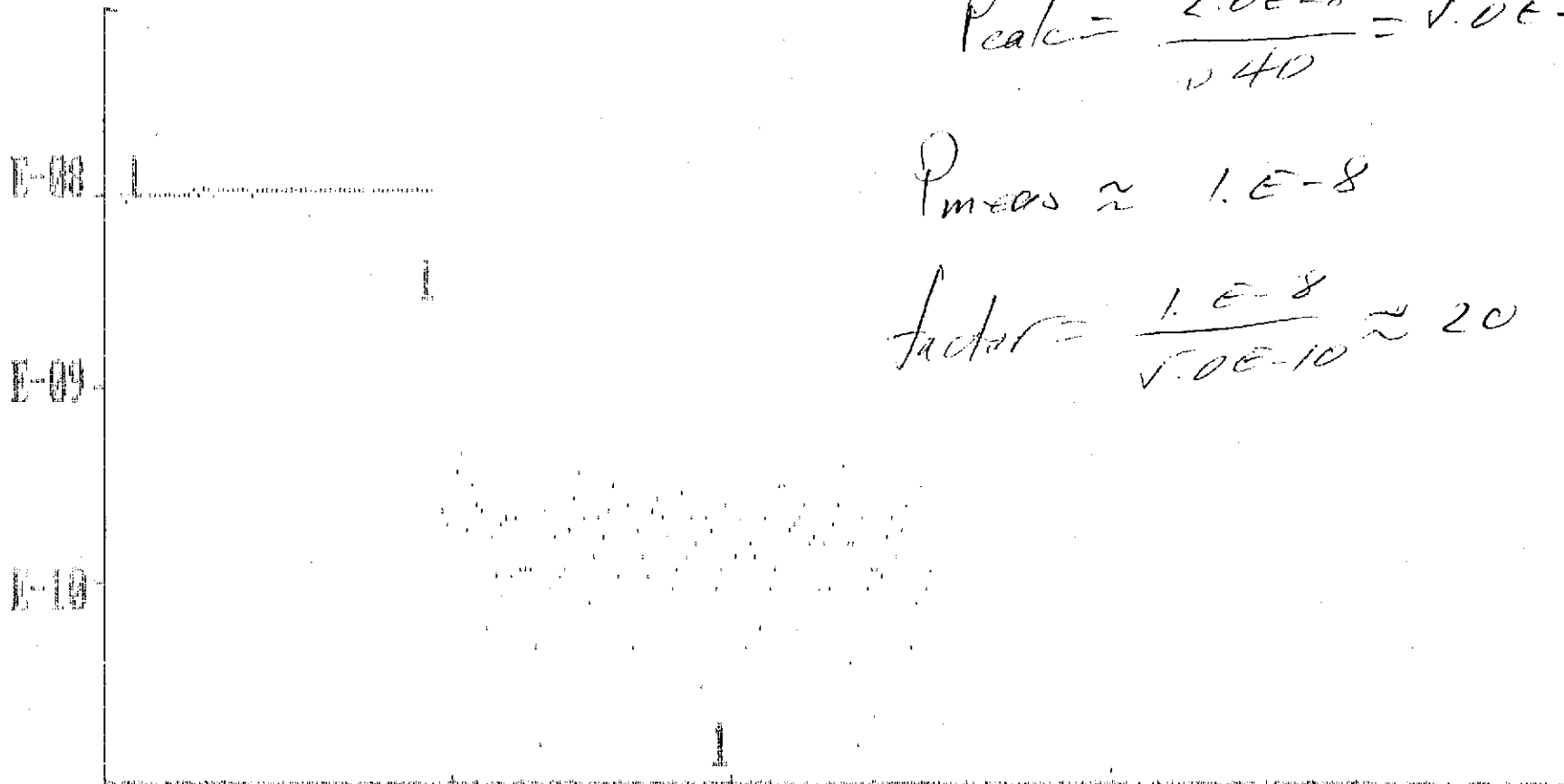
1.0E-07

'V3A' #354

$$Peak = \frac{2.0E-8}{0.40} = 5.0E-10$$

$$P_{meas} \approx 1.E-8$$

$$factor = \frac{1.E-8}{5.0E-10} \approx 20$$



0.0	100.0	200.0	300.0	400.0	500.0
CHANNEL	1. FREQUENCY	2.250E+06	COL MASS1	1. COL MASS2	200.
TAD MASS	0. RF TUNE	6.642	LO RES	4000. HI RES	2000.
TAD DWELL	120 NSEC	EMISSION	1.0E-03	LO POS	0.50
TOT. SENS	20.0	AMP CAL	7.0E+03	LO SENS	6.00
				HI POS	-3.00
				HI SENS	8.00

LIGO VACUUM BAKE OVEN PROCEDURE AND CHECK LIST

Oven: A B C D VSA Load # 354 Date: 10/1/99

Load Contents: E990356, 358 (JMR) (24) stands CBD

Cap Torqued: _____ ft/lbs _____ ft/lbs 20 rails CBD _____ ft/lbs _____ ft/lbs

Metal vlv Open: Y N Vent vlv Closed: Y N TP on _____:_____ : _____/_____
TP on _____:_____ : _____/_____
TP on _____:_____ : _____/_____
TP on _____:_____ : _____/_____

Pressure: _____ Torr Date & Time: _____:_____ : _____

Pressure: _____ Torr Date & Time: _____:_____ : _____

NOTE: Do not turn heat on when pressure is above 5E-5 Torr.

(AUTO)/MANUAL; Heat on: _____:_____ : _____/_____

RampTime: Oven: 3 Hrs, Pumpline: 3 Hrs

SoakTime: Oven: 48 Hrs, Pumpline: 48 Hrs

BAKE TEMPERATURE ('C');

Oven: 120 PumpLine: 200 TurboPump Heat On: Y N

TEMPERATURE: ('C');

	P-Line	End	Body	Cap	Date & Time	P(Torr)
1	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____

TP Heat Off: Y N Temp Cont. sw Off: Y N Reset PROG off: Y N

DEGAS;

Fil On? Y N W/Dycor# _____ Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___
Date: ___/___/___ Time On: ___:___:___ Time Off: ___:___:___

PURGE; N2 AIR

Comments: _____

