HIRDLS

TR-OXF-261

HIGH RESOLUTION DYNAMICS LIMB SOUNDER

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Date: 5th Aug 00

Subject/Title: **In-Flight Calibrator (IFC) Vibration Test Report**

Description/Summary/Contents:

This document is the vibration test report for the PFM In-Flight Calibrator Subsystem. The test was conducted at the Oxford University AOPP vibration test facility during 29th and 30th June 2000, with the limited performance tests included.

Keywords:

Reviewed/Approved by: Date (yy-mm-dd):			

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1. Introduction

This document is the test report for the Proto-flight model (PFM) In-flight calibrator (IFC) sub system acceptance vibration.

The items that were exposed to the specified vibration levels were the IFC-black body (IFCBB) and the Blackbody Electronics Uint (BEU).

The IFCBB was exposed to sine-dwell and random spectrum in three orthogonal axes.

The BEU was exposed to low-level sine-survey, sine-dwell and random spectrum in three orthogonal axes.

1.2 References

RD1 TP-OXF-211 IFC Vibration Test Procedure

2. Facility and Operators

The vibration test facility at Oxford consists of a dedicated room with a Ling-Dynamics DVC-4000S controller and shaker.

The facility operator was Mr. N. O'Donnell (OXU), witnessed by Mr. R., Carter (Swales) with the IFC RE Dr. C. Hepplewhite (OXU) and support from Mr. S. Graham (GSFC).

The test levels were entered into the controller and the bare fixture survey was performed. A bare fixture test run was then performed prior to each axis test on the PFM item. The procure specified in table 6.1 of RD1 was performed, starting with the IFCBB for all axes, then the BEU.

The tests were carried out on the 29th and 30th June 2000.

3. Record of Events

3.1 Summary

On the 29th June 2000 The limited performance test was performed with the IFC. All results nominal.

The IFCBB was shaken axis A3 first (sine dwell and random) followed by a passive electrical test. This test consisted of the IFCBB + U25 + 44-way break-out box and a digital Ohm-meter and is designed to demonstrate that no shorts or open circuits had occurred. All results were nominal - ref. item xx of table 1.

The remaining two axes for the IFCBB were then tested.

An LPT was performed on the IFC and consisted of the IFCBB-simulator, U25 and the BEU using the IPU-simulator. All results were nominal - ref. item xx of table 1.

The BEU was shaken axis A3 first followed by a safe to mate - all readings nominal. There was no discernible shift in the sine-survey signature. The LPT with the IFCBB-simulator was repeated - all values nominal ref. item xx of table 1, but note review §4.

The remaining two axes for the BEU were then tested followed by an LPT - all results nominal - ref. item xx of table 1.

Table 1.

3.2 Charts

The following charts are appended to this document:
1. Bare fixture survey
2. IFCBB Random vibration axes A1, A2, A3
3. IFC BEU A3 sine survey & A3 random; A2 sine survey and A2 random; A1 sine survey and A1 random vibration.

3.3 Photographs

The following photographs are appended to this document:
IFC BEU A3, BEU A2 and BEU A1 shake respectively.

4 Data Review

The following table summarises the results of the LPTs performed before and after the vibration tests.

The main points to notice are that in most cases there was no change in performance of the IFC. The one exception of significance is the shift of 6 to 7 bits of the PRT readings for side A, which was not observed for side-B. Such a shift is not unexpected, further exposure to vibration would be expected to result in a negligible further shift (assuming the levels are not greater than those used in this test). Any increase of offset error that this shift would induce in the PRT temperature characteristic would be taken into account during the final (post-environment) end-to-end calibration check at the Oxford University facility.

The stand alone passive electrical test performed on the IFCBB confirmed that there was no induced shorts or open circuits and the impednace of the PRTs was nominal. This test was not of sufficient to resolve any very small sifts of characteristics. A separate calibration check was performed on the black body. This process is quite complex as it involves comparison of data sets that were obtained under differing conditions. The results are summarised in table 2.

		Side - A Telemetry Monitors										Side - B Telemetry Monitors										Side=B HCW		Notes
		Time	+15V_mon	-15V_mon	+5V_mon	Rref_ Temp	PRT_1	PRT_2	PRT_3	HCW=Supp ly off	HCW=AB	Time	+15V_mon	-15V_mon	+5V_mon	Rref_ Temp	PRT_1	PRT_2	PRT_3	HCW=Supp ly off	HCW=AB		
BEU Pre-Vibe LPT	**(28/Jun/00)**																							
Input		17:12	15.00±0.02	-15.00±0.02	5.00±0.02							17:12	15.00±0.02	-15.00±0.02	5.00±0.02									
Telemetry Readings (hex)			E7	E7	DA	7B	B274	B286	B2C4				E8	E8	D8	7C	B2A4	AE32	B208					BEU+U15+IFCBB
Telemetry Readings (dec)			231	231	218	123	45684	45750	45764				232	232	219	124	45732	44594	45579					
Input		18:11	15.30±0.02	-15.30±0.025	10±0.02							17:55	15.30±0.02	-15.30±0.025	10±0.02									
Telemetry Readings (hex)			EE	EC	E3	7D	B368	B3AC	B3B0				EE	ED	E3	7A	B36D	AF1E	B335					BEU+U15+IFCBB
Telemetry Readings (dec)			238	236	227	125	45928	45996	46000				238	237	227	122	45933	44830	45877					
Heater Function										0.22V	10.18V											0.18V	10.2V	BEU+U15+IFC-Simulator
Input	**(30/Jun/00)**	8:52	15.0±0.05	-15.0±0.05	5.0±0.05							8:52	15.0±0.05	-15.0±0.05	5.0±0.05									
Telemetry Readings (hex)			E9	EB	DB	7D	AFB7	ABC3	A7D2				EA	ED	DB	7D	AFC6	ABCE	A7DE					BEU+U15+IFC-Simulator
Telemetry Readings (dec)			233	235	219	125	44983	43971	42962				234	237	219	125	44998	43982	42974					
BEU Post-Vibe axis A3 LPT	**(30/Jun/00)**																							
Input		12:24	15.0±0.05	-15.0±0.05	5.0±0.05							12:24	15.0±0.05	-15.0±0.05	5.0±0.05									
Telemetry Readings (hex)			E9	EC	DB	79	AFBE	ABC9	A7D8				EA	EC	D8	71	AFC6	ABCE	A7DE					BEU+U15+IFC-Simulator
Telemetry Readings (dec)			233	236	219	121	44990	43977	42968				234	236	216	113	44998	43982	42974					
Heater Function										0.23V	10.19V											0.18V	10.2V	
BEU Post-Vibe LPT	**(30/Jun/00)**																							
Input		18:00	15.0±0.05	-15.0±0.05	5.0±0.05							18:00	15.0±0.05	-15.0±0.05	5.0±0.05									
Telemetry Readings			E9	EB	D7	71	AFBE	ABCA	A7D8				EA	ED	DC	79	AFC7	ABD0	A7DF					BEU+U15+IFC-Simulator
Heater Function			233	235	215	113	44990	43978	42968	0.23V	10.19V		234	237	220	121	44999	43984	42975	0.18V	10.2V			

Pre & Post vibration calibration check of IFCBB PRTs.

Temperature of IFCBB: 22.1206 C during check 5/Jul/00.

	PRTA-1	PRTA-2	PRTA-3	PRTB-1	PRTB-2	PRTB-3	
pre-vibe	543.255	543.578	543.642	543.384	543.513	543.578	Ω ±0.005
5/Jul/00	543.144	543.470	543.510	543.470	543.350	543.359	Ω ±0.003
Delta	-0.111	-0.108	-0.132	+0.086	-0.163	-0.219	
D-mean	-0.003	0.000	-0.024	+0.194	-0.055	-0.111	

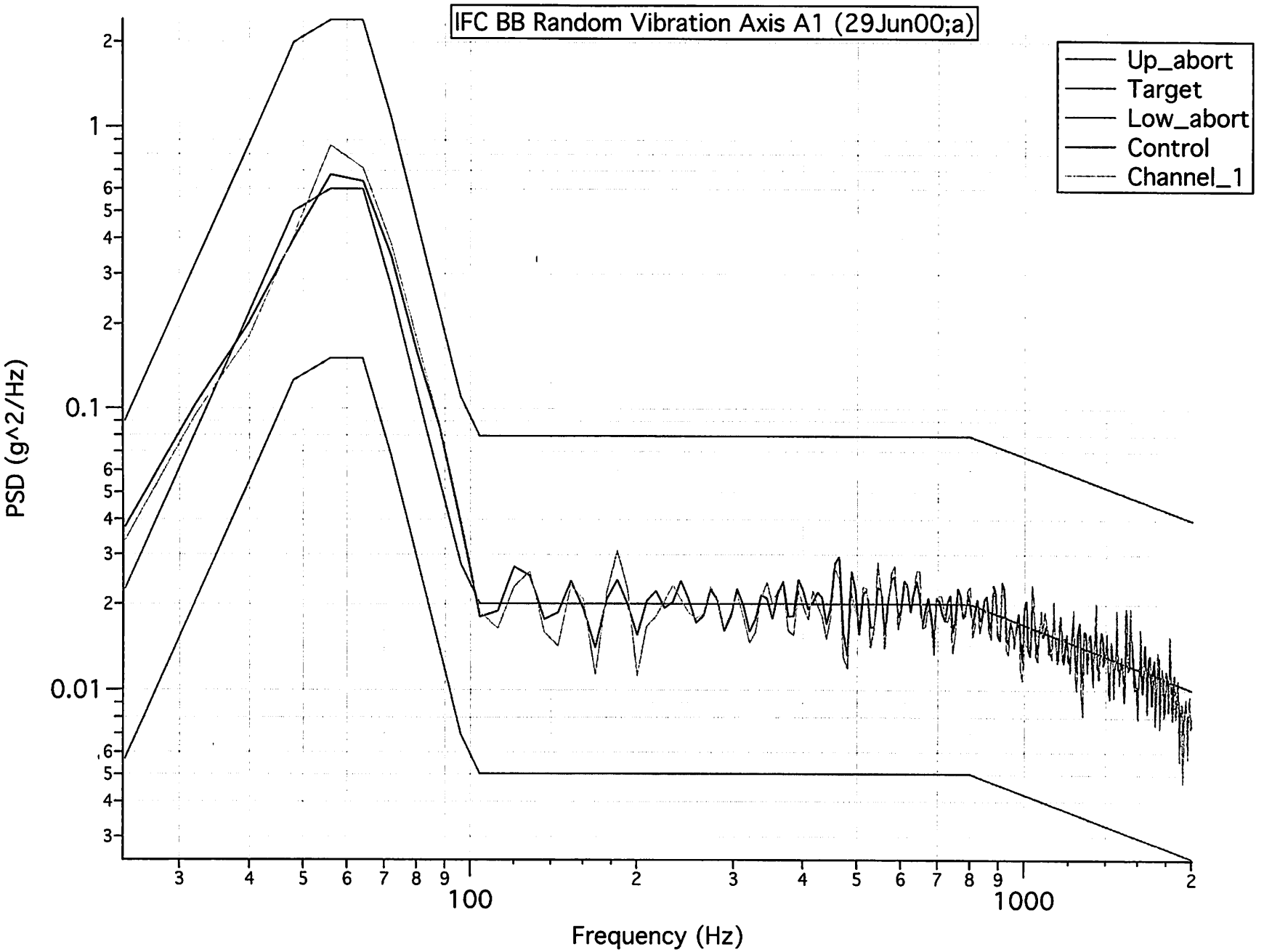
Values of PRT resistances have an associated random error distribution, which is indicated in the last column of this table, in addition there is an offset error due to the different methods used to acquire these data. One option to account for this offset error is to subtract the mean offset of all 6 PRTs so that any significant change of any one PRT can be distinguished.

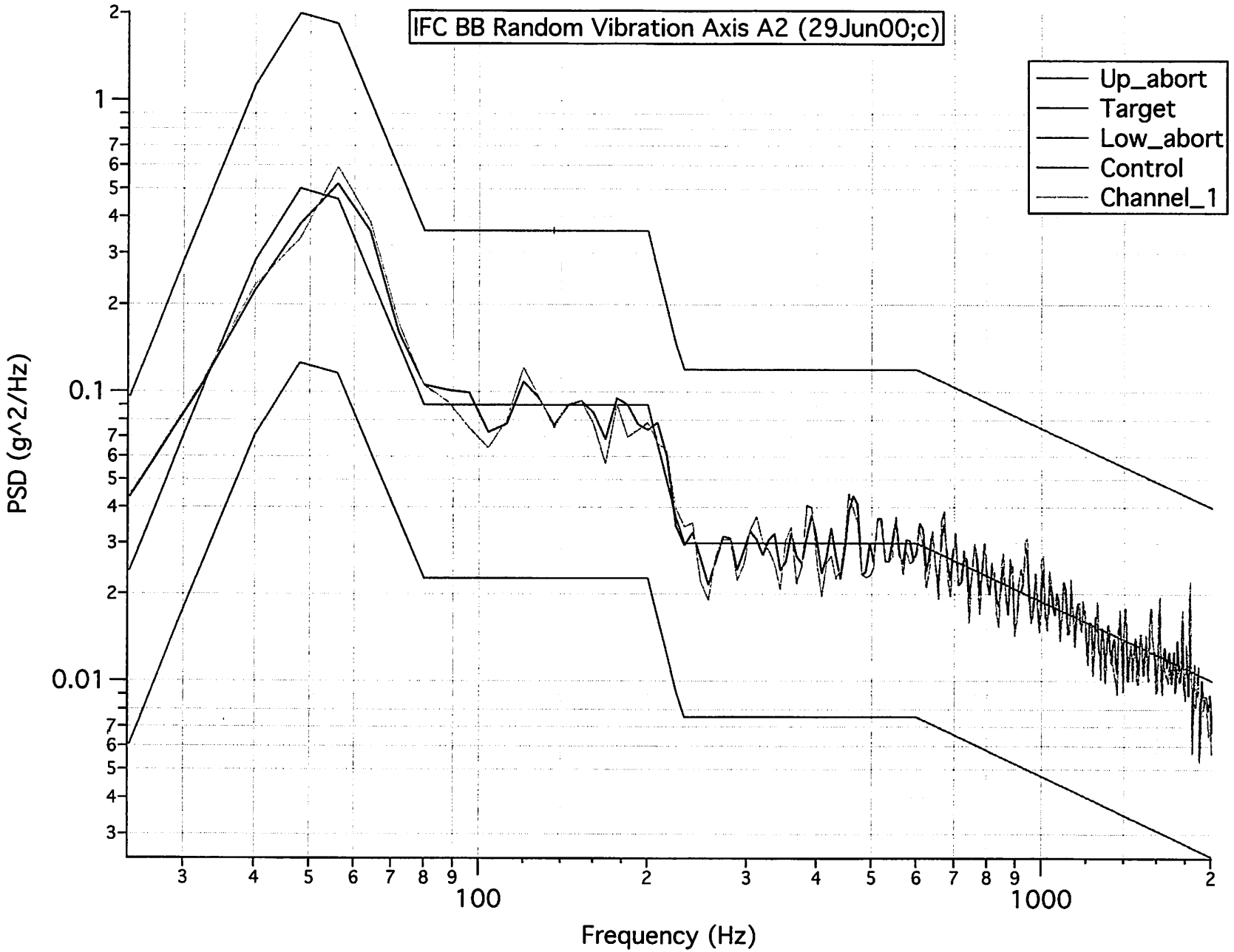
The 'pre-vibe' data are based on a three-term polynomial model fitted to calibration data obtained over the course of two weeks prior to the vibration test and using the end-to-end IFC subsystem.

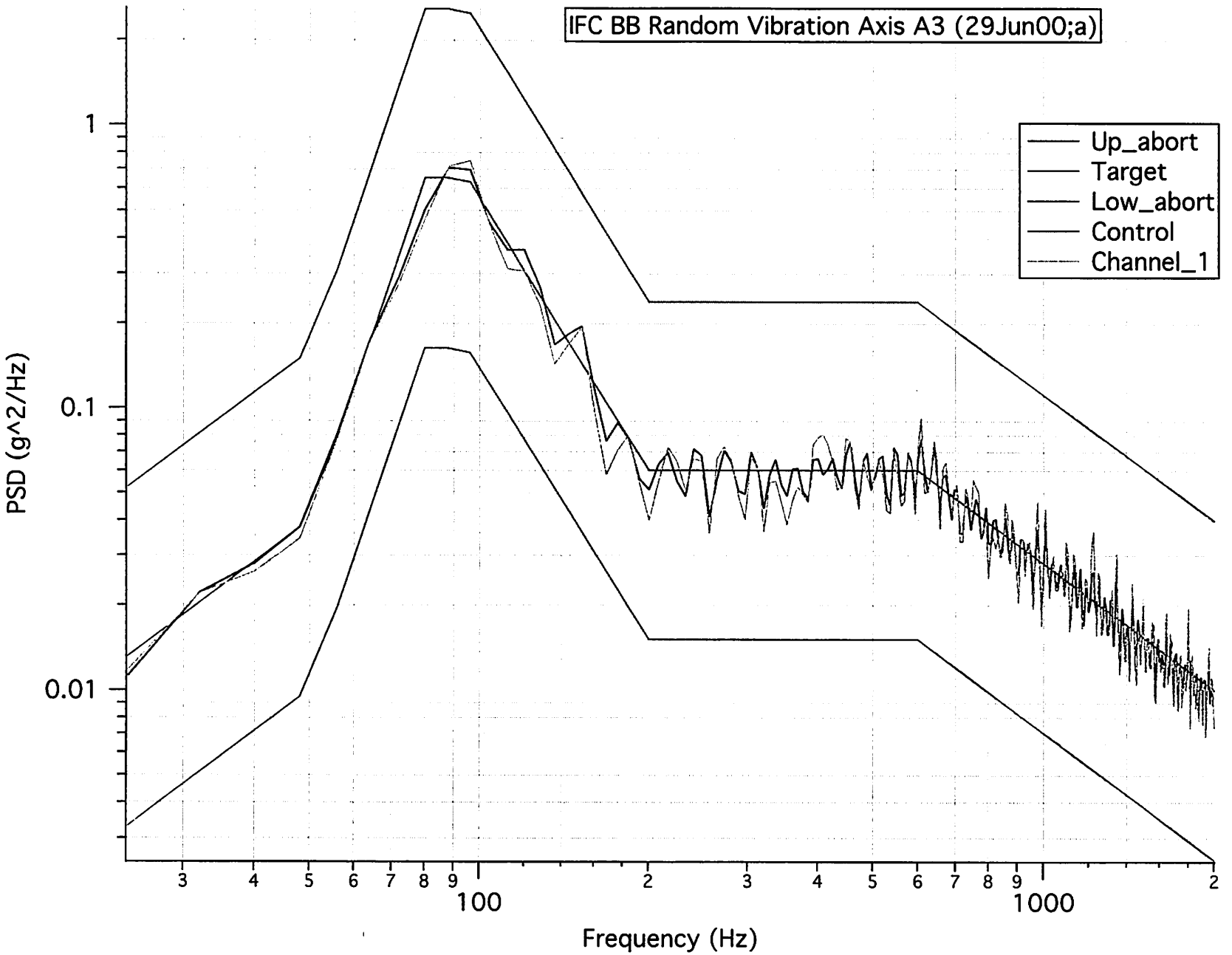
The post vibration data taken on the 5th Jul 00 are obtained with the IFCBB and the cryostat GSE at a known temperature. This temperature is used to find the resistance for each PRT using the model fitted to the pre-vibe data.

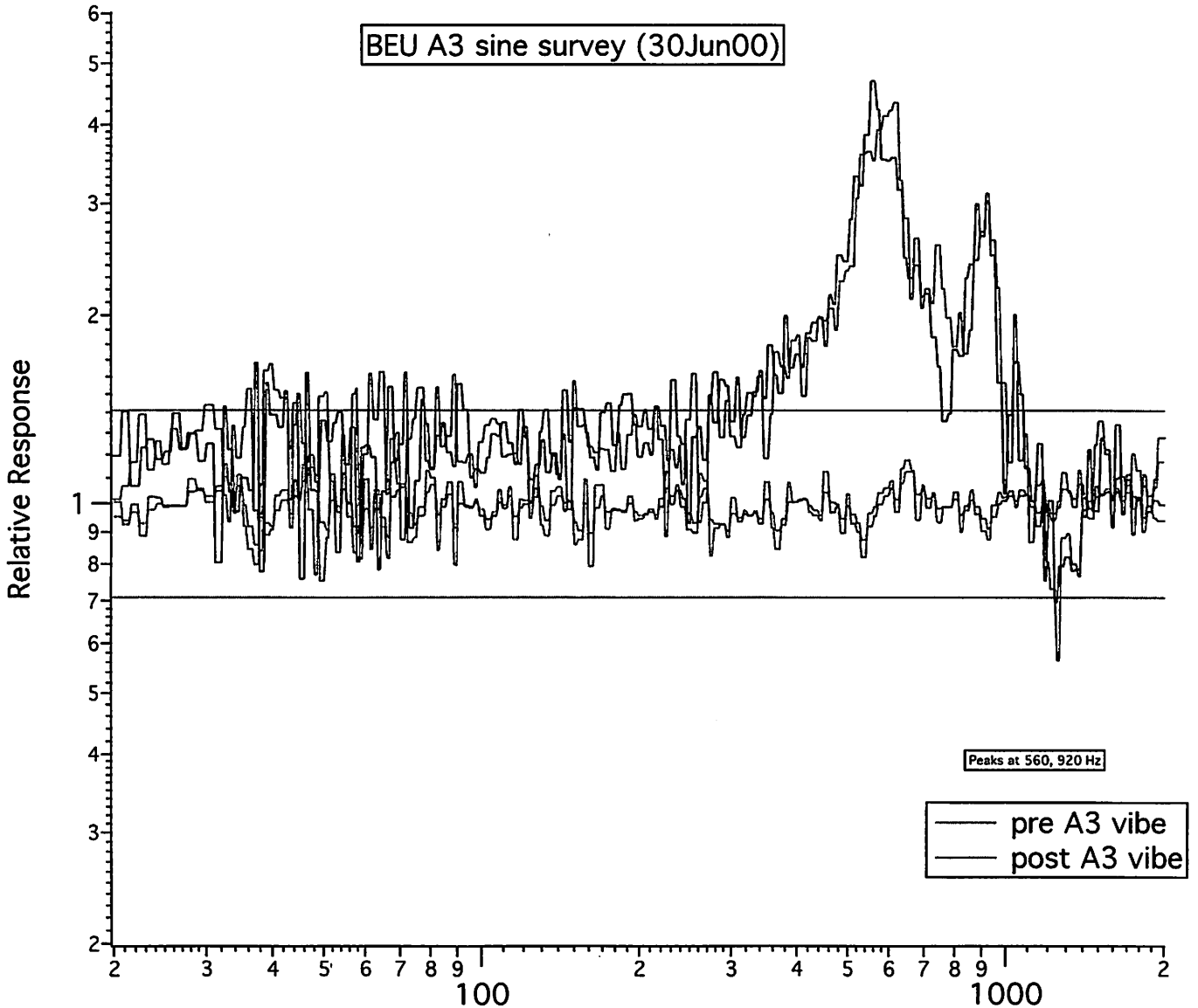
The indication here is that B1 has shifted up in resistance and B3 down in resistance. Although it may appear to have been a result of the vibration test this is not necessarily the case as the pre-vibe calibration data was obtained over a substantial period. These effects are the subject of other investigations not a part of this report.

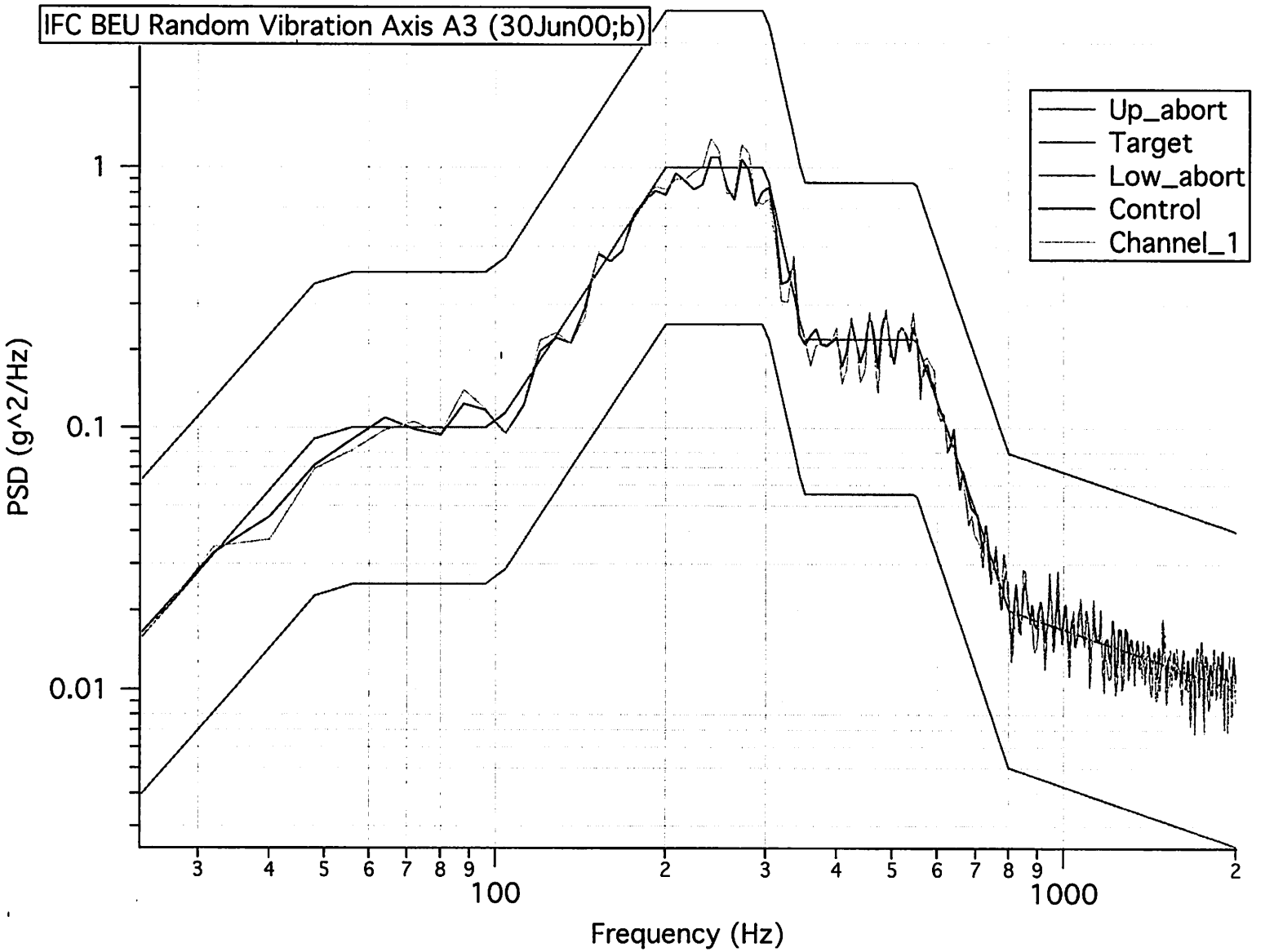
The BEU survived vibration with no significant change in performance.

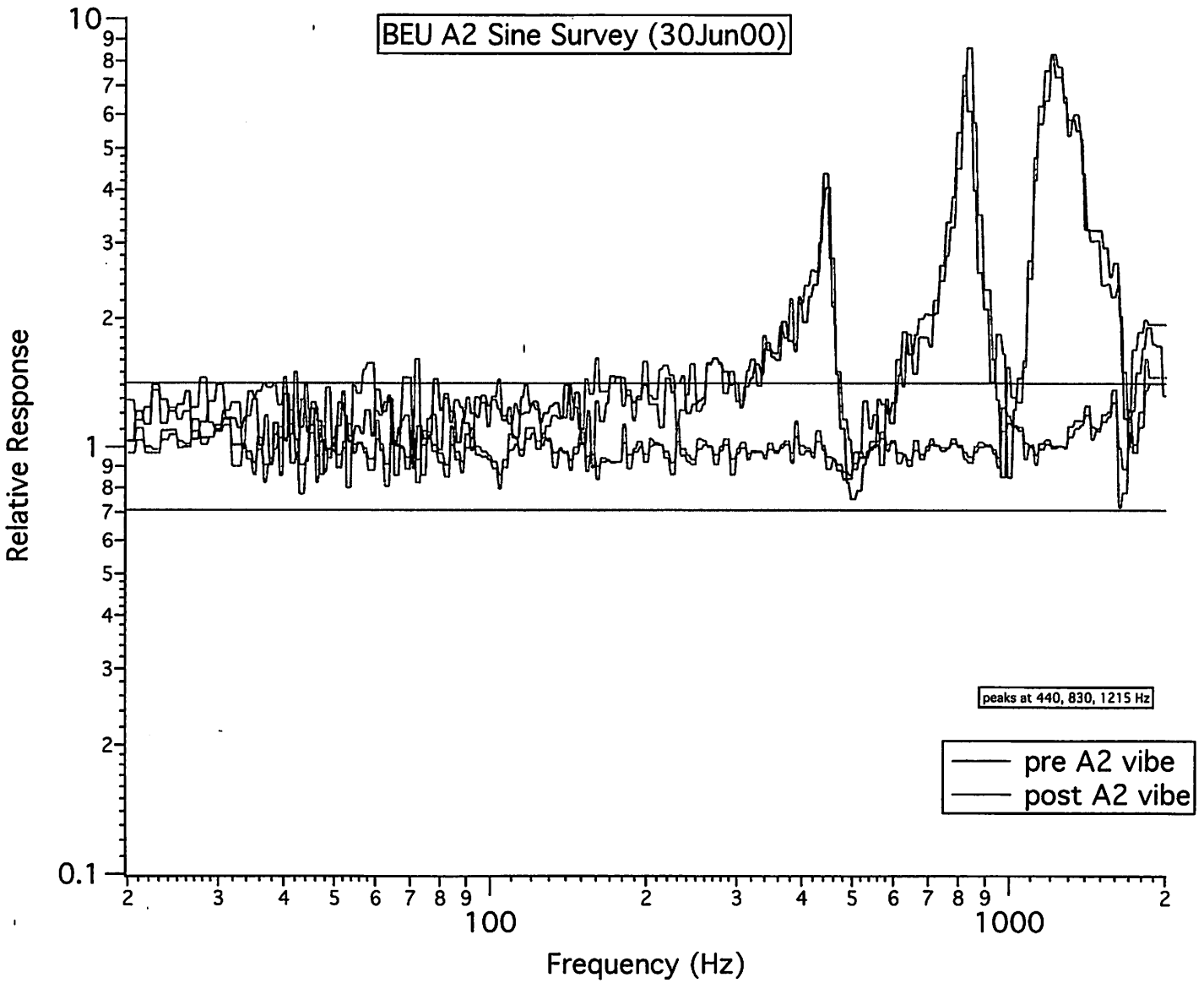

IFC BB Random Vibration Axis A1 (29Jun00;a)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
Frequency (Hz)
100
1000

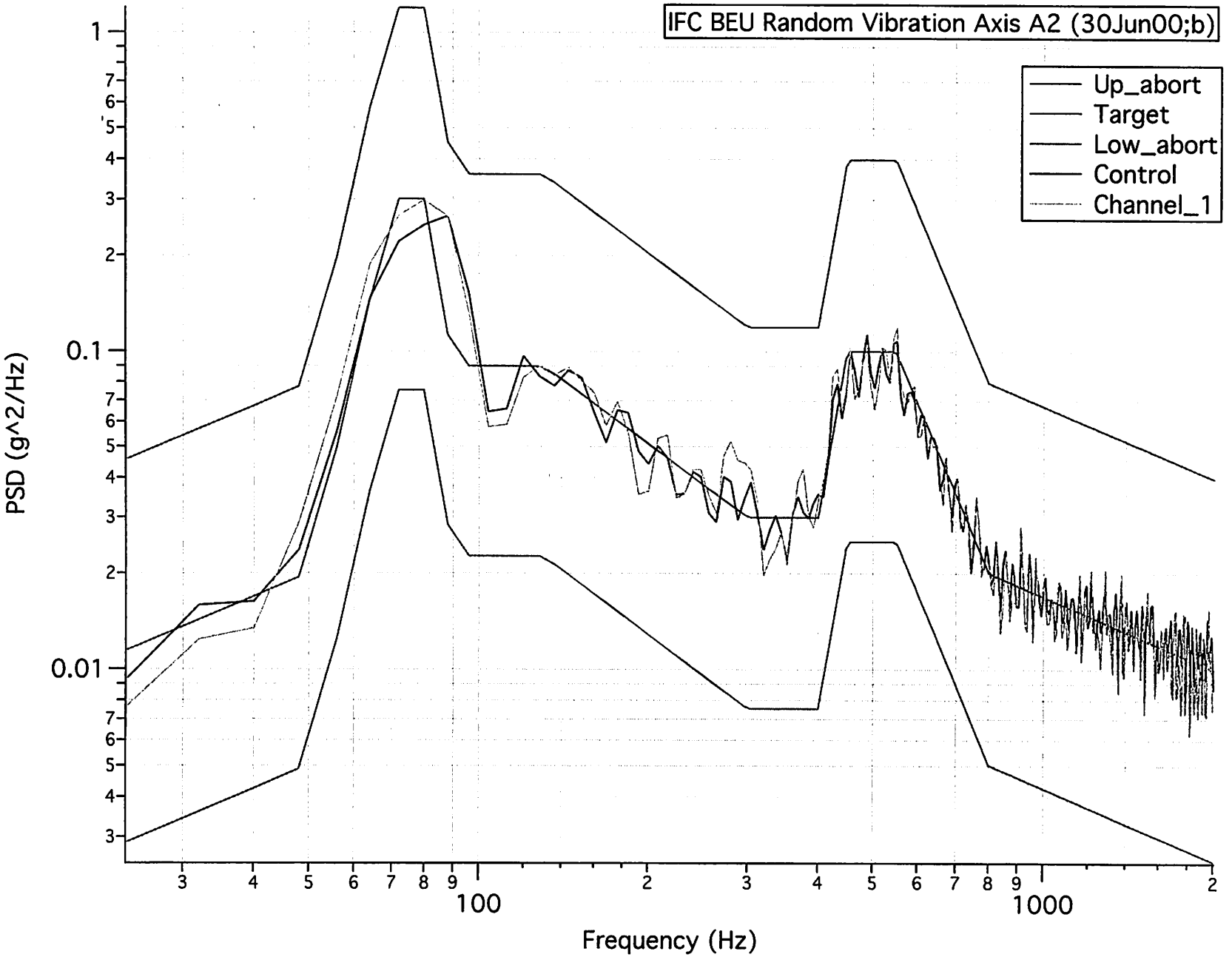

IFC BB Random Vibration Axis A2 (29Jun00;c)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
Frequency (Hz)
100
1000

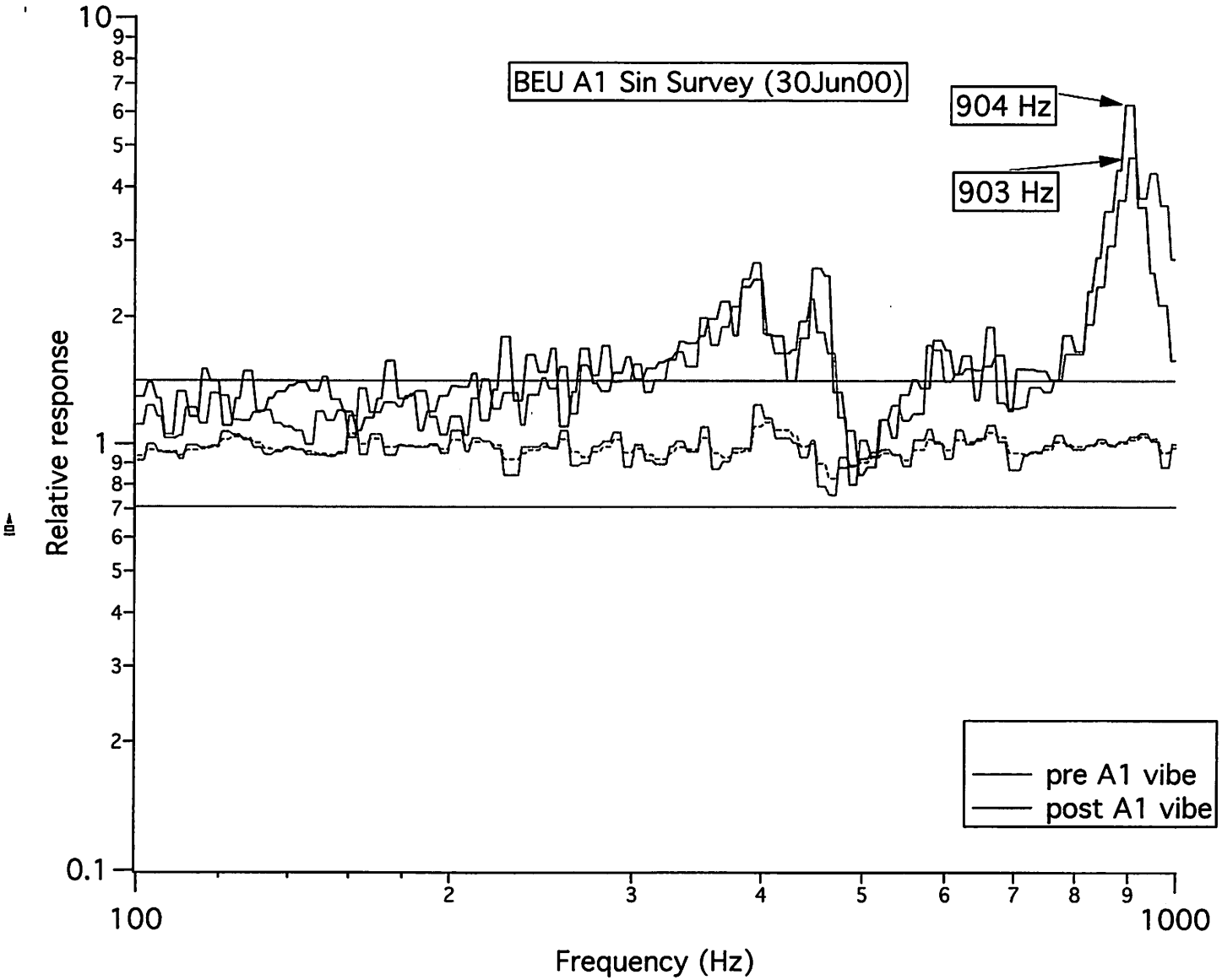

IFC BB Random Vibration Axis A3 (29Jun00;a)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
1
0.1
0.01
3
4
5
6
7
8
9
100
2
3
4
5
6
7
8
9
1000
2
Frequency (Hz)

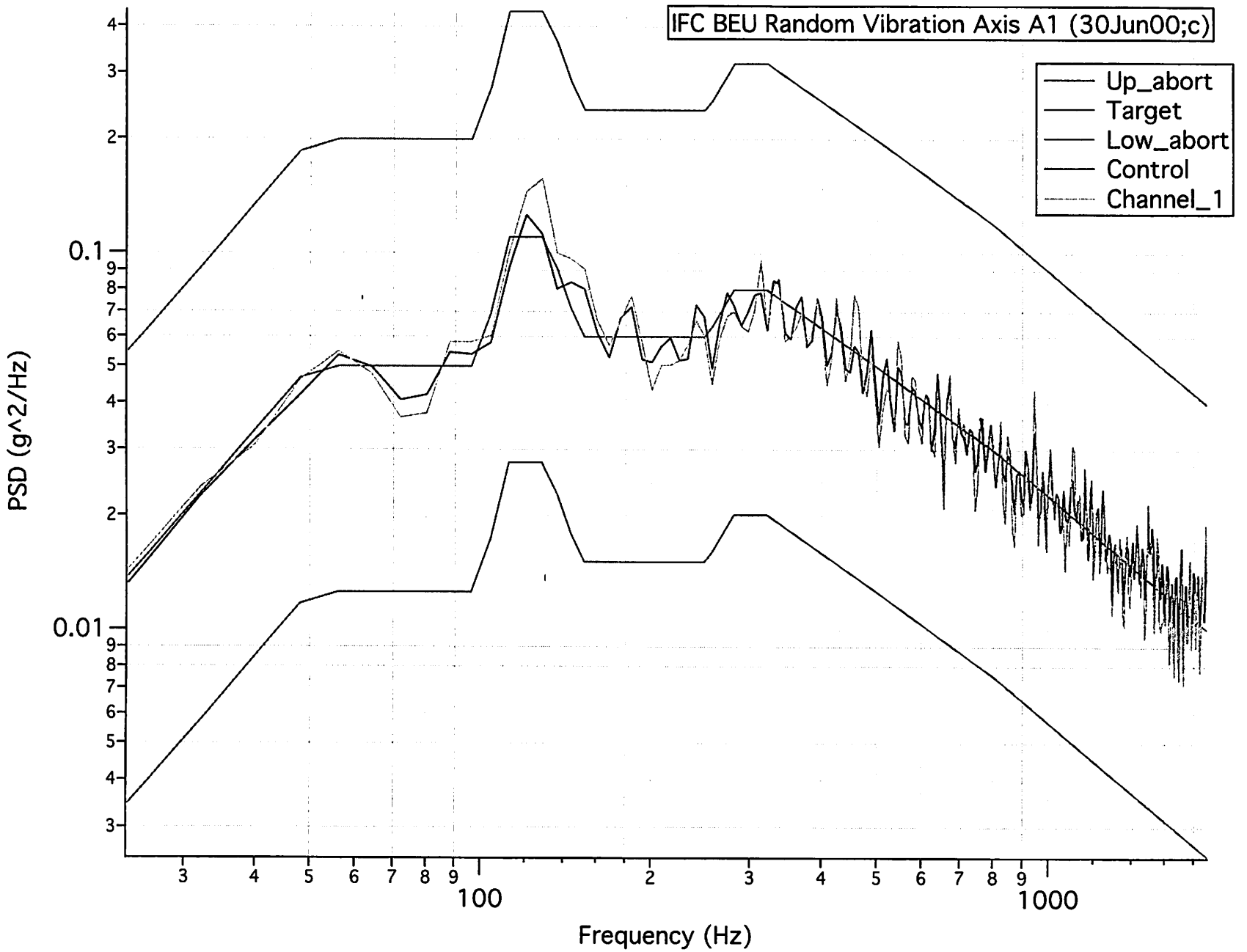

BEU A3 sine survey (30Jun00)
Relative Response
Peaks at 560, 920 Hz
pre A3 vibe
post A3 vibe
100
1000

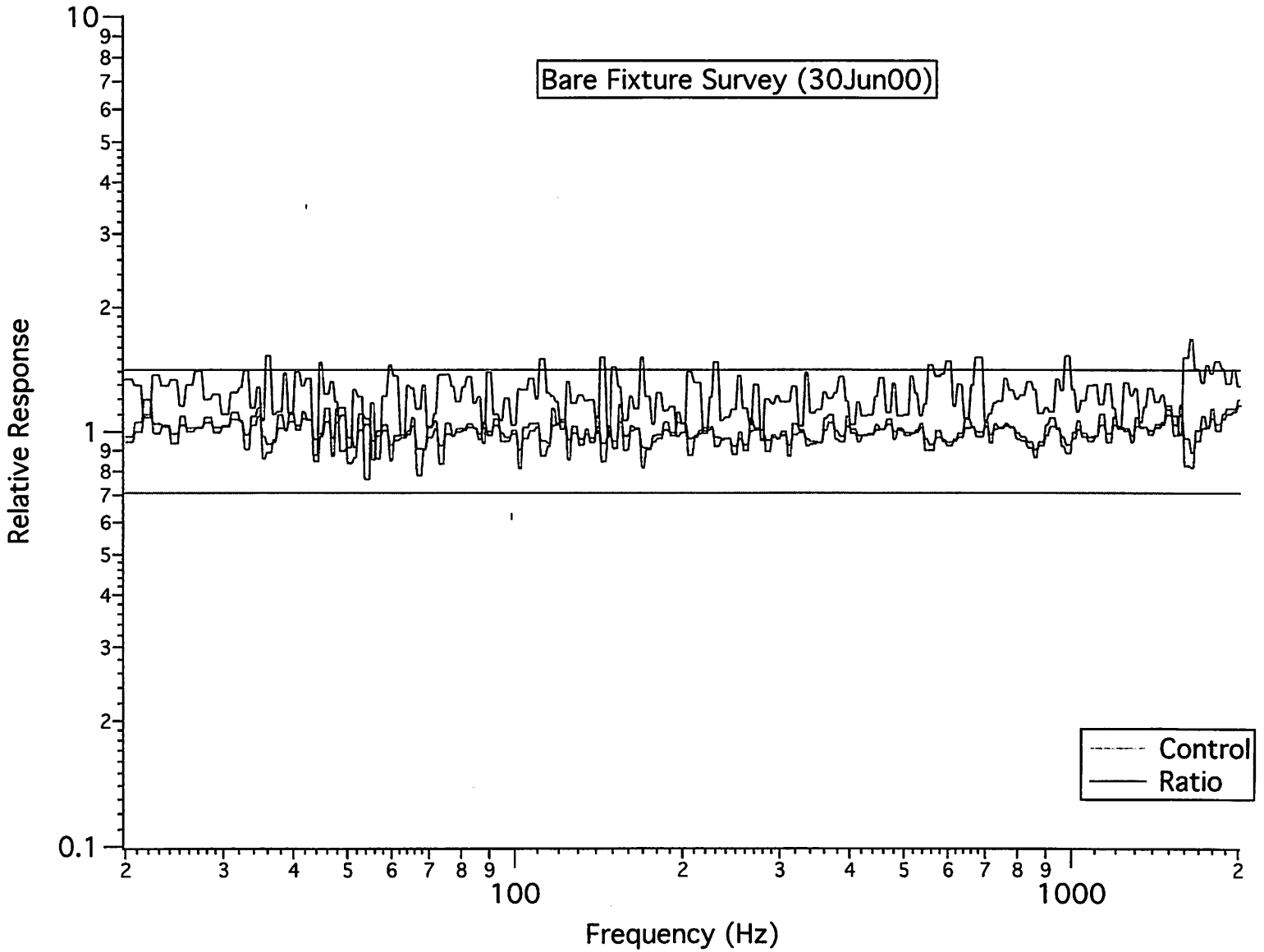

IFC BEU Random Vibration Axis A3 (30Jun00;b)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
1
0.1
0.01
3 4 5 6 7 8 9
100
2 3 4 5 6 7 8 9
1000
2
Frequency (Hz)

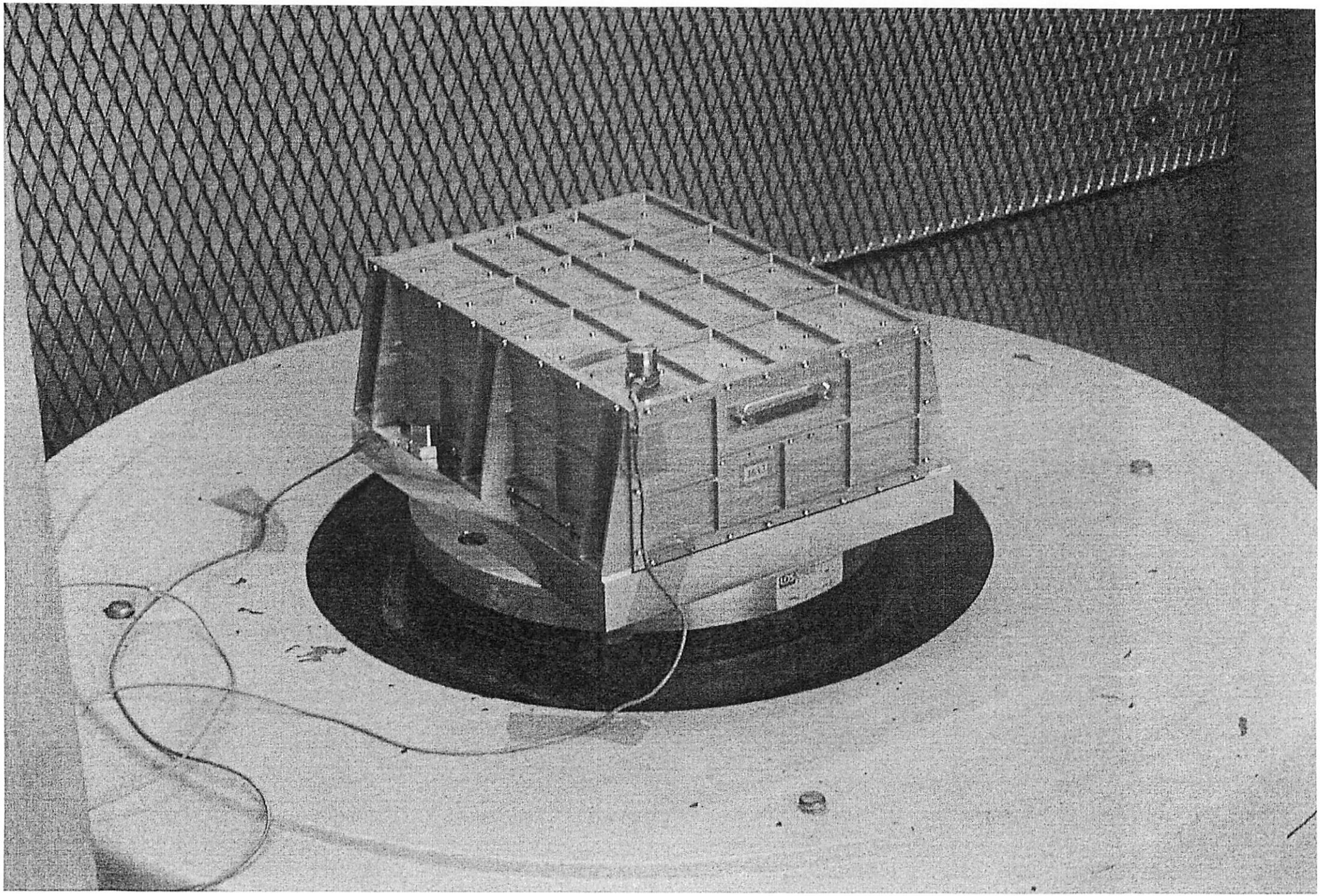

BEU A2 Sine Survey (30Jun00)
Relative Response
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
0.1
2
3
4
5
6
7
8
9
100
2
3
4
5
6
7
8
9
1000
2
Frequency (Hz)
peaks at 440, 830, 1215 Hz
pre A2 vibe
post A2 vibe

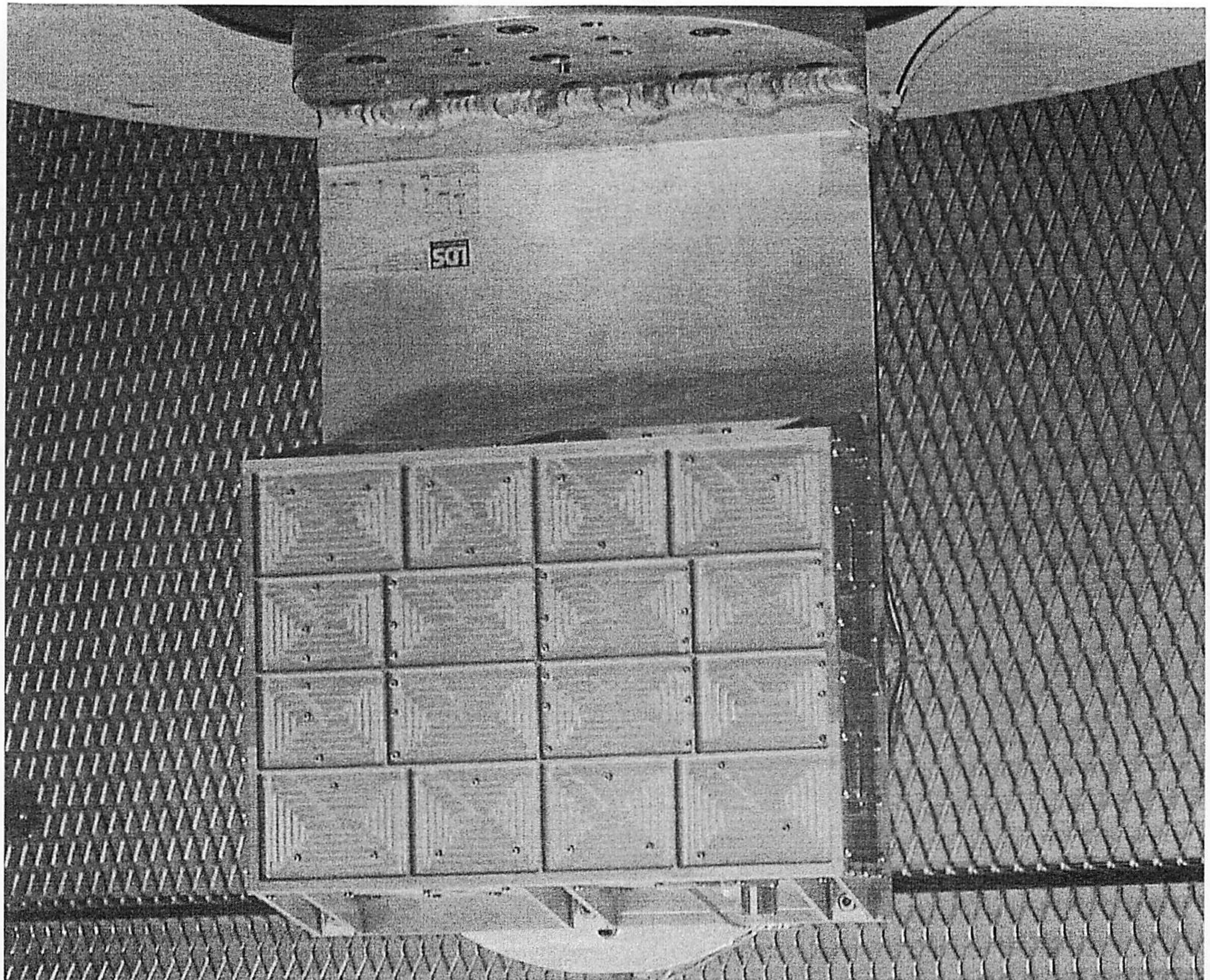

IFC BEU Random Vibration Axis A2 (30Jun00;b)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
1
0.1
0.01
Frequency (Hz)
100
1000

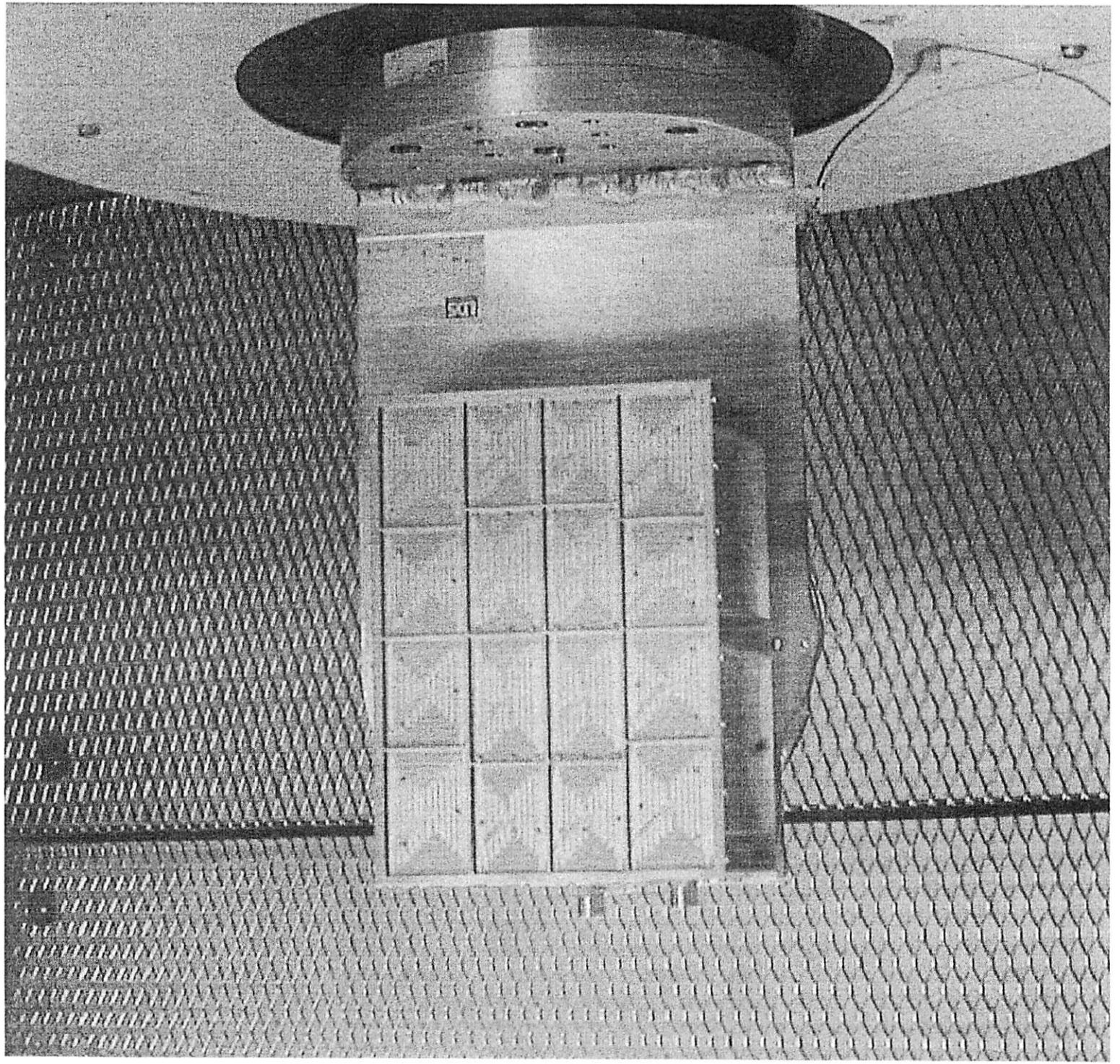

BEU A1 Sin Survey (30Jun00)
904 Hz
903 Hz
pre A1 vibe
post A1 vibe
Relative response
Frequency (Hz)
10
9
8
7
6
5
4
3
2
1
0.1
100
1000


IFC BEU Random Vibration Axis A1 (30Jun00;c)
Up_abort
Target
Low_abort
Control
Channel_1
PSD (g^2/Hz)
0.1
0.01
100
1000
Frequency (Hz)


Bare Fixture Survey (30Jun00)
Relative Response
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
0.1
2
3
4
5
6
7
8
9
100
2
3
4
5
6
7
8
9
1000
2
Frequency (Hz)
Control
Ratio



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