SPIRE-MSS-REP-002558

Herschel/SPIRE

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PFM LEVEL O EVAPORATOR THERMAL STRAP VIBRATION REPORT

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Change Record

ISSUE	DATE	
1.0	22 September 2005	New document

1. Applicable Documents

AD(1)	Vibration test specification Level-0 strap mechanical qualification	MSSL/SPIRE/SP019, issue 1, revision 0 issued on 12/09/2005
AD(2)	Instrument Cold Vibration Test Report CQM qualification (Cold)	SPIRE-MSS-REP-002049, Issue 1.4

2. Contents

3. Test Specification

Test performed following specification AD(1) which is based on the instrument cold vibration test results AD(2).

3.1. Sine Specification

QL Test sweep rate 2 Oct/min, the input is specified following AD1.

X axis

Frequency Range Hz	Qualification level
5 - 20.1	+/- 11mm
48 - 60	19.5 g
60 - 100	8g

Y axis

Frequency Range Hz	Qualification level
5 - 20.1	+/- 11mm
34 - 50	9.0 g
50 - 100	7.0 g

Z axis

Frequency Range Hz	Qualification level
5 - 20.1	+/- 11mm
34 - 50	9.0 g
50 - 100	7.0 g

3.2. Random Specification

Test duration 2 minutes in each axis, the input is specified following AD1.

X axis

Frequency Range Hz	Qualification level
20-120	+6.2dB/Oct
120-130	-113 dB/Oct
130-500	$0.01g^2$/Hz
500-600	-26.7 dB/Oct
600-2000	$0.002\ g^2$/Hz
Global	3.94 gRMS

Y axis

Frequency Range Hz	Qualification level
20-90	+5.06 dB/Oct
90-95	0.075 g^2/Hz
95-140	-202 dB/Oct
140-155	0.002 g^2/Hz
155-340	+116 dB/Oct
340-400	0.1 g^2/Hz
400-2000	-49.3 dB/Oct
Global	5.90 gRMS

Z axis

Frequency Range Hz	Qualification level
20-100	+3.6 dB/Oct
100-125	0.085 g^2/Hz
125-140	-56.8 dB/Oct
140-255	0.01 g^2/Hz
255-300	+33.2 dB/Oct
300-480	0.06 g^2/Hz
480-1000	-19.6 dB/Oct
1000-1800	0.0005 g^2/Hz
Global	5.02 gRMS

4. Test run log

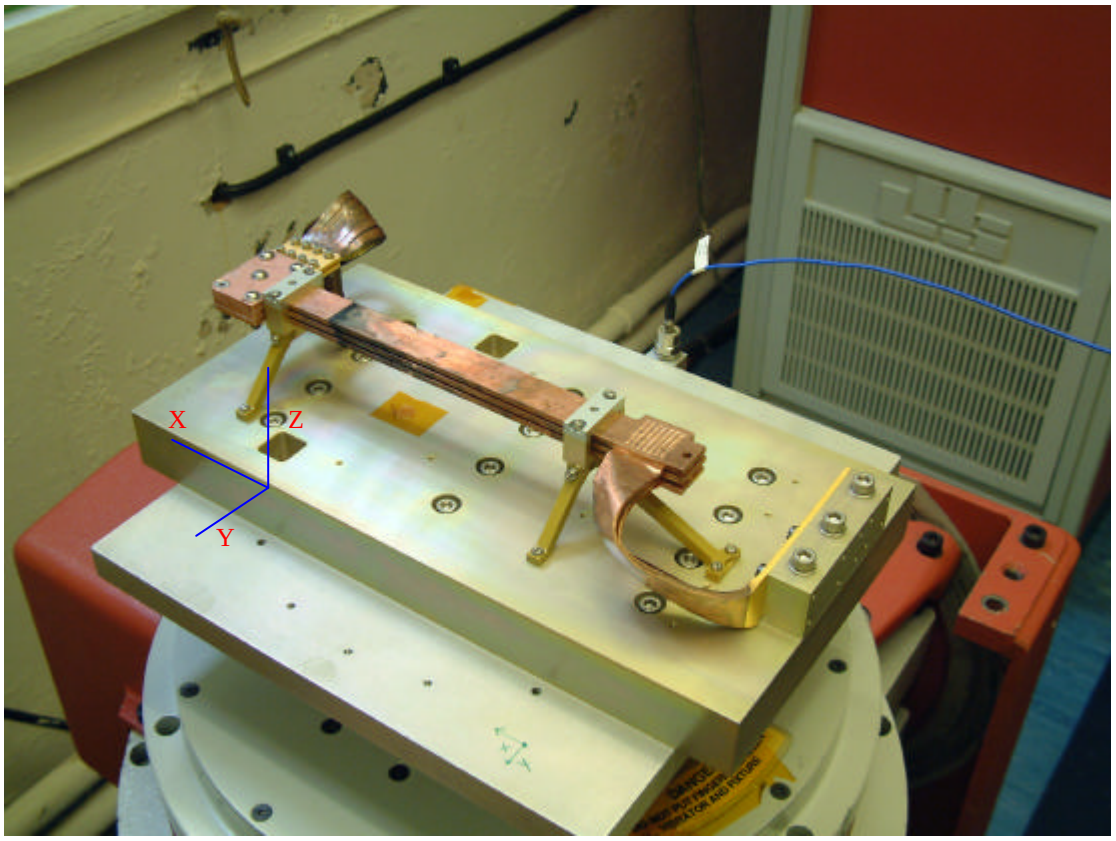
Z Axis (on the nose of the shaker)	Check	Note
Fixture qualification runs as required by the facility.	Y	
Mount instrument on vibration fixture	Y	
Visual inspection	Y	Looks fine, took photographs
Resonance search	Y	
QL random	Y	5.12 g-rms input achieved
Resonance search	Y	
Visual inspection	Y	Nothing out of the ordinary
replaced response accelerometer	Y	HN86 replacing JL70
Resonance search	Y	small resonance peak shift
Resonance search	Y	
QL sine	Y	
Resonance search	Y	
Visual inspection	Y	Nothing out of the ordinary
Change to X axis.		
X axis (on the slip table)		
Fixture qualification runs as required by the facility.	Y	
Mount instrument on vibration fixture	Y	
Visual inspection	Y	Nothing out of the ordinary
Resonance search	Y	lot of noise due to play in suspension
QL random	Y	3.99 g-rms achieved
Resonance search	Y	Small resonance peak shift
Visual inspection	Y	Nothing out of the ordinary
QL sine	Y	aborted and restarted
Resonance search	Y	perfect post match
Visual inspection	Y	Nothing out of the ordinary
Change to Y axis.		
Y axis (on the slip table)	Y	
Fixture qualification runs as required by the facility.	Y	
Mount instrument on vibration fixture	Y	
Visual inspection	Y	Nothing out of the ordinary
Resonance search	Y	
QL random	Y	5.89 achieved
Resonance search	Y	
Visual inspection	Y	Nothing out of the ordinary
QL sine	Y	
Resonance search	Y	Perfect Post match
Visual inspection	Y	Nothing out of the ordinary

4-1: Run checklist

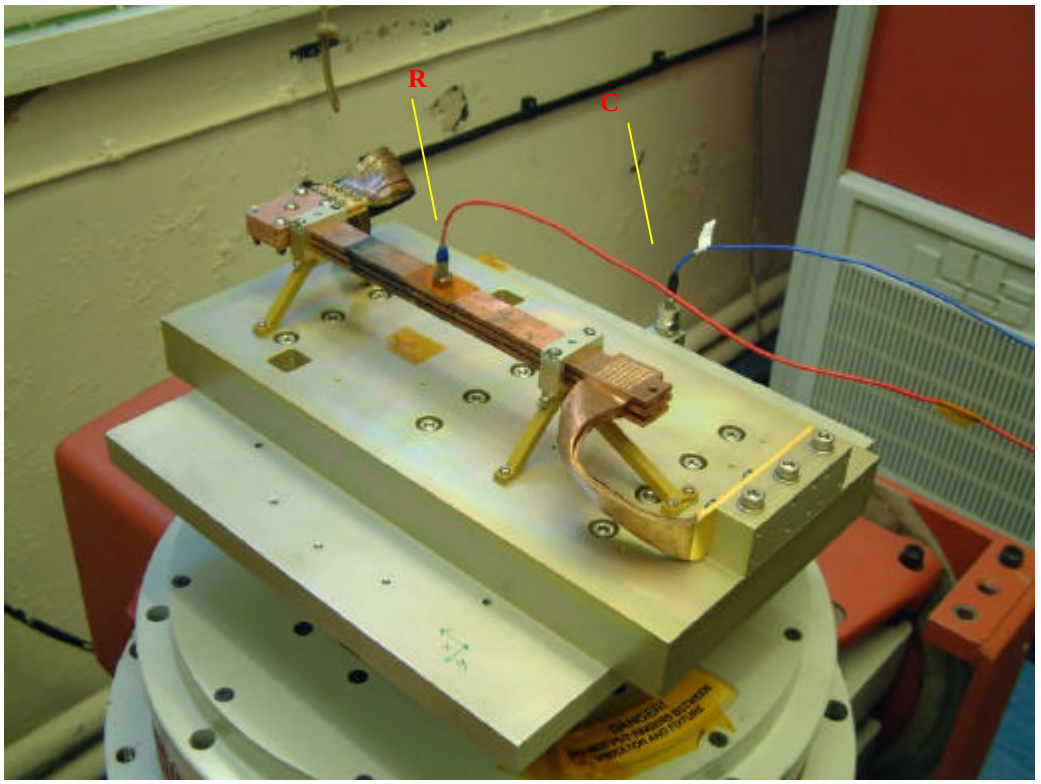
Test Run	Direction	Type	Note	Success
171	Z	Sine LL	0.3 g run first resonance at 282 Hz second 326 Hz	Y
172	Z	Random QL	5.12 g-rms input achieved and 11.06 g-rms response	Y
173	Z	Sine LL	0.3 g run first resonance at 279 Hz second 322 Hz response accelerometer dropped in sensitivity and will be replaced.	Y
174	Z	Sine LL	0.3 g run first resonance at 279 Hz second 326 Hz	Y
175	Z	Sine LL	0.3 g run first resonance at 279 Hz second 326 Hz	Y
176	Z	Sine QL	No incidents, noticed that the response accelerometer behaved odd	Y
177	Z	Sine LL	0.3 g run first resonance at 279 Hz second 326 Hz	Y
Replaced response accelerometer and taped the cable down better				Y
178	X	Sine LL	empty table run, calibration of accel	Y
179	X	Sine LL	0.3 g run, first resonance 188 Hz, 212 Hz, low resonance rumble due to play	Y
180	X	Random QL	Performed	Y
181	X	Sine LL	0.3 g run, first resonance 177 Hz, 204 Hz, low resonance rumble due to play	Y
182	X	Sine QL	Aborted by operator	Y
183	X	Sine QL	finished	Y
184	X	Sine LL	0.3 g run, first resonance 177 Hz, 204 Hz, low resonance rumble due to play	Y
185	Y	Sine LL	0.3 g, resonances at 239, 364,405 Hz	Y
186	Y	Random QL	Performed	Y
187	Y	Sine LL	0.3 g, resonances at 233, 364,405 Hz	Y
188	Y	Sine QL	finished	Y
189	Y	Sine LL	0.3 g, resonances at 233, 364,400 Hz	Y

4-2: Run log

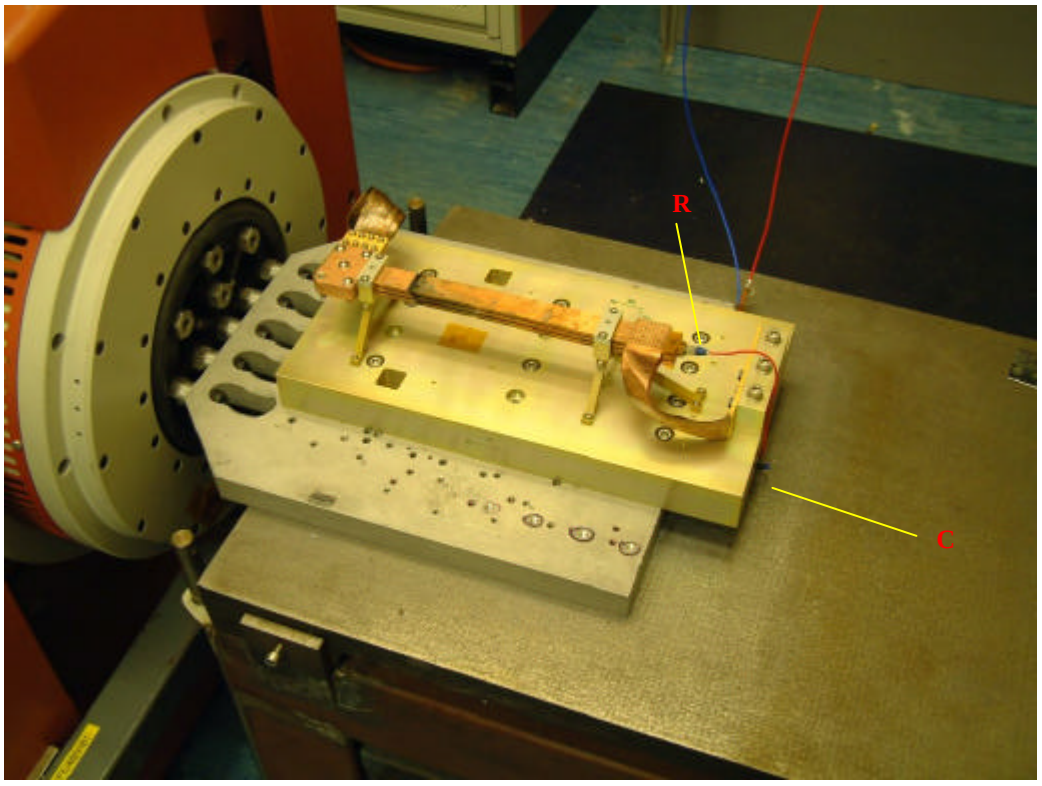
5. Test Coordinate System



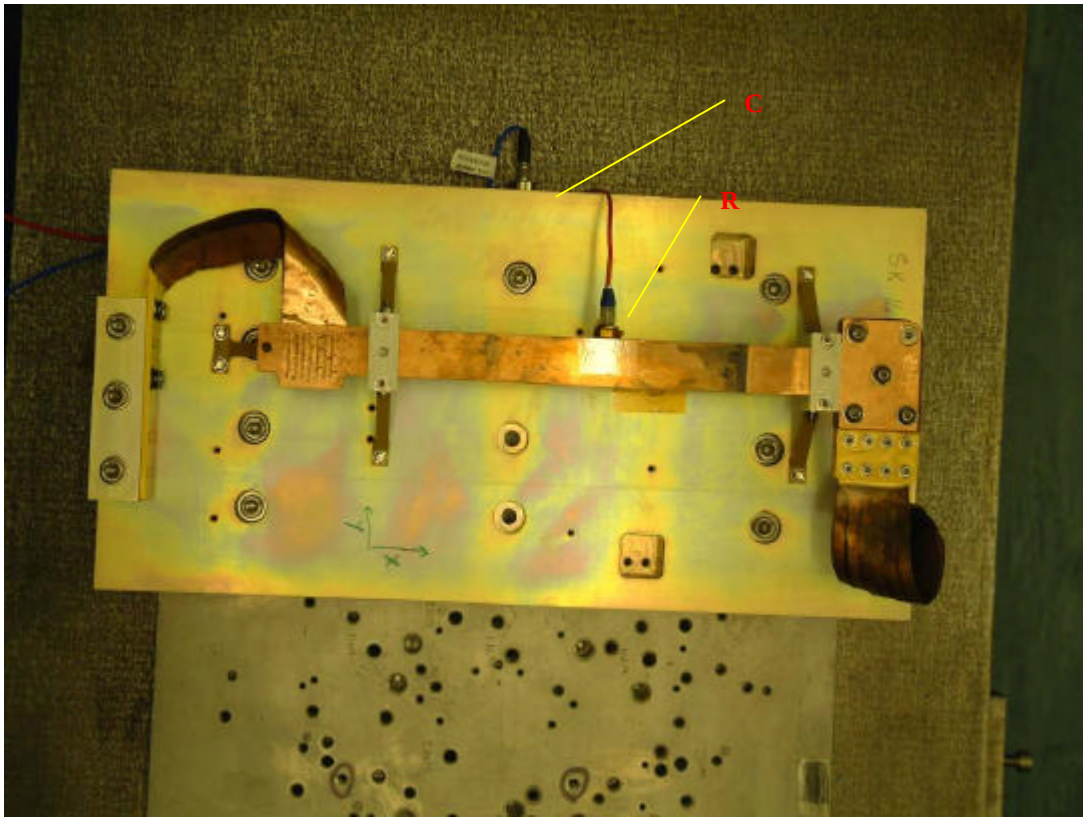
6. Instrumentation



6-1: Instrumentation for Z-axis vibration (Control and Response)



6-2: Instrumentation for X-axis vibration (Control and Response)



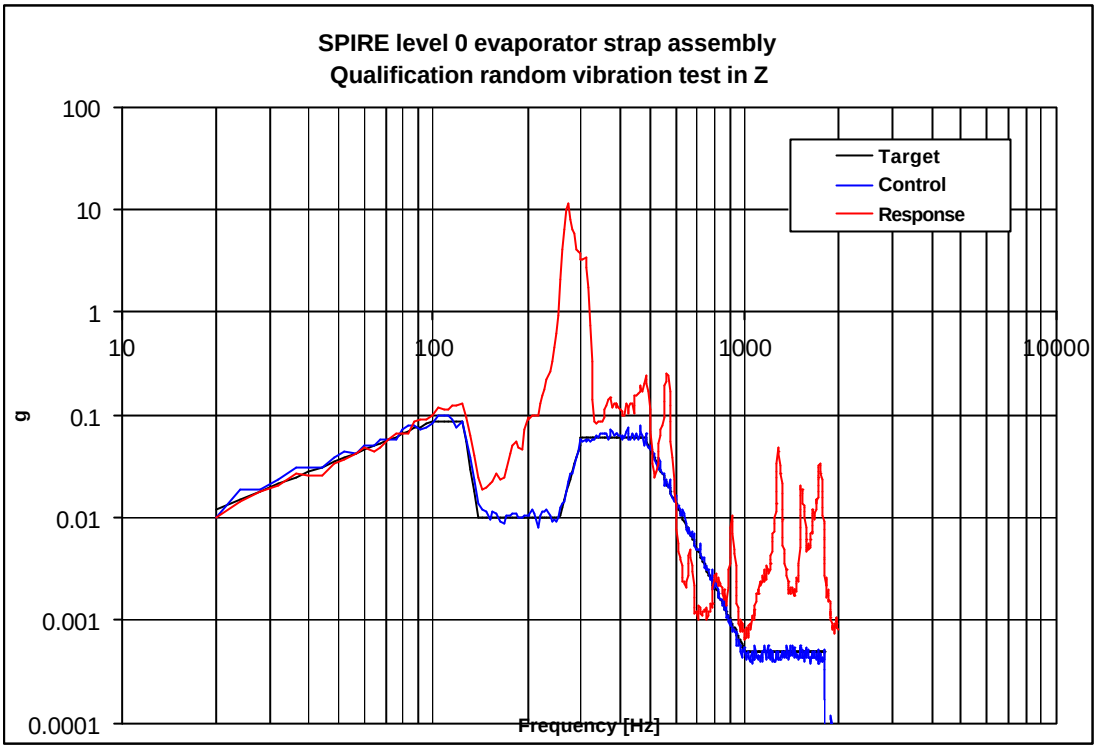
6-3: Instrumentation for Y-axis vibration (Control and Response)

7. Control channel and response plots

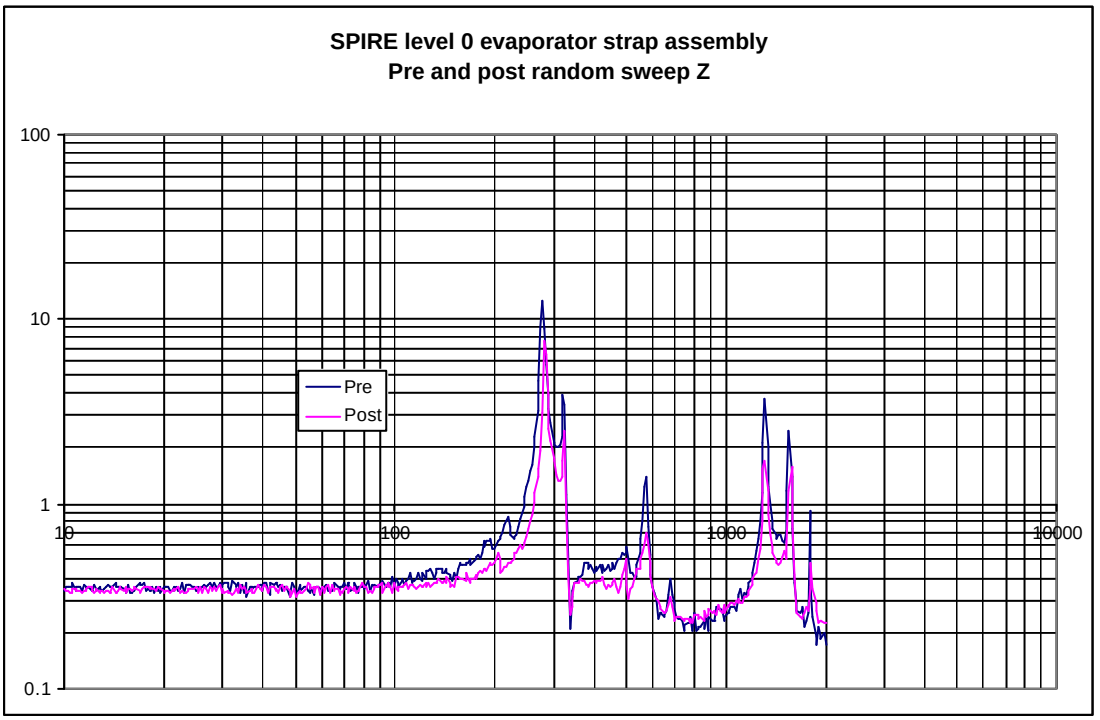
Achieved

Axis	Test	Control	Response
Z	Random	5.12 g-rms	19.77 g-rms
Z	Sine	9 g	10 g (estimate)
X	Random	3.99 g-rms	6.12 g-rms
X	Sine	19.5 g	26 g
Y	Random	5.89 g-rms	10.26 g-rms
Y	Sine	9 g	9 g

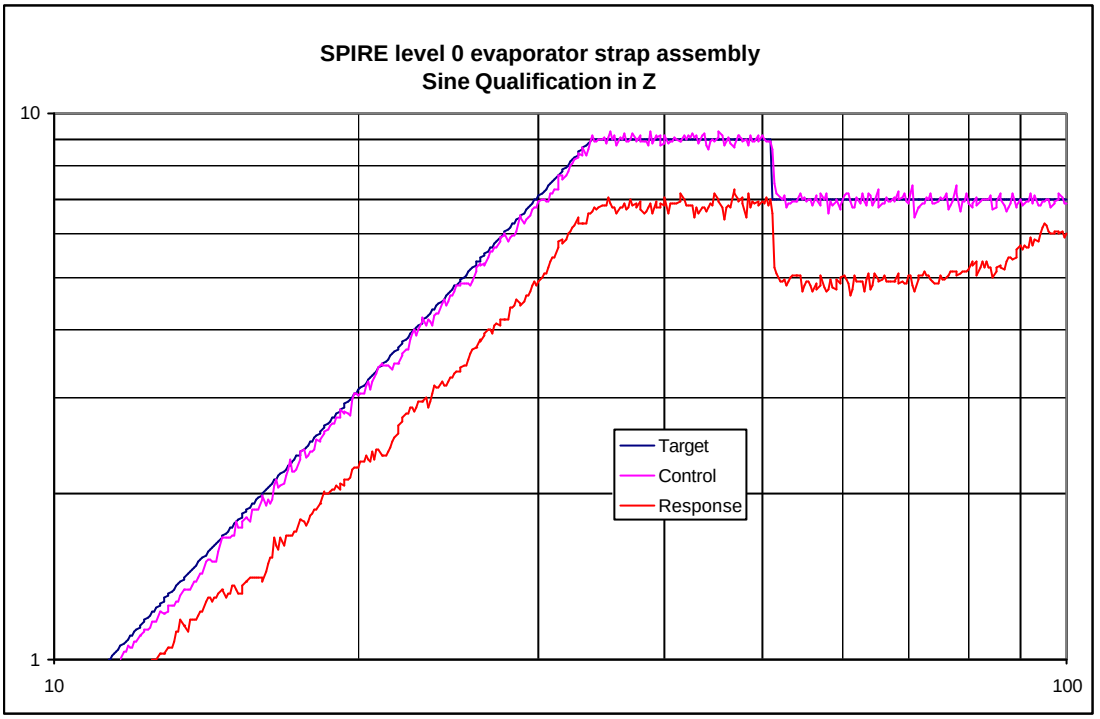
Table 7-1: Achieved levels/maxima



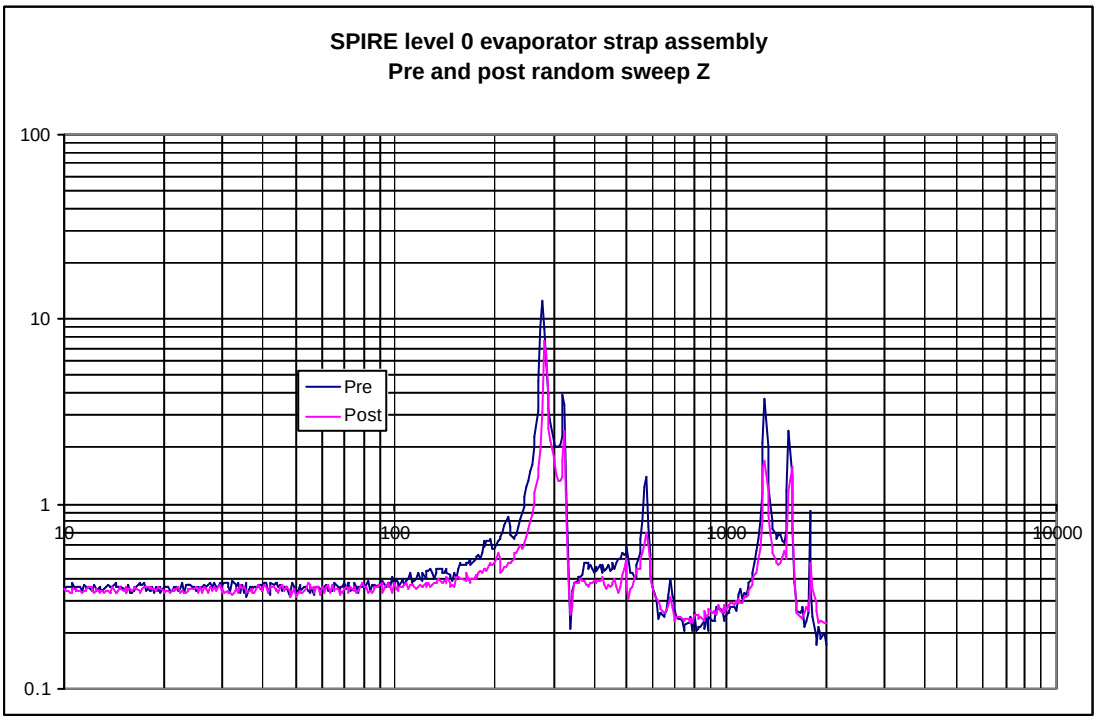
7-2: Random Vibration in Z – Qualification 2 minutes



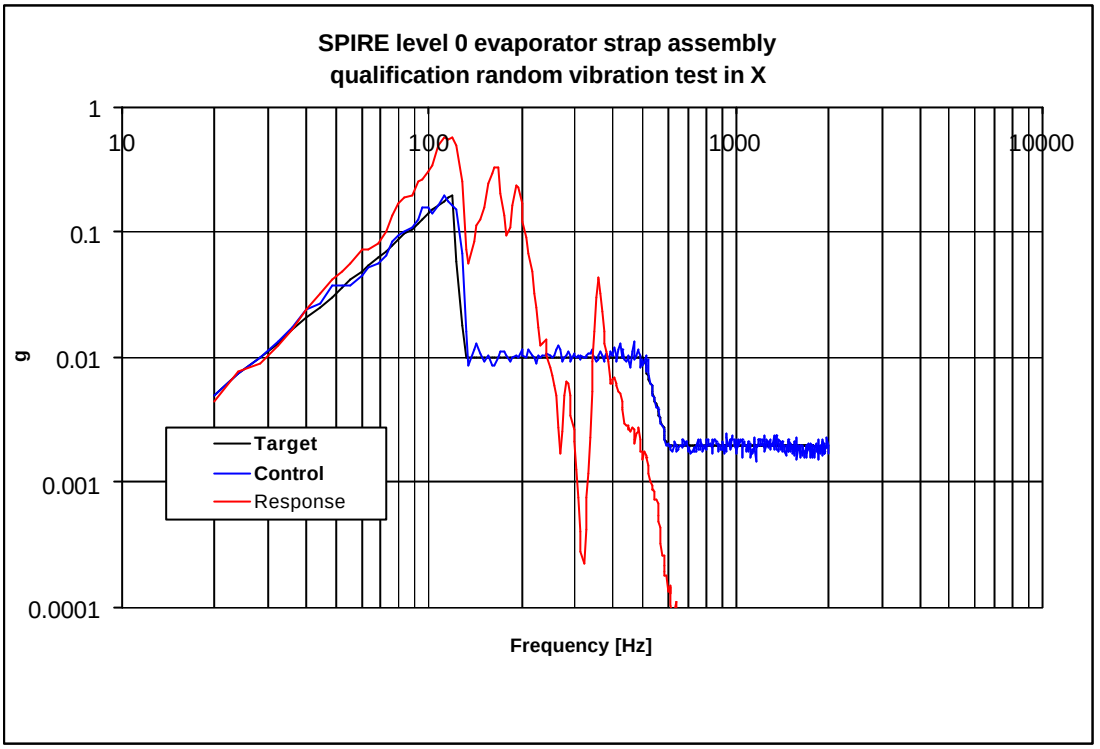
7-3: Pre and Post random sweep in Z. There appears to be some settling. Most peaks back to where they were, minor shift in first resonance.



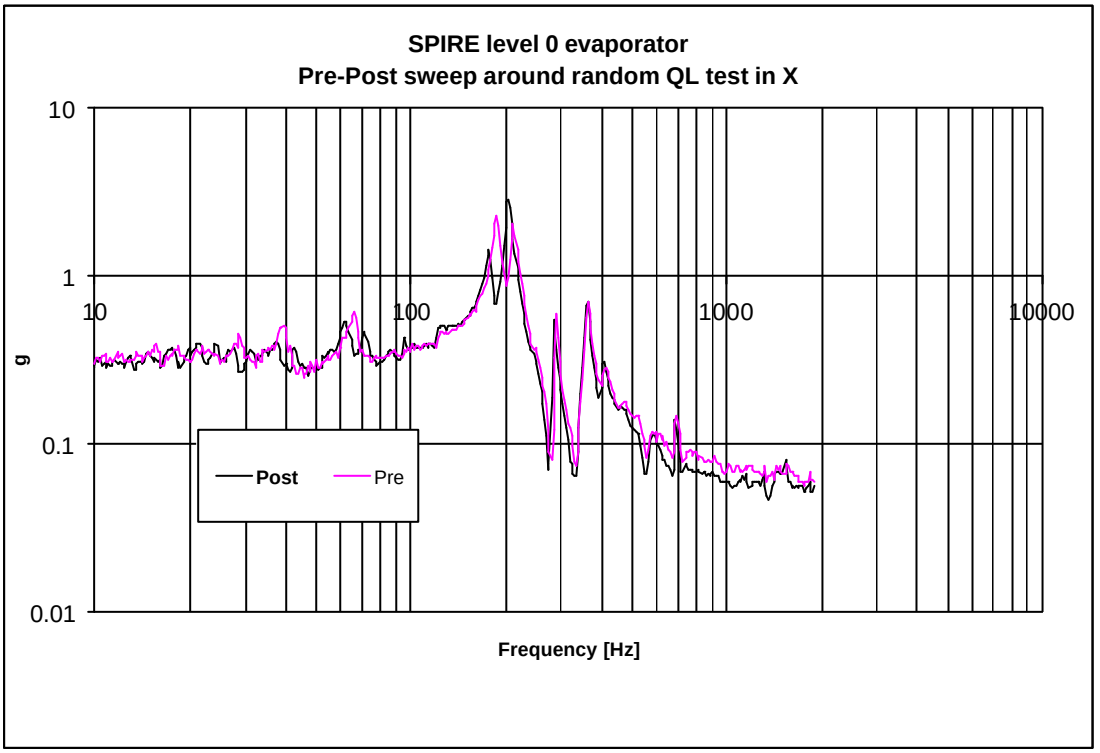
7-4: Sine Vibration in Z – Qualification 2 Oct/min – response channel is shifted



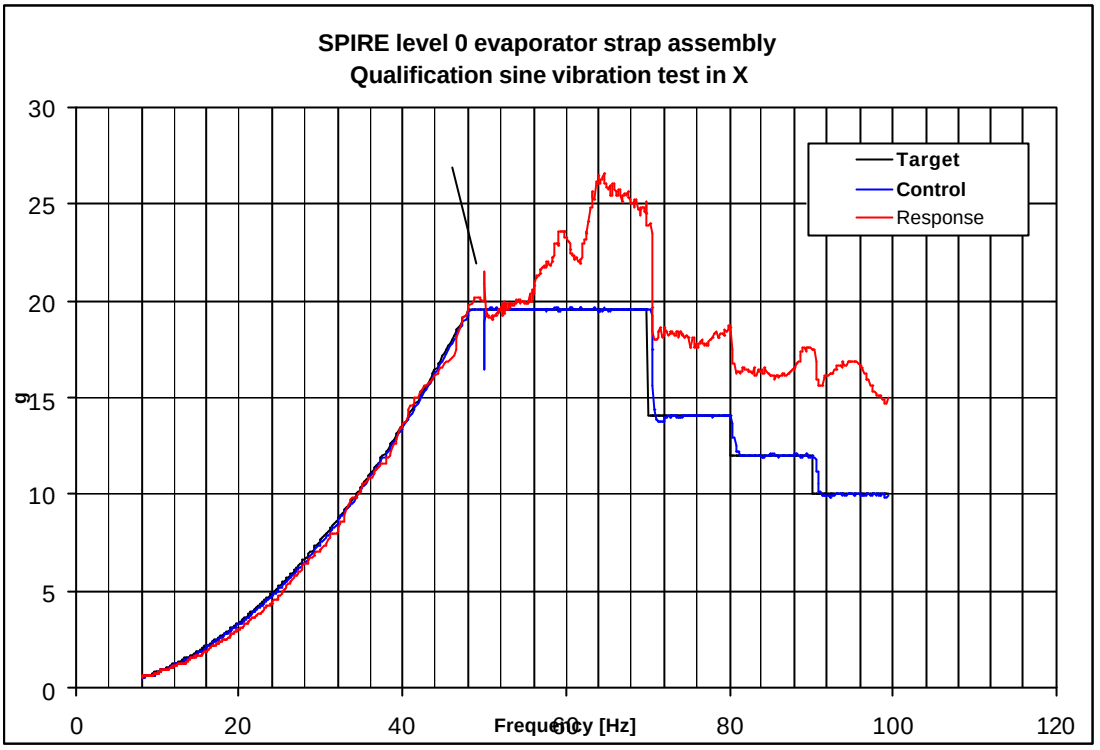
7-5: Pre-Post sine vibration sine sweep . Higher modes show a perfect mtach.



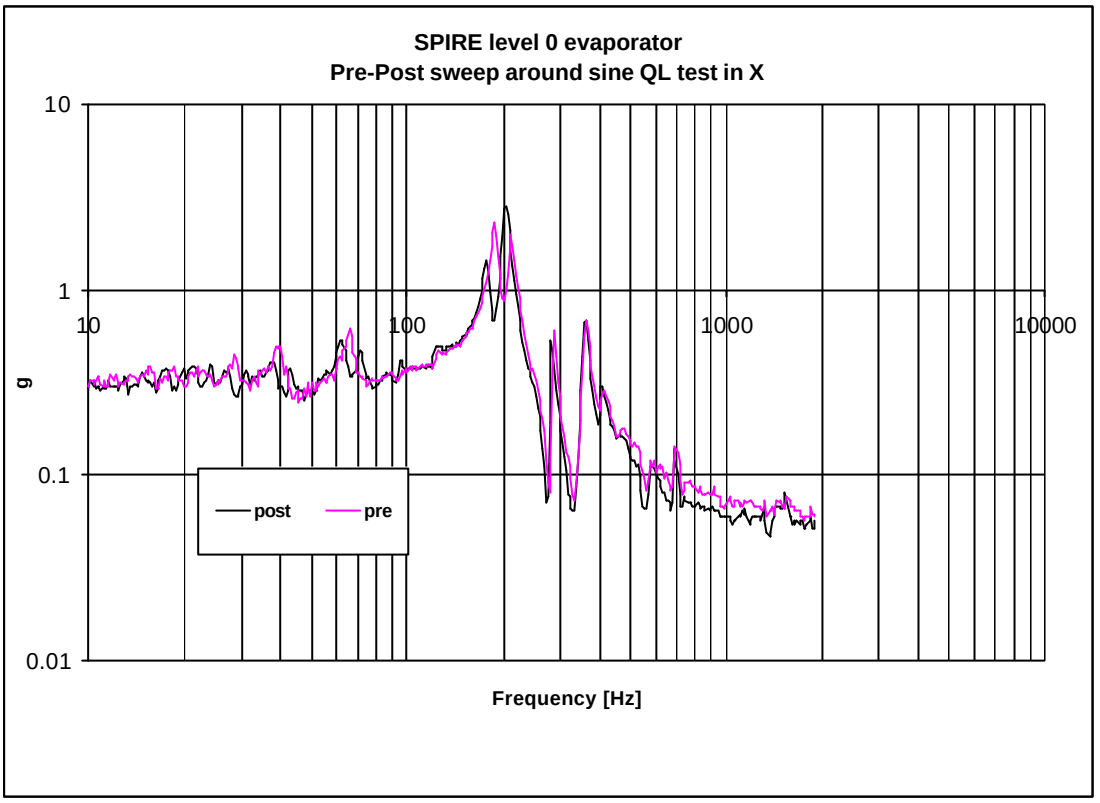
7-6: Random Vibration in X – Qualification 2 minutes



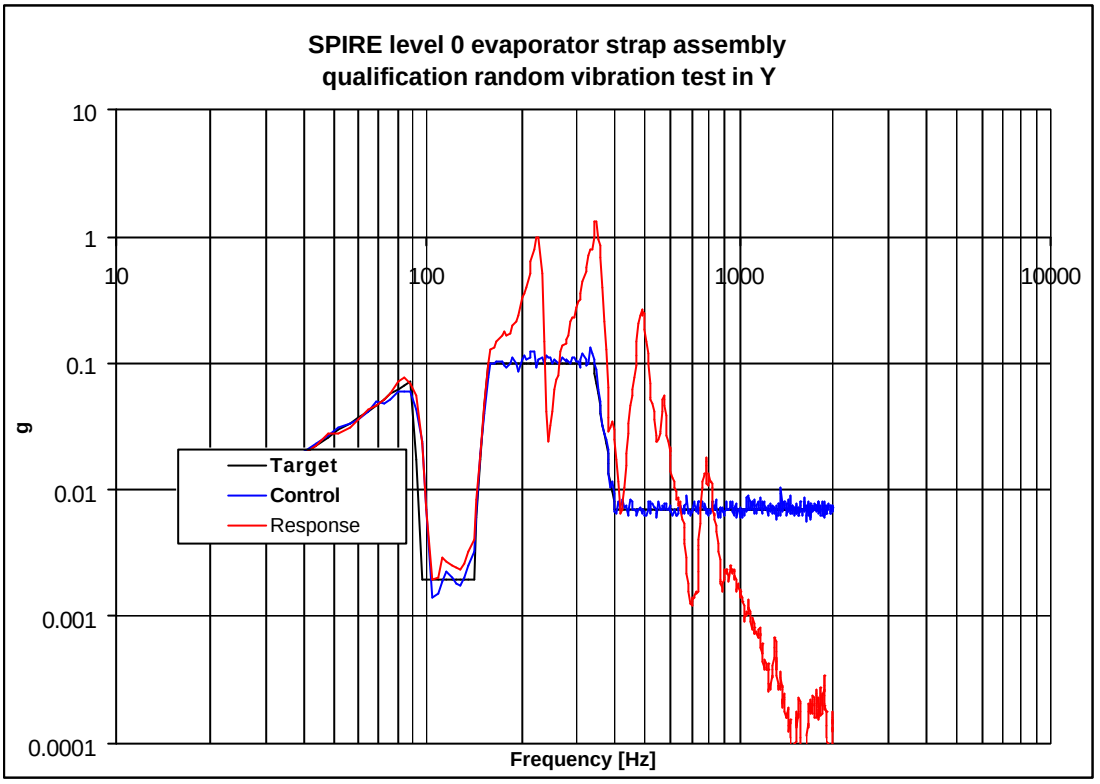
7-7: Pre and Post random sweep in X (there is play in the supports in this direction). Due to the rattle the first peaks are artefacts and the one at 188 Hz is noisy. Higher modes show a perfect match.



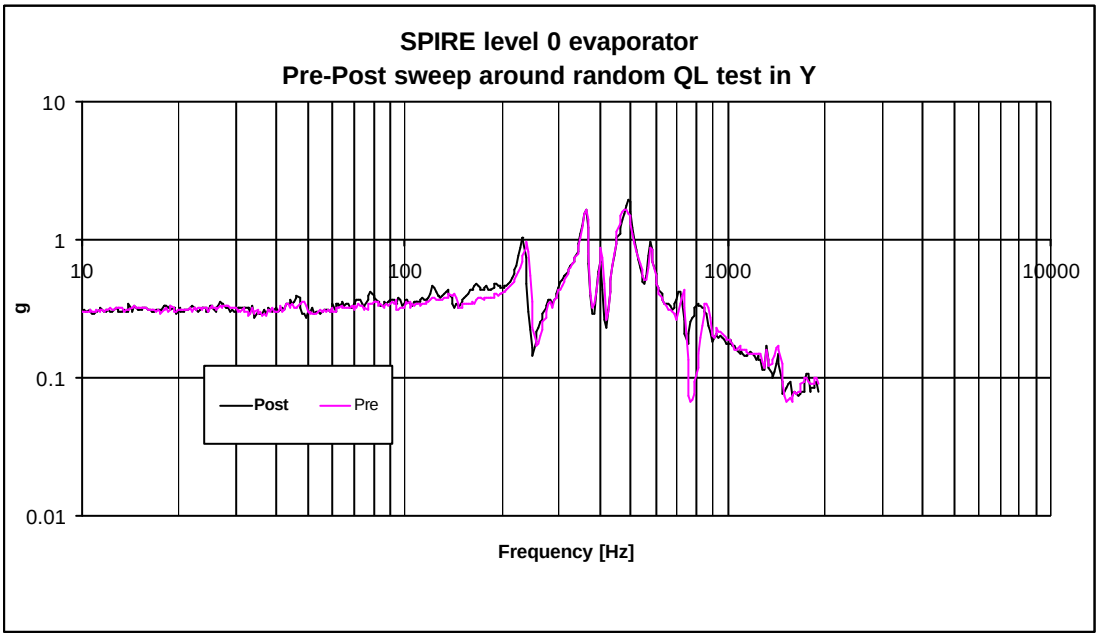
7-8: Sine Vibration in X – Qualification 2 Oct/min – test was aborted and then restarted (arrow)



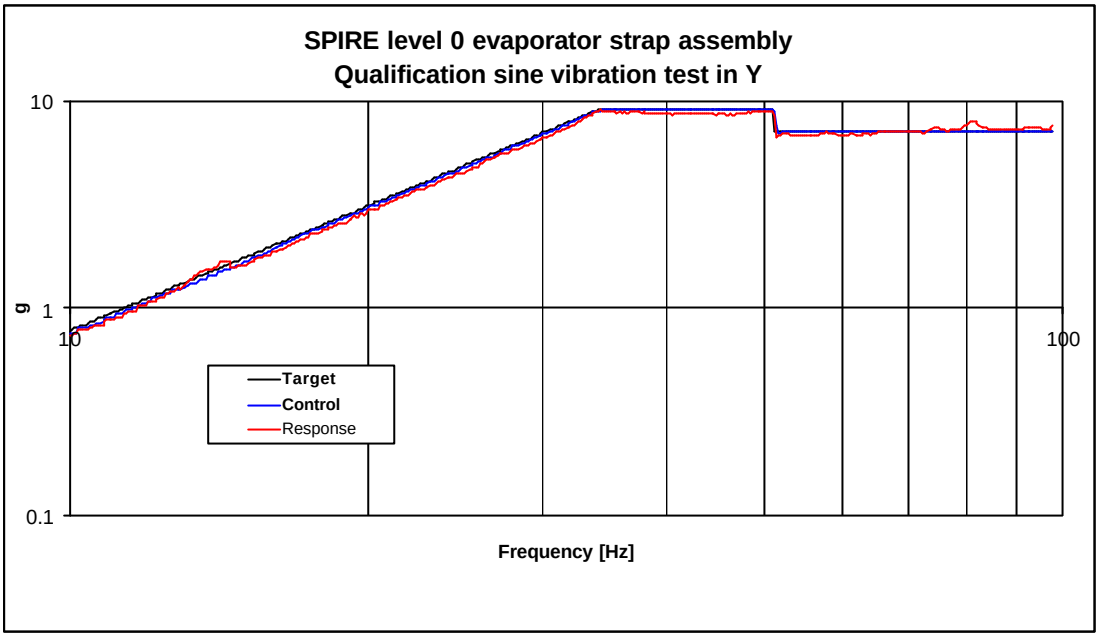
7-9: Pre-Post sine qualification test sine sweep, as for previous (figure 7-7)



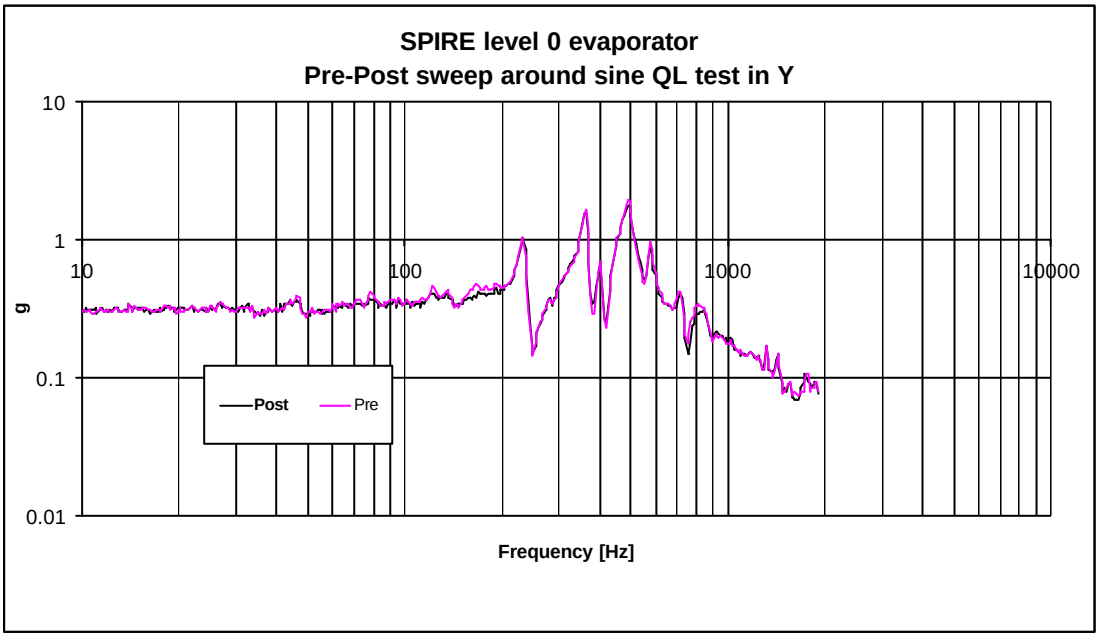
7-10: Random Vibration in Y – Qualification 2 minutes



7-11: Pre and Post sine sweep around random QL test in Y. Nice match all the way through

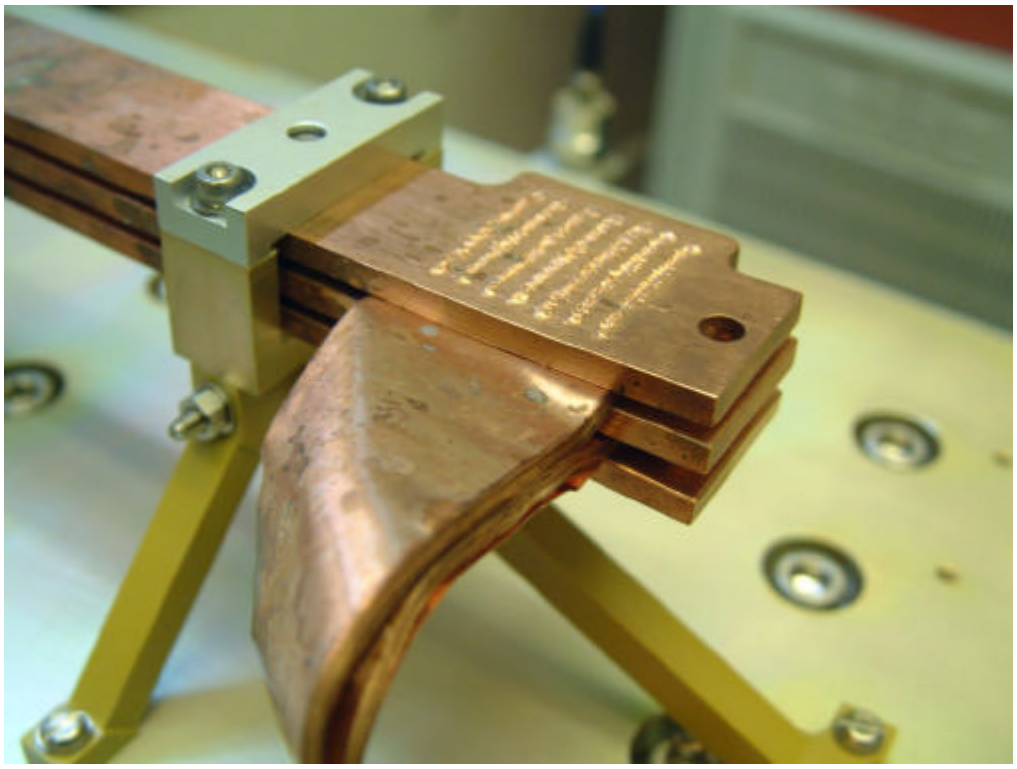


7-12: Sine Vibration in Y – Qualification 2 Oct/min



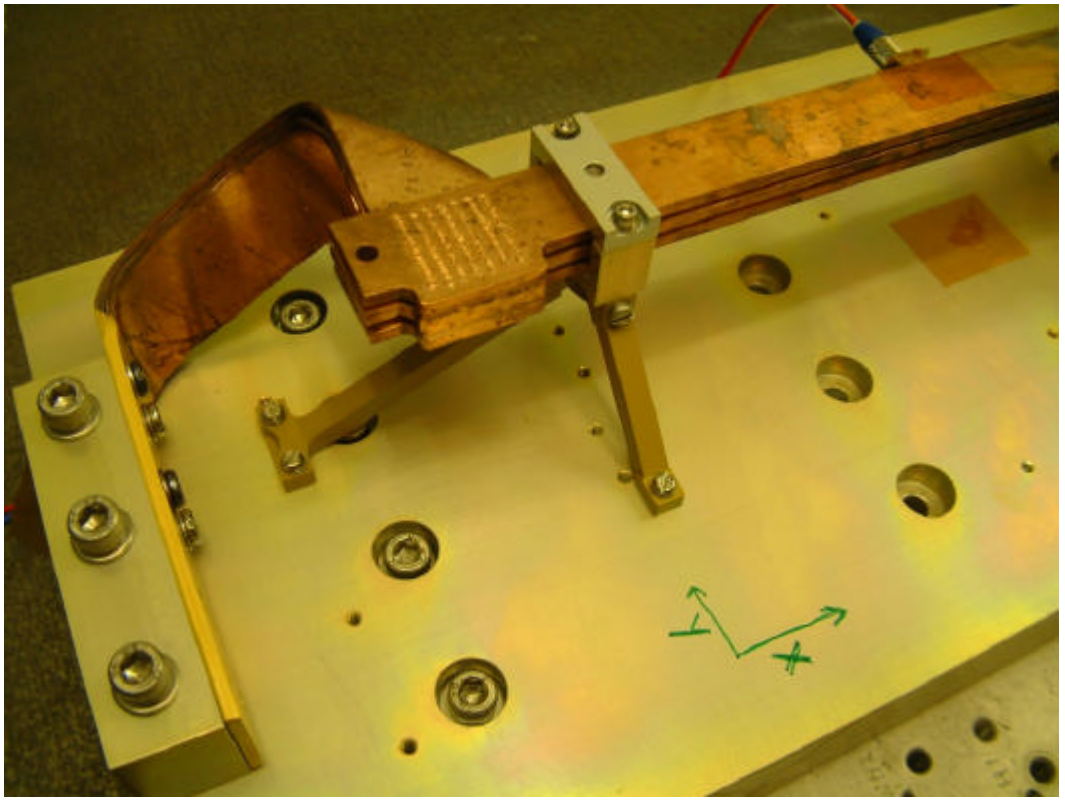
7-13: Pre-Post sine sweep around sine-QL, perfect match.

8. Photographed Details

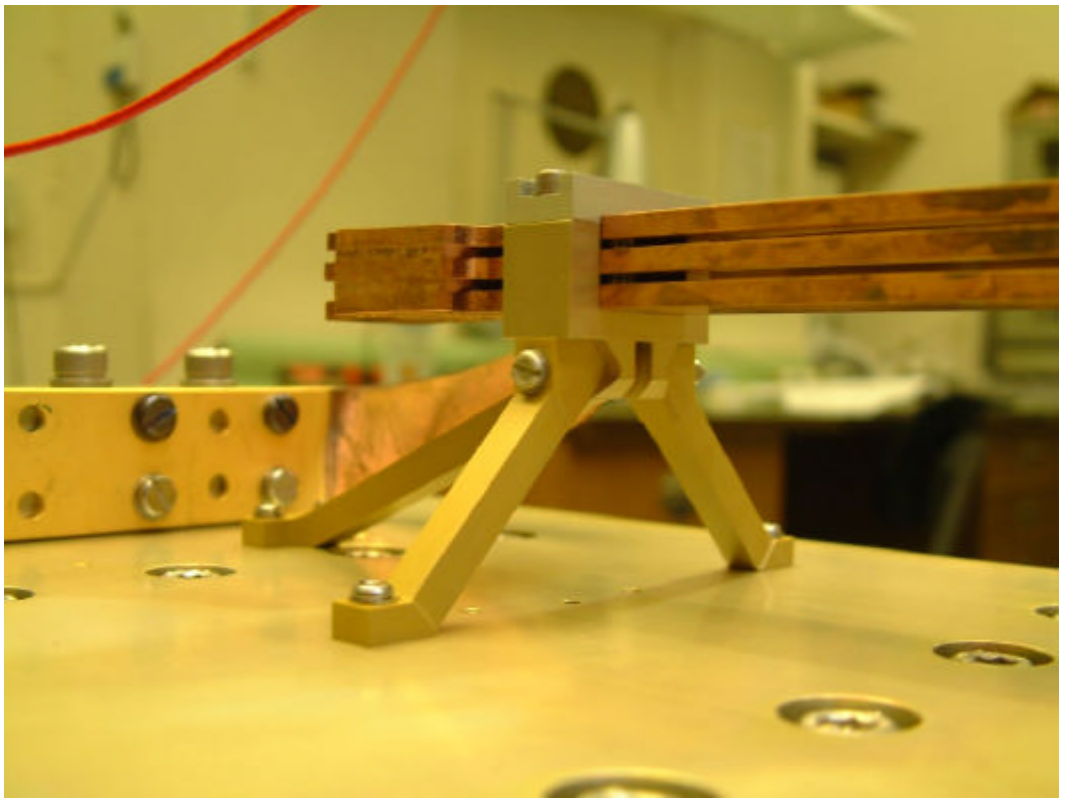


8-1: EB-weld

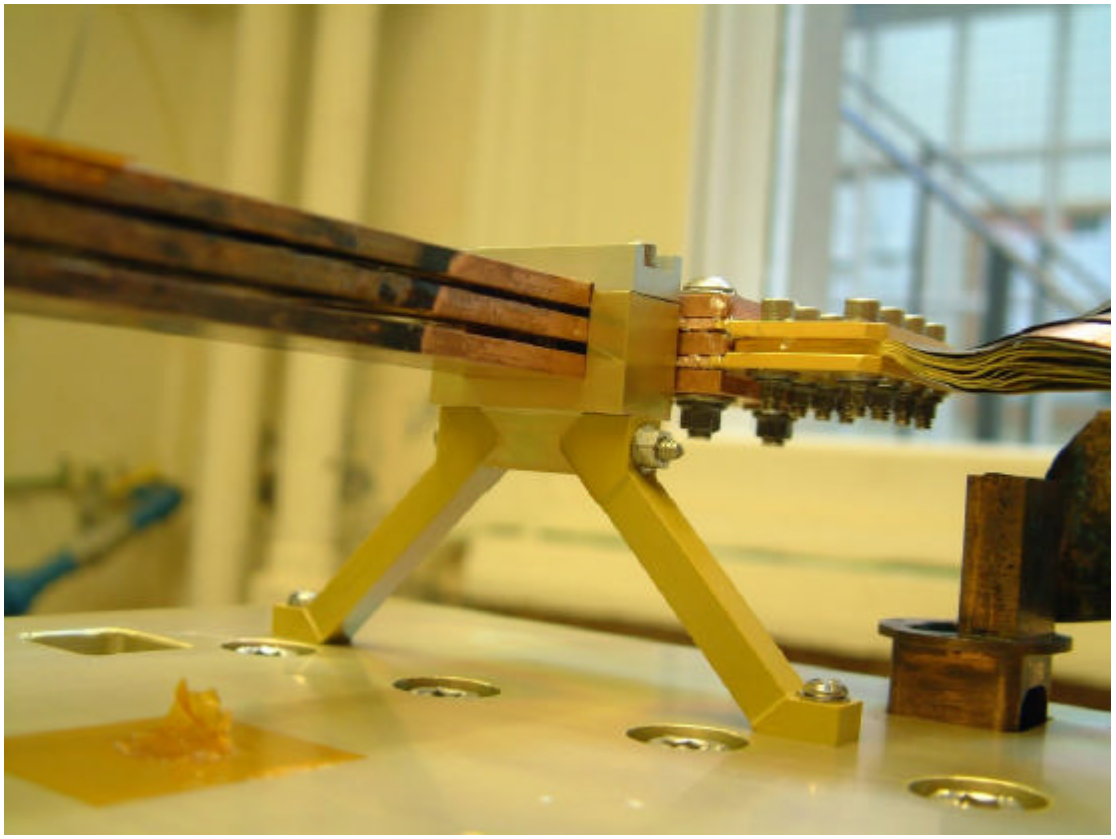
8-2: Compression weld



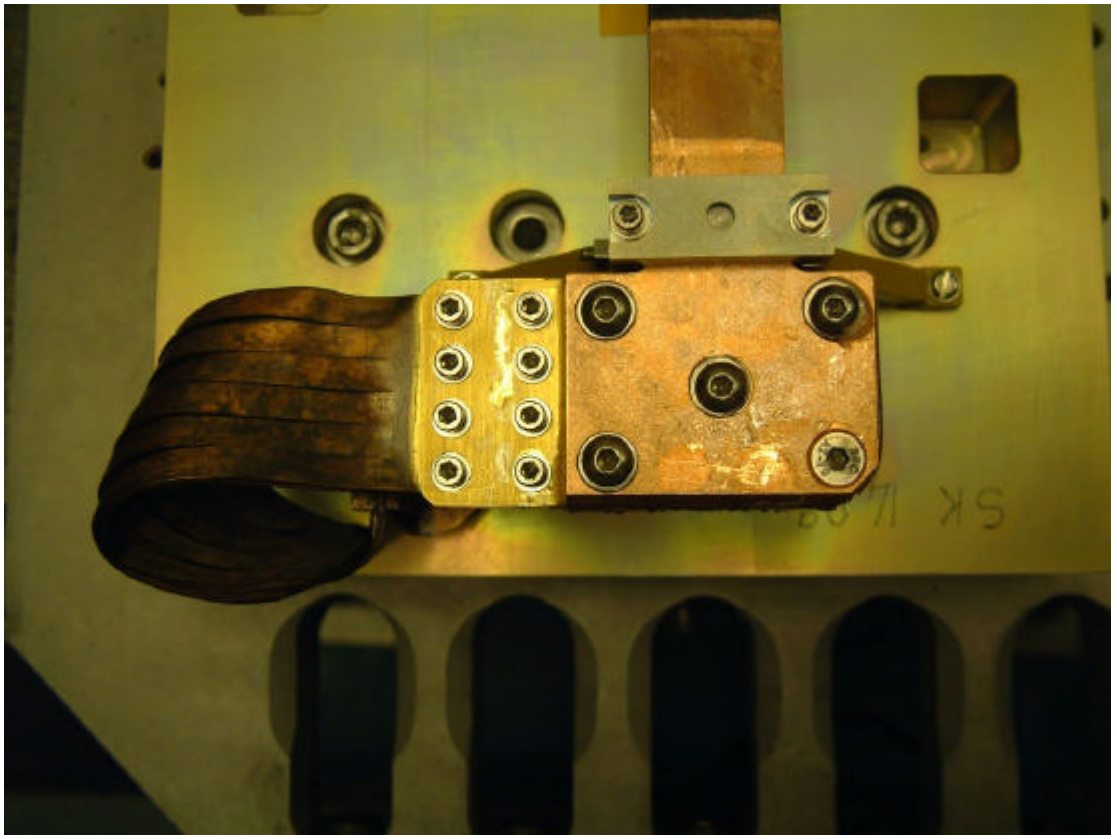
8-3: Bottom support assembly



8-4 Bottom support assembly



8-5: Top support assembly



8-6: Top assy

9. Conclusions

The input specification has been met and the thermal strap assembly appears to be undamaged. The test specimen is ready for thermal testing in Cardiff.

Note that the flexible links at both ends were bent slightly out of shape before arrival at MSSL. They needed to be pushed back into shape to fit the assembly (including supports). During this, the copper flexes did deform slightly, which is unavoidable for this very soft material.

10. Appendix A - Equipment Spec

Shaker: Ling Dynamics V762
Controller: DVC-4000 last maintenance 05/03/2004
Control accelerometer Endevco 224C, LC95, 1.26 pC/g,
Response accelerometer Endevco 226C, JL70, 3.2 pC/g
Response accelerometer Endevco 226C, HN86, 3.1 pC/g