Test Report established for:

ARGON ENGINEERING

Shock and Vibration Summary Test Report

Project number: D00318

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REVISION			
REV	**DATE**	**Details**	**Written by**
-	10/26/2003	Elaboration	JC ALDON

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1 SCOPE

This test report synthesizes the results of the shock and vibration test conducted by 901D to qualify the 4 enclosures designed for the ARGON SSEE-E system.

These cabinets are designed and manufactured by 901D (project number D00318)

The test results are completed by a summary of any difficulty and lesson learned during the different tests.

2 APPLICABLE DOCUMENTS

[1]: MIL-STD 167-1 (Ships)Mechanical Vibrations of Shipboard Equipment (Type 1 – Environmental, and Type II – Internally Excited), dated May 1, 1974

[2] : MIL-S 901D (NAVY) Military Specification, Shock Test, H.I. (High Impact) Shipboard Machinery, Equipment and Systems, Requirements for, dated March 17, 1989

[3]: "Shock and vibration qualification test procedure for the SSEE-E". Document number D00231-QTP-01.

3 IDENTIFICATION OF ITEMS BEING TESTED

Test Items

System	Description	Basic Function	P/N
AN/SSQ-137 (V)1	System Equipment Cabinet 1	HF Receiver	275032
AN/SSQ-137 (V)1	System Equipment Cabinet 2	System Control	275033
AN/SSQ-137 (V)1	System Equipment Cabinet 3	V/UHF Receiver	275034
AN/SSQ-137 (V)1	System Equipment Cabinet 4	CCOP	275035

4 SHOCK TESTS:

Shock Test Category

Heavyweight

Shock Grade

Class II

12-16 Hz Deck Simulator Fixture (DSF)

Equipment Class

Grade A

Shock Test Type

Type A

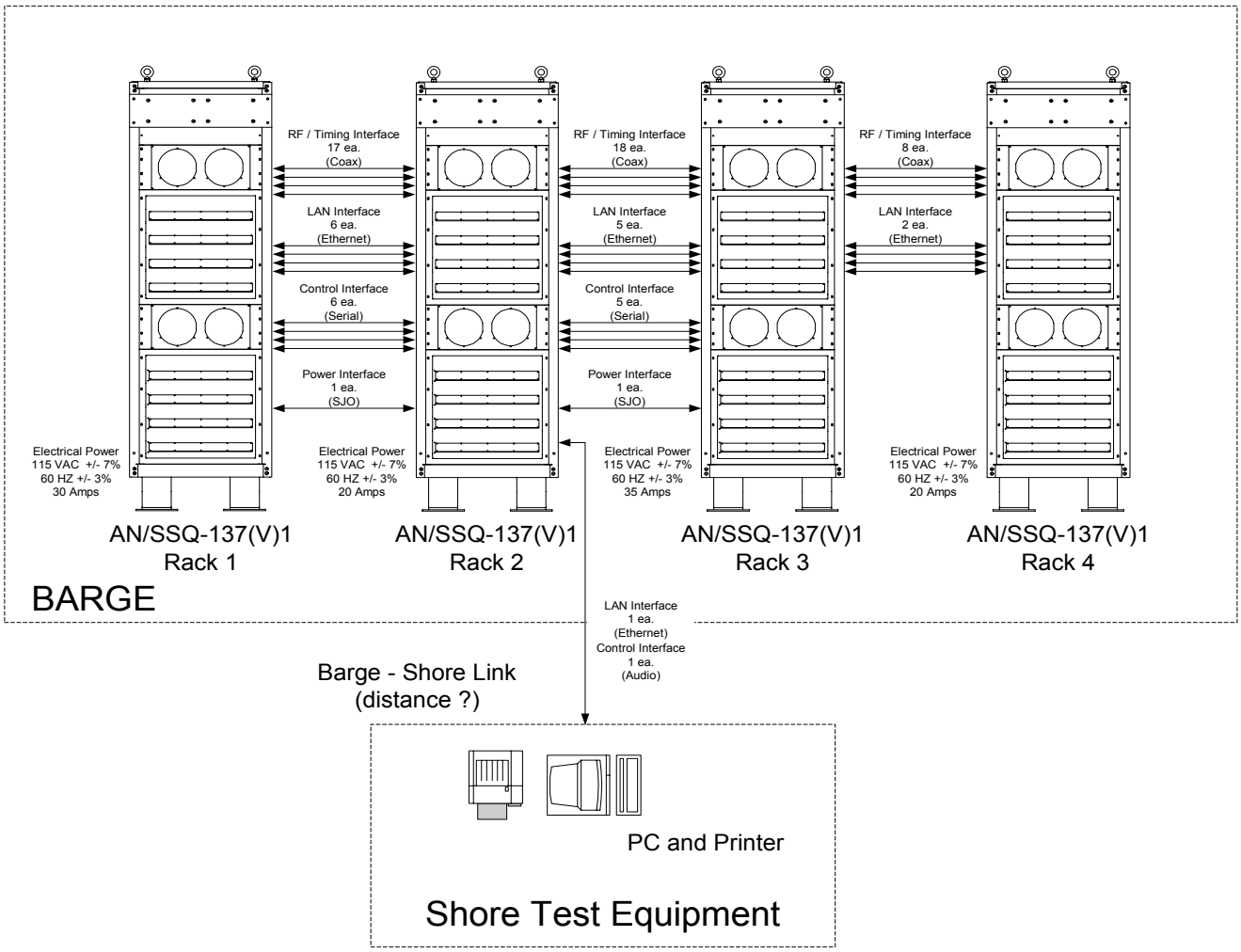
Equipment Mounting Locations

The Base of the racks is mounted on a Deck Simulator Fixture during barge test. The DSF also simulates bulkhead interface.

Mounting Orientation aboard Ship

Vertical orientation, front door facing forward for the first 3 shots. Racks are rotated 90 degrees for the last shot.

TEST SETUP FOR BARGE TEST



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Shock: FSP and Fixture Instrumentation

Accelerometers are installed on the DSF to verify proper test geometry and to monitor the shock input parameters. Accelerometers are placed on the cabinet and test fixture to verify proper shock conditions and to monitor shock at cabinet level. Accelerometer locations for the Class II equipment and DSF are listed in Table below. In addition to the accelerometers listed below, clay cones have been installed below each rack to monitor vertical deflection during shock.

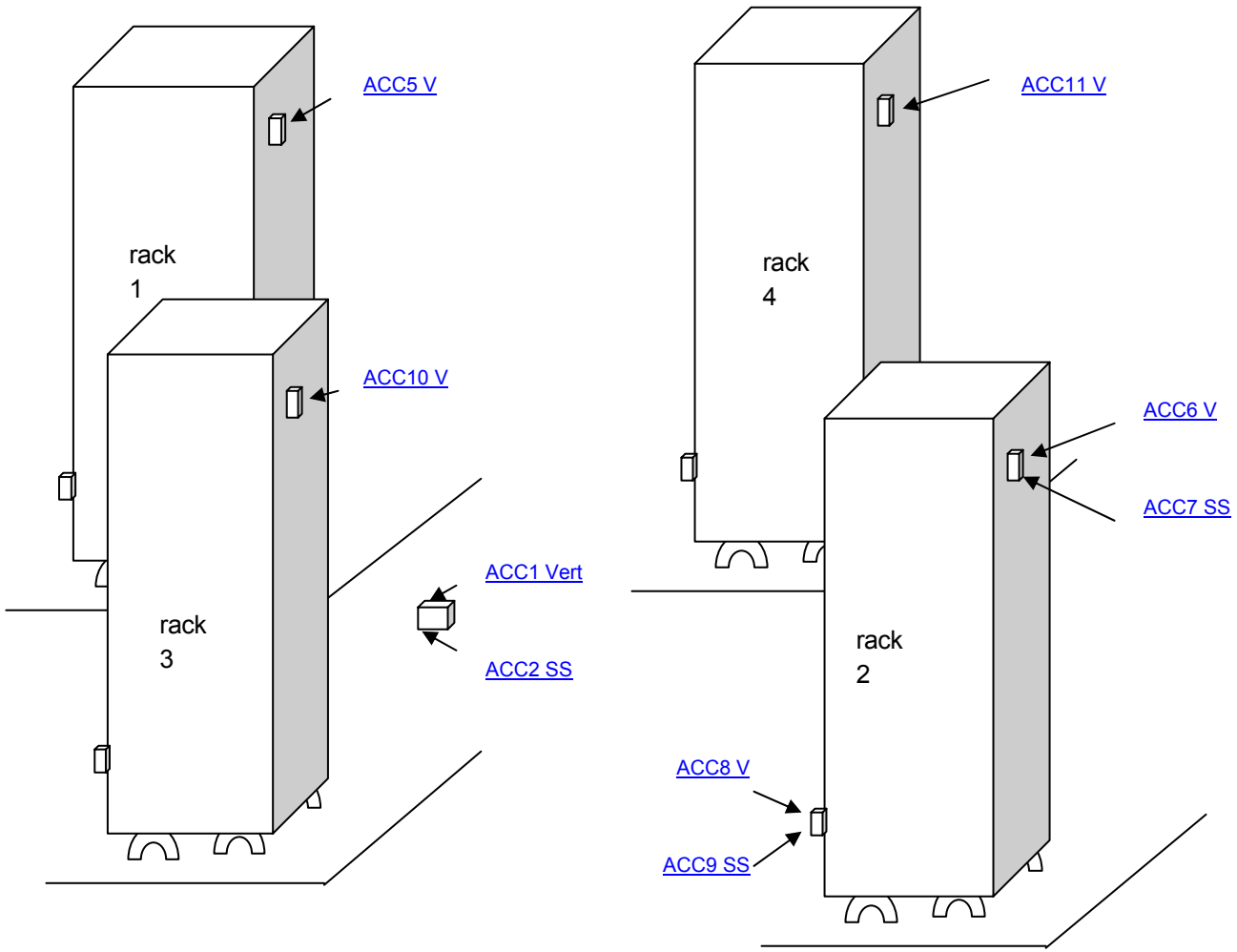
Gage	Orientation	Cabinet PN	Location
Acc-1	vertical		DSF center, middle of 4 racks
Acc-2	athwart ship		DSF center, middle of 4 racks
Acc-5	vertical	Rack #1	Front Top of rack (right side)
Acc 6	vertical	Rack #2	Front Top of rack (right side)
Acc 7	athwart ship	Rack #2	Front Top of rack (right side)
Acc 8	vertical	Rack #2	Front Bottom of rack (left side)
Acc 9	athwart ship	Rack #2	Front Bottom of rack (left side)
Acc 10	vertical	Rack #3	Front Top of rack (side)
Acc 11	vertical	Rack #4	Front Top of rack (side)

Shock Test Accelerometer Location for Class II Equipment

ARGON SHOCK TEST

test performed July 6 2003

Location: DTI, Rustburg VA



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	Project number	TYPE	FORMAT	PAGE
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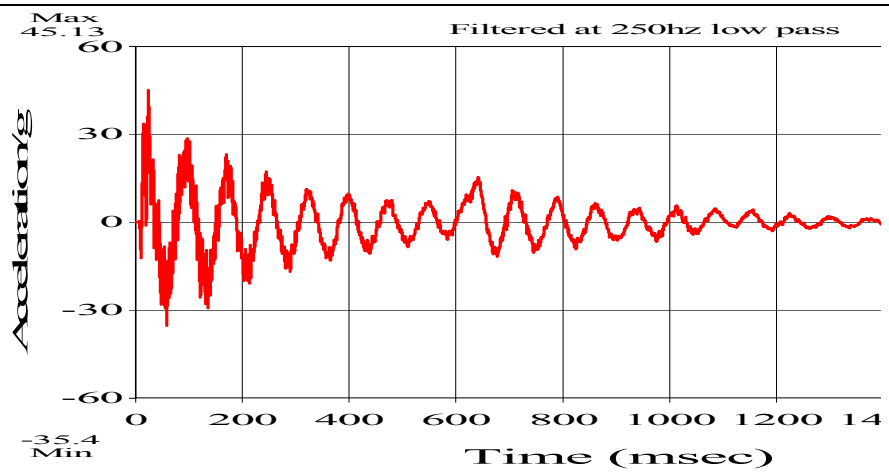
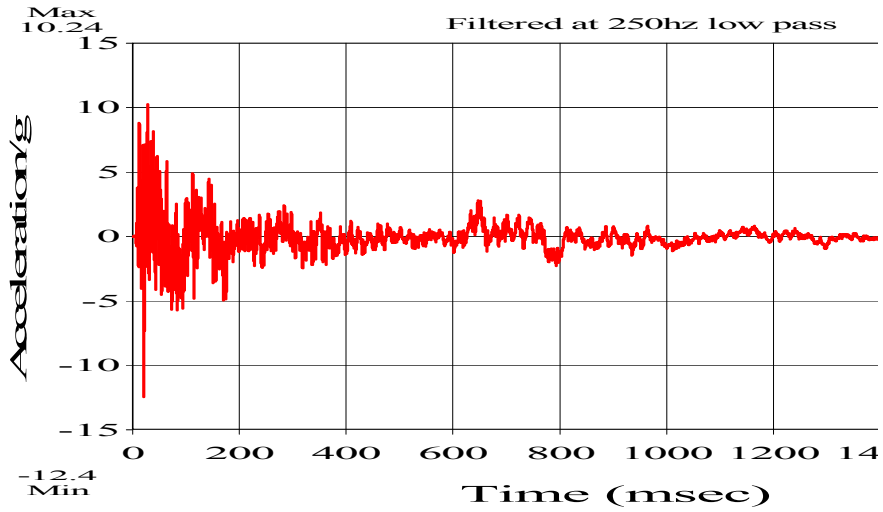
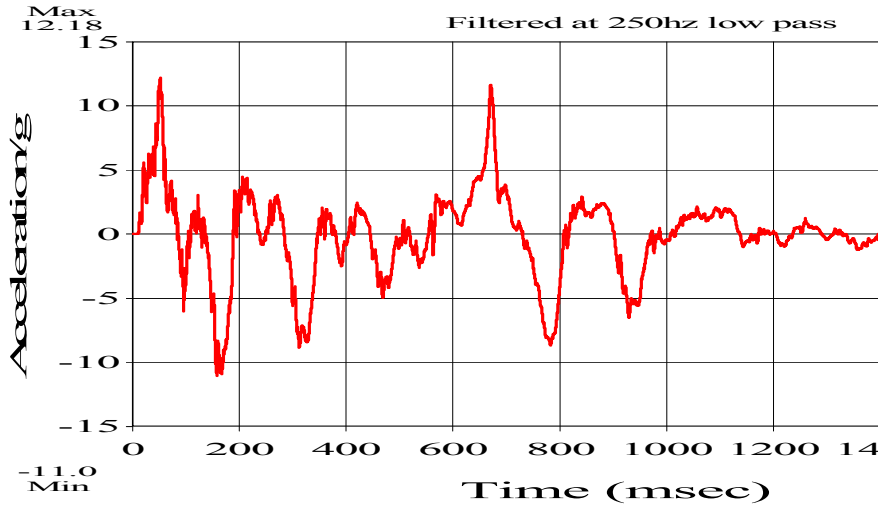
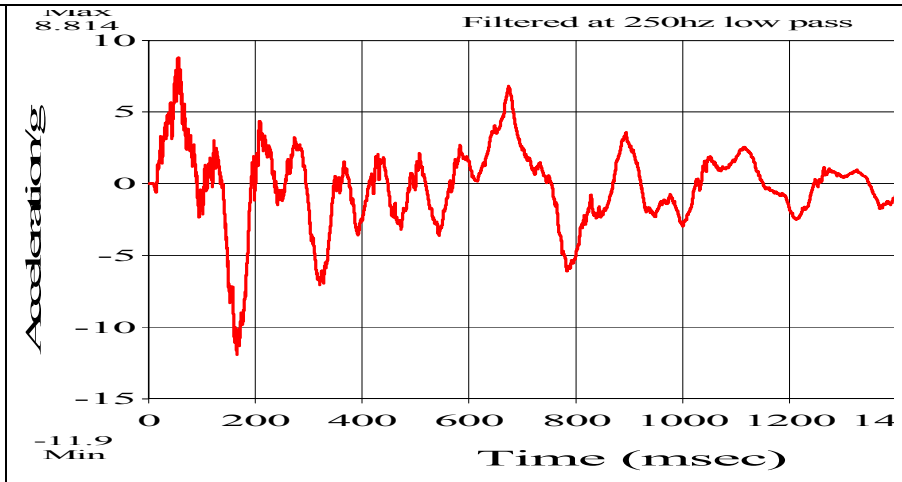
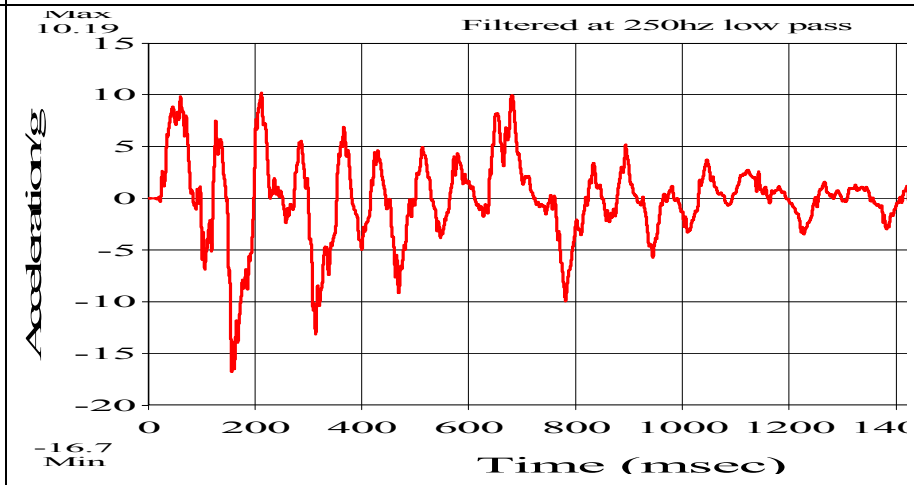
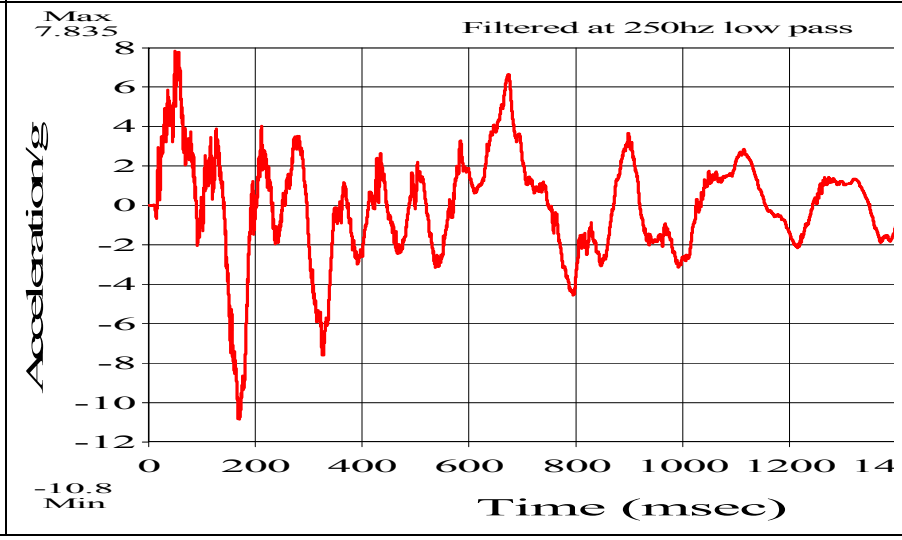
Shot 3 result summary

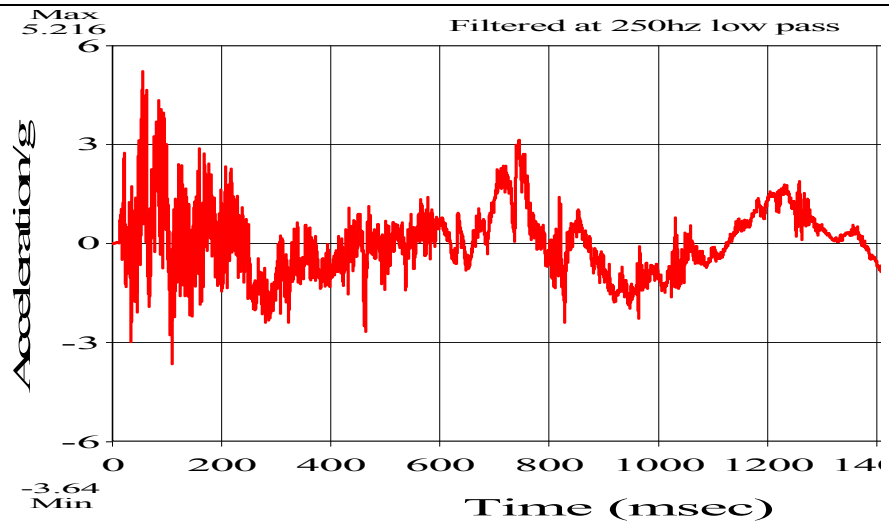
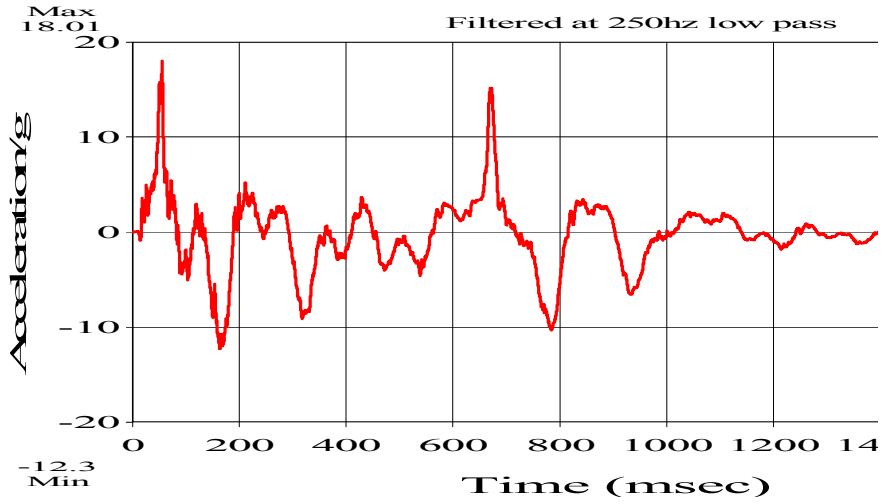
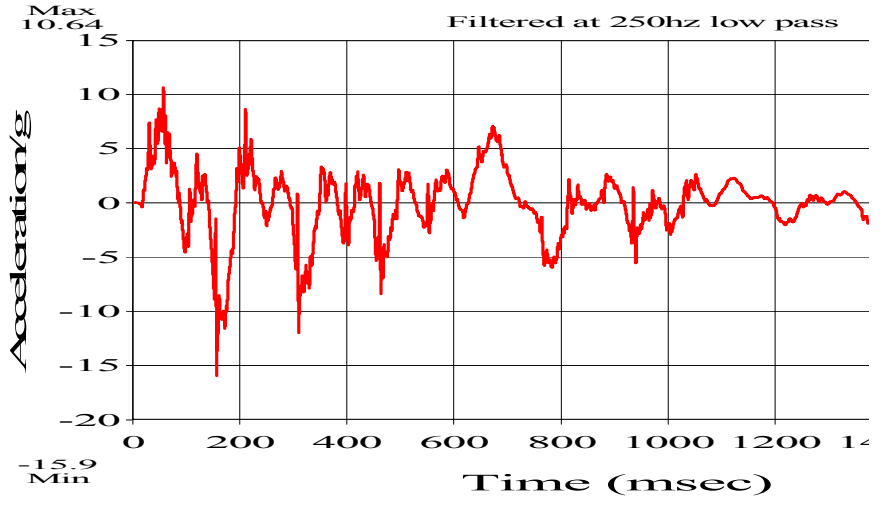
List of test conducted:

Shot no	Test fixture frequency Hz +/- 1	Equipment operating Mode	Charge depth	Horizontal standoff	Charge location	Orientation of SSEE system @ FSP
1	Class II-14	ON	24 ft	30 ft	athwart	Fore / aft
2	Class II-14	ON	24 ft	25 ft	athwart	Fore / aft
3	Class II-14	ON	24 ft	20 ft	athwart	Fore / aft
4	Class II-14	ON	24 ft	20 ft	athwart	athwart

Test results have been limited to the most severe and representative test (shot 3 with the 60lbs explosive charge horizontally located at 20 ft from the barge). Other results are fully documented in the shock and vibration test report (DTI document reference 655).

Acc	Shock acceleration measured during shot 3
1	
2	
5	

6	 Max 8.814 Filtered at 250hz low pass Acceleration/g 10 5 0 -5 -10 -15 0 200 400 600 800 1000 1200 14 -11.9 Min Time (msec)
7	 Max 10.19 Filtered at 250hz low pass Acceleration/g 15 10 5 0 -5 -10 -15 -20 0 200 400 600 800 1000 1200 140 -16.7 Min Time (msec)
8	 Max 7.835 Filtered at 250hz low pass Acceleration/g 8 6 4 2 0 -2 -4 -6 -8 -10 -12 0 200 400 600 800 1000 1200 14 -10.8 Min Time (msec)

9	
10	
11	

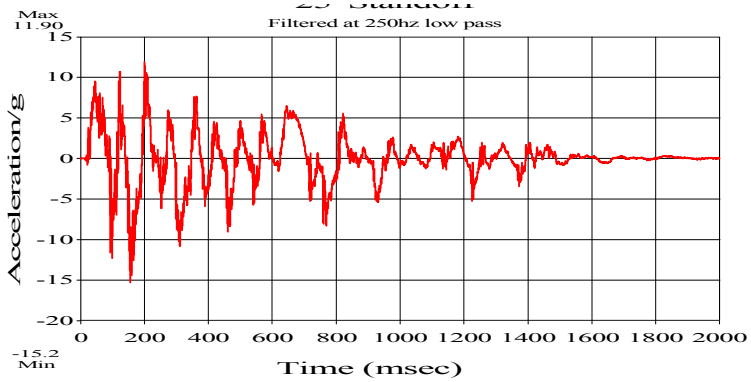
Max
5.216
Filtered at 250hz low pass
Acceleration/g
6
3
0
-3
-6
0
200
400
600
800
1000
1200
-3.64
Min
Time (msec)

Max
18.01
Filtered at 250hz low pass
Acceleration/g
20
10
0
-10
-20
0
200
400
600
800
1000
1200
-12.3
Min
Time (msec)

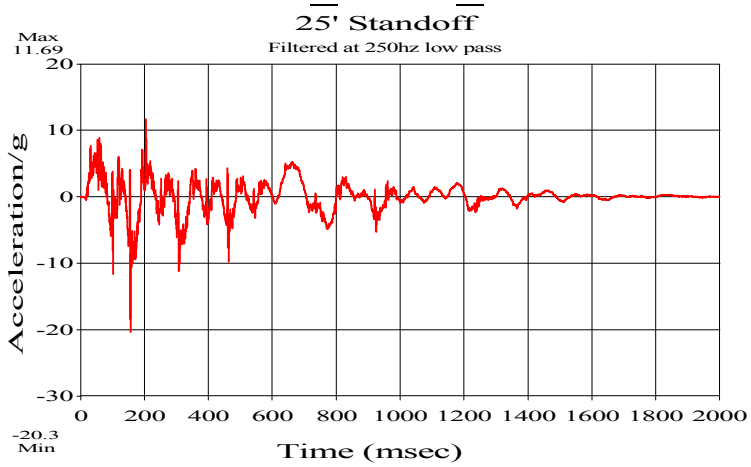
Max
10.64
Filtered at 250hz low pass
Acceleration/g
15
10
5
0
-5
-10
-15
-20
0
200
400
600
800
1000
1200
-15.9
Min
Time (msec)

Summary of hardware observations after the tests:

- No defect has been noted on racks (no loose hardware, scratch, dent…)
- The shock isolators did not bottom during the most severe shots (3 and 4).
- Vertical deflection (sway space downward) was measured at 3.5" on clay cone.
- The sway space measured and the level of G response inside the racks is in good accordance with the calculation performed to select the shock mounts. This validates the theoretical model and L/D data used by 901D,LLC to perform barge test shock analysis.
- During shot 2, accelerometers 7 and 11 were moved and relocated on the side of one of the servers. The first accelerometer was mounted on the rack side, the other one at its very proximity but on the server side (the general device slide being in between the 2 sensors). An acceleration spike was noted on the sensor located on the server during the shot: this confirms a mechanical interference between the 2 parts of the general device slide during the shock pulse, giving rise to a higher level of Gs. In order to reduce the level of stress generated on the server (the hard disk could more specifically be affected), a new slide with a tighter fit between the 2 members would be beneficial.



Accelerometer 7 on rack



Accelerometer 11 close to Acc 7 but on server: High frequency spike due to slide bottoming is noted on first rebound (20g)

- The 17” flat Panel display of the 2U Keyboard/FPD unit (TAG) was tested in the open position and remained well maintained by the top mechanical bracket tying it to the rack. With the tip of the keyboard being left free, no damage was noted during the test and the concept of holding the top of the display only has been validated.

5 VIBRATION TESTS:

Vibration Type

In accordance with the MIL STD 167, type I. Test will include, for each axis:

- Exploratory test, as detailed in paragraph 5.1.3.3.1 of the MIL STD 167
- Variable frequency test, as detailed in paragraph 5.1.3.3.2 of the MIL STD 167
- Endurance test: as described in paragraph 5.1.3.3.3 of the MIL STD 167.

Amplitude and frequency range are as defined in table I of the MIL STD 167

Vibration Test Range

As defined in table I of MIL STD 167. Frequency range is limited to 33 Hz.

Equipment Mounting Locations

A chassis simulating the ship interface (floor and bulkhead) is used to secure the racks on the shaker during vibration tests. This chassis shall be such that no frequency resonance is found during the survey over all the frequency range.

Vibration: Instrumentation of racks under test

Accelerometers are installed on the test chassis bolted to the vibration machine table to verify proper test geometry and to monitor the vibration input parameters. Accelerometers are placed on the cabinet to verify proper vibration conditions and to monitor vibration level at cabinet level. Accelerometer locations are listed in Table below.

Gage	Location
Acc-1	On vibration table (bottom)
Acc-2	On top of test fixture (chassis), close to the stabilizer plate
Acc-5	Front bottom left side of rack under test
Acc 6	Front Top right side of rack under test

Vibration Test Accelerometer Location

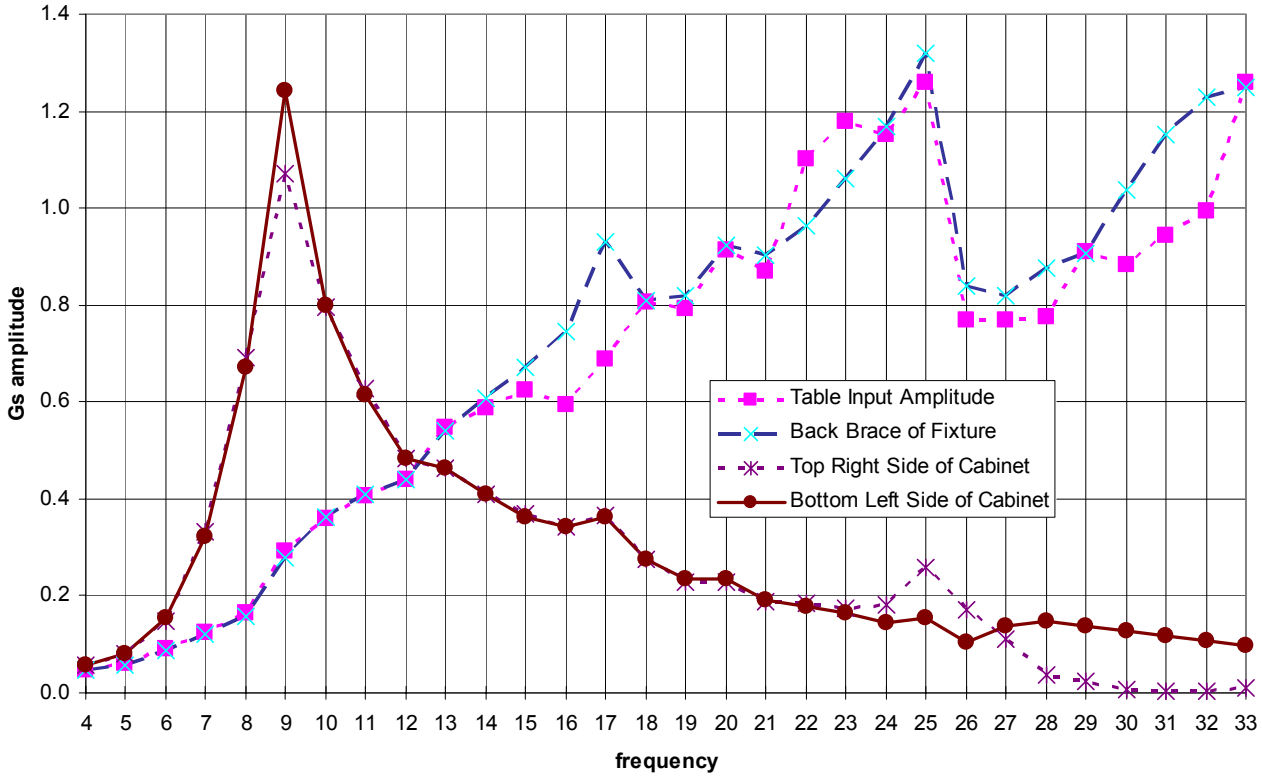
Vibration result summary

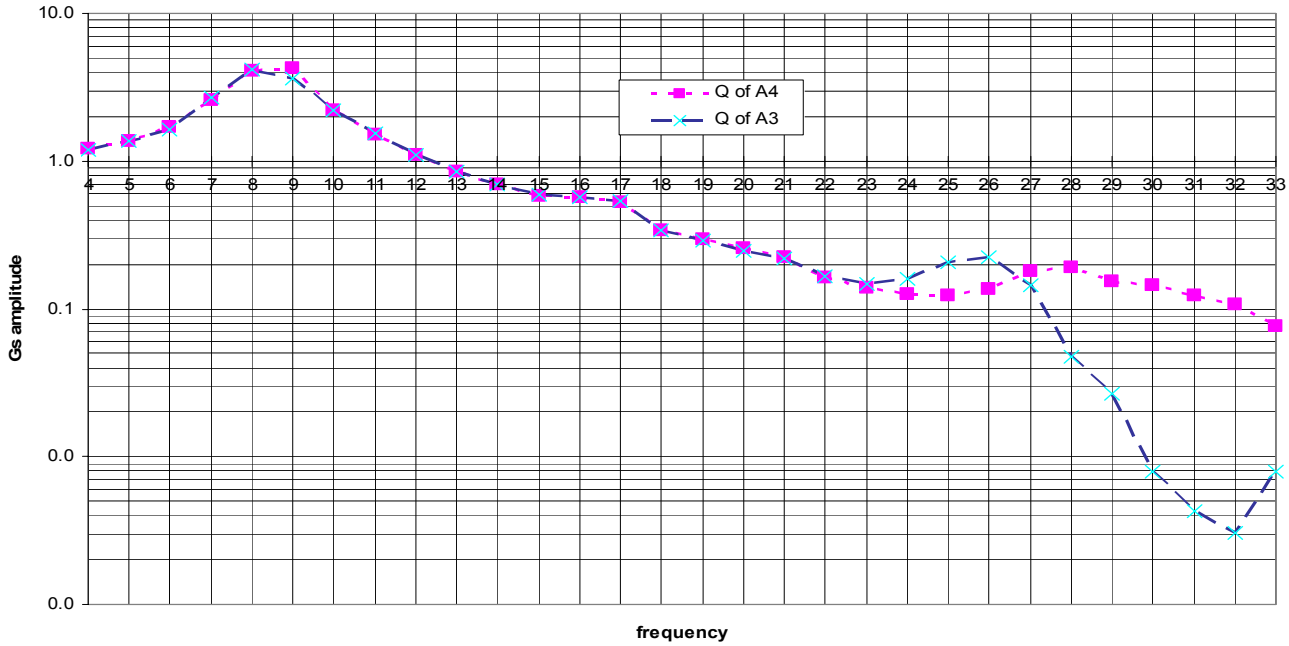
The test results presented here have been limited to one rack and are representative to the other test data measured for each rack. All other results are fully documented in the shock and vibration test report (DTI document reference 655V).

For each direction, the acceleration measured on the rack and the acceleration measured on the test chassis and on the shacking table are plotted on the same graph.

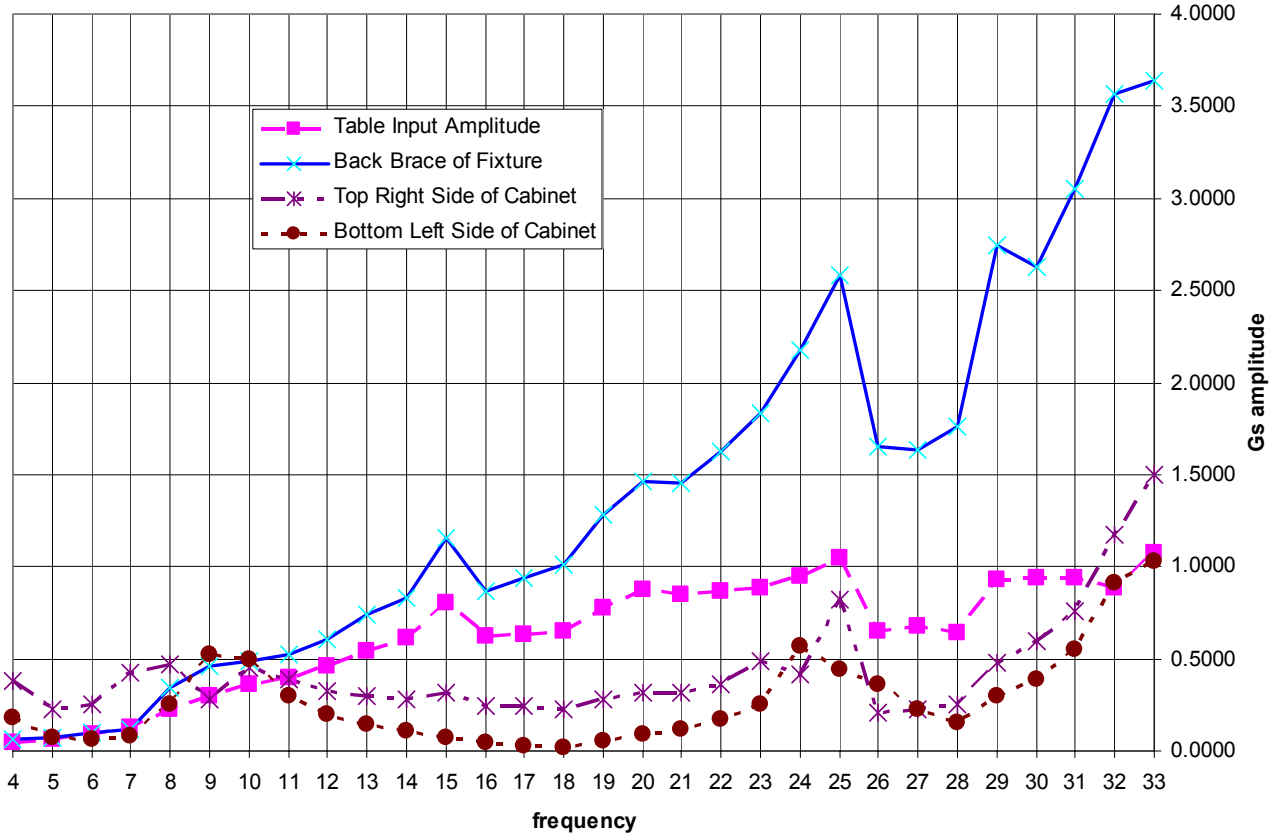
The Q factor is then calculated in each case and shows clearly the frequency resonance of the isolated rack.

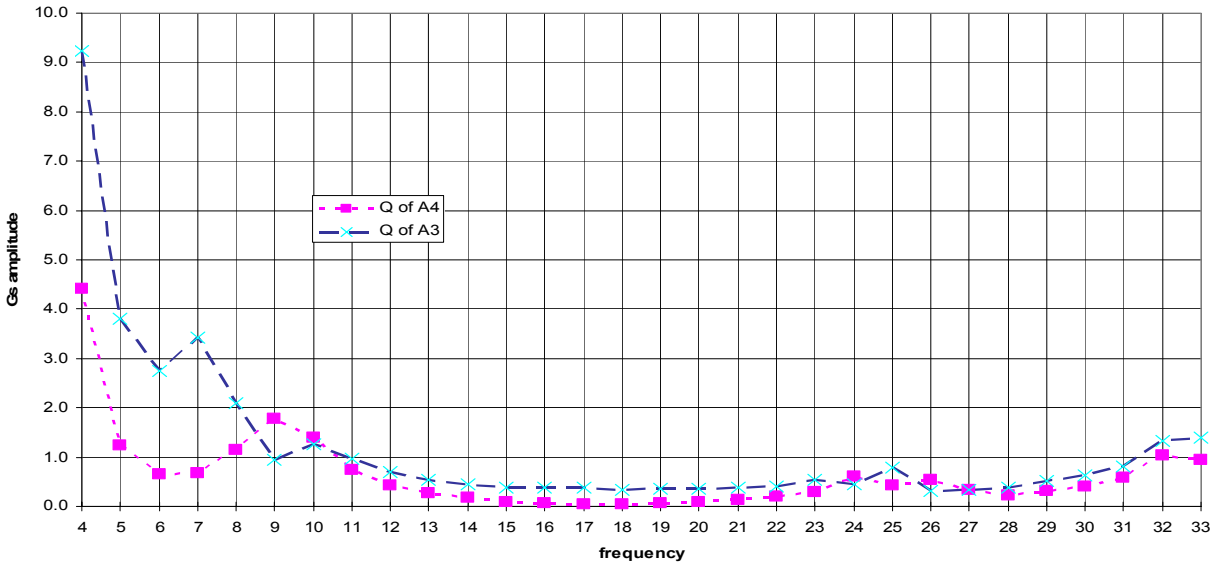
Direction:	Vertical



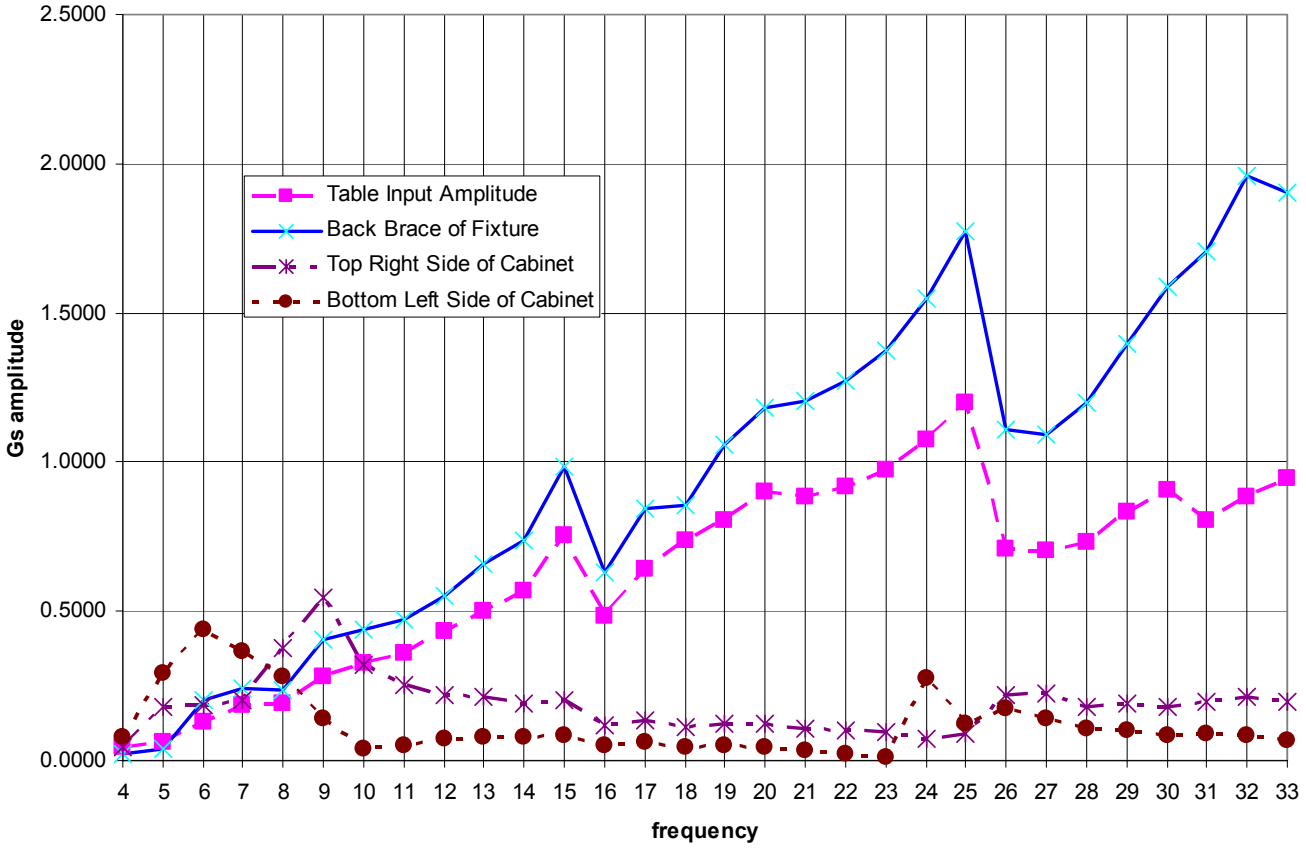


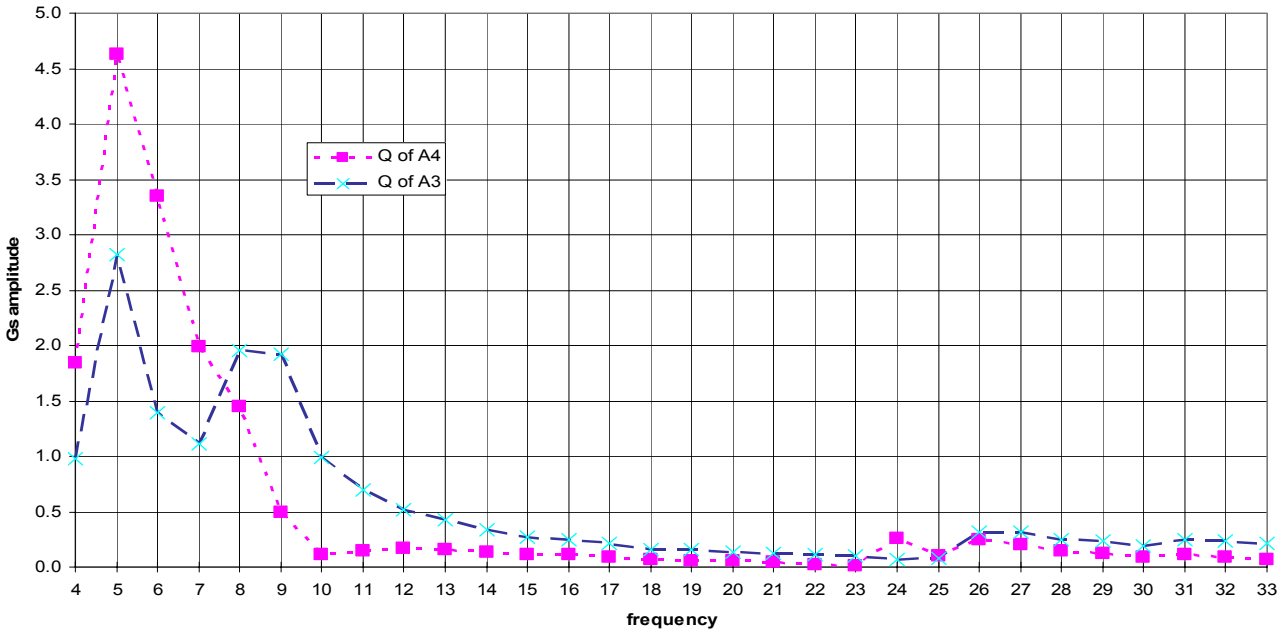
Direction:	Side to side





Direction:	Front to back





Comments on vibration tests:

The side to side test has shown an important coupling effect between the vibration table, the test fixture (chassis) and the rack under test. This condition has been generated by the test fixture having a frequency resonance in the side to side axis within the frequency range of the test

This coupling has generated a vibration input at the top of the test fixture well above the MIL STD 167 requirement: 3.7g instead of 1 g.

→ In this configuration, the rack has been over-tested.

Same phenomenon was also noted on the front to back direction, however significantly lower than in previous axis (1.9g instead of 1g).

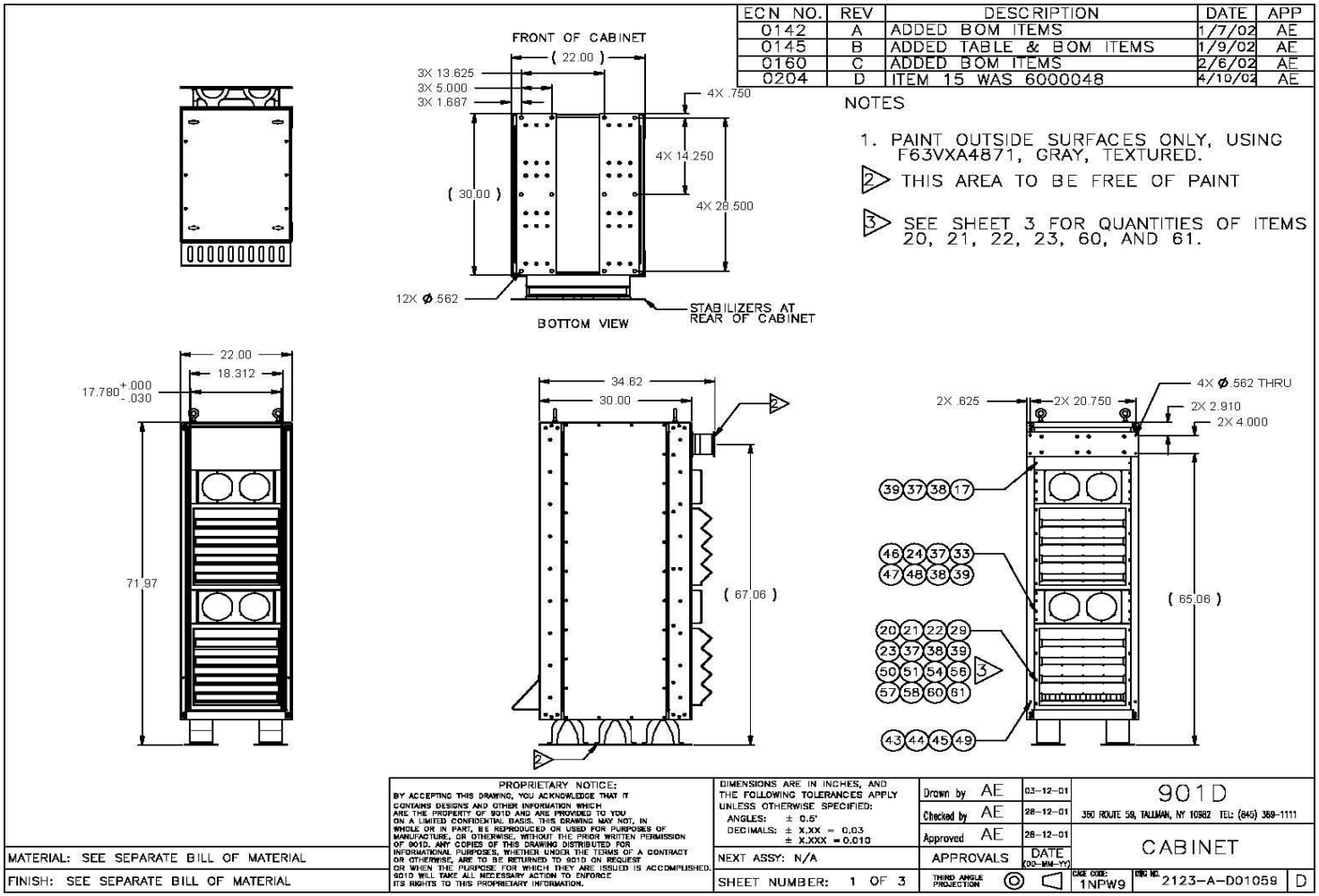
In both cases, the high damping effect of the shock absorbers has dramatically reduced the level of vibration applied to the rack. The vibration transmitted to the rack was always below 1g for these 2 axes.

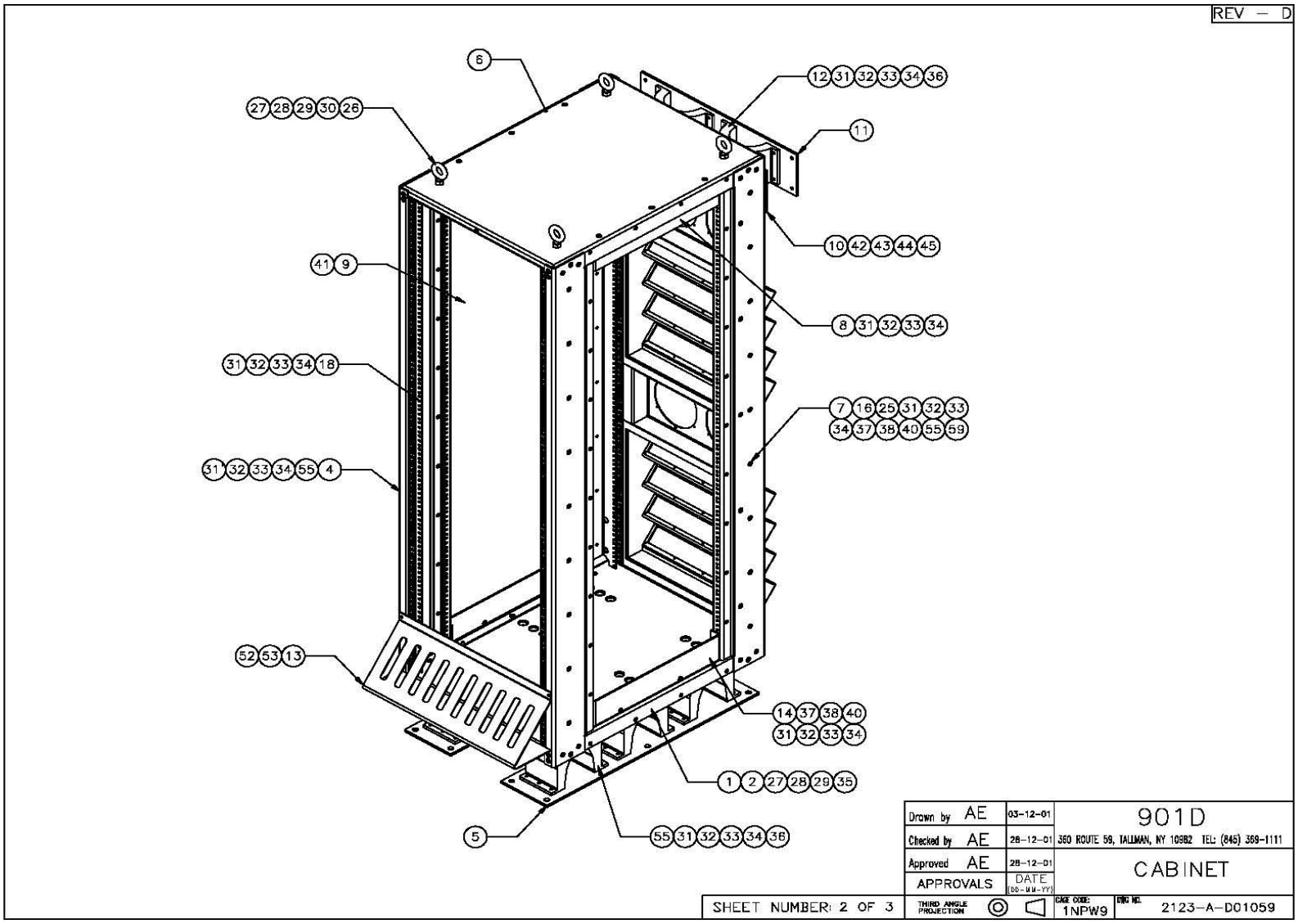
The maximum amplitude transmitted to the rack was measured at the resonance in the vertical direction around 1.2g @ 9 Hz.

Summary of hardware observations after the vibration tests:

- The vibration response measured inside the racks is in good accordance with the calculation performed to select the shock mounts. This validates the theoretical model and L/D data used by 901D,LLC to perform the vibration analysis.
- During endurance, a rattling noise was discovered at the top of the rack. After further investigation, the noise has been suppressed by adding a rubber protection above the top cable retractor.
- Some hardware used to tie the 2 members of the cable retractor was discovered loose after the endurance tests. A solution using a thread locker has been implemented and validated to solve the issue.
- A 0.5 Hz drift of the frequency resonance has been noted after each dwell test. This drift is associated with the warm-up of the isolators and is normal.

APPENDIX A: INSTALLATION AND INTERFACE DRAWING OF THE SSEE-E RACK.

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12 31 32 33 34 36
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31 32 33 34 55 4
52 53 13
14 37 38 40 31 32 33 34
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55 31 32 33 34 36
Drawn by AE 03-12-01
Checked by AE 28-12-01
Approved AE 28-12-01
APPROVALS DATE (DD-MM-YY)
901D
360 ROUTE 59, TALLMAN, NY 10982 TEL: (845) 369-1111
CABINET
SHEET NUMBER: 2 OF 3
THIRD ANGLE PROJECTION
CAGE CODE: 1NPW9
DWG NO. 2123-A-D01059