Request For Proposal
for
Vibration Shaker Components for
LDS V984

June 2016

Space Test Division

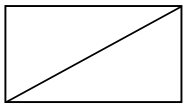
Korea Aerospace Research Institute

169-84 Gwahangno, Yuseong-gu, Daejeon, 305-806, KOREA
Phone : 82(42)860-2562, Fax : 82(42)860-2234

Request For Proposal

for

Vibration Shaker Components for LDS V984



IMPORTANT

1. This RFP should be kept in confidentiality and should neither be copied nor distributed to the third parties.

2. The questions and opinions on this RFP can be asked or suggested to Korea Aerospace Research Institute before submission of the proposal.

3. This RFP shall be legal bind after the contract is awarded unless the bidder explicitly expresses the differences from the RFP in the compliance sheet.

June 2016

Space Test Division

Korea Aerospace Research Institute

169-84 Gwahangno, Yuseong-gu

DAEJEON, 34133 KOREA

Phone : 82(42)860-2562, FAX : 82(42)860-2234

e-mail :acoust@kari.re.kr

Table of Contents

I. OVERVIEW 2

1. OVERVIEW OF THE PROJECT 2
2. WORK DESCRIPTION 3
3. MANAGEMENT REPORTING MEETINGS AND DELIVERABLES 4
4. WARRANTY 5

II. TECHNICAL REQUIREMENTS 6

1. TOTAL SYSTEM CONFIGURATION 6
2. TECHNICAL REQUIREMENTS 6

I. OVERVIEW

1. Overview of the project

1.1 Korea Aerospace Research Institute (hereinafter referred to as “KARI”) is located at Daeduk Research Complex, 140 km south of Seoul.

1.2 KARI has a satellite assembly, integration and test center (hereinafter referred to as “AITC”) for joint use by corporations and research institutes for the purpose of the effective development of domestic satellites. And basic facilities and equipment for satellite assembly and test have been supplied, installed and used.

1.3 To maintain the vibration shaker capability, KARI would like to procure maintenance parts for existing shaker system of LDS V984 shakers.

1.4 The purposes of this project are ;

1.4.1 To supply all related cable set for LDS V984 lateral shaker system
1.4.2 To supply all related cable set for LDS V984 vertical shaker system
1.4.3 To supply RCP unit for LDS V984 shaker
1.4.4 To supply connection of cable lines & acceptance test

The performance of the installed shaker system shall meet the requirements as detailed in the II Technical requirement.

2. Work description

2.1 WP S1000 Maintenance Part Manufacturing

2.1.1 General

An effective and economical management of the Project shall be conducted. A Project Manager shall be responsible for the management and execution of the work to be performed.

2.1.2 Manufacturing

The system hardware shall be manufactured to satisfy the shaker performance described in this RFP All manufacturing operations shall be planned in co-ordination with inspections and tests.

2.2 WP S2000 Installation

During this work package the following tasks shall be performed:

2.2.1 Mechanical Installation

The mechanical installation comprises the installation and connection of the cable set at KARI site.

2.3 WP S3000: Acceptance testing

Upon completion of the installation of the cable set, the acceptance testing of the LDS V984 shakers shall be took place according to the acceptance test sequence.
The acceptance tests shall be performed in accordance with formal test procedures.
During this work package the following tasks shall be performed:

2.3.1 Acceptance test sequence

The acceptance tests shall verify the capability of shaker in compliance with LDS V984 shakers specification. The following tests have to be performed:

2.3.1.1 *Drag force measurement test for slip table configuration*

2.3.1.2 *Bare condition performance tests*

2.3.1.3 *Loaded condition performance tests with dummy load*

2.3.1.4 *Abort sequence verification*

3. Management reporting Meetings and Deliverables

The hardware deliveries shall include, as a minimum, the following:

Item No.	Part name	Qty	Description
1	Cable set for LDS V984 combo(lateral) shaker system	1	- Degauss cable 40m - Field drive cable 40m - Distilled water supply cable 40m - Cooling hose return cable 40m - Oil hose return cable 40m - Oil hose supply 40m - Armature over travel cable 40m - Bearing oil pressure cable 40m - Armature support cable 40m - Armature cooling (Thermocouple) cable 40m - Field coil (Upper) cooling (Thermocouple) cable 40m - Field coil (Lower) cooling (Thermocouple) cable 40m - Vertical/Horizontal switch cable 40m - Body temperature cable 40m - Over travel (Slip table) cable 40m - BRG. Oil pressure (Slip table) cable 40m - Earth cable 40m - Armature drive cable 40m - Fiber optic cable Tri axial BNC cable and Emergency stop 55m - Amplifier energize/Body over travel Command / Control console cable 40m - External Emergency stop cable 40m - Field data link 15m - Cooling unit data link 15m - Other miscellaneous cables
2	Cable set for LDS V984 head expander (vertical) shaker system		- Degauss cable 40m - Field drive cable 40m - Distilled water supply cable 40m - Cooling hose return cable 40m - Oil hose return cable 40m - Oil hose supply 40m - Armature over travel cable 40m - Bearing oil pressure cable 40m - Armature support cable 40m - Armature cooling (Thermocouple) cable 40m - Field coil (Upper) cooling (Thermocouple) cable 40m - Field coil (Lower) cooling (Thermocouple) cable 40m - Vertical/Horizontal switch cable 40m - Body temperature cable 40m - BRG. Oil pressure (Head expander) cable 40m - Load support head expander cable 40m - Earth cable 40m - Armature drive cable 40m - Fiber optic cable Tri axial BNC cable and Emergency stop 55m - Amplifier energize/Body over travel Command / Control console cable 40m - External Emergency stop cable 40m

			- Field data link 15m - Cooling unit data link 15m - Other miscellaneous cables -
3	RCP unit for LDS V984 shaker	1	- Remote control panel for LDS V984

4. Warranty

4.1 The system shall be warranted for a duration of 1 years from the date of definitive acceptance on the site against any operational faults.

4.2 The warranty covers the replacement of faulty parts, the labor required for repair, traveling cost, living fees and all associated necessary costs.

II. Technical Requirements

1. Total System Configuration

This document covers the technical requirements applicable to maintenance parts for LDS V984 shaker system

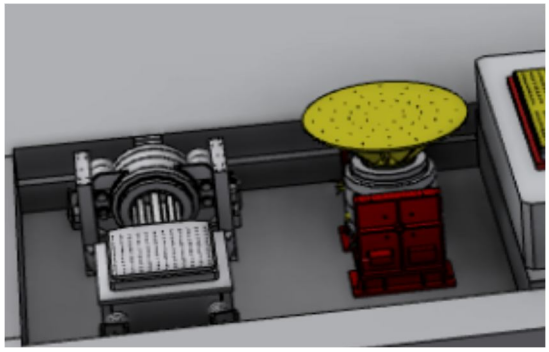


Figure 1 LDS V984 system of KARI

2. Technical Requirements

The work scope for procurement is

- To supply all related cable set between shaker body and cooling unit & amplifier system of LDS V984 lateral shaker system
- To supply all related cable set between shaker body and cooling unit & amplifier system of LDS V984 vertical shaker system
- To supply RCP unit for LDS V984 shaker
- To supply installation of cable lines & acceptance test

2.1 List of Maintenance Parts

The supplied maintenance part shall have the following requirement as minimum:

- **LDS V984 combo(lateral) shaker system**
  - ✓ Degauss cable 40m
  - ✓ Field drive cable 40m
  - ✓ Distilled water supply cable 40m
  - ✓ Cooling hose return cable 40m
  - ✓ Oil hose return cable 40m
  - ✓ Oil hose supply 40m

- ✓ Armature over travel cable 40m
- ✓ Bearing oil pressure cable 40m
- ✓ Armature support cable 40m
- ✓ Armature cooling (Thermocouple) cable 40m
- ✓ Field coil (Upper) cooling (Thermocouple) cable 40m
- ✓ Field coil (Lower) cooling (Thermocouple) cable 40m
- ✓ Vertical/Horizontal switch cable 40m
- ✓ Body temperature cable 40m
- ✓ Over travel (Slip table) cable 40m
- ✓ BRG. Oil pressure (Slip table) cable 40m
- ✓ Earth cable 40m
- ✓ Armature drive cable 40m
- ✓ Fiber optic cable Tri axial BNC cable and Emergency stop 55m
- ✓ Amplifier energize/Body over travel Command / Control console cable 40m
- ✓ External Emergency stop cable 40m
- ✓ Field data link 15m
- ✓ Cooling unit data link 15m
- ✓ Other miscellaneous cables

- **LDS V984 head expander(vertical) shaker system**
  - ✓ Degauss cable 40m
  - ✓ Field drive cable 40m
  - ✓ Distilled water supply cable 40m
  - ✓ Cooling hose return cable 40m
  - ✓ Oil hose return cable 40m
  - ✓ Oil hose supply 40m
  - ✓ Armature over travel cable 40m
  - ✓ Bearing oil pressure cable 40m
  - ✓ Armature support cable 40m
  - ✓ Armature cooling (Thermocouple) cable 40m
  - ✓ Field coil (Upper) cooling (Thermocouple) cable 40m
  - ✓ Field coil (Lower) cooling (Thermocouple) cable 40m
  - ✓ Vertical/Horizontal switch cable 40m
  - ✓ Body temperature cable 40m
  - ✓ BRG. Oil pressure (Head expander) cable 40m
  - ✓ Load support head expander cable 40m
  - ✓ Earth cable 40m

- ✓ Armature drive cable 40m
- ✓ Fiber optic cable Tri axial BNC cable and Emergency stop 55m
- ✓ Amplifier energize/Body over travel Command / Control console cable 40m
- ✓ External Emergency stop cable 40m
- ✓ Field data link 15m
- ✓ Cooling unit data link 15m
- ✓ Other miscellaneous cables

- **LDS RCP unit**
  - ✓ Remote control panel
  - ✓ Switch ON-OFF of amplifiers and auxiliaries
  - ✓ Master gain control and input attenuator for low level testing
  - ✓ Indicators for output current and voltage
  - ✓ Additional set of voltage and current measuring converters incl. suitable signal conditioning (for additional measurement interface)
  - ✓ Transformer tap changing device if applicable (contr. Voltage 240 V ac)

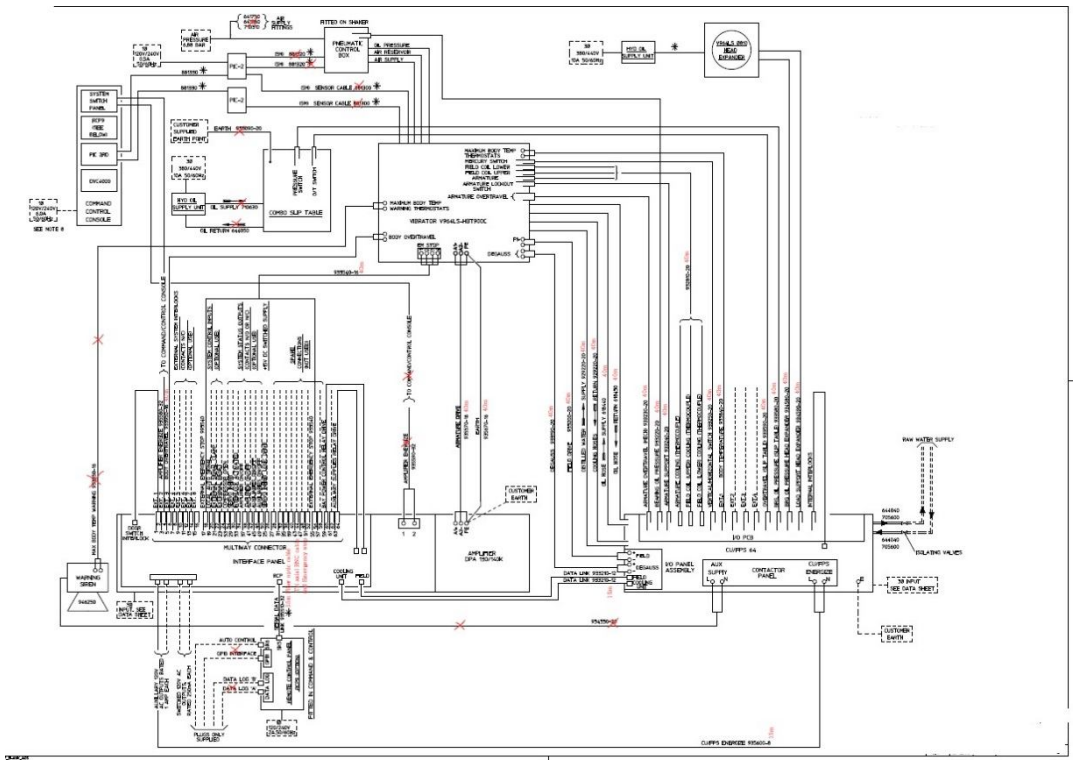


Figure 2 Cable diagram of shaker system

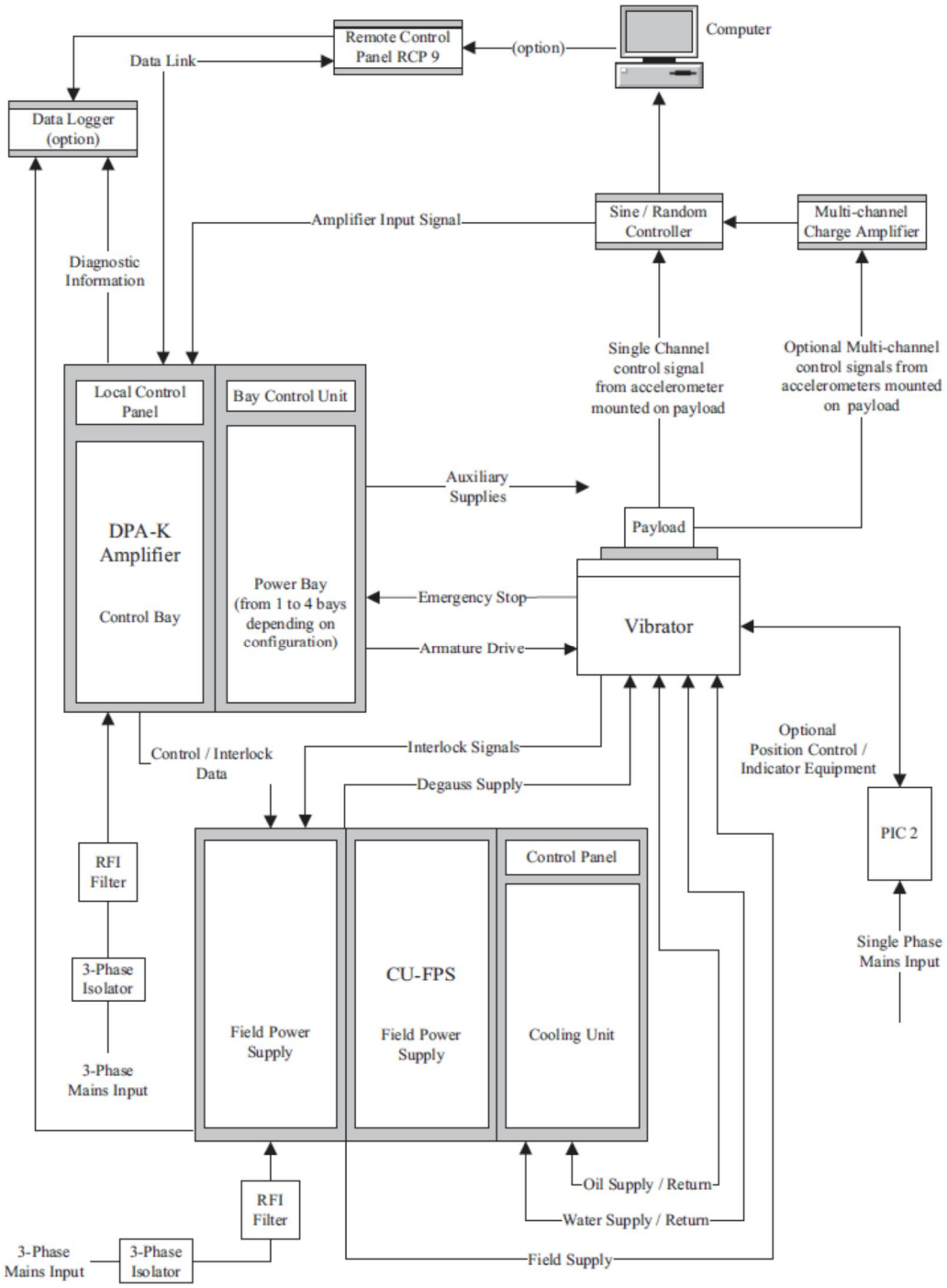


Figure 3 Configuration of shaker system

2.2 Performance Requirement

The supplied maintenance parts shall be compatible to V984 shaker system of KARI.
After the installation of supplied maintenance part, the vibration system shall have the performance of described ones of Manual of LDS V984 shaker system.
The preliminary check and procedures are performed according LDS V984 testing procedure. The test results will be compared with test report which is the previously tested results.
In the tables & Figures as shown at below, the typical requirements are described.

Table 1 Specification of V984 shaker system

Frequency range	Sine	3-2000 Hz
	Random	10-2000 Hz
	Shock	5-2000 Hz
Nominal maximum Thrust	Sine	≥160 kN peak
	Random	≥133 kN RMS
	Shock	>160 kN peak
Nominal maximum no load acceleration	Sine	≥100 g
	random	≥30 grms
	shock	≥100 g
Nominal maximum velocity	sine	≥1.6 m/s
Nominal maximum displacement	Sine	≥38 mm peak-peak
	Half sine bump	≥50.8 mm

Table 2 Field power requirement

Field coils	
Rated current DC	400 A
Rated voltage	240 V
DC winding resistance (at 20° C)	0.51 Ω
Degauss coil	
Rated current	4.0 A
Rated voltage	240 V

Table 3 Requirement of Armature

Displacement	
Continuous pk-pk	38 mm (1.5 in)
Transient (shock operation)	50.8 mm (2.0 in)
Rated travel between overtravel protection limits	56 mm (2.2 in)
Rated current (sine wave)	1700 A
DC winding resistance at 20° C	0.016 Ω
Effective mass	130 kg (287 lb)
Maximum load	
10 g_n vector	1500 kg (3300 lb)
50 g_n vector	195 kg (430 lb)
100 g_n vector	33 kg (73 lb)

Table 4 Specification of cooling unit/Field power supply

	CU/FPS84
Supply Voltage Range	380, 400, 415, 440V 50/60Hz 480, 500, 520V 60Hz
Overall Dimensions	Height1905 mm (75 in.) Width1500 mm (61.4 in.) Depth 825 mm (32.4 in.)
Audible noise (for all 3 units)	89 dBA
Ambient Working Temperature	+5°C to +40°C
Relative Humidity	0 - 95% non-condensing
Weight (approximate)	970 Kg (2139 lbs)
Supply input Power (Full Level FPS) Supply input Power (Economy FPS)	107.37 kW 56.83 kW
Supply input kVA (Full Level FPS) Supply input kVA (Economy FPS)	115.03 kVA 61.98 kVA
Heat Rejected to Air: a. Cooling Unit total b. FPS (Full Level Setting) c. FPS (Economy Level Setting) d. Degauss	 2.07 kW 3.30 kW 2.24 kW 0.06 kW
Total Unit Heat Rejected * (FPS Full Level) Total Unit Heat Rejected * (FPS Economy Level)	3.55 kW 2.49 kW

Table 5 Performance Specification of field power supply

		CU/FPS84
FPS Full Level Setting		
Nominal Load	ohms	0.6
DC Rated Output	Volts	240
DC Rated Output	Amps	400
DC Rated Output	kVA	96
Supply Input Power	kW	99.7
Supply Input kVA	kVA	104.7
Heat Rejected to Air	kW	3.30
Initial Switch on DC overload current (amps) Decaying to rated current within 5 minutes		480
FPS Economy Level Setting		
Nominal Load	ohms	0.6
DC Rated Output	Volts	168
DC Rated Output	Amps	280
DC Rated Output	kVA	48
Supply Input Power	kW	49.03
Supply Input kVA	kVA	51.48
Heat Rejected to Air	kW	2.24
Degauss Supply		
Nominal Load	ohms	57.83
DC Rated Output (Adjustable Volts)		0 - 240
DC Rated Output (Adjustable Amps)		0 - 4.15
DC Rated Output	kVA max	0.996
Supply Input Power	kW max	1.056
Supply Input kVA	kVA max	1.108
Heat Rejected to Air	kW max	0.06

Table 6 Specification of Amplifier

Amplifier	**DPA70K, 140K, 210K, 280K**
Classification	Class D switching amplifier, air cooled
Power range	40 to 280 kVA in 8 kVA increments
Input supply: 50/60 Hz 60 Hz	 380V, 400V, 415V, 440V line to line 380V, 400V, 415V, 440V, 480V, 500V, V520 line to line
Input Sensitivity (400 Hz) (400 Hz, Master Gain fully CW)	1.1 V +/-0.1 V rms input for 100 V rms output at rated sinusoidal Volt Amp output
Nominal Sine Output Voltage at rated power output	100 V rms
Differential Input Signal (10 Hz - 5 kHz)	+/-10 V rms (before limiting)
Common Mode Input Signal	+/-7 V rms (still allowing 100 V rms output without limiting if driven differentially)
Common Mode Rejection (DC - 5 kHz)	100 dB
Maximum No Load Voltage	110 V rms
Voltage Regulation 0 - 100 % rated power into rated resistive load	<45 % (measured at 400 Hz)
Input Impedance	10 KΩ nominal
Signal to Noise Ratio relative to 100 V rms output, 10K input termination. Rated resistive load connected. (100 kHz BW)	< 65 dB

V984 Shaker layout

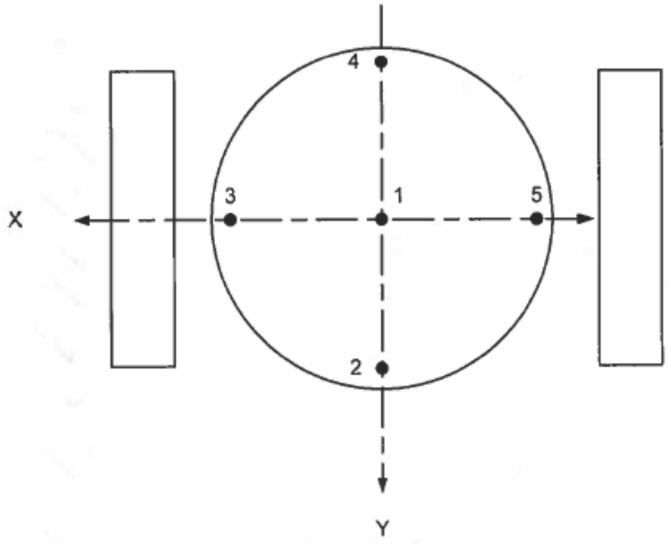


Figure 1: Shaker Accelerometer Positions

Single axis accelerometers at position 4Z and 5Z. Three axis accelerometer at positions 1, 2 and 3.

Position 1 - Centre of table

Positions 2 & 4 are at 90° and 3 & 5 are parallel to the Trunnion Axis.

Note: Z is the vertical axis.

X and Y are the lateral axes as shown in Figure 1 above.

Accelerometers are oriented towards +X/+Y/+Z for three axis accelerometers.

Accelerometer 1Z is oriented towards +Z.

Figure 4 Sensor location for acceptance test

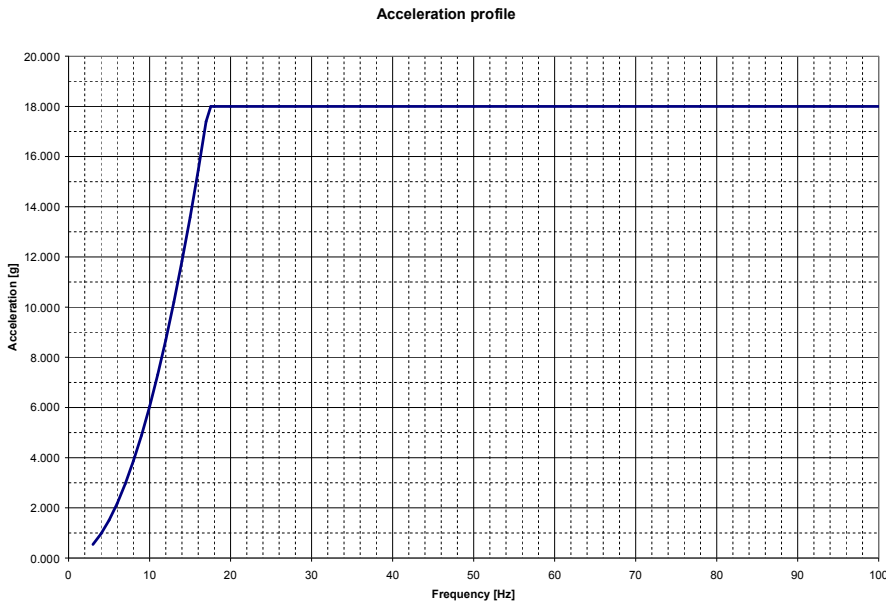


Figure 5 Acceleration profile for shaker

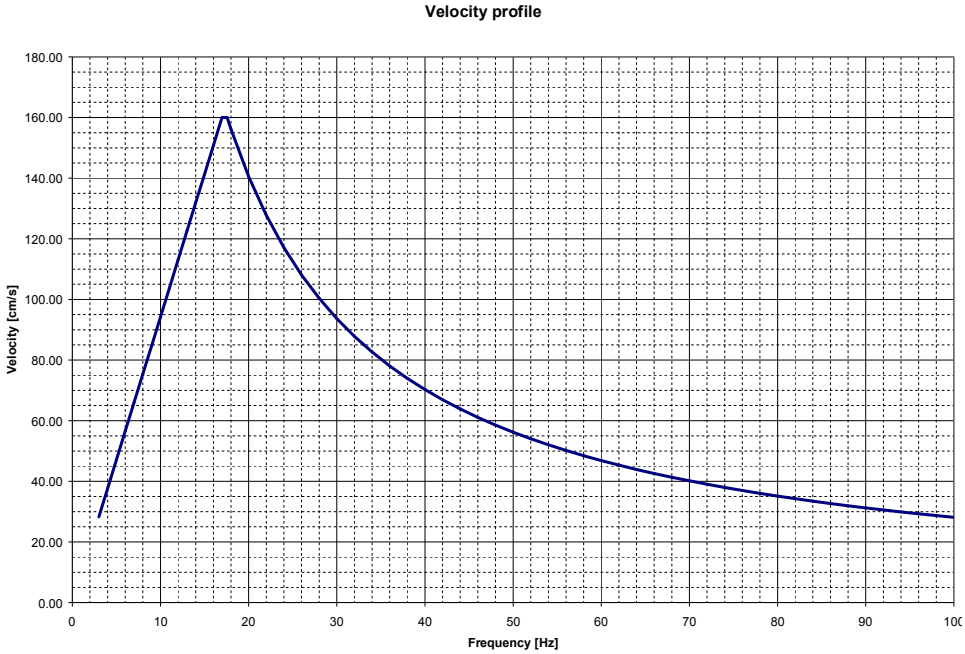


Figure 6 Velocity profile for shaker

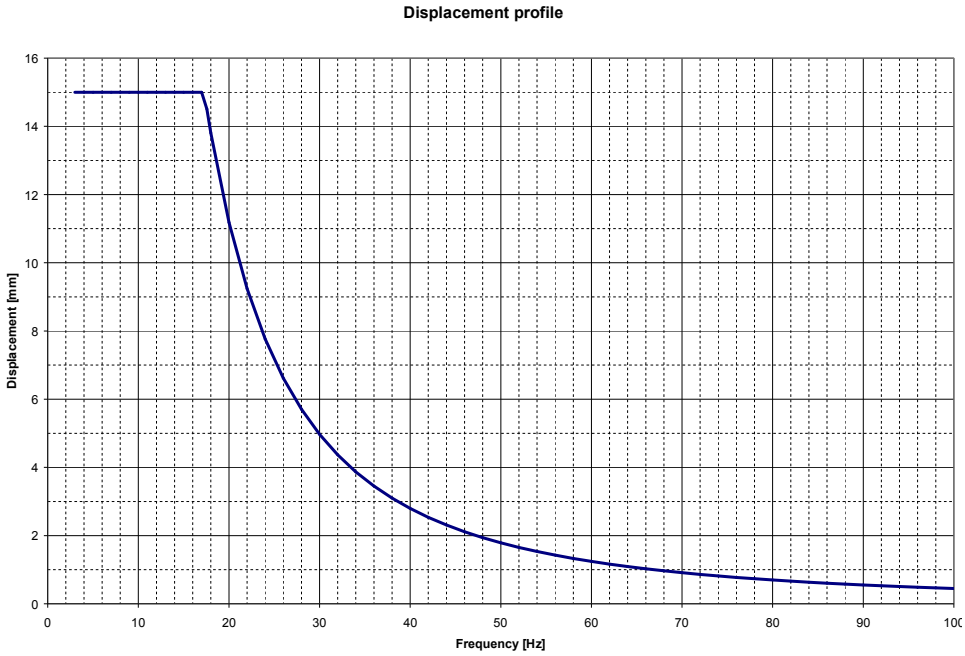


Figure 7 Displacement profile for shaker

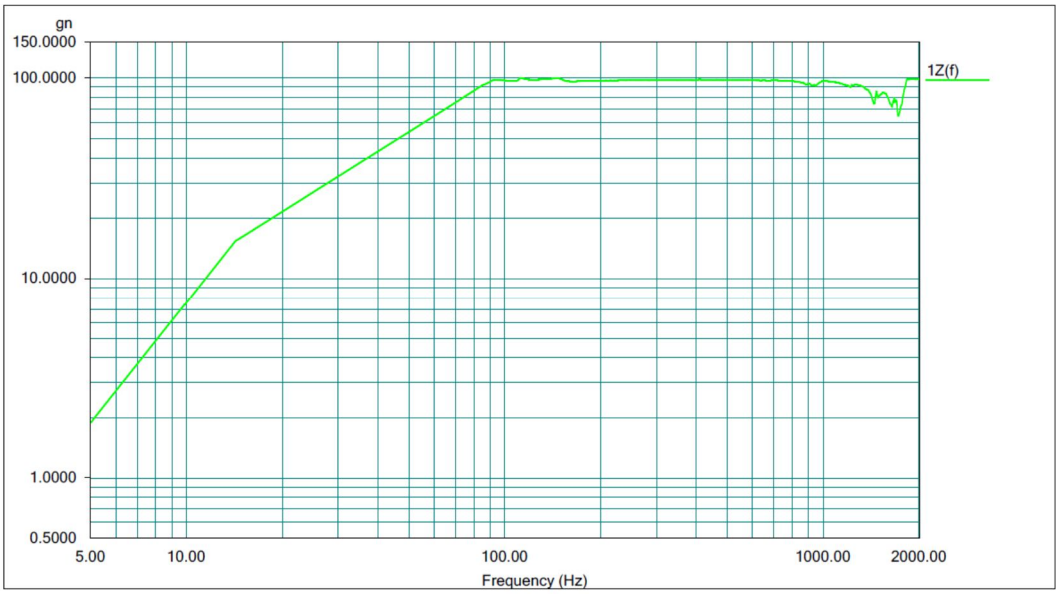
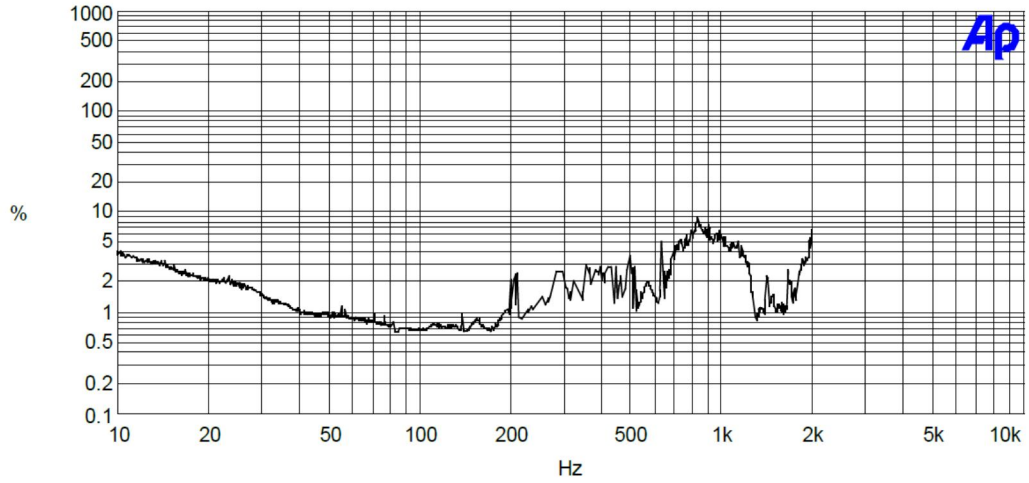


Figure 8 Bare Table Capability Test



Output voltage	Output power	Frequency					
		20 Hz	40 Hz	400 Hz	1 kHz	2 kHz	3 kHz
100 V	100%	0.5%	0.5%	0.5%	0.5%	0.8%	0.8%
50 V	25%	0.6%	0.6%	0.6%	0.6%	0.8%	0.8%
10 V	1%	2%	2%	2%	2%	2%	2%

Figure 9 Harmonic distortion of shaker system

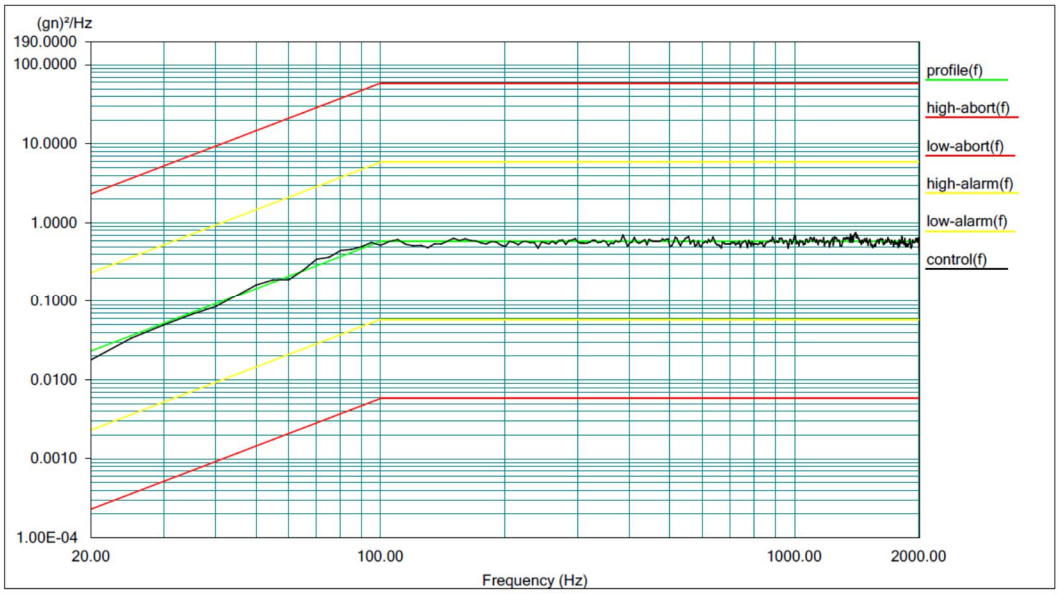


Figure 10 Loaded random vibration test

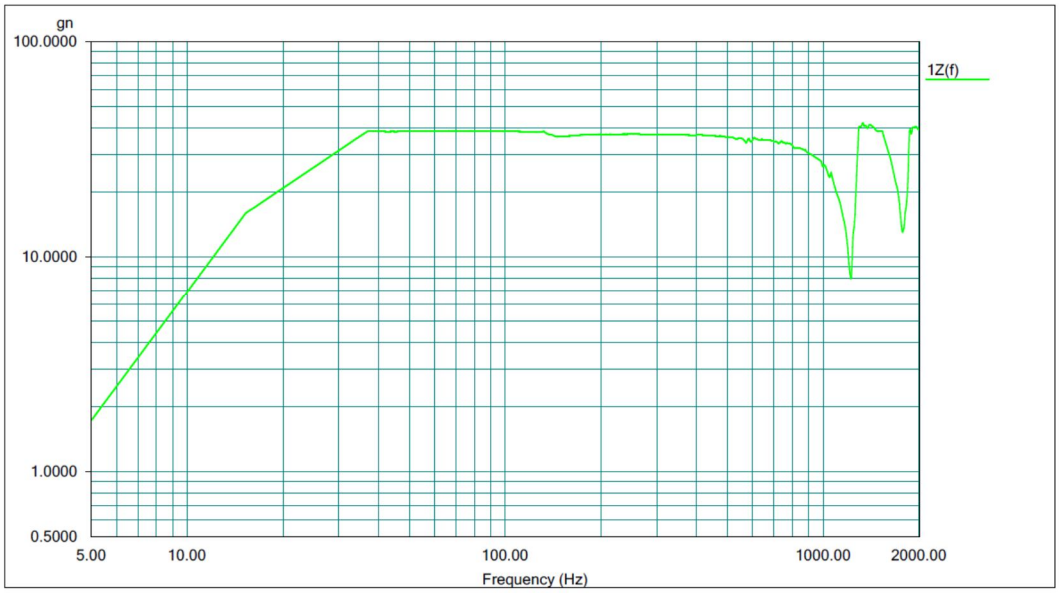


Figure 11 Loaded sine vibration test