

***Requirement Specification for the***

***VIBRATION MACHINE***

***Document No.: C33404000968-RS***

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## 1. Objective

The vibration machine is required for conducting Environmental Stress Screening (ESS) on units manufactured at EW&A. The machine shall meet the specifications of JSS55555 and MIL STD 810G.

## 2. Requirement specification of vibration machine:

SPECIFICATIONS OF VIBRATION MACHINE		
SI No	Requirement	Specifications
<b>(a) Electro-dynamic Vibration Shaker</b>		
1	Sine force	3500Kgf (35KN) Min
2	Random force	3500Kgf (35KN) Min
3	Maximum Sine acceleration (Bare table)	80g
4	Maximum Random acceleration (Bare table)	56g (rms)
5	Half sine, Saw tooth and Trapezoidal shock (Bare table)	160g (peak) with 3ms Pulse width:0.5msec to 18msec
6	Maximum displacement (Bare table)	51mm
7	Maximum velocity (Bare table)	1.8m/s
8	Frequency range	5Hz to 2500Hz
9	Armature Diameter	650mm (Min)
10	Armature Axial Resonance frequency (Bare table)	2100Hz (±5%)
11	Load capacity	400Kg (Min)
12	Shaker mounting	Air isolated trunnion mounted with geared rotation handle for 90deg tilting of the table to assemble with slip table.
13	Armature auto centering	Suitable auto centering system shall be used for keeping the armature in center.
14	Shaker cooling system	Air cooled
15	Air Hose length	15meters (min)

16	Armature hole pattern	The hole pattern requirement diagram is attached at Annexure-I
17	Cooling blower	External cooling blower for shaker, including flexible air duct having length min 25ft
18	Shaker body isolation	Air spring suspension
<b>(b) Power Amplifier</b>		
19	Digital Switching Power Amplifier	Suitable state of the art power amplifier to ensure the operation of the shaker to its full capacity as per specification. Power amplifier shall be touch panel based.
20	Power amplifier frequency response	DC to 3000Hz
21	Power amplifier efficiency	>90%
22	Power amplifier to shaker distance	20meters (Approx.)
23	Soft start/shutdown	Soft start/shutdown mechanism is required for power amplifier. In addition, Amplifier should have synchronized protection facility to have a smooth shut down in the event of power failure.
24	Signal to Noise Ratio	>70 dB
25	Safety interlocks requirements	The power amplifier & shaker system must be protected from the following with suitable interlocks.  Over/Under Voltage, Output Over Voltage, Output Over Current, Armature Over Travel, Shaker Over Temperature, Module DC Supply Over/Under Voltage, Module Failure/Fault, Field Supply Failure/Fault, Relay Overload
26	Power rating of the power amplifier	10KVA (Min)
27	Power requirement	415VAC $\pm$ 10%, 50Hz, 3 Phase
<b>(c) Slip table</b>		
28	Type	Shaker and slip table shall be mounted on a standalone single structure, providing permanent alignment of shaker with slip table.
29	Slip table useful mounting area	1000mm X 1000mm (min)
30	Slip table hole pattern	The hole pattern requirement diagram is attached at Annexure-I
31	Driver Bar	Driver bar made of Magnesium shall be provided between shaker and slip table.
32	Thickness of slip table	35 to 40mm (Approx) with flatness <2 $\mu$ m

33	Combined resonance frequency	$\leq 900\text{Hz}$
34	Slip table material	Magnesium alloy
35	Driver bar material	Magnesium alloy
36	Load capacity of slip table	500Kg (Min)
<b>(d) Head Expander</b>		
37	Type	Suitable Head Expander compatible with shaker that can accommodate large, heavy test specimens with high center of gravity, It shall be designed with light metal Magnesium Alloy, with required number of bearings to provide guidance for tall or offset loads.
38	Head expander useful mounting area	800mm X 800mm (Min)
39	Head expander hole pattern	The hole pattern requirement diagram is attached at Annexure-I
40	Head expander material	Magnesium Alloy with flatness $<2\ \mu\text{m}$
41	Frequency range	2000Hz
<b>(e) Vibration Controller</b>		
42	Type	(i) The vibration controller shall be entirely compatible with the proposed shaker and work with high efficiency and without any latency.
		(ii) It shall be based on the latest high speed DSP technology and Ethernet capability.
		(iii) The controller shall be PC based that is with latest configuration including DVD Writer, minimum 18" flat monitor, wired mouse & keyboard, latest Windows operation system and Microsoft Windows Office suite
		(iv) Compatible printer shall be provided.
		(v) UPS also shall be provided for the uninterrupted operation of controller
43	No. of channels	6 (Min). (6-Channel Controller Hardware and Software with user defined combination of controlling & monitoring channels).
44	Re-Calibration Software	Re- Calibration software package shall be provided
<b>(f) Software controls</b>		
45	Vibration control software shall be able to perform	(i) Sine Control (ii) Random Control (iii) Shock Control (iv) Sine on Random (v) Random on Random

		(vi) Resonance Search, Track & Dwell (vii) Re-Calibration Software (ix) Auto save PSD Vs Frequency graph with detailed information like time, status, G ref, Control (GRMS), Drv Limit, DOF, Control channels, Monitoring Channels
<b>(g) Accelerometers</b>		
46	Piezo-Electric Accelerometers qty required	6nos. (min)
47	Frequency range of accelerometer	3 Hz – 6 KHz; 20 m low noise connecting cable
48	Accelerometers Calibrations	Accelerometers shall be supplied along Calibration Certificates issued by NABL accreditation Lab.
<b>(h) General requirements</b>		
49	The Vibration Machine shall be able to perform tests inline with specifications of JSS55555 and MIL Std 810G.	
50	Supplier shall provide one set of operation and service/maintenance manuals in English (both hardcopy & softcopy)	
51	Supplier shall provide certificate of calibration for the vibration machine. The calibration certificate shall be traceable to NABL labs.	
52	Supplier shall provide a <b>warranty of 24months</b> for the vibration system from the date of installation & commissioning.	
53	Any kind of minor breakdown need to be rectified by supplier within 24hours from the date of intimation during the warranty period (24 months from the date of installation & commissioning)	
54	Any kind of major breakdown need to be rectified by supplier within 1week from the date of intimation during the warranty period (24 months from the date of installation & commissioning). If the time taken by the supplier for the rectification of breakdown is beyond 1week, extra days taken for rectification shall get added in to warranty period.	
55	Supplier is also responsible for calibrating the machine and providing the certificate during the warranty period.	
56	The supplier shall provide certificate of conformance for the vibration system.	
57	Supplier shall ensure the installation, commissioning & handing over the system to the end user (BEL).	
58	The supplier shall demonstrate the functionality of machine at BEL using sample test profiles provided by BEL.	
59	The supplier shall calibrate the vibration system and provide the certificate after installation & commissioning of the machine at BEL.	
60	Supplier should have supplied installed & commissioned similar systems with same or more capacity machine minimum 1no. in India. The supporting documents for the same shall be provided.	
61	Technical specification of supplied machine [as per point no 58)] shall be provided along with technical compliance.	

62	The supplier shall provide product support (for both hardware & software) for a minimum period of 15 years (beyond warranty period) from the date of acceptance at BEL-Bangalore.
63	The supplier as a part of this contract shall ensure completeness of the total system for installation and operation as per the above specifications for both hardware and software. The supplier shall ensure that all the necessary items for this total turnkey project are supplied, installed & commissioned as per the requirement.
64	Supplier shall provide their compliance against each point and sub points mentioned in this document (Requirement specification for vibration machine). Supporting documents shall be provided by the supplier, wherever applicable.
65	Pre-delivery inspection shall be conducted by BEL reps. at supplier premises for verifying the functional performance, documentation & tested profiles of the machine.
66	The supplier shall provide training (limited to one week) for BEL Engineers/Supervisors for operation, maintenance and troubleshooting of machine at BEL.
67	The supplier shall provide list of critical spares with cost & OEM for maintenance of the system after warranty period. However, the cost of spares is not part of actual cost of machine.
68	The supplier shall be responsible for the design/selection of all supporting equipment, components and material required for vibration machine realization.
69	The supplier shall be responsible for any defects arising from faulty design, material or workmanship, which may develop within the warranty period (24 months from the date of installation& commissioning). The supplier shall repair/or replace such defective parts.
70	Any kind of Civil and Structural Works such as electricity requirements, foundation works, making opening/closing in the wall/slab, Concreting and water proofing the platform (if required) for vibration machine at the time of installation at BEL will be under BEL scope.
71	The supplier shall provide the top level requirements (if any) needed from BEL well in advance.
72	The supplier shall provide all necessary tools for maintenance of the vibration machine

### 3. Hole pattern requirement for Slip table, Armature (inside the red marking) & Head expander (inside the red marking)

Insert pattern:

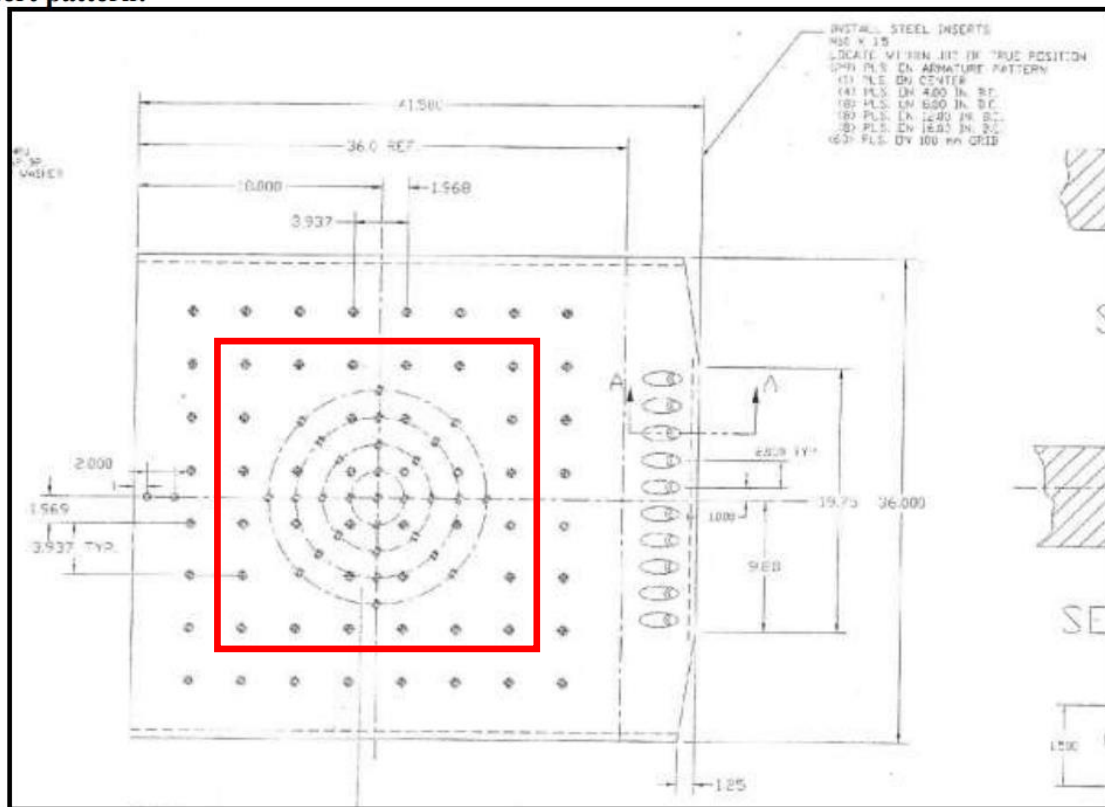


Figure: 1

### 4. Acceptance

- Final acceptance will be provided based on successful installation, commissioning & demonstration of functionality of the vibration machine at BEL as per specification.