P99.13

Vibreur V200

Product Sheet 203

Vibration Generator

100 and 200 Series

Model 101/102: 8.9N, 0.91 kgf (2 lbf)
Model 201/203: 17.8N, 1.81 kgf (4 lbf)

The 100 & 200 Series electro-dynamic vibration generators have been designed to reproduce a vibration environment under laboratory conditions. Although extensively used in industry the vibration generators are ideally suited for use in universities and research establishments to investigate the dynamic behaviour of structures and materials. Other applications include fatigue and resonance testing, used as velocity transducers or high speed actuators and various medical/veterinary purposes.

1. Standard base mounted 100 Series vibration generator.
2. Standard base mounted 200 Series vibration generator.
3. Auxiliary Suspension, AUX200 – provides additional stiffness to the standard vibration generator suspension, which increases payload capacity, or permits the vibration generator to be vertically suspended from the test structure.
4. 200 Series, mounted in a cast support trunnion, Model T200.

Both vibration generators incorporate a lightweight moving armature which have been optimised to provide the smallest mass with a wide frequency range. Laminated flexures are bonded to the armature to provide axial support for the armature and test load as well as providing lateral and rotational restraint.

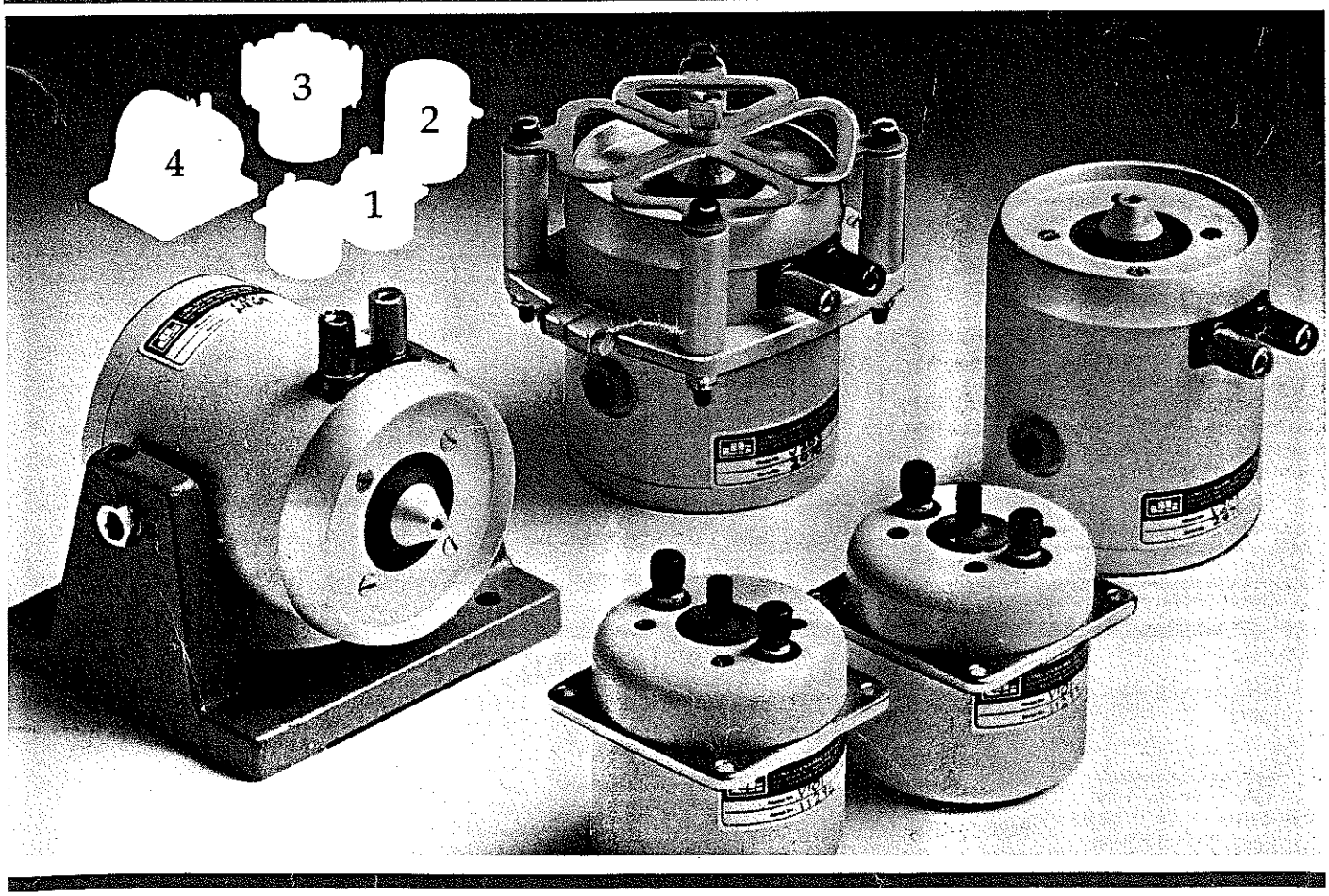
The 100 Series vibration generator is convection cooled and is available with a choice of coil impedance to match different types of power amplifier. With the LDS power amplifier PA25E, the model 101 achieves 8.9 Newtons (2 lbf) peak sine thrust and the model 201, 17.8 Newtons (4 lbf) peak sine thrust.

MODEL DESIGNATION

Vibration Generator Model	Power Amplifier	Vibration Coil Impedance (nominal)	Specimen Attachment Thread
101	PA25E	3.0 ohm @ 500 Hz	M4
102*	PA25E	3.0 ohm @ 500 Hz	6-32 UNC
106	#	28 ohm @ 500 Hz	M4
108	#	28 ohm @ 500 Hz	6-32 UNC
110	#	300 ohm @ 500 Hz	M4
111	#	300 ohm @ 500 Hz	6-32 UNC
201	PA25E	2.8 ohm @ 500 Hz	M4
203*	PA25E	2.8 ohm @ 500 Hz	8-32 UNC

* American Stock items

Alternative impedance coils for use with existing amplifiers.



Technical Specification

VIBRATION GENERATOR, Models: 101/102*, 106/108, 110/111, 201/203*

Prepared in accordance with ISO 5344 (BS 6140) 210

*American stock items.

OPERATIONAL CHARACTERISTICS	101/102*	106/108	110/111	201/203*
Rated Peak Sinusoidal Force:	8.9 N 0.91 kgf (2 lbf)	3.11 N 0.32 kgf (0.7 lbf)	6.67 N 0.68 kgf (1.5 lbf)	17.8 N 1.81 kgf (4.0 lbf)
Maximum Sinusoidal Force, Forced Air Cooled:	–	–	–	26.7 N 2.72 kgf (6.0 lbf)
Usable Frequency Range:	dc to 12 kHz	dc to 12 kHz	dc to 12 kHz	dc to 13 kHz
Fundamental Armature Resonance:	12 kHz	12 kHz	12 kHz	13 kHz
Rated Travel (Displacement):	± 1.25 mm (± 0.05 in)	± 1.25 mm (± 0.05 in)	± 1.25 mm (± 0.05 in)	± 2.5 mm (± 0.1 in) #
Rated Peak Sinusoidal Velocity:	1.31 m/s (51.57 in/s)	1.31 m/s (51.57 in/s)	1.31 m/s (51.57 in/s)	1.83 m/s (72 in/s)
Maximum Acceleration: Natural Cooled:	1373 m/s^2 (140 g_n)	520 m/s^2 (53 g_n)	579 m/s^2 (59 g_n)	892 m/s^2 (91 g_n)
Forced Air Cooled:	–	–	–	1334 m/s^2 (136 g_n)

Maximum rated travel, displacement, excluding auxiliary suspension.

MOVING ELEMENT (Armature) DATA	101/102*	106/108	110/111	201/203*
Rated Current, Natural Cooled:	1.5 A rms	0.3 A rms	0.1 A rms	2.5 A rms
Maximum Current, Forced Air Cooled:	–	–	–	4.5 A rms
Nominal dc Resistance at 20°C:	2.5 ohm	25 ohm	300 ohm	1.5 ohm
Nominal Impedance at 500Hz:	3.0 ohm	28 ohm	300 ohm	2.8 ohm
Effective Moving Mass:	6.5 grams (0.23 oz)	6.0 grams (0.211 oz)	11.5 grams (0.406 oz)	20.0 grams (0.706 oz)
Load Attachment Spigot:	M4 (6-32 UNC)	M4 (6-32 UNC)	M4 (6-32 UNC)	M4 (8-32 UNC)
Suspension Stiffness, Axial:	3.15 N/mm (18 lbf/in)	3.15 N/mm (18 lbf/in)	3.15 N/mm (18 lbf/in)	3.5 N/mm (20 lbf/in)
Suspension Guidance, Upper:	Laminated Spider	Laminated Spider	Laminated Spider	Laminated Spider
Lower:	Laminated Spider	Laminated Spider	Laminated Spider	Laminated Spider

DIMENSIONS AND WEIGHT	101/102*	106/108	110/111	201/203*
Vibration Generator:	0.908 kg (2 lb)	0.908 kg (2 lb)	1.25 kg (2.75 lb)	1.81 kg (4.0 lb)
Trunnion:	–	–	–	1.36 kg (3.0 lb)

PAYLOAD SUPPORT CAPABILITY

The maximum allowable payload, mass, which can be self supported by the machines suspension is as follows:

VERTICAL OPERATION relates to displacement required at lowest operating frequency

$$L = \frac{(S-D)K}{0.01962}$$

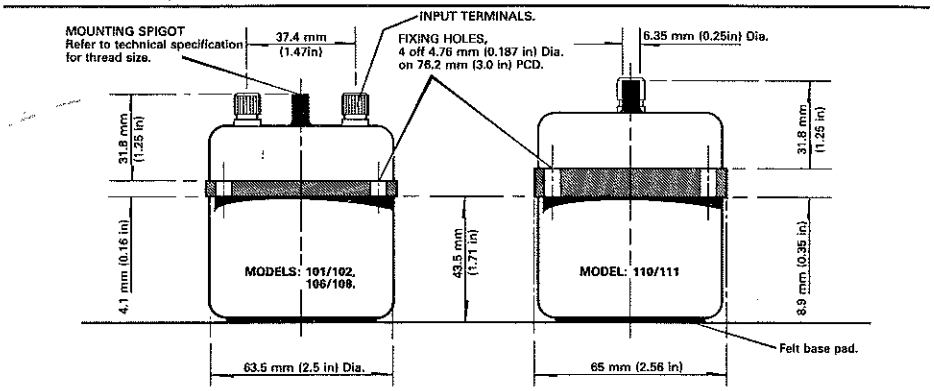
Where S = Rated Travel, pk to pk (mm)
K = Armature suspension stiffness, N/mm

100 Series 3.15 N/mm
200 Series 3.5 N/mm
200 Series 12.26 N/mm with auxiliary suspension

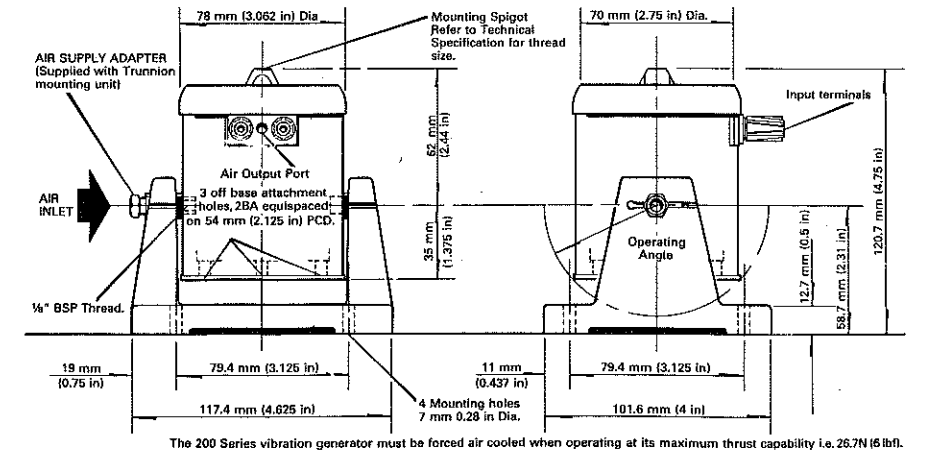
D = Maximum required displacement, (mm) then L = Load (grams) max.

If the required payload weight exceeds the value of L grams in the above formula, in respect of the desired displacement, additional means of payload support will be necessary, i.e. rubber shock cords such that the armature is returned to its original neutral position.

DIMENSIONS, 100 SERIES



DIMENSIONS, 200 SERIES



The 200 Series vibration generator must be forced air cooled when operating at its maximum thrust capability i.e. 26.7N (6 lbf).

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INSTALLATION AND OPERATING MANUAL

V200 SERIES VIBRATORS

Manual Number 892071

Edition 2
Amendment No. 10

SYSTEM MANUAL
LING DYNAMIC SYSTEMS

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AMENDMENT RECORD PAGE

V200 SERIES VIBRATORS

Manual Number: 892071

Edition 2 Published: January 1995

Serial Number of your equipment: _____

Date	*Amendment Number*	*Serial Nos Affected*	*Pages Affected*	*Brief Details*	*LDS ECO*
5.1.95	*6*	*ALL*	*ALL*	*Edition 2 introduced to include CE approval requirements*	*6680*
17.7.95	*7*	*ALL*	*Preface, Ch. 2.*	*Introduction of Appendix A (Auxiliary Suspension) and amplitude limitations clarified*	*6728*
20.7.95	*8*	*ALL*	*Preface*	*Declaration of Conformity corrected*	*6787*
1.4.95	*9*	*ALL*	*Preface*	*Declaration of Conformity updated to show EMC compliance*	*6890*
11.6.96	*10*	*ALL*	i, v, x	*To add warning notice re: the effect of Low Frequency Fields on humans*	*6949*

HEALTH AND SAFETY NOTICES - OPERATING (cont.)

Before operating any vibration system, check:

* **the vibration test area is clear of unnecessary obstructions.**
* **all terminal covers are correctly fitted.**
* **all equipment doors are correctly closed and secure.**
* **the supply of cooling medium (if applicable) is sufficient.**
* **the hydraulic oil supply (if applicable) is correctly topped-up.**
* **the 'item under test' is correctly secured to the vibrator or slip table.**
* **That all personnel are clear of the DANGER ZONE**

SAFETY WARNING

EFFECT OF LOW FREQUENCY FIELDS ON THE HUMAN BODY

Vibrators and associated power products produce DC and low frequency magnetic fields by virtue of their mode of operation. Current medical research is inconclusive as to the effect of low frequency electromagnetic fields on the human body. LDS is continuously monitoring the results of this research which presently cannot provide proof of either risk or zero risk.

It is our recommendation that all personnel, particularly those with medical implants, do not enter the 2 metre DANGER ZONE whilst the vibrator is running. LDS cannot accept responsibility for the results of electromagnetic field hazards present with vibration systems but strongly advise that all precautions, as defined in the product handbooks, are followed.

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(7)

CONTENTS (cont.)

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LIST OF FIGURES & TABLES

ASSOCIATED PUBLICATIONS:

PA25E Amplifier, Installation and Operating Manual — Manual No. 880491

CHAPTER 1 - SPECIFICATION

1. INTRODUCTION

The V200 Series electro-dynamic vibration generators are miniature units designed to reproduce a vibration environment under laboratory conditions. They are also suitable as non-seismic pick-ups and are widely used in educational and research establishments to investigate the dynamic behaviour of structures and materials. Other applications include fatigue and resonance testing, used as velocity transducers or high speed actuators and various medical purposes.

V200 series vibrators can be driven by any suitable oscillator/amplifier combination, but the Ling Dynamic Systems PA25E amplifier is specially recommended for this purpose. Being of the permanent magnet design, the V200 series vibrators do not require a field power supply. A typical system incorporating the V200-PA25E combination is shown in Figure 1.1.

The vibrator can be base or trunnion mounted and an auxiliary suspension is available, at extra cost, for use when the weight of the test package exceeds the table suspension rating (see Figure 4.2).

Cooling is not normally required, although provision is made for the easy connection of a forced air supply. This is only required when the input power is expected to exceed the specified figures.

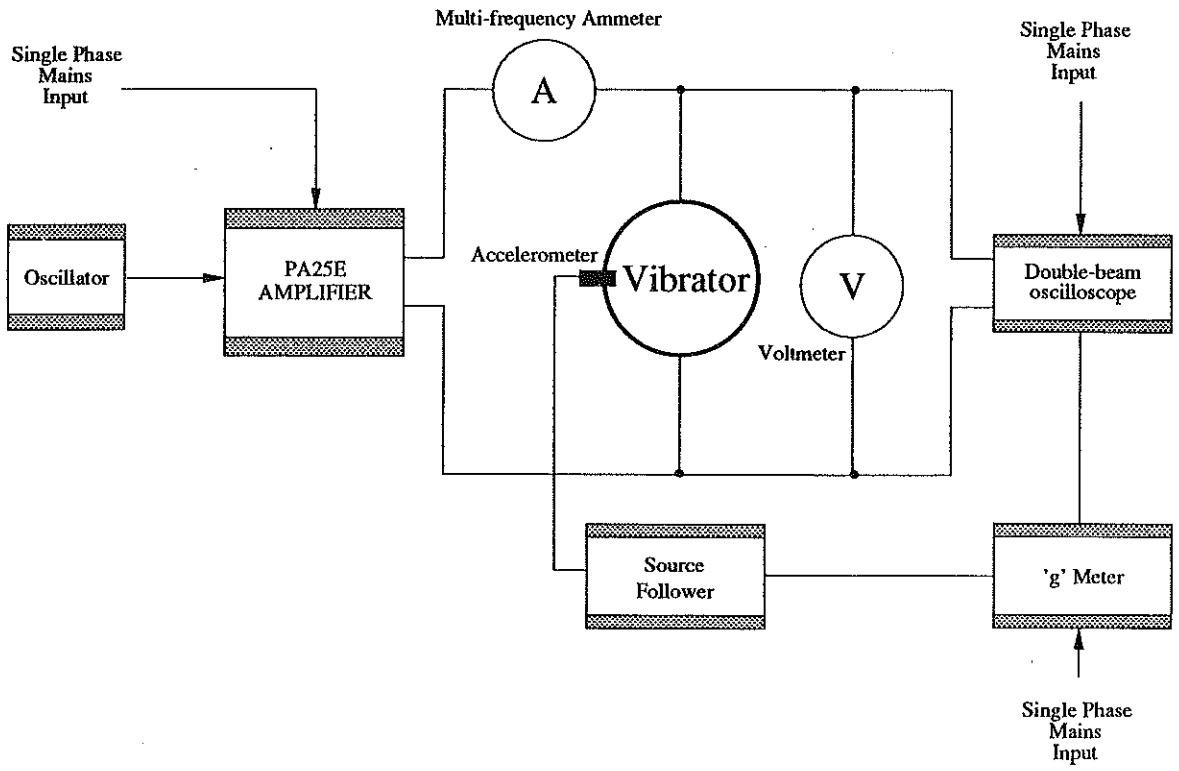
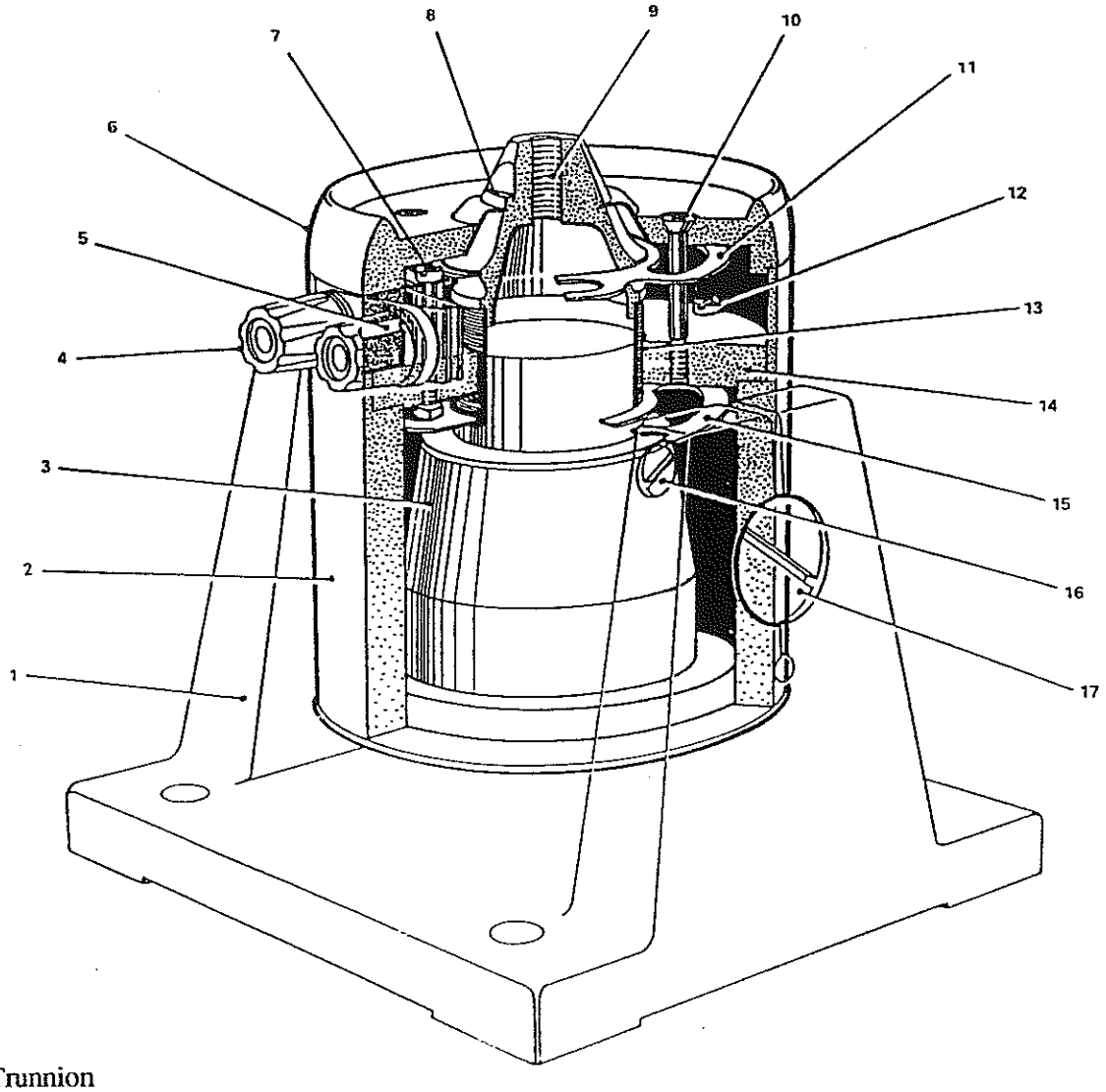


Figure 1.1 Typical System -V200 Series Vibrator with PA25E Amplifier

1. INTRODUCTION



1. Trunnion
2. Body
3. Centre Pole Magnet
4. Terminals
5. Air Vent
6. Top Access Cover
7. Top Suspension Spacer and Securing Screw (2 off)
8. Moving Coil and Suspension Assembly
9. Package Mounting Hole (V201 - M4 0.7SI; V203 - 10-32 UNF)
10. Top Cover Securing Screw (4 off)
11. Top Suspension Spider
12. Front Plate Securing Screw (3 off)
13. Moving Coil
14. Front Plate
15. Bottom Suspension Spider
16. Trunnion Clamp Bolt
17. Support Screw

Figure 1.2 Sectioned View - V200 Series Vibrator

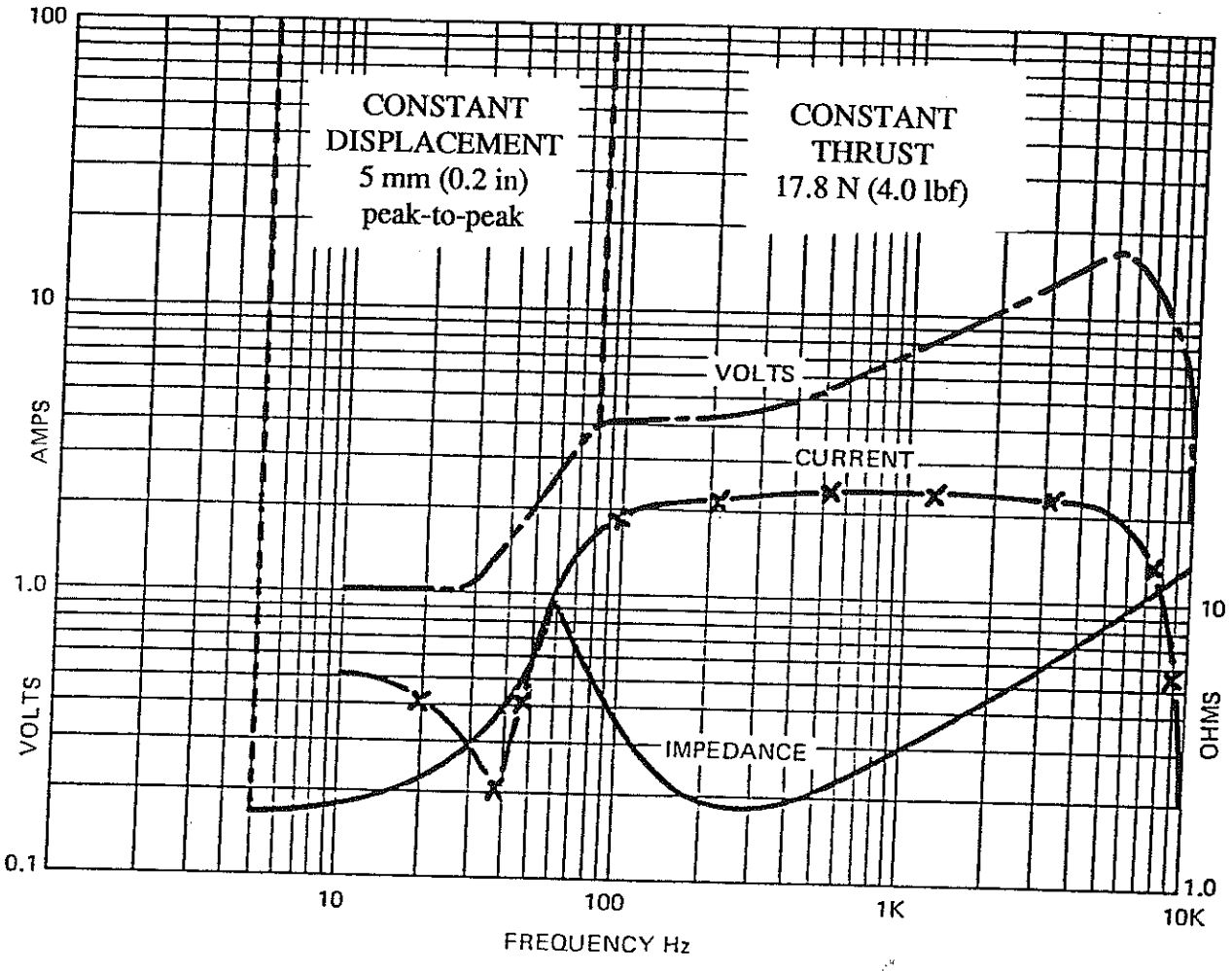
2. SPECIFICATION

2.1 Specification - V200 Series Vibrators

		Metric		American	
Model		**V201/203**		**V201/203**	
Sine force, peak	(Note 2)	17.8 N		4.0 lbf	
Maximum Sine force peak	(Note 3)	26.7 N		6.0 lbf	
Armature Resonance Frequency		13000 Hz		13000 Hz	
Useful Frequency Range		5 - 13000 Hz		5 - 13000 Hz	
Effective Mass of Moving Element		0.020 kg		0.044 lb	
Velocity Sine Peak	(Note 2)	1.49 m/s		58.7 in/s	
Maximum Velocity Sine Peak	(Note 3)	1.83 m/s		72.0 in/s	
Maximum Acceleration Sine Peak Maximum Acceleration Sine Peak	(Note 2) (Note 3)	890 m/s^2 1335 m/s^2		90.7 gn 136 gn	
Amplifier rating		0.048 kVA		0.048 kVA	
LDS Amplifier		PA25E		PA25E	
Suspension axial stiffness Stiffness with auxiliary suspension		3.5 n/mm 12.26 n/mm		20 lbf/in 70 lbf/in	
Displacement (continuous) pk-pk		5.0 mm		0.2 in	
Max. Displacement (cont.) pk-pk		5.0 mm		0.2 in	
Cooling Air Flow Rate		0.001 m^3/s		2.1 ft^3/min	
Max. working ambient temperature		30^0C		86^0F	
Heat rejected to air		48 W		48 W	
Electrical requirement - Amplifier		0.13 kVA		0.13 kVA	
Max. acoustic noise (Ref. Figure 1.4)		75 dBA		75 dBA	
Impedance at 500 Hz	(Fig. 1.3)	2.0 ohm		2.0 ohm	
Vibrator mass, (mounting)		(base) 1.81 kg	(trunnion) 3.17 kg	(base) 4.0 lb	(trunnion) 7.0 lb
Height width Length		96 mm 78 mm dia. - - -	128 mm 102 mm 117 mm	3.78 in 3.06 in - - -	5.06 in 4.00 in 4.63 in

Notes: 1. Details not applicable to this range of vibrator shown - n/a.
2. Performance available with LDS amplifier, naturally cooled.
3. Maximum performance with forced air cooling (with another amplifier)

2. SPECIFICATION (cont.)



Typical characteristics of the V200 series vibrator (natural cooling) with PA25E series amplifier.

Data plotted for a thrust of 17.8 N (4.0 lbf) vector, with displacement limit 5.0 mm (0.2 in) peak-to-peak

Figure 1.3 Typical Performance Curves

3. ENVIRONMENTAL DATA

3.1 Environmental Notes

3.1.1 Electrical supply input figures are worst case demands. Average power under swept sine or random test conditions will be lower.

3.1.2 Amplifier supply voltages over the range are catered for by means of taps on the supply transformer. Other voltages can be catered for by special order.

3.1.3 The determination of noise levels is a varied and complex procedure. Figure 1.4 shows the conditions under which the values stated on the specification sheet were obtained.

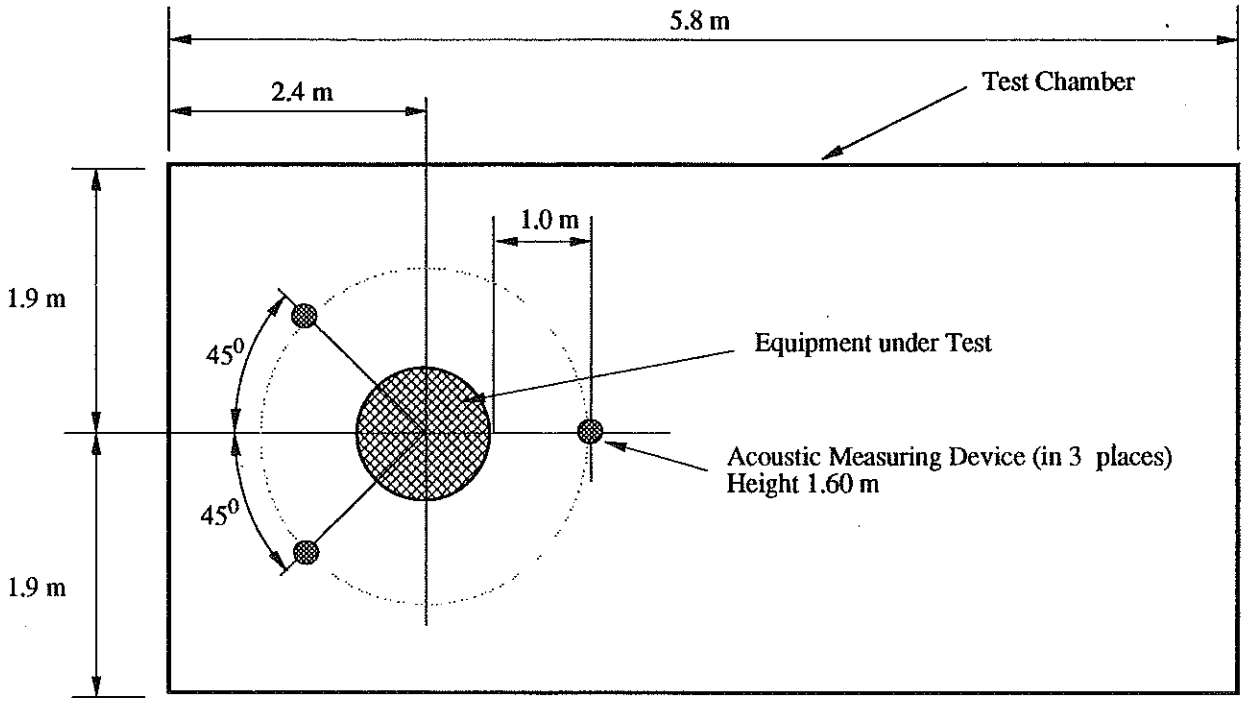


Figure 1.4 Noise Level Measurement Chamber

CHAPTER 2 DESCRIPTION

2.1 Construction

The main components of the vibrator comprising the yoke, magnet and pole tip, moving coil assembly and top cover are assembled as shown in Figure 1.2. The magnet and pole tip are assembled within the yoke casting so that an annular gap exists between the pole tip and the central bore in the front plate. The magnet and pole tip are retained within the yoke casting by means of adhesive. Four counter-sunk head screws, passing through a packing piece into the base of the yoke, retain the front plate.

The moving coil assembly is accurately located in the annular gap between the pole tip and the front plate bore by screws and distance pieces, passing through the front plate and the upper and lower flexible suspensions of the coil. The driving spindle is attached to the upper part of the coil and protrudes through a flexible dust cover in the top plate. The top cover, secured to the front plate by four socket head screws, carries two screw-down terminals for connection of the a.c. supply to the moving coil.

The magnetic circuit is formed by a slug magnet, the steel yoke and the front plate.

2.2 Principle of Operation

The vibrator functions by the interaction between a steady magnetic field, produced by a permanent magnet, concentrated in the annular gap formed between the pole tip and the cenral bore in the front plate, and an oscillating current flowing in the moving coil. In such circumstances, a force is generated at right angle to the lines of flux and to the conductor carrying the current. This force is proportional to the product of the instantaneous current and the magnetic flux density.

The drive is derived from the amplified output from a suitable oscillator. For the V200 series vibrators the Ling Dynamic Systems PA25E amplifier is recommended, but any suitable oscillator/amplifier combination can be employed.

The frequency of the movement at the moving coil is the same as the frequency of the oscillator signal, while the amplitude is proportional to the signal. Therefore, a test load mounted on the moving coil driving spindle can be vibrated at any fixed frequency pre-set on the oscillator or swept through a range of frequencies under manual or automatic control.

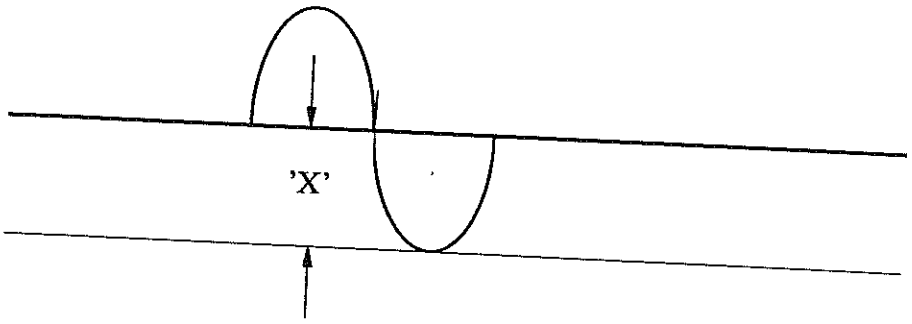
In addition to the electrical characteristics of the equipment, mechanical limitations must also be considered when assessing the performance of the vibrator. The construction of the moving assembly is such as to give the maximum possible strength compatible with the lowest possible weight. This is most important to the efficiency of the vibrator since the total weight to be vibrated necessarily means the weight of the moving system plus the weight of the test load. The greater the weight therefore, of the moving system, the less force is available to the test load.

2. DESCRIPTION

It will also be realised that, at the lower frequencies, amplitude limitations will restrict the theoretically available acceleration. This is governed by the standard formula:

$$\text{Acceleration} = 4\pi^2 \text{ frequency}^2 \text{ x amplitude} \quad (m/s^2) \qquad (7)$$

Note: In this connotation, amplitude means half the total stroke, i.e. 'X' = amplitude, m.



Performance data on the V200 series vibrator can be seen on the curves in Figure 1.3

CHAPTER 3 OPERATION

3.1 General

The V200 series vibrators, when part of a vibration test system, can handle relatively large amounts of power. Incorrect application of power can have a devastating effect on the vibrator and load-under-test.

The Ling Dynamic Systems model PA25E amplifier with suitable oscillator is recommended as a source for the V201 and V203 vibrators.

THIS EQUIPMENT SHOULD ONLY BE OPERATED BY PERSONS WHO ARE TRAINED IN THE TECHNIQUES OF VIBRATION TESTING.

The operating procedure for a vibrator is relatively simple but it is necessary to take elementary precautions to avoid overloading the vibrator, electrically and mechanically, and damaging the vibrator or the driving equipment or both.

For vertical operation the mass of the test load and subsequent deflection of the suspension system must be considered when calculating the available displacement. If necessary an auxiliary suspension system can be supplied which will increase the load carrying capacity as shown below. Alternatively, a low stiffnes spring, such as rubber shock cords, can be used to support the load at the mean working height.

$$\text{Maximum travel available peak-to-peak} = d = s - \left[\frac{2w}{k} \right]$$

Where:	d = Maximum travel available, peak-to-peak	=	..... mm
	s = Maximum travel permitted, peak-to-peak	=	5.0 mm
	k = Suspension stiffness, basic vibrator	=	3.5 N/mm
or	k = Stiffness, with auxiliary suspension	=	12.3 N/mm
	w = Load on armature (mass x 9.81)	=	..... N

The maximum permitted current is given in Figure 1.3, while the maximum output to be obtained from the driving equipment in use depends on impedance matching and power factor of the load. In general, bad matching will be indicated by inefficient operation of the equipment.

Should it be necessary to force air cool the vibrator, the following paragraphs describe a practical method of controlling the air flow in order to prevent overheating of the moving coil.

3. OPERATION (cont.)

If a high pressure factory line is to be used, the pressure should first be reduced to approximately 0.3 bar (4 p.s.i.) by means of a pressure regulator. The flow through the vibrator body should then be controlled with a needle valve and reduced to a level which does not lift the armature or cause leaks around the rubber diaphragm seal.

3.2 Operation

To operate the vibrator proceed as follows:

1. Connect the load to the vibrator by means of a suitable screw, ensuring that the maximum load attachment thread is fully utilised and that the moving system is not displaced from the mean position. Do not over-tighten the attachment screw, and always hold the drive spindle in position by means of the spanner supplied which fits over the two flats on the drive spindle header to prevent damage to the internal suspension. Similar care should be taken if a thread adaptor is fitted.

2. Check that the oscillator amplitude control is at the zero position, then switch ON the oscillator and amplifier.

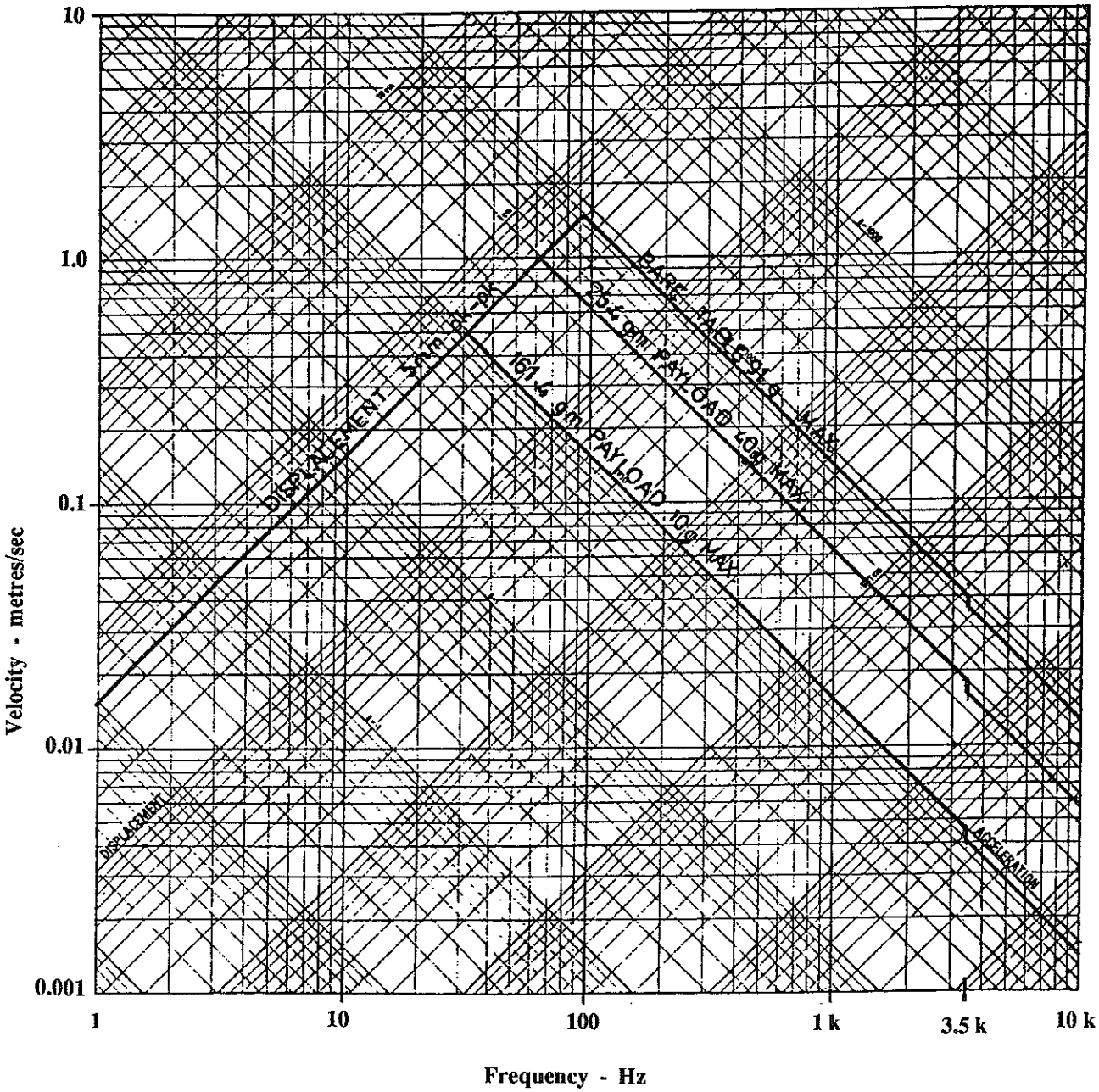
3. Select frequency and amplitude on the oscillator controls and check that the driving spindle commences to vibrate.

4. Carry out the test programme.

Note: If the frequency is varied, the output current and the matching condition will be liable to vary due to the variation of vibrator impedance and power factor with frequency. This is of particular importance when working in swept frequency conditions.

4. SYSTEM PERFORMANCE DATA SHEET

Vector thrust: 17.8 N (4.0 lbf)
Vibrator type: V201
Amplifier: PA25E kVA:
Transformer tapping: Direct coupled
Effective armature mass: 20 gm (0.044 lb)
Random rating: -------

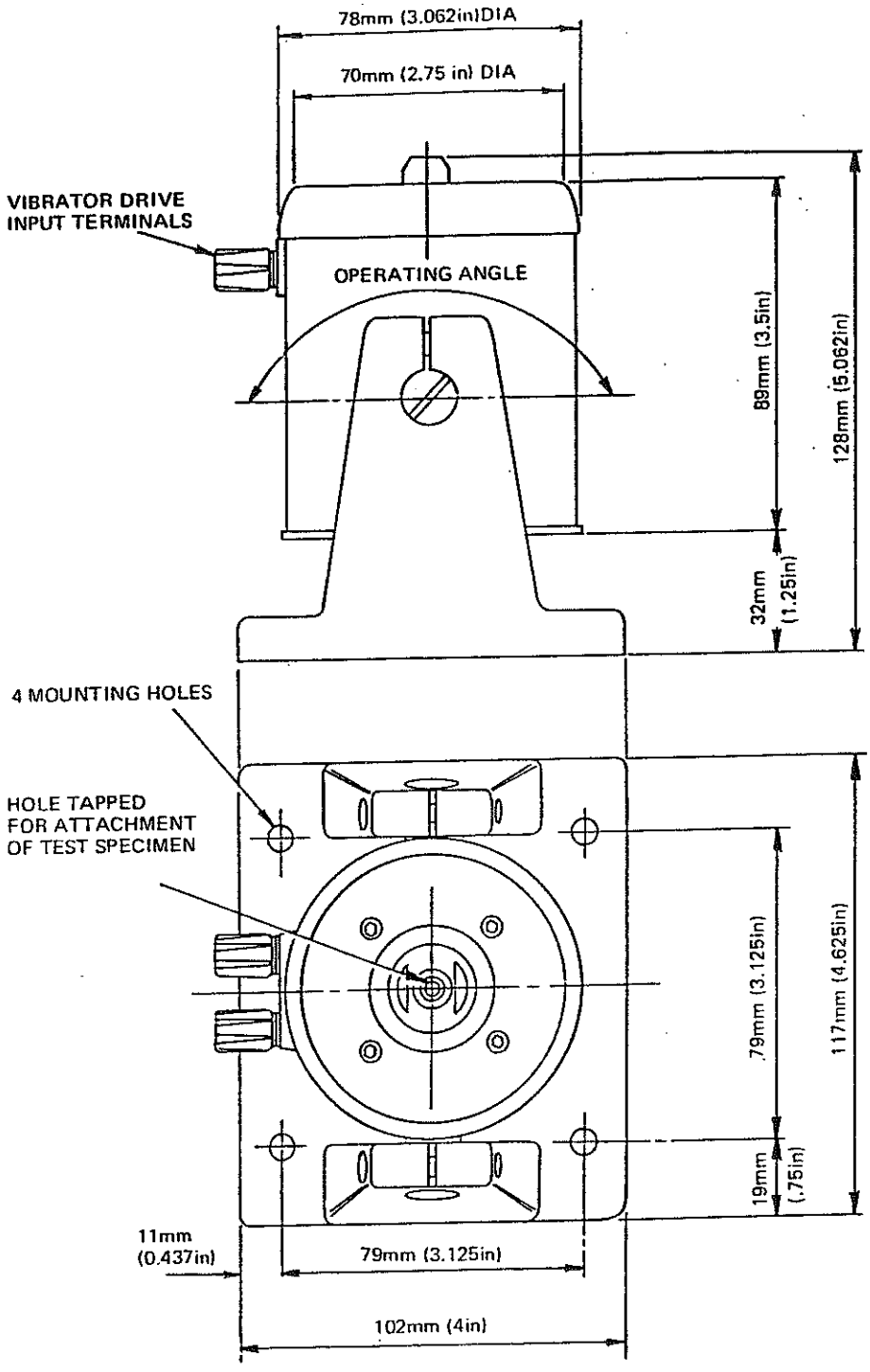


Example:

Given frequency	=	20 hHz
and, Displacement	=	25 mm P-P
then, Acceleration	=	20 g (vector)
and, Velocity	=	1.6 m/sec (vector)

1 lb = 0.454 kg 1 g = 9.81 m/sec^2 1 lbf = 4.448 N

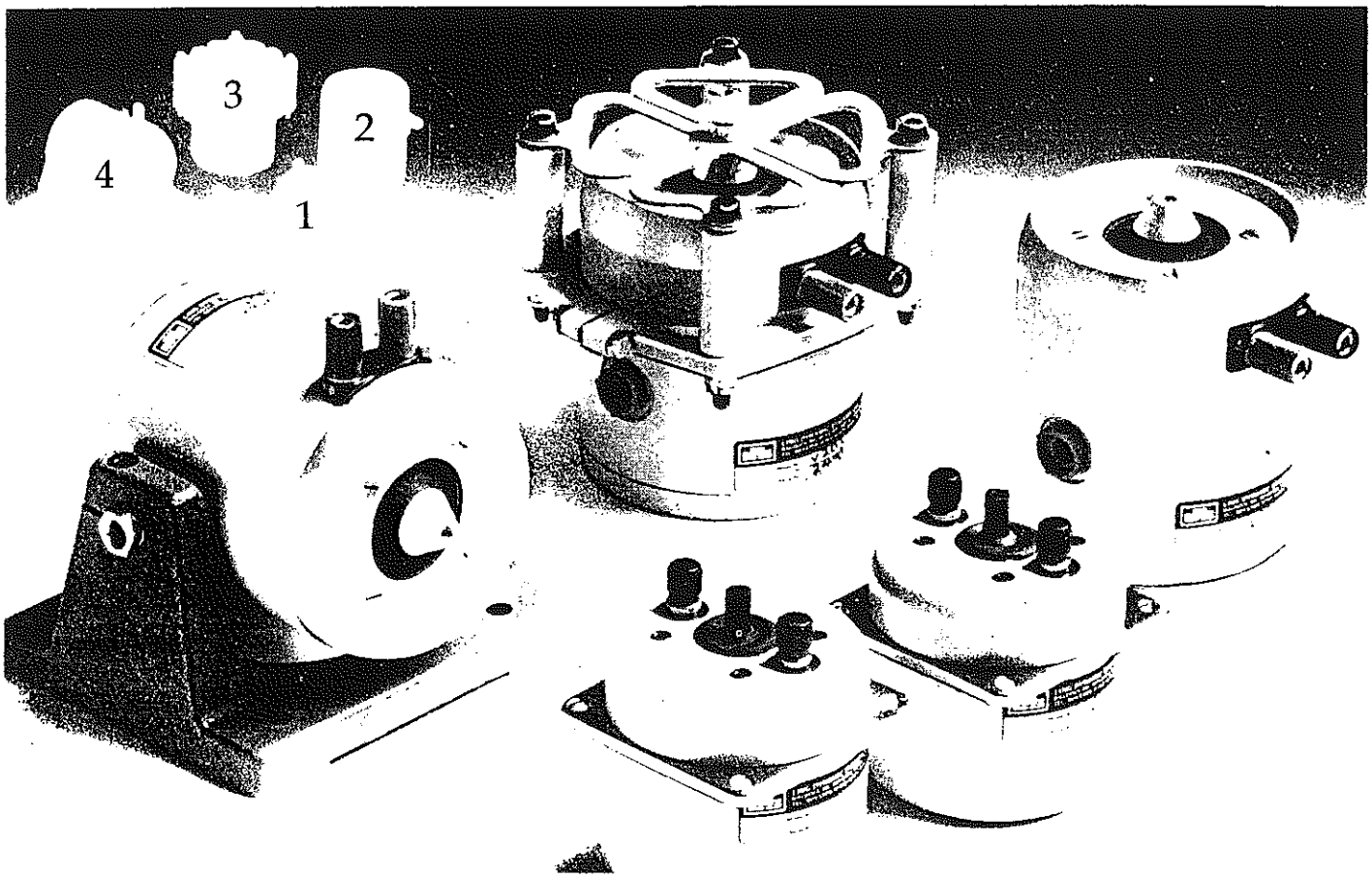
5. OUTLINE DETAILS



Model Designation	Impedance	Mounting Spigot Thread	Drive Input
V201	3 ohm	M4 x 0.7 Metric Thread	Screw terminal
V203	3 ohm	10-32 UNF Thread	Screw terminal

Figure 4.1 Outline Dimensions - V200 Series Vibrators

5. OUTLINE DETAILS (cont.)



1. Standard base mounted V100 Series vibration generator (not applicable to this manual).

2. Standard base mounted V200 Series vibration generator.

3. Auxiliary suspension, AUX200, provides additional stiffness to the standard vibration generator suspension, which increases payload capacity, or permits the vibration generator to be vertically suspended from the test structure.

4. V200 series vibratio generator mounted in a cast support trunnion, Model T200

Figure 4.2 Mounting Options - V200 Series Vibrators