APS 113 ELECTRO-SEIS®

Long stroke shaker with linear ball bearings

Applications

- calibration and test for seismic instruments
- seismic simulation for components
- determination of natural mode frequencies, shapes, damping ratios and stress distributions

Range of use

- geological services, science, physics and seismic applications
- excitation of manufactured equipment in the factory or installed in the field to demonstrate compliance with seismic specification criteria

Features

- force (sine-peak): 133 N (30 lbf)
- stroke (peak-peak): 158 mm (6 in)
- frequency range: DC … 200 Hz
- horizontal and vertical operation
- rugged standard armature and linear guidance system
- sine wave, swept sine wave, random or impulse force waveforms

Specifications

The APS 113 ELECTRO-SEIS® shaker is a long stroke, electrodynamic force generator specifically designed to be used alone or in arrays for studying dynamic response characteristics of various structures.

It finds use in modal excitation of complex structures, particularly when low frequencies are required. Furthermore it can be used for low frequency vibration testing of components and assemblies.

Technical Data

	APS 113	APS 113-HF High force
Force rating (sine-peak) [1)]	133 N (30 lbf)	186 N (42 lbf)
Displacement (peak-peak)	158 mm (6 in)	
Frequency range	DC … 200 Hz	
Direction of excitation	horizontal or vertical	
Payload, horizontal, max.	25 kg (55 lbs)	
Payload, vertical, max.	8 kg (18 lbs)	
DC coil resistance	4.4 Ω or 1.1 Ω	1.4 Ω
Weight (net weight)	36 kg (80 lbs)	
Moving table (weight)	2.3 kg (5 lbs)	
Dimensions L × W × H	168 mm × 213 mm × 526 mm (6.6 in × 8.4 in × 20.7 in)	
Temperature range (in operation)	+5 °C … +40 °C, ±2 K (+41 °F … +104 °F, ±2 K)	

1) Interval mode of operation

Performance

One application of the APS 113 ELECTRO-SEIS® shaker is to determine the dynamic characteristics of mechanical structures. At resonance, a large amount of energy is contained in the structure, and the shaker must accommodate the resulting motion. However, it need only supply the real mechanical power dissipated by damping mechanisms within the structure.

If a drive point on a structure in resonance is vibrating with a velocity of 1,000 mm/s (39 in/s) peak and a force of 133 N (30 lbf) peak is required to sustain the vibration level, then the shaker will be delivering approximately 65 W RMS to the structure. Such a load on the shaker is termed a matched resonant load, and it is purely resistive since the force is in a phase with the velocity.

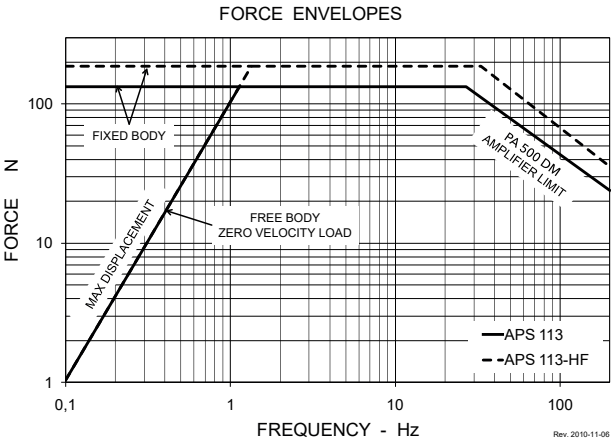
If the resonant load input is other than 133 N × 1,000 mm/s, the full 65 W of mechanical power cannot be delivered to the structure, the system being either force or velocity limited. If the resulting

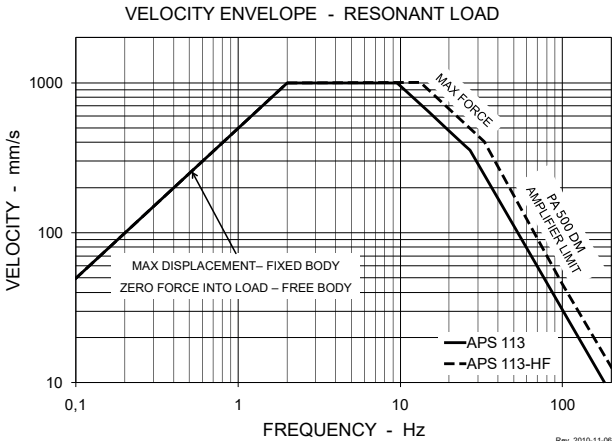
maximum response level is not great enough, the user may have the option of moving the shaker to a drive point having an impedance closer to the matched value, or adding more shakers to the array driving the structure.

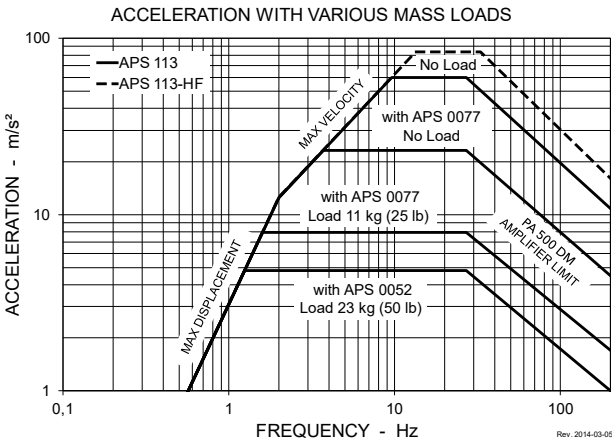
Within the limitations of maximum force and velocity, the actual power delivered to a structure is a function of the input mechanical impedance at the drive point. In typical modal testing, this input impedance varies widely in magnitude and phase angle. At different frequencies, the input impedance of the drive point may appear predominately spring-like, mass-like, or resistive. Since the object of the tests is to establish resonant modes, at which the input mechanical impedance of all drive points are resistive, the shaker's maximum performance capability is most meaningful stated in terms of the force and velocity that can be obtained when driving a matched resistive load.

Therefore performance is given in the form of graphs which present the envelopes of maximum force and velocity delivered to a resonant structure as functions of the resonance frequency of the structure.

Another application is the excitation for sensor calibration. Acceleration performance of the APS 113 ELECTRO-SEIS® shaker with various mass loads is shown in the graphs beside.







Description and characteristics

The APS 113 ELECTRO-SEIS® shaker has been optimized for driving structures at their natural resonance frequencies. It is an electrodynamic force generator, the output of which is directly proportional to the instantaneous value of the current applied to it, independent of frequency and load response. It can deliver random or transient as well as sinusoidal waveforms of force to the load. The armature has been designed for minimum mass loading of the drive point. The ample armature stroke allows driving antinodes of large structures at low frequencies and also permits rated force at low frequencies when operating in a free body mode.

The unit employs permanent magnets and is configured such that the armature coil remains in a uniform magnetic field over the entire stroke range – assuring force linearity. The enclosed, self-cooled construction provides safety and a minimum of maintenance. Attachment of the armature to the drive point is accomplished by a simple thrust rod like the APS 8610 modal stinger. An amplifier, such as the PA 500 DM, is required to provide armature drive power.

The drive coil is wound in a manner which allows series or parallel connection, offering the user the choice of standard or low impedance. This option is required if the shaker is to be used with the PA 500 DM power amplifier for extended frequency range or random noise excitation.

Accessories (optional)

Power amplifier	PA 500 DM
System interconnect cable	APS 0082-6E
Auxiliary table kit – horizontal	APS 0052
Auxiliary table kit – vertical	APS 0077
Auxiliary table kit – horizontal and vertical	APS 0078
Carrying handles	APS 0108
Reaction mass assembly	APS 0112
Lifting handles (set of 4)	APS 0414
Modal stinger kit	APS 8610
Steel cable kit	APS 8611
Overtravel switch[1)]	APS 8543
Overtemperature switch	APS 8544

Additional accessories available
1) Cannot be installed, if the CPC is used.

Modes of operation

Free armature mode

In this mode, the armature provides the reaction mass for force delivered to the test structure via the shaker body. Auxiliary reaction mass may be added to the armature to decrease the low frequency limit for rated force operation.

The APS 113 shaker and APS 0112 reaction mass may be used in a vertical or horizontal free armature mode with rated force down to 2 Hz. Feet and carrying handles are provided for ease in placement of the shaker on horizontal test surfaces.

▲ *APS 113 with reaction mass assembly (APS 0112)*

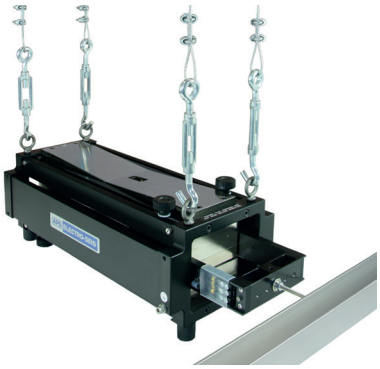
Fixed body mode

By providing a rigid attachment between the body and ground, the full relative velocity and stroke capability is available for load motion. Maximum rated force can be delivered down to 0.01 Hz and 70 % maximum to 0 Hz.

▲ *Fixed body mode with carrying handles (APS 0108) and tie-down bars and modal stinger (APS 8610)*

Free body mode

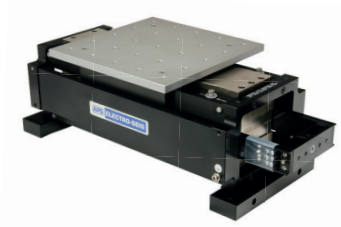
In this mode, the body provides the reaction mass. Load and body motion are accommodated within the total relative velocity and stroke. Because of the high cross-axis stiffness provided by the armature linear guidance system, the shaker may be supported above ground level by means of suspension lines (APS 8611 steel cable kit) attached to the body. This provides a convenient mounting for introducing force parallel to a horizontal mounting surface. Examples of such surfaces include floors, roofs, platforms, cabinets, bridges and tanks.



▲ *Free body mode with modal stinger (APS 8610) and steel cable kit (APS 8611)*

Shaker table mode

Auxiliary tables are available which attach directly to the armature and enable the basic shaker to provide long stroke, low frequency excitation to components or model structures mounted on the tables. APS 0052 auxiliary table provides a 10 in × 10 in horizontal load mounting surface for horizontal motion rated for 23 kg (50 lbs) test loads. The APS 0077 auxiliary table provides the same load mounting surface for vertical motion. The APS 0078 provides for both vertical and horizontal applications.



◄ *APS 113 with auxiliary table kit horizontal (APS 0052)*

auxiliary table kit vertical (APS 0077) ►