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*ENVIRONMENTAL
EQUIPMENT & TEST LAB*



VIBRATION TEST EQUIPMENT



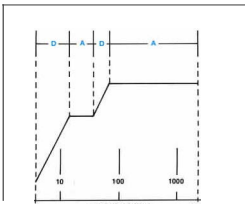
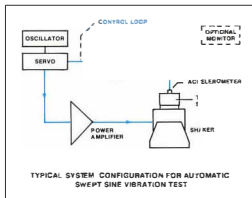
**UNHOLTZ-DICKIE
CORPORATION**

INTRODUCTION

Vibration testing has been a major tool used in the development of military and space hardware. Today, the benefits of vibration testing are being applied in a variety of commercial and consumer product areas as well. This trend parallels an increasing number of federal regulations which require more comprehensive testing to assure product reliability and safety.

Vibration testing can genuinely benefit the manufacturer. By simulating environmental vibration levels during actual product development, the engineer can verify that a design is suitable for its application. This type of testing establishes performance and reliability prior to release of a design for production. Such an approach can save money by minimizing the probability of major redesign work, and even legal liabilities which may result from inadequate product design. In addition, quality control procedures can be enhanced by using vibration testing as a tool to monitor the consistency of production methods and materials.

Electrodynamic vibration test systems are used to satisfy a wide variety of test requirements. A typical test configuration for swept sine vibration testing is illustrated below (left). This arrangement provides for automatic frequency cycling at preselected vibration levels under servocontrol. A typical four level sine test "program" is shown at the right.



VIBRATION TEST SYSTEMS

UnholtzDickie produces a wide range of vibration test systems to meet both military and commercial testing requirements. System force ratings from 50 to 40,000 pounds force are available. The table below lists these systems with pertinent technical data.

Every U-D system includes a solid state power amplifier and features reliable air cooling of the shaker armature. Systems engineering of each system component assures maximum performance with simplified operation.

SHAKER MODEL/ SERIES	SYSTEM PERFORMANCE				SHAKER DATA			
	FORCE, lbs.		STROKE Inches DA	MAX. SINE PAYLOAD AT 20g	ARMATURE WEIGHT, lbs.	TABLE DIA., inches	FREE TABLE f ₀	SUSPENSION STIFFNESS lbs./inch
	SINE pk	RANDOM rms						
5PM	50		0.5	1.8	0.7	2	8,000	60
1(1)	50		1	1.9	0.55	drive rod	5,500	0
20	120	60	1	3	3	3.5	3,300	225
4(1)	150		4	5.2	2.25	drive rod	3,000	0
4C(1)	250		4	9	3.5	drive rod	2,400	0
20	250	125	1	9.5	3	3.5	3,300	225
20	300	180	1	12	3	3.5	3,300	225
T102	500	300	1	19.7	5.3	4.5	4,300	225
6(1)	1,000		6	39	11	drive rod	1,800	0
200 SERIES	1,200	600	1	40	20	8	3,100	600
	1,700	900	1	65	20	8	3,100	600
	3,000	2,200	1	128	22	8	3,100	600
	3,000 (2)		0.5	119	31*	8	5,800	600
	4,000	3,300	1	171	29	8	2,700	600
RTS-5 560	CONSULTFACTORY (see page 11)							
500 SERIES	7,000	4,800	1	300	50	12	2,400	1,200
	7,000	5,500	1	300	50	12	2,400	1,200
	8,000	4,000	1	310	90	16	2,300	3,000
	10,000	6,500	1	410	90	16	2,300	3,000
	12,000	7,700	1	510	90	16	2,300	3,000
1000 SERIES	12,000	7,500	0.6 (3)	505	95*	16	2,300	3,000
	13,000	12,000	0.7 (3)	555	95*	16	2,300	3,000
	15,000	9,500	0.75 (3)	655	95*	16	2,300	3,000
	16,000	15,000	0.55 (3)	705	95*	16	2,300	3,000
	17,000	12,700	0.7 (3)	755	95*	16	2,300	3,000
	17,500	15,000	1	780	95*	16	2,300	3,000
	17,500	16,000	1	780	95*	16	2,300	3,000
	19,000	16,000	0.75 (3)	855	95*	16	2,300	3,000
	19,000	17,500	1	855	95*	16	2,300	3,000
	24,000	20,000	1	1,105	95*	16	2,300	3,000
	28,000	21,000	0.75 (3)	1,150	250*	24	2,000	4,000
4000 SERIES	36,000	33,000	1	1,550	250*	24	2,000	4,000
	40,000	28,000	1	1,750	250*	24	2,000	4,000
	40,000		1	1,750	250*	24	2,000	4,000
	40,000	37,000	1	1,750	250*	24	2,000	4,000

NOTES: * Induct-A-Ring (IAR) armature
(1) Modal shaker

(2) Special high freq. IAR design
(3) 1/16 inch stroke using reduced force rating mode

SHAKERS

Unholtz-Dickie manufactures a wide variety of general purpose and special application shakers, covering the force range from 50 to 40,000 pounds as illustrated on the following pages.

Model 5PM



Max Output:
50 lbs pk force
0.5 inch pk-pk stroke

Armature Type:
Wound Coil

Cooling:
Air

Body Dia:
8 - 7/16"

Model 20



Max Output:
300 lbs pk force
1 inch pk-pk stroke

Armature Type:
Wound Coil

Cooling:
Air

Body Dia:
11 - 3/4"

Model T102



Max Output:
500 lbs pk force
1 inch pk-pk stroke

Armature Type:
Wound Coil

Cooling:
Air/Water

Body Dia:
17"

200 Series



Max Output:
4000 lbs pk force
1 inch pk-pk stroke

Armature Type:
Wound Coil

Cooling:
Air

Body Dia:
27 - 1/2"

SHAKERS

All U-D shakers utilize **air cooled armatures** for maximum reliability. Many models are available with the unique **INDUCT-A-RING** armature, further described on page 6.

500 Series



Max Output:
7000 lbs pk force
1 inch pk-pk stroke

Armature Type:
Wound Coil

Cooling:
Air

Body Dia:
35"

1000 Series



Max Output:
24,000 lbs pk force
1 inch pk-pk stroke

Armature Type:
Wound Coil (to 12,000 lbs)
INDUCT-A-RING (to 24,000 lbs)

Cooling:
Air/Water

Body Dia:
35"

4000 Series



Max Output:
40,000 lbs pk force
1 inch pk-pk stroke

Armature Type:
INDUCT-A-RING

Cooling:
Air/Water

Body Dia:
44"

INDUCT-A-RING ARMATURE

INDUCT-A-RING is the U-D trade name for a revolutionary armature design concept. The principle of transformer action is utilized to transfer energy from stationary AC driver coils (stators) to the armature.



- The moving element is a simple two-piece metal structure. A single turn, solid metal cylinder is bolted directly to the shaker table casting, providing the ultimate in strength and rigidity.
- All points on the vibrating member are at ground potential (zero voltage) at all times. There are no electrical windings with epoxy bonded joints. There is no possibility of voltage breakdown, and therefore no insulation is required.
- The solid metal, single turn ring is air cooled. Cooling connections subject to armature vibration are eliminated.
- AC currents are induced into the solid metal ring, eliminating electrical connections which bridge stationary and moving parts.

The INDUCT-A-RING armature is featured in 1000IAR SERIES and 4000 SERIES shakers, rated up to 24,000 lbs force and 40,000 lbs force, respectively. A special high frequency 3000 lbs force configuration is also available, see below.

HIGH FREQUENCY 208IAR

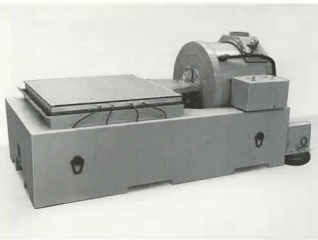
The Model 208IAR Shaker rated at 3000 pounds force utilizes a special "Induct-A-Ring" armature consisting of a one-piece continuous aluminum casting with an integral single-turn cylinder acting as the force generating coil (illustrated at the right). The 9 1/4 inch diameter table has an unloaded resonant frequency of 5,800 Hz making the 208IAR Shaker an excellent high frequency machine for use in testing turbine blades, engine accessories and related items. See above for additional discussion of the Induct-A-Ring concept.



PERMALINE

Combined Slip Table Assembly

The PERMALINE Combined Slip Table Assembly allows testing in three mutually perpendicular axes while using only one basic test fixture. Permanent factory alignment of the shaker and slip table provides quick changeover from vertical to horizontal operation. Inflatable air mounts effectively isolate the entire assembly from the supporting structure, thereby eliminating the need for special floor construction.



- Heavy loads may be vibrated horizontally without external support.
- Factory alignment of the shaker and slip table is maintained by the rigid common base.
- The massive base is deep sectioned throughout its entire length, minimizing bending vibration responses.
- An oil recirculation system is provided with multi-cylinder, constant flow pumps to assure uniform oil distribution over the complete bearing surface.

4HD HYDRAULIC BEARINGS

For large payload and/or high g level testing applications where substantial overturning moments are generated, hydraulic bearings are available to restrain lateral and vertical slip plate motion. One bearing is located at each corner of the slip plate, providing restraint at four widely spaced locations across the plate.



- Compression-Step drive bar design permits vertical/horizontal mode conversion in less than ten minutes, utilizing a "bolt-from-the-top" slip plate attachment (see below).
- The entire assembly is isolated from the floor by the heavy seismic mass supported on air mounts.
- The CSTA requires no special floor construction, and may be moved from one area to another by a suitable forklift.

COMPRESSION-STEP DRIVE BAR

Fast, convenient conversion from vertical to horizontal mode operation is provided by a unique "bolt-from-the-top" drive bar design. Total conversion time is typically less than ten minutes including attachment of the drive bar to the armature, manual rotation of turnbolls, and attachment of the slip plate to the drive bar using bolts totally accessible from above the plate, as shown below.



MODAL SHAKER SYSTEMS

Unholtz-Dickie manufactures a family of shakers designed specifically for "modal" testing. These shakers feature long stroke, low internal damping, and near zero axial spring rate. These special characteristics facilitate the excitation of pure structural modes, especially when multiple shaker arrays are utilized. The shaker moving element includes a hardened output shaft for connection to the test object.

These modal shakers incorporate a double ended field structure, providing parallel flux paths from above and below the magnetic air gap. This design gives maximum magnetic flux linkage with the armature coil, and assures optimum waveform purity. Uniform flux density throughout the operating stroke provides output force proportional to armature current, independent of armature position.

When driving power is provided by a U-D solid state power amplifier with "current feedback," these shakers can be operated as **constant force** generators. In this operating mode, shaker armature current is proportional to power amplifier input voltage through large variations of load impedance; therefore, the magnitude of the generated AC force in the armature coil remains constant as a function of frequency. This constant force characteristic also requires the shaker to have a "force/armature current" ratio reasonably independent of armature position, as described earlier. Constant force sweeps can be performed without force links, external servos, or tracking filters.

Three basic models are available. The Model 1 is a 50 pound force, permanent magnet design with a one inch stroke. The Model 4 is a four inch stroke shaker rated up to 250 pounds force. Both of these units feature folding-type carrying handles which enhance portability.

The Model 6 Shaker generates up to 1000 pounds force and provides a full six inch stroke. This shaker is frequently used to generate low frequency motion in seismic simulation studies, or for vehicular studies in aerospace applications.



Model 4

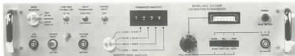
SERIES 300 VIBRATION TRANSDUCER CALIBRATION SYSTEMS

The Series 300 Calibration Systems are offered with manual controls for point by point calibration, or with frequency sweeping controls giving an automatically drawn curve of % deviation of the "unknown" transducer sensitivity relative to the "reference" accelerometer, as a function of frequency. Original data is permanently plotted, eliminating operator errors in readout and transcription.

At full system performance, and with automatic servo controls operating, acceleration waveform distortion is less than 1.5% at all operating frequencies. The overall system noise level is less than .005 g rms. Automatic plotting systems feature 0.25% plotting resolution of the unknown transducer output relative to the reference.



Model 351 System



The Model 1611 Precision Charge/Voltage Calibration Standardizer is supplied in 300 Series Calibration Systems to provide stable, high accuracy comparison calibrations. Typical overall instrument accuracy and stability is 1/4%, with flat response from 2 to 20,000 Hz.