

# TEST & MEASUREMENT PRODUCT - SHAKERS

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# SHAKER OVERVIEW

- Two primary shaker types:
  - Electromagnetic/Inertial
  - Piezoelectric
- Provide reliable structural excitation of test article within controlled, localized environment
- Simulate dynamic forces and natural frequencies
- Used along with accelerometers and other vibration monitoring devices to reveal cracks, defects, weaknesses, other abnormalities



# SHAKER APPLICATIONS

- Structural testing
  - Industrial plant pipework
  - Building walls and floors
- Material studies
- Product testing
- Quality Assurance
- R&D
  - Helicopter rotor force/modal analysis
  - Airplane wing analysis
- Modal testing
  - Naval ship & submarine bulkheads
  - Jet engine turbine



# ELECTROMAGNETIC SHAKERS

- Operate on the principal of magnetism:
  - Magnetic field is formed as current runs through a wire
  - As wire is wound in a coil, effect is multiplied and can be manipulated
  - When magnets are fixed on either side of coiled wire, alternating electric currents flow into coil, inducing vibration/oscillation
  - Motion is directed toward object under test
- Low frequency applications
  - First bending mode of airframes or ship hulls
- Usually include impedance head component



Model F3



Model F4



Model F10

# ELECTROMAGNETIC SHAKERS

Wilcoxon model	F3 / Z602WA	F4 / Z820WA	F10 / Z820WA
<b>Description</b>	Electromagnetic shaker system	Electromagnetic shaker system	Electromagnetic shaker system
<b>Impedance head</b>	Z602WA	Z820WA	Z820WA
<b>Frequency range (Hz)</b>	25 - 10,000 Hz	10 - 7,500 Hz	5 - 2,000 Hz
<b>Nominal force output</b>	1 lb (0.45 kg)	10 lbs (4.54 kg)	20 lbs (9.07 kg)
<b>Diameter</b>	2.26 in. (5.74 cm)	5.10 in. (12.95 cm)	8.25 in. (20.96 cm)
<b>Weight</b>	0.83 lbs (0.38 kg)	6.8 lbs (3.08 kg)	28.0 lbs (12.70 kg)

# PIEZOELECTRIC SHAKERS

- Utilize expansion and contraction properties of piezoelectric crystals to generate sonic and ultrasonic structural excitation
- Lightweight, portable shakers generate large dynamic forces at high frequencies
  - Semiconductor components and high-strength metal breakdown testing
- Reaction-type shakers – impedance head only available in F7 where head/case are one
- Require matching network for reactive load matching

# PIEZOELECTRIC SHAKERS

Wilcoxon model	F7	F7-1	F4 / F7
<b>Description</b>	Piezoelectric shaker	Piezoelectric shaker	Electromagnetic/piezoelectric dual shaker system
<b>Impedance head</b>	Integral	N/A	Integral
<b>Frequency range</b>	500 - 20,000 Hz	1,000 - 80,000 Hz	F4 = 10 - 7,500 Hz F7 = 500 - 20,000 Hz
<b>Nominal force output</b>	100 lbs (45.36 kg)	10 lbs (4.54 kg)	100 lbs (45.36 kg)
<b>Diameter</b>	2.20 in. (5.59 cm)	2.20 in. (5.59 cm)	5.10 in. (12.95 cm)
<b>Weight</b>	2.5 lbs (1.1 kg)	2.8 lbs (1.3 kg)	8.2 lbs (3.7 kg)
<b>Recommended matching network</b>	N7FS	N8HFS	N7FS

# MATCHING NETWORKS

- Provide interface between power amplifiers and piezoelectric shakers
- Enable voltage increases to allow shaker to be driven at full voltage level
  - Impedance the shaker presents to amplifier is capacitive (reactive) and therefore decreases with increasing frequency
- At very high frequencies, lower output voltages are used to better match the reactive load

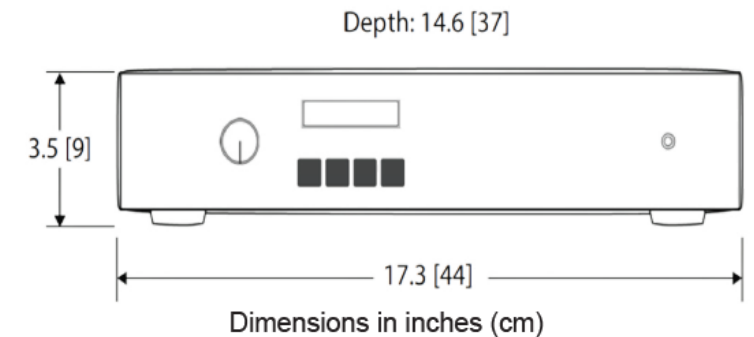


# MATCHING NETWORKS

Wilcoxon model	N7FS	N8HFS
Output voltage, max	100, 200, 300, 500, 800 V	360 V
Compatible shakers	F7	F7, F7-1
Dimensions, WxHxD (including handles)	19x7x13 in. (48.3x17.8x33.0 cm)	19x7x13 in. (48.3x17.8x33.0 cm)
Weight	37 lbs (16.8 kg)	25 lbs (11.4 kg)

# POWER AMPLIFIER – PA10A

- 400-Watt amplifier at 4Ω with flat frequency response up to 40 kHz
- Ultra lightweight (8.5lb) yet still 19” rack mountable (w/ brackets)
- Adjustable gain knob up to 26 dB
- Multiple integral protection methods:
  - DC fault detection
  - Clipping detection
  - Over-current / Over-temperature detection
  - Safe Start in Mute mode
- Programmable via four front-panel push buttons, LCD screen
- BNC input for common signal generators



# POWER AMPLIFIER – WST7B<sup>3</sup>

- 900-Watt amplifier at 4Ω with frequency response up to 150 kHz
  - Can be used with full range of Wilcoxon shakers
- 19” rack mountable
- Selectable gain of 23 or 29 dB
- Multiple protection methods:
  - LED clipping indicator
  - Rear-panel AC mains breaker
  - Internal thermal protection
- Maximum 50 V rms output
- BNC input for common signal generators

