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The World's largest producer of structural eccentric mass vibrators

ECCENTRIC MASS VIBRATORS

Eccentric mass vibrators are attached to equipment and structures to determine their response to sinusoidal forcing over a range of frequencies in order to estimate resonant frequencies, damping, mode shapes, and other dynamic properties. Knowledge of actual dynamic properties can be used to validate and improve analytical models, reveal margins unjustifiable by analysis alone, determine the source of troublesome vibrations, detect damage, and perform basic research into the dynamic of structures and structural components.

In addition to the vibrator, motion transducers and digital data acquisition is available. All ANCO equipment is field portable, even in remote areas, and can be set up in a few hours. ANCO vibrators have been used to test a variety of structures, including dams, boiler structures, nuclear power plant containments and equipment, foundations, bridges, offshore oil platforms, ships, stacks, floors, office buildings, isolated structures, and storage tanks.

Eccentric mass vibrators use one or more rotating eccentric weights to produce a force which increases in direct proportion to the eccentricity and to the square of the rotating frequency. The force produced is thus given by the relationship:

$$F\ (lbs) = 0.102 \times WR \times f \times f$$

where WR is the eccentricity in lb-inches and f is the frequency in Hz.

Alternately:

$$F\ (N) = E \times w \times w$$

where E is the eccentricity in Kg-m and w is the frequency in radians/sec.

A single eccentric weight produces an omnidirectional rotating force vector, which can be expressed as a force two perpendicular sinusoidal forces, with a 90 degree phase lag. The use of equal counter rotating eccentric weights produces a unidirectional sinusoidal force. Most eccentric weights are adjustable from zero to full eccentricity, so as to allow a wide range of frequencies to be covered with approximately the same force. Two or more vibrators, spaced apart on a structure, can provide torsional forcing, or enhance the motion of one particular mode over another. Multiple vibrators must be synchronized electronically which requires a more expensive control system. Almost all vibrators allow for horizontal forcing. Some also allow vertical forcing, but this requires larger drive units, in order to overcome the toque produced by gravity on the eccentric weights.

Most vibrators are driven by variable speed electric motors. The size of the motor will depend on the size of the vibrator (internal friction, windage) and the amplitude of the motion achieved on the structure being tested. Often a vibrator is provided with a transmission to allow near full power over a wide frequency range. Speed control accuracy is typically 1 part in 300 of full speed.

ANCO has provided eccentric mass vibrators to over 35 different universities, research groups, and test laboratories since 1971.

ATTACHMENT A

Selected List of ANCO Eccentric Mass Vibrator Customers

Customer	Vibrator Description
Atomic Energy Canada, Quebec	Miniature tube vibrator for investigation of reactor tubes
Babcock and Wilcox, Connecticut	Miniature tube vibrator for investigation of ship heat exchangers
Earth Products Company, Los Angeles	10 ton vertical and horizontal uniaxial vibrator, 1 kg-m eccentricity for soil wave propagation and bridge dynamic studies
Electric Power Research Institute, California	Miniature tube vibrator for investigation of power plant heat exchangers
Evergreen Corporation, Taiwan	15 ton uniaxial horizontal vibrator, 1000 kg-m eccentricity, for foundation/soil wave studies
Harvey Mudd College	10 ton horizontal vibrator, 50 kg-m eccentricity for building and bridge studies
Harza Construction Co., Chicago	10 ton horizontal vibrator, 50 kg-m eccentricity for dam and bridge studies
Kernforchung Centrum, Karlsruhe, Germany	1000 ton horizontal vibrator, 40000 kg-m eccentricity for high level excitation of nuclear power plant containments
National Center for Earthquake Engineering, National Taiwan University	10 ton horizontal and vertical uniaxial vibrators, 80 kg-m eccentricity for building and dam dynamic studies.
Oakland City Museum, California	Miniature vibrator for public education on earthquakes
OEDAN, Denmark	Compact high frequency unidirection vibrator (0-140 Hz.)
Phillips Petroleum Company, Oklahoma	Dual 5 ton horizontal and vertical vibrators, 100 kg-m eccentricity, for offshore oil platform studies
SERC, India	10 ton vertical and horizontal building vibrator
United States Bureau of Reclamation	10 ton horizontal dam vibrator
United States Navy	Miniature tube vibrator for investigation of ship heat exchangers
University of California, Irvine	10 ton horizontal vibrator, 50 kg-m eccentricity for building and bridge

	studies
University of California, Los Angeles	Dual 50 ton horizontal vibrators with 500 kg-m eccentricity for high rise building dynamic studies
University of Peshewar, Pakistan	Omnidirectional 10 ton vibrator 0-25 Hz for structural research
University of Sherbrooke, Montreal	10 ton horizontal vibrator, 50 kg-m eccentricity for building and bridge studies
University of Thessalonica, Greece	4 ton uniaxial horizontal and vertical vibrator, 25 kg-m eccentricity for building dynamic studies
University of Toronto, Canada	Dual synchronized 20 ton vibrators with high eccentricity for dam testing