©M/RAD Corporation
71 Pine Steet
Woburn, MA 01801
888-500-9578 • 781-935-5940
Fax: 781-933 -7210
www.mradcorp.com • inquiries@mradcorp.com

Technical Data Sheet

Mechanical Shaker
TDS-5

M/RAD is in the business of the design and fabrication of MECHANICAL REACTION VIBRATION TEST SYSTEMS. Although we standardize many systems, it is not uncommon for systems to be supplied whose capabilities exceed the specifications of our standard systems.

Force Ratings: 2,000 – 100,000 lbs
Motions: Elliptical, Vertical, Horizontal
Displacement: 0 – 1 inch peak-peak
Acceleration: 0 – 10g
Frequency Range: 4 – 60 Hz
Suspension: Coil Spring or Pneumatic Isolator
Price Range: $ 6,000 - $150,000

The Mechanical Reaction Shaker had been developed to fulfill the growing demand for inexpensive equipment to perform vibration endurance testing over extended periods of time. A family of test specifications had been developed from the finding of the Advisory Group on Reliability of Electronic Equipment (AGREE) Office of the Assistant Secretary of Defense (research and Engineering). MIL-STD-781B was developed from AGREE and specifies longevity tests of electronic equipment for time periods up to 2000 operating hours. These tests are normally performed at frequencies between 20 to 60 Hz and a fixed amplitude of 2.2g +/- 10% (1.0g for Navy applications).

The philosophy behind AGREE testing is to determine statistically whether the tested production items will have satisfactory reliability over its operating life, before the equipment has left the manufacturer’s plant. The AGREE test consists of a combination of temperature and vibration simultaneously. Temperature is periodically cycled up and down while vibration is generally applied for 10 minutes out of every hour. The extremes of temperature and the level of vibration is not intended to fatigue the tested item but to expose latent defects such as cold solder joints and loose screw connections which test acceptably when the equipment is new but are highly susceptible to early failure. The actual time duration of the test is a function of the failure rates experienced during the tests. For example, an extremely low failure rate may terminate the test early while a high failure rate will result in many more hours of testing until the failure rate falls into an acceptable category or the production lot under test is rejected.

It is not required to be a statistician to determine that the highest failure rates should be experienced early in the program when the most fragile defects will occur, after which the failure rate should decrease. Moreover, if the tests were conducted over an extremely long period of time, the failure rate should again increase because of fatigue considerations. Hence, the most favorable rates are achieved after some limited exposure to the tests. This initial phase is called "burn in" and failures recorded during this period do not count against the item.

Today, there are a plethora of reasons to use a mechanical shaker:

One may choose to utilize vibration as a method to qualify the design of a product, that is, to insure that a product can withstand critical frequencies, without failure, before it is released for production. It is not uncommon, for example, to determine that a PC Board exhibits a resonant frequency, which may cause it to mesh with other items in the chassis thereby causing damage. The solution could be to add a brace or stiffener to solve the problem. Or perhaps, an entire electronics console filled with product may react unfavorably to vibration creating a need for redesign.

Another domain for mechanical shakers is in the simulation of vibration environments. Shipping products by air, sea or land are all environments in which vibration is present. The vibration profile required to simulate any airplane, ocean vessel or truck are different and often require a field performed signature analysis or the guidance of a specification to duplicate these vibrations in a laboratory. There are myriad military and commercial specifications, which either suggest or mandate vibration levels for all environments.

A most popular use for mechanical shakers is to weed out manufacturing defects, such as excess solder and loose screws, during production. This process is called Environmental Stress Screening (ESS) where the product is stimulated, as opposed to simulated. In this regard, it is intended to ultimately build product from component to finished product with zero defects. This term, zero defects, has been popularly paraphrased as six-sigma reliability. The prevailing philosophy for the success of the mechanical shaker for ESS application is that the shaker, in all probability, has enough performance (force, displacement, acceleration) to damage product. If the shaker is capable of inducing failure and all aspects of the shaker are adjustable, (which they are!), then there may be a lesser vibration level in which manufacturing defects will occur.

The mechanical shaker is a versatile machine, which may be used as a quality tool to enhance the reliability and integrity of a product from the component level to the system level.