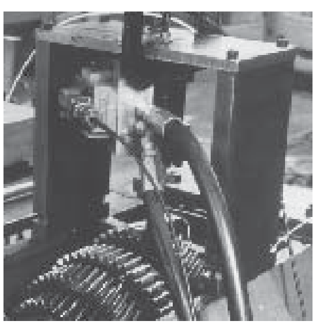
Advantages of Hydraulic Excitation for Measuring the Frequency Response of Structures

The FFT analyzer has rapidly gained popularity for making frequency response measurements on mechanical systems. One reason for this popularity is the ability of these analyzers to quickly and easily measure frequency response functions using impulsive excitation generated by an impact hammer. For lightly damped, linear structures, this low energy excitation technique provides good results, which accurately predict the dynamic behavior of the structure under higher level inputs.

However, many real-life structures exhibit a considerable degree of non-linearity and/or high damping. For example, bolted or riveted joints produce frictional damping and "gap" discontinuances; elastomeric isolation mounts are often highly non-linear. In such cases, the frequency response function can change dramatically depending on the amplitude of the input, and so a useful measurement requires higher energy excitation techniques which approximate the dynamic levels actually observed in the operating environment.

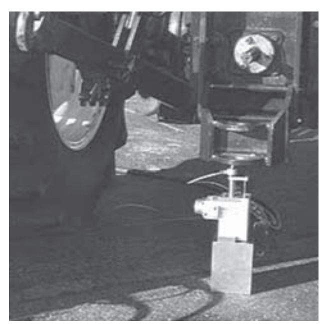
These techniques involve the use of an exciter which is able to reproduce a desired force waveform, usually either random or sinusoidal nature.

A properly designed hydraulic exciter system provides an excellent general purpose tool for high energy structural excitation. Some of the key features which may be important for a successful frequency response are:



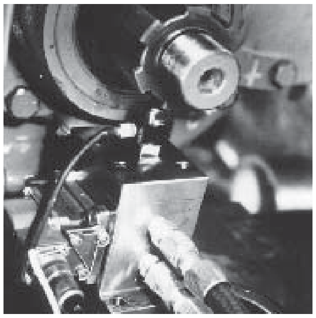
High Force Capability

Hydraulic exciters are available with peak force ratings from 1,000 lbs. to 20,000 lbs. or more. High force is essential for testing smaller structures which are highly damped, and for testing non-linear structures at a variety of input levels. It allows the use of broadband random excitation for faster results than would be possible using swept-sine testing with a lower force exciter.



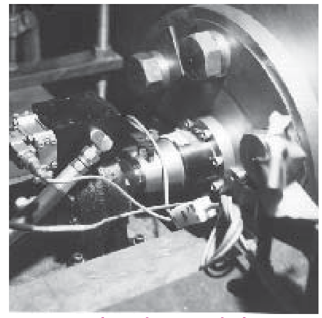
Ease of Fixturing

A hydraulic exciter provides an extremely compact point source of force which can normally be applied directly to the structure under test. This eliminates the need for complicated fixturing and the attendant distortion and resonance problems.



High Frequency Response

With hydraulic excitation there is no loss of performance at low frequency, and with a suitable design, excellent response can be achieved up to 1,000 Hz. This frequency range covers the vast majority of all structural analysis applications.

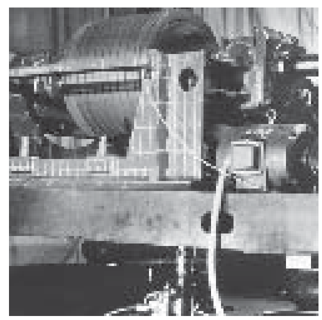


Preload Capability

Many structures require an accurately controlled static "preload" force in order to take up the slack in bearings, gears, or joints. Hydraulics provide a high preload capability, which is easily adjusted for studying the effects of variations in static loading.

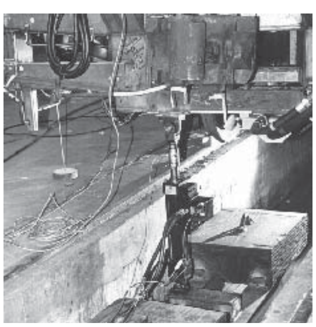
Independent Static and Dynamic Control

This feature allows independent control of separate static and dynamic feedback variables. For example, in testing compliant or freely-suspended structures, it is often necessary to control the dynamic input force while maintaining static displacement control. This helps to keep the exciter from drifting to the end of its stroke.



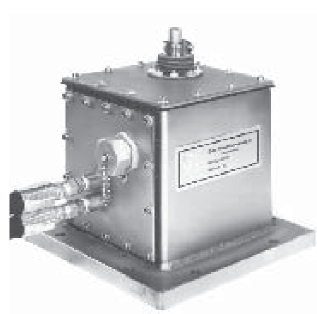
Automatic Gain Compensation

This feature maintains a constant level of force (or some other dynamic feedback variable) during a sine sweep, in order to automatically compensate for variation in the dynamic stiffness of the structure being tested.



Long Stroke

Hydraulics can provide up to several inches of stroke for testing vehicle suspensions, exciting total vehicle or similar applications.



Variety of Exciter Models

In addition to the full range of linear and torsional exciters, inertial mass exciters are available in linear and torsional models for applications in which backup fixturing is difficult, such as exciting buildings, turbine rotors, automotive drivelines, or shipborne structures.