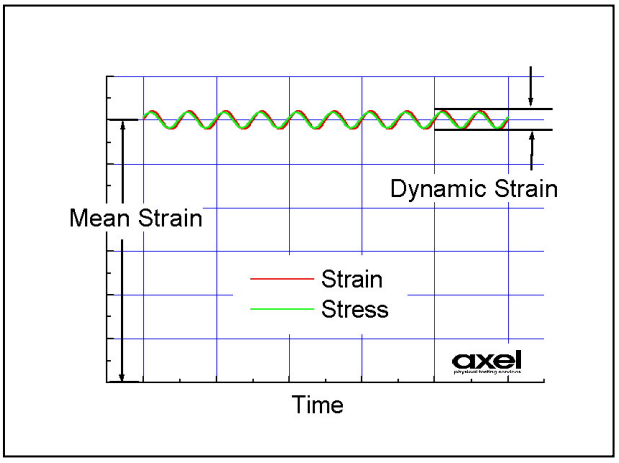
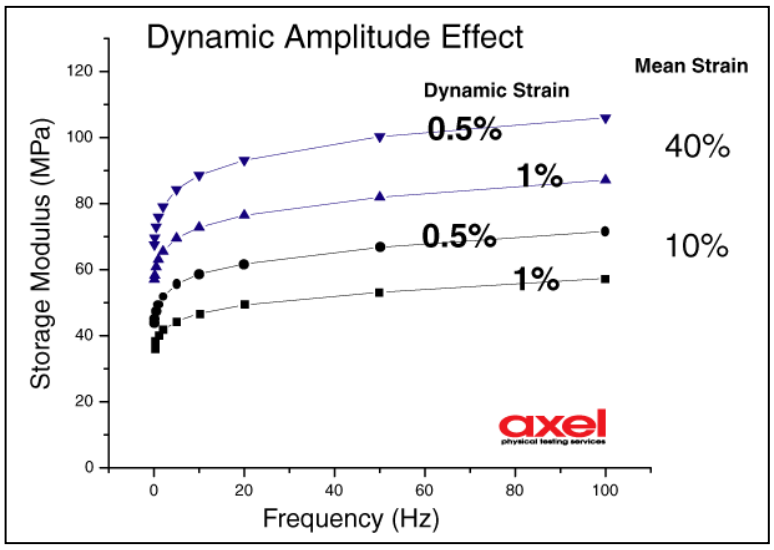
Dynamic and Visco-Elastic Elastomer Testing Services

1. Dynamic Elastomer Characterization by Forced Vibration (0.1 Hz to 200 Hz. typical)

Elastomeric components often experience dynamic sinusoidal loading superimposed on a larger mean strain. This is common for mounts, bushings and body seals. The response to the dynamic loading is such that higher frequencies result in higher stiffness values. However, for many engineering elastomers, the effects of mean strain amplitude and dynamic sinusoidal amplitude may be greater. At these frequencies, the elastomer is assumed to behave much like a spring and a dashpot.



Test specimens are stepped to a mean strain and held. Sinusoidal vibrations are super-imposed on this mean strain and the stress reaction is measured. From this, the dynamic modulus, storage modulus and loss modulus of the material is determined.



Multiple mean strains, strain amplitudes and sinusoidal frequencies are typically observed. Frequencies are run from low frequencies to high frequencies. Amplitudes are run from smaller amplitudes to larger amplitudes. Mean strains are run from lower strains to higher strains. There is a time delay between each sinusoidal excitation to reduce dynamic heating effects.

This test can be performed either on material test specimens (see below, under 'Strain Condition'), or on parts, such as bushings or seals. Typically, dynamic material testing data in Simple Tension is supplemented by stress relaxation data in Pure Shear and Equal Biaxial Extension. For this, see # 3 below.

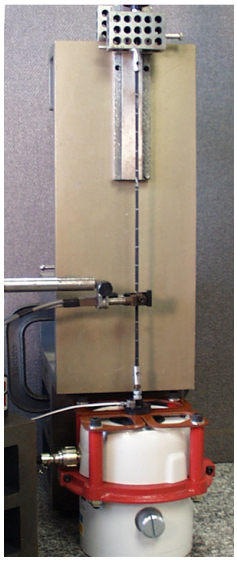
Typical Frequencies: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200 Hz.
Typical Mean Strains: 0.05, 0.10, 0.25, 0.50, 0.75
Typical Dynamic Amplitudes: 0.005, 0.01, 0.02
Strain Condition: Simple Tension, Planar Tension (Pure Shear), Simple Shear, or Simple Compression

The delivered test data set includes: mean strain, dynamic strain amplitude, sinusoidal frequency, stress amplitude, storage modulus, loss modulus and loss angle.

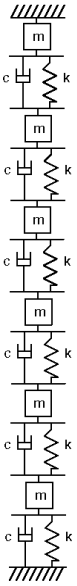
Axel Products, Inc. • www.axelproducts.com
2255 S. Industrial Hwy. • Ann Arbor • Michigan • 48104-8106 • USA
P: (+1) 734-994-8308 • F: (+1) 734-994-8309 • E: info@axelproducts.com

2. Dynamic Elastomer Characterization by Wave Propagation (500 Hz to 5000 Hz. typical)

At frequencies above approximately 500 HZ, it may not be reasonable to measure dynamic material properties assuming a simple specimen model as shown above. The short wavelength and mass effects of higher frequencies requires a different approach.



This is an infinite length specimen technique whereby longitudinal waves are transmitted along a long (greater than 300 mm) specimen (see left). The wave speed and wave attenuation are then determined at points along the specimen to determine the dynamic properties using basic wave equations. The specimen essentially behaves as a series of springs and dashpots (see right).



Test specimens are stretched to a mean strain and held. Sinusoidal vibrations are superimposed on this mean strain and the longitudinal wave speed and wave attenuation is measured. From this, the dynamic modulus, storage modulus and loss modulus of the material is determined.

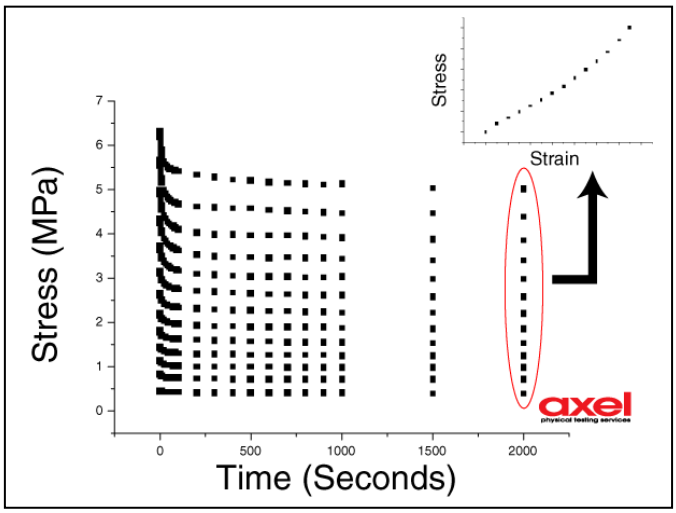
Multiple mean strains and sinusoidal frequencies are typically observed. Frequencies are run from low frequencies to high frequencies. Mean strains are run from lower strains to higher strains. There is a time delay between each sinusoidal excitation to reduce dynamic heating effects. This technique is used for very small dynamic strain amplitudes; much like elastomers experience in acoustic applications. At these very small amplitudes, most elastomers are insensitive to changes in strain amplitude.

Typical Frequencies: 500, 600, 700, 800, 900, 1000, 1500, 2000, 2500, 3000, 4000, 5000 Hz.
Typical Mean Strains: 0.05, 0.10, 0.25, 0.50, 0.75
Strain Condition: Tension

The delivered test data set includes a matrix of dynamic property data for each sinusoidal condition including mean strain, dynamic amplitude, sinusoidal frequency, stress amplitude, storage modulus, loss modulus and loss angle.

3. Complete Equilibrium Hyperelastic Data Set

This test is recommended when performing Dynamic Elastomer Characterization (see above, #1 and #2). The purpose of this test sequence is to provide a fully relaxed data set in multiple states of strain to complement the dynamic testing sequence in # 1 or # 2. The general testing sequence is as follows:



a) Pre-cycle the material to a reasonable in-use strain to stabilize the material properties. Allow the specimen to recover.
b) Using a quick step loading, strain the material to the desired first desired mean strain and allow the material to come to equilibrium.
c) Allow the material to recover in a near zero stress condition.
d) Repeat steps b) and c) (and step a), if so desired) at the desired mean strain conditions, corresponding to those under #1 or #2 above.

The delivered test data set includes a relaxation curve consisting of time and stress data pairs for each mean strain condition.

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General Pricing for Dynamic and Visco-Elastic Elastomer Characterization

1. Dynamic Elastomer Characterization by Forced Vibration (0.1 Hz to 200 Hz. typical)

- 3 Tests total
- 5 to 10 Mean Strain Levels
- 3 Amplitudes
- 11 Frequencies (between 0.1 Hz and 200 Hz)

A) At laboratory temperature of 23ºC **$2250**
B) At non-laboratory temperature from –40ºC to 200ºC **$3375**

2. Dynamic Elastomer Characterization by Wave Propagation (500 Hz to 5000 Hz. typical)

- 3 Tests total
- 5 Mean Strain Levels (between 5% and 100%)
- 11 Frequencies (between 500 Hz and 5000 Hz)

A) At laboratory temperature of 23ºC **$3900**
B) At non-laboratory temperature from 24ºC to 150ºC **$4200**

3. Complete Equilibrium Hyperelastic Data Set (quasi-static)

- 3 Simple Tension Tests
- 3 Pure Shear (Planar Tension) Tests
- 3 Equal Biaxial Extension Tests
- 5 to 10 Strain Levels
- Equilibrium relaxation periods of 2000 seconds each
- Pre-cycling at each level optional
- No dynamic measurements

A) At laboratory temperature of 23ºC **$1500**
B) At non-laboratory temperature from –40ºC to 200ºC **$2250**

February 2013. Pricing subject to change.

Notes:

a. The data is delivered via e-mail in an ASCII format.
b. These are typical dynamic and visco-elastic experiments. Feel free to request a proposal for other interests or specifications, or for custom part testing.
c. Customer data and materials will be retained for 1 year after initial data delivery.

Purchase Order, VISA, MasterCard, AMEX, and Discover Card are accepted methods of payment.
Terms: NET 30 Days after Delivery of Data