

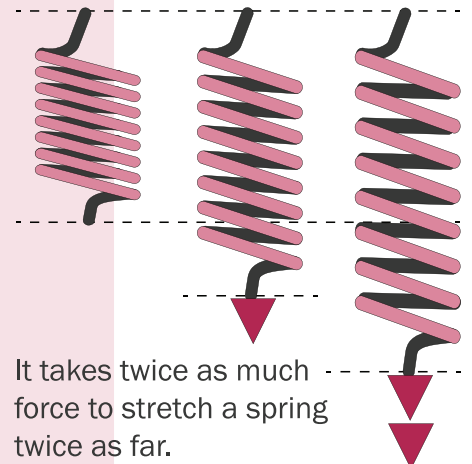
**CONCEPT** Dynamic testing is a technique used to study and characterize materials by subjecting them to various forms of stress and observing their behavior. This can include tensile, compressive and torsional stress. By conducting these tests, manufacturers can gain a better understanding of how their materials will perform under real-world conditions.

One area in which dynamic testing is particularly useful is in the study of viscoelastic behavior of polymers. Viscoelasticity refers to the property of materials that exhibit both elastic and viscous behavior when subjected to deformation. By studying this behavior, manufacturers can produce products that are more durable and long-lasting.

## BACKGROUND

Dynamic testing has a rich history dating back to the early 1900s when rudimentary experimental setups were used to analyze the deformation of metals. In the 1950s, manufacturers such as Weissenberg and Rheovibron introduced instruments that exclusively measured torsional stress. As research on polymers increased, so did the popularity of dynamic testing, which became integral in the analysis of polymer properties by 1961. In 1966, the revolutionary torsional braid analysis was developed, allowing scientists to determine the transition temperatures of polymers through temperature programming. Within two decades, commercial instruments became more accessible and less specialized. In the early 1980s, one of the first DMAs using linear forces (instead of twisting) was introduced. Since then, DMA has become much more user-friendly, faster and less costly due to competition between vendors and developments in computer technology.

## HOOKE'S LAW



*Make sure it measures up*

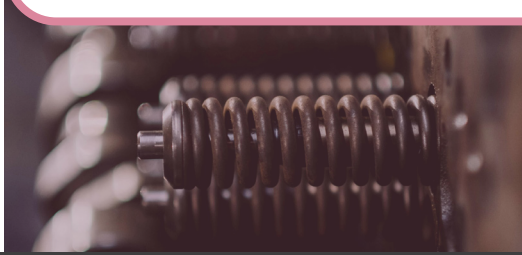
## APPLICATION

Tires are made from a variety of materials including rubber, steel and fabric, and must withstand a wide range of stresses and strains while in use. During the development process, tire manufacturers use dynamic testing to study the behavior of their materials under various conditions. They may conduct tensile testing to measure the strength of the rubber compounds used in the tire tread, or compression testing to study how the tire sidewall responds to changes in air pressure.

Once a tire design has been finalized, manufacturers use dynamic testing to ensure their tires meet or exceed industry standards for performance and safety. This can include tests such as high-speed durability testing, where tires are run at high speeds for extended periods of time to ensure they can withstand the stresses of highway driving.

## REAL WORLD CONNECTIONS

The Nebraska Engineering Additive Technology (NEAT) Labs was established in spring 2018 as part of the Nano-Engineering Research Core Facility. The facility provides a regional hub for additive manufacturing technology and houses state-of-the-science research instrumentation to position UNL researchers at the forefront of global research efforts focused on advanced manufacturing of materials, nanostructures and nanodevices. These labs conduct a wide range of dynamic testing on materials such as metals, ceramics, polymers and composites. Some of these tests include tensile testing, compression testing, torsion testing and fatigue testing.



## EXAMPLES

Dynamic Mechanical Analysis (DMA) is a specific type of dynamic testing used to study the viscoelastic behavior of materials such as elastomers, polymers and shape memory alloys. This technique involves applying stress to a material and measuring the resulting strain to determine its characteristics. Other forms of dynamic testing are:

**MULTIPURPOSE LOAD FRAMES:** Versatile test systems used for a wide range of dynamic testing applications

**BIOMEDICAL TEST SYSTEMS:** Specialized test systems designed for biomedical materials and devices

**GEOMATERIAL TEST SYSTEMS:** Specialized test systems designed for testing geomaterials such as soil and rock

**ELASTOMER TEST SYSTEMS:** Specialized test systems designed for testing elastomers and other rubber-like materials



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