

*Why is it
important to
test
Materials?*

Who Does Materials Testing?

- ***EVERYBODY!***

Material Suppliers

Steel, Aluminum, Plastics, Rubber, Textiles...

Manufacturers

Automotive, aerospace, biomedical, electronics, civil, packaging, sporting goods, construction...

Government

Defense Agencies & contracts, Regulatory Agencies, NASA, Bureau of Land Management

Food Industry

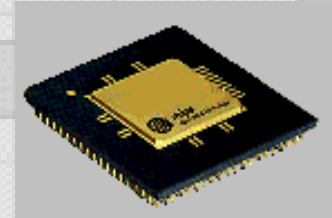
Food Processing Plants, Carriers, Growers, Research Labs

Academic

Research & post graduate studies, Undergraduate teaching labs

What gets tested?

- ◆ **Clothing**
- ◆ **Cars, airplanes, boats, etc.**
- ◆ **Food**
- ◆ **Packaging**
- ◆ **Most parts of the body**
- ◆ **Tools & materials**
- ◆ **Roads, bridges, and buildings you use**
- ◆ **TV, computer, stereo, carpets, paper**
- ◆ **Take a Look Around You for more examples.**



What are Major Focuses of Materials Testing?

- **Research & Development**
- **Quality Control**
- **Material Selection & Performance**
- **Safety**
- **Failure Analysis**
- **Cost Effectiveness**



Overview of Mechanical Test Types

Static - Slower tests, constant speed; electromechanical or Hydraulic Driven.



Impact - High rates; gravity or impulse drop.



Hardness - penetration, non-destructive method of testing.



Dynamic - Higher rates of speed, cycling, frequencies; servo-hydraulic.



Creep/Stress Rupture - Long-term Constant Loads, often at high temperatures.

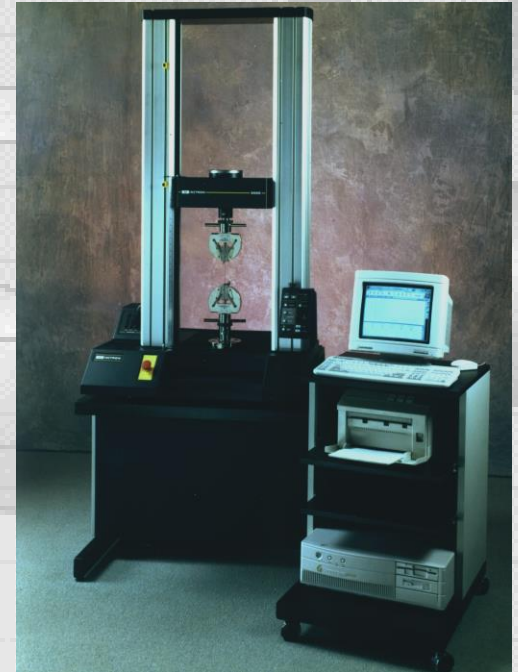


Durometer - Rubber hardness testing.



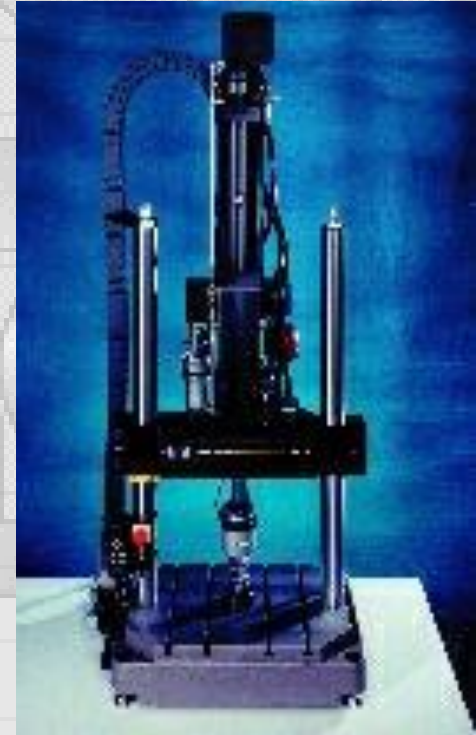
Universal Static Testing - Tension & Compression Testing

- ◆ **General purpose in their capabilities and applications (Most Common)**
- ◆ **Apply force in a uniform manner to test specimens.**
- ◆ **Uniaxial loading...Tensile or Compressive.**
- ◆ **Pushing or pulling a material until it breaks to find the failure point.**
- ◆ **Record Data on the “static” behavior of materials - like the strength of a rope in Newtons.**



Dynamic Testing - Servohydraulic Testing

- ◆ Applying cyclic loading to your test specimen to understand how it will perform under similar conditions in actual use.
- ◆ Testing materials by vibrating or oscillating forces to determine how a material will behave under repeated cycles of loading and unloading.
- ◆ “Fatigue” testing gives data to predict the in-service life of materials.
- ◆ It usually uses higher speeds and frequencies, and up to millions of cycles when compared to static testing.



CREEP/RELAX/Stress Rupture Testing

- ◆ Creep tests involve monitoring the amount of elongation a specimen exhibits while maintaining a constant force and temperature for extended period's of time. (Extensometers are used)
- ◆ Stress-Rupture tests monitor the amount of time it takes for a specimen to reach failure under constant load and temperature.
- ◆ Stress Relaxation tests involve monitoring the decreasing stress in a material subjected to prolonged constant strain and temperature.
- ◆ Furnaces or temperature chambers are typically used to maintain constant temperatures.



Impact Testing

- ◆ Determines the energy dissipated in fracturing a test piece at high velocity.
- ◆ Load is continually recorded as a function of time and/or specimen deflection prior to fracture.
- ◆ Used on plastics, composites, ceramics, metals and biomaterials in many diverse industries.
- ◆ Test sporting goods (helmets, protective gear), automotive components, packaging, aerospace, medical, military, etc.



A product is more likely to fail when it is subjected to an impact blow than when the same force is applied more slowly.

Hardness Testing

- ◆ Measure resistance of materials to permanent deformation.
- ◆ Operate by applying a known force, or combination of force, to a test piece using an indenter.
- ◆ Hardness values determined by measuring either the depth or size of the resulting indent.
- ◆ Non-destructive test on metals or metal parts.
- ◆ Types of hardness tests:
 - ⇒ *Brinell.*
 - ⇒ *Vickers.*
 - ⇒ *Rockwell.*
 - ⇒ *Microhardness.*



Durometers - Rubber Hardness Testing

- ◆ Shore durometers are used for hardness testing of elastomers and plastics.
- ◆ Test the indentation hardness of materials ranging from cellular products to rigid plastics.
- ◆ Hand-held or stand-mounted models.
- ◆ Each type is made to a specific scale (i.e. A,B,C,D)
- ◆ Capable of producing a value between 0 and 100.



Structural Testing

- ◆ Laboratory testing of Structures and Components carried out to ensure fitness of design and function.
- ◆ Encompasses the following categories of test types: *Durability Testing, Vibration and Shock Testing, Simulation Testing.*
- ◆ Simulation testing to determine stresses and strains experienced in the field
- ◆ Optimization of parameters...for example, suspension tuning of automobiles

