Instron® TechNotes Getting the most up-to-date information on materials testing

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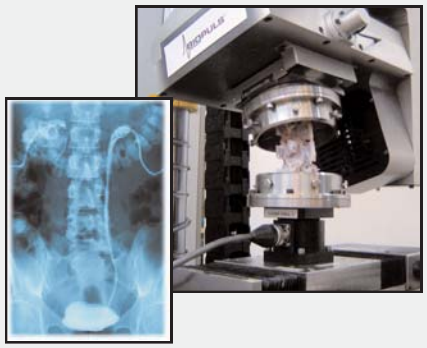
Application Story

Characterizing Spinal Range of Motion for Development of Improved Devices



Did you know that back and spine injuries are the most common musculoskeletal impairments? In fact, in a single year, more than 31 million doctor visits will be made for back pain. When an intervertebral disc bursts or slips and is beyond repair, surgery is required to remove the damaged disc and implant a fixation device, such as a plate or interbody fusion cage. These devices stabilize the spine, but also limit or eliminate the motion that occurs at the damaged location. This reduced range of motion is driving engineers to develop better spinal devices.

The University of Minnesota is characterizing the spine's natural range of motion; a critical step for the development of improved spinal devices. The spine's motion is complex with six degrees of freedom. To evaluate the effect of implants on these natural motions, a comparison of a spine with and without the device must be made. The effect of an implant is not necessarily local, adjacent vertebrae may be affected, so understanding the full implications of a spinal fixation device requires engineers to characterize the range of motion over an extended section of the spine. The test data gathered by Instron's **six-axis testing system** reveals restrictions in movement and load bearing capabilities at the implant area and adjacent vertebrae.

Tech Tip

Testing rubber specimens?
The specimen should occupy 100% of the grip face to reduce the possibility of slippage, jaw breaks and specimen extrusion.

Ask the Expert

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Technologies

The Invisible Rebar: Microscopic Nanotubes Dramatically Increase Material Strength

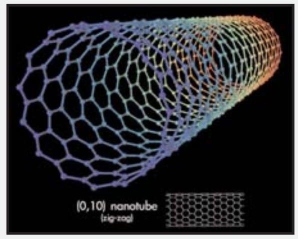


Diagram created by Michael Strck (mstroeck) on February 1, 2006. Released under the GFDL.

One of the exciting new building blocks for very small systems is carbon nanotubes (CNTs). These single- or multi-walled cylinders, made up of carbon atoms, are about 1/100th of the diameter of one piece of human hair.

What makes CNTs attractive is that they are light (about 1/6 the weight of steel), strong (about 100 times stronger than steel), electrically conductive (more conductive than Copper), thermally conductive and UV absorbing.

A promising application for CNTs is nanocomposites, where tubes are combined with another material (either an epoxy or polymer). The CNTs behave much like fibers in wood or rebar in concrete. The fibers are strong and make up most of the strength, whereas the matrix holds the fibers in place and makes it a usable material.

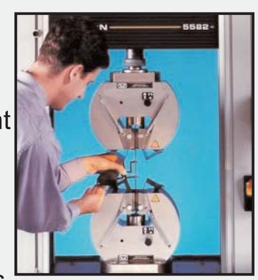
In 2004, Nanocomposites, Inc. licensed the Rice University patented process for functionalizing CNTs, a process which affects the surface of the nanotubes and makes them more suitable for mixing with polymers. The process dramatically reduces the CNTs tendency to stick together, thereby allowing them to mix and bond with the matrix, significantly improving mechanical properties.

For example, by adding treated CNTs to a rubber compound, Nanocomposites, Inc. measured a 35% increase in ultimate tensile strength. Additionally, 90% of the material's strength is retained at temperatures up to 400°F (204°C).

Nanocomposites, Inc. used an Instron **electromechanical testing machine** equipped with a **video extensometer** to measure the mechanical properties of their materials at ambient and elevated temperatures. For more information on Nanocomposites, Inc., please email Dr. Christopher Dyke at **dyke@nanocompositesinc.com.**

You Asked - We Answered

Q: Why am I getting low modulus values from my test machine?



A: Elastic modulus values are affected mainly by how strain is measured. Small errors in strain measurement can result in large errors in modulus values. If crosshead extension is used for strain, it will include small deflections of the testing machine and the grips under load, which are added to the specimen elongation. This results in artificially large strain values and lower-than-expected modulus values. The most accurate approach for modulus measurement is to measure strain by applying an extensometer directly to the gage length of the sample, thereby eliminating errors from other sources of deformation. **Browse Instron's extensometers.**

What do you think? Tell us!

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