INSTRON®
The difference is measurable®

TechNotes

Getting the most up-to-date information on materials testing

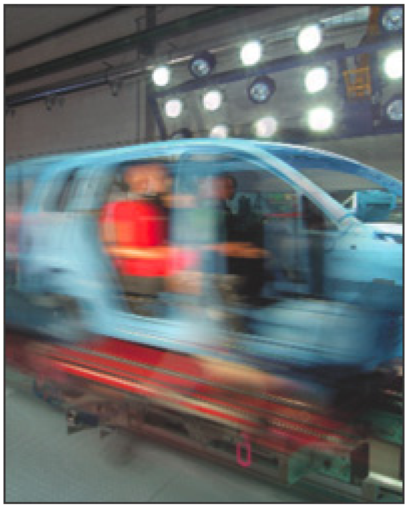
Instron.com | Subscriptions | Newsletter Archive | Testing Solutions | Contact Us

Issue 46

In This Issue

Application Article:	Advances in Crash Testing
Technical Tip:	Control Your Chamber
You Asked – We Answered:	Q: My specimen is very compliant and I cannot get it to run a fatigue test in load control. What can I do?

Advances in Crash Testing



Automobile manufacturers and component manufacturers spend millions of dollars running cars into walls and other cars, or running concrete sleds into cars, to simulate head-on crashes, side crashes, and rear end crashes. Full vehicle crash testing is destructive. It requires a complete and fully instrumented vehicle for each single test. To assess the effects of these crashes, they use sophisticated crash test dummies that can cost upwards of $100,000.

Partly funded by a consortium of automobile and component manufacturers, researchers and engineers in many fields are working to reduce the expense of destroying cars and equipment and increase the fidelity of the tests. Two technologies in particular stand out – the virtual crash test dummy and the servohydraulic catapult.

Crash Testing - Not for Dummies

Even the best crash test dummies are not sophisticated enough to show the real injuries resulting from a crash. So in 2006, a group of automobile manufacturers and automotive component manufacturers from the USA, Europe, and Japan formed the Global Human Body Model Consortium (GHBMC) with the aim of developing a computer-based virtual crash test dummy.

Teams of researchers at eight universities and institutes, funded by the GHBMC, are creating models of parts of the human body. For example, the University of Virginia has two separate teams: one is developing a realistic computer model of the human thorax and upper extremities, including the ribcage, muscles and ligaments, and the lungs and heart, while the other team is developing a virtual pelvis and lower extremities. All of these models will eventually be combined to create the most sophisticated and life-like simulation of the entire human body ever assembled for safety testing. GHBMC plans to develop a set of human digital models of different size and gender, and eventually to build a family of virtual humans over several years, from children to the elderly.

A virtual human can be subjected to an infinite number of crash scenarios to determine what happens to organs, bone, and tissue when subjected to forces and impacts from a range of angles at different velocities. Researchers will be able to see how a neck breaks in a crash, how a broken rib punctures a lung, how a liver bruises, or a hip shatters. The software also enables engineers to remove the dummy's body parts to reveal previously unseen injuries. The tests will help manufacturers improve safety features in cars to prevent injuries, keeping drivers and passengers safer.

The purpose of the virtual crash test dummy is not to replace physical testing but to supplement it. Many computer-based crash tests can be simulated without having to build and destroy a physical prototype for each case. Instead, ideas can be tested in complex mathematical models in the computer, and the most promising then replicated as physical experiments.

Of particular interest, Ford Motor Company, Virginia Tech and Wake Forest are working on the development of a computer-based model of a pregnant woman for virtual crash test simulations. The model being developed should help Ford safety researchers better understand how crash forces affect pregnant women and their unborn children.

Testing with a Slingshot

One of the key development tasks in automotive manufacturing is optimizing the interaction between the occupants of a vehicle, the structures and the passive safety devices such as airbags, safety belts, head restraints, windscreens, steering wheels, seat, and seat anchorage systems. The dynamics of a crash are infinitely complex. It's not enough to simply run a car at a certain speed into a concrete barrier. Drivers usually react if they are aware of an impending impact. Their muscles tense. They brake, causing other occupants to be thrown forward in their seats. The deceleration causes the car to pitch, usually, but not always, nose down. The driver may turn the steering wheel to avoid a crash, moving the occupants sideways in the car.

Modern crash simulations or catapult systems are designed to reproduce these motions. The servohydraulic catapult uses precise servohydraulic control in concert with a sophisticated computer system to reproduce the complex multi-axis behavior of a crash.

The test catapult inverts the principle of rapid deceleration during a crash. Instead of decelerating a vehicle into a rigid wall, a vehicle or substructure is mounted onto a carrier sled and accelerated backwards from standstill up to driving velocity. In this way the vehicle interior, the dummies and the safety equipment experience the same kinematics as in a full-scale crash without the costly destruction of the classic crash test.

Through the efforts of many teams of researchers and engineers in universities, institutes, and testing equipment manufacturing companies, the automotive world is moving toward more cost-effective testing that generates improved results and safer cars, a win-win situation for all of us.

Control Your Chamber

Long-term fatigue tests often finish outside of work hours when the lab is empty. If an environmental chamber or furnace has been used in the test, the furnace continues to consume large amounts of power until someone shuts it down.

It’s possible to control certain environmental chambers or furnaces via a USB or RS232 link from an Instron Dynamic system. You can set the control software to change the set point on the temperature control system to ambient at the end of the test, thus cooling the chamber/furnace and consuming far less power. Don’t forget to enable specimen protection if necessary to prevent the generation of high loads as the specimen cools and contracts.

Q. My specimen is very compliant and I cannot get it to run a fatigue test in load control. What can I do?

A. It is often very difficult, and sometimes almost impossible, to run a test under load control with really compliant materials such as polymers, elastomers, and soft tissues. However, most Instron Dynamic systems run tests using ‘outer loop’ control. This lets you set up the system to run the test in position (stroke) control, which is both simpler to set up and more stable, while it measures the maximum and minimum load during each cycle. Outer loop control modifies the mean level and amplitude of the initial position waveform to achieve the specified target load peaks.

Subscribe Today
and receive the latest
testing news

Visit the Instron
Community Blog

View upcoming events
where Instron will
be attending

Submit your questions
for future issues
of TechNotes!

Instron Worldwide Headquarters
825 University Ave
Norwood, MA 02062
www.instron.com

If you would like to subscribe to this newsletter or others, you may do so on the Subscriptions page of our website.