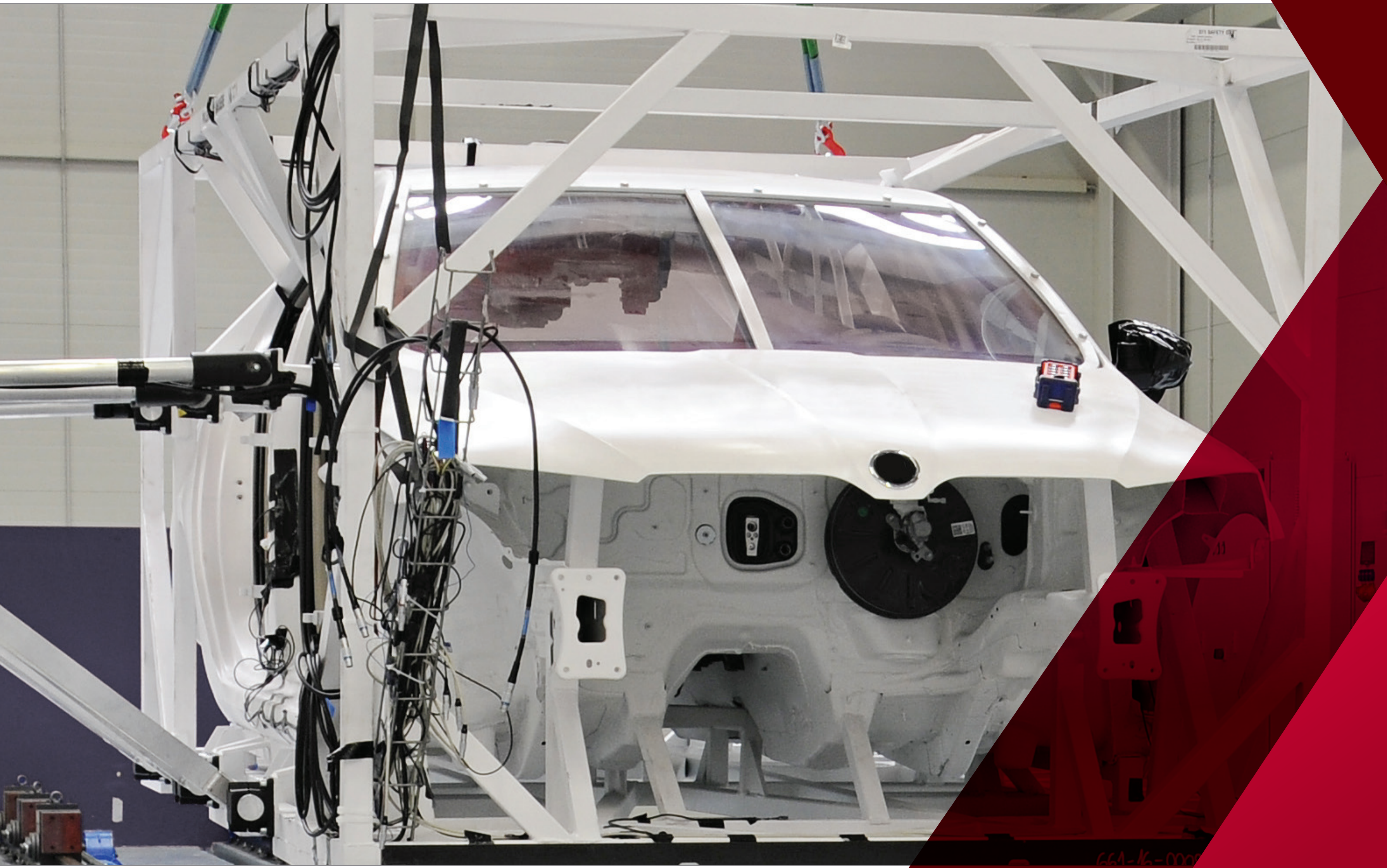
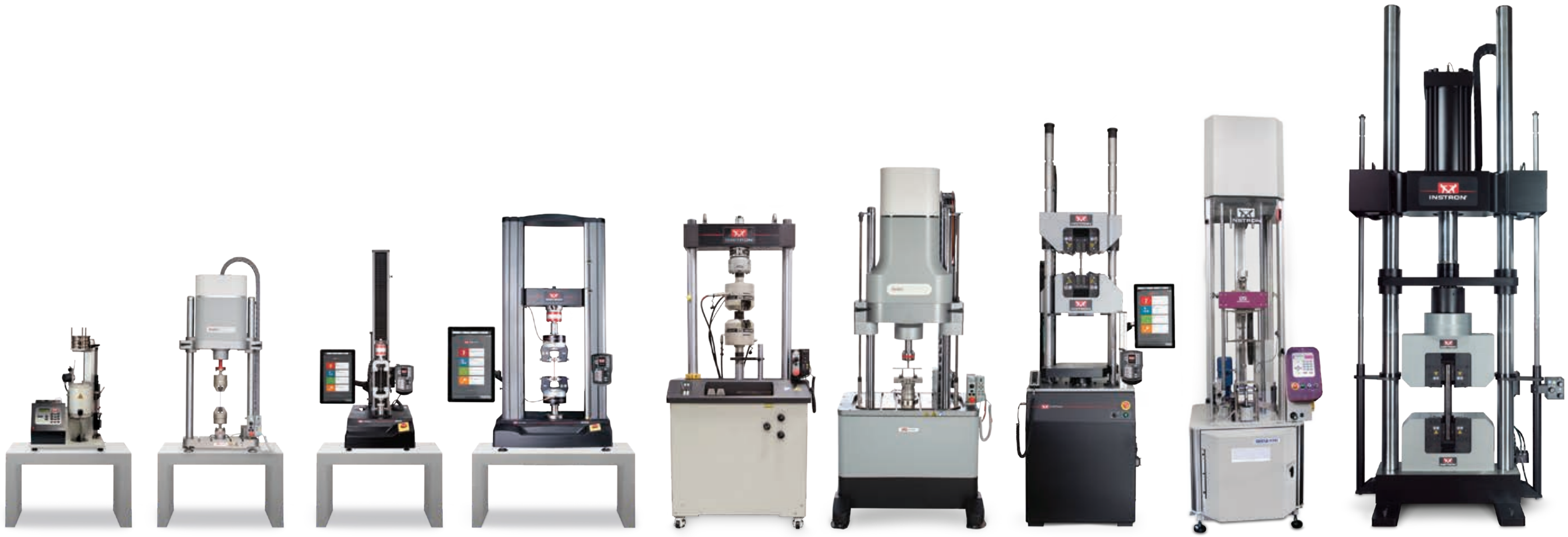
Automotive Testing Solutions

Materials, Components, and Structures



INSTRON®



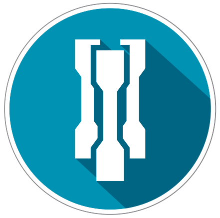
With more than **70 YEARS** of materials testing experience, Instron® delivers impactful innovations to enable our users business to thrive. We are committed to delivering services which delight, as well as usability improvements throughout the lifetime of the system.

1500+ Employees
A highly-educated, experienced, and diverse workforce

Representing **160 Countries**, speaking **40+ languages**

50,000+ systems installed worldwide

70+ years of engineering and manufacturing testing systems



Diverse product range for nearly all global markets and industries

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BUMPER IMPACT TESTING

Impact testing on plastic components used in cars and motorcycles determines their response to a sudden high-speed mechanical impact, providing invaluable safety information.

Challenge

Impact testing of bumpers is an important part of vehicle development. To absorb an impact, such as an unintentional bump at low speeds, bumpers must deform in a flexible manner. However, at the same time, they must have the ability to break and dissipate part of the impact energy during a major incident. These material properties must be determined at a multitude of working temperatures and conditions.

Solution

To understand the impact resistance properties of bumper materials, a series of tests on specimens should be conducted, in plaque form, at varying impact energies, velocities, and temperatures. After collecting this data on the raw material, the finished bumper can then be tested under the same set of conditions. Fully instrumenting the test with a force sensor (Tup) and data acquisition system, we are able to evaluate how the bumper reacts to an impact event by studying the changes in the load-deformation curves during the test.

Globally, there are increasing efforts to reduce the weight of automobiles, increasing fuel efficiency, which aids in the reduction of emissions. Various grades of steel have been the predominant material used for manufacturing automobiles chassis' and body. A new generation of advanced high-strength steels (AHSS) are being developed and produced to maintain the automotive industry's demand for steel. Despite this, automotive manufacturers are now also working with aluminum producers to increase the percentage of aluminum used in the production of automobiles. Aluminum offers low density, excellent formability, corrosion resistance, and high strength.

Challenge

Sheet metal product development is currently driven by the demand for increased strength with minimal impact to formability. The automotive industry is the greatest driver for increasing strength, meaning thinner/lighter material can be used in the production of cars, reducing overall emissions. Plastic strain ratio (r-value) and the strain hardening exponent (n-value) are critical mechanical properties that define the formability of these products.

Solution

During a tensile test, these formability properties can be determined automatically using Bluehill® Universal software. To determine n-value, axial strain needs to be measured after yield and determined at or between strain values. More traditional contacting extensometers are designed to be removed during the test and may be limited in total travel. Using the latest technology, such as the Advanced Video Extensometer (AVE 2) or the AutoXBiax, strain can be measured throughout the test while ensuring the highest accuracy of results. To determine r-value, the transverse strain must also be measured, traditionally done using an additional extensometer. With either of these devices (AVE 2 or AutoXBiax), axial and transverse strain can be measured at the same time.

HIGH RATE TENSILE TESTING

Crash safety is a high-profile part of automotive design and it depends upon how the structure deforms, absorbs energy and fails. An essential part of the performance of automotive structures under crash conditions is the performance of materials and joints at high strain rates, far higher than encountered normal quasi-static tests or even fatigue.

Today's industry uses high quality simulation of different collision scenarios to generate near-perfect prototypes for validation. High rate tensile testing is needed in order to provide data on material behavior at high strain rates and it can also be used to test parts and sub-assemblies under high rates of deformation.

Challenge

To generate effective crash simulation models, it is critical to provide good quality measurements on representatively sized specimens of engineering materials. That means achieving a range of strain rates up to and exceeding 500 s-1, and maintaining that through to failure. It also means analyzing complex raw data to generate clean plots for engineering design and analysis.

Solution

Instron® VHS systems are available with up to 100kN force capacity and can achieve up to 25 m/s actuator velocity. VHS systems incorporate control systems capable of driving a constant engineering strain rate through to failure (something generally unachievable with drop-weight equipment) and configurable data acquisition rates up to 60 MHz to suit even the fastest tests on brittle materials. A data analysis package provides all the necessary tools for filtering and fitting raw data, as well as re-sampling and data integration tools for strain measurements from high speed digital image correlation (DIC).

Instron expertise in system configuration and testing covers the full range of structural materials, but also extends to testing of safety critical assemblies, such as seat belts and fixtures.

FATIGUE TESTING

Fatigue performance has always been important in automotive design, where the sources of cyclic loading and vibration are many and varied. Hence fatigue behavior is a long-established part of qualification for automotive steels and remains essential for newer designs with aluminum and composites.

Challenge

In today's automotive industry, cyclic loading represents a diverse range of evaluation needs; including low cycle fatigue of metals, high cycle fatigue of composites and joints, damping behavior of mountings and interior panels – all of which affect the NVH (noise vibration and harshness) and hence, passenger comfort.

Solution

For a multipurpose laboratory handling large specimens, Instron® servo-hydraulic systems provide excellent capability for medium to high-capacity dynamic testing. The load frames can be configured to meet a wide range of materials, component testing, and requirements; and can be fitted with interchangeable fixtures to perform specific tests.

The Instron 8800MT controller with WaveMatrix dynamic test software provides high fidelity of control, and synchronous data acquisition, with easily configured test sequences and live calculations to facilitate everything from "simple" fatigue, to vibration analysis, to multi-step conditional test sequences.

Additionally, application-specific software packages can be used seamlessly on the same system to provide more streamlined workflows for LCF, fracture toughness, or quasi-static testing.

STRUCTURAL DURABILITY TESTING

Growing demands on the comfort and reliability of vehicles require functional and life-time tests of components or complete systems to avoid hazards for humans and the environment or economic damage for the manufacturer.

Challenge

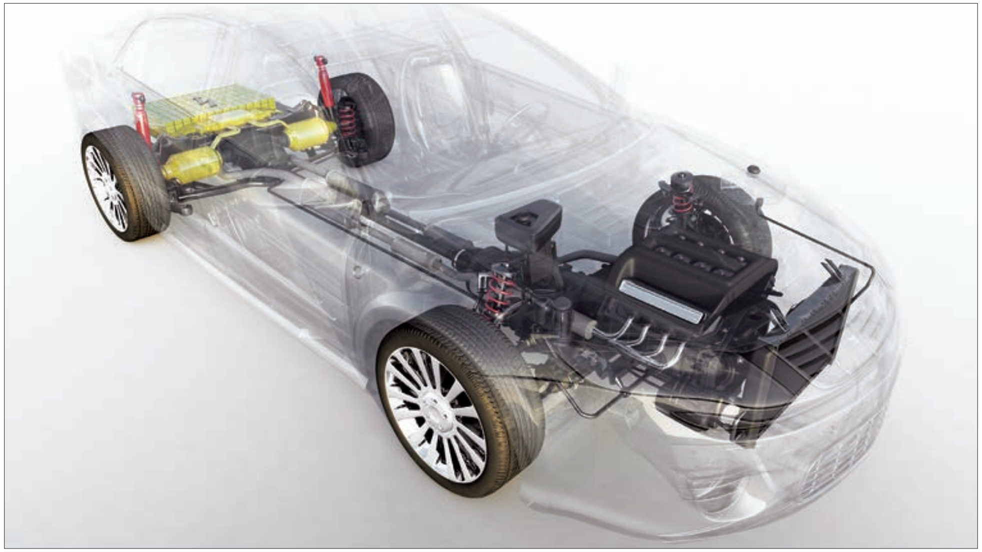
A car consists of an average of 10,000 individual components. During their lifetime, diverse service loads affect most of those vehicle components. Components weaken or wear through their lifetime meaning that safety and reliability can no longer be guaranteed. Fatigue damages caused by bad road conditions or extreme driving maneuvers can cause damage to car components, which can lead to serious accidents. Currently, automotive manufacturers and their component suppliers must carry out extensive functional and service life tests of vehicle components or entire systems in order to avoid personal injuries, and property or environmental damages.

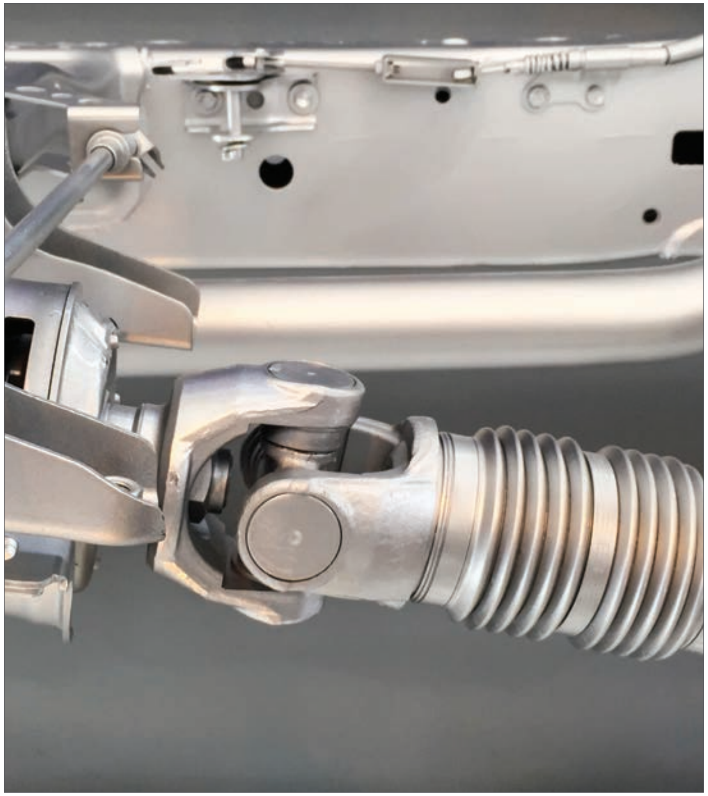
Solution

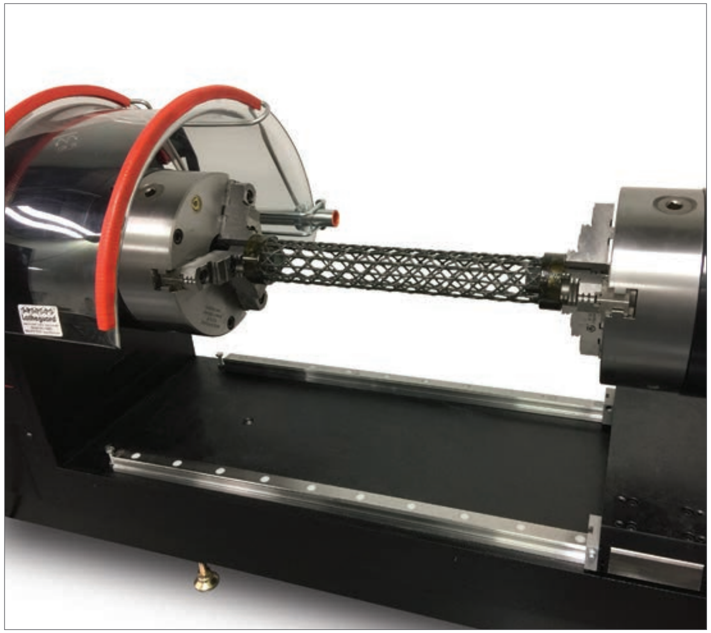
Instron® offers comprehensive expertise in the areas of service load simulation, comfort, and vibration tests designated for testing passenger cars, buses, trucks, and special vehicles.

The offered solutions give a wide range from simple, single-channel component testing to complex, multi-axis, test systems which enable the simulation of all service loads including those under environmental conditions. A modular concept allows individual test rig components to be customized and tailored to the specific requirements of the application at hand.

With our test and simulation systems, we bring the road directly into your laboratory allowing you to reproduce and simulate all desired real-world conditions in a laboratory setting.







DRIVE SHAFT TORSION TESTING

Driveshafts rotate at very high speeds and experience high torque forces; and therefore must be precisely balanced and weighted. Inferior driveshafts can cause problems that affect the drivability of the vehicle.

Challenge

Most commonly made of steel, a driveshaft transfers power from the transmission to the wheels of a vehicle. As the drive for light weighting increases, a new range of materials used in composite driveshafts is now being developed. These driveshafts are made of carbon and polymer fiber, and are designed to break into small fiber fragments upon failure, increasing safety. Composite driveshafts are also lighter weight (compared to typical steel) with higher torque capacity, higher rpm value, and reduced noise and vibration.

Determining the torque and rotation properties of driveshafts is critical to meeting the desired performance.

Solution

Instron® MT Series systems offer a range of capacities for torsion testing ideal for testing drive shafts. These systems offer accurate, multi-turn capability with high torsional stiffness. Adjustable horizontal test openings and lathe chuck grips facilitate easy specimen loading.

The system utilizes powerful Bluehill® Universal software, with a specific torsion application module providing default methods. The TestProfiler module can also be used for more complex loading scenarios, such as applying torque at different rates within the same test or cyclic testing.

SHOCK ABSORBERS IMPACT TEST

The automotive industry remains one of the most susceptible and vulnerable to impact events. Depending on the component, impact damage can have a minor effect on appearance or lead to a major failure in vehicle safety. Both car assemblers and OEM part suppliers must comply with strict safety standards in order to produce high-quality products. Automotive test standards and regulations place an emphasis on impact performance of assemblies and components.

Challenge

Shock absorbers used in an automotive suspension assembly can experience impact damage. In real-life conditions, these dampers are exposed to multiple impacts and are expected to make vibrations as smooth as possible (e.g. speed bumps). It's necessary for suppliers to understand the behavior of the rubber damper or plastic part connected to it after repeated impact cycles.

Solution

Instron® designed a special tall thermostatic chamber for a 9350 Drop Tower to accommodate a 600 mm tall damper assembly, and developed a dedicated software module to perform multiple impacts on it. This software module enables automatic repetitive impact tests up to 1200 consecutive cycles to simulate the actual use scenario. This helped our customer with new product development and material selection for dampers to be used in this application.

SHOCK ABSORBER CHARACTERIZATION

Damping devices have been critical to automotive design since the earliest days of motorized transportation. Driven by the desire to provide better, more consistent levels of passenger comfort, an increased focus on improved damping devices has resulted.

Challenge

It is important to characterize both the performance and life of all sorts of damping devices and materials, ranging from rubber engine mounts, to shock absorbers, to seat foams.

Solution

Instron® dynamic systems provide suitable solutions across the range of test needs. We can provide small self-contained all-electric machines employing our patented linear motor technology for low force requirements, and high performance servohydraulic machines for heavier test capacities. Standard software features are available to easily tailor your test to analyses such as frequency response, energy absorption, recovery rate, playback of recorded loading data, or constant fatigue to failure. Visual test method design allows convenient set up of multi-step tests, and customizations can be provided to run externally set sequences of loading.

BUTTON AND SWITCH TESTING

In today's automobiles, nearly everything is controlled by buttons or switches, including starting the engine, navigating the dashboard for entertainment and diagnostic information, and controlling advanced door locking systems.

Challenge

It is critical to test the functionality of buttons and switches, as the risk of a defective button could be very high; for example, a driver not being able to enter or turn on their vehicle. Mechanically testing buttons is mainly compression testing in order to understand how much force is required to push a button to engage the electrical signal. This is also known as tactility testing of buttons where OEMs are interested in testing to determine the "feel" of a button.

Solution

Instron® offers various XY stages that can move to test multiple buttons on the same specimen. Standard and custom solutions are available to hold specimens securely during testing. In addition to the standard probes offered, Instron's Custom Solutions Group is committed to working with customers on designing probes of different materials and sizes based on specimen and application requirements. Instron also offers a multiple point compression software solution that is strictly designed for testing buttons and switches at high speed. Parameters include button height and return height, eliminating long travel times.

As infotainment display panels and screens are becoming standard features in many automobiles, it is important for manufacturers to understand their mechanical reliability. These displays need to last the lifetime of the vehicle, much longer than a standard electronic device. Therefore, it is relevant to study their mechanical reliability.

Challenge

Display panels need to withstand years of abuse. A multitude of rigorous testing needs to be completed to ensure the panel will last. Compression testing should be completed on multiple locations on the panel, which has historically been very time-consuming. Additionally, flexure tests are also conducted, sometimes to a point of failure. Panels can fail out of nowhere and it can be hard to observe the break. All these factors make display testing challenging.

Solution

Instron® offers an XY stage that will move the display panel so that compression testing can be completed at multiple locations. The stage is driven to different points taught by the operator using the Multi-Test module for Bluehill® 3 Software. The test is then automated so all points can be tested in a single run at high speed. Alternatively, TestMaster software is also capable of running the XY stage and will treat each point as a separate sample, if desired. Probes of different sizes are available as well. With a variety of flex/bend fixtures, Instron is able to meet most any display panel bend test need. Fixtures include both 3 and 4 point models with fixed and variable span options. Fixtures can also be altered with a variety of options. If you have a unique bend test need, Instron's Custom Solutions Group can work with you to develop a fixture to your specifications.

Understanding the failures of display panels can be complex. The Instron TestCam module generates a video recording synchronized with the test data allowing a complete understanding of how the panel reacts at break.

NON-AMBIENT METALS TENSILE TESTING

When working in automotive R&D, awareness of how various materials act at ambient temperature, as well as normal operating temperature, is important. Many original equipment manufactures have unique temperature requirements that all components need to achieve, (i.e. -30°C to 80°C). However, engine and transmission components get considerably hotter. It is extremely important to subject the material to these temperatures during testing to understand their performance.

Challenge

In order to determine the material's performance at high temperatures, is it critical that the temperature of the material is carefully controlled when the desired temperature is reached. For auxiliary parts or components, the temperature requirement will not be as high when compared to the material within the engine block, which will be considerably hotter and can be closer to the melting point of the material, which could cause failure.

Solution

3119-600 Series environmental chambers can accurately control the temperature from -150°C up to 600°C (-240°F to 1110°F) making them suitable for all types of materials within the engine and transmission assemblies. Alternatively, the 1200°C (2200°F) Model SF-16 three-zone resistance furnaces have a split construction design that facilitates fast and easy loading of a pre-assembled load string. Adjustable stainless steel latches keep the furnace halves locked together during use, but are then easily opened once testing is complete. The temperature soak time can be automatically set in Bluehill® Universal and, once complete, the test will start. Alternatively, utilizing TestProfiler, you can have different temperatures under different loading conditions during the same test.

NON-AMBIENT PLASTICS TENSILE TESTING

Most plastic components are expected to be used in various environmental conditions, some of which may include cold and hot temperatures. Since the mechanical properties of plastics are influenced by temperature, it is very important for designers to consider a plastic's performance over the temperature range a component is expected to perform in.

Challenge

Determining the mechanical properties of plastic materials over a wide temperature range requires a stable and accurate specimen temperature during testing. Test fixtures, such as grips and flex jigs, and strain measurement, must be capable of reliable operation at the test temperature. Accurate measurement of specimen strain at temperature can be challenging, requiring extensometers or deflectometers suitable for use at the test temperature.

Solution

Instron® 3119-600 series environmental chambers can accurately control the temperature from -150°C up to 600°C (-240°F to 1110°F) making them suitable for materials of all types within the engine bay. Optional roller mounting brackets make it easy to move the chamber in and out of the test space to quickly change between ambient and non-ambient testing.

For strain measurement, the majority of our basic standard clip-on style extensometers are designed to work within a temperature range of -100 to 200° C (-148 to 392° F), which covers a vast range of the testing needs. However, there are some applications that have higher temperature requirements, and for these applications, we recommend our high-temperature clip-on extensometers, which can be used in temperatures as high as 600° C (1100° F). In addition to contacting solutions, video extensometers, such as the AVE 2, can also satisfy requirements for a variety of hot and cold applications. The AVE can mount to the outside door of most Instron environmental chambers, allowing it to measure strain through the viewing window while not subjecting it to the various temperature extremes .

THERMOMECHANICAL FATIGUE TESTING FOR ENGINE AND EXHAUST MATERIALS

The need for lightweight design extends to increasingly aggressive measures to reduce mass in every part of the vehicle, including the power unit.

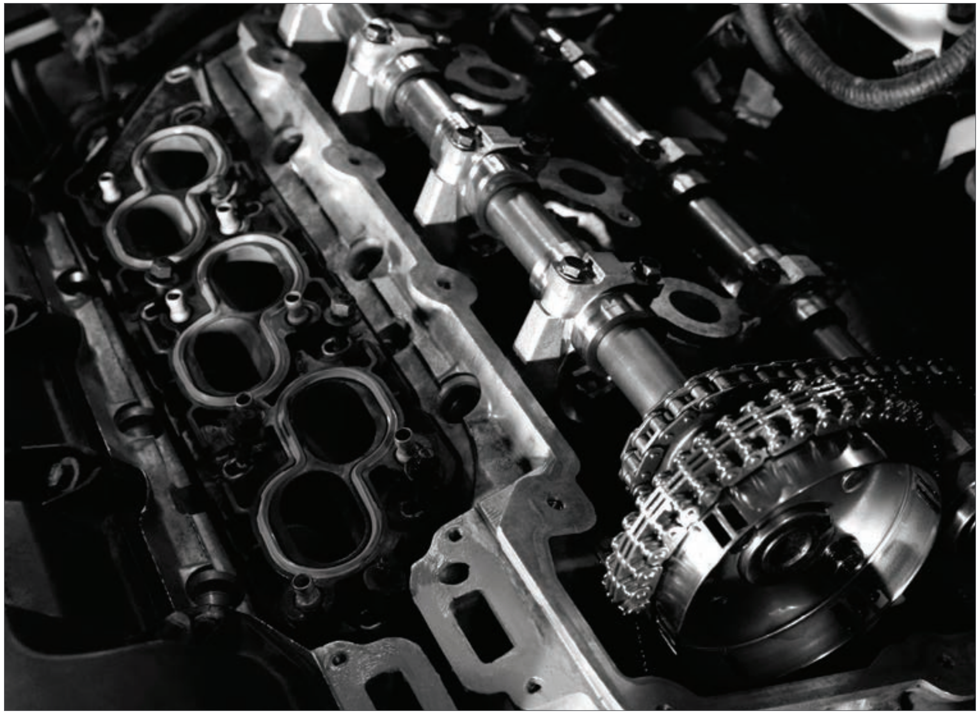
Challenge

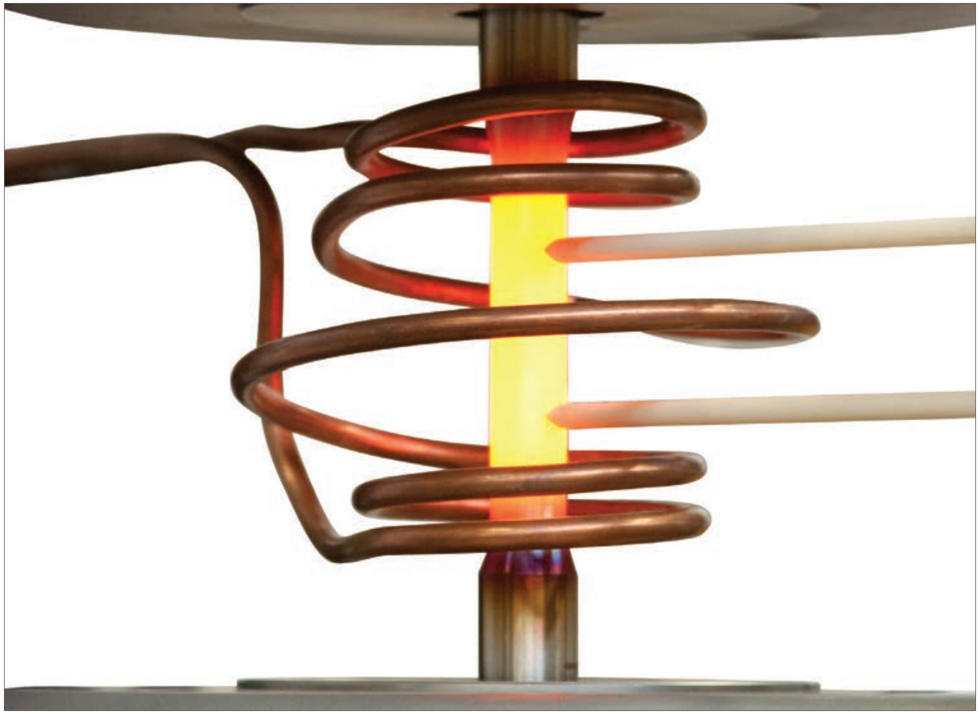
Engine and exhaust components are subject to complex combinations of strain as the system heats up and vibration while running, and the effects of these combinations are not easily predicted or modeled. Detailed characterization is needed to determine how weight can be minimized, but also whether production costs can be reduced by making simpler choices or modifying material or processing techniques.

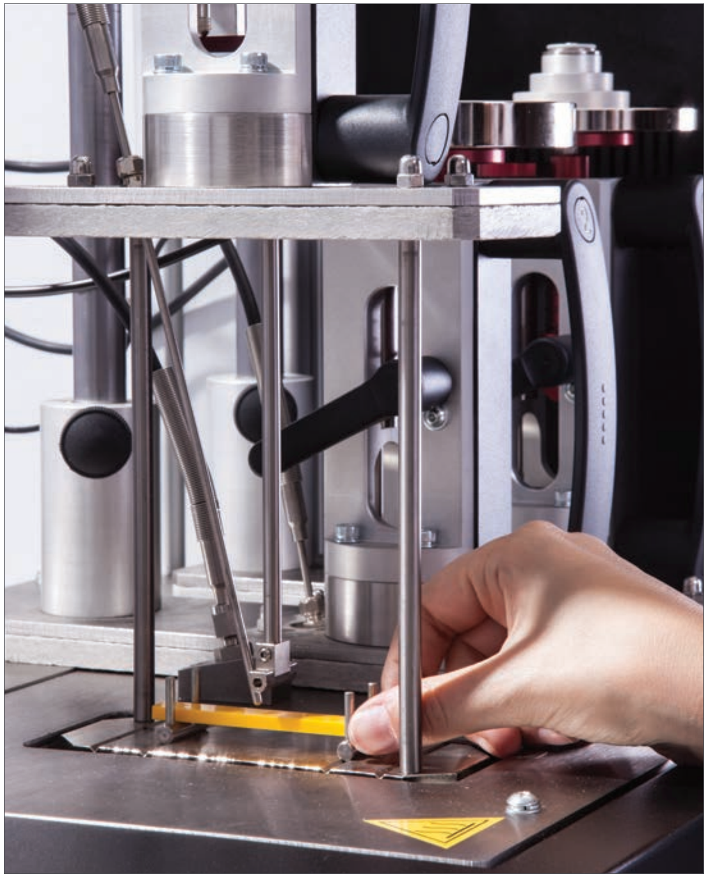
Solution

Thermomechanical Fatigue (TMF) systems simulate the complex effects of simultaneous thermal and mechanical strain. This test is able to replicate the service conditions normally experienced by engines. TMF testing helps to better evaluate the life of materials and engineering components that are used in critical, high-temperature applications.

Instron® thermo-mechanical fatigue systems incorporate over 30 years of equipment and test development in an integrated state-of-the-art machine and software, designed to provide consistent reliable tests even for this complex characterization process.







HDT AND VICAT TESTING

Using lightweight materials, such as thermoplastic polymers, can help to meet increasing demand for reducing vehicle weight, fuel consumption, and production cost.

Challenge

Automotive interior design is influenced by the proportions, shape, placement, and surfaces for the instrument panel, seats, interior trims, fans, shrouds, etc. Smoothness, feel, and stiffness are just a few of the material characteristics considered when developing automotive interiors.

It is also important to evaluate the short-term heat resistance of materials used in automotive interiors. For example on a hot summer day the temperature of the dashboard can easily reach 50°C (122°F). If the material used to make the dashboard is not tested under these conditions, the dashboard can potentially deform and suffer damage.

Solution

Instron® HV systems allows performing both heat deflection temperature (HDT) and Vicat softening temperature (VST) tests according to both ASTM and ISO standards. The polymer specimen is immersed in a fluid bath where the temperature is raised uniformly at a specific rate (120°C/h or 50°C/h). A predefined load or stress is applied to the specimen in order to measure the temperature at which it shows a set deflection (HDT test) or penetration (VST test). Higher HDT and VST values obtained in a test signify that the tested material is suitable for high-temperature applications, making it a preferable material for automotive applications. In addition to the bulk properties, HDT and VST test results also provide input on the surface properties of a polymer. At temperatures higher than those established by an HDT or VST test, it can be anticipated that the polymer sample undergoes permanent deformation, generating further surface defects.

IN SITU TESTING

Not all human interactions with automotive components are purely axial and always vertical. If only using a vertical, axial frame, this can create a challenge for the fixture design, or prove to be impossible to test in situ. It is important to test final components in the way that the end user will interact with them.

Challenge

Shifting an automatic or manual transmission is not a purely linear motion. As you shift between gears, the gear shift moves through an arc. If this test was forced into a linear axial system, a complex fixture design would be needed and the gear shift would have to be placed on its side, not mimicking the real-life application.

Solution

The Electric Actuator is a modular tester which has the flexibility to be easily mounted and installed to suit the application. Flexibility in mounting allows the customer to mount the actuator in any angle to simulate the final use scenario. If the actuator is mounted on a trunnion, it enables it to pivot a move through an arc as the shifter moves between gears.

METAL BOLT TESTING

In the manufacture of automobiles, metallic bolts are used in large volumes ranging in application from high strength required for structural assembly to securing lightweight parts to the vehicle. Whatever the application they are used for, testing is critical to determine if they will be suitable for the application and/or to ensure they meet quality standards.

Challenge

Bolts are typically produced in extremely large quantities; and testing needs to be completed as quickly as possible to ensure that product can be shipped.

Solution

Bolt testing accessories enable proof tests, axial and wedge tensile tests, and cone stripping tests on most standard bolts, screws, studs, and nuts. They are compatible with most universal and tensile testing machines. Each bolt holder has a key slot that allows the operator to quickly and correctly load the specimen. A recessed circular area in the bottom of each bolt holder ensures that the washer will fit snugly (sheet metal alignment device is used on Series E holders). This reduces loading time and occurrences of slippage because a secure, centered seating is ensured for each test.

ADHESIVE TESTING

As the drive for light weighting expands the range of materials used in automobiles, the requirement for reliable ways of joining these materials grows in importance. Adhesive joining technology is capable of joining dissimilar materials and can offer improved performance over traditional methods in many situations. However, careful qualification and quality controls are needed to ensure reliable results.

Challenge

As adhesives find their way into even more arduous automotive applications, the need to understand their static and fatigue behavior under different environmental conditions grows.

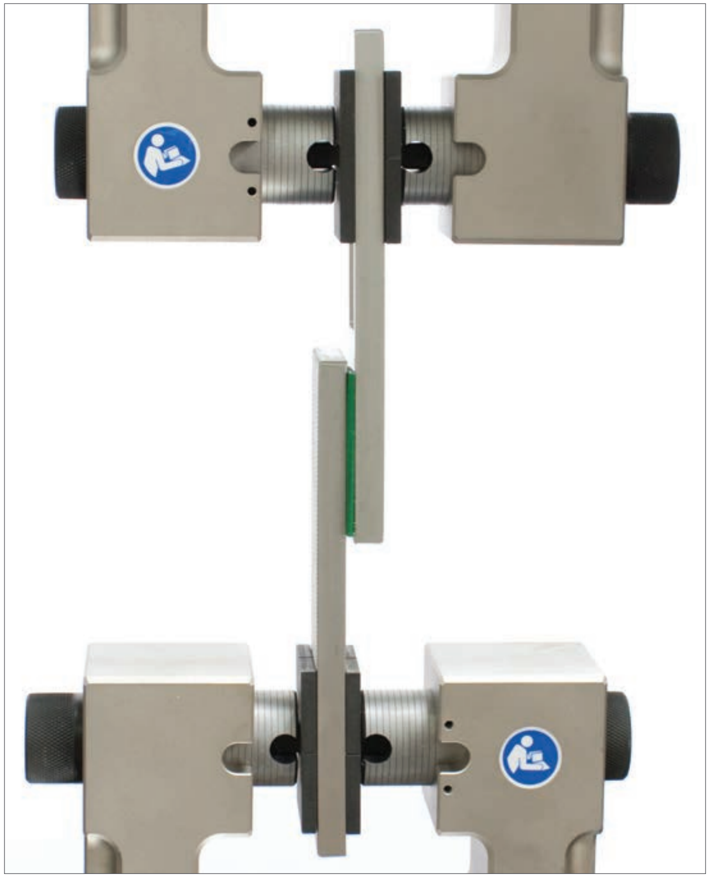
A variety of techniques can be employed to test the mechanical properties (e.g. strength and stiffness) of adhesive joints. Measuring the strength of an adhesive joint between rigid parts is usually performed using a lap-shear test. Various forms of peel tests are used to measure the strength of joints between flexible and rigid/flexible parts.

Fracture toughness tests are used to explore crack growth in bonded joints under both static and fatigue loading. The results of fracture toughness tests can provide a better understanding of the mechanisms of adhesion and the reasons for joint failure.

Solution

The Instron® range of electromechanical and dynamic testing machines are well suited for all types of adhesive joint testing. A range of grips and fixtures are available to assess the strength of adhesives. Tests on lap-shear specimens are commonly performed using either; wedge action grips, screw operated side action grips or pneumatic grips. Peel test fixtures include; 90° peel, variable angle, floating roller and rotating wheel types. Specialty fixtures, such as the climbing drum peel fixture, are available for testing the adhesive bonds in sandwich core materials. Bluehill® Universal software is ideal for static adhesive testing and an optional Adhesives Application Module includes a number of pre-configured test methods to ASTM, EN and ISO standards.

Fatigue tests on adhesive joints can be performed on dynamic machines using fatigue-rated mechanical or hydraulic grips. Adhesives are often tested under various environmental conditions, in this case, Instron environmental chambers are available.



Over the past 20 years, the importance of occupant protection in the development of automobiles has greatly increased. Tighter legal requirements and consumer protection programs have led to significant innovations in the area of active and passive safety. Passive safety is mainly focused on the development of methods and guidelines that reduce the severity of injuries caused by accidents.

Challenge

The implementation of these methods and requirements are extremely demanding for car manufacturers and their component suppliers.

When developing safety components such as airbags, seat belts, seats, etc., a wide range of crash scenarios must be covered and tested in a timely manner. In addition to the modeling process in the design phase and the test of a complete car in the real crash test, the crash simulation system, also known as a sled test system, is one the most important tools in the development process of these safety components.

Today, these crash simulation systems must ensure an efficient and productive testing process, in addition to the performance required for the test. This way, these instruments can optimally support the development of safety systems.

Solution

In the area of passive safety, Instron® is the market leader, with over 75 installed crash simulation sled systems. In addition to well-known applications, such as frontal, offset, and rear impact, the actively controlled pitch motion simulation for frontal tests has proven to be an outstanding technology in the field.

Acceleration sled systems from Instron are used for the development and approval of vehicle safety systems and vehicle parts, as well as for the investigation of material and structural behavior during crash procedures.

These innovative systems have a proven record of strong performance and undisputed quality. Having original and unique solutions for current and future testing increases productivity and ensures efficient test operation.

DASHBOARD DROP WEIGHT IMPACT

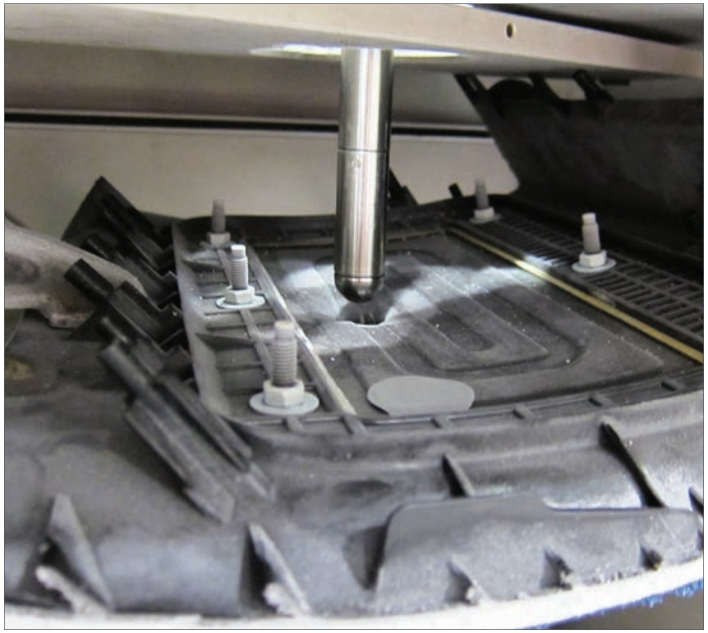
In the automotive field, the safety of passengers is key and drives research and development as well as quality control procedures. Each critical component has to be tested.

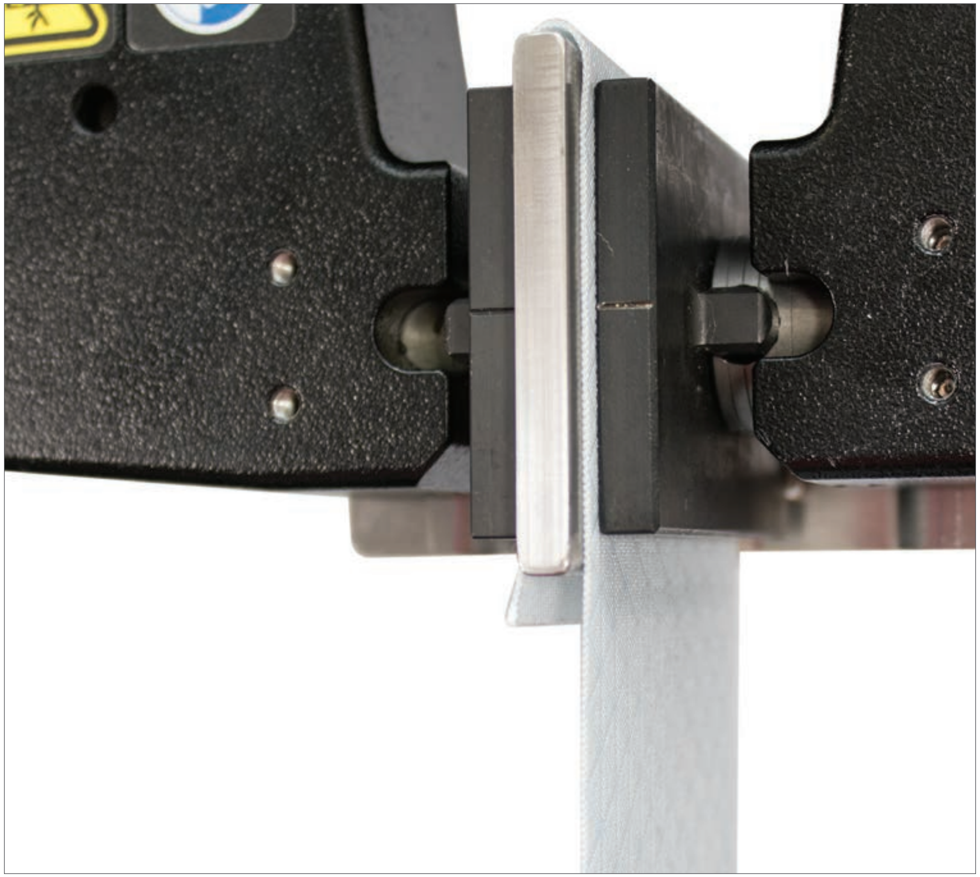
Challenge

Looking to gain larger market share in recent years, automotive producers have been including new and original features in car interiors. Besides aesthetics, all of these features have to meet precise technical specifications with regards to strength, durability, and safety. Some of the most critical parts are dashboards and surrounding items, such as steering wheel columns, column switches, and airbags. In the event of an accident, the dashboard will absorb a significant amount of the impact energy and, when needed, airbags will deploy. Dashboards are designed to minimize and absorb shocks; their basic construction consists of foam padding and a cover made of PVC. This cover must break in a specific way when an airbag has to deploy to protect the occupants without causing additional injuries.

Solution

To understand the sequence in which the PVC cover breaks as the airbag is deployed, engineers perform impact tests on both samples of the materials used as well as the finished cover itself. The 9350 drop tower paired with both standard and custom fixtures is an ideal solution for this application. The addition of a thermostatic chamber and the high energy options allows the materials to be impacted over a wide variety of temperatures and speeds – up to 24 m/s. By testing both the raw materials and the finished product, engineers can investigate how changes in material selection, design, and manufacturing processes have an effect on impact performance of the cover. This is critical testing for the safety of vehicles passengers.





AIRBAG MATERIAL TESTING

Over the past 20 years, the importance of occupant protection in the development of automobiles has greatly increased. Tighter legal requirements and consumer protection programs have led to significant innovations in the area of active and passive safety. Passive safety is mainly focused on the development of methods and guidelines that reduce the severity of injuries caused by accidents.

Challenge

Reliable and effective operation of air bag systems depends on the performance of a variety of materials – one of the most important materials is the textile used to make the air bag.

Solution

Instron® has created a set of integrated wedges that can easily be mounted on a set of 2712-04X side-action pneumatic grips. These pneumatic side action grips combined with the integrated wedges allow for testing of high-strength strips of material without slippage or jaw breaks while maintaining high throughput.

The wedges can easily be removed, and the grips can then be used as normal pneumatic side-action grips.

The wedges are mounted directly to the grips, and specimens are wrapped around the wedge insert so that the amount of material being gripped is effectively doubled. Standard serrated jaw faces are then able to grip the material without inducing jaw breaks.

TIRE CORD TENSILE TEST

Metallic and polymer tire cords are an essential component of a tire. Determining the properties of these cords is important for both development and quality control.

Challenge

Tire cord is extremely strong, and gripping the test specimen can be challenging. Designed to be strong and durable, these cords provide critical reinforcement and structure to tires, and are an integral part of the automobile's safety. Testing must be performed with utmost care, making sure to avoid inducing early failure from gripping incorrectly.

Solution

Instron® has a range of capacities for cord grips that were designed specifically for these hard-to-grip specimens. These grips have a smooth, curved face that distributes the stress evenly along a large section of the specimen, greatly reducing the chance of jaw breaks.

When testing, the elongation of elastomers is a critical property used by tire manufacturers to predict how tires may behave in use. This property however, can create challenges in testing due to its very nature.

Challenge

While extensometers are not required by the most common standards (ASTM D412 and ISO 37), a strain measurement device is recommended to ensure the most accurate and repeatable results. Traditional clip-on extensometers do not provide sufficient travel for elastomeric testing.

Solution

The Advanced Video Extensometer (AVE 2) is a non-contacting extensometer, which is ideal for elastomeric materials. The AVE 2 is capable of measuring strain up to 2400% with a 1-inch gage length and can also measure strain up to break. It does not require contact with the specimen and therefore does not produce pinch points, which may cause a premature failure and an invalid test. The AVE 2 can be used to measure strain inside of an environmental chamber when testing at non-ambient conditions.

Instron® XL long travel extensometers can also be used through break and are designed to work for elastomeric materials. The adjustable clamping force on the knife edges reduces premature failure of the specimen. Strain can be measured up to 3000% with a 1-inch gauge length.

RHEOLOGY OF TIRE RUBBER

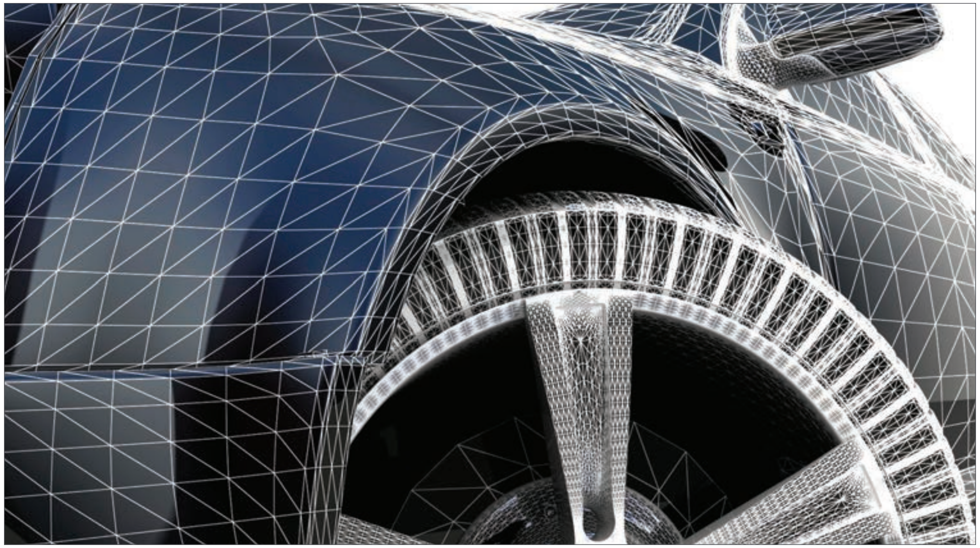
Tires are manufactured worldwide for cars, trucks, industrial vehicles, and common conveyances, such as baby carriages, bicycles, etc. A tire is a strong and flexible rubber casing attached to the rim of a wheel that provides a gripping surface for traction and serves as a cushion for the wheels.

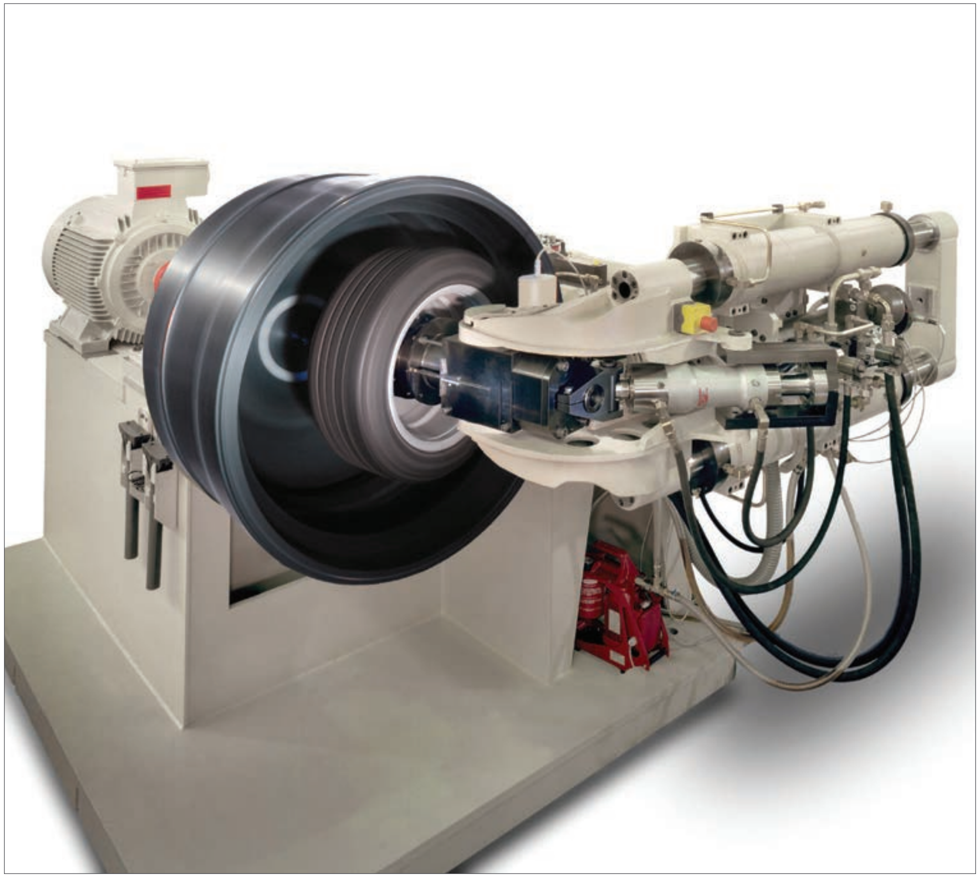
Challenge

Natural or synthetic rubber is typically the primary material used in tire production however, thermoplastic elastomers are often used to produce tires. Thermoplastic elastomers have the same mechanical and chemical properties, but can also be easily recycled and processed via extrusion and injection molding techniques (common methods used for thermoplastics). In this case a tire manufacturer needed to study their rubbery compound for its viscosity properties and swelling at the exit of the die. The sample consisted of an elastomer, carbon black, and additives in form of flat sheets.

Solution

A capillary rheometer is a useful tool for determining flow characteristics of thermoplastic elastomers to understand their behavior during the processing phase. Besides determining the rheological curve (viscosity vs shear rates), it is often useful to study the extrudate swelling characteristics thanks to an add-on laser device for swell measurements. In this case, a CEAST SR20 (equipped with a 20 kN load cell) is used to perform both rheological tests according to ISO 11443 and die swell tests. The rheological test was carried out at 100°C spanning shear rates between 1 to 1000 s-1 through a capillary die and a twin bore configuration was used to perform two tests simultaneously. This material showed a non-Newtonian behavior with a viscosity ranging from 100,000 Pa*s at 1 s-1 shear rate to 800 Pa*s at 1000 s-1. Overall, the sample showed good repeatability and reproducibility of results. Furthermore, a die swell test was carried out by using the CEAST die swell laser system to study the influence of swell in this compound upon exit from the die.





BIAXIAL WHEEL FATIGUE TEST

Wheels are safety-critical components of any vehicle and are exposed to severe loads over their lifetime. Their reliability can only be safeguarded by performing tests under laboratory conditions which resemble actual loading conditions as closely as possible.

Challenge

Reproducing multi-axial service loads on a wheel under laboratory conditions requires equipment that combines excellent mechanical design with advanced control electronics. Based on an idea of the FRAUNHOFER LBF, the Biaxial Wheel Test Facility was developed in the early 1980´s. This test procedure became a standard at most of the European wheel producers and was also introduced as SAE wheel standard J 2562, in 2003. Standardized load profiles like Euro-Cycle or AK-Cycle have been developed which can reduce the test time to a minimum by transforming damage content of the original design spectra of 300.000 km to an accelerated one of 10.000 km only.

Solution

The Biaxial Wheel Test (ZWARP) developed by Instron® includes an additional hydraulic actuator which allows a controlled and highly accurate adjustment of the angle of attack to produce high lateral forces. It is also distinguished by its compact design, high robustness, and extremely high reproduction quality.

By using this so-called “Hayes Lemmerz” method, the ZWARP’s control parameter could be determined directly from the wheel forces without the need for the long detour of strain gauge measurement.

COMPONENTS

Components for additional testing challenges

Interior Components

01 Seatbelt Testing

02 Torsion and Compression Testing of Buttons

03 Durability Testing of Automobile Headrest

04 Hemming Bend Test

05 Push Test of Buttons using Probe

06 Compression Test of Plastic Fastener

07 Bend Test of Signal Control Unit

Exterior Components

08 Bend Test of Antennae

09 Automobile Strut Compression Test

Engine Components

10 Spark Plug Cap Insertion and Removal Test

11 Tensile Test of Belt

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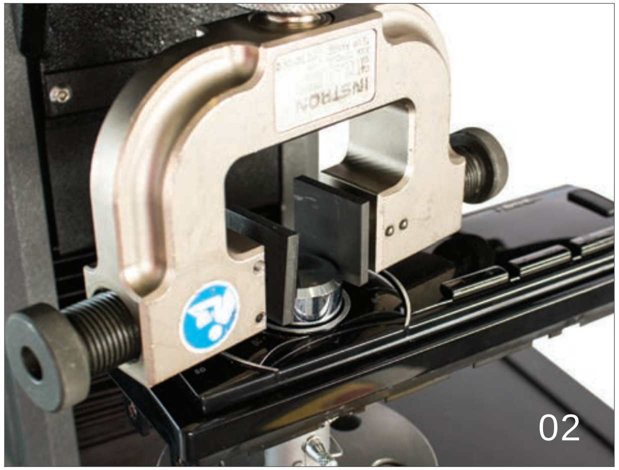

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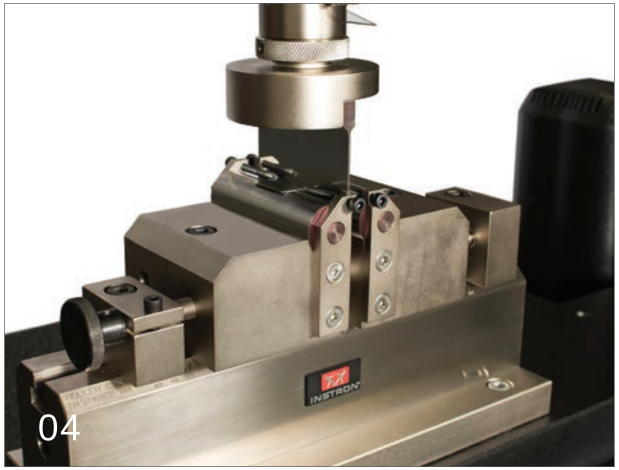

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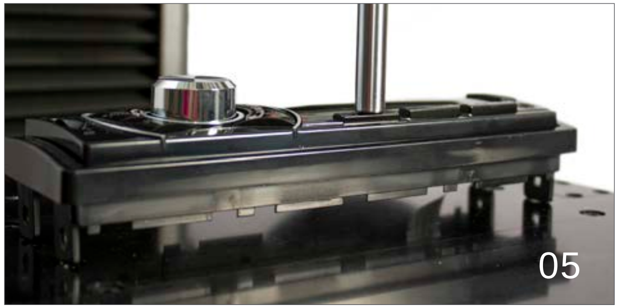

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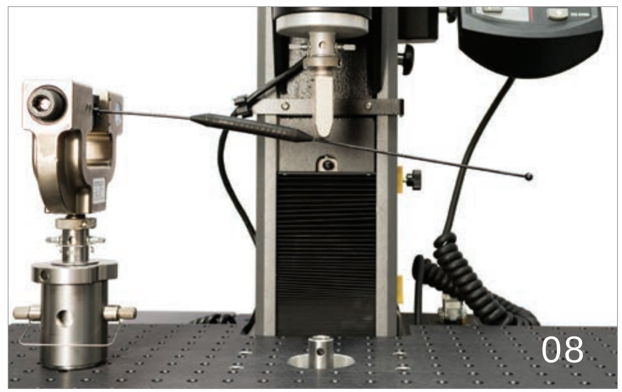
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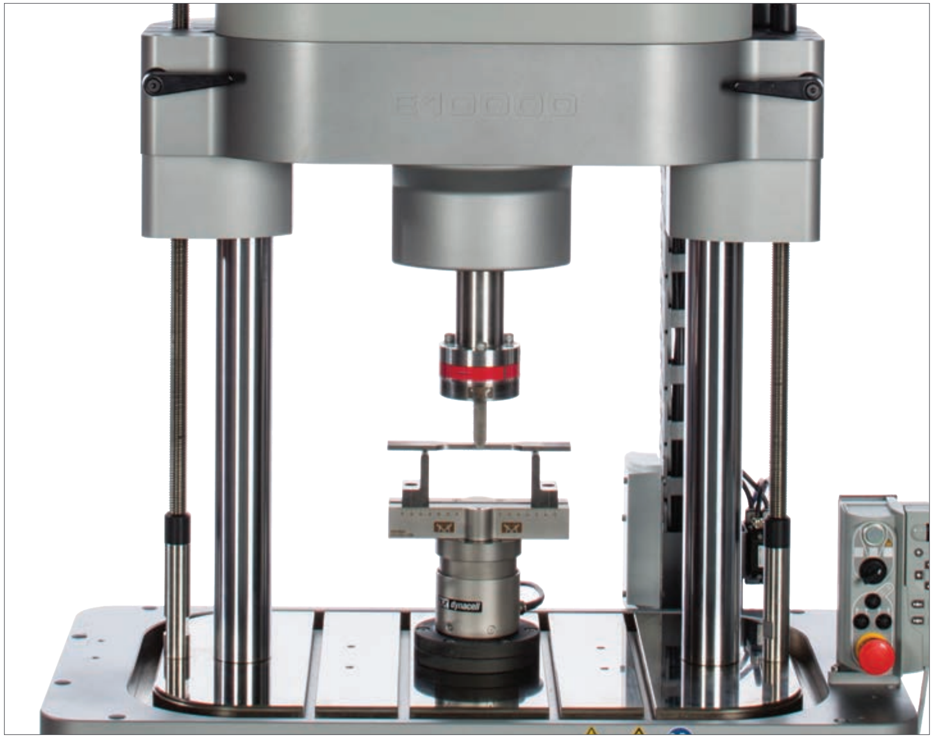


Electromechanical Systems

Instron® electromechanical universal testing machines perform tensile, compression, bend, peel, tear, and other mechanical tests on materials and products to ASTM, ISO, and other industry standards. These systems are available in a range of sizes and maximum force capacities. From small, low-force systems to test microelectronics, biomaterials, and films in the biomedical and electronics industries to large, high-force systems to test metals and composites in the automotive and aerospace industries, Instron has systems suitable for all applications. With over 50,000 systems installed worldwide, businesses and universities involved in quality control and research & development have relied on Instron systems to perform groundbreaking research, develop innovative new materials, and ensure best-in-class manufacturing processes.

Dynamic and Fatigue Testing Systems

Instron offers an extensive range of fully-integrated dynamic and fatigue testing systems from 1000 N up to 5000 kN. Incorporating servohydraulic, servo-electric and linear motor technologies, these test instruments cover a broad range of fatigue, dynamic, and static testing applications. These applications include high-cycle fatigue, low-cycle fatigue, thermo-mechanical fatigue, fracture mechanics, crack propagation and growth studies, fracture toughness, bi-axial, axial-torsional, multi-axial, high strain rate, quasi-static, creep, stress-relaxation, and other types of dynamic and static tests.

Our large product portfolio allows technicians to evaluate materials, components and structures ranging from biological tissue to whole vehicles by performing a variety of tests such as compression, cyclic, fatigue, impact, multi-axis, rheology, tensile, and torsion.

Static Hydraulic Industrial Series

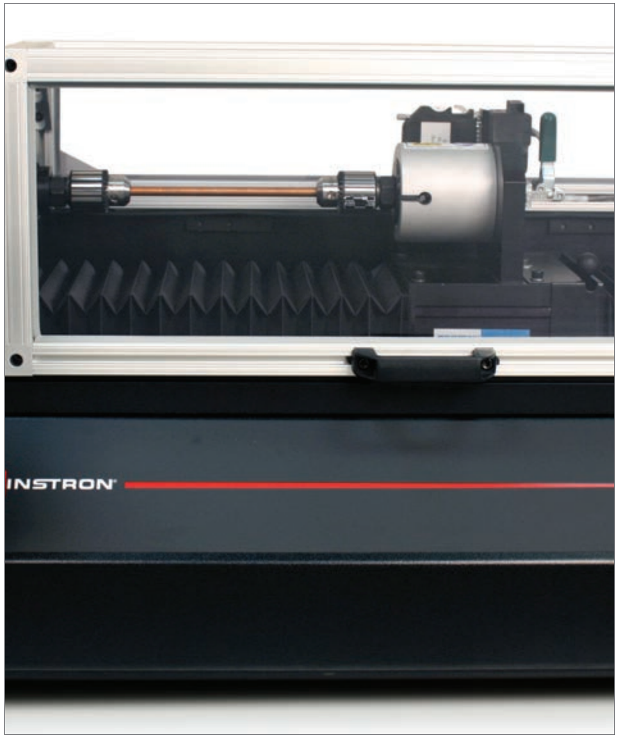
The Industrial Series is comprised of high-capacity, hydraulic testing systems for tension and compression applications. Ranging from 300 kN (67,500 lbf) to 2,000 kN (450,000 lbf), standard models feature large diameter columns and rugged components for superior frame stiffness and durability. Understanding the critical importance of operator safety, these models incorporate high-quality materials, components, and craftsmanship. Custom designs are also available in higher capacities or unique configurations such as horizontal or compression-only frames.

Impact Testing Systems

Impact resistance is one of the most important properties for component designers to consider, as well as the most difficult to quantify. Impact resistance is a critical measure of service life and it involves the perplexing problem of product safety and liability. Instron® has more than 80 years experience in designing impact testing systems to simulate real-life impact conditions.

Automated Testing Systems

Automate Testing Systems enable a new dimension of testing productivity, improve safety, reduce variability, save time, and increase throughput. Available as either a complete turnkey solution or fitted to existing Instron testing instruments, options are tailored to your testing operations and throughput requirements.



Rheometers and Melt Flow Testers

The Instron® line of CEAST Rheology systems are used to measure the rheological properties of thermoplastics to characterize the polymer melt flow behavior in the process conditions. This is achieved through a broad range of rheology systems - from Melt Flow Testers to Capillary Rheometers.

Thermo-Mechanical Systems

The Instron line of CEAST Thermo-mechanical systems are used to characterize the behavior of plastic materials at high temperatures, measuring the heat deflection temperature (HDT) and the Vicat softening temperature (Vicat). These HDT and VICAT testers range from very simple units for quality control labs to more advanced and automated systems.

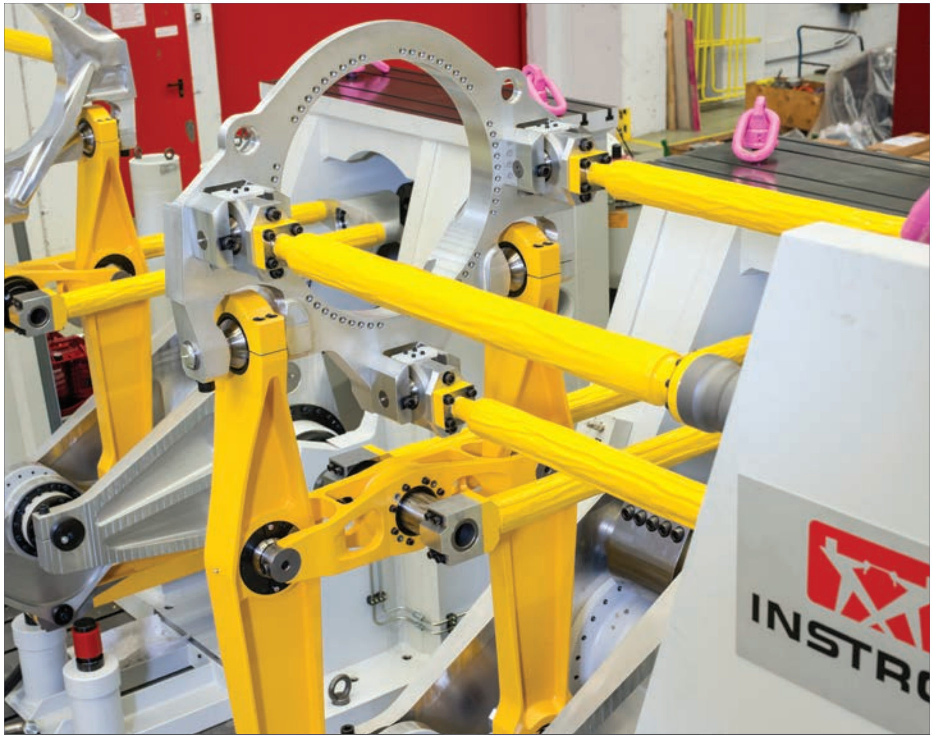
Torsion Testers

The Instron line of low and medium capacity torsion testers provide dependable multi-turn capability. Available in capacities ranging from 22 - 5,650 N-m (200 - 50,000 in lb), these systems are ideal for biomedical, automotive, and aerospace applications.

To learn more about our
product and services, please
visit www.instron.com

Crash Simulation Systems

Instron® is the market leader in crash simulation sled systems with over 80 facilities installed worldwide. The crash simulators are capable of reproducing a wide range of standardized and user-defined crash tests including advanced applications such as side impact and vehicle pitch simulation. Instron's acceleration sled systems are used for the development and approval of vehicle safety systems, vehicle parts and also for the investigation of solids and structures during crash events.



Structural Durability

Growing demands on the comfort and reliability of vehicles require functional and life-time tests of components or complete systems to avoid hazards for humans and the environment or damage in the economic field. Instron offers comprehensive know-how in the area of service load simulation, comfort and vibration tests in the area of testing passenger cars, buses, trucks or special vehicles.

"True innovation occurs when product designers and developers show relentless curiosity towards the needs of their customers. This builds an understanding that allows them to anticipate and create a new suite of solutions that are Simpler, Smarter, and Safer."

Yahya Gharagozlou

Group President
ITW Test & Measurement
(Instron is an ITW Company)

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