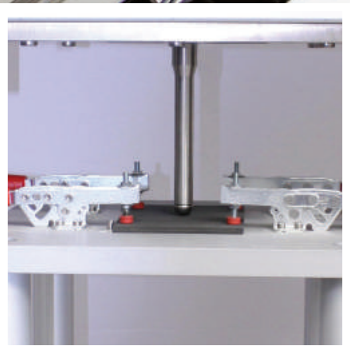
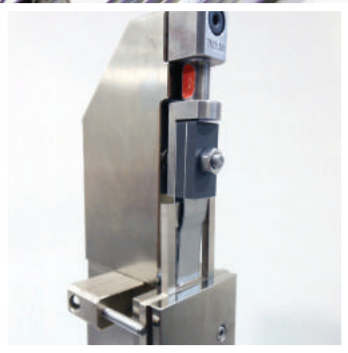
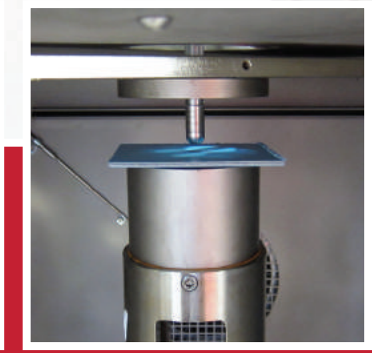
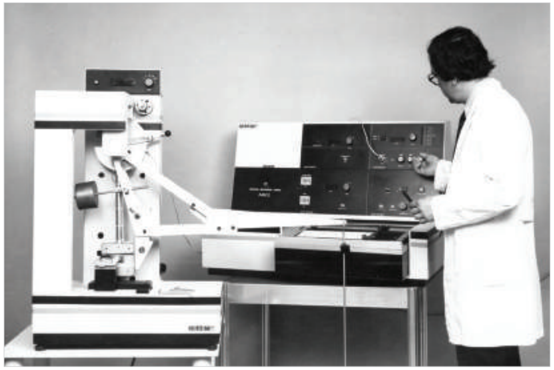
INSTRON®

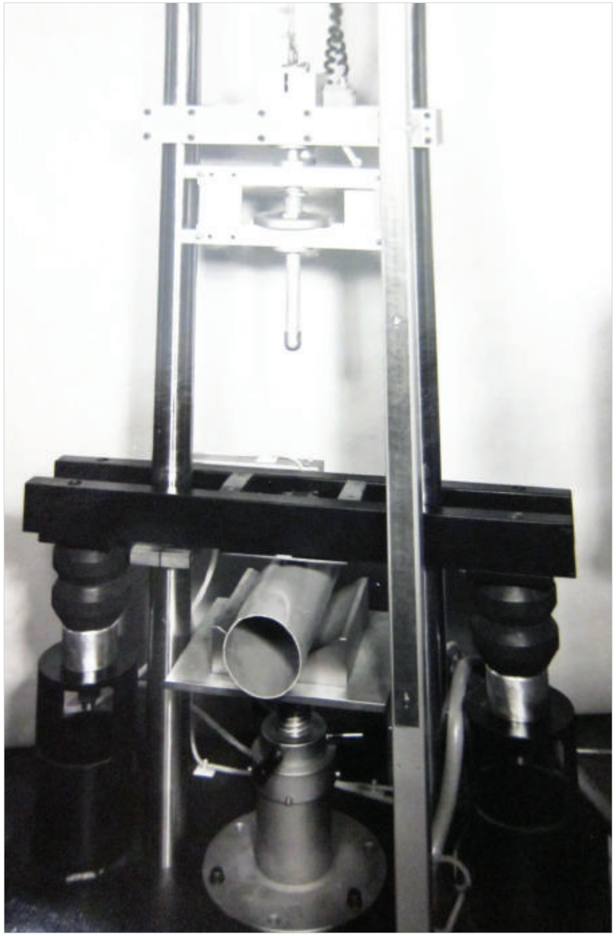






Impact Testing Solutions





ABOUT INSTRON

Founded in 1946

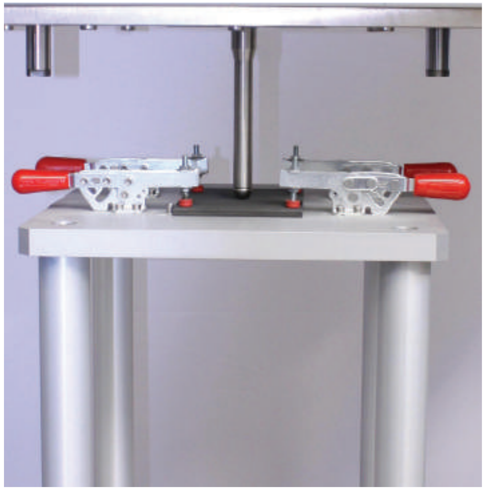
Instron® is a recognized worldwide market leader in the materials testing industry. Our goal is to provide our customers the best ownership experience by delivering the highest quality products, expert support and world-class service. We are committed to exceptional quality standards, throughout our products, services, research and development, operations and into sales and marketing. Through a global infrastructure, we are local to our customers with nearly 1700 employees around the world.

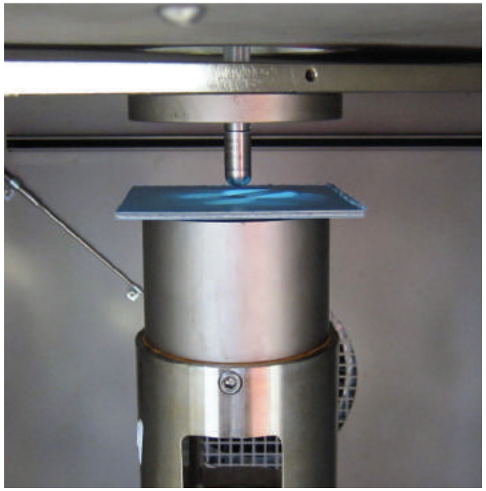
Pioneer in Impact Testing

You have selected your material, finalized your design and fabricated your prototypes. The next step is to test your component to ensure that it will perform under all anticipated field conditions. You know that your component will be exposed to routine collisions, accidental drops or repeated impacts in the field, but how can you simulate these conditions in a laboratory environment with “traditional” impact test equipment? Furthermore, does your impact test setup provide you with the detailed information you need to fully understand how your component will respond to these impact events?

Impact performance can be one of the most important properties for a component designer to consider - and also the most difficult to quantify. For over 70 years, Instron has maintained an exclusive focus in the materials testing industry, providing instrumented drop-weight testers that help manufacturers to simulate real-world impact events on their finished components and to collect detailed technical information about how their components perform during these impact events.

This brochure features examples from the broad array of industries and applications in which Instron solutions are being used to help specify, develop and test finished products and components. As you read further, you will get a better sense of how Instron can help you with your particular real world impact challenge.





Beyond Traditional Testing

Impact testing was originally developed to determine the fracture characteristics of raw materials under high strain rates. Standard test methods designed for pendulums and simple drop weight testers require specific equipment design, specimen geometry and analysis of results.

For many materials, the act of processing them into finished components directly affects their impact performance characteristics. Standard test methods such as Charpy, Izod and Gardner are important tools for raw material research and quality control, but they provide little value to engineers seeking to understand how their finished components perform in real-world impact situations.

Many leading manufacturers today are utilizing more sophisticated techniques for validating the impact performance of their finished components. To support this trend, test equipment manufacturers have developed modern drop weight instruments designed to simulate a wide variety of real-world impact conditions and collect detailed performance data for R&D or quality control applications.

Specimen Impact Resilience

In quality control, material impact resilience properties are measured with pendulum testing methods (i.e. Charpy, Izod, Dynstat testing). Tests can be performed on a wide variety of samples as per international standard specifications. Usually raw material specimens are tested to select the most suitable material for the final application.

In the case of molded plastics, for example, any of the following variables can affect how the finished components reacts to impact loading:

- Molded-in stresses
- Parting lines
- Gate areas
- Geometry
- - Coloring agents

Testing raw material specimens may not provide information suitable or sufficient to solve component-level problems. Finished component can have very different impact performance characteristics than raw material specimens.

Impact Simulation: Energy, Geometry and Environment.

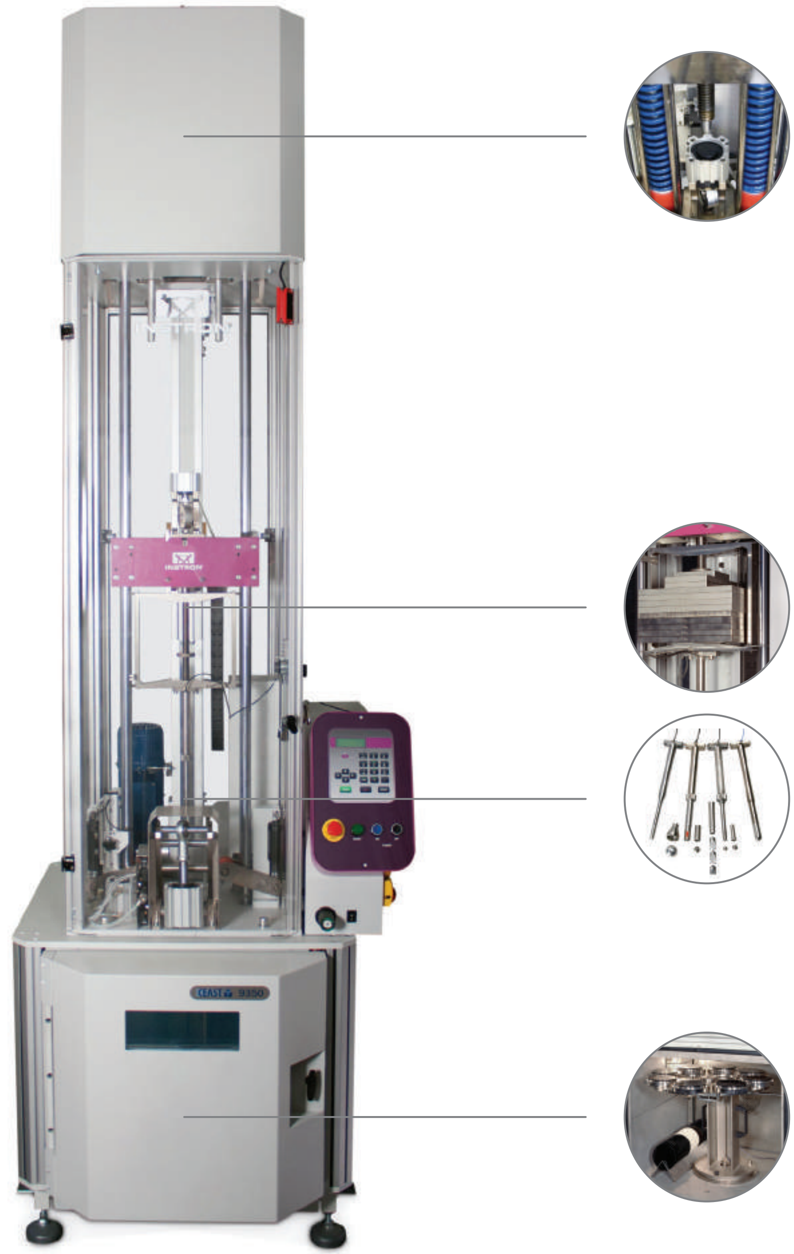
In many component applications, it is impractical to recreate a real world impact event in a laboratory setting. Advanced drop weight impact testers with variable mass, height and velocity configurations solve this dilemma by enabling engineers to simulate the impact energy of real-world objects.

With impact energy reproduced, a custom striker is utilized to simulate the physical profile of the impacting object. A matching fixture is also developed to reconstruct the support geometry of the component in its application environment.

Real-world impact events may also occur under a variety of environmental conditions. To ensure further accuracy of the test, product developers have the option of utilizing an integrated environmental chamber to condition the component prior to or during the test.

Additional benefits of drop weight test instruments include:

- Flexibility for simulating a wide variety of real-world impact events to provide a strong return on investment.
- Repeatability for consistent testing and analysis of results over time and across multiple sites.
- Suitability for the modern laboratory environment with integrated safety and ergonomics features.



Instrumented Testing: Benefits of Information.

Instrumented impact testing offers engineers, scientists and quality managers visibility to performance data that are otherwise unavailable from less sophisticated pass/fail techniques. More importantly, sophisticated plots of these data can help to identify important component-level impact characteristics, such as:

- Initial break point of internal fibers in a composite aerospace component
- Total deflection of a polymer panel designed for an automotive body application
- Force required to deform a metal implant tool used in a high-risk surgical procedure

Engineers who rely on simple pass/fail testing to solve impact problems can over-design a component, needlessly adding cost or compromising performance in other areas. Trial-and-error impact experiments can require large quantities of specimens, time-consuming iteration and labor-intensive data collection and analysis. Without truly understanding impact behavior, it can also be difficult to gain confidence about a product when safety is a concern. Instrumented impact tests can dramatically improve the efficiency of a test program by reducing uncertainty and minimizing the amount of time and material required to obtain meaningful results.

Instron DAS 64K (data acquisition system) is specifically designed for impact testing to acquire the force signal measured by the force sensor of the striker during the impact event.

VisualIMPACT software package is designed to manage different testing methods, process force measurements as a function of time and specimen deformation, and present detailed graphs and reports.

Impact Testing Solutions Table of Contents

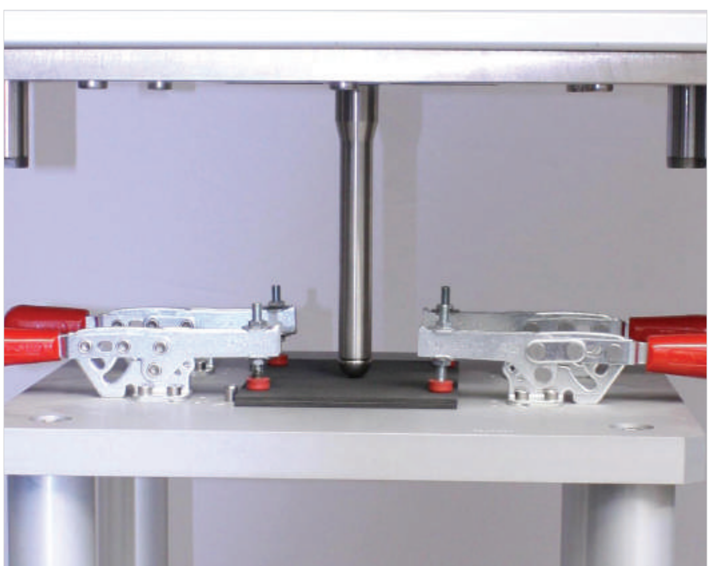
ABOUT AEROSPACE AND DEFENSE TESTING

Aerospace and defense vehicles face unique and intense operating environments. Materials engineered for structural applications must be highly capable of absorbing rapidly applied forces. During the course of normal operation, commercial or military aircraft can be hit by runway debris, hail or maintenance tools. A minor impact from any of these objects can cause significant internal damage to a structural component and lead to performance failure. Internal to the vehicle, instrumentation is also at risk. Crewmembers or loose objects can strike sensitive navigation and control equipment during turbulent operating conditions. Impact testing early in the R&D phase helps ensure that proper materials and geometries are selected to perform during any of these impact events.

Compression After Impact

Challenges:

Since their introduction in military applications the use of composite materials in the aerospace market have increased significantly. These materials are typically composed of a polymer matrix with carbon fiber reinforcements. While they have excellent mechanical properties (i.e. strength and stiffness) with a lower weight as compared to their metallic counterparts, they can exhibit poor tolerance to damage caused by impact. The types of damage to composite materials can be complex, irregular in shape and may affect all layers of the structure. They may be barely visible or hidden from view.



Solutions:

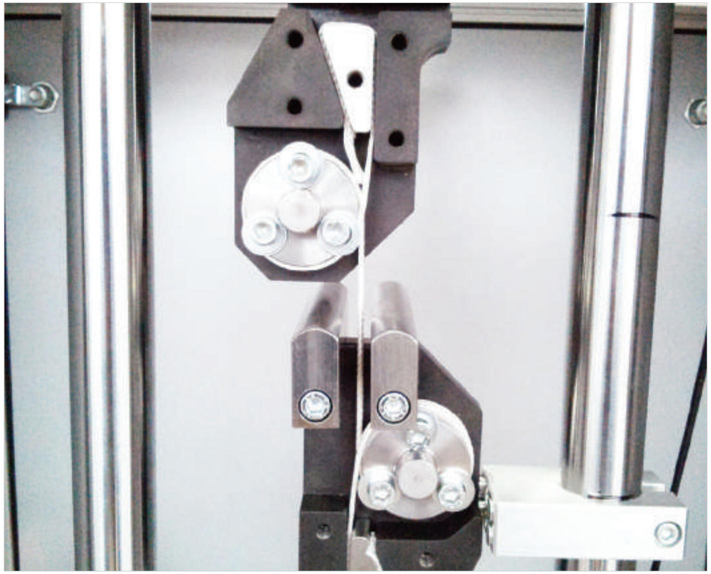
Compression After Impact (C.A.I.) test standards help composite suppliers gain insight and understanding on the damage performance of the materials. Using a predefined energy, samples are impacted to create a point of damage. The Instron® 9350 drop tower is equipped with a CAI support and pneumatic anti-rebound device allows customers to perform a single impact test to investigate how the damaged material holds up to compressive loads.
When configured with an instrumented tup, data acquisition and software the force signal from each impact can be captured and analyzed, helping engineers improve their knowledge about the materials performance. Addition of a special temperature chamber allows the user to investigate how these same materials may react in high temperature environments up to 300°C.

Parachute Cords

Challenges:

Parachutes are used to slow the movement of a person/object as it falls or moves through the air. Used primarily for a safe descent from high altitudes, parachutes can also be used in horizontal configurations to slow objects such as a race car. From the beginning of the twentieth century, and significantly more during and after World War II, parachutes have become standard equipment for military pilots as well as a means for troop & equipment deployment. The parachute usually consists of a fabric canopy with continuous suspension lines that run across its' entire span and extends to a harness on each end thereby forming a skeleton for the canopy. The suspension lines are made of plastics (mainly nylon) and are complex in construction with braided and twisted cords. Of interest in the industry are the effects of impact on the breaking strength of the lines. Due to their structure, they show lower strength when tested at impact speeds as compared with values from the traditional static test. This difference in performance at the higher speeds has serious implications for users.

Solutions:



To enable engineers to analyze cord behavior at varying impact energies and velocities Instron designed a custom set of accessories for cords tensile impact testing. This solution consists of a dedicated striker and a set of grips which properly fit and preload the cord for the test. A sensor included in the grips coupled with the DAS 64K acquisition system acquires the load behavior during the impact test and allows the end user to examine the failure mechanism of the cord, including the maximum force and energy required. By testing cords with this fixture at varying impact energies and velocities engineers can evaluate the efficiency of different materials and designs.

ABOUT AUTOMOTIVE TESTING

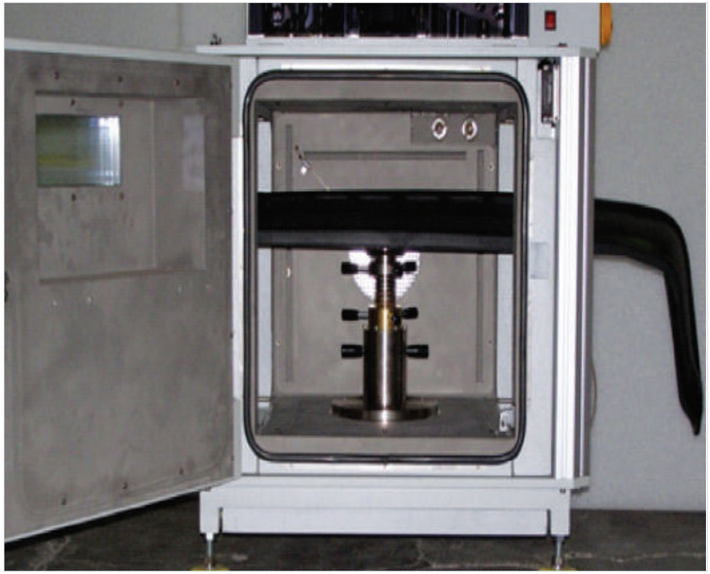
Advances in materials science have enabled auto manufacturers to improve fuel efficiency without sacrificing performance or safety. As lightweight alloys, protective coatings and high performance adhesives become common in automotive design, these new material applications require creative impact test methods for research, development and validation.
The automotive industry remains one of the most common 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.

Bumpers

Challenges:

Impact testing on plastic components used in cars and motorcycles provides data about their response to a sudden high-speed mechanical impact and invaluable information in regards to safety. One example comes from studies completed by automotive companies on vehicle bumpers. To absorb an impact, such as an unintentional bump at low speed, 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 qualities must be determined for different working temperatures and conditions.

Solutions:



To understand the impact resistance properties of the materials used in the bumper, we recommend performing a series of tests on specimens - 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. By fully instrumenting the test with a 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 from the varying test events.

Adhesives

Challenges:

As automotive design evolves, adhesives are rapidly replacing mechanical fasteners as a conventional solution for joining many metals, plastics, rubbers and glass. Specially formulated adhesives used to bond structural frame assemblies, windshields and other components can offer improved aesthetics, quieter interiors and reduced manufacturing costs. With increased use of adhesives, however, automotive and adhesives suppliers must develop new test protocols to ensure the structural integrity of the bonds under all possible field conditions. Impact forces in a crash may cause bonded areas of the frame or windshield to fail, resulting in serious injury to vehicle passengers.

Solutions:

Automotive and adhesives suppliers commonly use ISO 11343 wedge impact method testing to compare the relative effects of various product and process variables on impact performance. Instron has developed standard and custom test configurations based on ISO 11343, including a unique support fixture and striker arrangement to impact windshield specimens bonded to auto frame components. Packaged with an Instron thermostatic chamber, this impact system enabled an adhesives R&D team to experiment with different material compositions, cure conditions and climatic temperatures to optimize product performance and comply with government regulations.

Dashboards

Challenges:

In the automotive field, safety of passengers is key and drives research and development as well as quality control procedures. Each critical component has to be tested. 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 a foam padding and a cover made of PVC. This cover must break in a prescribed order when an airbag has to deploy to protect the occupants without causing injuries themselves.

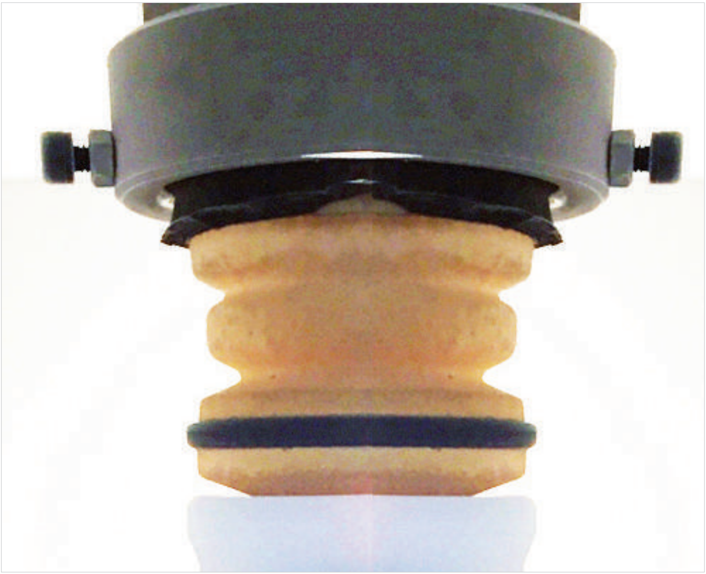
Solutions:

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 energyoptions allows the materials to be impacted over a wide variety of temperatures and speeds – up to 24 m/s. By testing in this way – both the raw materials used and the finished product engineers can investigate how changes in materials, designs and manufacturing processes have an effect on impact performance of the cover.

Shock Absorbers

Challenges:

The automotive industry remains one of the most common 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 and provide a high quality product. Automotive test standards and regulations place an emphasis on impact performance of assemblies and components. Shock absorbers used in an automotive suspension assembly are one such part. In real life these dampers are exposed to multiple impacts and are expected to make the vibration as smooth as possible (e.g. for speed bumps on the road). It's necessary for the suppliers to understand the behavior of the rubber damper or plastic part connected to it as to how many impact cycles it can sustain before a final failure.



Solutions:

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

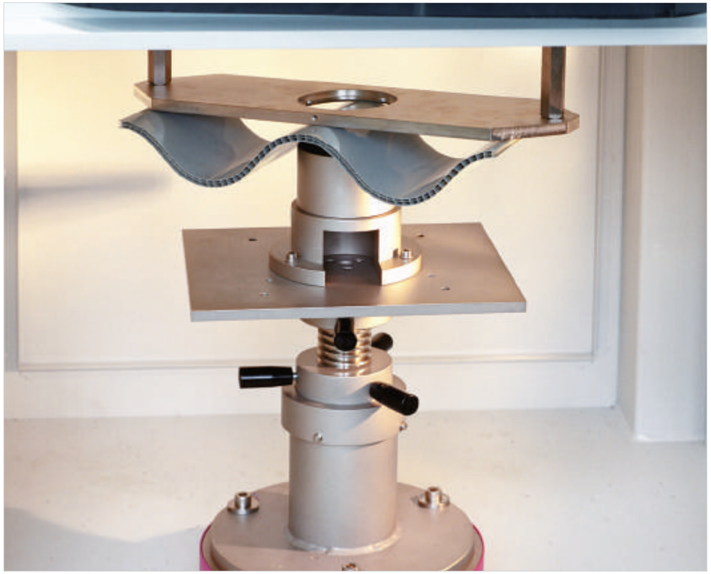
ABOUT CONSTRUCTION TESTING

Products used in construction applications face demanding environments. To maintain proper visual appeal and structural integrity, components must be engineered to withstand a great variety of static and dynamic loads. Over its lifetime, a construction component may be impacted by objects such as hail, tree branches and dropped power tools. In recent years, manufacturers have developed innovative construction materials that combine improved weather resistance and aesthetics with reduced maintenance costs. Consumers pay a premium for such materials and expect superior performance. Impact damage can be visually unappealing, expensive to repair and even structurally unsafe.

PVC Vinyl Material

Challenges:

Homeowners looking to remodel the exterior of their house often turn to vinyl siding for its appearance, low maintenance and resistance to weather, and insects. Since consumers also value design flexibility, manufacturers must offer a portfolio of impact-resistant styles. The siding needs to withstand accidental impact from tools and rough handling during installation. Over the lifetime of the house the product must be durable enough to resist rain, ice, and other weather-induced impacts, as well as sudden blows from objects such as lawn furniture, children's toys, balls, and rocks. Damaged panels and unrepaired cracks can propagate allowing penetration of insects and harmful moisture.



Solutions:

The 9350 Impact Drop Tower was configured to meet ASTM D4226, an industry specified test for identifying the energy required to fracture a specimen of PVC vinyl siding material. The Data Acquisition System (DAS 64K) instrumentation package collects detailed data plots comparing the performance levels of vinyl panels with different surface textures and color additives. While the ASTM standard prescribes a nominal striker and support geometry, optional tools are developed to better simulate and study the effects of balls, rocks, and drills impacting the vinyl siding samples at various speeds and drop heights. Moreover, both Charpy and tensile impact specimens can be removed from the PVC profiles and impacted with either a 9050 Pendulum impact system or on the drop tower.

Roofing Tiles

Challenges:

Modern architectural roof designs in both residential and commercial buildings have driven the development of new lightweight synthetic roofing materials. Available in a wide variety of styles, colors and textures, today's man-made roof tiles are highly durable and often guaranteed by manufacturers to last over 50 years. More than any other exterior building surface, a roof is most vulnerable to impacts from weather-driven objects such as tree debris and ice. Synthetic roof tiles cracked by impacting objects will allow moisture to penetrate and decay the underlying structure, with costly implications for replacement. Increasing tile thickness arbitrarily can improve impact performance, but designers must consider the additional weight and cost of material inherent in this simplistic approach. Impact performance needs to be quantified accurately to optimize design variables.

Solutions:

Instrumented impact testing was performed at various energy levels on different synthetic tile designs to identify the onset of incipient damage. Test parameters were set to identify specific impact conditions that would cause internal cracking not visible in a finished roof construction. To ensure accuracy of the application, Instron designed a custom support fixture in which the open test span mimics the span between roof rafters below the tiles. Testing revealed several instances of product failure that would not have been identified on less sophisticated test equipment.

Composite Decks

Challenges:

Outdoor decks are heavy-use structures that are exposed to harsh environments and frequent impact events that must be factored into product design. To reduce maintenance costs and improve aesthetics and durability, innovative manufacturers have developed new composite decking materials comprised of recycled plastic and natural wood fibers. Both during and after the installation process, the composite deck boards must be able to withstand a wide variety of impacts from weather, human use, and falling objects such as tools and furniture. If a composite board is damaged by an impact, the structural integrity and safe use of the deck may be compromised.

Solutions:

To simulate a hammer falling from a rooftop onto a deck, Instron mounted a tup with a 1-inch hemispherical striker to the crosshead of a 9350 test instrument and performed testing from an energy-equivalent height and weight. High velocity hailstone impacts were also recreated by utilizing a smaller striker and lightweight crosshead together with an increased drop height. Though a standard fixture was used to test sample composite specimens in this case, a custom support structure could have been developed to simulate and test actual support geometries used in deck constructions.

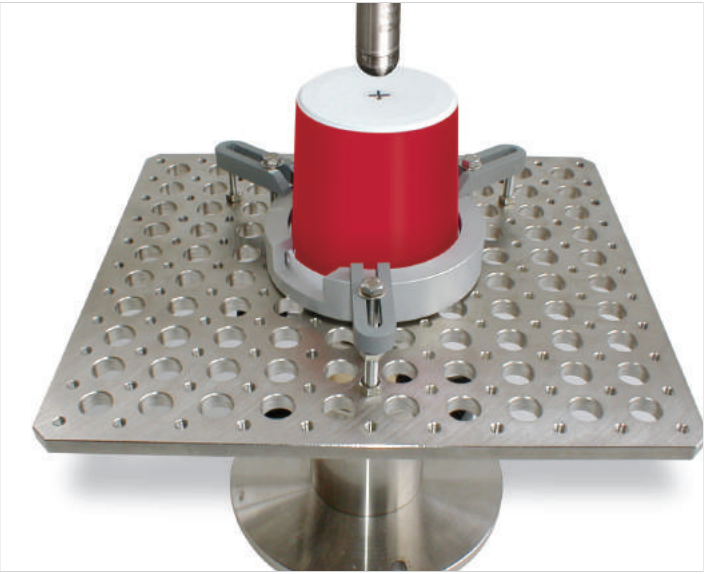
ABOUT CONSUMER GOODS TESTING

Many consumer products are manufactured in high volume for sale worldwide. From the factory floor to retail store shelves, these products (and their packaging) must withstand a variety of impacts during the transportation and handling process on trucks and in warehouses. Once in the home, consumer products can experience accidental drops, kicks or bumps in the course of normal use. At stake for a manufacturer is brand Image. In a highly competitive marketplace, products burdened with a reputation for poor quality are less likely to survive. When safety issues are involved, a large recall prompted by impact failures can also erode brand image and sink profitability.

Plastic Storage Containers

Challenges:

Reusable plastic containers - sold in a wide range of shapes, sizes, and colors - are popular for preparing and storing food. Designed for use in refrigerators, freezers, microwave ovens, and dishwashers, these versatile containers must withstand harsh temperature extremes without deterioration. Cold containers can easily crack or split when dropped; hot containers can become too soft and easily separate from a lid. In either case, the resulting food spills or contamination leads to consumer frustration. Key for the provider of these containers is how to strengthen the impact resistance while maintaining costs associated with their production.



Solutions:

By comparing resistance to impact data on both raw materials and finished products storage container producers can determine the best mix of material components – raw to regrind and resin to resin to be used. Testing the finished products allows the producer to analyze the containers design for impact resistance (knit line locations, overall design/shape) as well as the manufacturing process employed. Using a 9340 or a 9350 drop tower configured with lighter weight crossheads and anti-rebound devices – incipient crack damage forces can be established. Lastly, the addition of an environmental chamber allows for heating and cooling of specimens for further testing and evaluation.

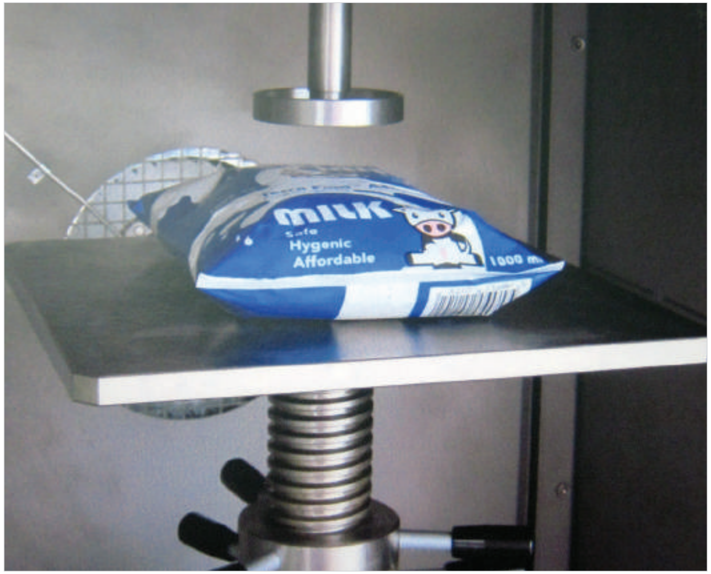
Food & Beverage Pouches

Challenges:

Milk is one of the most popular beverages around the world and is the primary source of nutrition often consumed outside the home. The increasing need to distribute, transport, and store milk bags, which minimizes the production costs, is one essential element of the packaging producers. Due to this request, all operations are done in a manual process and the milk bags are often manually moved and distributed. One of the biggest challenges for bag producers is developing advanced technologies that reduce costs and increase impact resistance of the milk bags that may be subject to impacts during these manual movements.

Solutions:

The milk bag is placed on the flat support and a tup, instrumented or not, is released with a predefined energy per the testing standard. A flat surface insert will impact the bag, causing the milk bag to compress. By following this process, quality professionals can verify the impact resistance of the bag. The instrumented tup captures the force of impact onto the bag - allowing users to evaluate the failure force and the energy that is necessary to break the bag.



Spray Canisters

Challenges:

Spray cans may, at some point, be subjected to incidental impacts (drops, kicks) which may damage the can and/or the spray nozzle allowing for the accidental release of their contents into the environment.

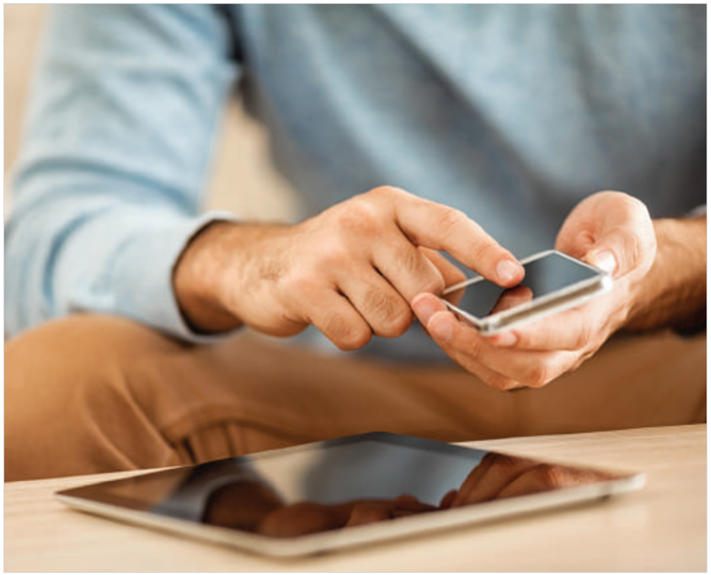
Solutions:

The Intron® 9300 Series Drop Towers are suitable to investigate the type of failure that spray nozzles may suffer as the result of an accidental impact. By using different drop heights along with the lightweight crosshead and an instrumented tup, it is possible with an impact test to establish the minimum force required to break the nozzle. Visual inspection of the nozzle will provide additional input on the failure mode. A standard generic fixturing plate was used to hold and orient the spray can so that the trajectory of the tup was in line with the spray nozzle during the impact event.

ABOUT ELECTRONICS TESTING

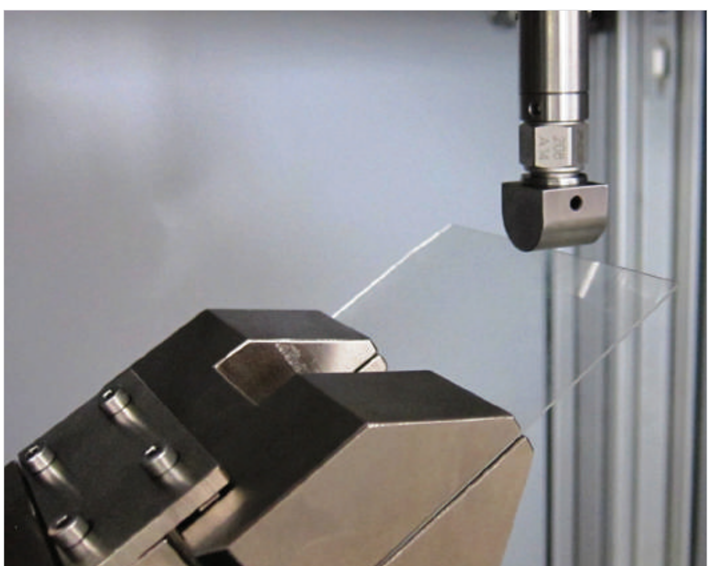
Electronic products in a variety of industries continue to become smaller in size with a growing number of features and capabilities. As more and more components are assembled to smaller printed circuit boards, the interconnections between these components must also become miniaturized. In many applications, these same electronic devices must be designed to ithstand mechanical shocks encountered during their use. Sudden impacts can dislodge electronic components assembled with tiny solder joints, crack entire circuit boards or damage the external casing of a product.

LCD Screens



Challenges:

Electronic devices such as mobile phones, notebook computers or television sets with LCD screens have become indispensable tools in our professional and personal lives today. Designed to be lightweight and stylish, these products must also be rugged and durable to withstand numerous impacts throughout their lifetime. Accidental drop resulting in cracked glass or plastic is the most common impact experienced by electronic products.
In such an event, electronic components and interconnections on the circuit board inside the device can also be damaged, causing intermittent functional or complete failure of the device. Engineers need test equipment that can simulate and quantify the impact forces required to damage glass or plastic casing materials of such products.



Solutions:

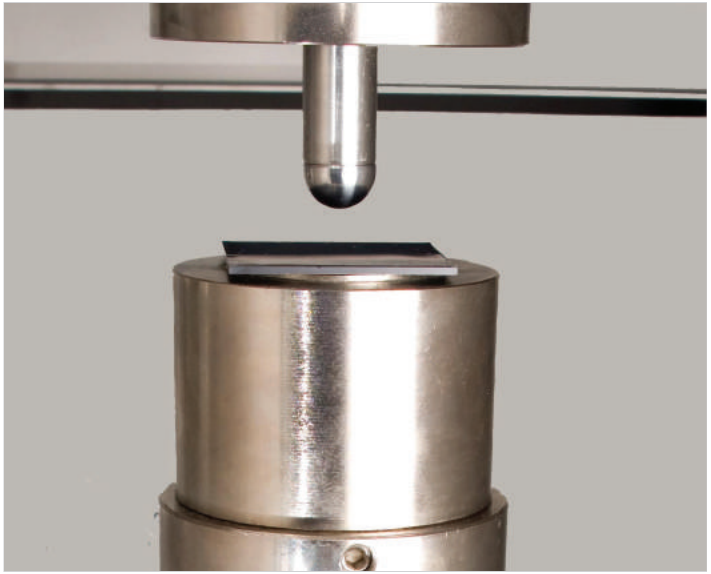
Instron has delivered several impact test solutions for electronic devices, with designs ranging from modified drop weight instruments to completely customized configurations. Working in partnership with a customer, Instron developed a unique fixture focused exclusively ton simulating accidental drops on the edges of LCD glass panels. The striker was released from various drop heights to impact the glass panel at different angles of tilt. The discrete predetermined angles in which the glass panel was clamped on this fixture ranged from 50, 150, 300, 450, and 600. This test fixture enabled product designers to methodically experiment with different impact energies with the LCD glass in different impact positions and measure the resulting impact forces on the LCD glass.

Electronic Devices

Challenges:

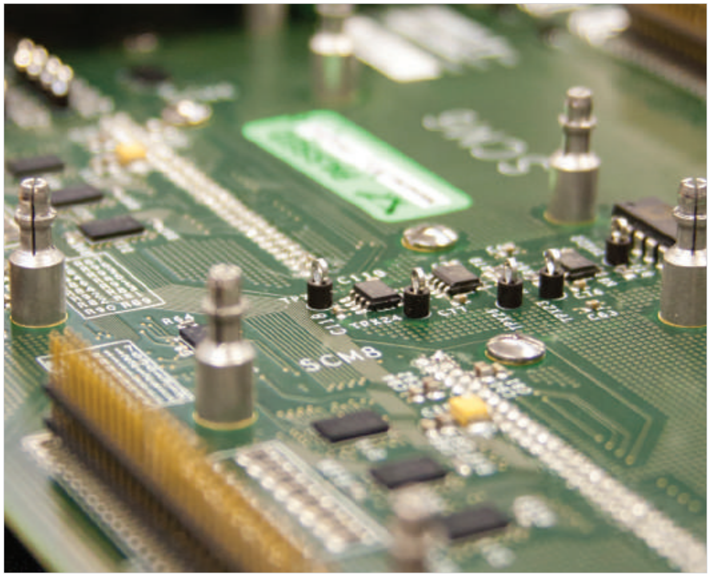
Many consumer electronic products ranging from mobile phones and cameras to game controllers and MP3 players are subject to a variety of arduous conditions during everyday use. Repetitive operational forces, along with accidental damage caused by drops, bumps, and other misuses, cause damage to plastic casings, lens covers, keypads, and buttons. Cumulative effects can result in a buildup of microscopic damage that may eventually result in failure of a piece part and render the device inoperable. With the widespread use of handheld electronic devices in the marketplace and the growing dependence our population places in them, it is becoming more unacceptable to consumers for these electronic products to fail during a reasonable product life. As the feature gap between many products narrow and with increased competitiveness of many devices in the market, differentiators such as quality, robustness, and durability of these consumer products can be advantageous to many manufacturers.

Solutions:



For testing the materials used to make game controllers we recommend using either the 9350 or the 9340 drop tower with Data Acquisition System (DAS) and Visual Impact software, configured to meet ASTM D3763 and/or ISO 6603-2. With either of these systems the test can be set up to replicate a drop that the controllers may be subjected to during their life. A custom fixture allows the controller to be impacted in several locations that are important to the controller surviving the impact. The impact resistance information gathered by performing instrumented testing can be used to help determine the best material and manufacturing process for the casing, as well as making improvements to the overall design.

Adhesives for Electronic Components

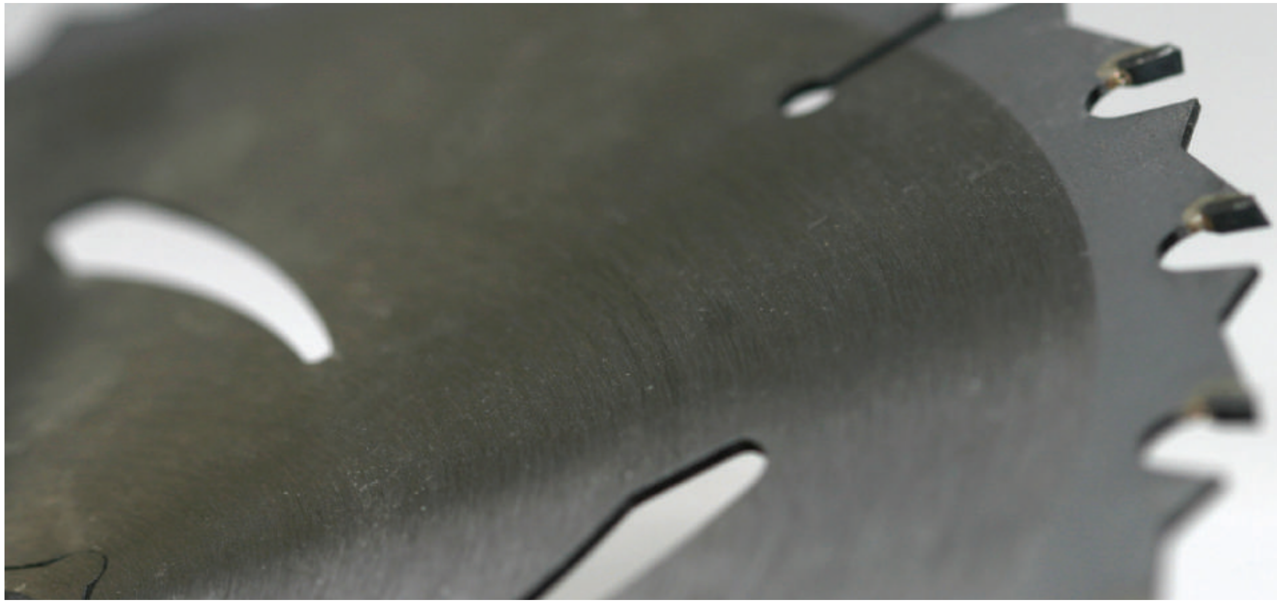


Challenges:

In an electronic product the proper integration and interaction of all parts is essential for the quality of the final products (tablets, smartphones, laptop, smart watch..). A variety of structural adhesives for metal, plastics and low surface substrates are used to secure electronic components in place, reduce weight, minimize process time and increase long-term performance. The adhesives used must be strong enough to withstand mechanical stresses that the product may be subjected to. Strength of the adhesive bond is a key data point for engineers when selecting the most suitable adhesive for the application.

Solutions:

With either the 9340 or the 9350 drop tower, Instron can provide two solutions for the measurement of resistance in a high strength adhesive bond when impacted. With the use of a fixture designed to meet ISO 11343 a wedge is forced thru the bonded portion of a test specimens at either 2 m/s or 3 m/s. The sample is attached to a 15 kN strain gauged sensor in order to acquire the force used to break the bond as a function of timer and displacement. In the second test, a puncture impact test, the specimen is comprised of two parts – one slightly smaller than & set below an opening in the larger. The two parts are bonded together with an adhesive applied on the outer edges of the smaller piece. The specimen is located so that the impacting area is free and it is impacted in the center at low energies. The force required to remove the adhesive and the total energy absorbed to remove it are recorded. Addition of a environmental chamber allows for both test to be conducted at either low or high temperatures.



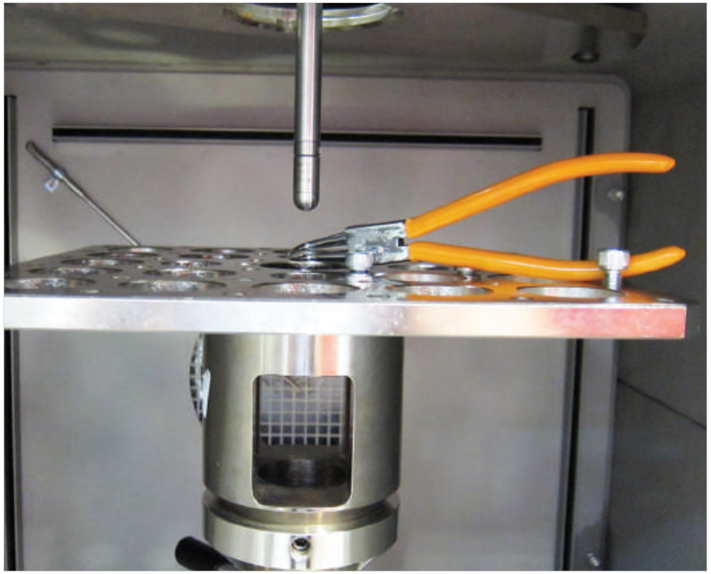
ABOUT INDUSTRIAL TESTING

Many industrial products are purposefully designed to receive or deliver impacts in their application - tools used in manufacturing and maintenance operations, for example, or heavy-duty mining and construction equipment. These components need to be extremely hard and tough, so manufacturers utilize high strength steels, coatings and even diamond-based materials to ensure a long impact service life. Failure to perform can compromise the economics or safety of a project, therefore impact performance is often a critical measure of product quality.

Hand Tools

Challenges:

Simple hand tools made from steel can be found in private residences, manufacturing facilities, construction sites and service garages. Many of these tools, such as chisels and pin punches, are purposefully designed to be struck with a hammer. Others, including screwdrivers and wrenches, have a different purpose but are often used as impact tools as well. Improperly designed tools can bend or crack during a hammer strike. The resulting debris or hammer deflection can injure the user or cause damage to surrounding objects. While the effects of impact failure are rarely severe, a manufacturer can earn a reputation for poor quality that is difficult to overcome. To avoid this problem, tool designers need to verify the mechanical design of steel shafts and integrated plastic handles with an appropriate impact test system.



Solutions:

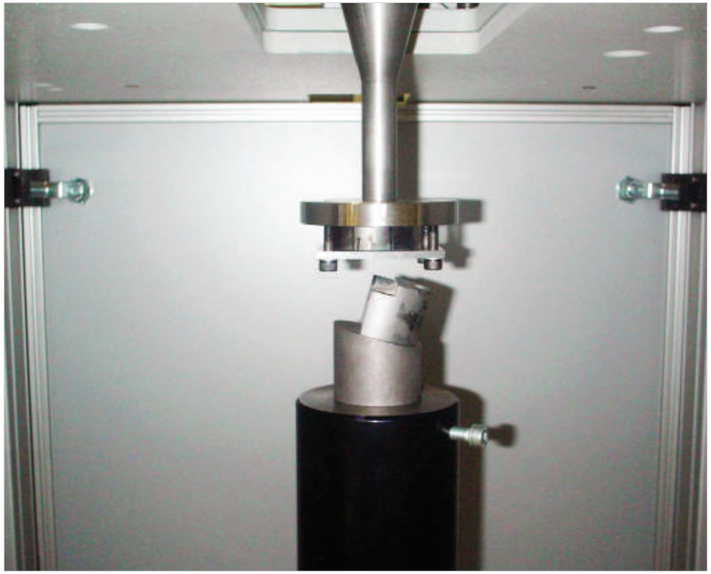
Instron configured a 9350 drop tower with a 50,000 lb (222 kN) tup to capture the high-impact loads expected during tool strikes. A standard 2-inch spherical insert (to simulate the head of a hammer) was used to strike the various products, which were all mounted in a custom fixture to ensure direct axial loading. A rebound brake prevented second strikes on the specimen. The instrumented tup insert provided a wealth of performance data previously not available using a more basic free-fall test technique. Analysis software was used to develop a thorough database of impact energies required to initiate damage in several hand tool designs. The 9350 also enabled repeat testing at defined energy levels to quantify the service life of the tools.

Challenges:

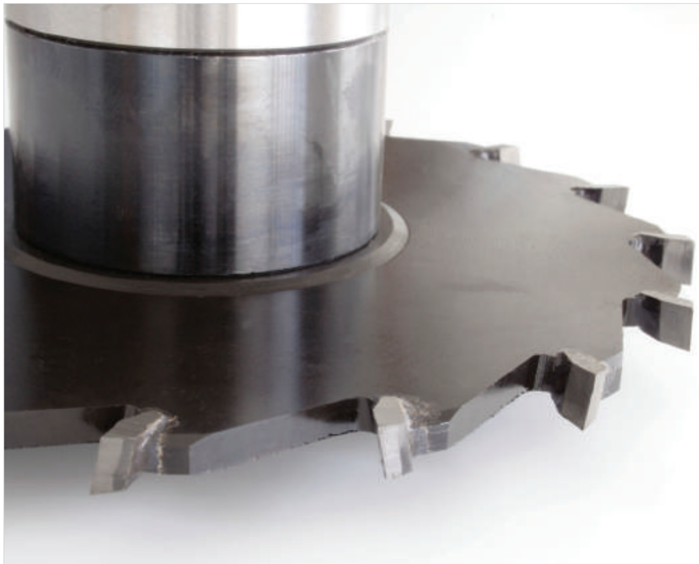
For oil, natural gas and other mining applications, ultra-hard drill materials are necessary to penetrate underground rock formations. Drill bits made from industrial diamond are manufactured under extreme temperature and pressure conditions to obtain maximum hardness and durability. Both are key measures of performance in this high-speed, abrasive environment. Drilling companies strive to maximize rate of penetration into the rock. Prematurely worn or damaged drill bits can slow down the progress of the operation. To reduce costly maintenance and improve drilling efficiency, component manufacturers invest heavily in materials and equipment R&D labs. Instrumented impact testers are among the tools found in these labs for comparing drill bit material compositions, cutting structures and manufacturing processes.

Solutions:

A special application-specific fixture and striker system were mounted to a 9350 drop tower to perform impact testing on various mining drill bit designs. Industry-standard fixturing supplied by the customer properly located and oriented the sample to be tested. A custom tup insert that accommodated a disk of softer metal to be indented during the impact was also provided. Tests are performed on the material with the softer material being replaced or rotated to a clean surface each time. The impact energy was increased each time until he sample failed. Several drill material development labs – previously using crude drop weight techniques to analyze impact performance – benefited from the repeatability and instrumentation provided by the 9350. A new level of information regarding impact force and energy became available to provide further visibility and new insight into failure modes.

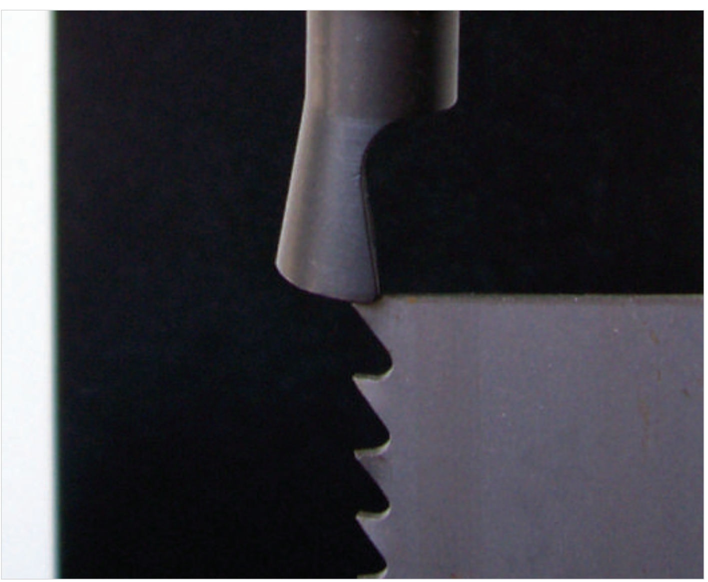


Saw Blades



Challenges:

Power saws used to cut metals, plastics and wood are a basic piece of equipment found in machine shops and on all types of job sites. The blades used in conjunction with the saws are made from various steels and geometric designs to optimize performance for different materials and types of cuts. The most important feature of a saw blade is the cutting edge. Saws operate at high speeds and the cutting teeth must be designed for long fatigue life, good thermal conductivity and minimal vibration and noise. Each tooth must be highly resistant to impact shock. A saw tooth may strike the material being cut at high velocity many thousands of times during its service life. Failure of a saw tooth due to impact can have economic or safety related consequences. A damaged saw blade can cause machine downtime and reduce job efficiency. More seriously, a saw tooth that clips off at high velocity may cause injury to the operator or a bystander.



Solutions:

The 9310 drop tower is well suited for testing the impact performance of saw blade teeth. During operation, the tip of each tooth faces the greatest impact load as it strikes the material. To duplicate this event, an Izod style tup insert made from hardened tool steel is positioned in line with the cutting edge of a saw blade specimen. The specimen itself is held vertically in a customer supplied fixture. Using a fully instrumented tup and data acquisition software with this test configuration engineers can perform tests to understand the impact force and energy limits of the saw blasé teeth. Understanding how each tooth fails can help lead to improvements in the geometry of the cutting edge or specification of better base materials, coatings or manufacturing processes.

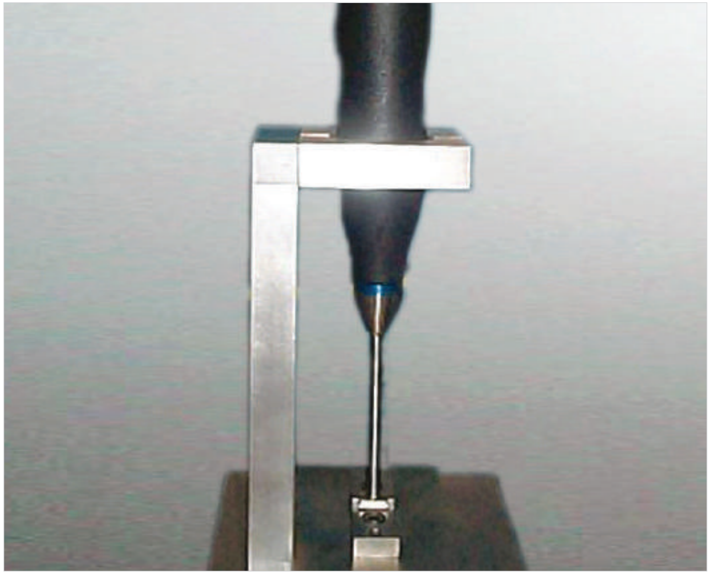
ABOUT MEDICAL TESTING

Medical products is a fast-growing, global industry driven by innovative manufacturers. Surgeons, doctors, nurses and consumers all place great trust in the quality, safety and reliability of the medical devices they use. Some products, such as surgical and dental tools, are purposefully designed to receive impacts. Others, like medical durables and disposables, can face accidental impacts during field use. In many applications,the consequences of a medical product failure can be severe for both the patient and manufacturer. A patient can suffer serious injury or death, damaging the manufacturer's reputation in the marketplace and exposing the company to product liability lawsuits.

Surgical Tools

Challenges:

The successful completion of certain surgical procedures, such as vertebrae fusions and hip replacements, requires the use of high performance implant delivery tools. During the course of the procedure, these tools are subjected to repeated impacts from the surgeon's hammer and must perform flawlessly. A tool failure can lead to complications during surgery such as unwanted debris in the wound field or excessive time under anesthesia. It is critical for manufacturers of implant delivery tools to earn the confidence and respect of surgeons by providing a product that has been thoroughly tested under enduse conditions.
Without sophisticated test equipment, manufacturers may not be able to accurately simulate forces, geometries and other impact characteristics that their tools will experience in the operating room.



Solutions:

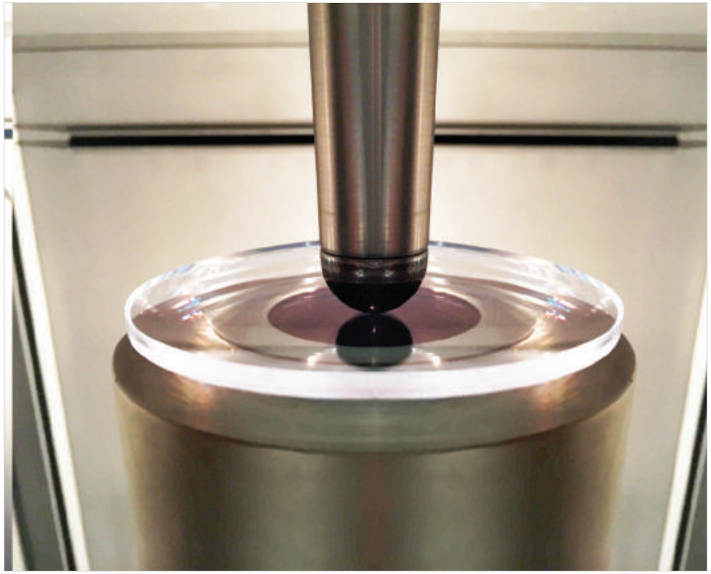
To identify design features of the implant tool most likely to fail, Instron developed a test setup on a 9350 instrumented drop tower to simulate surgical impact conditions.
Custom fixturing was assembled to grip the impact tool and a striker head was selected to replicate the face of a surgical hammer. A rebound brake was also installed to prevent secondary impacts on the tool. Once the relevant geometries were recreated, a simple modification to the VisualIMPACT software enabled the drop tower to perform automatic cyclic testing - effectively reproducing the motions of a surgeon repeatedly striking the tool.
By methodically and consistently simulating the energy level, frequency, quantity and geometry of impacts, Instron was able to improve quality control testing of the implant tool.
A previously undetected failure mode was identified during analysis of the data.

Optical Accessories

Challenges:

A significant percentage of the world's population wears some form of corrective or protective eyewear such as reading glasses, sunglasses or sports goggles. The primary purpose of eyewear is to improve vision, but the lenses must also withstand impact forces resulting from unintentional drops and hits. To the eyewear consumer, the potential consequences of impact failure - a shattering lens and serious injury to the eye – are immediate and severe. Government regulations set minimum impact performance standards for eyewear products. Lens manufacturers need a flexible test instrument to research materials and demonstrate product compliance to government specifications.

Solutions:

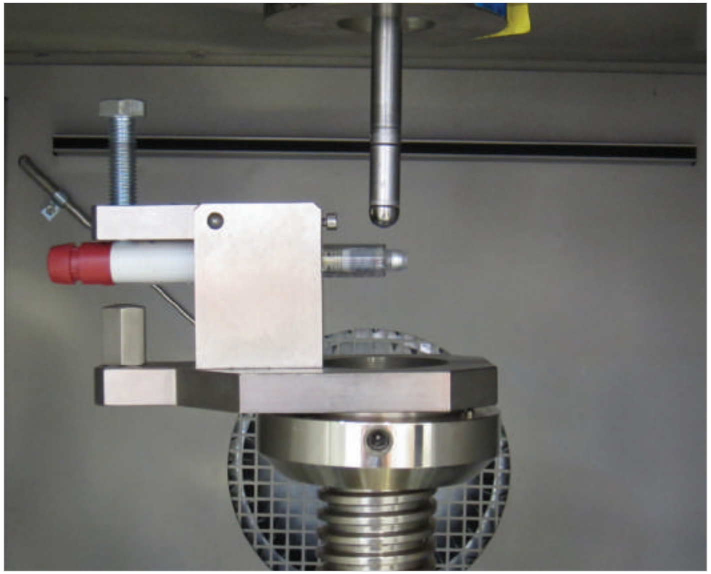


Instron created a support fixture to simulate human facial geometry and test the impact performance of eyeglass lenses. The fixture allows centring the lens and sliding it in the base of an instrumented 9310, a table top tower. Sample lenses of different mineral & organic compositions having various diameters and thicknesses were placed unrestrained on the fixture. They were impacted by a hemispherical 3kN strain gauge striker fastened to an ultra-light weight striker holder that was dropped from various heights. The resulting array of data provided detailed information about the relative deflection, maximum load and energy absorption of the different materials - information that was used to steer product development and to demonstrate product compliance.

Drug Delivery Systems

Challenges:

Manufacturers have developed innovative injector pens with disposable, pre-filled glass cartridges designed for convenient self-treatment. Consumers expect these injector pen and cartridge systems to be robust against accidental impacts. The disposable cartridges must also be packaged effectively to resist impact strikes commonly experienced during shipment. A glass cartridge broken during shipping or in use can cause injury and prevent the patient from receiving necessary medication. For the manufacturer, the patient's resulting loss of confidence in the product can be the most harmful effect of an impact failure. The product must be thoroughly tested for impact performance prior to launch into the consumer marketplace.



Solutions:

For this low-energy application, Instron worked with a customer to configure an instrumented 9340 drop tower to simulate various types of impact on the disposable glass insulin cartridge. Izod vice was used to represent different injector pen designs in the customer's product family. Utilizing the 9340 drop tower as an R&D tool, Instron's customer tested the cartridges in many different energy levels. The resulting data provided an impact resistance profile that revealed sensitive design features and confirmed a specific field failure mode, helping the manufacturer to make decisions about product design and process quality control.

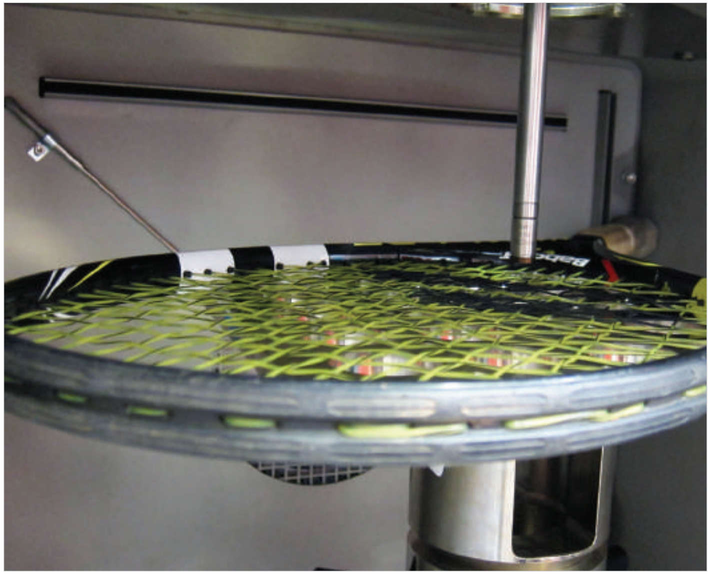
ABOUT SPORT TESTING

Designers of sporting goods used by recreational and professional athletes compete to provide superior fit, durability and performance. Products are often made from lightweight materials including composites, plastics, rubbers and foams that are selected to perform under specific impact conditions. Racquet designs are optimized for striking game balls, for example, while helmets must protect athletes from impact injuries. For many of these products, the amount of energy returned or energy absorbed during an impact is an important performance feature.

Sports Racquets

Challenges:

The design of tennis racquets has evolved dramatically over the past 20 years. Fiber reinforced, composite materials have enabled manufacturers to develop racquets that are lighter and better performing than their wooden predecessors. Tennis racquets must withstand frequent, high-speed impacts with tennis balls and fixed objects such as playing surfaces, net supports and fences or walls. Under such real-world impact conditions, composite materials can have complex and hidden failure modes with resulting effects on the performance of the racquet. Instrumented impact testing is a valuable tool to help identify and improve product durability.



Solutions:

A unique fixture was created to firmly grip and support a series of tennis racquet designs. The fixture/racquet assembly was mounted beneath a high-velocity drop tower fitted with single impact rebound brakes to reproduce common tennis impacts. Using a custom flat-faced striker or a 1.5” hemispherical insert on the tup to mimic the tennis ball, Instron’s equipment delivered application-representative impacts to the top surface and front face of the racquet’s composite frame. After incipient damage points were identified and recorded, further testing was performed on both strung and unstrung racquets to measure the effects of string tension on impact performance. Finally, the rebound response of strings was compared between damaged frames and undamaged frames to characterize the reduction in overall product performance.

Ski Boots

Challenges:

Originally skis were only pieces of wood with laces to link traditional leather boots to them. They were used primarily to transport loads in the Nordic and Alpine regions.
The growth of alpine skiing as a recreational sport has led to advances in materials and designs used for both skis and ski boots. These new and improved products have increased the level of performance, security (prevention of injuries) and comfort of ski boots. Every part of the boot is made from a different material and the parts are assembled by means of metallic or plastic connectors. The choice of the right material and design is critical in order to have efficient transmission of loads to control the ski, good absorption of shocks, along with protection and comfort of the skier's feet.

Solutions:

An Instron 9350 drop tower was used to perform impact tests on ski boots.
A special fixture allows for the ski boot to be located at a defined angle for impact in order to understand the effect of a failure under different impact energies and angles. Moreover use of a thermostatic chamber allows for impact tests to be performed at different temperatures which are used to simulate the real environment (i.e. -20°C). The optional high speed accessory can be used to impact at a maximum speed of 24 m/s (86 km/h).

Sport Shoes

Challenges:

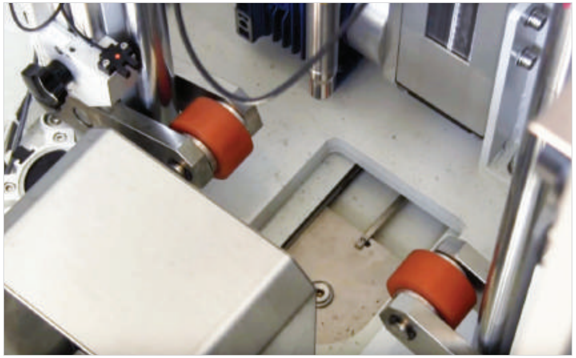
One of the most common sports played around the world is football (American soccer). An important piece of equipment that the player wears is their shoes, giving them the best support, stability, grip and traction necessary. Furthermore, the type of sole, which is the most strategic component of the shoe, will strongly depend on the field and the weather conditions. With such a great investment in research and development to correctly design and shape the lower surface, the material to be adopted is highly important and plastic is playing a dominant role in this market.

Solutions:

Manufacturers need a flexible system to evaluate the impact resistance of raw materials, as well as the end-product. The 9300 drop tower series is versatile enough to guarantee the test of the raw material, as well as testing the finished soles of the shoes at different impact energies and speeds. Using a multi-purpose plate allows the accessory to be placed in the correct test position. We suggest using interchangeable tup inserts of different shapes and sizes to simulate the effect of an impact on the lower surface during rushes, runs, jumps, and accelerations. These inserts can be used in combination with an instrumented tup and a Data Acquisition System (DAS) to gather impact results.

Accessories

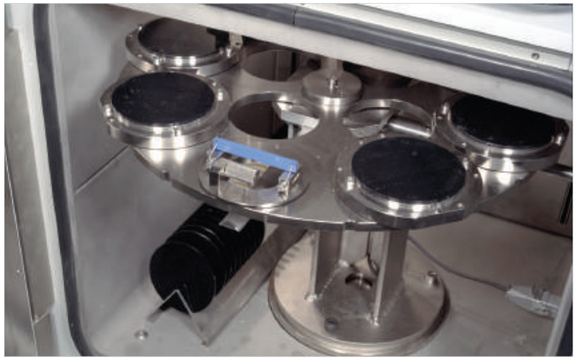
Explore a wide range of accessories to suit all of your application needs



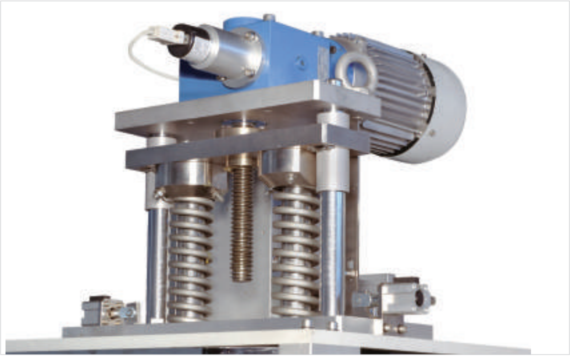
Anti-reboud system

Oil lubrication system

Specimen loader



Thermostatic chamber



High Energy


CEAST 9340
CEAST

Drop Towers

Product Portfolio

The 9300 Impact Series is designed for measuring the impact performance of raw material specimens and finished components. Drop towers capacities range from 0.15 J (0.11 ft-lbs) up to 1,800 J (1,330 ft-lbs) for testing a wide variety of plastic, metal, and composite materials.

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

Yahya Gharagozlou

Group President
ITW Test & Measurement

ImpactTestingSolutions_BrochureV2