Tekscan™

Pressure Mapping as a Research & Development Tool

A Technical Overview Demonstrating How Pressure Profile Data Enhances Product Development

Contents

Introduction

Solving Complex Problems with an ROI-Driven Solution

The Challenge for R&D Teams

In today's fast-paced and competitive landscape, Research & Development (R&D) teams are under constant pressure to deliver innovation quickly and efficiently.

For design engineers, that often means identifying potential problems as early as possible - sometimes before they fully materialize.

Paths to Innovation

No two paths to innovation are the same. Developing better products or processes requires testing new approaches, investing in modern tools, and capturing insights that guide decision-making. One powerful tool in this process is pressure mapping.

Why it Matters

Pressure mapping measures the distribution of force between two interacting surfaces, providing engineers with valuable data on contact area, uniformity, and potential failure points. These insights help identify design flaws, optimize performance, and reduce costly redesigns.

Technology evolves when it is challenged, and in the case of pressure mapping, design engineers are continuously discovering new opportunities to use the technology.

What You'll Learn in this eBook

This paper provides an overview of pressure mapping technology and explores how it's used in R&D to solve real-world engineering challenges. It will share application examples and demonstrate how this proven technology helps reduce risk and deliver measurable ROI.

What is Pressure Mapping?

Even between relatively flat surfaces, the interface pressure distribution is often not uniform, with localized areas of peak pressure. Pressure mapping technology provides insight into areas that may impact design and quality.

Pressure mapping systems consist of 3 components – **sensors, scanning electronics and software** – to deliver real-time, actionable data, in ways other methods cannot.

1. **The sensor transforms compressive pressure loads to a change in resistance.**

2. **The scanning electronics collect analog data from the sensor and convert the data to a digital signal.**

3. **The software displays real-time activity of the sensor area, allowing the user to see force, pressure, contact area, and timing data.**

Now Available:

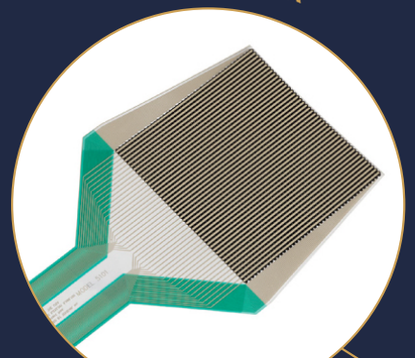
Temperature Mapping

Teksan now offers a thin-film temperature mapping solution that integrates with I-Scan, enabling users to collect thermal data, and in some cases, thermal and pressure data simultaneously.

Explore the Possibilities

Components of a Tekscan Surface Sensing System

SENSOR

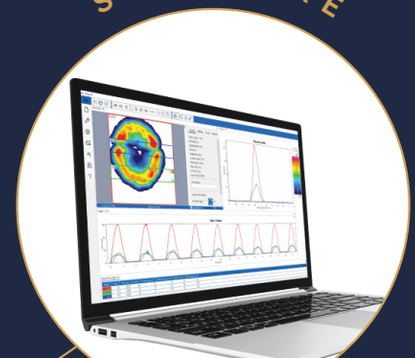


- Minimally invasive
- High resolution
- Thin & flexible
- Reusable
- Trimmable
- Multiple pressure ranges and form factors

ELECTRONICS

- Scan thousands of sensing points within each sensor
- Instant data relay to PC via USB or WiFi

SOFTWARE



- Display data in multiple formats for superior analysis
- 2D & 3D graph display
- Capture peak pressures and center of force in real time
- Video playback

REAL-WORLD R&D USES OF PRESSURE MAPPING TECHNOLOGY

The following pages present 6 unique real-world examples where pressure mapping technology had played a role in enhancing product development or improving R&D processes.

1 Evaluating Product Performance

Pressure mapping helps R&D teams take a glimpse into the future and assess how a product will perform over its use.

Product longevity is a key differentiator for most industries. Pressure mapping is an effective tool that can provide instant feedback on how a product will respond to long-term wear-and-tear. R&D teams can use this information to make modifications to product designs that elevate standards for product lifecycle. This can go a long way in producing a premium product and building customer loyalty.

CASE EXAMPLE:
Optimizing Quality Testing in the Tire Industry

A tire is only as good as its ability to maintain performance under various loads and applications. Additionally, qualitative data on the void ratio of a tire is critical for understanding the water displacement potential of the design. Pressure mapping has played a major role in enhancing how tire R&D teams optimize tire performance and verify their design with a fast, efficient system.

As shown in **Figure 2**, tire footprint pressure output was captured in a dynamic roll test. This helps tire manufacturers predict road surface wear on tire design. The system's tailored graphing and image analysis software enables quantitative and qualitative evaluation of tire behavior. From this information, tire manufacturers can make adjustments to their design. They can evaluate tread design and contact pattern in order to improve the long-term durability of their tires on the road. Prior to pressure mapping technology, this information was obtained using ink and paper. However, this testing method cannot show dynamic activity nor evidence of pressure changes when the tire is operating under different loads.

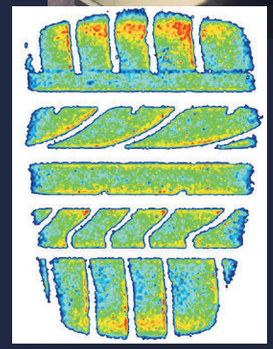


Figure 2
Tire Footprint Data

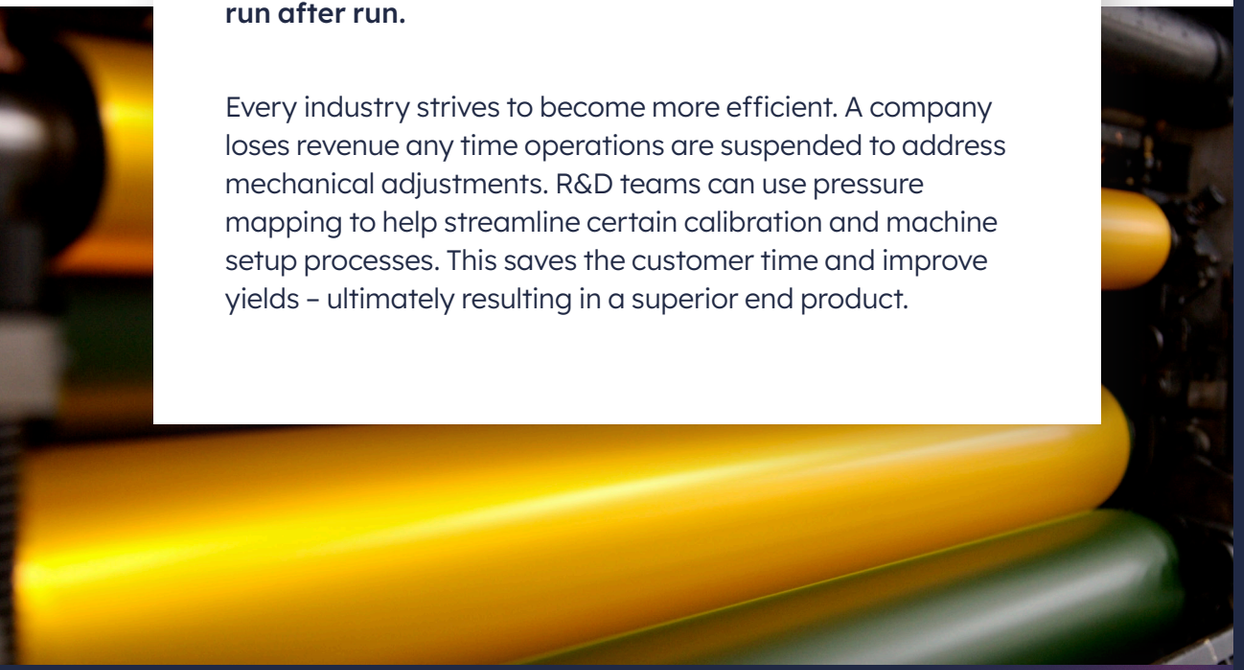
Other Product Performanc Evaluation Applications

- Tire Bead Pressure Profile
- Wiper Blades

2 Ensuring Precision in Nip Setup

Pressure mapping helps R&D teams standardize machine design & setup processes. This ensures a consistent product, run after run.

Every industry strives to become more efficient. A company loses revenue any time operations are suspended to address mechanical adjustments. R&D teams can use pressure mapping to help streamline certain calibration and machine setup processes. This saves the customer time and improve yields – ultimately resulting in a superior end product.



Measure Temperature Between Two Surfaces

Tekscan has enhanced the I-Scan™ platform with a new thin-film temperature mapping capability, enabling you to capture detailed temperature distribution across a surface—or in between two surfaces where thermal cameras can't. Here is a small sample of application uses for evaluating product performance:

- **Optimize heat shield performance in vehicles**
- **Analyze thermal distribution in battery cells**
- **Measure heat dissipation efficiency between components and heat sinks**
- **Measure temperature consistency in nip rolls for laminating and packaging processes**

Explore the Possibilities

CASE EXAMPLE:
Nip Pressure Measurement

A nip creates pressure between two rolls that are forced together. The pressure profile created by those rolls is known as a nip footprint. Consistent, precise nip pressure is crucial to producing a uniform product and reducing waste. Uneven nip footprints can lead to costly issues, including product defects and equipment damage. Depending on the size of the nip, the uniformity evaluation can be a time consuming process, which is not ideal for time-sensitive production cycles.

An R&D team sought a verifiable way to ensure their web handling machine could achieve a more precise nip. They incorporated pressure mapping technology to assess the effectiveness of crowning, and differences in pressures and contact width along the length of the nip roll. **Figure 3** demonstrates how a tactile pressure sensor could be positioned on the nip roll to analyze nip-pinch along the surface area. This data not only improved machine setup, but also enabled machine-to-machine comparisons to validate the impact of process changes.

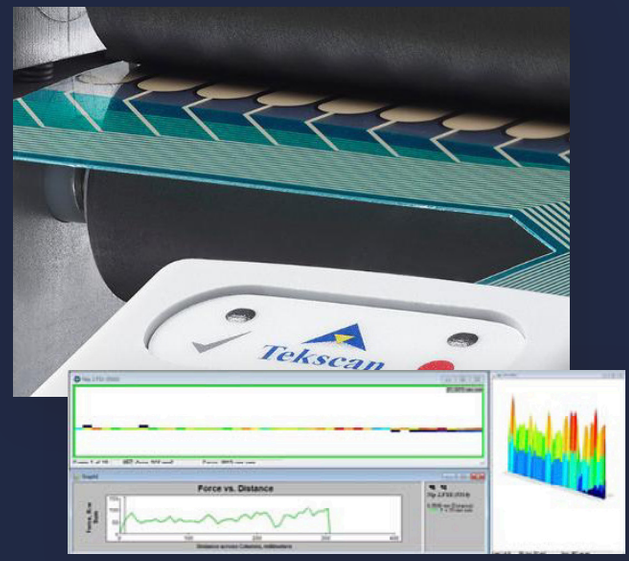


Figure 3
Nip Contact Evaluation

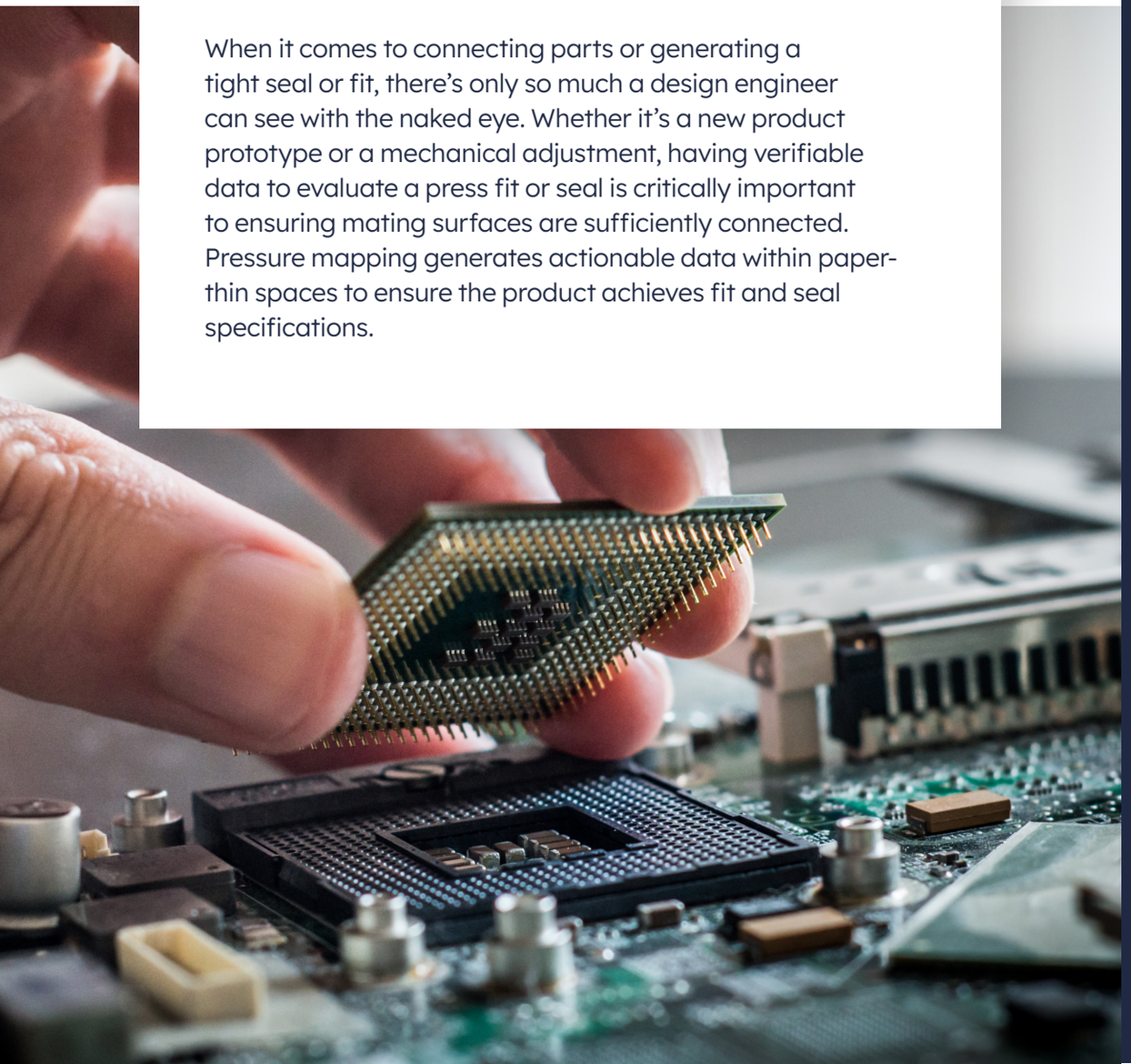
Other Machine Setup Applications

- Tool & Die
- Horn & Shoe
- Printing & Packaging
- Chemical Mechanical Polishing
- Laminating

3 Evaluating Component Press Fits & Seals

Pressure mapping can be a design engineer's magnifying glass to confirm the quality of a product's design.

When it comes to connecting parts or generating a tight seal or fit, there's only so much a design engineer can see with the naked eye. Whether it's a new product prototype or a mechanical adjustment, having verifiable data to evaluate a press fit or seal is critically important to ensuring mating surfaces are sufficiently connected. Pressure mapping generates actionable data within paper-thin spaces to ensure the product achieves fit and seal specifications.



CASE EXAMPLE:
Enhancing Catalytic Converter Durability

New regulatory standards require automobile manufacturers to design greater surface area into the catalyst in order to dilute emissions. One way to achieve this is by designing with thinner walls. The downside is that thinner catalytic converter walls are significantly more susceptible to cracking if an uneven pressure is applied in the assembly process. These defects can lower product quality, reduce yields, and ultimately result in higher emissions.

Figure 1 shows how an automotive R&D team positioned a tactile pressure sensor around the cylindrical catalyst to analyze peak pressures that occur when the catalytic converter can is sealed. With the help of pressure mapping, the team could make the necessary adjustments. Time and money are saved in design, process verification, and re-engineering.

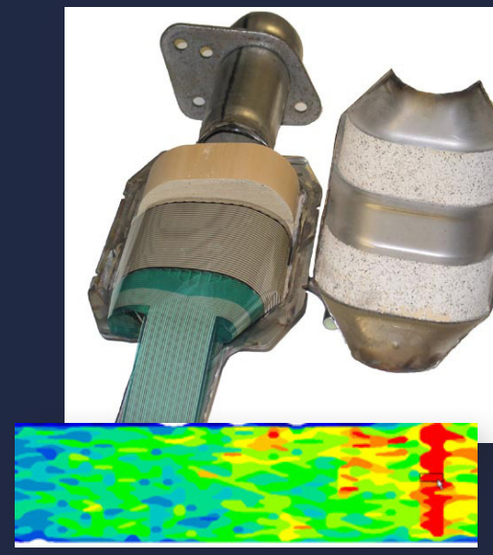


Figure 1
Identifying localized pressures on the catalytic converter wall

Other Press Fit or Seal Applications

- Hose Clamp & Crimp
- Surface Contact for Thermal Conductivity (Heat Sinks)
- Semiconductor Testing
- Printed Circuit Board Components
- Gasket Seal
- Door Seal

4 Lifecycle Testing of Batteries

Pressure mapping helps R&D teams engineer safer, longer-lasting batteries by making data-driven, informed decisions.

Across various market segments, there is increasing demand for batteries that are smaller, lighter, and capable of faster charging. Additionally, there is a growing expectation for batteries to be safer while carrying a higher energy density. As next-gen batteries push limits in energy density and form factor, mechanical behavior under real-world conditions becomes more critical than ever. Pressure mapping enables R&D teams to quantify and localize internal stress; validate fixture and compression designs while informing predictive models of mechanical failure.

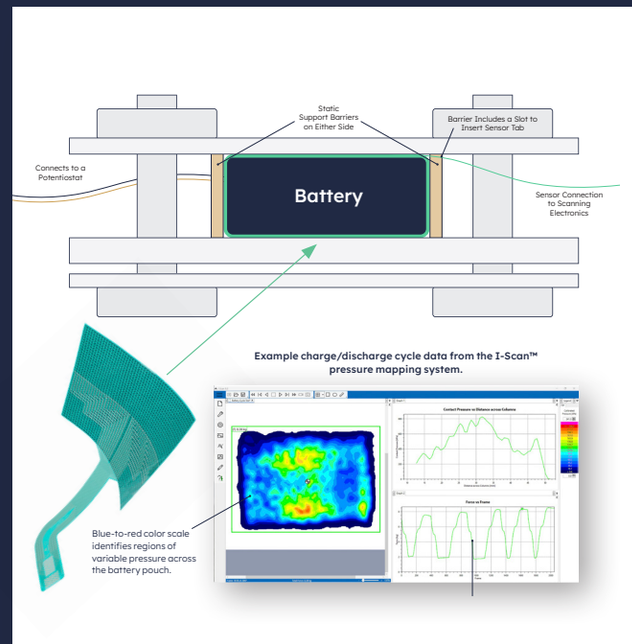
CASE EXAMPLE:
Lithium-ion Battery Stack Pressure

A 2014 study by researchers at Princeton (Cannarella & Arnold) revealed that stack pressure significantly affects lithium-ion battery degradation. Using load cells, they demonstrated that:

- **Excessive pressure** accelerates capacity fade via electrode deformation and loss of contact.
- **Insufficient pressure** can lead to delamination and uneven SEI growth.

This foundational work elevated pressure as a critical, yet often under-characterized, mechanical factor in battery design and testing.

In a 2019 follow-up published in the Journal of The Electrochemical Society, researchers integrated Tekscan's high-resolution pressure sensors into battery cycling tests—capturing spatial and temporal pressure data in real time.



Key Findings for R&D Teams

- **Pressure is dynamic:** Fluctuates through charge/discharge cycles due to swelling, heat, and chemistry.
- **Hotspots matter:** Localized pressure peaks aligned with early mechanical and electrochemical failures.
- **Data drives design:** Mapping insights guided improvements to cell construction, compression fixtures, and test protocols.

Other Battery Testing Applications

- Formation Process Monitoring
- Module & Pack Assembly Validation
- Fixture & Housing Evaluation

5 High-Speed Impact Testing

Pressure mapping helps R&D teams develop products that stand up to the rigors of everyday use.

Accidents happen. The challenge for R&D teams is to mediate the effects accidents can have on a product, especially in situations where drops and blunt forces can occur over its use. Capturing quantifiable high-speed impact data can help R&D teams develop stronger product designs that customers can trust.

CASE EXAMPLE:
Packaging Drop Test Experiment

For product packaging R&D teams, it's what's on the outside that counts. Knowledge of how a product will react in different drop testing scenarios can help manufacturers determine the best way to pack the product for shipping, and what could happen if the end user were to drop the product.

In this drop testing experiment, shown in **Figure 5**, a pressure mapping system was used to test high-speed impacts of a plastic container filled with liquid that was dropped at different angles and heights. A low resolution sensor that measures at 20 KHz was used to identify the concentration of pressure. With this information, the R&D team was able to ensure the bottom of the product could handle drops without any breaks or leaks.

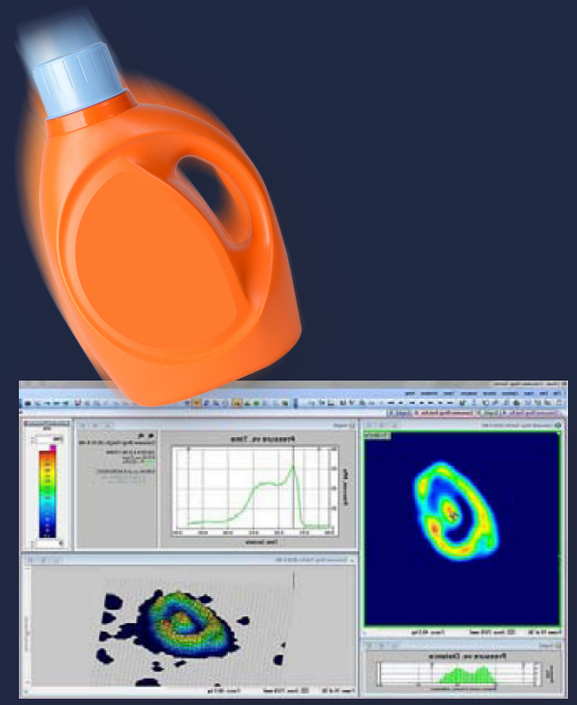


Figure 5
Drop Testing Results

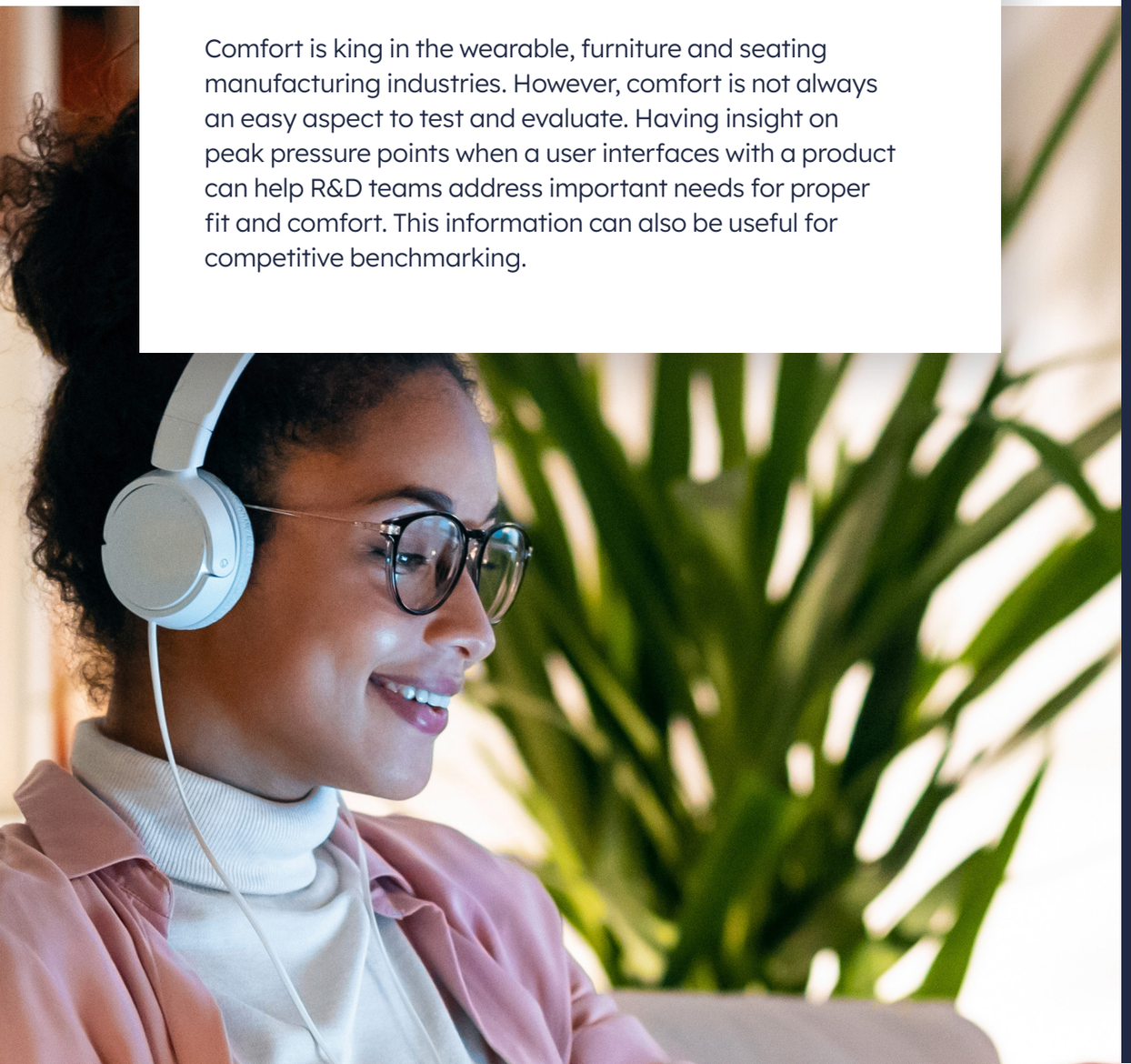
Other High-Speed Impact Testing Applications

- Collision Testing
- Ballistics Recoil
- Machine Press
- Airbag Deployment

6 Comfort & Ergonomic Assessment

Pressure mapping helps R&D teams target opportunities to produce a more comfortable end-user experience.

Comfort is king in the wearable, furniture and seating manufacturing industries. However, comfort is not always an easy aspect to test and evaluate. Having insight on peak pressure points when a user interfaces with a product can help R&D teams address important needs for proper fit and comfort. This information can also be useful for competitive benchmarking.



CASE EXAMPLE:
Quantifying Car Seat Comfort

Comfort is an important part of the overall driver and passenger experience. Ergonomic pressures change as the driver makes different movements like accelerating or applying brakes. Car seat R&D teams can use this information to develop better seat designs that accommodate specific driving activities.

The images in **Figure 4** illustrate how an automotive R&D team used pressure mapping to show the dynamic inter-relationship of seat back and cushion pressure when the driver pushes the brake pedal. This information helped the team determine peak pressure zones and predict pressure changes over time. From there, the team could more accurately assess the effect of stitching, bolsters, wire stays, foam stiffness, seat angles, lumbar supports, and cover materials used in the design.

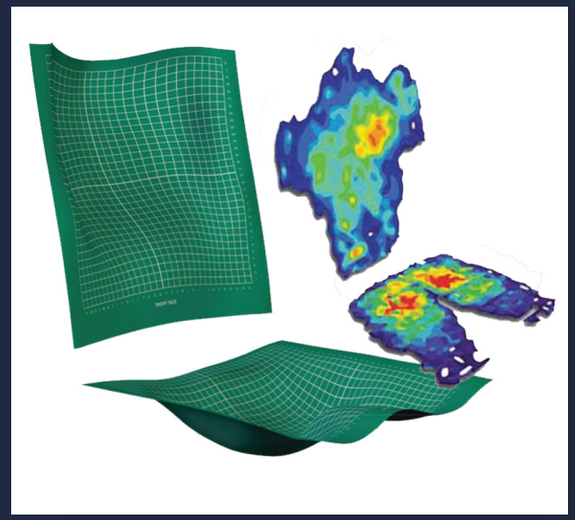


Figure 4
Example of a seat pressure distribution scan

Other Comfort & Ergonomic Assessment Applications

- Headphones
- Eyewear
- Grip
- Furniture & Mattress Design

Conclusion

How Can Pressure Mapping Enhance Your R&D Processes?

The examples and successes shared in this paper are the result of an R&D team partnering with a trusted pressure mapping resource that could provide a solution to meet their specific goals. While every process is different, there are important qualities an R&D team should consider when selecting a collaborative partner:

1. Experience & Longevity

Does the company have a respected position in their market and a proven track record of success?

2. Mastery of the Technology

Is the company continuously delivering new innovations and improvements to their technology?

3. Proven & Diverse Application Portfolio

Has the company demonstrated several examples where they were presented with unique challenges and developed value-added solutions?

Let's discuss your next R&D project

We at Tekscan understand the challenges R&D teams face, and the risks they take when investing in test & measurement technology. Whether it's a standard pressure mapping system, or a custom solution, Tekscan has a proven track record for helping R&D teams achieve a better understanding of their products and procedures by providing trustworthy, actionable data. Your return on investment comes in the form of confidence in your product design, a shortened development process time, and an improved end user experience.

Visit **www.tekscan.com**
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for more information

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