

Capacitive Displacement Sensors
Eddy-Current Displacement Sensors
Label/Package Sensors
Spindle Error Analysis

Corporate Overview

Precise noncontact measurement since 1958



“Lion Precision provided me with a total system solution, and they were a big help in educating me in using it and maximizing its effectiveness. They have really helped me push the envelope of measurement technology.”

Klaus Obergfell, Seagate

“Lion Precision enabled us to see deeper into the inner working of spindle error motion and worked with us to develop a set of tools that have allowed us to push the state of the art in ways that were simply not possible before.”

Jim Arneson, Professional Instruments

“Krones, Inc. has had great success with Lion Precision sensors. I also cannot express enough how Lion Precision has come through during many a crisis condition. This level of service is rare in industry these days.”

Steve Retzlaff, Krones Inc.

We Started It All

In 1958, Professor Kurt Lion of the Massachusetts Institute of Technology (MIT) started Lion Precision and introduced the world's first capacitive noncontact measurement system to the commercial market. Today, companies large and small throughout the world depend on our products for their critical measurements. The addition of our eddy-current products in 2002 radically increased our ability to assist our customers in their continuing quest for better, more flexible, and more reliable measurement systems.

Looking to the Future

Our floor space has increased by nearly three times what it was in 1995. Our engineering staff has tripled as well. We've invested in people and equipment to position ourselves to help take our customers to the next level.

A Global Outlook

Over half of our sales are outside the U.S. To help our customers compete in the new global economy, we have adopted the ISO9001 standard and have been registered since 1998. Our customers can be confident that we are deliberate about the quality of our products and processes.

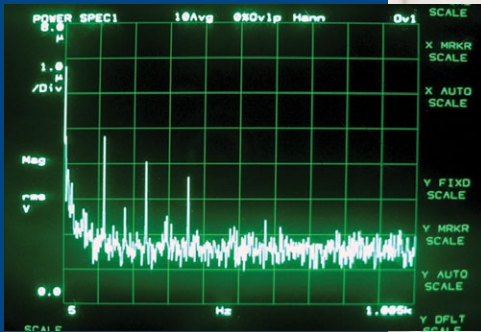
We Make It Possible

Producing today's advanced technological products, from mobile phones to medical devices, requires measurements of incredibly small magnitude. Developers call us because of our reputation as partners—working alongside them to provide unique solutions to their unique measurement problems. A significant portion of our sales includes custom designs to suit specific applications. The development of the next generation of high-tech products requires tiny measurements—we make it possible.



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Research and Development

Our engineering staff combines for over one hundred years of sensor and electronic design experience. We maintain close relationships with several research universities and national research institutions such as Lawrence Livermore National Laboratory. Cooperation with these institutions has advanced measurement technology on several fronts and produced award-winning designs of high-performance measurement systems.

Members of our staff sit on ANSI (American National Standards Institute) committees (B5 and B89), have held office as president of the American Society for Precision Engineering (ASPE), and served as council members of the European Society for Precision Engineering and Nanotechnology (euspen).

Fully Equipped

Serving our customers and advancing our technology require advanced tools. We continue to invest in equipment and facilities that enable us to conquer the design challenges that we face every day and every year. Much of our equipment is designed and built specifically for Lion Precision.

Six ultra-precise calibrators designed to our specifications which provide our customers with NIST traceable factory calibrations

Five computer-controlled environmental chambers providing 10%–90% relative humidity and a –75°C to 200°C temperature range

Computer-controlled, high-vacuum chamber capable of 10^{-7} Torr with a 300amu residual gas analyzer

Multiple 16-channel 24-bit data-acquisition systems

3D inductive-field modeling software

Solid Works 3D mechanical design software with standard file format output for use in customer designs

A History of Innovation

1963 — Lion Precision worked with spring makers and developed the world's first "spring gage"—an instrument that measures the length of springs during production. Today, nearly all spring coilers use spring gages and the vast majority carry the Lion Precision logo. The product line was sold in 2002.

1986 — Automated Quality Technologies purchased Lion Precision in Boston and moved it to the current headquarters in St. Paul, Minnesota.

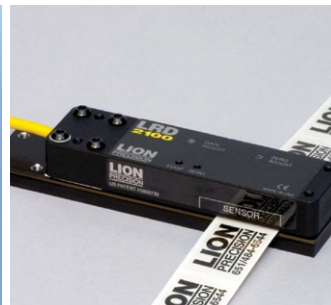
1992 — Lion Precision, working with the University of North Carolina at Charlotte (UNCC) developed the Spindle Error Analyzer (SEA). SEA uses high-performance capacitive sensors and proprietary software to measure precision spindles used in machine tools and hard-disk drives. These systems are now used worldwide in over a dozen countries to maintain part quality and monitor machine performance.

1994 — The LRD2100, the world's first and most popular clear-label sensor, revolutionized the packaging industry. Today, over 50,000 Lion Precision label sensors are in use throughout the world.

1998 — The TARGA Dynamic Runout Tester measures high-speed drill spindles for the printed-circuit board industry. High-speed spindle builders and users across the globe use the TARGA to maintain peak production performance.

2009 — The ECL202 is the industry's first digital-based eddy-current sensor. For specific application problems, a digital core allows us to modify the sensor in ways that simply are not possible with analog sensors.

2012 — The CompactFLEX platform for eddy-current and capacitive sensors is easily customized and can include a digital output for easier implementation.



1960

1970

1980

1990

2000

2010

Associations

American Society for Precision Engineering (ASPE)

American Society of Mechanical Engineers (ASME)

European Society for Precision Engineering and Nanotechnologies (EUSPEN)

Awards

Several respected organizations have recognized and honored Lion Precision's innovative designs with their awards.

In addition to several U.S. Patents, our designs have won:

The Dupont Award

R&D 100 Award

Best of Sensors Bronze Award

Best of Sensors Silver Award





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Eddy-Current Products

Eddy-Current sensors use magnetic fields to induce small electrical currents (called "eddy currents") in target materials. The interactions of the magnetic fields of the eddy currents and the sensor indicate the distance between the probe and the target. Eddy-Current sensors provide precision, noncontact measurement even in hostile environments where oil, water, dirt, or other contaminants are in the measurement area.

The design philosophy for our eddy-current products is to achieve better overall performance than anything currently on the market. We've been successful. Our combined specifications are an industry best. In addition to our standard eddy-current products, we are focused on providing custom, optimized solutions for moderate- and high-volume applications.

Eddy-current sensors, with their tolerance of hostile environments, are particularly well-suited for use in manufacturing and automotive applications. Thanks to the ruggedness of these sensors, they are even installed in running engines for real-time performance tests.

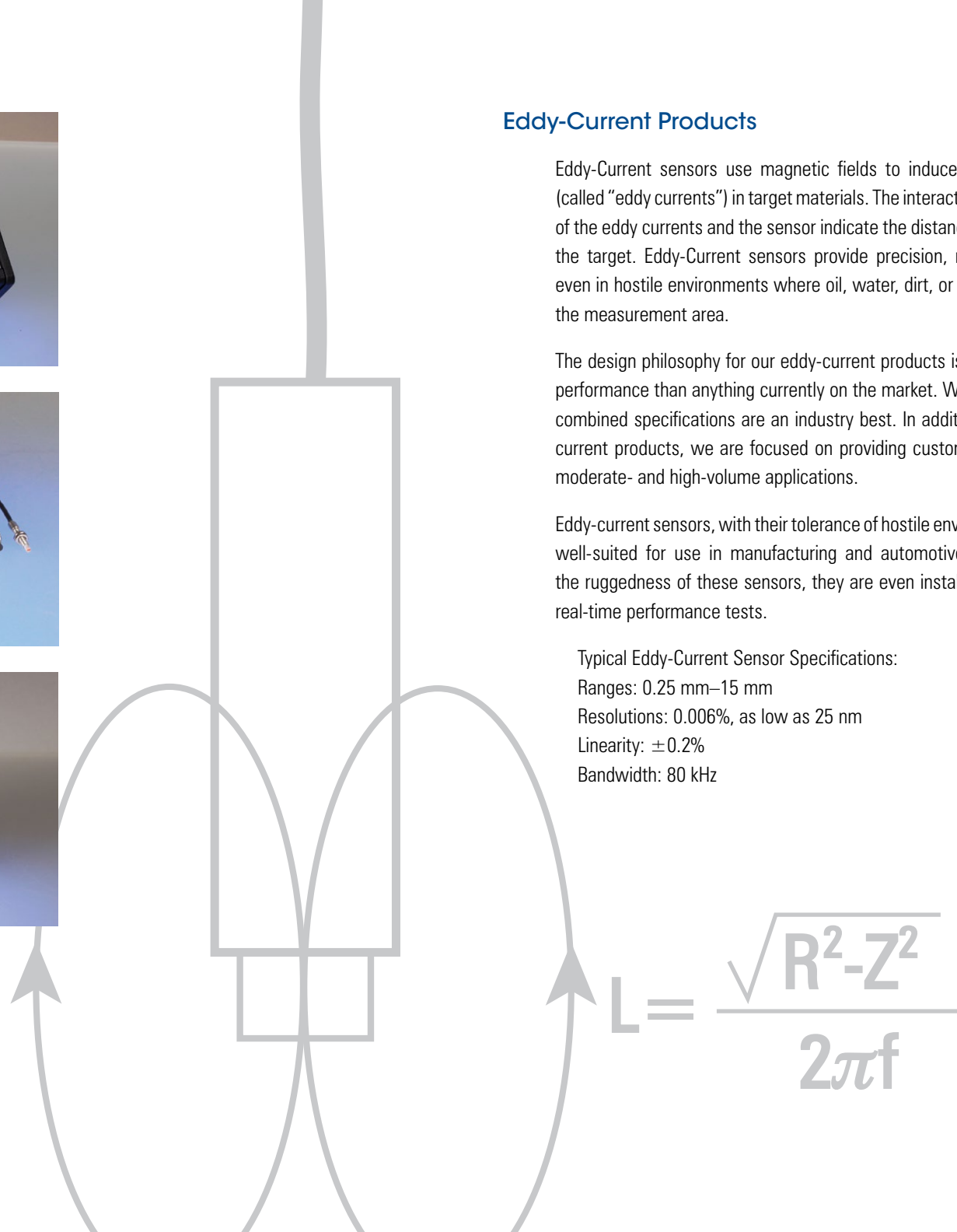
Typical Eddy-Current Sensor Specifications:

Ranges: 0.25 mm–15 mm

Resolutions: 0.006%, as low as 25 nm

Linearity: $\pm 0.2\%$

Bandwidth: 80 kHz



Capacitive Products

Capacitive sensors use electric fields to sense the surface of the target. This electric field changes with the distance between the target and sensor. Because electric fields are also affected by nonconductive material between the sensor and the target, capacitive sensors also measure targets such as plastic and paper. Capacitive sensors are well-known for very high resolutions and are used when maximum measurement performance is critical.

In 1958, Lion Precision introduced the first commercial capacitive noncontact measurement system. Since that time, advances in electronics and sensor design techniques have enabled us to increase resolutions to astonishing levels. Our newest sensors can see target movements less than 0.1 nanometers—that's a human hair split one million times.

In addition to position measurement of conductive targets, capacitive sensors are used in nonconductive applications such as coating thickness, double sheet detection, glue sensing, etc. Capacitive sensors perform well in the demanding environments of high-vacuum and space.

Typical Capacitive Sensor Specifications:

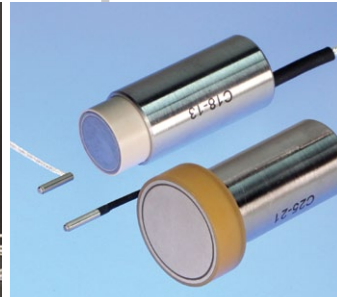
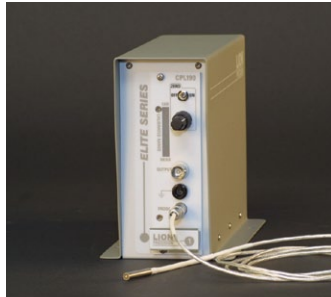
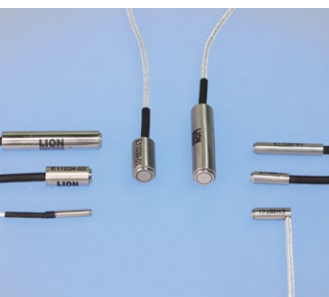
Ranges: 0.01 mm–12.5 mm

Resolutions: 0.003%, as low as 0.05 nm

Linearity: $\pm 0.2\%$

Bandwidth: 15 kHz

$$C = \frac{\epsilon_0 \epsilon_r A}{d}$$



Example Applications

Deformation Measurement

Disk-Drive Assembly

Disk-Drive Spindle Performance

Film Thickness

Glue Detection

Internal Engine Monitoring

Flat-Panel Display Processing

Material Separation

Medical Instruments

Metal Forming

Missing Assembly Component

Nanopositioning Stages

Position

Printing-Press Drum Runout

Roller Runout

Semiconductor Photolithography

Micro-Manufacturing

Thickness

Thread Detection/Quality

Ultrasonic Welders

Vibration

Photovoltaic Process Control

Label Sensors

To accurately place a label in the right location on a package, the machine must know the exact location of the label edge. In 1993, Lion Precision used capacitive sensor technology to create the world's first and only "clear label sensor" – the LRD2100. Until that time, clear labels presented a difficult challenge for packaging professionals. Existing optical technology required additional "eye-marks" on label webs to trigger the sensors. This added cost, complexity, and potential error source is eliminated with Lion Precision label sensors.

The LRD2100 was an enormous success. Since then, new models with more capabilities have been added to the product line. In 2010 the LRD8200 was introduced. It uses ultrasonic sensing techniques with a very easy pushbutton interface.

Lion Precision is the world's most popular brand of clear label sensor. To date, over 50,000 LRD brand sensors have been sold and installed on packaging equipment around the world. We continue to ship thousands of sensors every year.

The LRD label sensor line is a perfect example of Lion Precision's commitment to solving customers' unique sensing problems.



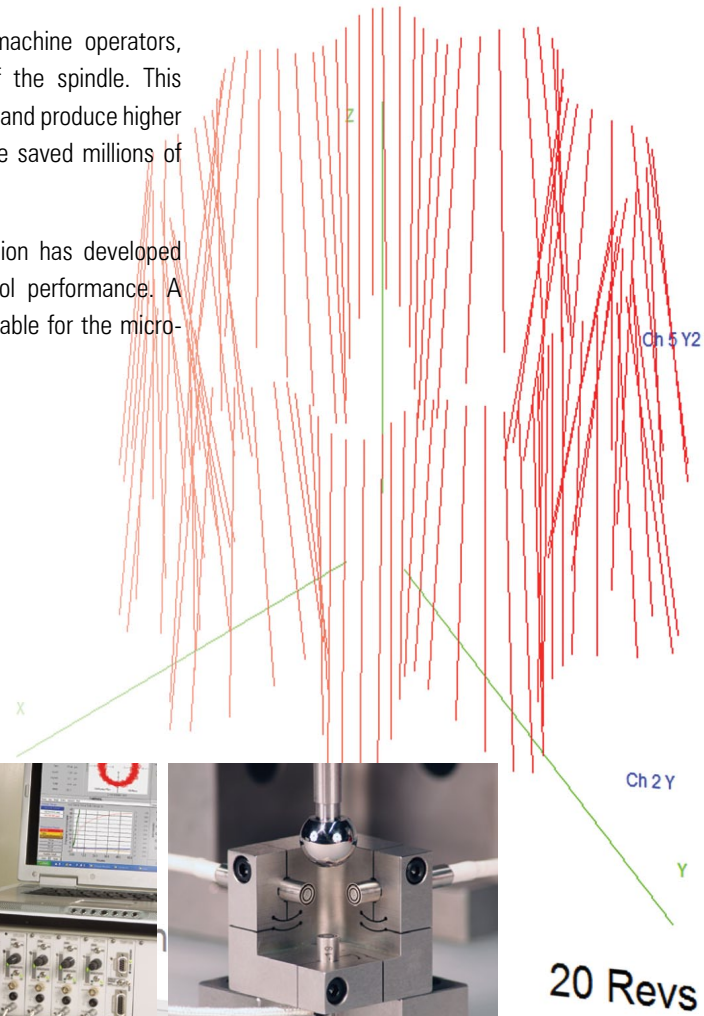
Spindle Error Analysis

Manufacturing precision components requires precise movement of cutting tools. The rotary motion of a spindle is a critical factor in finished part quality. In 1990, Lion Precision worked with the University of North Carolina at Charlotte (UNCC) to develop a Spindle Error Analyzer (SEA). This tool used high-resolution capacitive sensors to monitor motion of a machine tool spindle at operating speeds and analyzed that information with proprietary software.

Using discrete data and graphical displays, SEA shows machine operators, programmers, and designers any errors in the motion of the spindle. This empowers them to correct problems to improve performance and produce higher quality parts with reduced scrap. Some users claim to have saved millions of dollars through the use of the SEA.

Working with other institutions and end users, Lion Precision has developed the SEA into the premiere tool for analyzing machine tool performance. A smaller version specifically for micro-machining is now available for the micro-manufacturing market.

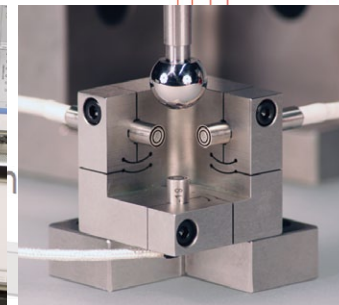
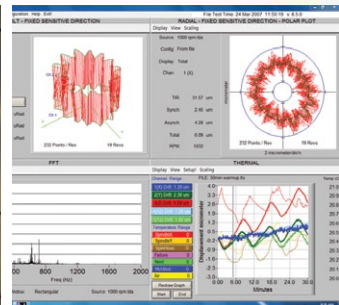
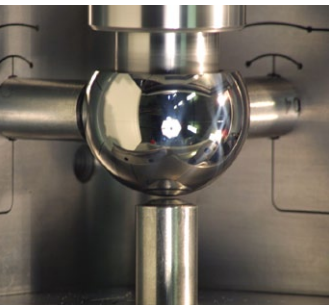
TILT - FIXED SENSITIVE DIRECTION



Update Display

Synch 34.40 uRad

Asynch 101.30 uRad



20 Revs

R&D Partnerships

Lion Precision frequently works with universities and government laboratories to develop new products.

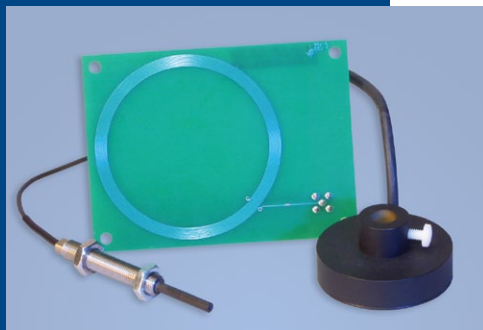
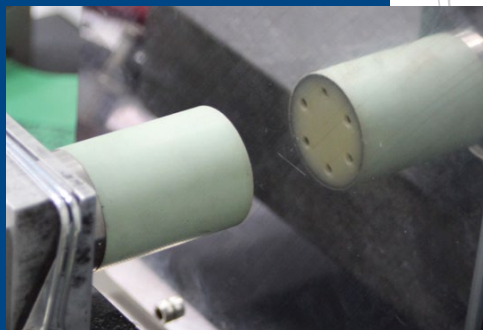
We worked with the University of North Carolina at Charlotte (UNCC) to develop the Spindle Error Analyzer (SEA). The SEA is now the world's primary tool for measuring and analyzing machine tool performance.

Lawrence Livermore National Laboratory worked with us and Colorado Precision to develop the world's most accurate LVDT. The design won the R&D100 Award for R&D Magazine.

We have an ongoing relationship with the Machine Dynamics Laboratory and The Pennsylvania State University which uses SEA in its research.

The National Ignition Facility uses Lion Precision capacitive probes to check position of the deuterium capsule used in their development of a fusion energy source.

Our equipment and expertise is used in universities and research institutions in countries around the world.



Custom Solutions

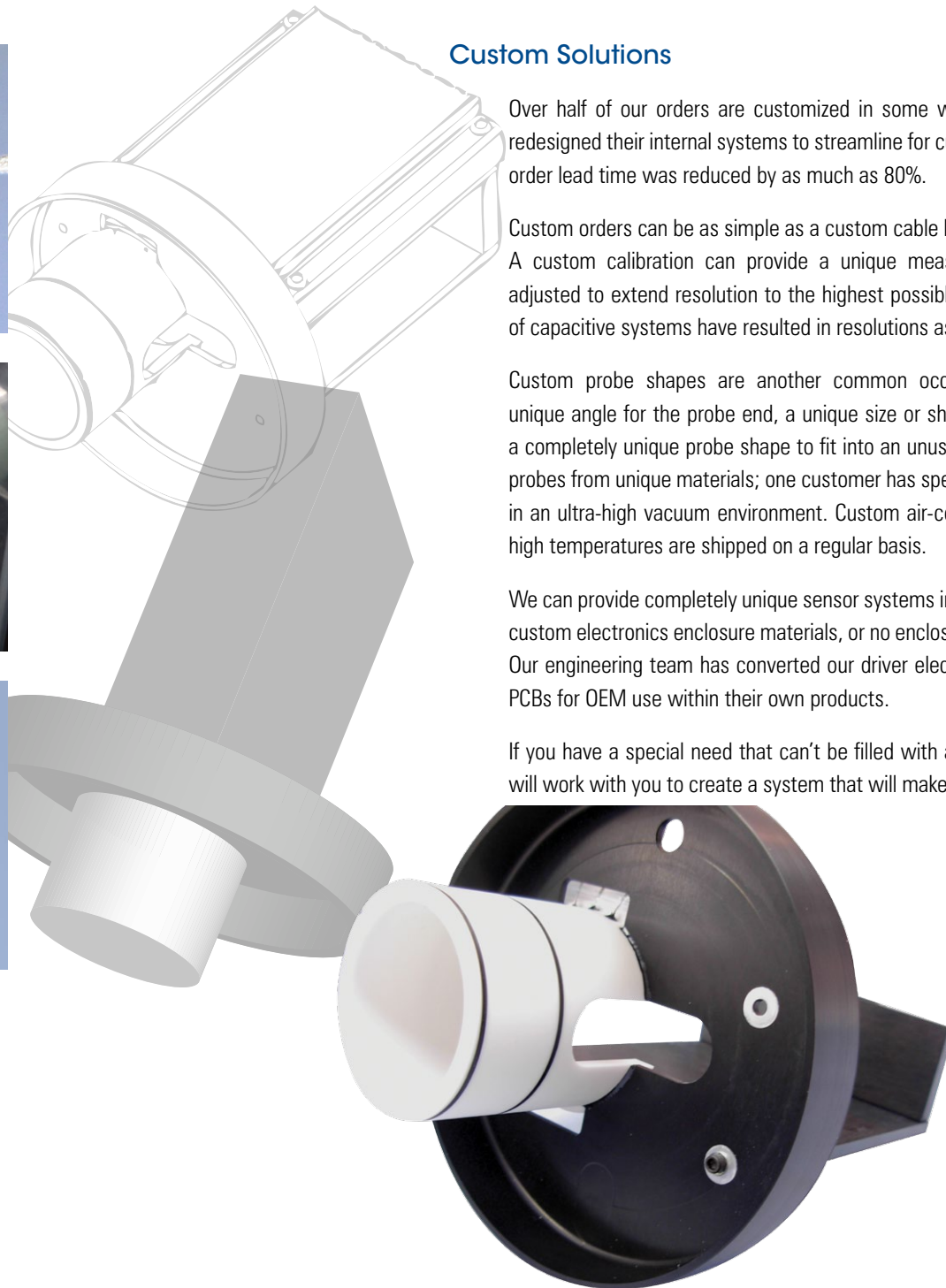
Over half of our orders are customized in some way. In 2009, Lion Precision redesigned their internal systems to streamline for custom products. Our custom order lead time was reduced by as much as 80%.

Custom orders can be as simple as a custom cable length or custom calibration. A custom calibration can provide a unique measurement range or can be adjusted to extend resolution to the highest possible level. Custom calibrations of capacitive systems have resulted in resolutions as low as 0.0002% of range.

Custom probe shapes are another common occurrence. You may need a unique angle for the probe end, a unique size or shape for the sensing area, or a completely unique probe shape to fit into an unusual location. We have made probes from unique materials; one customer has specified copper probes for use in an ultra-high vacuum environment. Custom air-cooled probes for use in very high temperatures are shipped on a regular basis.

We can provide completely unique sensor systems including custom electronics, custom electronics enclosure materials, or no enclosure at all – we've done it all. Our engineering team has converted our driver electronics into edge connector PCBs for OEM use within their own products.

If you have a special need that can't be filled with an off-the-shelf product, we will work with you to create a system that will make your needed measurement.



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Building Trust Around the World

Some of the best-known companies around the world put their trust in Lion Precision's ability to help them continue their leadership position in their respective industries.

Whether pushing hard disk drive capacity to new limits, ensuring reliability for consumer products, or improving quality and productivity in state-of-the-art factories, our sensors provide the critical information our customers need to stay competitive.

Some companies display their trust by incorporating our products into theirs. Others use our products to control critical operations during manufacturing and assembly.

We work with many of the world's best-known companies to design custom sensors to fit their unique needs. Sometimes it's a different probe shape to fit in a small area; sometimes it's custom electronics to deliver a unique sensor system; sometimes it's an industry-wide solution to a nagging problem. Whatever the measurement challenge, Lion Precision expertise is available to help create a solution.



Global Partners

Distributors and customers around the globe.

Argentina	Japan
Australia	Malaysia
Austria	Mexico
Belgium	The Netherlands
Brazil	New Zealand
Canada	Nigeria
Chile	Norway
China	Philippines
Colombia	Poland
Czech Republic	Portugal
Denmark	Puerto Rico
England	Singapore
Finland	Slovakia
France	South Korea
Germany	South Africa
Great Britain	Spain
Guatemala	Sweden
Hong Kong	Switzerland
India	Taiwan
Indonesia	Thailand
Israel	Vietnam
Italy	Wales

Lion Precision's commitment to quality

is unsurpassed in the industry. We've built a reputation on customer service and quality products. We've dedicated ourselves to producing innovative products, designed and built by a workforce motivated to set the standard in noncontact sensing technology.

When you are trying to make a difficult measurement,
we make it possible.

"Please accept my congratulations on your superb capacitive measurement systems. We thank you for your dedication to developing the world's best sensors."

*Eric Marsh, Penn State
Machine Dynamics Research Lab*

"After introducing a Lion sensor to a customer, they always buy. The sensors are not only versatile, but incredibly reliable; to date, we've never had a warranty replacement."

*Jason Rochus, RJD Packaging
Professionals, Inc.*

"Lion Precision came through for us when we were in a pinch. We needed to detect the presence of threads. They provided us with an inexpensive sensor that did the job and backed it up with excellent technical support."

Matt Schroeder, Tier 1 Auto Supplier

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