



Leica Absolute Tracker
Product Brochure

Version 01/2009

Leica
Geosystems



www.leica-geosystems.com/metrology

 **HEXAGON**
METROLOGY

Absolute Tracker. Simply the Best.

The Absolute Tracker from Leica Geosystems is a portable measurement system that relies on a laser beam to accurately measure and inspect in a spherical volume of up to 160 m [525 ft]. The Absolute Tracker can gather 3D coordinates in 3 ways: by following a small mirrored sphere, also known as a reflector; by tracking a Leica T-Probe, a hand-held "Walk-Around" wireless contact probe; or by tracking a Leica T-Scan, a contactless high-speed laser scanner. Which measurement method you should use will depend on your application.

From prototyping and reverse engineering to tooling inspection and part mating, from automotive to aerospace and everything in-between, our customer list reads like a "Who's Who" of the world's most successful enterprises – yet our equipment is just at home in small and medium-size companies. With the introduction of the world's first laser tracker in 1991, we revolutionized high-accuracy inspection as the world knew it. With the Absolute Tracker, we have done it again.

Our best laser tracker to date.

It is not only splendid to behold but also bestowed with a dowry of features and genuine talent. At Leica Geosystems, we have built up a rock-solid reputation for designing and manufacturing absolutely reliable, robust laser trackers that find application in the most demanding environments, from factory shop floors to metrology labs. It all started with the legendary SMART laser tracker series, then came the LTD500 generation, followed by the LTD700/800 lineup, and in 2005 we gave you the LTD640/706/709/840 family. With the Absolute Tracker, our fifth-generation laser tracker and running, we took everything we know about laser tracking and moved it to the next level in dependability, stability of operation, volumetric accuracy and ease of use.

The best tribute to our quality is the undisputed fact that most contract inspection companies rely on Leica Geosystems for their most crucial jobs. Most of our laser trackers, regardless of their age, are still up and running, including most of the venerable SMART series laser trackers, which are by now in their late teens.

Lighter and more compact than ever.

At about 22 kg [48 lbs] and 62 cm [2 ft], our Absolute Tracker enables easy one-person operation. A quick release mechanism securely locks the sensor onto the sturdy, heavy-duty tripod. You get the no-compromise stability that's paramount for accurate measurements. Better still, the entire setup can be transported in the trunk of an average station wagon.

Intermediate compensation – What's that?

The Absolute Tracker, just like its earlier Leica Geosystems brethren, relies on a technically sophisticated yet surprisingly maintenance-free internal design that allows it to run hour after hour, day after day, month after month without the need for any compensation whatsoever. Some of our customers physically relocate their Leica Geosystems laser trackers daily, subjecting them to harsh handling conditions, yet their systems work within specification with no complaint. Drifting out of spec is an unknown phenomenon to Leica Geosystems customers.

It's something you'll quickly learn to forget to think about – because good things are easy to get used to.





We lead. Others follow.

When we gave you the world's first laser tracker in 1991, many had thought laser tracking would be a passing fashion. More than 15 years later, most of our original laser trackers are still up and running – we couldn't ask for a better seal of approval. In the meantime, we have delivered more than 2000 laser trackers to customers the world over, turning large-scale metrology into an integral part of industrial processes in the automotive and aerospace segments but also in nearly every other industry in which assuring a perfect fit is part of the equation.

We at Leica Geosystems never rest on our laurels. With our offerings in Portable CMM, we have taken laser tracking to the next level, leaving the others to ride on our coattails. They say that imitation is the highest form of flattery. Since 1991, this much has become apparent:

We lead. Others follow.



Very fast warmup, thermal stability and robustness second to none



6 DOF capabilities



Absolute Interferometer



Why Absolute Tracker?



Absolute Interferometer

In the ideal world, a laser tracker would combine the ability to instantly re-establish a broken laser beam and immediately start measuring a moving target. At the same time, it would measure absolute distances with the highest precision and would be arbitrarily fast with near zero integration times (the time required to determine the target's position). Until now no single distancing unit was capable of this, so laser tracker manufacturers were forced to use both laser interferometers (IFM) and Absolute Distance Meters (ADM) separately.

Each individual technology has its own strengths and weaknesses. An IFM can determine relative distances (i.e. the change in distance from point to point), with accuracies on the nanometer level. They have an almost instantaneous update rate that is given only by the speed at which the reflector can be moved. This makes them perfect for dynamic measurements, because no matter how quickly the target accelerates the exact change in location is immediately known to the sub-micron level. Laser interferometers have been an industry standard for over 30 years and remain the most accurate system for measuring large distances. However change in distance, or relative motion is all that they are capable of measuring.

An IFM is unable to determine an absolute position in 3D space without having a known starting point first. An ADM on the other hand, measures absolute distances (i.e. distances to a known point in a 3D coordinate system) with extreme precision, but even the fastest ADM will never be able to achieve the speed of an IFM for dynamic measurements. All absolute distance meters must deal with integration times, the time is the time required to perform the operations that determine the target's position. This is similar to the shutter speed on a camera, the longer the exposure time, the harder it is to take a clear picture of a fast moving object. The same is true with integration time, the longer the integration time, the more likely you are to introduce an error in the measurement of a moving object. An IFM doesn't have this problem. The change in distance is always immediately known. This is what makes the AIFM or Absolute Interferometer revolutionary, it can measure absolute distances to a moving target without a loss in accuracy due to target instability during integration.

The AIFM combines the best of both worlds. It provides a leading edge solution to an age old problem, but does so using mature technology. The IFM and ADM core technologies have been used for more than a decade in our laser trackers around the world. These core technologies have been improved and combined to create what we have dubbed the "Absolute Interferometer", or AIFM, and represent the most accurate and stable dynamic distancing unit that we have ever created.





Thermal stability and robustness second to none

Despite being an extremely sophisticated piece of equipment, a laser tracker is not intended just for controlled laboratory settings in which the temperature, humidity and the like are kept in check. In the real world, a laser tracker is subjected to punishing atmospheric conditions.

Accounting for how they affect the refraction index of the emitting laser light is easy. The much bigger challenge lies in making sure that all the components inside the laser tracker also stay within check. There is plenty of room for things to go wrong, with electronic components inside all emitting heat.

The Leica Geosystems engineers have designed each and every component with the eye on the big picture, never losing sight of how different parts will mechanically and thermally interact with one another. The result: an extremely homogenous internal design and a laser tracker that refuses to drift out of spec. The Absolute Tracker's stunning looks are merely an extension of its inner beauty: a judicious, clean-cut design that leaves nothing to chance.

With the Absolute Tracker's, intermediate adjustments typically required to "reset" the entire apparatus to avoid going out of spec are rendered superfluous. Rather than performing frequent, time-robbing mathematical compensations to keep in spec, you'll be performing measurements instead.



6 Degrees of Freedom

The Leica T-Cam, part of every Leica Geosystems Portable Coordinate Measurement System (PCMM) or as an add-on option for existing Leica Geosystems Laser Trackers migrating from reflector measurements to other target devices, is a CMOS digital camera system operating with visible light and near infrared (IR) radiation, with an optical vario zoom and a motor for vertical, angular movement. Mounted onto the Leica Absolute Tracker, the Leica T-Cam continuously follows the target device and captures the images of the IR LEDs located on them. The T-Cam's incremental angle encoder is used to provide the vertical, angular movement of the T-Cam based on tracker guidance angles.

A reflector integrated in a target device, together with a set of ten IR LEDs embedded on the surface of the target device, represent the measurement targets of the system. Six measurement parameters describe the target device in relation to the laser tracking system completely. These are 3 position parameters (x, y and z) and 3 orientation parameters (pitch, yaw and roll). Together, they comprise the Six Degrees of Freedom (6DOF) principle. These parameters are determined by the Leica Absolute Tracker (position) and the Leica T-Cam (orientation).

The vario zoom in the Leica T-Cam keeps the size of the target device as seen by the CMOS sensor constant, thus resolving the biggest issue previously faced by photogrammetry systems: their inability to follow targets due to the camera-perceived changing size of the tracked object (i.e. the farther away the target device, the smaller it appears on the camera sensor).

Impervious to environmental light

Regardless of whether you are conducting your measurements in direct sunlight, with welding sparks flying around or with sharply changing environmental light, the Leica T-Cam functions flawlessly. The target devices emit pulsating infrared light of a known wavelength, and the CMOS camera utilizes a shutter that engages at the same frequency at which the target device pulsates. That way, it can effectively "tune out" all other light sources except for the target device itself. Simply put, the Leica T-Cam "only has eyes" for Leica Geosystems target devices.





Absolute Tracker – that's right for you

Leica Absolute Tracker product family

Leica Geosystems Laser Trackers have been at the forefront of laser tracking technology since 1991 – the year we gave you the world's first laser tracker. Bringing a machine, a fixture or tools into their correct position – from the trailing edge of an airplane to the Body-In-White inspection on a passenger car to the rollers on a paper mill – are some of the most critical production stages that will determine the overall quality of the finished product. Chances are, the car you are driving or the plane you recently flew on or even the press used to print this brochure were all built using our laser trackers. Their other uses may be less spectacular, but the relentless focus on manufacturing perfection is the same.

In today's technology-dominated world, the engineering prowess seems to be the only limit. Rather than play catch up with the needs of our customers, we have actively involved them in the design process, responding with cutting-edge engineering that has tremendously improved their innovation processes. Our new line of Absolute Trackers is just the latest installment in our never-ending quest for perfection.

Absolute Tracker 901-Basic

If your application requires positioning machines, fixtures or jigs, or if you are in the business of installing and aligning machine tools, roll mills, presses or gantry-based machines, Leica AT901-Basic is your tracker. Operating solely with a reflector, it is optimized for inspections within a typical measurement volume of up to 160 m (525 ft).



Absolute Tracker 901-Mid Range

Since the introduction of the Leica T-Probe in 2004 and the Leica T-Scan a few months later, practically all leading automobile manufacturers have joined the ranks of our customers. When a reflector simply won't cut it because there is no clear line of sight to the part you are trying to inspect, the part is hidden or sunken deep beneath surrounding sheetmetal, or because you need to reverse-engineer a part right there on the spot, the Leica AT901-MR is all you will need. When coupled to the Leica T-Probe and the Leica T-Scan, the Leica AT901-MR gives you a measurement volume of up to 18 m (59 ft). Use it with the Leica T-Probe to measure recesses and cavities with an astonishing precision. Couple it to the Leica T-Scan, our high-speed contactless scanner, and small and large objects as well as complex surfaces can be quickly digitized with minimal preparation times and regardless of the surface material. Of course, it can also be used with a standard corner cube, in which case its measurement volume goes up to a full 50 m (163 ft).

Absolute Tracker 901-Long Range

False modesty aside, this laser tracker is the new benchmark for aerospace and other general industry precision (GIP) large-scale applications such as windmill blade inspection or heavy industrial machinery alignment. It gives you hand-held wireless probing or hand-held contactless scanning volume of up to 30 m (98 ft). Of course, it can also be used with a standard corner cube, in which case its typical measurement volume goes up to a full 160 m (525 ft). Its high-end specifications let you conduct demanding wireless inspections of very large parts with just one setup, with no need to reposition the laser tracker. With its unmatched robustness and reliability, repeatable accuracy and compact size that's perfect for one-person operation, the Leica AT901-LR is the ideal GIP workhorse for those applications in which taking second guesses is absolutely not an option.



Portable CMM. Because a laser tracker is just the beginning.

User-friendly, fast and accurate, Portable CMM from Leica Geosystems allows you to assemble aircraft faster and inspect automotive parts more efficiently while minimizing digitization times and costs. If you want the whole picture, go portable CMM. A laser tracker is just the beginning.



Leica AT901-MR gives you a measurement volume of up to 18 m (59 ft), Leica AT901-LR up to 30 m (98 ft)

Leica T-Probe

Leica T-Probe, the "Walk-Around" armless, wireless solution for probing of hidden, hard-to-reach points in one go with minimal setup times, sets new standards by increasing accuracy, with a high point-acquisition rate and user-assignable multi-function buttons.

Small, light, user-friendly and more accurate than any other hand-held probe in the world, the Leica T-Probe gives you more than 6 Degrees of Freedom: It gives you the right way to measure. Now featuring longer styli, Leica T-Probe reaches up to 30 m [98 ft] in any dimension.

- Smaller, lighter and more convenient than comparable solutions
- Largest armless operation measurement volume of up to 30 m [98 ft], reducing inspections by min. 50%
- Wider acceptance angle than any comparable system: pitch $\pm 45^\circ$, yaw $\pm 45^\circ$, roll 360°
- Battery-powered for wireless operation and increased productivity
- Extended battery life with flexible "sleep" mode
- Automated styli identification reduces operator errors
- User-assignable multi-function buttons for individual application functionality for all buttons
- One-hand operation with left/right-hand functionality
- Renishaw-compatible with a wide range of styli available, incl. 100 mm, 200 mm and longer
- Visual feedback for battery, in-view and in-distance status and for process information
- Acoustic process information feedback
- Insensitive to environmental light
- Precise quick release and automated stylus recognition for exchanging styli without calibration



Leica T-Scan

Leica T-Scan TS50 is a high-speed hand scanner for large-volume portable applications. This third-generation Leica T-Scan is more accurate, provides a better performance on challenging material types and offers double the point acquisition rate compared to the previous generation.

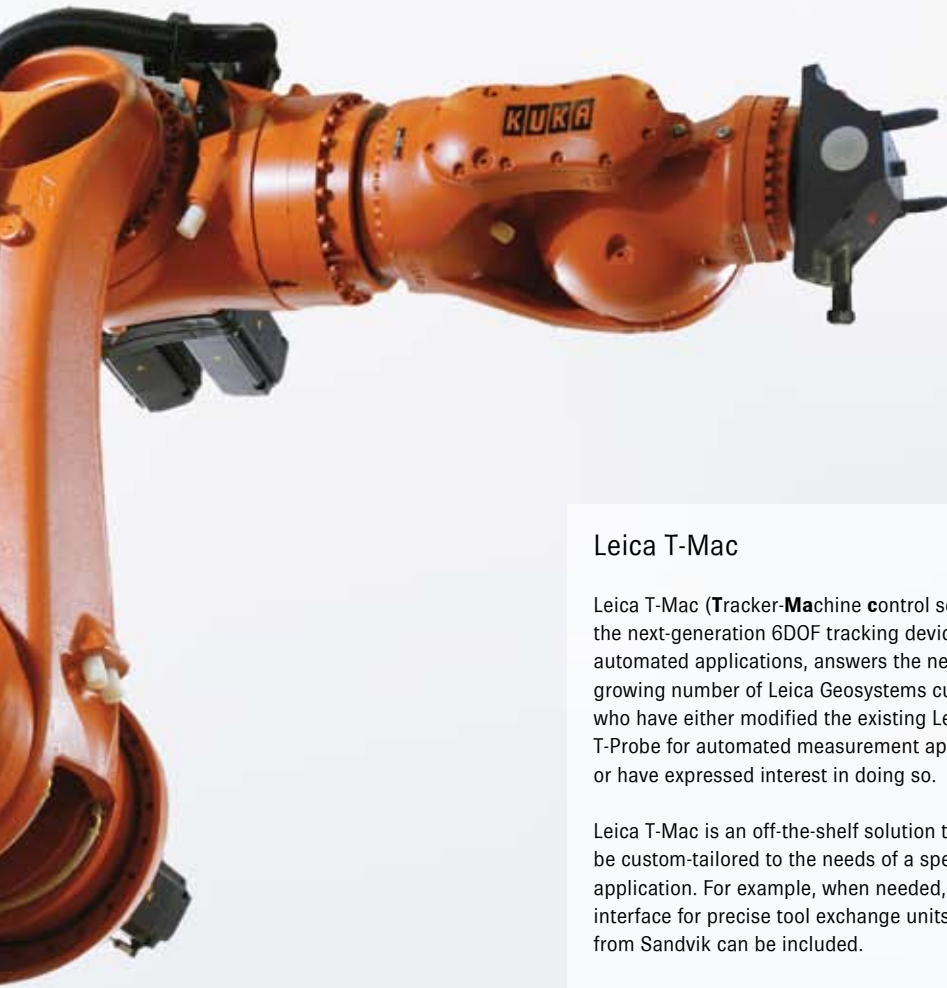
The Leica T-Scan is more than just a line scanner. Its Flying Dot technology is the only truly automated scanning solution. The adjustment of the laser power to obtain the best measurement result of a specific surface type is completely autonomous. This ensures the best possible results – independent from the operator.

The Leica T-Scan adapts the laser intensity to shiny metallic or dark surfaces. They can even be captured in one scan pass! Powdering is not required and the technology is impervious to changing environmental light – which reduces preparation time to the absolute minimum.

And if the measurement object is extremely large, no photogrammetric targets are required after the tracker relocation. Save time and do not compromise on accuracy.

Leica T-Scan scans large objects more accurately and 50 percent faster than comparable products.





Leica T-Mac

Leica T-Mac (**T**racker-**M**achine control sensor), the next-generation 6DOF tracking device for automated applications, answers the needs of a growing number of Leica Geosystems customers who have either modified the existing Leica T-Probe for automated measurement applications or have expressed interest in doing so.

Leica T-Mac is an off-the-shelf solution that can be custom-tailored to the needs of a specific application. For example, when needed, an interface for precise tool exchange units like those from Sandvik can be included.



Feature	Benefit
Robust construction and superior thermal stability with homogenous internal design and non-heat emitting tracker sensor head	Continuous on-spec operation in tough industrial environments with no need for frequent compensation routines; a yearly calibration is all your Absolute Tracker will ever need
The AIFM or "Absolute Interferometer" combines the absolute measurement from the ADM with the almost instantaneous update rate of the interferometer to produce the most accurate, stable, technologically mature distancing unit we have ever created	Waiting for the tracker to "lock-on" is now a thing of the past. Simply catch the beam and you are measuring again without delay. No matter if you are using a reflector, Leica T-Probe, Leica T-Scan or Leica T-Mac, the AIFM can instantly re-establish a broken laser beam and immediately start measuring the moving target.
6 Degrees of Freedom (6DOF) Portable CMM available as an option	The world's only technologically mature PCMM system that can probe like a fixed CMM, scan like a laser scanner and track automated applications – all in one system
Lean construction and compact dimensions, weighing just about 22 kg and slightly over 62 cm in length	Easy one-person transportation and installation, in full compliance with labor department regulations; whole system fits in an average-sized station wagon

	AT901-B	AT901-MR	AT901-LR
Absolute Interferometer	✓	✓	✓
Typical measurement volume up to	160 m	50 m	160 m
Compatible w/ T-Products		✓	✓
Max. measurement volume w/ T-Products		18 m	30 m
5-Year Warranty Program as standard <small>(see page 12 for more details)</small>	✓	✓	✓

Your trust.
We've been earning it
for almost 200 years.



Leica

Both international and Swiss at the same time, Leica Geosystems is a global enterprise serving customers in some 120 countries. Those customers continue to work with us because of our exceptional support and service that accompanies every laser tracker we manufacture. We offer you a partnership, a commitment to fulfilling the trust you placed in Leica Geosystems by purchasing our equipment.

Due to the complexity of modern Portable CMM instruments, we put high value on making sure that our customers are armed with all the technical knowledge they need to not only meet but exceed their expectations over the entire product lifetime.

The purchase is just the beginning.

Our "worry-free" concept of Service & Support has established a benchmark standard in the industry. At Leica Geosystems, we not only manufacture the world's most advanced Portable CMM products, we also provide world-class Service & Support that are second to none.

Confidence in Quality

All Absolute Trackers are backed by our 5-Year-Warranty Program. It covers preventative inspection, re-certification and an extension of the factory warranty. After the factory warranty has expired, the warranty can be extended by one year, simply by having your system serviced and re-certified by Leica Geosystems Metrology Service at a very affordable price. This procedure can be repeated up to 4 times, resulting in a total of 5 years of prolonged warranty time, covering repairs, parts and labor.

In addition to our 5-Year Warranty Program, Leica offers top-of-the-bill service contracts, comprising a variety of services, such as stand-by systems, full onsite coverage, application software maintenance, telephone support, on-site application support, etc. If you want to get the most out of your system, the Silver and Gold Contracts are the way to go.

Leica Geosystems Service & Support program begins with our global Leica Absolute Tracker warranty and initial support program, which accompanies all new instrument sales for up to one year following the delivery of a new system and completion of at least Basic Level Training.

When second-best is not an option.

We are interested in working with you to find a custom solution that best suits your particular situation. This commitment to excellence is not part of some premium customer care package, it is something we guarantee to every single customer as a matter of fact. Leica Geosystems maintains a dedicated support force that only focuses on customer support issues and is available in most countries in which our equipment is available. Our service centers are fully equipped, are authorized by Leica Geosystems, offer ISO9001 certification and employ superbly and regularly trained engineering staff.

Laser trackers from Leica Geosystems have been around since 1991. Nearly all of our now-legendary SMART Series laser trackers introduced that year are still up and running, not to mention the subsequent generations that followed.

The Absolute Tracker from Leica Geosystems starts our fifth generation of laser trackers. Owning one is a benchmark experience to which everyone else is compared.

What our customers say

"After dealing with Leica Geosystems service department for over the past ten years, I have been impressed with the professionalism and the rapid response time I have experienced with them. Their group of professionals combined their expertise to resolve my situation. I have found that it never seemed to matter when it happened. I always receive a quick response, but much more importantly, I get the correct resolution to the problem. I have always relied on Leica Geosystems to provide me with the equipment, accessories and technical expertise to satisfy my customers' requirements."

*Jeffrey D. Brehm
Computer Aided Measurement Services
St. Louis, Missouri
USA*

"The Leica Geosystems Laser Trackers have been supported by yearly service contracts and emergency call-outs as and when required. My Maintenance and Production colleagues have always been impressed with the Leica Geosystems support organization in maintaining our laser trackers."

*Joe Fare, Senior Facilities Engineer
JSF Operations, BAE Systems
Samlesbury Aerodrome
Lancashire
United Kingdom*

"The consistently high level of service we receive from the UK Leica Geosystems Service Center ensures the Airbus UK at the Broughton tooling department meets the demanding re-certification schedules that we are continually aiming to achieve."

*Geoff Griffiths
Aerotoooling Teamleader
Airbus UK Ltd.
Broughton
United Kingdom*

"We at Schott Glass Manufacturing have been using a Leica Geosystems Laser Tracker for over six-and-a-half years. Over time, we have grown to depend on Leica Geosystems equipment because of its high dependability, great flexibility, precise measurement results and, last but not least, the outstanding service and support we receive from them – all factors that have made our Leica Geosystems equipment indispensable."

*Kirsten Wetzstein
Quality Control Astro Space
Schott AG
Mainz
Germany*





- 1 Leica Geosystems, Heerbrugg, Switzerland
- 2 Each wave modulator is painstakingly put together by hand; most mechanical components are so miniaturized, they have to be made under a microscope. This part alone takes 1.5 days to make.
- 3 A long series of exhaustive benchmark tests is made throughout the manufacturing process of each unit in order to assure that it will work on spec for years to come.
- 4 Fine motor skills are required when calibrating instruments prior to final customer delivery.
- 5 A highly skilled workforce is required to produce state-of-the-art components like the Leica T-Cam. In addition to requiring an education in fine mechanics, each team member undergoes 6 months of rigorous on-the-job training before he or she is able to work autonomously.
- 6 Space-age alloys and high-precision optics combined in a zero-dust housing assure that the laser beam remains stable and can be predictably manipulated.
- 7 All critical components are housed in high-strength, low-thermal-expansion alloy casings to guarantee predictable operation over the entire product lifetime.
- 8 Sophisticated inspection methods objectively verify the integrity of finished components throughout the production process.
- 9 Highly sensitive cameras are used to visually inspect the otherwise invisible laser light, thus inspecting the correctness of the optical path.



Two centuries of quality Swiss manufacturing and innovation.

From its origins in a small Swiss town almost two centuries ago, Leica Geosystems has established a tradition of quality, innovation and dedication to customer satisfaction. In 1819 we started manufacturing geodetic instruments. In 1921 we gave you the world's first portable opto-mechanical theodolite, in 1925 the first-ever aerial photography camera, in 1969 the world's first infrared-based distancer. And in 1991 we brought the world's first laser tracker to the market. In each one of these segments we are the recognized world leader.

The inner workings of a laser tracker are a mind-boggling combination of extremely complex, miniaturized, highly sensitive mechanical, electronic, optical and software components forming a delicate system whose optimal functioning requires perfect operational harmony. Yet the instruments as a whole are expected to perform flawlessly under the harshest industrial conditions, constantly being exposed to unforgiving atmospheric elements and rough day-to-day handling.

To achieve this ambitious objective, our instruments are made using the most robust, durable, thermally stable materials available today, from carbon fiber to high-tech alloys. We employ only the best electronic components available. Every Leica Geosystems instrument is hand-assembled under the watchful eye of seasoned industry professionals with decades of experience in precision mechanics.

At our plant in Heerbrugg, Switzerland you will see no mass manufacturing, no robots, no pre-assembled components from questionable suppliers. Every finished component is painstakingly tested and retested for every eventuality before it is delivered to the customer.

We've helped hundreds of customers optimally measure their world. We can do the same for you.

Good reputation is extremely hard to achieve. It is not created with a clever marketing campaign. It is earned. We at Leica Geosystems have earned ours by adhering to a simple principle of honest hard work, stubborn unwillingness to make engineering compromises that jeopardize the impeccable quality of the products we make, and by delivering what our customers want. They can go to anyone for a laser tracker, but they come to us. For a good reason.

The same applies to contract inspection companies. They get called in to fix problems by customers to which one hour of downtime may mean hundreds of thousands of dollars in lost revenue. That's why most of these companies rely on Leica Geosystems Laser Trackers for their most important jobs, when performing a compensation routine half way through the measurement would mean losing the face in front of a customer forever.

With the fifth generation of Leica Geosystems Laser Trackers, the Leica Absolute Tracker, our best laser tracker yet, we are giving you, our customers, exactly what you asked for: a superbly engineered, reliable laser tracker that is lighter and more compact than ever before.



Whether building the fastest car, the biggest plane, or the most precise tooling, you need exact measurements to improve quality and productivity. So when it has to be right, professionals trust Leica Geosystems Metrology to help collect, analyze, and present 3-dimensional (3D) data for industrial measurement.

Leica Geosystems Metrology is best known for its broad array of control and industrial measurement products including laser trackers, Local Positioning Technology (LPT) based systems, hand-held scanners, 3D software and high-precision total stations. Those who use Leica Metrology products every day trust them for their dependability, the value they deliver, and the world-class service & support that's second to none.

Precision, reliability and service from Leica Geosystems Metrology.

Leica Geosystems

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Printed in Switzerland. April 2009

