



Case study  
Lifelong Absolute Accuracy  
for Industrial Robots

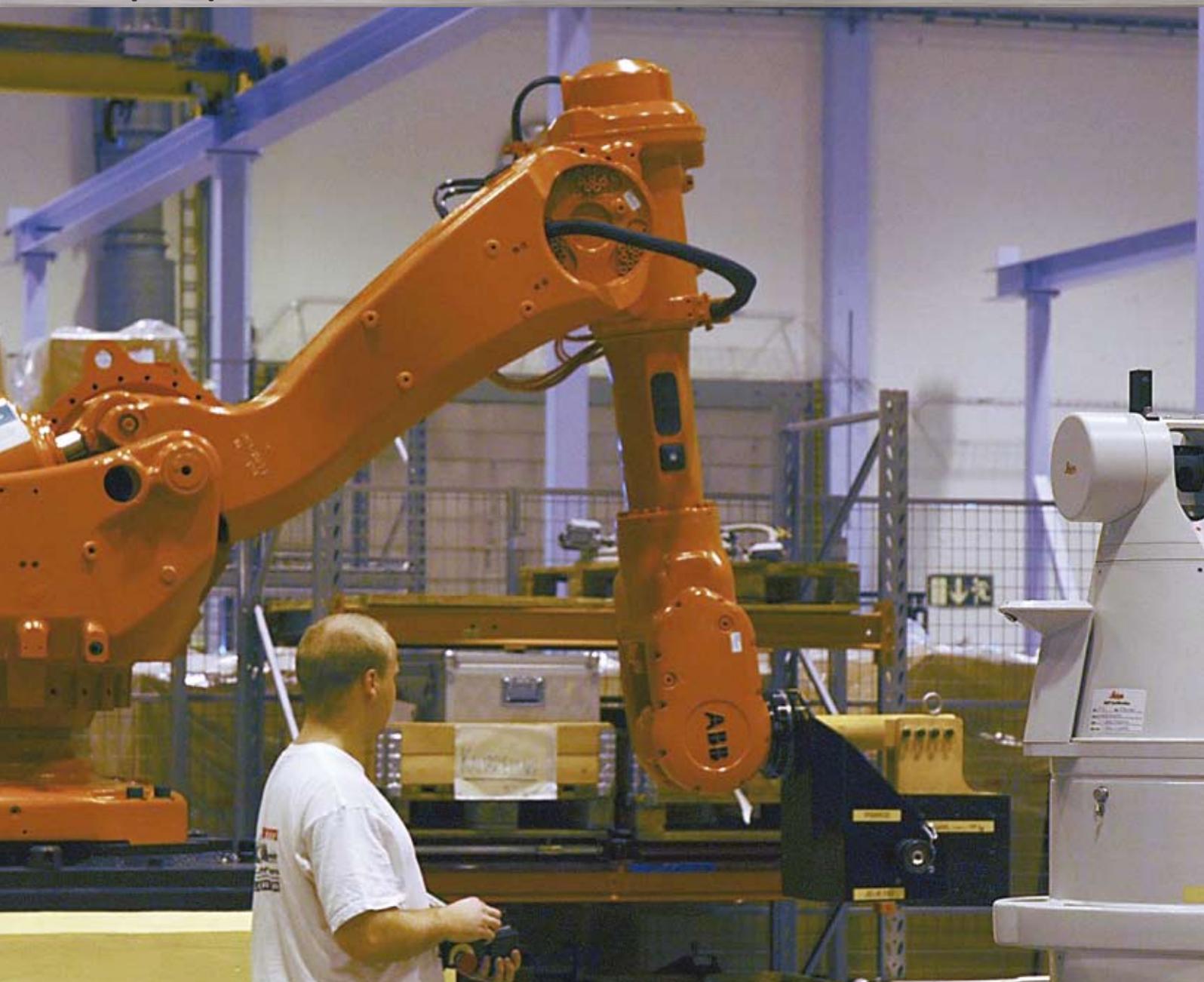


ABB in Västerås lives and learns when it comes to efficiency and accuracy in production. By having its Leica Laser Tracker located between two cells, the operator can calibrate a robot in one cell while a second robot is set up in the other.



**High speed tracking is one of the most stringent requirements for robot control, machine guidance and Metrology Assisted Assembly. Robot calibration, accuracy improvement of drilling machines or automation of wing-to-body assembly are just some examples of machine control applications of Leica Laser Trackers.**

By Rickard Lindhé, Independent Journalist

*"When it comes to Absolute Accuracy calibration at a customer's premises, the measuring is best done with Leica Total Station," says Peter Fixell, calibration manager at ABB. "It measures a position with an accuracy of 0.2-0.3 mm per metre in a couple of seconds."*



**Leading industrial robot manufacturer, ABB Robotics, in an industry first application, uses Leica's Laser Tracker Systems to guarantee movement precision during an innovative calibration process.**

ABB of Västerås, Sweden is a pioneer among world industrial robot manufacturers when it comes to using laser-based measuring technology to ensure robot precision. ABB, with an installed base of 125,000 robots, stands out as the world's largest in the arena of industrial automation. And Leica Geosystems' equipment is instrumental in a unique calibration method that offers customers exact robot positioning accuracy throughout the entire life cycle of their robots. Known as Absolute Accuracy, ABB's calibration method turns a standard robot into an exact robot by applying software-controlled correction of errors that arise in normal use caused by overload, kinematics and dynamics.

"A really great industrial robot is one that maintains its accuracy throughout its entire life cycle, including factory installation, motor output, regrouping of fixtures and everything else a robot might experience," says Peter Fixell, product manager responsible for calibration and quality assurance

at ABB in Västerås. "The difference in accuracy between a virtual, ideal robot and an actual robot is usually between 8-15 mm. The difference stems from mechanical tolerances and load. With Absolute Accuracy, we reduce the gap to an average 0.5 mm," Peter Fixell concludes.

ABB has two adjacent work cells for calibrating robots, each of them measuring 10 x 10 metres. Between the cells stands the Leica Laser Tracker. The operator controls the measurements phase from a PC that is situated to allow him a full overview of both cells. While he is measuring a robot in one cell, his colleagues can use the time rigging up or putting away a robot in the other cell. After the robots are measured and calibrated, they are packed, ready for delivery to the customer.

#### **A dream come true**

ABB's Absolute Accuracy method eliminates the differences between the virtual robot's precision in the CAD system and the work done by the actual robot on the factory floor.

The robot is instructed to move to 100 coordinate locations in the work area. The actual positions are determined by the Leica Laser Tracker. Then, by comparing the theoretical and actual positions, ABB creates a set of compensatory parameters that correct the robot's positioning and thereby its movements. The parameters take into account both the mechanical imperfections in the pattern of the movements and the bending or distortions downwards caused by the loads.

For companies using the robot, Absolute Accuracy means that they can install and run a robot directly with the greatest degree of precision possible. The same tool configuration is used throughout the process from calibration and verification to installation, operation and maintenance. ABB's CalibWare, Calibration Pendulum and operating system algorithms (see below) are the same at ABB as at the customers' premises, which essentially

reduces the risk of incompatibility to zero. "For companies using a single robot, this means that they have a robot that maintains high and consistent precision year in and year out," says Peter Fixell. "The company can download without any difficulty new simulated programmes that the robot will work to without any corrections."

#### **Home and away**

Helping customers achieve robot-supported production with a minimum amount of delays is key for ABB in Västerås. For that reason, Peter Fixell and his team also offer Absolute Accuracy calibration at the customer site.

"Customers who invest in robots without Absolute Accuracy need not think they have gone down a blind alley," he says. "We have equipment that enables us to calibrate the robots effectively at the customers' premises."

"What is required is measuring equipment that can deliver measurement data in (x, y, z) so that it can be imported into our CalibWare calibrating tool. For measurements at customers' premises we use Leica's Total Station (TDA 5005). It is lighter to carry than the Laser Tracker (LTD500), which is the model used in our production facilities".

With a Total Station in one hand and the stand in the other, it is easy for an ABB engineer to move around any of its customers' production environments. Battery operation provides flexibility and it takes just a few minutes to get it up and running. Measuring a position takes just 3-5 seconds, and accuracy is 0.2-0.3 mm.

#### **Speaking the same language**

Regardless of whether measurement is done at ABB with the Leica Laser Tracker or at the customers' premises with a Leica Total Station, the compatible measurement data is exported to ABB's CalibWare, an add-on to the Robot Studio development and simulation environment. This is how

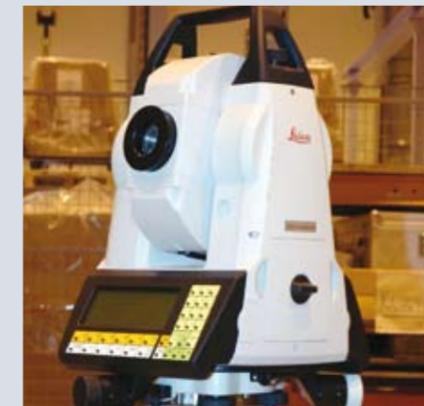
the robot's cell is simulated and displayed; and where the 100 calibration location coordinates in the robot's working area are generated. The robot's compensation parameters, unique to each single robot, are calculated on the basis of these locations, which are integrated into the robots' operating systems. Performance is further verified by checks in 50 new locations, in which the Robot Tool Centre Point position accuracy is fixed and a certification ticket issued.

CalibWare ensures consistency between ABB and customer production environments and produces a checklist of simple calibration instructions and an accuracy menu that links the customer's maintenance measures to the fixed level of accuracy.



*Leica Laser Tracker can follow a movement of 6 m per second with an acceleration of 2G and measure 1,000 points per second. The accuracy of some 0.01 mm per metre suits ABB's work in supplying robots with lifelong position accuracy.*

*Leica Total Station helps ABB to calibrate robots in the most changeable of industrial environments. It is easy to carry and usable in temperatures of -20 to +50 degrees. Setting it up on a stand and preparing it for use takes only a couple of minutes.*



**Absolute Accuracy** is a process that ensures that a robot will retain its accuracy throughout its entire life cycle. The method bridges the gap between the CAD system's virtual robot's precision and the work done by the actual robot on the factory floor. Using Leica's measuring equipment; a compensation parameter is established that corrects the positioning and the robot's movements. These parameters take into account both the mechanical imperfections in the pattern of movements and the bending downwards caused by the loads.

*For the company using the robot, Absolute Accuracy means that it can install and run a robot directly with the greatest degree of precision possible. Upgrading an existing robot "in the field" to Absolute Accuracy is also straightforward. The same tool configuration is used throughout, from calibration and verification at ABB in Västerås to installation, operation and maintenance. ABB's CalibWare, Calibration Pendulum and operating system algorithms are the same at ABB as at the customers' premises. That reduces the risk of incompatibility to zero.*

#### **Leica Geosystems at ABB**

ABB has been using laser-based measuring equipment from Leica Geosystems since the mid 1990s. Besides Leica Laser Tracker LTD 500 and the Leica Total Station TDA 5005, which is used for Absolute Accuracy calibration, ABB's robot unit also has two ISO standard verification tests. Furthermore, ABB Corporate Research uses a Laser LTD 800 in development work at several of the group's units. It is Leica Geosystems' most advanced tool for precision measurement.

#### **ABB – World's Leading Manufacturer of Industrial Robots**

Around 125,000 ABB robots are in use in industry throughout the world, mostly in the automotive production sector and its suppliers. All the major car manufacturers are on the customer list. Welding, operating machinery, handling materials, packing and mounting are the most common uses. Around 90% of the products are sold outside Sweden.



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.

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