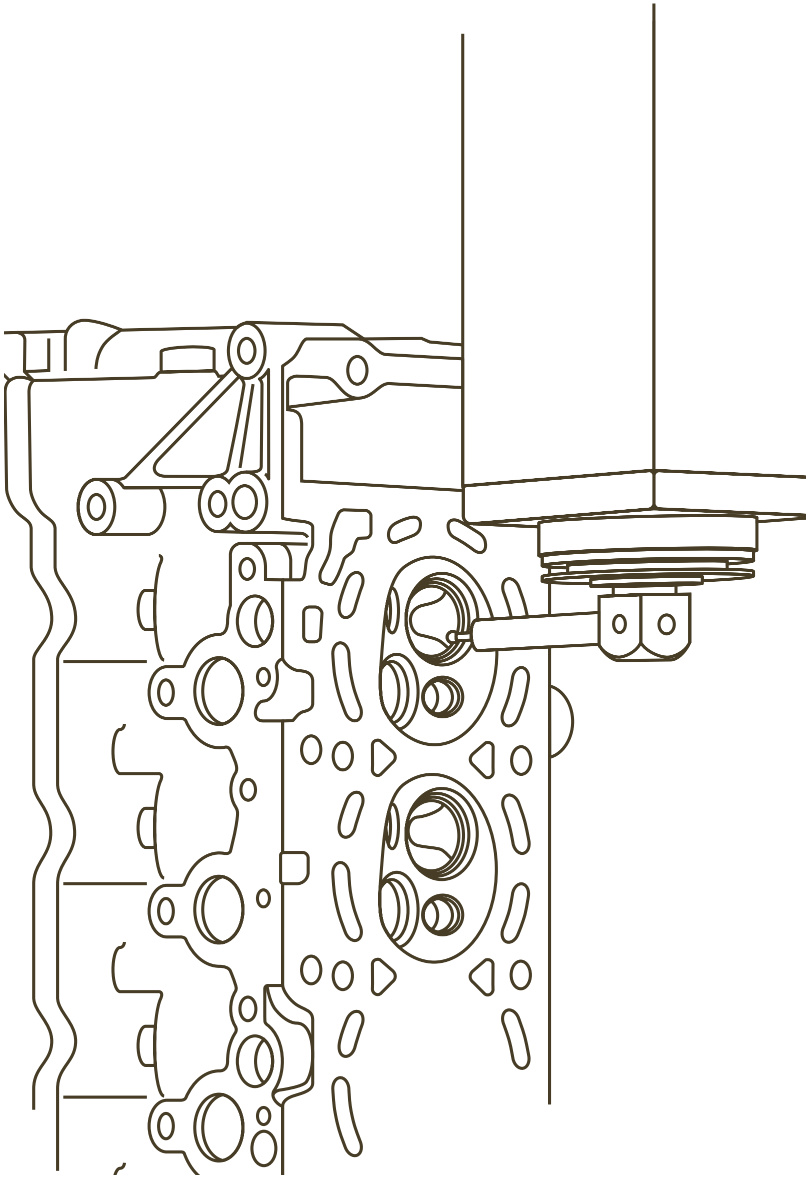
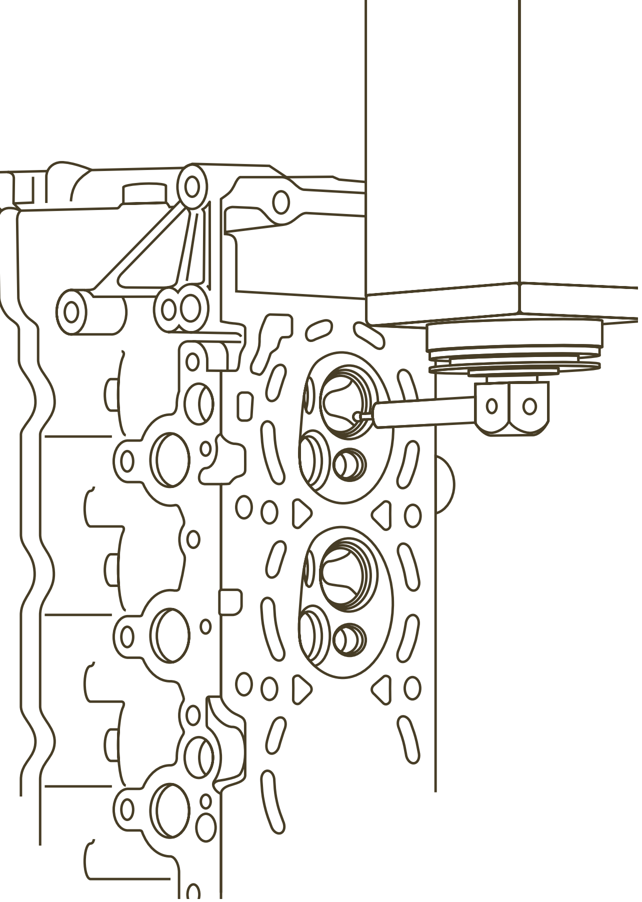


90 years
Industrial Metrology
at Carl Zeiss

Dear Customer, Dear Reader,



Among the many undisputed achievements of Carl Zeiss are the advancement of optics, science and technology in many fields – often with truly revolutionary ideas – and the ability to open up new fields of application.

Company founder Carl Zeiss long ago realized that the state-of-the-art industrial production of high-quality microscope optics can only be efficiently and successfully achieved on a scientific foundation. This led him to hire physicist Ernst Abbe as a partner and part owner in his company. Glassmaker Otto Schott, who had sought contact with Jena, further advanced the construction of optical instruments with the development and manufacture of special types of glass.

Physicist, entrepreneur and social reformer Ernst Abbe founded the Carl Zeiss Foundation in 1889. With a social responsibility that far exceeded the conventions of the times, he set examples that served as models for industry and society at the end of the 19th century. His ingenious developments in the fields of science and optics are still valid today.

In 2009, Carl Zeiss will celebrate the 90th anniversary of its Industrial Metrology Group. However, the cornerstone for today's measuring technology in industry was laid by Ernst Abbe already in 1890 with the formulation of the comparator principle named after him.

Otto Eppenstein headed the precision measuring department called "Feinmess Department" founded in 1919 for a total of 19 years, during which he applied for 78 patents. These were of key importance for the development of industrial metrology. Many of the measuring machines he developed had such advanced designs and technology that they continued to be built without modifications for decades. Eppenstein was also the source of the "golden rule of production" which states that the inaccuracy of the measuring machine used must be no more than one tenth of the tolerance to be inspected on the test piece.

Carl Zeiss played a key role in the stormy times of the still young industrial development. Carl Zeiss has been inextricably linked with renowned industrial companies right from the outset, e.g. with Bosch, Daimler and Siemens.

Today, 90 years after the founding of the Feinmess Department, Carl Zeiss Industrial Metrology, with its three production sites and a global focus, is a key pillar of Carl Zeiss. Highly skilled colleagues in sales, technical service and application technology provide assistance around the globe. They fully understand your work, advise you and aspire to fulfill your requests and satisfy your requirements. Our local organizations render the services locally that you need for productive and efficient industrial manufacturing and quality assurance. These organizations are integrated into the global structure of Carl Zeiss with its balanced, broad product portfolio.

Almost 30,000 installations of measuring machines around the world testify to the trust placed in the problem solutions, products and services from Carl Zeiss Industrial Metrology. We would like to thank you for the trust you have placed in our company. And we promise that we will do everything in our power to ensure that we will continue to earn this trust in the future.

Dr. Rainer Ohnheiser

Revolution in Precision Measuring

New fields of business for Carl Zeiss

The success story of what is now Carl Zeiss Industrial Metrology (IMT) began in 1919 at the Spring Fair in Leipzig with a few measuring machines displayed on a small table. Back then, 90 years ago, Carl Zeiss presented its production measuring technology for the first time. Numerous customers from the field of industry who were on the lookout for new products in Leipzig were absolutely amazed.

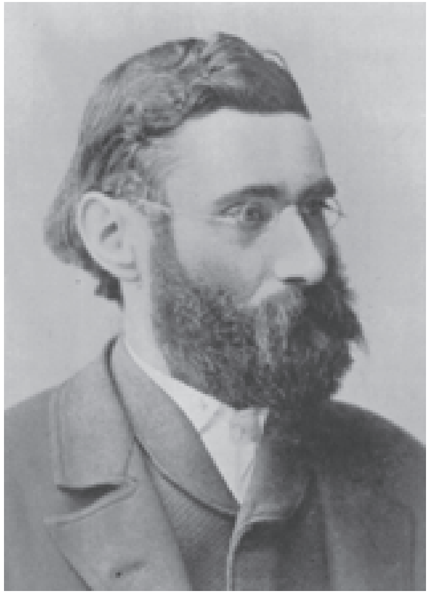
Strictly speaking, the entry of Carl Zeiss into the field of Industrial Metrology was a total accident. At the turn of the century, the Carl Zeiss factory in Jena enjoyed high growth rates. Production increased strongly with the start of the First World War, primarily due to the manufacture of military equipment. This came to an abrupt end in 1918. With the defeat of the German Empire, production aimed at the army and navy declined dramatically. In order to compensate for this sudden loss of income, Carl Zeiss was forced to look for new fields of activity: household items, furniture and artificial limbs were proposed as substitute products. However, only one idea promised sustained success: the manufacture of precision measuring machines for industry.

Accurate measurements enable efficient production

Since the turn of the century, several sectors of industry implemented high-volume assembly lines, with which enormous increases in productivity had been achieved in the USA. In accordance with the principle of interchangeable component manufacture, parts produced on an assembly line independently of each other had to fit together precisely without any need for reworking during the assembly of a car or machine tool. Precision was an absolute must. Precisely monitoring the tolerances and quality in the production process demanded high-quality measuring machines.

At first, manufacturers were satisfied with the measuring equipment they produced themselves. However, as demands on precision increased, the quality of such instruments no longer sufficed. Otto Eppenstein, head of the rangefinder department at Carl Zeiss until the end of the war spotted the gap in the market and began setting up the new business unit. It produced simple goniometers, dial gages, screw gages and try squares. Carl Zeiss

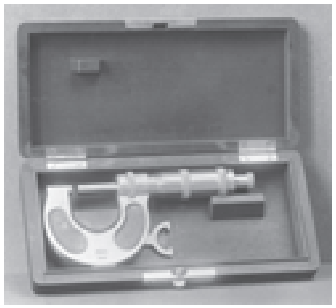
In 1846, mechanic Carl Zeiss (1816–1888) founded a workshop for precision mechanics and optics in Jena, which developed into a global enterprise within a few decades. At the end of the 19th century, microscopes, eyeglasses, binoculars and other precision mechanical-optical products from Jena dominated global markets. This photo was taken around 1847.



Left: Ernst Abbe (1840–1905), Carl Zeiss' ingenious business partner. Without the physicist, the company's rise would not have been possible. His pioneering developments in microscopy revolutionized the construction of microscopes. Abbe proposed generally valid physical principles, upon which microscope lenses could be manufactured en masse. Until then, the perfect combination of lenses was achieved through a tedious process of trial and error. Abbe also demonstrated his entrepreneurial skills when he founded the Carl Zeiss Foundation as the sole owner of the company Carl Zeiss in 1889 and transferred his shares in Schott Glassworks to the foundation.

Center: At the beginning of the 1880s, Carl Zeiss and Ernst Abbe teamed up with Otto Schott (1851–1935), an excellent glass specialist who produced high-quality glass for their company in his own factory. Until then, there had been no glass materials specially developed for optical instruments. In 1920, Otto Schott's shares in the company were also transferred to the Carl Zeiss Foundation. This made the foundation the sole owner of both companies.

Right: Since the end of the 19th century, Carl Zeiss has developed into a modern large company with effective manufacturing processes. The company premises became the dominant center of the city of Jena. This even led to the construction of high-rises such as Building 15 which was erected during World War I and accommodated the optical production divisions.



Top: In 1847, Carl Zeiss began manufacturing simple microscopes with magnifying glasses.

Bottom: An order for more than 10,000 screw gages for internal testing in November 1918 provided the spark that led to the founding of the Feinmess Department.

was able to utilize many years of experience. The company had already manufactured measuring equipment for its own use since the 1890s. Ernst Abbe had formulated one of the most important basic rules of metrology with the comparator principle which describes errors caused by tilting.

Founding of Feinmess

The precision measuring department called Feinmess had a very modest beginning. This all changed at the Leipzig trade fair with one visitor who would have a pronounced impact on the development of the Feinmess Department. The Carl Zeiss booth attracted the attention of Berlin-based tool company Schuchardt & Schütte which encouraged Carl Zeiss to expand the production of the exhibited measuring machines, with Schuchardt & Schütte as the sole distributor of the precision measuring equipment. The Berliners recognized the potential of the instruments and became an official partner of Carl Zeiss on May 23, 1919. This partnership lasted almost 10 years. It was their dedication that led to the rapid increase in demand from industry for the precision measuring instruments from ZEISS. Schuchardt & Schütte, whose engineers were very familiar with the production procedures of their customers, constantly provided feedback on how the instruments could best meet customer requirements.

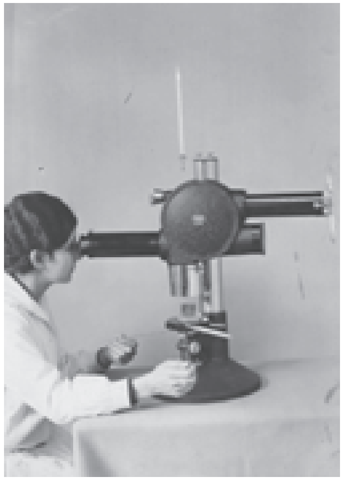
Precision measuring machines from Jena for the world

Innovative from the beginning

As the specialist for optics, it was only logical for Carl Zeiss to integrate optics into precision measuring technology which until then had been dominated by precision engineering. By the beginning of 1919, the designers in the Feinmess Department had integrated technical optics into the measuring instruments and therefore began the construction of advanced instruments. With almost 80 patents, Eppenstein, in particular, played a key role in the development of industrial measuring technology. He developed the Eppenstein Principle which simplified the measurement of longer lengths using optical equipment and eliminated first order errors. He was also the source of the "golden rule of production" which states that the inaccuracy of the measuring machine must be no more than one tenth of the tolerance to be inspected on the test piece.

Left: Until 1930, tool manufacturer Schuchardt & Schütte was responsible for the sales of precision measuring tools from Carl Zeiss. After seeing the precision measuring tools for the first time at the 1919 Spring Fair in Leipzig, employees of the Berlin-based company urged Carl Zeiss to expand production. The precision measuring tools from Carl Zeiss were quickly demanded everywhere thanks to Schuchardt & Schütte's good contacts to the industry and outstanding product quality.

Right: Otto Eppenstein, founder and long-term head of the Feinmess Department at Carl Zeiss Jena. His inventions played a key role in advancing the still young discipline of precision metrology in the 1920s and 1930s. Because of his value to the company, Eppenstein, who was originally Jewish before converting to Protestantism, was allowed to work for Carl Zeiss in Jena until his death in 1942 – however, his name could no longer be mentioned in the public and in scientific publications.



The history of the Feinmess Department at Carl Zeiss is closely tied to the development of metrology in general. In 1920, the company began building measuring machines with optical components, thus offering a real alternative to traditional precision mechanical measuring equipment. They enabled fast and precise measurements at a time that saw the breakthrough of efficient production. One of the most important devices from this time was the interference comparator for the inspection of gage blocks.

Proud to be connected to these innovations and the roaring development of precision measuring technology, Schuchardt & Schütte announced in the foreword of a catalog: "It was a great achievement by the company Carl Zeiss in Jena, for whom we are the sole distributor of measuring tools, to have made the sensitive optical measurement and microscopic examination of materials accessible to workers and the shopfloor." From then on, industrial companies such as Opel, BMW, MAN, Ford, Daimler-Benz, Bosch, Krupp, the Zahnradfabrik Friedrichshafen and many others purchased measuring machines from Carl Zeiss with which they inspected workpieces and tools in their measuring labs. They were also able to rely on the outstanding customer support of Carl Zeiss. The international success was also impressive: in the 1930s, there were times when every second precision measuring machine was sold outside Germany.

Early milestones in machine technology

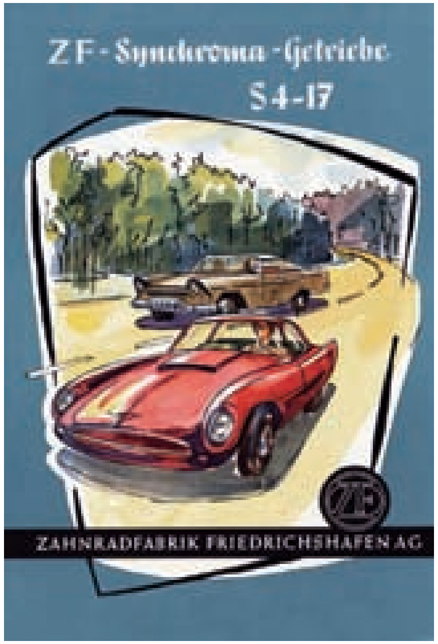
The Optimeter linear measuring machine from 1920 is one of the most important machines from the early days of the Feinmess Department. It provided users with 1 µm accuracy. The large toolmaker's microscope from 1924 and the first universal measuring microscope (UMM) from 1926 also represented milestones in measuring technology. For the very first time, the UMM enabled users to determine all five parameters of a thread in a single setting. The interference comparator built from the mid 1920s was a key instrument for the inspection of gage blocks. Within a few years, these and many other tools from Jena became the benchmark of optical and mechanical precision measuring technology. It is no wonder then that a British toolmaker simply called its measuring lab the "Zeiss Room" – they were probably not the only ones.

World War, partition, economic miracle

Carl Zeiss on the brink

During World War II, Carl Zeiss and the Feinmess Department produced, partly with the help of foreign and forced labor, almost exclusively for the military. The armament boom provided the company with high production figures, but was also responsible for the fall of the global company Carl Zeiss after the war. Numerous allied bombing campaigns severely damaged or destroyed factories and took the lives of many employees. The US troops who initially occupied Thuringia after the war, had to leave

ZEISS precision measuring representatives proudly pose for the camera. The team was assembled within three years following the bankruptcy of Schuchardt & Schütte in 1930.



Increasing mobility was one of the most visible signs of the West German economic miracle following World War II. Millions were able to afford a car. Manufacturers such as ZF Friedrichshafen delivered key components. Without its gears, no car would have worked – be it a compact model or the luxury vehicle depicted in this advertisement. ZF Friedrichshafen tested its gears on ZEISS precision measuring machines.

the country to the Soviets in accordance with an allied agreement. Under the motto "We take the brain," they took the entire management team from Carl Zeiss and the Schott Glassworks with them to the West. The main factory in Jena was dismantled by the Soviet occupiers and only later painstakingly rebuilt as a state-owned enterprise.

Feinmess East – Feinmess West

Zeiss employees brought to Heidenheim succeeded in establishing a new ZEISS factory in the nearby village of Oberkochen. Initially, they received support from Jena. However, during the course of the coming Cold War, the "hostile brothers" increasingly distanced themselves from one another and fought bitterly over the name and trademarks. Nevertheless, Carl Zeiss in Oberkochen grew into a very successful company. The partition of the company resulted in two Carl Zeiss precision measuring departments – Feinmess East and Feinmess West – which initially focused on the manufacture of optical and precision mechanical machines. However, Carl Zeiss in Oberkochen strived to avoid using pre-war designs. In 1953, just three years after the department was founded, the company in Oberkochen developed a new, more technically advanced UMM universal measuring microscope. Additional important instruments included the Abbe perpendicular and horizontal length meter, and the SPG 600 inclination testing machine which were seen as the leading products on the global market.

The future is electronic

The beginning of the 1960s marked the advent of numerically controlled measuring machines. Due to the poor performance of the computers available at that time, engineers still primarily experimented with the electronic-numeric output of measured values. This preceded the use of computers and microelectronics that would revolutionize metrology in the 1970s. While the engineers in Oberkochen followed this trend and introduced the first machine with a digital display, their counterparts in Jena missed the boat: data processing technology in East Germany was unable to keep pace with that of the West.
Nonetheless, the development of precision measuring department in Oberkochen was anything but good; the department had to deal with losses for many years. Due to the centrally organized sales department of Carl Zeiss which also distributed precision measuring machines, there was insufficient communication between customers and the

department. Feinmess in the West lost too many small machine customers to Carl Zeiss Jena and to competitors in the Far East who offered their products at considerably lower prices. Furthermore, while several products such as the "UMM 200 digital" were seen as technically advanced, many machines in the very broad product portfolio such as hand measuring machines were outdated, impractical and too expensive. To compensate for this, the department developed highly precise machines which were then only built in small numbers. This "flight into super accuracy," which was criticized several years later in the company, was unsuccessful. The number of employees in the Feinmess Department had clearly declined since the 1960s. At the beginning of the 1970s, the department was on the verge of closing.

An employee of the Feinmess Department at Carl Zeiss founded in 1950 in Oberkochen during assembly of a UMM universal measuring microscope. First introduced in the mid 1950s, the machine was completely different from the pre-war models from Jena as it enabled the central observation of all measuring positions and the measured object in a single, binocular microscope. This enabled the UMM to replace several single-use measuring instruments.

Into the 3rd Dimension with ZEISS measuring technology

Coordinate measuring technology – an opportunity not to be missed

The few remaining employees and Klaus Herzog, the new department head, knew right away that the future of measuring technology was in computer-guided 3D coordinate measuring technology. This technology, in which the workpiece is measured point-by-point using a stylus system and the measured coordinates numerically assembled in a data processing system to create a complete workpiece geometry, would eliminate the need for the widely used, expensive single-purpose measuring tools. Despite the high procurement price, a coordinate measuring machine has lower measuring costs than traditional equipment.

The entry into coordinate measuring technology was triggered by intensive discussions with Volkswagen. With in-depth knowledge of the measuring problems and the needs of industry, precision measuring engineers at Carl Zeiss developed a new coordinate measuring machine with an unparalleled measuring probe featuring five single styli in a star arrangement. Additionally, software developed internally on a Hewlett-Packard computer was available for control and the mathematical processing of the measuring results.

Used for the first time on the UMM 500, the measuring probe head was Carl Zeiss' key to 3D contact measuring.

Klaus Herzog, initiator of three coordinate measuring technology at ZEISS, presents "his" UMM 500.

The UMM 500

In 1973, amazed visitors to the Microtecnic trade fair in Zurich, Switzerland, flocked to the booth of the Feinmess Department of Carl Zeiss. They all wanted to see the UMM 500, a 3D measuring machine that would revolutionize metrology. They were shown how the machine was able to do things in metrology that practically no one had thought possible. Without prior alignment, it was possible to measure workpieces with an accuracy of 0.5 µm; an electronic bearing controller ensured that the linear measuring system in the probe always reached the zero setting and users were able to conveniently operate the machine with joysticks and easily launch programs via a control panel.

The UMM 500 proved to be a real success for the department. Numerous German and non-German companies such as Philips, Daimler-Benz, Bosch, IBM, Ford and Hitachi definitely wanted this machine in their measuring labs. Dominated by oil and economic crises, the 1970s provided a good market environment to sell large numbers of coordinate measuring machines. Anyone measuring their workpieces using exact, fast and cost-saving processes was subsequently hardly at risk of having to stop their production process because of overly high tolerance deviations and thus losing a lot of money. By the end of the 1970s, more than 100 UMM 500 measuring machines were in operation throughout the world. The machine became an absolute legend and some – retrofitted with the latest software – are still in use today.

A rosy future

With the success of the UMM 500, the perspectives of the Feinmess Department changed almost overnight: initially faced with closure, the future of the department was now secure. This decision was made when the department was able to acquire several buyers such as BMW and MBB for the UMM 800, the successor to the UMM 500. The department for precision measuring machines was thus saved and had redefined its existence overnight with its developments in coordinate measuring technology. Another key to this success was the restructuring of the distribution network. Before then, Carl Zeiss Sales had not been adequately present in industry. For this reason, the Feinmess Department adopted its own approach in many regions and increasingly worked with representatives, enabling them to establish good contacts in industry. With expertise and a sharp customer focus, the new industrial sales department played a key role in the growing success of Carl Zeiss coordinate measuring technology in the 1970s.

With a measuring range of 500 x 200 x 300 millimeters, the UMM 500 was the first three-coordinate measuring machine built by Carl Zeiss. It was known for its many special features and system components such as the measuring probe head, an integrated computer, software and an ergonomically correct design. The machine was capable of measuring in 3D with an accuracy of 0.5 µm. Aligning the workpiece to be inspected to the machine axes of the previously used single-use instruments, reading scale values and manually processing the results were no longer necessary. The UMM 500 was a major success and marked the technological revolution in precision measuring technology. Shortly thereafter, the department was renamed to IMT (Industrial Measuring Technology).

With the WMM 500 and 850 at the end of the 1970s, IMT launched coordinate measuring machines that could be used near production. This marked the first step towards production measuring technology. MTU used this image of a WMM 850 in a brochure in the 1980s to emphasize its high demands on quality.

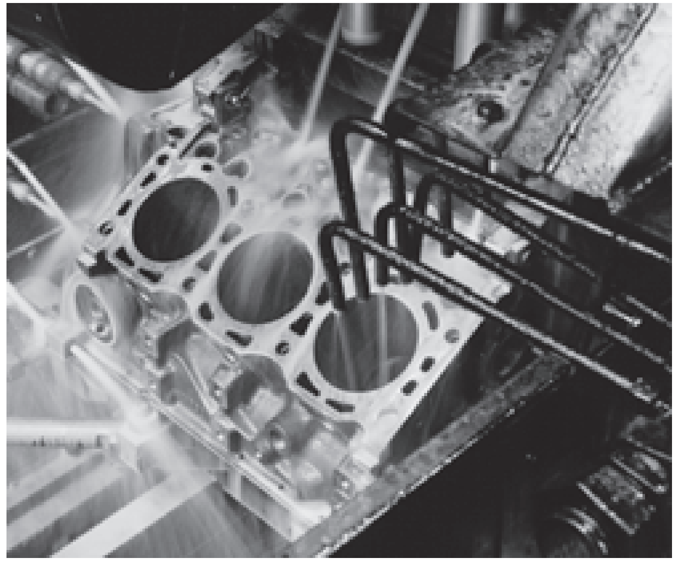
New technology, new name: IMT

New name for the department

With the construction of the UMM 500 and its measuring components, the Feinmess Department in Oberkochen launched a new era in industrial metrology. Within a few years, many companies and facilities such as boards of weights and measures, examination offices, technical schools and research institutes made the leap to coordinate metrology. Although many small and mid-sized companies still relied on traditional measuring equipment for a long time, it was clear that the convenience of 3D measuring was the future. In 1976, in order to meet the changed conditions in measuring technology, Carl Zeiss decided to rename its department: the name Feinmess was too closely connected to the less successful, recent history of traditional measuring instruments. Since then, coordinate measuring machines (CMMs) from Oberkochen have born the name Industrielle Messtechnik (IMT). This name still stands for coordinate measuring technology from Carl Zeiss.

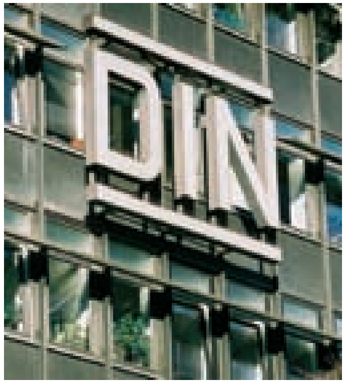
A broad field for new developments

It was clear to everyone at IMT that the company was treading a new field of technology that still held numerous possibilities for innovation and opportunities to boost the name of the company. The growing IMT division worked tirelessly on additional developments. A key factor in the success of the company was (and still is) IMT's ability to learn about the wishes and ideas of its customers and implement them into the development of the machines and components. This led, for example, to the touch-trigger probe with Piezo sensors whose additive Piezo signal eliminates the hysteresis and bending influences of probing. In addition to the measuring probe, it is still one of the standards of sensors in coordinate measuring technology. Furthermore, IMT developed the central drive for measuring machine bridges, numerous software programs such as UMESS to measure different and partially complicated geometries, and the possibility of performing fully automatic gear measurements on a coordinate measuring machine. Air bearings, which enabled a machine bridge to hover only 3 µm over the base plate, was another global innovation. Since IMT did



Left: A climate-controlled enclosure to house a coordinate measuring machine in the 1980s. It provided conditions like those in a measuring lab and protected the sensitive coordinate measuring machine against the unfavorable ambient conditions in production. 3D measuring in production was now reality.

Top: Until the 1980s, only gages and special measuring equipment were used for large scale production. IMT and its customers put forth a pioneering effort in the integration of universal coordinate measuring machines into production lines. IMT successfully completed a project with the Ford factory in Cologne in 1984. A WMM was given a protective enclosure and used directly in engine production. More manufacturers followed this example, giving IMT a good reputation in the field of production measuring technology. This photo was taken in the Ford factory in 1987.



The standards committee of German industry, the origin of today's German Institute for Standardization (DIN) was founded during World War I to increase production. Employees of Carl Zeiss measuring technology have been members of this committee since its inception. Employees from Carl Zeiss IMT still work in the national and international work groups and committees of important standardization institutes. They carry a lot of weight here as a result of the company's outstanding reputation and the quality of its products.

not build gantry measuring machines, Carl Zeiss joined forces with the company Mauser in Oberndorf, Germany, in 1976. Mauser integrated IMT components such as controllers, probes and software into its machines.

New measuring machines
Measuring machines such as the PMC 850 precision measuring center and the UMC line of universal measuring centers to measure large parts and for the serial measurement of entire pallets were created in Oberkochen until 1980. Another new line stood out in particular: the WMM line of workshop measuring machines. The WMM 550 and the WMM 850 made it possible to set up the highly sensitive coordinate measuring technology closer to production areas, a difficult job if you think about how dust, oil mist, heat and vibrations severely affect the accuracy during a measurement – then even more so than today. With the WMM line, Carl Zeiss IMT took the first step towards production metrology.

Partnerships: KOMEG
ZEISS has relied on collaborations and partnerships with other companies since the early days of precision measuring in Jena. This exchange of experience and know-how repeatedly spawned new developments in measuring technology. With the success of coordinate measuring machines, the Feinmess Department once again looked for a strong partner. Shortly after the launch of the UMM 500, it agreed to work with KOMEG (Koordinaten Messmaschinen Gesellschaft) in Völklingen, Germany. Founded in 1974, the company was also an early player in the field of coordinate measuring technology. The company's achievements include the presentation of the first production measuring computer with SPC application. In the years to come, KOMEG successfully distributed ZEISS machines and had, in many regards, a similar position as Schuchardt & Schütte five decades earlier. The president of KOMEG was Dieter Gengenbach, a sales expert with good contacts in the industry who used his persuasiveness to encourage many hesitant metrologists to purchase a coordinate measuring machine.

Left: The OPTON labeling on this UC 850 coordinate measuring machine indicates that it was intended for an Eastern Block country. In accordance with the London Agreement negotiated with Carl Zeiss Jena in 1970, all instruments sold in the East by Carl Zeiss Oberkochen had to carry the name OPTON. Carl Zeiss Jena was known in the West as Jenoptik.

Right: The ceramic technology and the portfolio with economical, high-quality bridge-type measuring machines was decisive for the acquisition in 1989 of Numerex, from which IMT's US subsidiary originated. The ECLIPSE bridge-type measuring machine with ceramic parts originally built in Minneapolis and later in Oberkochen provided an affordable entry to the world of production measuring technology. IMT added a production site in Shanghai in 2001 to go along with Minneapolis and Oberkochen.

A wide range of everyday products are measured with machines from IMT. These include many components found in cars such as engine parts, gears and bevel gears, and all types of circuit boards and housings. Even the seals on throw-away cans are subject to coordinate measuring machines from Carl Zeiss IMT.

Working with customers

The trends of the 1980s

By the early 1980s, IMT had become a fully established member of Carl Zeiss. Although the metrologists were considered somewhat strange by the rest of science-oriented Carl Zeiss, it was impossible to imagine Carl Zeiss without IMT. The success of IMT made the entire company less susceptible to economic fluctuations.

There was no shortage of innovative developments in the 1980s, which surely helped IMT attain this status. For IMT and coordinate metrology, the decade was marked by key phrases such as expansion of inspection possibilities, production metrology and speed. New micro and process computers further reduced measuring times. IMT developments during these years included the CAA method that mathematically corrects guideway errors occurring during a 3D measurement, axis wobble correction with a completely integrated rotary axis, and fully automatic gage measurements.

Production metrology takes shape

In 1984, IMT achieved a revolutionary advance together with the Ford factory in Cologne which eliminated the need for traditional gages: a WMM 850 measuring machine was integrated directly on an assembly line instead of being set up close to production. To protect the machine against dust and contamination, they built an enclosure and developed for the first time an automatic stylus changer during the course of the project. The success of the project encouraged other automobile manufacturers to also buy coordinate measuring machines from Carl Zeiss for their production areas.

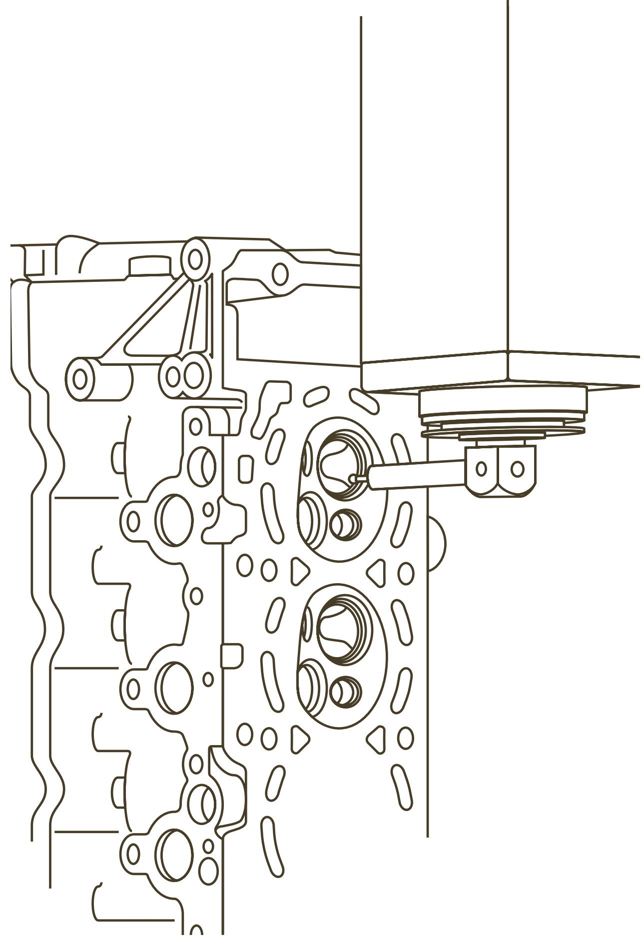
Regardless of whether car manufacturers such as Daimler-Benz or Audi, suppliers such as Bosch and Kolbenschmidt or the airplane engine manufacturer Pratt & Whitney in the USA, more and more companies are now opting for coordinate measuring technology. They are increasingly focusing their activities on IMT and the excellent training measures offered by Oberkochen. In addition, Carl Zeiss IMT made it possible to link the manufacturing measuring machines with the entire production procedure and thus integrate them into the automated production process so that the measuring results could be directly processed by the production computer.

Diversification
During the 1980s, Carl Zeiss diversified its product range, which was achieved through the close cooperation with other companies. The collaboration with Stiefelmayer in Esslingen – an old customer from the founding years of Feinmess – added large horizontal-arm measuring machines to the product line; The Höfler company provided instruments for gear measurements. The developments by US-based Numerex in Minneapolis at the end of the 1980s added small, economical bridge-type measuring machines with new ceramic technology for the workshop. Shortly thereafter, Carl Zeiss IMT acquired Numerex and converted it to a new production site.

Crises and successes in the 1990s

Reunification
The fall of the Berlin Wall, the end of the Cold War and the German Reunification at the start of the 1990s also lead to the reunification of Carl Zeiss east and west. It was a painful process with many tens of thousands of employees at the bloated VEB Carl Zeiss Jena losing their jobs. Carl Zeiss in Oberkochen, from then on headquarters of the entire company, was unable to integrate all divisions of its Jena counterpart. As a result of the gap in coordinate metrology – IMT's main area of business – and the insufficient computer performance of the machines from Jena, all attempts to merge the Feinmess Department in Jena with IMT failed. This ended the 70 year tradition of Carl Zeiss precision measuring products in Jena. From now on, the Zeiss Works in Jena focused on microscopy and ophthalmology, launching a success story that has not ended.

Major, new innovations for the upturn
Carl Zeiss and IMT were confronted with a serious crisis as a result of the global economic downturn in 1992 that led to layoffs in Oberkochen. Using a multi-pronged strategy that included acquiring Stiefelmayer, adding the company Mauser's measuring machine line of large workpieces and establishing a new sales organization, IMT returned to its road to success around two years later. By the end of the



Available since 1995, the hand-guided ScanMax brought the benefits of scanning to the workshop. The mechanical design corresponds to the Skara principle proven in the world of robots, in which the use of high-tech materials compensates for damaging environmental influences and enables low weights. The key to ScanMax is the special scanning probe head with a 3D sensor hand grip. It allows you to quickly, easily and exactly scan workpiece surfaces. The small machine is easy to use and can be used practically anywhere. Key components of ScanMax were developed by Prof. Dr. Werner Lotze from Dresden. This partnership led in 2001 to the creation of the Carl Zeiss Innovation Center for Measuring Technology in Dresden, which works on developments for IMT.

1990s, IMT had achieved a market share of 25 percent with its large number of new products: horizontal-arm and bridge-type measuring machines such as PRISMO and ECLIPSE became best sellers. Companies such as ABB and Pratt & Whitney used VAST scanning technology to measure the contours of turbine blades, for example. CALYPSO replaced its predecessor UMESS as the standard measuring software. And finally, with ScanMax, IMT once again delivered a key advancement in production measuring technology.
ScanMax could be used for the first time on the shopfloor without an enclosure. Instead of the entire machine, IMT designers enclosed the measuring systems. As a hand-operated, articulated-arm machine, ScanMax was ideal for smaller operations in which coordinate measuring technology was now making inroads.

The new millennium

Globalization
As a reaction to the accelerating globalization since 2000, IMT founded a subsidiary in Shanghai and expanded its production facility in Minneapolis. Both factories have the same quality standards as Oberkochen. IMT recently opened a technology center for industrial metrology in Bangalore, India. The fact that companies such as VW, Stihl and Renault almost always choose measuring machines from Oberkochen, including IMT services, when equipping new factories on other continents demonstrates that IMT products have long been the international benchmark for quality in coordinate metrology.

IMT repositions itself
Carl Zeiss and IMT underwent several key changes during the stormy times of the recent past. In 2003, the parent company, like Schott Glaswerke in 2003, was converted into a stock corporation which is solely owned by the Carl Zeiss Foundation. For IMT, these changes primarily manifested themselves in a clear expansion of the company's fields of activity and business areas. It had been known for several years that customers increasingly wanted to outsource measuring operations to external providers. IMT, which has always been a powerful force in customer support, accepted this challenge and has positioned itself

Sports car manufacturer Porsche has used coordinate measuring machines from IMT for years. Machines such as the SMM and various measuring and machining heads are used throughout production. Measurements are already made on the first plasticine models during the design phase of a new Porsche.

Left: The PRISMO measuring machine launched in the mid 1990s became a best seller. Tens of thousands of these affordable, easy-to-use machines for the middle and upper class have since been built. Ferrari, for example, uses them to measure the skin of its Formula One race cars.

Right: Introduced in the 1990s, VAST provided active scanning technology, and enabled multifunctional and affordable scanning of test pieces. Scanning became a special area of IMT at an early stage. The scanning probe head provided users with access to this technology in the 1970s.

as an all-round service provider for measuring tasks. Together with its subsidiary in Aalen, Carl Zeiss 3D Metrology Services GmbH, IMT today offers consultation during the purchase and operating phase, on-site support, contract measurements and programming, training at its own academy and the expansion of demo centers. This enabled the company to become the global leader in the service sector within a short time. With this expanded service offering and many new products, IMT has been able to grow dynamically since 2000. The company now has almost 1,800 employees around the world.

Continuous innovative power

Several recently introduced products and technologies demonstrate that IMT has not lost any of its innovative power in its ninth decade. The CenterMax production measuring center, the smaller GageMax CNC production measuring center and the small DuraMax measuring machine, for example, now enable you to perform measurements directly in production and achieve results as if you were in a measuring lab. In addition, the measurement of small and extremely small parts is now reality. The O-INSPECT multisensor measuring machine permits the alternating use of optical and contact sensors during CNC operation, while the F25 measuring system enables measurements in the range of nanometers. With "metrotomography," measurements are no longer limited to the exterior of a workpiece: METROTOM unites metrology and tomography by using a 3D computer tomograph with x-ray tube and detector to x-ray the workpiece. Geometries and dimensions can be captured even in the interior of the tiniest parts. The idea behind the development came from Robert Bosch GmbH, which suggested turning a tomograph into a measuring machine.

Well poised for the future

90 years of IMT stands for 90 years of expertise, reliability and a high degree of innovation in industrial metrology. This is exemplified in how Carl Zeiss technicians overcame the greatest crisis in the history of their department at the beginning of the 1970s by using their creativity to develop something completely new and lay the foundation for modern coordinate measuring technology. IMT

is following in the tradition of Carl Zeiss, Ernst Abbe and Otto Eppenstein who laid the foundation for modern measuring technology in industry with the first developments more than 160 years ago.
90 years and going strong, IMT is a key pillar of the Carl Zeiss Group. It not only offers proven measuring technology that can be found in numerous well-known companies around the globe, but also financing and special usage models. The decentralized measuring houses permit all types of contract measurements and programming, and provide IMT customers with the know-how of Carl Zeiss. History, experience and proximity to the customer, as well as motivating and training employees guarantees that IMT will also lead the development of coordinate measuring technology in the future.

DuraMax is a cost-efficient, easy-to-use instrument measuring machine. It can be used in CNC operations and comes standard with scanning technology.

Left: The GageMax CNC production measuring center marked the full establishment of coordinate measuring machines in production. The enclosed measuring systems allow GageMax to be set up directly in production where it delivers measuring results as if it were in a protected measuring lab.

Center: METROTOM is a 3D computer tomograph that x-rays workpieces. During this process, the part rotates 360° around its own axis to generate a 3D image of the entire volume of the workpiece. This machine is capable of measuring very complex and small interior and exterior geometries. METROTOM was developed based on an initiative from Robert Bosch GmbH which wanted to make computer tomography useful for destruction-free measuring. A Lego brick was used for the trial phase because it has geometries that are similar to the plug systems used in cars, for example.

Right: The F25 was developed to measure micro-parts in the nanometer range. Introduced in 2004, this coordinate measuring machine enabled the measurement of rotationally symmetrical parts with free-form surfaces, small radii and undercuts or prismatic parts with small and deep boreholes.

Comments

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Photographic credits: ZF Friedrichshafen AG, Ford-Werke GmbH Cologne, DIN, Carl Zeiss Archives Jena.

Chronology

1890
Comparator principle from Ernst Abbe: the foundation of modern metrology

1900
First measuring instruments, e.g. thickness measuring instruments and comparators

1918
First major internal order for 10,000 precision measuring screw gages

1919
Founding of the precision measuring department, the Feinmess Department

1920
First large machines: Optimeter, shopfloor measuring microscopes and inside micrometers

1924
Large tool measuring microscope for form inspections, measurement of orthogonal and circular coordinates on form gages, thread measurements

1926
First universal measuring microscope

1953
New universal measuring microscope introduced

1962
Interference comparator for parallel gage blocks from 10 cm to 1 m

1963
First digital measuring instruments with electronic-numeric output of measured values

1973
UMM 500: highly accurate three-coordinate measuring machine with measuring probe, integrated HP desktop computer and UMESS measuring software from Carl Zeiss

1976
Touch-trigger probe, RT 05 computer-guided rotary table

1978
WMM line with new air bearings featuring extreme rigidity and low air consumption for use directly in production

1980
Start of marketing for CNC-controlled horizontal-arm measuring machines: sensor system, controller and software from Carl Zeiss; instrument technology from Stiefelmayer
UMC 850 universal measuring center

1982
Three new 3D coordinate measuring machines: ZMC Gear Measuring Center
UPMC Universal Precision Measuring Center, PMC Precision Measuring Center

1983
First supplier of a CNC stylus changer for coordinate measuring machines
Comprehensive software packages enable measurements of free-form surfaces, curves and gears: HOLOS, KUM, GON

1985
CAA procedure: mathematical compensation of systematic guideway errors
First CAD programming of CNC measuring runs on the basis of a saved workpiece model

1989
SMC horizontal-arm measuring center allows change between mechanical and optical probing

1990
CARAT technology to eliminate temperature influences in highly accurate measuring centers
Acquisition of Numerex in Minneapolis, Minnesota, an American manufacturer of bridge-type CMMs

1990
LTP laser probe head for use with horizontal-arm measuring machines

1991
High-speed scanning
FMC production measuring centers: highly accurate and fast gage replacement for production and the measuring lab

1994
Scanning with VAST technology
Acquisition of Stiefelmayer to enable Zeiss to complement its own range of horizontal arm CMMs

1995
PRISMO VAST 3D coordinate measuring machine: scanning technology in production
ScanMax: measuring machine with an articulated arm design – for measuring precision in production without an enclosure
CALYPSO: revolutionary, CAD-based measuring software design

1998
VISTA: small, highly accurate 3D coordinate measuring machine

1999
Demo center for industrial metrology in Shanghai

2000
Reduced calibration time due to RDS-CAA articulating probe holder
CONTURA: line of mid-sized measuring machines

2001
Founding of Carl Zeiss 3D Metrology Services GmbH
CALYPSO standard measuring software also usable on a computer
CenterMax inline measuring machine for temperature-stable measurements as in a measuring lab

2002
Navigator principle: measurements with unparalleled speed

2003
GageMax: coordinate measuring machine for use as flexible gage directly in production
PRO select horizontal-arm measuring machine

2004
F25: coordinate measuring machine for micro-parts with measuring accuracy of 100 nanometers
Third assembly site: Shanghai

2005
UPMC ultra with specified linear measuring tolerance of 0.3 µm +L/1000: the reference instrument for research, development and quality assurance

2006
METROTOM: computer tomography for industrial applications; metrotomography in the micrometer range

2007
Winner of the Bosch Supplier Award for the third consecutive year
O-INSPECT: multi-sensor measuring machine
25.000 3D measuring machines delivered

2008
DuraMax: scanning technology for any workshop
The MMZ B Plus gantry measuring machine with a measuring range of 5 x 16 x 2.5 meters, the largest ever built by Carl Zeiss

2009
The new ACCURA, an entirely new, fast and accurate coordinate measuring machine with laser safety enclosures and large measuring ranges

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Neumann & Kamp Historische Projekte, Munich
Setting: Anne Dreesbach
Production: Wahl-Druck GmbH, Aalen/Württ.
Printed in Germany.
August Dreesbach Verlag, Munich

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EN_60_025_108I Printed in Germany. IV/2009