

Measuring Demands Today

Gaging evolves for precision, productivity, ergonomics and more

The L.S. Starrett Company

Precision has not always been associated with measurement. In fact, at the dawn of civilization, man began to use parts of the body to estimate dimensions, and in about 6,000 B.C. from such measurements, there evolved the inch, hand, span, foot, cubit, year, and fathom—the first standards of measurement. Of course, the tools of the past did not demand great accuracy as most products were manually and custom made, so a fraction of an inch in one way or the other made little difference to satisfactory operation.

However, mass production of today demands precision measuring because the parts in any product must be uniform to be interchangeable. Eli Whitney first conceived the basic idea of mass production through interchangeable parts, and it was only through improved methods of measurement and mechanically powered machines that would make mass production possible. There was tremendous growth in mass production of all types of goods during the 19th century. Yet, it was not until after the Civil War that machines and measuring tools approaching the accuracy of modern standards were developed. In 1877 the first combination square was invented by Laroy Starrett, founder of The L.S. Starrett Co.

For precision measuring, skilled machinists, toolmakers, and inspectors must have accurate tools and gages, produced from quality materials, carefully manufactured, and rigidly inspected, to ensure lasting dependability. Gages have evolved throughout the years beginning with mechanical, then electronic models, and now convenient wireless electronic versions have come on the scene. Each type has an important place in today's quality control and inspection processes.

Mechanical

The first precision gages were mechanical, featuring analog readout and are still widely used today. It is safe to say that one would be hard pressed to find a manufacturing operation that is not actively using a mechanical tool. Some precision tools are still only offered in mechanical versions, while many have digital and wireless versions. For linear and round measurements, gages and tools that are used vary with the size of the dimension, the nature of the work and the degree of accuracy required. Mechanical types range from a steel tape, rule, divider or trammel, to a micrometer, vernier caliper, dial indicator and many more.

Electronic

Over the last several decades, electronic gages were introduced offering digital readout and the ability to acquire measurement data for collection purposes and for Statistical Process Control (SPC), analysis and documentation. These types of gages make readings faster and easier for every machinist, regardless of experience.



Electronic gages are capable of transmitting data through cables or wireless without cables, to collection devices to provide a permanent record for SPC, required for many industries today. Properly used, the data collected can provide printouts for analysis and can help a machinist control process, as well as to predict and prevent out-of-tolerance conditions.

Wireless

Relatively recently, wireless precision gages were introduced. Key benefits of using wireless gages including using them as a gage only or within an advanced data collection system are as follows:

- The need for bulky and cumbersome hardware such as backpacks and cables which can be safety hazards is eliminated. Also, by eliminating backpacks and cables, there is less equipment to purchase, so startup costs are decreased, and related maintenance requirements are reduced within the manufacturer's shop tool calibration program.
- Collecting and transmitting measurement data is faster and less error-prone, facilitated simply by measuring and pressing a button to send the data to a mobile phone, tablet, or PC. In this way, operator subjectivity and recording measurement errors are removed, and time is saved when not manually transcribing data. Wireless provides speed, convenience, and ease of collecting and storing data.
- Wireless precision measuring tools are engineered for efficient data collection for a wide range of end uses. Whether it be for International Organization for Standardization (ISO), government, aerospace, or medical requirements, or for smaller shops, the need for accurate data is crucial for traceability to demonstrate qualified parts or to trace back any manufacturing errors. Accurate measurement data provides assurance for the end user and insurance for the manufacturer.
- By using wireless tools and an advanced data collection software system, the data can be efficiently integrated in ERP/ MRP programs. Also, wireless gages promote a cleaner work environment by removing the need for a log journal and pens/pencils, in step with lean manufacturing.
- Quality control is the last step when producing manufactured parts, so if a "bad part" slips by, problems can result in the assembly of the final product or the use of the part in the final product. Using wireless precision gages, inspectors can measure with confidence in order to qualify the part. With the simple push of a button, the measurement data is stored for future analysis or for history purposes. The time and money saved by going wireless and implementing a data collection system is incomparable. Online form-based digital calculators are available that can demonstrate this.

Refining Gage Design

Gage design is continually being enhanced and refined. The first gages, designed by pencil and paper, were bulky and cumbersome featuring crude heavy steel construction with rough edges. These initial gages earned low scores for operator comfort. Over time, gage design significantly improved for fit, size and maneuverability. Using advanced CAD programs with 3D models, gage designs are now generated faster with high accuracy. Improvements keep the operator experience as a top priority, and today's gages are constructed with honeycomb aluminum and rounded contours, making them lightweight and easy-to-hold. One person can use a gage repetitively, compared to earlier times when two people might have needed to complete the same operation due to fatigue resulting from holding and maneuvering the gage.

Special Custom Gages

Even with an extremely broad range of standard precision gages available, whether mechanical, electronic or wireless, some applications require measurements that cannot be taken with a standard gage. So, for these instances unique gages can be designed and manufactured to order. In fact, as gaging technology has advanced so has all tooling and machinery—all which have made it possible to manufacture special gages. The latest advanced gages and tooling are being utilized to manufacture custom gages. For over 50 years, Starrett has provided special gaging solutions to industries including energy, aerospace, automotive, food packaging, high-technology plastics, medical components and to NASA and over government agencies.

The Case for Multisensor Metrology Technology for Gear Parts

Multisensor technology, including vision and touch probe capability, is also a key consideration for fulfilling gear measurement and inspection needs. Having fast, reliable data acquisition in the process is important. The more complex the gear, the higher the demands are for inspection and the more important efficiency becomes.

Providing exceptional speed and efficiency, a multisensor measurement system can easily increase QC throughput by performing multiple processes on a single machine, while maintaining accuracy. For greater productivity and accuracy, more of the gear

can be viewed in every image on the latest multisensor vision systems such as the Starrett AVR-FOV featuring a 0.14 magnification lens, large field-of-view of 2.36" x 1.90" (60 mm x 48 mm), and automatic part recognition. Due to "super image" technology, which allows multiple images to be stitched together to form one larger image, together with the system's touch probe technology, the AVR-FOV can accurately inspect a wide range of applications including large, complex and multiple small gears and parts.

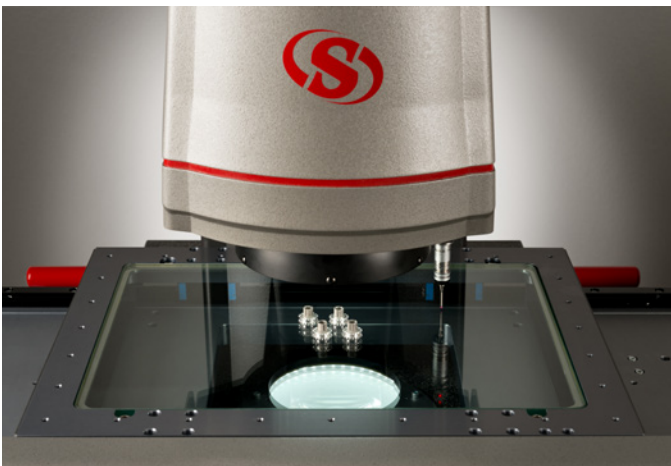
The AVR-FOV automated part programs deliver accurate results to the micron level in a matter of seconds with "Go/No-Go" tolerance zones, and data are provided in one easy-to-interpret report. Video edge detection along with touch probe capability enables measurements to be taken of discreet points along a part's profile, producing accurate profile and pitch inspection results across a wide range of gear sizes. Ensuring that gear production is reliable and consistent protects manufacturers from several issues, including excess noise, load and tooth-to-tooth challenges, as well as premature gear wear or failure.

Also, the Starrett AVR-FOV multisensor vision system is equipped with M3 software from MetLogix which speeds inspection throughput due to features such as auto part recognition. A user can create a part measurement program that comprises the desired features of a part for inspection, which can automatically be saved in the system or to a network. Gear manufacturers can use the line, radius, and circle annotation in the software to create a part inspection program for an individual gear tooth profile or an entire gear.

Programmable light output options can be built into the program as defined steps, including being called up as the part recognition program initiates. Once the program is created, placing that part within the camera's field-of-view allows for the saved program to initiate and run the inspection. A Renishaw Touch Probe may also be utilized for quick acquisition of discreet points along a part's profile as well as Z-axis measurements.

These advancements, when combined with CNC control, advanced edge detection, and one touch measurement, facilitate what is known as "walk-up metrology". Walk-up metrology enables multiple operators, including those right on the shop floor, to utilize the same system for a variety of applications. This versatility and ease of use significantly helps with bottlenecks in the inspection process and dramatically increases speed of workflow efficiency.

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Starrett AVR-FOV multisensor vision system offers micron level accuracy across a wide range of gear sizes.

