LMI TECHNOLOGIES

FactorySmart® Inspection

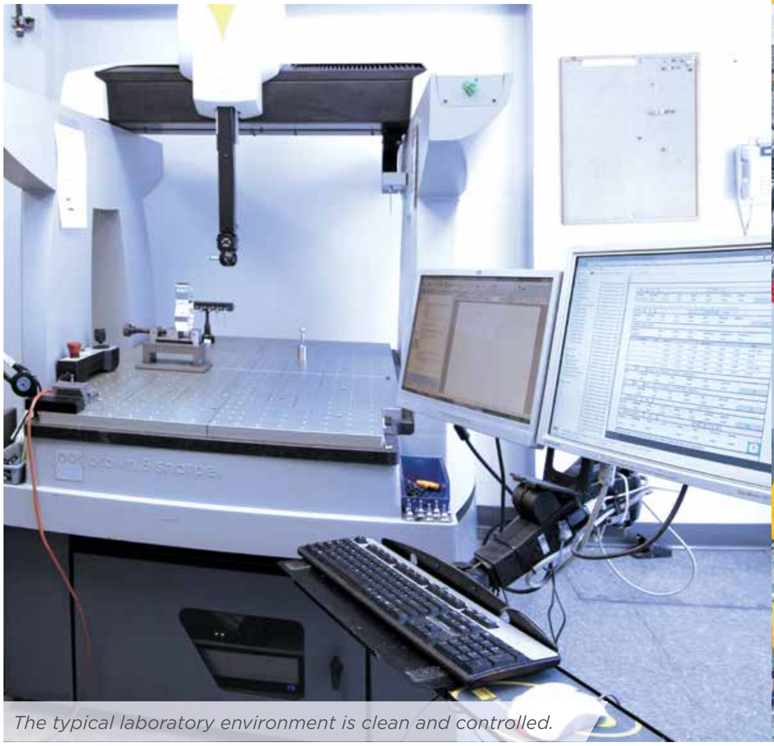
DELIVERING INLINE METROLOGY WITH SMART SENSOR TECHNOLOGY

THE WAY OF QUALITY CONTROL TODAY

Worlds Apart: Lab vs. Factory

Quality control processes fall into two distinct environments: (1) metrology laboratories where first article parts are digitized offline typically using contact-based solutions, and (2) factories where parts are inspected in fast-moving inline processes using non-contact optical methods. Both environments have their own approaches to ensuring quality.

The challenge for today’s factory is how to bring metrology-grade accuracy and precision to high-speed inline processes in order to achieve 100% quality control.


The typical laboratory environment is clean and controlled.


The factory environment is rugged, fast and dynamic.

METROLOGY

CMMs and the World of the Lab

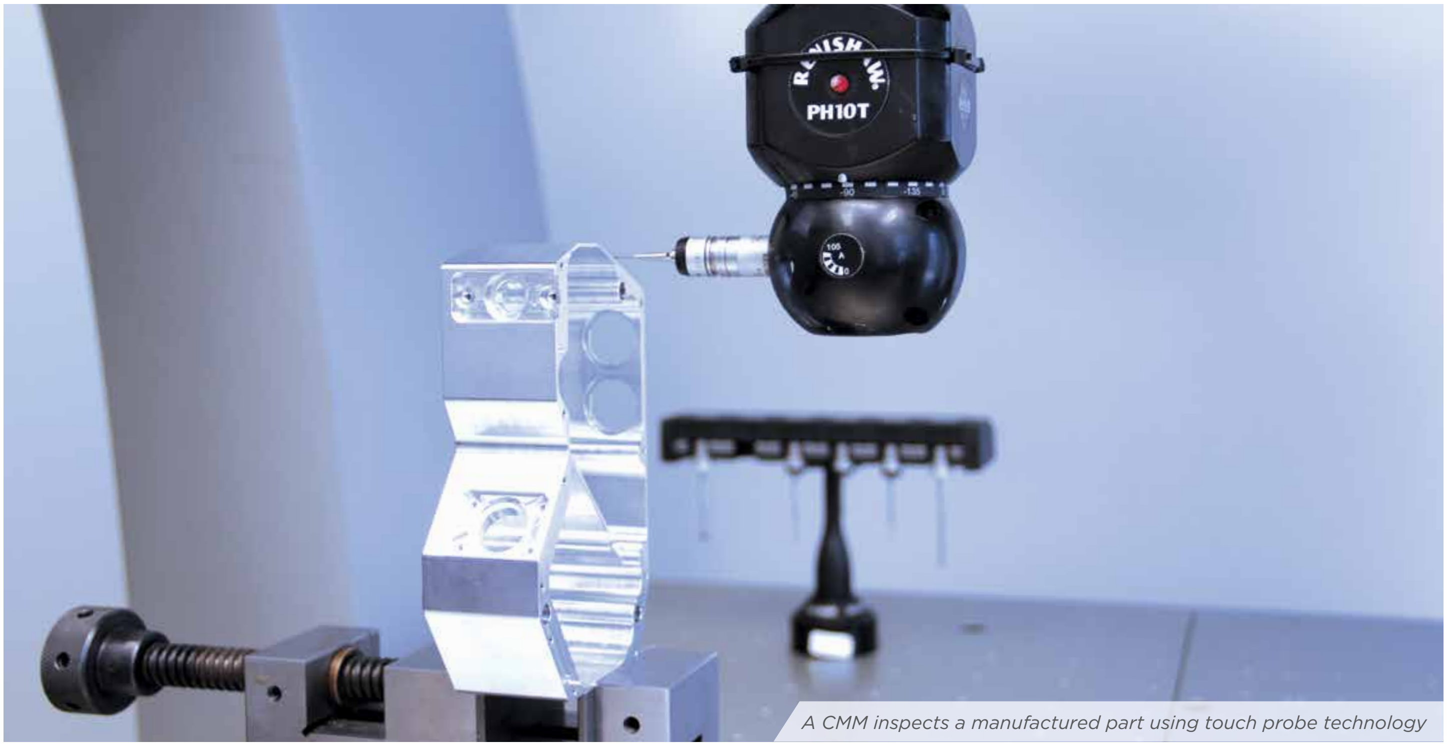
The laboratory environment is clean, controlled and slow-paced. Time is not critical, with the emphasis instead placed on measurement precision and accuracy.

Contact Based

The metrology world relies on contact-based solutions. CMM machines using touch probes are programmed to digitize target parts. Tool changers are often used to exchange one touch probe for another specialized for the type of geometry that is being probed. The touch probe determines the overall resolution and point density that can be achieved to build a 3D model. CMMs, while highly accurate, are slow to setup and measure, with typical digitization of a part requiring 1-2 hours.

Calibration Required

In the laboratory environment, regular calibration is required to ensure 3D points are accurately translated from a coordinate measuring machine to real-world coordinates. Calibration is a necessary process to carry out before a CMM machine can reliably be used to deliver 3D data.



A CMM inspects a manufactured part using touch probe technology

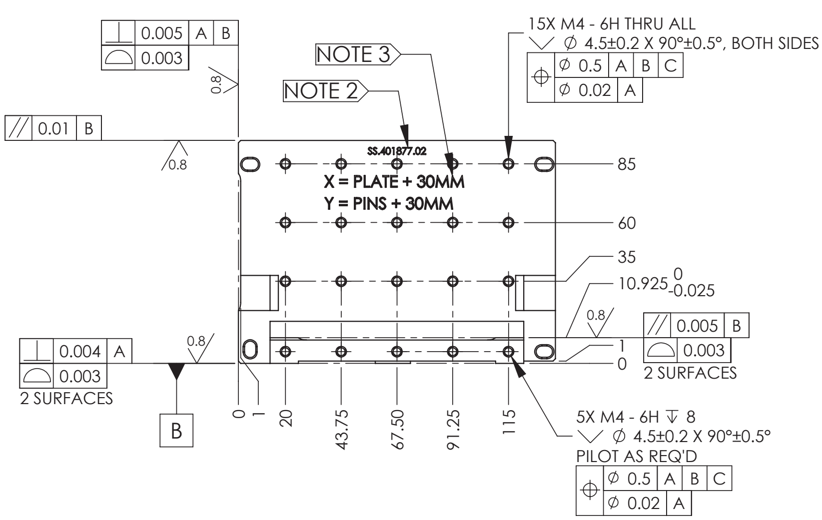
VERIFYING DESIGN INTENT

GD&T

GD&T stands for Geometric Dimensioning and Tolerancing and is the language used by design engineers to communicate critical tolerances in manufacturing a part. Metrologists carry out 3D measurements on first articles of a part to verify GD&T features are meeting design intent.

TYPE OF TOLERANCE	CHARACTERISTIC	SYMBOL
FORM	STRAIGHTNESS	—
	FLATNESS	▱
	CIRCULARITY	○
	CYLINDRICITY	⌭
PROFILE	PROFILE OF A LINE	⌒
	PROFILE OF A SURFACE	⌓
ORIENTATION	ANGULARITY	∠
	PERPENDICULARITY	⊥
	PARALLELISM	//
LOCATION	POSITION	⌖
	CONCENTRICITY	◎
	SYMMETRY	⌯
RUNOUT	CIRCULAR RUNOUT	↗
	TOTAL RUNOUT	⌰

GD&T provides explicit measurement callouts that identify specific tolerances. These strict definitions can be used to program inspection systems—ultimately increasing throughput and finished product quality while cutting production costs.



In addition to CMMs, articulated measurement arms and handheld scanners are other common methods to digitize parts and perform GD&T analysis.

Articulated measurement arm (top) and handheld 3D scanner (bottom).

INSPECTION

3D Sensors and the World of the Factory

The factory environment is anything but clean, quiet and slow. There are multiple inspection cells or stations, transport systems such as conveyor belts, fast-moving parts and even robots—all working together dynamically.

Need for Speed

Speed is the major differentiator between metrology and inline inspection environments. In the factory, conveyor belts and robot motion are all optimized to increase production output. Scan acquisition times are often measured in microseconds with measurement cycle times in milliseconds.

Non-Contact Based

Inline inspection requires non-contact scanning of the target. The most common solutions for digitization are laser triangulation and structured light 3D sensors. Lasers are used for inspecting moving parts, and structured light is used for applications with start/stop motion such as robotic pick-and-place.

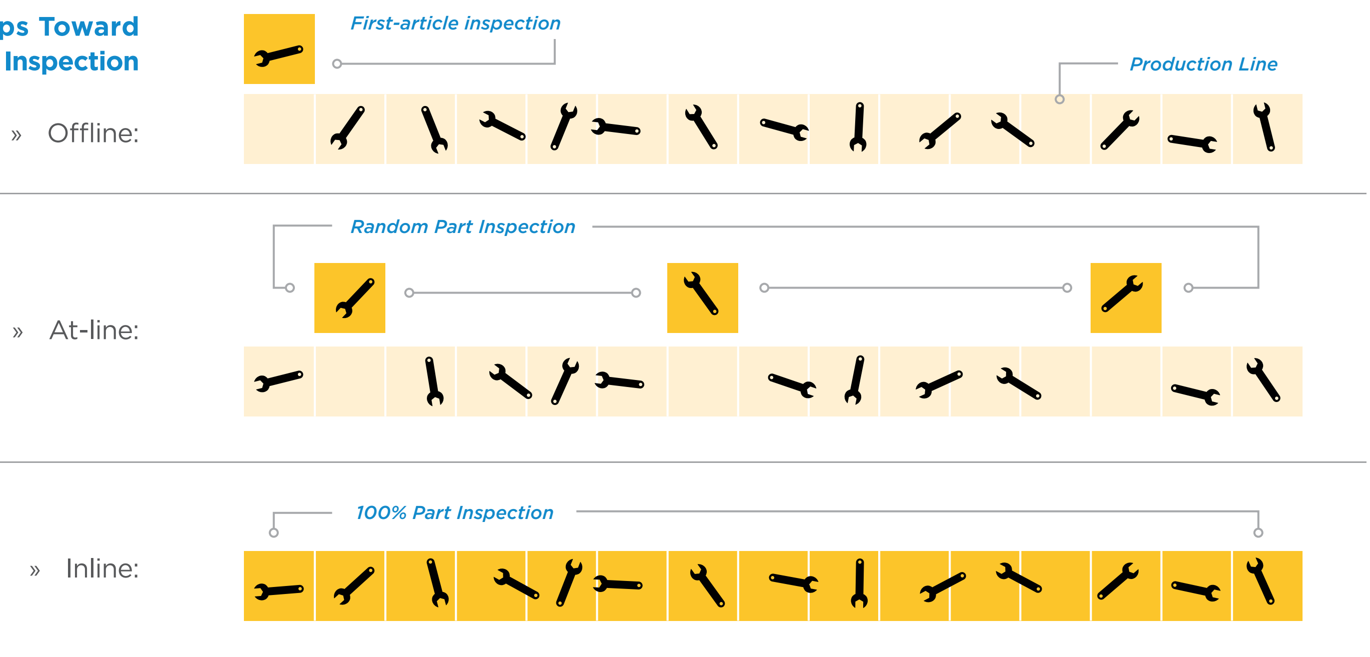
Industrial Design

In order for measuring devices to fit within an automated inspection system, they have to be compact and designed for industrial use (i.e., fully sealed and passively cooled to protect against the harsh factory environment).

Factory Pre-Calibrated

There is no possibility to linearize measuring devices once they are installed in factory machinery. This means inspection sensors must be factory pre-calibrated to produce measurements in standard units on power up maintaining high accuracy over many years of operation. Pre-calibration ensures that each sensor meets a traceable metrology verification process to deliver consistent, uniform results.

3 Steps Toward 100% Inspection



ENSURING 100% QUALITY

Inspection involves scanning, measurement and control—all done inline while a part is in motion. The part is scanned with non-contact optical methods to produce a highly detailed 3D model offering sufficient resolution to measure critical features.

Scanning

For moving parts, a laser line profiler generates 3D profiles in the direction of travel to generate a surface of the scan target. This surface information represents the geometry or shape of the part. Shape information is unique to 3D and critical to achieving quality control.

Measurement

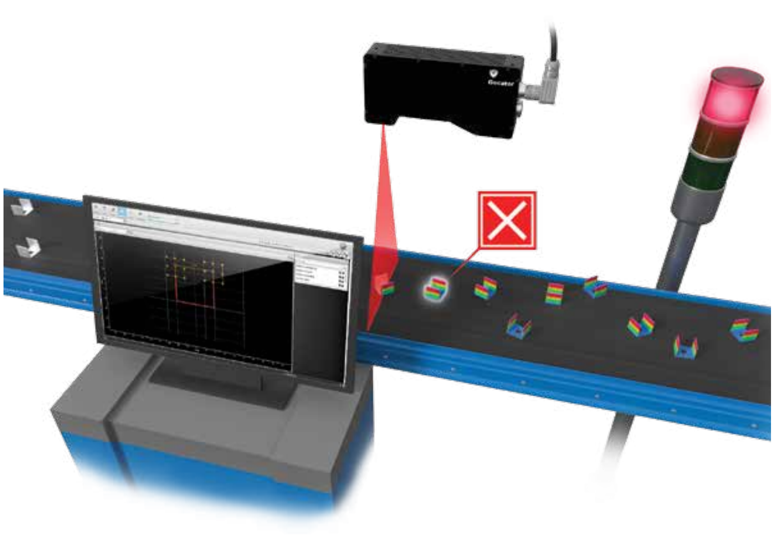
Using built-in measurement tools, users can setup many measurements depending on what critical features are required for inspection—whether it is hole diameter, step height, angle, or relationship between features.

Control

Based on pass/fail criteria, the final step is to communicate measurement outcomes to factory machinery—either to activate rejection or sorting hardware or send part measurement data over the factory network. Built-in factory protocols support direct communication over the factory network with PLCs and robots.

Why Sensor Speed is So Important

When you don't have sufficient speed, you end up testing offline (for example, with a CMM). When you increase speed to a certain threshold, you can perform at-line inspection (random spot checks). The ideal is reaching factory speed, where you're able take your inspection inline to achieve 100% quality control.



100% Quality Control with Inline Metrology

100% quality control is not the ability to scan the entire surface of a single part; it is the ability to scan **every single part on the production line**. The best method for achieving this goal is **inline inspection**—which requires a combination of metrology-grade precision and non-contact, high-speed inspection capabilities. This combination is called **inline metrology**.

THE NEW WAY: INLINE METROLOGY

Achieving 100% Quality Control with 3D Smart Sensors

3D smart sensors combine metrology-grade accuracy, precision and repeatability with advanced inspection-level capabilities and design.

Easy-to-Use

Features such as web-browser driven point-and-click environment for rapid configuration, built-in measurement tools and rich I/O for communicating results make it easy for factory technicians to get the results they need.

Low Latency

Real-time measurement capabilities minimize lag between data acquisition and visualization, which means factories can consistently meet their throughput targets.

Non-Contact

Laser profilers and structured light snapshot sensors leverage proven 3D technologies to meet the challenges of inline quality control.

Metrology-Grade

3D sensors based on laser triangulation and structured light can achieve resolutions down to 1-2 microns in Z and 5-10 microns in X and Y matching the typical performance of a lab-based CMM machines.

Flexible I/O

3D smart sensors interface with a wide variety of outputs to communicate results directly to PLCs and execute timely, accurate control decisions.

FactorySmart®

Today's 3D smart sensors connect seamlessly with factory infrastructure to report results, monitor trends from a web browser, upgrade sensors over the Internet, or network with other machinery to exchange or combine data.

Laser Triangulation

Two non-contact technologies.
One smart solution.

Stereo Fringe Projection

IT'S BETTER TO BE SMART

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ABOUT LMI TECHNOLOGIES

ADVANCING 3D MEASUREMENT WITH SMART SENSOR TECHNOLOGY

LMI Technologies advances quality and productivity with award-winning, sensors that power FactorySmart® 3D inspection systems in the factory. Visit www.lmi3d.com or email contact@lmi3d.com for more information.

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