CENTRAL SCREW PRODUCTS

PRECISION PLUG GAUGE CALIBRATION

ENGINEERING CASE STUDIES 03

REDUCING THE COST OF QUALITY WITH NON-CONTACT METROLOGY

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Central Screw Products Company (CSP) is a 3rd generation machining company, founded in 1924.

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We machine Titanium, Inconel, and other hard materials to precise tolerances for the most demanding industries such as defense, medical, aerospace, and automotive.

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CSP is ISO 9001:2015 Certified, AS 9100 Compliant, ITAR Registered, and a proud recipient of a number of industry and OEM supplier quality awards.

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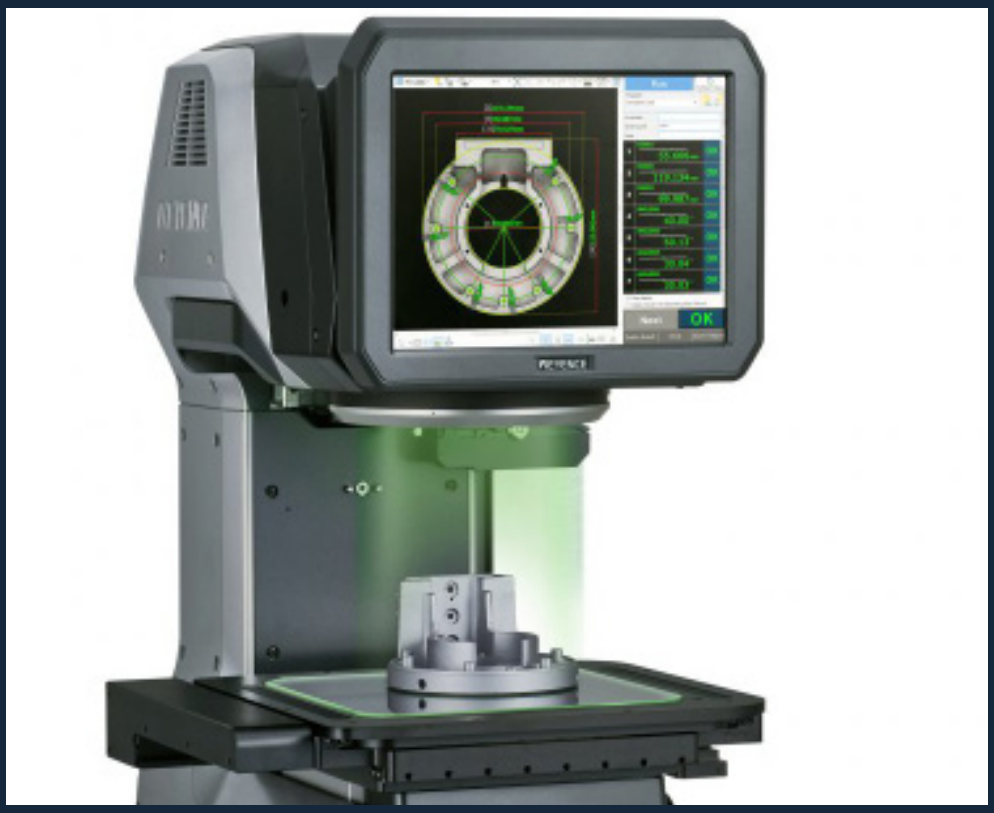

All precision manufacturing Quality Management Systems (QMS) depend on accurate gauge calibration and verification. Failure to precisely manage and maintain metrology equipment creates a multitude of problems, including customer returns and worse, loss of customer confidence for future orders.

Large-scale manufacturers often address this challenge with dedicated calibration personnel or third-party calibration services. This process is a time-consuming operation and susceptible to serious consequences if inconsistencies arise. Cost of quality typically skyrockets here, and quickly distinguishes the average manufacturing facility from the exceptional.

As a Tier 1 OEM component supplier, CSP has substantially reduced the time and risks associated with typical plug gauge calibration by using the Keyence IM-7000 Instant Measurement System. This recent addition to our manufacturing floor boasts 0.5-micron accuracy, with instant results stored directly to our Zeiss database, PiWeb.

INSTANT MEASUREMENT vs. "THREE-WIRE" METHOD

Using the Keyence as a central part of our gauging process enables CSP to achieve perhaps the two primary goals of every precision manufacturer: improved accuracy in less time, resulting in an exponential increase in complexity of parts with lower cost. Our method requires no dedicated calibration personnel and no costly thread-wire libraries, while maintaining NIST traceability with all plug gauges.

By way of example, this case study highlights our use of this system in one of the trickier metrology challenges: threaded plug gauges. A thread is a functional feature that relies on three discrete dimensions (major, minor, pitch). The time-tested system for verifying an internal thread is using go/no-go thread plug gauges. The irony in modern manufacturing is that we are compressing three distinct metrics into a single validation method, with no numeric feedback. The other primary drawback of a thread plug gauge is its susceptibility to wear. The "action" of mating the gauge to multiple threads naturally creates friction and abrades the gauge, reducing the effective life-cycle and, crucially, the precision of the gauge. The challenge is further exacerbated at DGW where we manufacture many components from aerospace-grade superalloys like Titanium and Inconel that create faster wear on our gauges.

Gauge monitoring processes are typically the answer to these problems though, as mentioned above, and are significant contributors to cost. The traditional method to inspect and quantify the validity of a thread plug gauge involves a time-consuming process termed the "three wire method." In basic terms, this uses three pins connected to a micrometer. The size of each of the pins is determined by the gauge's TPI (threads per inch.) The pins are positioned on the micrometer in a triangular geometry; two on one side, one on the other. These are closed to align parallel to the female thread on the component being measured.

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VALIDATION WORKFLOW AND GAUGING COSTS REDUCED

Verifying an average of ten plug gauges per day (twenty total members) at an optimistic average of four minutes per measurement contributes 1.33 hours of labor cost This calculation also doesn't include the time to set-up the thread wires, verify master micrometer calibration and clean the gauging. This time-consuming process is the very definition of a non-value added activity that works at odds with the lean production goals of an operation like DGW, where we always look for ways to optimize time and efficiency. There is also a significant expense to these physical tools, with thread wire libraries costing over $3500 each, and only applying to 22 different gauge geometries. There's also the hidden cost of one or several highly trained individuals making these measurements that can be subject to human error and repeatability concerns.

By introducing the Keyence IM-7000 to this stage of operation, CSP has seen an immediate improvement in both time and accuracy. We start by writing a program for the Keyence based on the specific dimensions of the threaded member. The Keyence allows us to repeat the plug gauge validation process literally at the click of a button. Over an eight-week trial, DGW performed a comparative analysis between manually validating plug gauges versus using the Keyence IM-7000. The results were self-evident.

CSP eliminate roughly two-thirds of the labor costs and time deployed by highly-skilled operators on gauge calibration and monitoring

Over an eight-week period, CSP spent 43.8% less time validating our plug gauges by using the Keyence IM-7000 versus the traditional "three-wire" method. This number includes the programming time for the Keyence for each specific gauge. Furthermore, as we have streamlined the validation workflow using the Keyence, we have increased this time reduction to 62.8%. This saving translates to eliminating roughly two-thirds of the labor costs and time deployed by highly skilled operators on gauge calibration and monitoring.

The Keyence also eliminates the variation imposed by the operator taking the measurement while providing numeric data on the pitch, major, and minor diameters all at the same time. This system removes variability while exploiting the full potential of our cloud-based SPC database. Gauges can now be tracked throughout their lifecycles, and we can identify when each will produce non-conformance in a predictive model that removes or replaces worn members pre-emptively. The fixed cost of gauging is also reduced. We can now evaluate which parts warrant chrome plated gauges to minimize wear, and where standard steel will suffice.

CONCLUSION: GREATER ACCURACY IN LESS TIME

Determining the conformance of internal threads poses one of the most critical and challenging operations in the precision manufacturing process, and the risks of non-conformance are exceptionally high. Drilling and threading have always been a core competence at CSP. In the past, our ability to master and control this demanding process depended on taking the time to validate our analog gauges. Now, using the Keyence IM-7000, we have reduced costs and time, and we've enhanced the precision of our metrology systems. Our investment in digital technology and cutting-edge equipment consistently drives CSP to be leaders in modern manufacturing. As always, savings in time or cost and increases in performance and quality allow us to provide tangible benefits to our customers!

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