

The Future Looks Bright for the Gear Inspection Industry

Empowering quality through deeper precision

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On the surface, it may not seem like the gear inspection industry has changed much over the last few years. Shops still primarily use either machines that are dedicated solely to measuring gears, or multiuse Coordinate Measuring Machines (CMMs). And regardless of which machine they use, software serves as the backbone that supports their many diverse sensors.

Despite the turbulent economy of the last few years, the gear manufacturing market is expected to grow at a fairly modest CAGR of 5.73 percent through 2026, according to Technavio. As the industry expands, more gear manufacturers are streamlining and automating the inspection process with multisensor CMMs.

But underneath the surface, several exciting and innovative developments are driving the gear inspection industry forward. These bright spots have the potential to transform not only how gear inspection is conducted, but also the tools and processes that companies use as well.

Bright Spot #1: CMMs

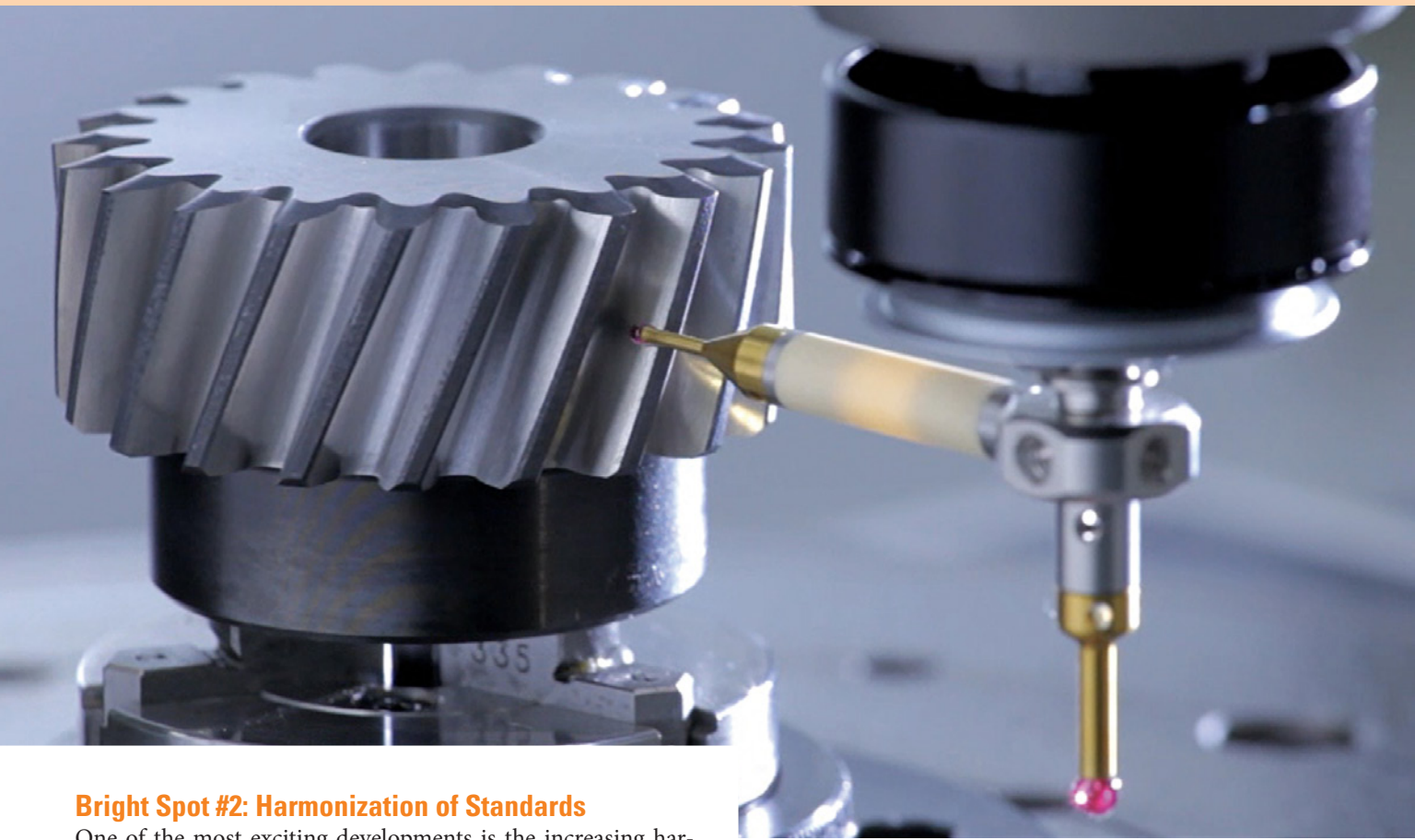
While not new, CMMs continue to be a game changer in the industry. Combining multiple gear inspection and measurement tools into a single platform is a highly attractive feature for businesses, and provides several time- and cost-saving benefits:

- **Improved quality:** CMMs help create higher-quality gears by eliminating operator error. Since the engineering CAD model automatically generates the inspection program, the results are clear and unambiguous, nor are they subject to different interpretations by an operator. Additionally, automated optical tools don't touch the gear, ensuring that high-precision measurements can be taken without damaging the gear's precision surface.
- **Improved costs:** High-end, automated, programmable, and dedicated gear-checking equipment can cost hundreds of thousands of dollars. You also need to account for the additional costs of master gears and the artifacts. All told, that equipment can be two or three times more expensive than a multisensor CMM equipped with a rotary table, high-speed scanning probe head and gear measurement software.

- **Improved productivity:** Perhaps the greatest advantage of multisensor CMMs is that they save a significant amount of time since they measure several characteristics faster and more accurately compared to manual methods. And with shops pressed for time more than ever before, this benefit can't be overstated. Whether used for gear checking or regular SATIC geometry, CMMs can provide a 30 percent to 98 percent time savings. The amount of time saved actually grows as the complexity increases. Multiple functions—such as gear parameter inspection, microscopic gear teeth measurement and high-accuracy 3D scanning—can all be done on the same machine. And by using a surface probe, you can check the surface and finish of gear teeth, the internal bore of a gear, as well as the mounting and shaft.



Special CMM software supports measuring different types of worm gears using a touch trigger probe or scanning probe on a CMM.



New technology in CMM probes allow for touch probes to measure gears with high accuracy and repeatability.

Bright Spot #2: Harmonization of Standards

One of the most exciting developments is the increasing harmonization of gear measurement standards across the globe. In the U.S., gear quality standards are set by the American Gear Manufacturers Association (AGMA). However, other countries utilize their own set of standards. For example, Germany relies on the German Institute of Standardization (DIN), while Japan utilizes the Japanese Industrial Standards (JIS), and several other countries have their own standards as well.

Many of these standards are similar, but not quite the same, which can be confusing and frustrating for companies that manufacture or sell gears in multiple countries. If a gear manufacturer is based in the U.S., but also has a facility in Europe, which set of standards should they use? This presents a similar challenge when using gear measuring software. Most software platforms have the major standards built in as selectable options, but knowing which one to use can be challenging.

To solve these challenges, the International Organization for Standardization (ISO) has been pushing for harmonization across the industry, and in recent years has made significant headway. Coordinating among the various standardization bodies—and getting them to agree on common standards—is a complex process. And when you factor in that gear measurement standards can encompass a multitude of different items, it's easy to see why this could take so many years to complete.

While it may still be several years before we're closer to full harmonization, this is an exciting development, both for manufacturers and companies that design measuring equipment and software. For manufacturers, recertifying a single gear or part under multiple standards can be a time-consuming and expensive process—harmonization can minimize effort and cost. For businesses that make measuring equipment or software, this would streamline the process of keeping up with new or updated standards.

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Noncontact laser probes have some advantages to measuring gears and parts of gears, including having great accuracy even though the measurements might take a little longer.

Bright Spot #3: Exciting Equipment Innovation

Several innovations on the equipment side also offer exciting glimpses into the future of the gear measurement industry:

- **Integrating Artificial Intelligence (AI):** It seems like every day there's a new headline about AI transforming some aspect of our lives. Gear measuring is no different. Integrating AI into CAD software has the potential to drastically speed up development time and improve accuracy. This could also free up engineers to focus on more valuable work, which can be especially helpful if the labor shortage continues.
- **Laser sensing in CMMs:** Right now, CMMs and other measuring equipment almost exclusively utilize mechanical sensing. Lasers are useful in some applications, but there are several barriers that make widespread use impractical at the moment. Although they are more accurate, lasers take longer to measure, and they need to be extremely close to the part being measured for the high-accuracy requirements of some gears. In some cases, the size, shape, or dimensions may make it impossible to use lasers. However, advancements in laser technology could make them feasible in a wider range of applications.
- **Imaging cameras:** Using high-resolution cameras can make the gear-measuring process much easier and potentially shrink the equipment's footprint as well. Currently, cameras that can provide adequate detail are often too expensive to be practical, and processing high-resolution images is time-consuming. But as camera technology gets less expensive and computer processing becomes faster, they could prove to be an exciting innovation in the gear measuring industry.

Choosing the Right CMM Is Still Key

Standards harmonization and other technological advancements all offer intriguing new possibilities and point to a bright future. But it's still critical to make sure you have the right inspection equipment and software, which will largely depend on the size, weight, and quality specifications of the gears you produce. Will your gears be under heavy load or subject to intense stresses? Is noise an issue? What kind of materials are they made of?

Answering these questions will help ensure that you have the measuring equipment and software that's best suited for your needs. And having the right tools in place will help ensure that you can respond to the ever-evolving industry.

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