KMM GROUP LTD.

Case Study

Valuable Expertise + Overcoming Aerospace Challenges = Solving For Why

> **"60 component manufacturing companies had previously considered the project, each one either refusing to take on such a complex job or trying and failing to produce the parts according to [our] uncompromising specifications."**
>
> *– high-end motor manufacturing customer*

BACKGROUND

One of our high-end motor manufacturing customers is headquartered in Switzerland, with U.S.- based divisions on the east and west coasts. Its global research and development capabilities draw leading companies like a large defense contractor with a concentration on weapons and military and commercial electronics. Having met the motor manufacturer's representatives at a trade show, we learned that they were already involved with the defense contractor on the development of a classified defense program. The tightly controlled tolerances on the motor's pen-sized components prevented the motor manufacturer from producing them in-house.

The high-end motor manufacturer explained that 60 component manufacturing companies had previously considered the project, each one either refusing to take on such a complex job or trying and failing to produce the parts according to the large defense contractor's uncompromising specifications.

As we learned more, we discovered that the project would require a multi-discipline effort combining ultra-precision machining with grinding, and the motor manufacturer was hunting for a partner that could produce the parts complete. Our AS9100D certification and ITAR registration positioned us as a viable mission-critical component manufacturer, and our rare degree of expertise in both disciplines gave us an edge. So, the motor manufacturer gave us the green light to attempt the near-impossible with an initial order of 100 parts.

CHALLENGE

We embraced the challenge that we were presented and started by attempting to simplify our approach to enhance the chance of success. Extensive testing was performed in machining and grinding. The testing on one of our Kellenberger grinders proved that we would have to incorporate additional equipment, and operations, to achieve the desired results. From experience, we knew that incorporating multiple processes into the same project increases the failure risk because it requires us to give up the control advantages of using a single machine.

We were also challenged to meet the exceptionally tight tolerances in the finishing portion of the grinding operations. The titanium part featured multiple-sized diameters that had to be concentric for a highly smooth surface, with some roundness tolerances as low as 40 millionths of an inch. The diameter size and concentricity were so tightly controlled that they weeded out many rivals unable to meet such stringent requirements.

With the challenges mounting up and no possibility of redlining the print, the New England-based motor manufacturer's buyer began to wonder whether manufacturing the defense contractor's motor part was feasible, a sentiment shared by the company's Swiss division. But we remained optimistic that we could manufacture the part as drawn. So, we assembled our team of engineers, technical developers, craftspeople, and quality controllers across our machining and grinding departments and began working on a solution.

SOLUTION

With the project already behind schedule by the time we took it over, we had no time to lose. So, for three fast-paced weeks, we poured over the print, performed a risk assessment, and evaluated our processes, determining that we'd apply both Swiss Screw Machining, OD/ ID, and centerless grinding disciplines. Then, when it was time to advance the project to our production floor, we dedicated highly advanced equipment and craftspeople to produce the parts, continually testing and adjusting our process based on the results.

We developed several proprietary techniques to resolve the challenges associated with the inconsistencies and unknowns of blending machining and multiple advanced grinding operations to achieve a result that no rival had yet approached. We also devised intelligent solutions for handling the unstable parts while in motion, relying on decades of advanced expertise with ultra-precision component manufacturing equipment and high-end specialty abrasives designed for sensitive materials like titanium.

Meeting the extraordinarily tight tolerances hinged on using state-of-the-art grinding equipment capable of achieving sub-micron tolerances. We also explored several grinding options for achieving the correct diameter, concentricity, and surface finishes, deploying various wheel configurations, abrasives, and approaches to get it right. While we had to reroute our strategy a few times, our perseverance and commitment to the mission allowed us to remain nimble enough to pivot, altering the procedure when necessary to get a good yield. Using our specialized grinding techniques, we achieved the required roundness and size tolerances without disrupting the concentricity.

In the finishing stage, we realized that we had to take each part to a certain level using one process, then complete the operation using a different one. So, every component started on the Kellenberger before moving on to another machine, requiring us to meticulously align and re-align each part. To reduce the margin of error, we also devised strategies for working with partly finished components while still hitting the required tolerances.

Critical Dimensions

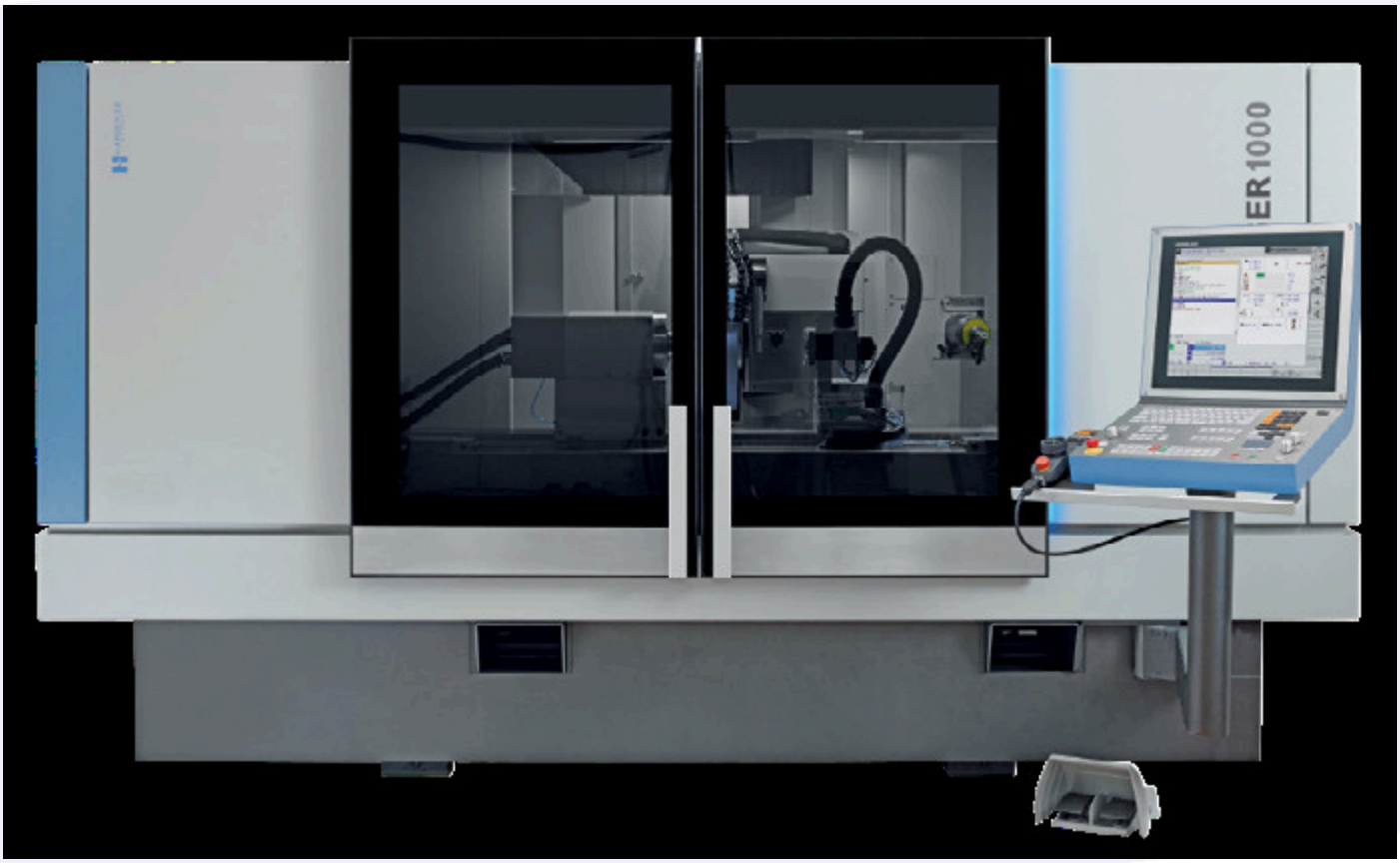
Material: Titanium

Roundness: 40 millionths of an inch (1 micron)

Diameter: Multiple diameter sizes, down to .1840”

Tolerance: +/- .0002”

Surface finish: 4 Ra (.1um)



RESULTS

Accounting for 10-20% attrition on a project this complex, we set out to yield at least 90-100 good parts. However, we performed much better than anticipated, manufacturing 107 of 108 components according to the print, less than 1% attrition. While we were sure the components were accurate, we provided the motor manufacturer with inspection reports generated from our advanced equipment capable of reading parts down to nearly a billionth of an inch.

The New England-based motor manufacturing division verified the accuracy, but the Swiss division wasn't convinced until they could inspect our parts for themselves. Upon completing a thorough double-checking procedure, the Swiss division confirmed that 107 pieces had indeed passed inspection, meeting their high-precision standards.

"It was a very validating moment for us," said John Shegda, CEO, KMM Group. "There was an awful lot of development in this project, with some stopping and starting along the way. But in the end, we helped the motor manufacturer achieve a seemingly impossible victory, a source of pride for our veteran team."

Since completing the initial order, the high-end motor manufacturer placed a reorder on behalf of the large defense contractor, giving us another opportunity to hone our techniques. With every pass, we're one step closer to a stable process that we can duplicate with efficiency and accuracy.

"While there are some really capable component manufacturing companies out there, it's rare to find high-level competency in machining and grinding under one roof," Shegda added. "Some grinding shops specialize in either OD/ID or centerless, but we do both. This multi-disciplined expertise allowed us to be the ones to succeed in manufacturing these ultra-high precision parts."

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