KMM GROUP LTD.

Case Study

Producing H2O In Space:

How KMM Groups Cutting-Edge Grinding Unlocks In-Space water

BACKGROUND

The Southwest Research Institute's (SwRI) Space Research and Technology Division develops innovative technologies and provides technical support to clients in space exploration, satellite operations, and other space-related activities. They conduct research in astrophysics, planetary science, and astrobiology while working on projects such as new propulsion systems and instruments for space missions. The division serves government agencies like NASA, commercial space companies, and other organizations to advance space exploration and improve our understanding of the universe.

SwRI approached our ultra-precision centerless grinding division for help with an innovative concept aimed at reducing the burden of transporting large quantities of water to the International Space Station (ISS), which would help cut down on payload and mission expenses. The concept involved modifying the raceways of an existing compressor bearing to make it more robust and accurate, allowing it to withstand the forces required to produce water from hydrogen and oxygen gas.

According to SwRI engineers, this would then enable astronauts to combine the gasses and produce water in orbit, significantly reducing the amount of water that needs to be transported from Earth. In addition, the success of this innovation could ease the pressure on future missions, making them more cost-effective and sustainable.

Though it was difficult for SwRI to find a suitable partner for the incredibly advanced precision grinding required for this project, we were confident in our ability to deliver results.

CHALLANGES

As we embarked on this groundbreaking project, it quickly became apparent that conventional methods would not suffice. The space environment poses distinctive challenges, from the meticulous fine-tuning of the bearing design to grappling with highly specific shapes and unmatched smoothness demands. Furthermore, the requirement for extremely tight tolerances added another layer of complexity.

Meticulous Fine-Tuning

Bearing manufacturing is an incredible science. While SwRI engineers excellently predicted in-space forces, it took several rounds of meticulous design fine-tuning to achieve the ideal result. Every new version was more precise and refined than the others, demonstrating the remarkable skill and expertise required for high-level bearing manufacturing.

Difficult Shape & Uneven Smoothness

The original raceways of the bearings had an uneven smoothness and a complex gothic arch shape, making it a high-level task to grind a new raceway. Therefore, we needed to create a strategy to modify the raceways with exceptional precision and accuracy to accommodate these shape and smoothness requirements.

Extremely Tight Tolerances

The compressor required high-ABEC-rated bearings with micron-level tolerances for concentricity and roundness due to the tight play allowed by the enormous pressure in creating water from oxygen and hydrogen. Achieving these highly tight tolerances was a significant challenge, requiring careful attention to detail.

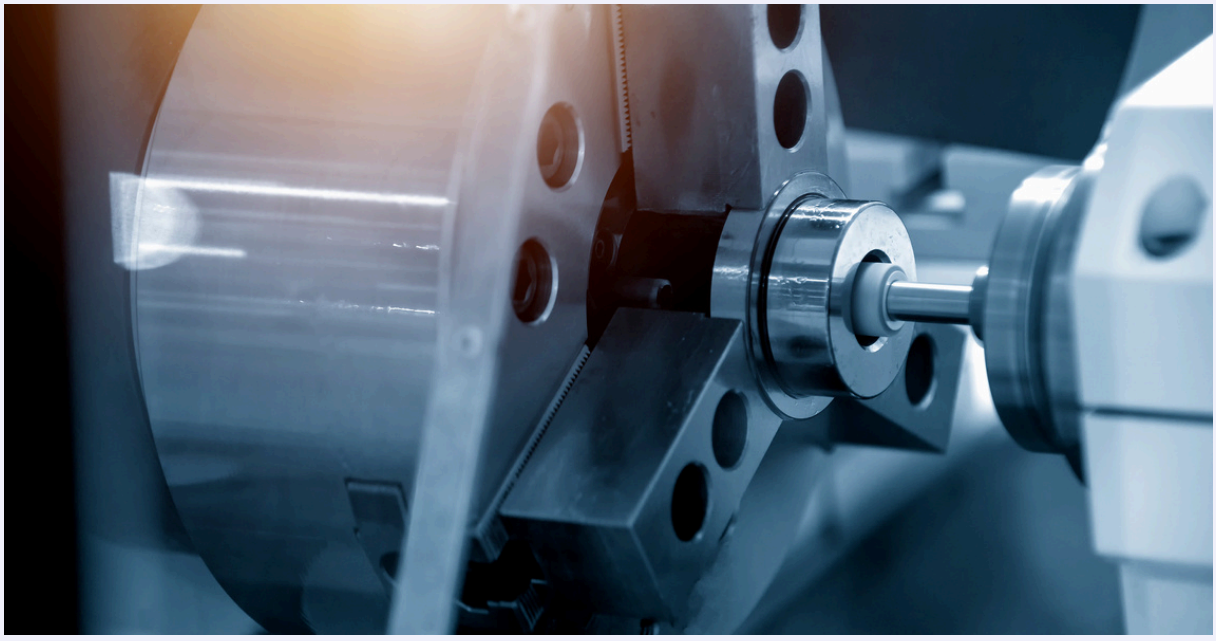
SOLUTIONS

We overcame these compressor modification challenges with a thoughtful and innovative precision grinding strategy.

Grinding to Success: Water Innovation on the ISS

Our team meticulously fine-tuned the bearing using SwRI's design modifications, tweaking the radius and shape of the groove to provide more rigidity. Then, working closely with SwRI's engineers, we ensured that every new version of the compressor bearing was robust enough to withstand the enormous pressure required to compress hydrogen and oxygen and produce water in space.

To achieve the necessary precision, we relied on the latest multi-axis CNC OD/ID grinding techniques and cutting-edge equipment, including the Kellenberger® 1000. Thanks to the skill and expertise of our team, we successfully delivered a result that could withstand the high-pressure requirements of space.



Once the parts were completed, the compressor and its modified bearing were transported to the ISS. They were crucial in helping to close the water loop and ensuring more efficient and successful missions. John Shegda, CEO at KMM, expressed his pride in contributing to the progress of space exploration, saying, "By providing a solution to a problem like this, even to a small degree, we're helping to advance the space mission."

OUR INNOVATION

We're not your traditional machining and grinding shop. We embrace the future of manufacturing today by continually pivoting in response to an ever-changing climate. From investing in the most advanced technologies to retaining the brightest forward-thinking professionals, we have the skills, infrastructure, and drive to develop bold and groundbreaking solutions for seemingly impossible challenges.

Our dedication to excellence includes a supportive client experience centered on transparency and responsiveness with direct and frequent access to our team. We listen, understand, and thoughtfully communicate – it's the KMM way.

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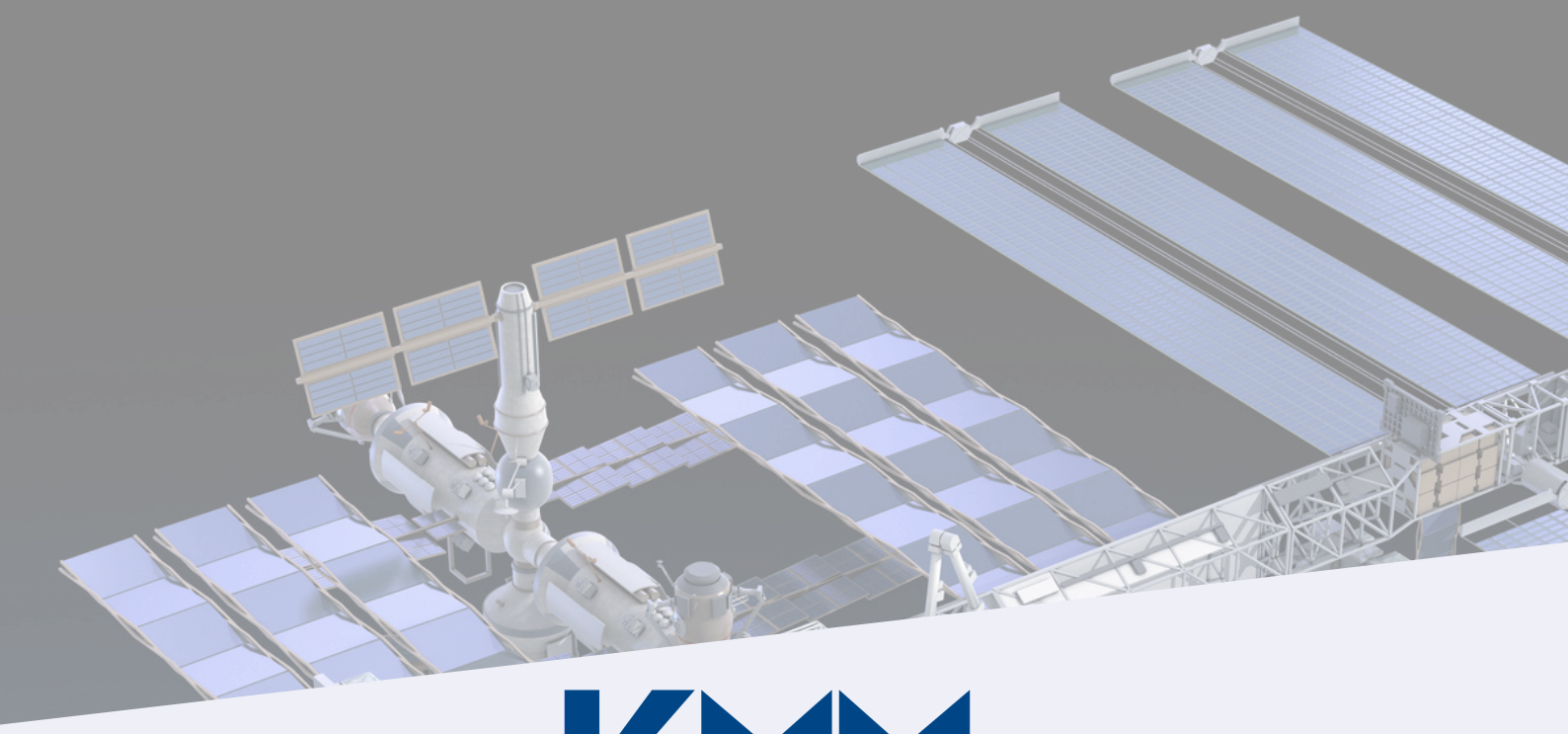

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