ELECTRON BEAM ENGINEERIN
A Precision Electron Beam & Laser Weldin

Tribogenics Customer Story

The Customer

Tribogenics is headquartered in Los Angeles, California, and is a leading innovator of x-ray technology for the industrial security and scientific industries. Its new Watson XRF handheld spectrometer removes the risk of error in performing non-destructive, positive material identification (PMI) analysis and testing of metals and alloys for scrap metal recycling, metal fabrication, machining, and manufacturing. Leveraging its proprietary x-ray technology, Tribogenics eliminates the need for costly, high voltage transformers by using a process similar to static electricity (known as the triboelectric effect) to generate x-rays. Since users need different characteristic x-ray emissions for different applications, the Watson features user-exchangeable x-ray sources, which swap in and out like a power tool battery.

With this technology, you can simply point the Watson at any piece of metal and immediately determine its composition. While the technology's current capabilities include applications in manufacturing and recycling, the Watson will soon be able to measure and identify a wide variety of elements at oil and gas sites and be used in precious metal identification. The Watson designers also envision lead detection, precious jewel identification, security, and portable medical imaging among its future applications.

The Goals and Challenges

Based on the precision requirements in the manufacturing of some of the Watson's key components, Tribogenics Chief Executive Office, Dale Fox, made the decision to outsource the welding and testing of those parts to Electron Beam Engineering (EBE). "We need accurate welds of delicate assemblies, and it is imperative that there is no leakage," said Fox. "We chose EBE because it is an established precision electron beam and laser beam welding facility specializing in working with complex components, and they have a reputation in the industry for quality work."

The initial welding assignment consisted of welding a fitting, approximately 0.740 inches in diameter, to the center of an end cap, as well as welding five small feedthroughs, approximately 0.190 inches in diameter, into their respective holes. Once the welding was completed, EBE's quality control department was to perform a helium leak vacuum test to assure the integrity of the welded components.

Once the initial prototypes were welded, EBE performed some tests and determined that the feedthrough tubes were leaking. The customer supplied feedthroughs were ceramic with pins brazed in place, and were not tested by either Tribogenics or EBE prior to welding. The other problem found with the feedthroughs is that the brazing left flux on the parts, which caused contamination in EBE's welds. EBE also discovered that the thickness of the flanges was inconsistent causing difficulties welding the feedthroughs. This required each feedthrough weld to be customized for the variance, which was extremely time consuming and didn't have a high success rate. Laser welding of the feedthroughs was used initially, but the pins in the feedthroughs were getting too hot. EBE also found that the machined holes in the supplied endcaps lacked proper preparation causing additional welding problems.

"EBE was able to pinpoint the exact location of each leak and all were a result of the leaking feedthroughs (between the ceramic and the pin), so we could conclusively determine that the leaks were not a result of the welds," added Fox.

The Recommendations and Solution

EBE recommended that Tribogenics go back to their supplier and ask that they improve the manufacturing of the feedthroughs to improve the yield, and have them leak test each one prior to shipping. They also requested that they improve the tolerances on the machined holes to improve the fit-up of the feedthrough, and asked that they machine a step for the feedthrough to sit in and to do a better job at removing the burrs. The supplier was also asked to improve the flange thickness consistency, as the thicknesses tended to be wavy and uneven.

To improve leak testing, EBE suggested to add an O ring to be used in the groove of the base plate. EBE also designed and manufactured a leak test tool in order to quickly, accurately, and easily test for leakage. Although the supplier followed the recommendations from EBE to supply more consistent feedthroughs, EBE performs another inspection themselves and they will not weld any parts that look suspect. An electron beam welding process was developed for the feedthrough welds to reduce heat input, and because the beam can be angled differently than the laser, the heat can be kept away from the pins.

“We had to teach Tribogenics how to correctly machine the holes to accept the feedthroughs,” said Grant Trillwood, general manager at EBE. “With small, thin parts, the fit-up of the two pieces is very important. We advised them to inspect everything under magnification as the holes and counterbores are very small.”

“We also suggested that Tribogenics make some custom, padded cases for part transportation,” added Trillwood. “The ‘as welded’ parts are very delicate and before the cases were introduced, parts were being damaged in transit.”

Even with these changes, there were still cases of leaking feedthroughs resulting in unusable endcaps. Since the cost of these are significant, EBE began a rework plan and recommended to Tribogenics that the leaking feedthroughs be removed by a machining process so new feedthroughs could be rewelded to reduce scrap.

The Result

“The current success rate is about 95%,” said Trillwood, “and with the rework plan in place, we can approach almost 100%!”

“We outsourced the welding to EBE because we thought we would get excellent welds,” said Fox. “Ultimately, however, we got a strategic partner who analyzed and improved our process, allowing us to produce a higher yield, resulting in a lower overall cost to manufacture our product.”