CASE STUDY

After evaluating several potential providers, the igus team chose Cincinnati Sub-Zero Testing Services and its testing procedures, which subject items to simulated environmental, corrosion, climatic, shock and vibration situations. Source: CSZ Testing

CUSTOMIZED TESTS HELP SUPPLIER VALIDATE MILITARY HARDWARE

The process required custom robotics and fixturing in an extremely compressed timeframe.

Serving as the umbilical cord of modern machines, cable carriers guide and protect moving cables and hoses on automated machinery as the equipment cycles through repetitive linear or rotary motions. By organizing and shielding the electrical and hydraulic components stored within, the carriers minimize downtime while protecting, supporting, and extending the service life of cables and hoses.

As one of the leading global suppliers of cable carriers, continuous-flex cable and plastic bearings, igus® (Rhode Island) was called upon by an original equipment manufacturer (OEM) of military hardware that was working to modify and upgrade an existing piece of equipment. The new design called for igus to supply a rotary version of its Energy Chain® cable carriers.

"The rotary model was a new type of technology for the OEM, one that they had to sell their customer on," recalls Greg Bruno, Technical Sales Representative for igus. "Because the equipment in question is being designed to ensure the safety and protect the lives of military personnel, both the OEM and the end user wanted to be certain that the cable carrier would perform reliably in a variety of extreme conditions."

When the rotary cable carrier was initially proposed in 2008, igus' engineers ran the component through a variety of repetitive motion tests at their testing facility in Germany. Those tests, however, were conducted in small scale. At the behest of the end user, the OEM returned to igus with a new list of environmental and durability specifications for further verification of the component part's reliability—in full scale.

TESTING REQUIRES OUTSIDE EXPERTISE

The new list of environmental and durability test requirements compelled the igus team to seek outside assistance, says Bruno.

First, the size of the cable carrier itself—while average for the industry from igus' perspective—required a large area in which the flexible rotary action could be safely repeated for several thousand cycles. The system's design enables the rotation of either the inner or outer radius, concentrically aligned and connected by the igus Energy Chain. The Energy Chain essentially loops back upon itself within a trough between the inner and outer diameters, securing and protecting the cables within, while accommodating the 360-degree movement of the equipment they power.

Further, how to drive the repetitive movement posed a challenge. In igus' previous, small-scale testing, engineers had used a relatively small-scale robot. But the new specifications also called for sub-zero to super-heated environmental simulation testing, and igus didn't have a robot that could withstand such temperature extremes, says Bruno.

"Our testers actually didn't think it would even be possible to procure a robot that could operate under those conditions, and in fact had considered a completely different option. The alternative was to use drives and propulsion instead of a robot, but that method would have been much more mechanical in nature and therefore much more unpredictable," he recalls.

Finally, the new testing requirements included the MIL-STD-810 overwriting specification, a common standard for performing environmental testing on components and equipment destined for use in military applications. Although they were confident in their product's ability to perform, the testing engineers at igus were not as familiar with the MIL-STD-810 standard as they would have liked to be in order to produce the most reliable test results, adds Bruno.

"Our testing engineers didn't feel that they had the capability to do the environmental testing in alignment with those specific MIL-STD-810 standards," he said. Determined to find a way to meet his customer's testing needs, Bruno turned to the Internet.

GOOGLE TO THE RESCUE

"We didn't want to lose the opportunity to supply the component, nor did we

want our OEM customer to lose their opportunity with the end user. So we turned to Google and searched online for a certified independent testing provider who could help us meet the objectives for the testing," says Bruno.

After conducting a keyword search, igus found several independent testing facilities around the country and put out a Request for Quotes (RFQ) at the end of 2010. After evaluating several potential providers, the igus® team chose Cincinnati Sub-Zero (CSZ) Testing Services (a division of Cincinnati Sub-Zero Products, Inc., Cincinnati, OH), after several exchanges with CSZ Testing's General Manager, Scott Thomas, throughout January 2011.

"Not only was Scott attentive and quick to respond, he was also straightforward and timely in getting back to us. Scott also asked a lot of questions that clearly were driven from CSZ's high level of testing experience," Bruno notes. "The CSZ team was much more thorough in the quoting process than anyone else, so we felt very comfortable that the specs were being read and understood."

With laboratory facilities in Cincinnati and Detroit, CSZ Testing Services offers testing services that simulate various conditions faced by products and components, coupled with a comprehensive evaluation of the findings. The company serves manufacturers from 22 different industries including aerospace, military, automotive, electronics, medical and plastics with tests available for virtually any product at any point in the design cycle.

CSZ's testing procedures subject items to simulated environmental, corrosion, climatic, shock and vibration situations. Findings are used to improve design and/or production processes, to reduce after-sales service and/or to ensure product quality and reliability, says Thomas.

CUSTOM FIXTURES ENGINEERED TO ACCOMMODATE TESTS

In addition to adhering to the testing standards established by the applicable governing bodies in each of those industries, CSZ Testing Services is also frequently called upon to create custom setups to achieve the unique performance validation goals of their customers.

The company's testing technologies include more than 35 environmental chambers, HALT and HASS chamber, six vibration tables, and two corrosion chambers. For temperature and humidity tests, CSZ's advanced testing chambers accommodate an extreme range from -184 degrees Celsius (-300 degrees Fahrenheit) to 190 degrees Celsius (374 degrees Fahrenheit). CSZ has done testing to elevated temperature up to 538 degrees Celsius (1,000 degrees Fahrenheit). Altitude testing simulates conditions up to 100,000 feet above sea level (40,000 feet when combined with temperature testing conditions), while thermal shock testing accommodates very rapid transfer (less than 10 seconds in most cases) of products weighing up to 600 pounds between extreme temperatures.

"We perform a significant amount of environmental testing that follows the standards established in the MIL-STD-810 specification," notes Thomas. "But in a larger sense, many of the testing procedures, processes, and fixturing called for by igus' customer required a completely custom approach, and that's a capability we pride ourselves on offering."

Thomas worked from the instructions provided by the OEM and end user regarding their objectives for the test procedures to engineer a custom testing set-up.

As a result of Thomas' many questions, the initial testing specifications were slightly altered for both safety and feasibility. For example: the original environmental test requirement included chilling the component to a significant sub-zero temperature, holding it at that temperature for a predetermined amount of time, and then rapidly warming it with a blast of heat.

"The original spec proposed used a mix of volatile fuels to create this intense, instantaneous temperature shift," says Bruno. "Scott proposed a less dangerous alternative to achieve the same end by using electricity, which the OEM and end user ultimately accepted as an appropriate course of action."

Thomas leveraged his contacts in the robotics industry to source two identical, reconditioned robots that could be procured in an extremely short period of time, as testing was slated to start within eight weeks of igus issuing a purchase order to CSZ. Thomas deliberately chose robots with capacities and capabilities that far exceeded the testing requirements—as well as researched to find a way to further extend their operating ability—to ensure that they would function in the extreme temperature ranges.

igus was called upon by an original equipment manufacturer of military hardware to supply a rotary version of its Energy Chain cable carriers. Source: CSZ Testing

"There are companies that create specialized protection 'suits' for a robot to 'wear' to shield them from extreme temperature exposure in their surroundings by environmentally controlling the temperature inside the suit,"says Thomas. "Unfortunately, all of them required a minimum 20-week lead time to build a custom suit, so I decided we'd just build our own. We were very

aggressive about minimizing the time delays involved in setting up for the testing as much as possible, because this was a very sensitive concern for igus® and their customers." In addition to installing and programming the robots in mid-May, CSZ Testing Services also had to expand one walk-in test chamber to accommodate running the environmental test, while the durability test ran simultaneously in ambient surroundings. Because its robot didn't require the special protective suiting, the durability test started June 15 and concluded nine weeks later, on August 15. The environmental testing process was started as soon as its robot's protective suiting was complete, on July 1, and wrapped up October 5, about 14 weeks later. In addition to evaluating the cable carrier's performance in stepped extreme high and low temperatures, the environmental testing took longer because it also examined the component's functionality when exposed to varying proportions of humidity.

COMMUNICATION KEY TO SUCCESSFUL TESTING PROCESS

From the moment the purchase order was issued, Bruno and Thomas—as well as representatives from the OEM and the end user—participated in scheduled conference calls every morning on Mondays, Wednesdays, and alternate Fridays. The calls were organized by the OEM's design engineering team, who wanted to be kept in the loop throughout the entire set-up process, as well as during the testing and into the final data analysis phase. The ultimate report, including test parameters, photos, and actual data gathered, was accrued and finalized by the CSZ team in December 2011.

Although the findings are confidential, Bruno says the next steps involve a re-evaluation of some of the cables (which igus did not supply) used within the cable carrier, which performed as expected.

"This project has been years in process, so clearly nothing is happening overnight," Bruno notes. "But I'm grateful in the sense that when it's all said and done, if the customer ultimately uses our component in their design, we'll know that they got the right product."

Once a decision is made by the OEM, igus plans to work with CSZ Testing Services again should additional testing be required, adds Bruno. "At every step, every time we faced a wall, Scott and his team worked to remove it—or to propose an alternative—so at each step we were in good hands. I'm grateful to have worked with Scott and CSZ Testing for a number of reasons, but the primary one, of course, is user safety," he concludes.

About CSZ Testing Services
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