The Outpost

Published for the employees and families of Yuma Proving Ground, Yuma Test Center, U. S. Army Garrison - Yuma, Cold Regions Test Center, and Tropic Regions Test Center

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Yuma Proving Ground pioneers laser-based mapping technology

New technology benefits YPG, customer and the Soldier in research and development

Laser-based bore mapping technology developed at Yuma Proving Ground is keeping gun tube testing and evaluation on the cutting edge of measurement and inspection technology.

After determining, in late 2000, that something new was needed to improve inspections inside large and small gun tubes, David Le, mechanical engineer in Ground Combat System's Metrology and Simulation Division, contacted a Bellevue, Wash., company that specializes in advanced laser inspection technology. Working with Le, and based on YPG's requirements, Laser Techniques Co. built the Army's first-ever laser-based bore mapping system for .50 caliber gun tubes. Le said it benefits YPG, the customer and the Soldier by quickly finding design issues during the early stages of research and development.

Today, that system is in use providing high quality data feedback to customers at the proving ground conducting research and development of munitions and weapons systems like the .50 caliber M2 machine gun, the 81 mm and 60 mm mortars and 155 mm towed and self-propelled cannon. The laser-based inspection system (LBIS) conducts high resolution, 360 degree inspections of gun tubes at a high rate of speed, Le said. It can map the interior of an entire M2 .50 caliber gun barrel in less than seven minutes, and is capable of accurately mapping the nearly 30-foot-long 155 mm gun tube in only 17 minutes. Using the old system took two hours and provided only primitive data, Le pointed out.

UP CLOSE AND PERSONAL – The laser-based bore mapping system scope prepares to enter a developmental 81 mm tube. The scope will send back three dimensional electronic data. (Photos by Public Affairs Staff)

The laser-based scanning system provides customers with standard or high resolution images that can be analyzed for erosion, wear or pitting. Customers get a true picture of a bore's condition for the very first time

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through the scope's three dimensional data capturing capabilities, Le said.

The system not only shows the wear on a tube, it also gives the length, width and depth of any anomalies. The accurate and quantitative three-dimensional scan results can also be used to create modeling and simulation packages, and its unique LaserVideo™ images provide a visual indication of the gun tube's surface.

Gun tube inspection technology has steadily evolved over the past 25 years and YPG has become a pioneer in this field. High-tech testing and evaluation tools are being developed within the industry to meet the demands and challenges of finding the capabilities and limitations of modern weapons systems, which are now usually a complex system-of-systems.

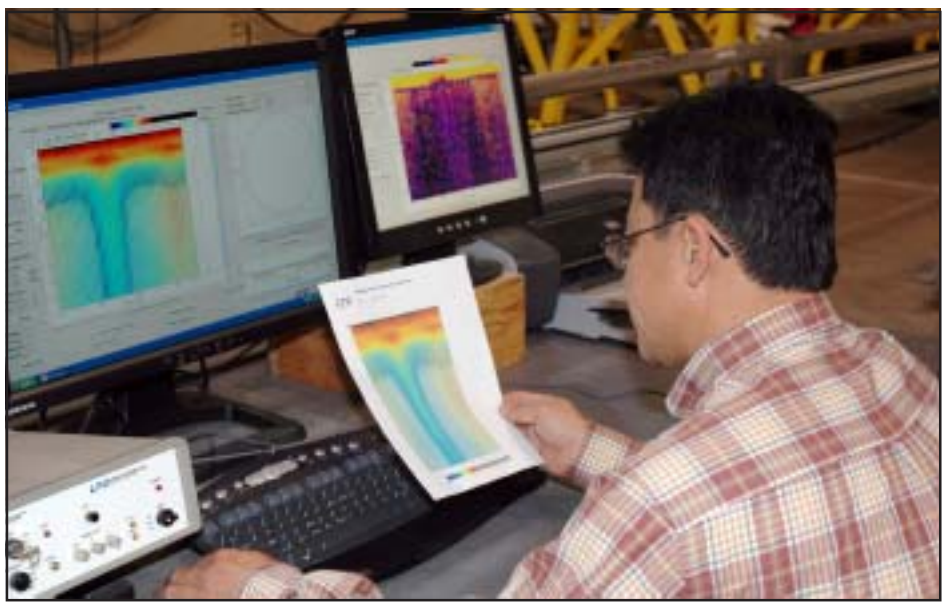
In the pre-Desert Storm 1980's, gun tubes were inspected by hand using a mechanical "star" gauge that had to ride in the barrel's grooves, Le said. It only measures diameters and takes two people three hours to manually measure a large tube. That inspection only returns data from two set points on the tube, zero and 90 degrees. It was also possible that copper build up could slow the inspection and the gauge could actually get stuck inside the barrel.

In the early 1990's, electronic star gauges were developed. They were similar to earlier gauges, but testers and evaluators could access the data via computer to enhance speed and accuracy, Le explained. This inspection took one person between one and two hours to complete, but still only yielded data at the zero and 90 degree points.

In the mid-1990's came the video bore scope that allowed 360 degree video data. This was a high technology revolution of video inspection, Le said. The video was 480 lines of resolution and provided video documentation for the customer. The most recent video bore scope, developed about 1999, provides 700 lines of resolution and has a laser positioning system to quickly locate specific spots. In developing these scopes, off-the-shelf technology was modified to fit YPG's test and evaluation application requirements, Le said. The drawback of this technology, however, was that the images could be distorted and data analysis was still labor intensive and time consuming. In addition, video bore scope inspection is subject to operator interpretation.

In early 2000, Le started working and coordinating with Laser Techniques to develop the laser-based bore mapping system because he saw the need for a new instrument that could perform automated, quantitative, non-contact measurements in a short period of time.

The laser spot size is approximately 2/1000th of an inch in diameter when it is projected onto the barrel surface and the sensor is capable of acquiring over 7,000 data points per revolution inside the barrel, Le said; adding that this level of resolution is a long way from the two zero and 90 degree data points that were attainable just a few years ago.



PERFECTIONIST AT HEART – David Le, mechanical engineer in the Weapons and Munitions Division, inspects a sample computer readout of the three dimensional data captured by the laser-based bore mapping system.

Precision calibration rings are used before every setup to insure uniform accuracy. In a smooth-bore 42-inch mortar tube, the sensor scans at 270 degrees per second and moves about an inch down the tube during that tick. It can be set up to scan at different rates and intervals. If it is set up to scan every 50- thousandth of an inch for 42 inches, Le determines the scope will rotate 840 times in 12.9 minutes.

Live data is transmitted to a computer that uses specialized software to assist in analysis and can be captured for later study and manipulation. That software allows users to accurately locate and measure damage or wear within 1/1000th of an inch.

All of this technology has helped put Yuma Proving Ground in the forefront the testing and evaluation of endurance and performance of conventional and experimental munitions.

For now, all work is done in the lab with detached gun barrels. Le said the next generation will consist of portable field inspection systems that can scan a barrel without disassembly. Mostly, the field systems would be providing preliminary results, but the data could be transmitted through a network back to the lab for in-depth analysis.

These systems are already in the preliminary design stage. If funded, Le expects the systems will be built and tested at YPG.

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