Drive & Control
profile

Servo-controlled nondestructive testing scanner offers faster scanning, more versatility

The gantry style AG2 Overhead Scanner is capable of scanning large, sophisticated parts and intricate shapes, without the use of immersion tanks.

Large, complex parts inspire completely automated inspection system

Critical components in the aerospace and defense industries, such as engine housings, wings and control surfaces, undergo rigorous testing to ensure quality and safety, but require methods that won't damage or permanently alter the product during inspection. Historically, x-ray methods were used in non-destructive testing (NDT) to check the strength of welds and look for evidence of defects and faults in both large and small parts. However, the use of complex shaped carbon fiber and other advanced composite materials require different testing methods other than x-ray. Machine design companies like Marietta Nondestructive Testing, LLC (MNDT; Marietta, GA, (www.marietta-ndt.com)—in

Challenge:

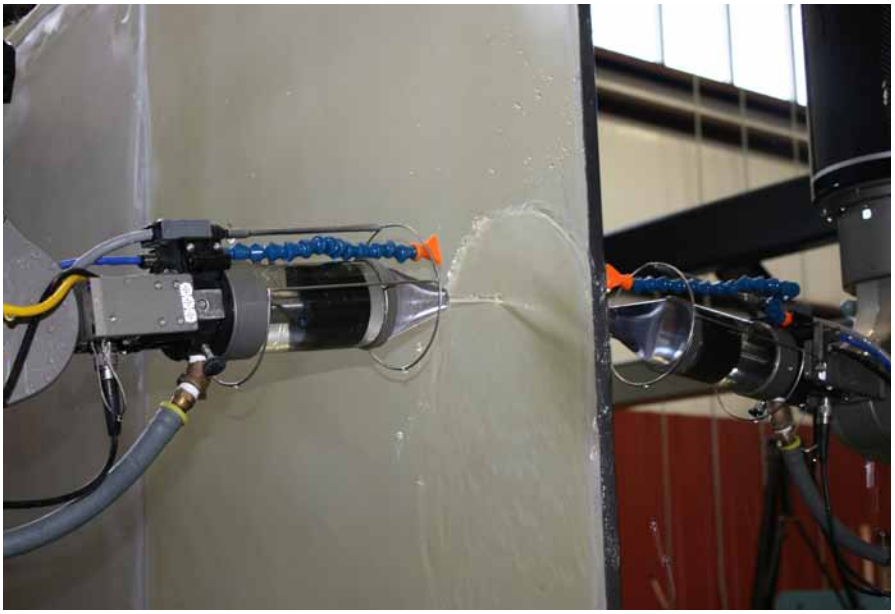
- Design an NDT scanning system to accommodate larger, complex aerospace parts
- Reduce high costs of ownership
- Automate the system to increase speed and produce consistent results
- Improve accuracy and minimize electrical interference
- Reduce maintenance requirements

Rexroth Solution

- IndraDrive C digital servo drives and L65 servo controller with SERCOS III Ethernet communications
- IndraDrive MSK series servo motors
- Chrome-plated Ball Rails®
- TC08 and HF03 pneumatic directional control valves
- IndraWorks software

Results

- Larger scanning envelope handles more variety of parts
- Reduced electrical interference
- Increased accuracy
- Control system integrates with LabVIEW for ease of use
- Faster scanning
- Ease of maintenance



The scanner's ultrasonic scanning system utilizes two sets of squirter jets that face each other. During inspection, the jets stream water—the medium that the sound wave travels through—around the part.

partnership with drive and control experts from Bosch Rexroth (Charlotte, NC, www.boschrexroth-us.com) and its automation distributor, Livingston & Haven (Charlotte, NC, www.lhtech.com) —needed to get creative in their approach to developing testing equipment.

Large parts present big problems

Large parts made of carbon fiber are difficult to inspect with x-ray technology, which had been used for other aerospace components. "X-ray is limited in determining the defect size and depth in composite parts; however, it can be accurately inspected using ultrasonic technology," said Curtis Cooper, director of engineering for MNDT.

The most common automated ultrasound testing machines employ immersion tanks filled with water as a medium through which the sound waves travel. As parts requiring this level of inspection became more complex, the immersion tanks became impractical. Instead, technicians used to scan complex parts by hand, a slow and labor-intensive process that resulted in overlapping scans, which could lead to inaccurate or inconsistent test results.

Complex challenges require innovative solutions

MNDT's new ultrasonic inspection equipment is custom-designed for each client, based on the unique specifications of the parts being inspected. To overcome the challenges of scalability, reliability and speed, the engineers at MNDT designed the gantry style AG2 Overhead Scanner—a rigid, multi-axis, automated testing machine capable of scanning large, sophisticated parts and intricate shapes, without the use of immersion tanks. With a scanning envelope of up to 60 x 20 x 16 feet, the machine can easily be configured to test a wide range of parts for each customer, instead of being designed for one specific part. The scanner's ultrasonic scanning system utilizes two sets of squirter jets that face each other. During inspection, the jets stream water—the medium that the sound wave travels through—around the part.

The precise servo motion control of the system became a critical factor in the design. In order for the machine to offer multiple axes of motion, component synchronization had to be tightly controlled so the testing would be accurate. "Each nozzle is roughly five inches from the face of the part," said Cooper. "Since the two nozzles face each other, they have to be lined up. We were able to make streams of water, which are each manipulated by five axes of servo motion, concentric within 0.020 of an inch."

Servos provide outstanding motion control while keeping the AG2 compact and efficient, yet robust enough to scan the largest and most intricate parts.

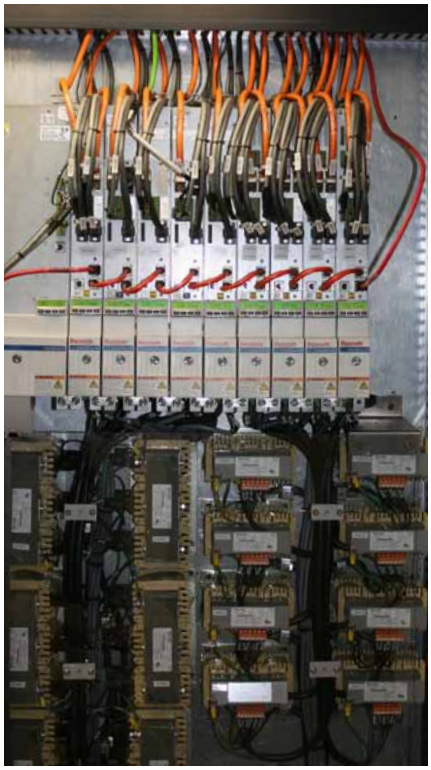
Select components for precision and reliability

To ensure precise control, accuracy and reliability, MNDT used drive and control components from Bosch Rexroth. Rexroth's components—including digital servo drives and controllers, profiled guide rails and pneumatic components— allow the machine to follow intricate path planning for scanning complex, curved objects with tightly controlled motion tolerance. Rexroth distributor Livingston & Haven provided design and programming expertise for the new line of machines.

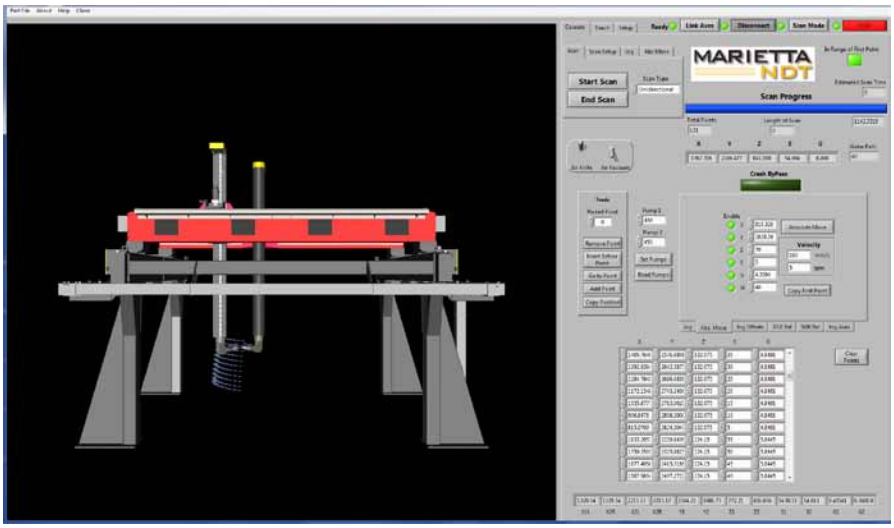
"The high-quality controllers are reliable and easy to program. They can also accommodate the large number of interpolated axes of the machines," said Cooper. In addition, the controllers generate minimal overall electrical noise to minimize ultrasound interference, which can distort the image quality of the scan. The pneumatic components include a vacuum generator to remove air from the nozzle which also improves the quality of the ultrasonic scans.

According to Ben Strong, automation specialist at Livingston & Haven, the linear guide rails used in the AG2 also contribute to the overall rigidity and accuracy of the machine. "If the machine is not stiff enough to handle the squirter system, it will begin to vibrate, which adversely affects the testing," Strong said. He added that from a maintenance perspective, the linear guide rails are an ideal solution due to their longer lubrication interval, dual rail datums and interchangeable runner blocks. In addition, the rails are plated with thin dense chrome to resist rust, a crucial consideration for a machine that incorporates water.

Livingston & Haven also assisted MNDT in adapting the Rexroth control system to communicate with LabVIEW™, a robust platform and development package that design and control engineers use to automate measuring equipment. It's commonly used for data acquisition, instrument control and industrial automation on a variety of programs, including Microsoft Windows and Mac OSX. "We implemented a solution utilizing TCPIP sockets that provides real-time communication of position commands," said Strong. "As a result, MNDT can present an image of the machine in real time." This allows for remote viewing of the status of the system and for virtual programming of parts.



Rexroth's components allow the machine to follow intricate path planning for scanning complex, curved objects with tightly controlled motion tolerance.



Livingston & Haven assisted in adapting the Rexroth control system to communicate with LabVIEW™ that allows for remote viewing of the status of the system and for virtual programming of parts.

Scalable machine with consistent, reliable testing capabilities and lower cost of ownership

"Because of the path planning and motion control, this machine is greatly improved over other inspection equipment," said Cooper. The new

Servo motors like the IndraDrive MSK, along with Rexroth L65 servo controllers, provide precise positioning on the AG2's 16 axes of motion.

squirter-based machine can perform scans accurately and quickly with complete part coverage. "We can scan parts at about 25 inches per second, which increases our speed and output," said Cooper.

Because the programming, software and mechanics are configurable, the machine can easily accommodate a variety of parts from the same customer; before, customers had to order separate, custom-built systems to inspect each individual part. The AG2's functionality extends its usefulness and significantly reduces the cost of ownership for customers.

MNDT is currently working on the next set of improvements for the scanner, by designing an interface to simplify the machine's operation even further. MNDT engineers are currently integrating a CAD file importing feature to allow for automatic motion path planning. "The machine is specifically designed so users can update new part sets easily," said Cooper. "We want operators to be able to simply log in and create their own scan plans."

Bosch Rexroth Corporation
14001 South Lakes Drive
Charlotte, NC 28273-6791
Telephone (800) 322-6724
www.boschrexroth-us.com