

Scaling Up Inspections for Rolled Ring Forgings

Devising an ultrasonic inspection solution to provide faster, automated scanning of metal rings up to 10 meters in diameter to meet increased production volume

The Challenge

The Customer fabricates seamless rolled rings for a variety of industrial, mining and aerospace uses. These rolled rings—which can be made of steel, aluminum, titanium or various alloys—can range in size and weight from just 20 pounds (10 Kg) to as much as 44 tons (40 metric tons), with diameters up to eight meters.

The Customer manufactures these rings through a series of steps that include punching a hole in a thick sheet of metal to create a donut, then performing additional rolling, heating, pressing or machining to shape the rings. Often the rings are formed into a simple rectangular cross-section, allowing the end customer to further machine the ring into whatever finished shape is needed. Or the rings can be produced as contour rolled rings, where each piece is shaped in the forging process to meet specific, sometimes complex, contours and dimensions for both the interior and exterior of the ring.

The rings are used for industrial applications ranging from the mining industry (e.g., in large cranes and excavator machines) to very demanding aerospace applications such as jet engine turbines

that require a zero failure rate. It is vital that the rings be free of defects such as cracks and voids in the metal and that the material is homogeneous throughout. The Customer had been inspecting rings using manual ultrasonic methods. However, due to increasing production demands, a need for automated inspection and detailed quality documentation was recognized.



Industry: Manufacturing / Materials

Technology: Ultrasound

Products & Services: P-Scan / Material evaluation for cracks, voids and homogeneity

Customer Profile: An Italian company that fabricates a variety of industrial metal rings for mining and aerospace applications

Business Challenge: Introduce an automated scanning system capable of handling very large metal parts to increase production speed over manual inspections, without sacrificing inspection quality and accuracy

Solution: Ultrasonic inspection system using the P-Scan System 4, combined with a large probe rail assembly for rotating rolled rings up to 10 meters in diameter

Benefits:

- Increase in inspection speed by use of the automated scan system enables increased production volume
- A solution that scaled from a temporary to a permanent installation provides flexibility and cost control as the company's production scales over time
- Quality and accuracy of inspections has been maintained, supporting the zero-defect requirement for mission-critical parts

P-Scan 4 ultrasonic scanner and assembly being used to scan a rectangular cross-section forged ring for material homogeneity and defects prior to final machining

The Solution

Adaptive Energy worked in partnership with FORCE Technology to deliver two different specialized solutions that were custom designed for the Customer. At the core of each solution was FORCE Technology's P-Scan System 4 (P-Scan 4) for advanced ultrasonic scanning and data capture. The system uses ultrasonic probes to capture images of the rings.

To enable the probes to scan multiple rings of different sizes, the first solution also involved fabrication and delivery of probe rails for moving the scanning probes around the full dimension of each ring, no matter how large. To perform an inspection, the Customer's testing personnel mounted these probe rails temporarily onto a lathe machine in place of machine cutting tools.

The Customer used this solution successfully for a year, but found that production volume necessitated a more permanent set up for continuous inspection activity. So a second solution was designed and implemented: a new machine that could rotate rings up to 10 feet (three meters) in diameter during ultrasonic inspection. The second solution used a flexible permanent probe rail assembly.

The automated ultrasonic P-Scan inspection of the rings is typically performed prior to final machining operations. Rectangular cross-section rings are inspected while each ring is placed vertically in the test stand and rotated. Ultrasonic probes are mounted on the probe rail and moved across both the face and the outside surface of the ring. The P-Scan 4 can inspect two surfaces simultaneously with up to eight probes. The ultrasonic data captured by the system are analyzed with integrated P-Scan 4 software and saved into the Customer's quality documentation database.

Results

With the P-Scan 4 automated ultrasonic scanning system, the Customer found they were able to increase the speed of inspections. As their manufacturing volume continued to increase, the probe rail structure evolved from a temporary to a permanent installation, allowing the Customer to scale inspection rates to match ongoing production demands.

The solution captures, analyzes and stores thorough and detailed ultrasonic scan data that enables the company to meet zero-defect requirements for the rolled rings. Its customers know they can rely on the quality of these components to support their mission-critical needs.

About Adaptive Energy

Adaptive Energy creates customized, non-destructive material evaluation solutions to address mission-critical, time-sensitive testing needs. By combining the latest digital radiography, computed tomography, and ultrasonic imaging technologies with innovative mechanical and robotic assemblies, Adaptive Energy's integrated systems offer rapid deployment, are easy to learn and maintain, and perform reliably under pressure.

Working collaboratively with organizations in the aerospace, automotive, energy, petro-chemical, defense, infrastructure, and materials industries, our experts develop optimized solutions for flaw and crack detection, composite delamination, weld inspection, hardness testing, custom radiation enclosures and overhead gantry systems, and more.

Adaptive Energy is also the exclusive distributor in the U.S. and Canada of FORCE Technology's P-Scan ultrasonic scanners, including the P-Scan Stack with Phased Array, a next generation automated inspection system.



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