Automated Ultrasonic Testing System for Inspection of ERW Pipes

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Abstract
In recent years among different NDE Methods used for inspection in various industries Ultrasonic Examination Method has become more popular mainly for detection of internal discontinuities in large number of industrial items. To meet large production inspection requirements, automated ultrasonic testing using on line or off line systems have become quite popular and are in very much use by various manufacturing units. The paper deals in particular with UT system for Ultrasonic Examination of ERW Pipes.

ERW Pipe Weld Online UT System:
8 channel Online Weld UT System is installed In-Line for evaluation of Weld discontinuities such as cracks, weak weld, improper de-burring, incomplete fusion with pipe wall, etc. in ERW Pipes. Acceptable pipes are used to fabricate various automobile products.
The paper mainly describes in brief the Test System, Test Technique, Transducers employed in the system, Reference Calibration Standard used, Data Logging and Test Report Generation, etc.

Key Words: Automation, ERW Pipes, Multi Channel

Introduction:
The auto system can be designed for pipe OD of 40mm and above and having wall thickness of 2mm and above. Once the pipe is welded and the process of fabrication of the ERW pipe is completed, ultrasonic inspection is performed to test the weld for defects and weak weld.

Testing is performed On-line after welding section & cooling section, on an independent test station which is fitted on the pipe mill. Testing is done after sizing rolls & before flying cutting saw.

Paint marking the defective area, segregation of defective cut length pipe, data log & reporting are part of the UT test system.

Technique:
Bubbler technique, which creates a captive water column on the pipe surface is used. A set of 6 nos probes with a custom built probe holder will test the welds using shear wave angle beam. Probes are immersion type, normal beam is incident at an angle of 19° to the entry into the pipe surface, creating 45° shear wave scanning the weld cross section.

Total 3 pairs of probes are placed on each side of the weld. One pair each is adjusted such that the scanning beam will cover the OD, MID & ID of the pipe weld cross section.

The combination covers the weld cross section, scanning it from the two (opposite) sides.
The probes work in Pulse-Echo (T + R) mode for flaw detection & additionally work in Through Transmission (T - R) mode. While in T - R mode one probe acts as a transmitter whereas the probe placed opposite to the transmitting probe acts as a receiver. The received beam amplitude is monitored in the test electronics.

A healthy test condition will be when the received beam signal is within the set limits, if the amplitude falls, it
will indicate that the test reliability is questionable. This process is called 'Coupling' check. When De-Coupling alarm comes 'ON', one needs to check the probe functioning, probe placement, cable connections & correct it to ensure a healthy 'Coupling' signal which is an assurance that the test process is in a healthy condition.

The system has the mechanics built in such a manner that the complete test section can be placed Online during testing or taken to an Offline position for performing the Calibration by adjusting the probes & test electronics parameters.

Sensitivity setting is done by means of artificially created longitudinal notches on the IO & OD of the weld line. Typically notch dimensions are 0.1mm depth x 25mm length, square shape.

Probes used are 10mm crystal dia with frequency of 4mHz. Contact angle beam profiled wedges using a screw in probe or angle beam probes with matching curvature matching the pipe OD are as well used. They are suitable for larger pipe diameters and are convenient to use. However they are subject to wear & tear.

The type of probes and the probe holders to be used have to be carefully selected based on the Mill space, layout, test speeds among other factors.

During size change, following settings are necessary:
- Probe holder positioning
- Probe holder setting & alignment to weld seam
- Test electronics parameters
- Testing of calibration pipe piece

The ERW pipe welds are trimmed, 'Deburring' operation is performed after welding. This process has to be carefully fine tuned such that the process does not leave scratch marks on the weld thus simulating a weld defect. Pipe Mill production team & the NDT team jointly work on the aspect to ensure compatibility.

The UT machine operator needs to have a basic understanding of UT technology. The UT team may have atleast one competent & qualified supervisor in each shift who in turn will train & supervise the operation.