CATEGORY: ROLL INSPECTION

TYPE: ULTRASONIC TESTING

Ultrasonic testing is the main non destructive method of inspection employed by roll makers during the manufacture of a roll. Manual and more recently automated ultrasonic testing in conjunction with eddy current testing is increasingly being used in rolls shops. Ultrasonic testing can with the correct choice of equipment and level of operator training detect and asses flaws within rolls either at the surface or at depth and in any orientation. Flaws that can be detected include cracks and voids as well as included non metallic materials. Ultrasonic inspection can also be used to asses certain aspects of a roll materials physical and mechanical properties.

The principle method of ultrasonic testing used for rolls is that of the reflection or pulse echo method. During testing a transducer connected to an ultrasonic flaw detector unit is passed over the surface of the roll being inspected. The transducer is separated from the roll surface by a couplant such as oil or by a water column in the case of automated systems. The transducer performs both the sending and the receiving of a pulsed ultrasound wave. Reflected ultrasound will come back to the transducer from any interface such as the back wall of the roll or from a flaw such as a crack or void within the roll. The flaw detector unit displays the results of these reflected waves in the form of a signal or echo with a screen amplitude representing the intensity or size of the flaw and its distance from the transducer relative to its position on a time base line.

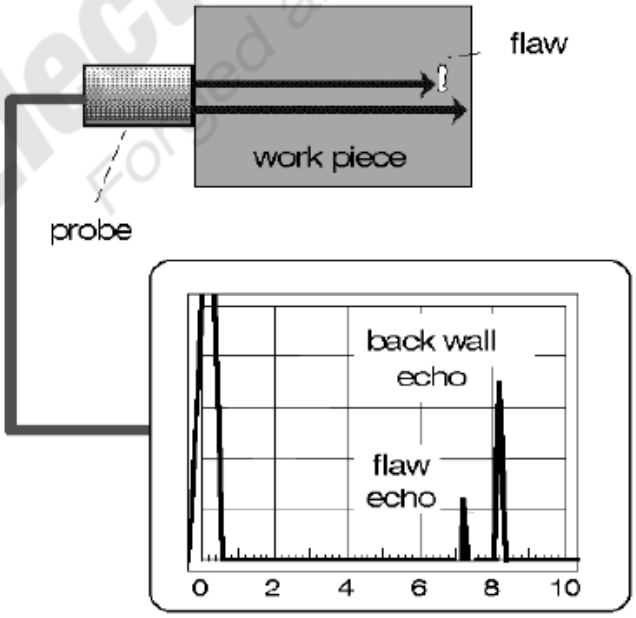

Figure 1
Diagrammatic representation of the ultrasonic testing system

The frequency of the transducers employed for roll inspection are typically within the range of 0.5 MHz to 5 MHz with twin or single crystal elements both being used. A list of recommended transducers and there use for roll inspection is shown below in table 1.

Angle	Size (mm)	Elements	Frequency (MHz)	Use
0°	25	Twin	2.5	Shell / core bond zone of work rolls. Mid-deep working layer flaw detection, evaluation and depth
0°	15	Twin	5.0	Near surface-mid working layer flaw detection, evaluation and depth
0°	50	Single	0.5	Work roll core and back up roll centerline evaluation
45°	30 x 15	Single	2.0	Deep to mid working layer flaw depth
70°	30 x 15	Single	2.0	Near surface to mid working layer flaw depth
90°	30 x 15	Single	2.0	Roll surface flaw detection (surface wave testing)

Table 1

For flaws that are oriented parallel to the test surface then 0° probes are used. The higher frequency transducers are best suited to detection of near surface flaws within the working layer of a roll and have better resolution. The lower frequency transducers will detect deeper flaws within the working layer and are used to examine and identify flaws or degradation in the strength at the shell to core bond of a work roll. Angle transducers are employed to determine the depth and location of flaws oriented perpendicular to the test surface.

Figure 2
Typical ultrasonic flaw detector and range of transducers used for roll inspection

For ultrasonic inspection to be effective suitable test procedures need to be designed that will target a specific type of problem or defect. For example the presence of a crack within the barrel surface should not only be assessed with an angle probe but also a 0° probe due to its likely method of propagation and change of orientation during rolling.

Advantages

- ✓ Flaws can be detected and evaluated throughout the full roll cross section.
- ✓ Surface wave testing can detect smaller flaws than that of the automated eddy current units.
- ✓ Absolute determination of flaw depth.
- ✓ Evaluation of the shell to core bonding of work rolls.
- ✓ Can be used to determine material type and approximate mechanical properties. For example core material type of work rolls.

Disadvantages

- × Manual inspection requires a high level of operator training and experience.
- × Surface wave inspection cannot be reliably carried out on all work roll grades.