Surface wave ultrasonic inspection is performed using a transducer attached to a 90° surface wedge and is the most accurate method for detection of surface cracks. Surface wave ultrasonic inspection transmits high frequency sound waves around the circumference to detect conditions that reflect or absorb the sound waves. All interfaces will reflect or scatter the waves to some degree. This includes cracks, inclusions, grain boundaries and other discontinuities. Metal-to-air interfaces (cracks) reflect most of the sound wave while metal-to-solid interfaces (inclusions) partially reflect the sound waves. The reflected sound wave is then returned to the transducer and is displayed on the testing screen as a spike. The following is a basic procedure for performing the surface ultrasonic test:

1.0 Ultrasonic Inspection Technique

Utilize the ultrasonic contact method based on the back reflection technique referenced in ASTM A388.

1.1 Ultrasonic Equipment

1.1.1 An ultrasonic pulse-echo type instrument shall be used to generate and display the ultrasonic signals.

1.1.2 A contact search unit utilizing a piezoelectric material shall be used to transmit and receive the ultrasonic signals.

1.1.3 A coaxial cable with appropriate adapters shall be used to connect the ultrasonic instrument and the search unit.

1.1.4 A couplant shall be used to effectively transmit and receive the ultrasonic signals to and from the forged steel roll, typically oil, glycerin or water.

1.2 Ultrasonic Tests

1.2.1 Circumferential Surface Test

This test is designed to detect longitudinal surface and shallow sub-surface indications.

1.2.2 Longitudinal Surface Test

This test is designed to detect transverse surface and shallow subsurface indications.
SURFACE WAVE ULTRASONIC INSPECTION

1.3 Circumferential Surface Test

1.3.1 Search Unit

Utilize a 2.25 MHz, 0.5” x 1.0” contact search unit with a 90° lucite wedge to generate the surface wave.

1.3.2 Prepare Roll

Place the roll on machine centers, stands or “V” blocks with the supports located away from the roll body. Clean the body with a solvent if necessary and dry with a cloth or rag.

1.3.3 Apply Couplant

Apply a thin, light band (≈ 1”) of couplant on top of the body along the full body length.

1.3.4 Setup, Display and Sensitivity

Setup on an area that has no relevant indications. Set the sweep line to represent a distance greater than 1/2 the circumference of the body with the initial pulse at the extreme left side of the screen. Place the search unit on the couplant and obtain a circumferential back reflection. Adjust the gain (dB) to obtain 1 full back reflection (100% amplitude). Adjust the sweep line to position the back reflection at the extreme right-hand side of the screen (Figure 1).

1.3.5 Conduct Test - First 180° Of The Rolls Circumference

Place the search unit at one end of the body and direct the surface wave circumferentially. Traverse the length of the body along the couplant at less than 8” per second while maintaining 1 full back reflection (Figures 2 and 3). Monitor the screen for 100% back reflection amplitude. Locate and mark the indications for further evaluation and report documentation.

1.3.6 Conduct Test - Second 180° Of The Rolls Circumference

Reverse the circumferential position of the search unit and repeat step 1.3.5 (Figure 2).

1.3.7 Conduct Test - Overlap Dead Zone

Wipe the couplant from the roll body and reapply couplant approximately 90° from the original location. Repeat steps 1.3.5 and 1.3.6.
SURFACE WAVE ULTRASONIC INSPECTION

1.4 Longitudinal Surface Test - Roll Body

1.4.1 Search Unit

Same as 1.3.1.

1.4.2 Prepare Roll

Same as 1.3.2.

1.4.3 Apply Couplant

Apply a thin band (≈ 1”) of couplant around the circumference (360°) on the drive end of the roll body. Note: If the roll rotating mechanism is not available, apply on 1/2 of the circumference (180°), reposition the roll and repeat.

1.4.4 Setup, Display and Sensitivity

Same as 1.3.4 except set the sweep line to represent a distance greater than the body length. Place the search unit on the couplant and obtain a longitudinal back reflection (Figure 1).

1.4.5 Conduct Test - Drive End

Place the search unit at the drive end of the body and direct the surface wave longitudinally. Traverse the circumference along the couplant at less than 8” per second while maintaining 1 full back reflection. Monitor the screen for 100% back reflection amplitude and any indications greater than 10% amplitude. Locate and mark the indications for further evaluation and report documentation (Figure 4).

1.4.6 Conduct Test - Operator End

Wipe the couplant from the roll body and repeat steps 1.4.3, 1.4.4 and 1.4.5 on the operator end.
FIGURE 1
Ultrasonic testing unit screen display.
FIGURE 2
Circumferential surface test

FIGURE 3
Circumferential surface test being performed on a roll body.
FIGURE 4
Longitudinal surface test