

Acoustic Pulse Reflectometry for Tube Inspections

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Acoustic Pulse Reflectometry (APR) has been applied extensively to tubular systems in research laboratories, for purposes of measuring input impedance, bore reconstruction, and fault detection. Industrial applications have been mentioned in the literature, though they have not been widely implemented. Academic Acoustic Pulse Reflectometry systems are extremely bulky, often employing sophisticated set-ups, which limits their industrial use severely. Furthermore, leak detection methods described in the literature are based on indirect methods, by carrying out bore reconstruction and finding discrepancies between the expected and reconstructed bore. Here, we describe an APR system which is named APRIS designed specifically for detecting faults commonly found in industrial tube systems such as heat exchangers, condensers, and boiler leaks, increases in internal diameter caused by wall thinning, and constrictions by blockages or deposits or scales. The system extremely employs hardware setup, making it extremely portable, but creating a large degree of overlap between forward and backward propagating waves in the system. A series of patented algorithmic innovations enable the system to perform the wave separation mathematically, and then identify the above faults automatically, with a measurement time on the order of 10 seconds per tube. APRIS is able to inspect tubes of any shape and material.