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# Abstract

Vintage pipelines, which in the context of this paper refer to pipelines built before approximately 1970, account for a large portion of the energy pipeline systems in North America. Integrity assessment of these pipelines can sometimes present challenges due to incomplete records and lack of material property data. When material properties for the welds of interest are not available, conservative estimates based on past experience are typically used for the unknown material property values. Such estimates can be overly conservative, potentially leading to unnecessary remedial actions. This paper is a summary of PRCI-funded work aimed at characterizing material properties and flaw characteristics of vintage girth welds. The data obtained in this work can be utilized to understand and predict the behavior of vintage pipelines, which is covered in a companion paper.

The material property data generated in this work include (i) pipe base metal tensile properties in both the hoop (transverse) and the longitudinal (axial) directions, (ii) deposited weld metal tensile properties, (iii) macrohardness traverses, (iv) microhardness maps, and (v) Charpy impact transition curves of specimens with notches in the heat-affected zone (HAZ) and weld centerline (WCL). These data provide essential information for tensile strength, strength mismatch, and impact toughness. In addition to the basic material property data, instrumented cross-weld tensile (ICWT) specimens with no flaws, natural flaws, and artificially machined planar flaws were tested and analyzed.

The cross-weld tests provide an indication of the welds' stress and strain capacity without and with flaws. For welds with even-matching or over-matching weld strengths, the CWT specimens usually failed outside of the weld region, even for specimens with natural flaws reported by non-destructive examination. Having over-matching weld strength can compensate for the negative impact of weld flaws.

All tested girth welds were inspected using radiography and/or phased array ultrasonic testing. The inspection results are compared with the flaws exposed through destructive testing. The ability of these inspection methods to detect and size flaws in vintage girth welds is evaluated.

**Keywords**

Vintage pipeline, girth weld, material properties, weld flaws, non-destructive testing