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# Abstract

Single edge-notch tension (referred to as SE(T) or SENT) tests are increasingly being used in the pipeline community, as they are a laboratory-scale fracture toughness test, capable of being performed on linepipe steels and welds. The constraint and loading conditions of the SE(T) specimens more closely correspond with actual field flaws than those of the conventional three-point-bend CTOD (crack tip opening displacement) specimens. The test matrix covered in this paper consists of two nominally X65 pipes and one X80 pipe. Two welding procedures were applied to one of the X65 pipes, resulting in two different welds. Consequently four girth welds were in the test matrix. Notches were cut with electrical discharge machining (EDM) from the outer-diameter (OD) surface of the pipe with the target locations in the base metal, weld centerline, and heat-affected zone (HAZ). The EDM notches were grown by fatigue precracking in a three-point bend fixture to generate sharp flaws. The specimens were loaded in tension and periodically unloaded to generate J-integral resistance curves. The specimens with the weld and HAZ flaws were tested at room temperature and three to four lower temperatures. This paper covers the specimen preparation and the comparison of test results among specimens with different flaw locations at a wide range of temperatures. The specimen preparation and fatigue crack front straightness presented significant challenges. In general, at a given temperature, cracks propagated at lower energies in the weld material than in the HAZ or base material. Comparison of the J-integral curves for the even-matched and over-matched welds showed greater toughness in the over-matched weld at lower temperatures (but still on the upper-shelf of the curves of the ductile-to-brittle transition temperature (DBTT)). Testing at low temperatures appears to affect the HAZ differently than the weld material, as significant increases in toughness were observed between room temperature and –80 ˚C in the HAZ.

**Keywords**

Pipeline welds, SE(T), Low-constraint testing, Resistance curve, Toughness transition