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CRES Author

Fan Zhang, Honggang Zhou, Yong-Yi Wang, Ming Liu

Abstract

A crack is highly constrained in traditional toughness tests, e.g., CVN and SE(B). However, a crack in the girth welds of pipelines under longitudinal loading is low constrained. Curved wide plate (CWP) test provides similar constraint condition as that of pipeline girth weld. CWP tests are being used recently for strain-based design. One of the desirable outcomes from those tests is fracture toughness resistance curves. The resistance curve consists of two components, the crack growth and the toughness measure, such as J-integral or CTOD. The paper describes the development of procedures for the determination of those two components. A normalized equation was developed to estimate the crack growth from the experimentally measured unloading compliance. The equation was verified by multiple FEA simulations with different pipe geometries and materials. The second set of equations was developed to evaluate the J-integral through an incremental frame based on the instantaneous crack growth and the load-CMOD record. The application of the resistance curve procedures was demonstrated through CWP tests of X80 and X100 welds.

Keywords

Strain Based Design, J Resistance Curve, CWP