Abstract

This is the second paper in a three-paper series related to the development of tensile strain models. The fundamental basis of the models [1] and evaluation of the models against experiment data [2] are presented in two companion papers. This paper presents the structure and formulation of the models. The philosophy and development of the multi-tier tensile strain models are described. The tensile strain models are applicable for linepipe grades from X65 to X100 and two welding processes, i.e., mechanized GMAW and FCAW/SMAW. The tensile strain capacity (TSC) is given as a function of key material properties and weld and flaw geometric parameters, including pipe wall thickness, girth weld high-low misalignment, pipe strain hardening (Y/T ratio), weld strength mismatch, girth weld flaw size, toughness, and internal pressure. Two essential parts of the tensile strain models are the crack driving force and material's toughness. This paper covers principally the crack driving force. The significance and determination of material's toughness are covered in the companion papers [1,2].

Keywords

Strain-based design, Tensile strain capacity, Tensile strain models, Crack driving force, Crack tip opening displacement (CTOD)