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## Abstract

High levels of high-low misalignment in pipeline girth welds have been identified as one of the possible contributing factors to some of the recent pre-service hydrostatic test failures. However, long-term pipeline service experience demonstrates that some pipelines can survive a large degree of high-low misalignment at girth welds. In this paper, recent experimental and analytical work aimed at understanding the impact of high-low misalignment in girth welds is described. The misalignment is treated in two ways, to be consistent with either the workmanship or ECA-based flaw acceptance criteria. For workmanship applications, nominally defect-free welds are analyzed. The performance of girth welds is found to be predominantly determined by the misalignment ratio, weld strength mismatch ratio, and the weld profile. Iso-load-capacity relations are developed through finite element analysis to capture the interdependence of those key parameters. The analysis procedure is validated by cross-weld testing of girth welds with various levels of misalignment and weld strength mismatch. In the presence of planar flaws in girth welds, the effects of misalignment are examined in the context of the tensile strain capacity of girth welds. Guidelines are provided for the proper treatment of high-low misalignment. These guidelines are (1) practical to use, (2) not overly restrictive, and (3) sufficient to ensure pipeline safety and integrity. Gaps in the current understanding are highlighted. Possible venues for code adoption of the work products are presented.

## Keywords

Girth weld, High-low misalignment, Load capacity, Strain capacity, Weld strength mismatch