Wang, Y.-Y., Rudland, D., and Horsley, D., Development of a FAD-Based Girth Weld ECA Procedure: Part II — Experimental Verification, Proceedings of 4th International Pipeline Conference, Calgary, Alberta, Canada, 2002, Paper No. IPC2002-27173

Abstract

An ECA procedure specifically tailored to pipeline girth welds is developed under a PRCI (Pipeline Research Council International) funded project. This procedure of FAD (Failure Assessment Diagram) format incorporates some of the most recent developments in crack driving force, plastic collapse, and effects of weld strength mismatch match. The theoretical framework of this procedure is given in a companion paper. This paper focuses on the experimental verification of the procedure. Some particular issues related to girth weld ECA are discussed first. The experimental database includes both full-scale and wide plate test results. Most of the full-scale data are from pipes of API Grade X70 (483 MPa); a few were X65 (448 MPa) and X60 (414 MPa) grades. The diameter of the pipes ranged from 20 inch (508 mm) to 42 inch (1067 mm). The wide plate test data are taken from a PRCI project performed at the University of Gent. The plates were cut from an X60 36-inch OD 11.6-mm pipe. Surface-breaking defects were artificially introduced from the root side of the girth welds. The plates were loaded to failure in tension after the defects were fatigue pre-cracked. The girth welds had a range of yield stress levels ranging from 20% undermatching to 24% overmatching. In almost all the cases, the newly developed procedure proved conservative as compared to the experimental data. The comparison with the wide plate tests was particularly interesting with its wide range of weld strength mismatch levels. It was demonstrated that the inclusion of the weld strength mismatch in the new procedure improves the consistency and the accuracy of the predictions. It also showed that non-conservative predictions might result if the undermatching welds are not properly accounted for.

Keywords

Pipeline, Girth weld, Flaw acceptance criteria, Fitness-for-service, Experimental test