1st Biennial ESIS-CSIC Conference on Structural Integrity
(BECCSI 2025)

November 25-28, 2025, Metropol Palace, Belgrade, Serbia

The Universal Failure Curve applied to repurposing natural gas pipelines to hydrogen service: assessment of safety margins and comparison with ASME B31.12.

Nicolas O. Larrosa[a,b*]

[a] University of Bristol, Bristol, UK
[b] Tecnalia R&I, San Sebastian, Spain

nicolas.larrosa@bristol.ac.uk

Abstract

The Universal Failure Curve (UFC) has been recently proposed by the author and co-workers as damage tolerance design approach which enables the used of normalised global stress (e.g. membrane, bending) and a configurational normalised fracture toughness to define conditions to failure The methodology is derived from fracture mechanics principles, and its formulation has been derived using using a dataset of 588,000 cases generated with API 579 procedures and validated with experimental data obtained from the literature, including burst pressure tests, fracture tests of panels and welded components. In this paper the UFC is used to interrogate ASME B31.12 design procedure and to evaluate the safety margins derived from its application. Results show that safety margins for the higher grades (e.g. X80) are small for the minimum required toughness values in the performance-based approach in ASME B31 are used for operating pressures leading to hoop stresses of 72% SMYS. The approach allows target safety margins to be defined by using more refine values of operating pressure and estimates for the normalized toughness (mainly K_{mat}, a)

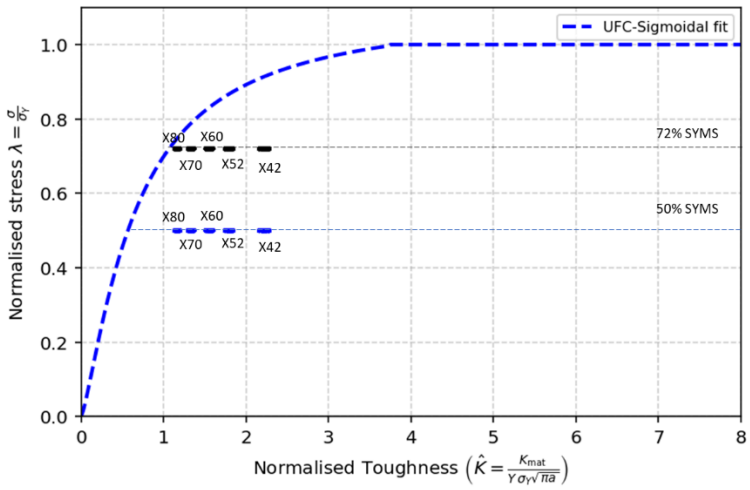

Figure 1. ASME B31.12 performance-based design approach interrogated by the UFC

Keywords: Universal Failure Curve, damage tolerance design, hydrogen , ASME B31.12.