

API 579: a comprehensive fitness-for-service guide

Ted L. Anderson^{a,*}, David A. Osage^b

^aStructural Reliability Technology, 1898 S. Flatiron Court, Suite 215, Boulder, CO 80301, USA

^bM & M Engineering, Shaker Heights, OH, USA

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Abstract

This article presents an overview of the recently published American Petroleum Institute (API) Recommended Practice 579, which covers fitness-for-service assessment of pressure equipment in petrochemical and other industries. Although API 579 covers a wide range of flaws and damage mechanisms, including local metal loss, pitting, corrosion, blisters, weld misalignment, and fire damage, the emphasis of the present article is on the assessment of crack-like flaws. The API 579 procedure for evaluating cracks incorporates a failure assessment diagram (FAD) methodology very similar to that in other documents, such as the British Energy R6 approach and the BS 7910 method. The API document contains an extensive compendium of *K* solutions, including a number of new cases generated specifically for API 579. In the initial release of the document, API has adopted existing reference stress solutions for the calculation of *L* in the FAD procedure. In a future release, however, API plans to replace these solutions with values based on a more rational definition of reference stress. These revised reference stress solutions will incorporate the effect of weld mismatch. In addition to the Appendices of *K* and reference stress solutions, API 579 includes appendices that provide guidance on estimating fracture toughness and weld residual stress distributions. Over the next few years these appendices will be enhanced with advances in technology. Recently, API has entered into discussions with the American Society of Mechanical Engineers (ASME) to convert API 579 into a joint API/ASME fitness-for-service guide. © 2001 Published by Elsevier Science Ltd.

Keywords: American Petroleum Institute; Failure assessment diagram; Flaw assessment; Fitness for service; Fracture toughness; Reference stress; Residual stress; Stress intensity factor

1. Background

Existing US design codes and standards for pressurized equipment provide rules for the design, fabrication, inspection and testing of new pressure vessels, piping systems, and storage tanks. These codes do not address the fact that equipment degrades while in-service and deficiencies due to degradation or from original fabrication may be found during subsequent inspections. Fitness-for-service (FFS) assessments are quantitative engineering evaluations, which are performed to demonstrate the structural integrity of an in-service component containing a flaw or damage. The American Petroleum Institute (API) Recommended Practice 579 [1] has been developed to provide guidance for conducting FFS assessments of flaws commonly encountered in the refining and petrochemical industry which occur in pressure vessels, piping, and tankage. However, the assessment procedures can also be applied to flaws encountered in other industries such as the pulp and paper industry,

fossil fuel utility industry, and nuclear industry. The guidelines provided in API 579 can be used to make run-repair-replace decisions to ensure that pressurized equipment containing flaws that has been identified during an inspection can continue to be operated safely.

API 579 is intended to supplement and augment the requirements in API 510 [2], API 570 [3], and API 653 [4]: to ensure safety of plant personnel and the public while older equipment continues to operate; to provide technically sound FFS assessment procedures; to ensure that different service providers furnish consistent remaining life predictions; and to help optimize maintenance and operation of existing facilities to maintain availability of older plants and enhance long-term economic viability. In addition, API 579 will also be used in conjunction with API 580 Recommended Practice For Risk-Based Inspection [5] that is being developed to provide guidelines for risk assessment, and prioritization for inspection and maintenance planning for pressure-containing equipment.

The initial impetus to develop an FFS standard that could be referenced from the API inspection codes was provided by a Joint Industry Project (JIP) administered by the

* Corresponding author. Tel.: +1-303-415-1475; fax: +1-303-415-1847.
E-mail address: tanderson@un-boulder.com (T.L. Anderson).

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