

API 579: a comprehensive fitness-for-service guide

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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

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Applied Metallurgy and Corrosion Control Amiya Kumar Lahiri, 2017-08-23 This book serves as a comprehensive resource on metals and materials selection for the petrochemical industrial sector. The petrochemical industry involves large scale investments and to maintain profitability the plants are to be operated with minimum downtime and failure of equipment which can also cause safety hazards. To achieve this objective proper selection of materials corrosion control and good engineering practices must be followed in both the design and the operation of plants. Engineers and professional of different disciplines involved in these activities are required to have some basic understanding of metallurgy and corrosion. This book is written with the objective of serving as a one stop shop for these engineering professionals. The book first covers different metallic materials and their properties metal forming processes welding and corrosion and corrosion control measures. This is followed by considerations in material selection and corrosion control in three major industrial sectors oil gas production oil refinery and fertilizers. The importance of pressure vessel codes as well as inspection and maintenance repair practices have also been highlighted. The book will be useful for technicians and entry level engineers in these industrial sectors. Additionally the book may also be used as primary or secondary reading for graduate and professional coursework.

Handbook of Engineering Practice of Materials and Corrosion Jung-Chul (Thomas) Eun, 2020-09-04 This handbook is an in depth guide to the practical aspects of materials and corrosion engineering in the energy and chemical industries. The book covers materials corrosion welding heat treatment coating test and inspection and mechanical design and integrity. A central focus is placed on industrial requirements including codes standards regulations and specifications that practicing material and corrosion engineers and technicians face in all roles and in all areas of responsibility. The comprehensive resource provides expert guidance on general corrosion mechanisms and recommends materials for the control and prevention of corrosion damage and offers readers industry tested best practices rationales and case studies. [Piping and Pipeline Engineering](#) George A. Antaki, 2003-05-28 Taking a big picture approach [Piping and Pipeline Engineering](#) Design Construction Maintenance Integrity and Repair elucidates the fundamental steps to any successful piping and pipeline engineering project whether it is routine maintenance or a new multi million dollar project. The author explores the qualitative details calculations and techniques that are essential in supporting competent decisions. He pairs coverage of real world practice with the underlying technical principles in materials design construction inspection testing and maintenance. Discover the seven essential principles that will help establish a balance between production cost safety and integrity of piping systems and pipelines. The book includes coverage of codes and standards design analysis welding and inspection corrosion mechanisms fitness for service and failure analysis and an overview of valve selection and application. It features the technical basis of piping and pipeline code design rules for normal operating conditions and occasional loads and addresses the fundamental principles of materials design fabrication testing and corrosion and their effect on system.

integrity **Mechanical Integrity and Risk-Based Inspection of Process Equipment, Piping and Pipelines** Jorge Luis Gonzalez-Velazquez, 2024-07-15 This book explores Mechanical Integrity MI and Risk Based Inspection RBI methodologies specifically tailored for professionals in chemical petrochemical and petroleum refining plants It starts with foundational aspects of equipment and pipe design and manufacturing within the process industry followed by an introduction to prevalent damage mechanisms in metal components during service The book then delves into the general methodology for mechanical integrity analysis covering remaining life estimation and methods for assessing common defects found in in service components It further introduces the principles and overall methodology of Risk Based Inspection detailing approaches for evaluating Probability of Failure and Consequences along with the application of risk matrices to formulate Inspection Based Risk IBR plans Lastly it directs attention to the practical implementation of MI and IBR methodologies for managing the integrity of pipelines transporting liquid and gaseous hydrocarbons aligned with API codes and ASME standards offering a comprehensive example illustrating the development of an integrity management plan for a real life pipeline Through this structured approach professionals can gain actionable strategies and insights essential for ensuring the safety and reliability of industrial plants and pipelines **Handbook of Pipeline Engineering** ABCM - Brazilian Society of Mechanical Sciences and Engineering, José Luiz de França Freire, Marcelo Rosa Rennó Gomes, Marcelino Guedes Gomes, 2024-07-25 This Handbook covers a large number of Pipeline Engineering topics ranging from the initial stages of designing constructing operating and managing the integrity of a pipeline to several of their fluid transportation applications such as oil gas derivatives slurry hydrogen and CO₂ Traditional onshore and offshore pipelines are covered as well as chapters on present and future interaction with modern society This Handbook serves as a first reference resource for new readers entering the field but also as a complement to those who are aware of the general principles encompassing areas of pipeline engineering This Handbook has been developed in close cooperation with ABCM the Brazilian Society of Mechanical Sciences and Engineering **Service Experience and Fitness-for-service in Power and Petroleum Processing** Marvin Cohn, Martin Prager, David Osage, 2000 **Pipeline Engineering ebook Collection** E.W. McAllister, W. Kent Muhlbauer, Marshall Parker, Keith Escoe, Roy A. Parish, Mehdi Farshad, 2008-09-05 Pipeline Engineering ebook Collection contains 6 of our best selling titles providing the ultimate reference for every pipeline professional's library Get access to over 3000 pages of reference material at a fraction of the price of the hard copy books This CD contains the complete ebooks of the following 6 titles McAllister Pipeline Rules of Thumb 6th Edition 9780750678520 Muhlbauer Pipeline Risk Management Manual 3rd Edition 9780750675796 Parker Pipeline Corrosion Cathodic Protection 3rd Edition 9780872011496 Escoe Piping Pipeline Assessment Guide V1 9780750678803 Parish Pipe Drafting Design 2nd Edition 9780750674393 Farshad Plastic Pipe Systems Failure Investigation and Diagnosis 9781856174961 Six fully searchable titles on one CD providing instant access to the ULTIMATE library of engineering materials for pipeline professionals 3000 pages of practical

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Comprehensive Structural Integrity Ian Milne,R. O. Ritchie,B.L. Karihaloo,2003-07-25 The aim of this major reference work is to provide a first point of entry to the literature for the researchers in any field relating to structural integrity in the form of a definitive research reference tool which links the various sub disciplines that comprise the whole of structural integrity Special emphasis will be given to the interaction between mechanics and materials and structural integrity applications Because of the interdisciplinary and applied nature of the work it will be of interest to mechanical engineers and materials scientists from both academic and industrial backgrounds including bioengineering interface engineering and nanotechnology The scope of this work encompasses but is not restricted to fracture mechanics fatigue creep materials dynamics environmental degradation numerical methods failure mechanisms and damage mechanics interfacial fracture and nano technology structural analysis surface behaviour and heart valves The structures under consideration include pressure vessels and piping off shore structures gas installations and pipelines chemical plants aircraft railways bridges plates and shells electronic circuits interfaces nanotechnology artificial organs biomaterial prostheses cast structures mining and more Case studies will form an integral part of the work *Innovations in the Analysis and Design of Marine Structures* Yordan Garbatov,C. Guedes Soares,2025-05-09 *Innovations in the Analysis and Design of Marine Structures* is a collection of papers presented at MARSTRUCT 2025 the 10th International Conference on Marine Structures MARSTRUCT 2025 Lisbon Portugal 20 22 May 2025 The contributions cover a wide range of topics including Loads and load effects Strength assessment Experimental analysis of structures Materials and fabrication of structures Structural design and optimization Structural reliability and safety *Innovations in the Analysis and Design of Marine Structures* is essential reading for academics engineers and professionals involved in the design of marine and offshore structures The *Proceedings in Marine Technology and Ocean Engineering* series is devoted to the publication of proceedings of peer reviewed international conferences dealing with various aspects of Marine Technology and Ocean Engineering The Series includes the proceedings of the following conferences the Marine Structures MARSTRUCT Conferences the Maritime Technology MARTECH Conferences the Renewable Energies Offshore RENEW Conferences the Collision and Grounding of Ships and Offshore Structures ICCGS Conferences and the International Maritime Association of the Mediterranean IMAM Conferences The *Marine Technology and Ocean Engineering* series is also open to new conferences that cover topics on the sustainable exploration and exploitation of marine resources in various fields such as maritime transport and ports usage of the ocean including coastal areas nautical activities the exploration and exploitation of mineral resources the protection of the marine environment and its resources and risk analysis safety and reliability The aim of the series is to stimulate advanced education and training through the wide dissemination of the results of scientific research **Advanced PHP Programming** George Schlossnagle,2004-02-20 This is the eBook version of the printed book If the print book includes a CD ROM this content is not

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