

Damage Mechanisms Affecting Fixed Equipment in the Refining Industry

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Introduction

While ASME and API design codes and standards provide rules for the design, fabrication, inspection, and testing of new pressure vessels, piping systems, and storage tanks, they do not address equipment deterioration while in service, nor do they account for original fabrication defects not discovered during construction but found during subsequent inspections.

The interactions between the materials of construction and the environmental conditions to which they are exposed, including process conditions and external conditions, are extremely varied within an operating oil refinery. Oil refineries contain many different processing units, each having its own combination of process streams and temperature/pressure conditions. The purpose of this recommended practice is to describe the wide variety of service-induced damage and deterioration mechanisms, including corrosion and other types of metallurgical damage, that are most likely to affect the condition of the materials of construction commonly used in refinery equipment.

This document incorporates information gathered from major incidents in the refining industry and is intended to be consistent with applicable API documents as well as other related industry standards and practices. It is meant to provide guidance to pressure equipment integrity personnel but should not be considered the final technical basis for damage mechanism assessment and analysis or inspection and monitoring. The damage mechanism descriptions herein are not intended to provide a definitive guideline for every possible situation that may be encountered, and the reader may need to consult with an engineer or other corrosion specialist familiar with applicable degradation modes and failure mechanisms, particularly those that apply in special cases.

Damage Mechanisms Affecting Fixed Equipment in the Refining Industry

1 Scope

This recommended practice discusses damage mechanisms applicable to oil refineries; however, much of the information herein can also be applied to petrochemical and other industrial applications, as the user deems appropriate. It is up to the user to determine the applicability and appropriateness of the information contained herein as it applies to their facility.

API 571 is a reference document that provides useful information by itself and also complements other API standards and recommended practices. The document should be utilized as a reference to other integrity related documents. It is intended to contribute to the overall management of pressure equipment integrity and is a useful resource for many mechanical integrity program activities including:

- a) identification of existing damage or deterioration and anticipated rates of degradation,
- b) identification of future damage mechanism susceptibilities,
- c) development and maintenance of inspection and monitoring strategies, programs, and plans (e.g. per API 510, API 570, and API 653),
- d) implementation and monitoring of integrity operating windows (IOWs) (see API 584),
- e) development of corrosion control documents (CCDs) (see API 970),
- f) implementation of Risk-Based Inspection (RBI) programs (see API 580 and API 581),
- g) conducting Fitness-For-Service (FFS) assessments (see API 579-1/ASME FFS-1),
- h) application of proper examination techniques, and
- i) conducting pressure equipment integrity incident investigations (see API 585).

The information for each damage mechanism is provided in a set format as shown below.

- **Name of the Mechanism**—The term commonly used to describe or name the mechanism.
- **Description of Damage**—A basic description of the damage mechanism.
- **Affected Materials**—A list of the materials prone to the damage mechanism.
- **Critical Factors**—A list of factors that affect the damage mechanism (i.e. rate of damage).
- **Affected Units or Equipment**—A list of the affected equipment and/or units where the damage mechanism commonly occurs. This information is also shown on generic process flow diagrams (PFDs) for typical process units.
- **Appearance or Morphology of Damage**—A description of the damage mechanism, with pictures in some cases, to assist with recognition of the damage.
- **Prevention/Mitigation**—Methods to prevent or mitigate the damage and in some cases to evaluate by engineering analysis.