API RP 571 and Advanced Damage Mechanisms and Material Investigation in the Refining, Petrochemical and Petroleum Industries Training Course

Professional Development Training Course Outline

Category	Oil and Gas	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The **API RP 571** (Recommended Practice 571) and Advanced Damage Mechanisms course provides a comprehensive and in-depth understanding of the critical factors that lead to material degradation and equipment failure in the refining, petrochemical, and petroleum industries. This training is essential for **asset integrity**, **risk-based inspection (RBI)**, and **fitness-for-service (FFS)** professionals who need to diagnose, mitigate, and prevent damage mechanisms. By focusing on real-world case studies and advanced investigative techniques, the course equips participants with the expertise to identify the root causes of failure, ensuring the long-term **reliability** and **safety** of fixed equipment.

API RP 571 and Advanced Damage Mechanisms and Material Investigation in the Refining, Petrochemical and Petroleum Industries Training Course is meticulously designed to go beyond the theoretical concepts of API RP 571 by integrating practical **material investigation** and **failure analysis** methodologies. Participants will gain a robust knowledge of various corrosion, mechanical, and metallurgical damage mechanisms, and learn to apply this knowledge to make informed decisions regarding equipment maintenance and design. The curriculum emphasizes a **proactive maintenance** approach, helping organizations to reduce operational costs, extend the lifespan of critical assets, and minimize the risk of catastrophic failures.

Programme Curriculum

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Course Duration

5 days

Course Objectives

This course aims to empower professionals with the skills to:

1. Gain a deep understanding of the recommended practice for damage mechanisms.
2. Accurately diagnose and classify a wide range of corrosion, mechanical, and metallurgical damage.
3. Apply advanced techniques to determine the root cause of equipment failures.
4. Improve the structural reliability and safety of fixed equipment in complex environments.
5. Use knowledge of damage mechanisms to inform and optimize inspection schedules.
6. Evaluate the remaining life and integrity of damaged equipment.
7. Advise on appropriate material selection to prevent future degradation.
8. Develop effective strategies for preventing and mitigating damage.
9. Understand how process conditions affect the microstructure of materials.
10. Select and use specialized Non-Destructive Testing (NDT) methods for damage detection.
11. Link operational parameters (temperature, pressure, and chemical composition) to damage mechanisms.
12. Design and implement corrosion prevention and control programs.
13. Align with international standards and best practices for equipment integrity.

Organizational Benefits

- Proactive identification and mitigation of damage mechanisms prevent costly failures and unscheduled shutdowns.
- Minimizing the risk of catastrophic equipment failure protects personnel and assets.
- Effective management of damage mechanisms extends the service life of critical infrastructure.
- Personnel are equipped with the advanced skills needed to solve complex integrity challenges.
- The organization can better adhere to industry regulations and reduce liability through improved integrity management.
- Knowledge of damage mechanisms allows for more efficient and targeted inspection and repair efforts.

Target Audience

- Inspection and Maintenance Personnel.
- Corrosion and Materials Engineers.
- Mechanical and Process Engineers.
- Risk-Based Inspection (RBI) Professionals.
- Integrity and Reliability Engineers.
- Quality Assurance (QA) and Quality Control (QC) Personnel.
- Plant Managers and Supervisors.
- Fitness-for-Service (FFS) Practitioners.

Course Modules

Module 1: Introduction to API RP 571 & Damage Mechanisms

- Fundamentals of API RP 571: Scope, organization, and application of the standard.
- Key Concepts: Introduction to the main categories of damage: corrosion, mechanical, and metallurgical.
- Process Unit Overview: Understanding how different refinery and petrochemical units operate and their associated damage risks.
- Material Selection Fundamentals: The role of metallurgy in preventing equipment degradation.
- **Case Study: Uniform vs. Localized Corrosion.** An analysis of a pipeline failure due to uniform corrosion versus localized pitting in a specific process unit, highlighting the different inspection approaches required.

Module 2: Uniform and Localized Loss of Thickness

- General Corrosion Mechanisms: Amine corrosion, ammonium bisulfide, and acid corrosion (HCI, HF, H2SO4).
- Microbiologically Influenced Corrosion (MIC): Identifying and mitigating corrosion caused by microorganisms.
- Corrosion Under Insulation (CUI): The insidious nature of CUI and effective inspection techniques.
- High-Temperature Sulfidation: Understanding how sulfur compounds at high temperatures cause metal loss.
- **Case Study: CUI on a Stainless Steel Vessel.** A detailed investigation into the failure of an insulated stainless steel vessel, revealing chloride stress corrosion cracking initiated by CUI from moisture ingress.

Module 3: Environment-Assisted Cracking

- Chloride Stress Corrosion Cracking (Cl-SCC): Mechanisms and critical factors affecting austenitic stainless steels.
- Caustic Stress Corrosion Cracking (Caustic Embrittlement): Causes and prevention in carbon steel and low-alloy steel.
- Wet H2S Damage: An overview of HIC, SOHIC, and SSC, and their impact on equipment integrity.
- Polythionic Acid Stress Corrosion Cracking (PASCC): Cracking in sensitized stainless steel during shutdown periods.
- **Case Study: Hydrogen-Induced Cracking (HIC) in a Reactor Vessel.** A failure analysis of a reactor that developed blisters and cracks due to high-pressure hydrogen sulfide service.

Module 4: High-Temperature Corrosion

- Oxidation and Carburization: Degradation of materials at elevated temperatures in oxygen and carbon-rich environments.
- Metal Dusting: A severe form of carbon corrosion in high-temperature syngas and reformer units.
- High-Temperature Hydrogen Attack (HTHA): The mechanism and detection of HTHA in pressure vessels and piping.
- Fuel Ash Corrosion: Damage caused by deposits from fuel combustion.
- **Case Study: HTHA Failure in a High-Pressure Heat Exchanger.** An investigation into the catastrophic rupture of a heat exchanger tube, linking the failure to HTHA due to a process upset.

Module 5: Mechanical & Metallurgical Damage

- Brittle Fracture and Creep: Understanding the mechanisms of sudden, low-stress failure and high-temperature deformation.
- Thermal and Mechanical Fatigue: Failure from repeated stress cycles and temperature fluctuations.
- Graphitization and Temper Embrittlement: Metallurgical changes that reduce the toughness of carbon and low-alloy steels.
- Vibration-Induced Fatigue: The role of vibration in equipment cracking.
- **Case Study: Creep Rupture of a Furnace Tube.** Analysis of a furnace tube that failed after prolonged high-temperature service, showing microstructural changes consistent with creep.

Module 6: Material Investigation & Failure Analysis Techniques

- Root Cause Analysis (RCA): A structured approach to determining the cause of failure.
- Nondestructive Testing (NDT) Methods: Advanced techniques like Phased Array Ultrasonic Testing (PAUT) and Eddy Current Testing (ECT).
- Metallurgical Examination: Using microscopy and other lab techniques to analyze material microstructure.
- Chemical Analysis: Determining the elemental composition of materials.
- **Case Study: Stress Corrosion Cracking in an Ammonia Storage Tank.** An investigation using NDT and metallurgical analysis to identify the cause of cracking and propose mitigation strategies.

Module 7: Prevention, Mitigation, and Monitoring

- Process Control and IOWs (Integrity Operating Windows): How to manage process parameters to prevent damage.
- Protective Coatings and Linings: The selection and application of corrosion-resistant barriers.
- Corrosion Inhibitors and Material Upgrades: Chemical and material solutions to combat degradation.
- Monitoring Techniques: Online and offline methods for tracking damage progression.
- **Case Study: Implementing an Effective CUI Mitigation Program.** A review of a plant's successful program, detailing the inspection, insulation, and coating changes that reduced CUI-related failures.

Module 8: Application in RBI & FFS

- Integrating API RP 571 into RBI: Using damage mechanisms to assess the Probability of Failure (PoF) in RBI programs.
- API 579-1/ASME FFS-1 Integration: How to apply the principles of API RP 571 to FFS assessments.
- Remaining Life Assessment: Calculating the remaining useful life of equipment based on observed damage.
- Developing Inspection Plans: Creating data-driven inspection plans based on potential damage mechanisms.

- **Case Study: RBI for a Crude Distillation Unit.** A scenario where an RBI study is performed on a CDU, using knowledge of damage mechanisms to prioritize inspection of specific components and reduce inspection costs.

Training Methodology

The course employs an **interactive, hands-on methodology** that combines theoretical knowledge with practical application. The training will feature:

- Interactive Lectures: Led by certified instructors with extensive industry experience.
- Real-World Case Studies.
- Group Discussions and Workshops.
- Practical Exercises: Applying learned techniques to simulate real-life scenarios.
- Q&A Sessions.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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