IDC Training House

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API 571 CORROSION & MATERIALS PROFESSIONAL

CERTIFICATION PREPARATION PROGRAM

SUPPLEMENTAL INSPECTION CERTIFICATION PROGRAM DAMAGE MECHANISMS AFFECTING FIXED EQUIPMENT IN THE REFINING AND PETROCHEMICAL INDUSTRIES

COURSE DURATION: 6 DAYS

The API 571 Advanced Corrosion & Materials Professional Certification Preparation program is designed to enhance the knowledge of **corrosion processes** among specialized inspectors, corrosion engineers, chemical engineers and other professionals across the entire petrochemical industry.

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COURSE DESCRIPTION

This course is designed to:

- ✓ Train individuals who are interested in obtaining the **API 571 Inspector Certification.**
- ✓ Provide individuals with an advanced knowledge of **how corrosion mechanisms drive RBI conclusions.**

Proper identification of damage mechanisms is important when implementing the API Inspection Codes **(API 510, API 570, API 653)** and conducting Risk Based Inspection (RBI) per **API 580** and **API 581.** When performing a fitness-for-service (FFS) assessment using **API 579**, the damage mechanisms need to be understood and need to be considered when evaluating the remaining life.

This program aims to **improve safety, reliability, and minimize liability** of fixed equipment by learning common damage mechanisms in the refining and petrochemical industry as covered in **API 571.** The roles of the engineer and inspector in identifying affected materials and equipment, critical factors, appearance of damage, prevention and mitigation, inspection and monitoring will be covered to introduce the concepts of service-induced deterioration and failure modes.

This course is intended for anyone interested in gaining a fundamental understanding of damage mechanisms in metals. Obtaining the API 571 Inspector certification will add value to your professional credentials and show your employers and clients that you have obtained a high level of proficiency and understanding in this field.

COURSE OBJECTIVES

The course provides participants with the knowledge necessary to:

- ✓ Be well prepared and equipped with adequate knowledge and skills to pass the API 571 Exam.
- ✓ Have a general background on the scope, organization and use of API 571 and be able to review the standards and other references related to it.
- ✓ Understand general damage mechanisms applicable to the industry and be able to identify their features and functions.
- ✓ Determine the various mechanical and metallurgical failure mechanisms such as brittle fracture, stress rupture, steam blanketing, cracking, thermal shock, corrosion and fatigue.
- ✓ Identify general damage mechanisms on uniform or localized loss thickness and explain the various types of corrosion related to it.
- ✓ Describe damage mechanisms on high temperature corrosion including oxidation, sulfidation, carburization and metal dusting.
- ✓ Know refining industry damage mechanisms used in uniform of localized loss in thickness phenomena.
- ✓ Describe refining industry damage mechanisms for environment-assisted cracking and be able to identify the other types of mechanisms.

WHO SHOULD ATTEND?

- Engineers
- Inspectors
- Designers
- Experienced Maintenance Personnel

who are involved in designing, operating, maintaining, repairing, inspecting and analyzing pressure vessels, piping, tanks and pipelines for safe operations in the refining, petrochemical and other related industries.

No required class pre-requisites. However, if you wish to pursue the API Certification Exam, a minimal years of experience on subject matter is required depending on your educational qualifications.

Please refer to the Exam Qualification Requirements at: www.api.org/icp

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COURSE OUTLINE

MODULE 1: THE API 571 TEST OVERVIEW

- Introduction

MODULE 2: REFINERY MATERIALS OF CONSTRUCTION

Part I (Introduction)

- Steel
- Carbon Steel
- Cast Iron
- C-MoSteel
- Cr-Mo Steels
- Killed Steel
- Stainless Steels

Part II

- How Steel and Cast Iron Differ
- Stress Relieving
- Annealing and normalizing
- Dehydrogenation

Part III - General Corrosion Tips

Part IV - Glossary of Terms

MODULE 2.5: AMINE TREATING

Corrosion Mechanisms:

- Wet H2S Damage
- Ammonium Bisulfide
- Erosion/Erosion Corrosion
- Amine Cracking
- Amine Corrosion
- Titanium Hydriding
- Cooling Water Corrosion

MODULE 3: FATIGUE, STRESS CORROSION CRACKING (SCC) & HYDROGEN

Fatigue (Part 1 of 3)

- Thermal Fatigue
- Mechanical Fatigue
- Vibration Induced Fatigue
- Corrosion Fatigue

Stress Corrosion Cracking (Part 2 of 3)

- Chloride SCC
- Caustic SCC (Caustic Embrittlement)
- Ammonia Stress Corrosion Cracking
- Liquid Metal Embrittlement (LME)
- Polythionic Acid SCC
- Amine SCC
- Carbonate SCC

Hydrogen Cracking (Part 3 of 3)

- Hydrogen Embrittlement
- High Temp H2/H2S Corrosion

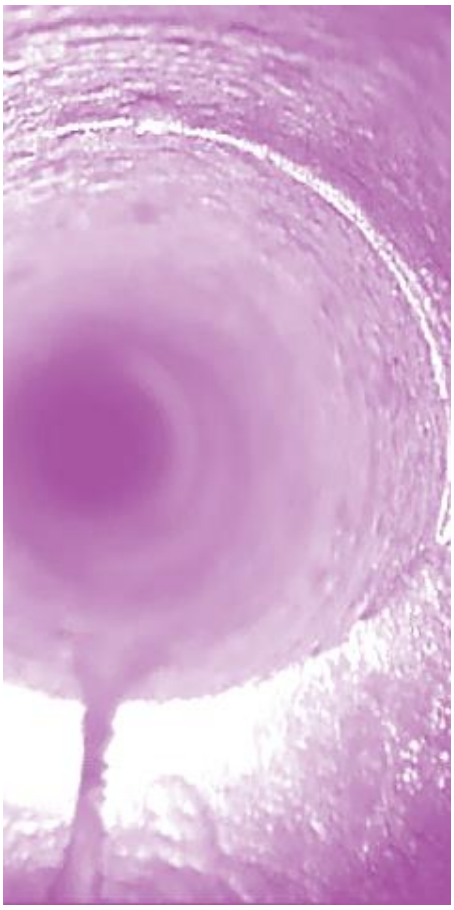
- Wet H2S Cracking
  - Hydrogen Induced Cracking (HIC)
  - Stress Orientated HIC (SOHIC)
  - Sulfide SCC (SCC)
- Hydrogen Stress Cracking – HF
- HTHA

MODULE 4: HIGH TEMPERATURE CORROSION, 400+ °F (204°C)

- Sulfidation
- Carburization
- Decarburization
- Metal Dusting
- Oxidation
- Fuel Ash Corrosion
- Nitriding
- Graphitization
- Softening (Spheroidization)
- Temper Embrittlement
- Strain Aging
- 885 °F Embrittlement
- Sigma Phase Embrittlement
- Brittle Fracture
- Creep / Stress Rupture
- Short Term Overheating – Stress Rupture
- Titanium Hydriding
- Refinery Operations 101

MODULE 5: GENERAL DAMAGE MECHANISMS – ALL INDUSTRIES

- Steam Blanketing
- Dissimilar Metal Weld Cracking
- Thermal Shock
- Erosion / Erosion – Corrosion
- Cavitation
- Refractory Degradation
- Reheat Cracking
- Refinery Operations 101



COURSE DURATION

- 6 Days Training

DAILY SCHEDULE

- 8:30am - 5:30pm

ITEMS TO BRING

- Calculator
- Lots of Questions
- A "CAN-DO" Attitude
- **API RP 571 Code** (in soft / hard copy)

Stationeries such as pen and highlighter will be provided.

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MODULE 6: UNIFORM OR LOCALIZED LOSS OF THICKNESS

- Galvanic Corrosion
- Atmospheric Corrosion
- Corrosion Under Insulation (CUI)
- Cooling Water Corrosion
- Microbiologically Induced Corrosion (MIC)
- Dealloying
- Graphitic Corrosion
- Boiler Water condensate Corrosion
- CO2 Corrosion
- Flue Gas Dew. Point Corrosion
- Soil Corrosion
- Caustic Corrosion
- Refinery Operations 101

MODULE 7: GENERAL DAMAGE MECHANISMS – REFINERY INDUSTRY

- Amine Corrosion
- Ammonium Bisulfide Corrosion (Alkaline Sour Water)
- Ammonium Chloride Corrosion
- Hydrochloric Acid (HCl) Corrosion
- High Temp H2/H2S Corrosion
- Hydrofluoric (HF) Corrosion
- Naphthenic Acid Corrosion
- Phenol (Carbonic Acid) Corrosion
- Phosphoric Acid Corrosion
- Sour Water Corrosion (Acidic)
- Sulfuric Acid Corrosion
- Titanium Hydriding

MODULE 8: REFINING UNITS

- Putting it all together - Process Units

FINAL: API 571 TEST

- Test Preparation
- Tips on taking the Test (VERY IMPORTANT)
- Test & Review

TRAINING METHODOLOGY

- 80% - Lecture
- 20% - Workshops, Group Work & Practical Exercises

Participants will receive instruction regarding how to take the test, as well as insight into its application in "real world" situations. Daily tests have been designed to gauge students' proficiency and understanding of the material.

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TRAINER'S PROFILE

DANIEL BALOS

MSc in Mechanical Engineering with the specialization in applicative IT and industrial management, PhD in application of data mining techniques on material behaviour modelling for high temperature components.

Almost 20 years of work in research and industrial projects, as well as training activities especially in risk-based inspections for power plants and refining industry. Participated or led more than 20 EU funded projects, and participated in a number of national projects in the area of material research and education abroad.

In these projects, a vast understanding and knowledge about materials, material degradation mechanisms, inspection methods, risks has been accumulated. Project and risk management skills are proven in numerous projects in last 10 years. Sub-project leader and part of the management team for iNTeg-Risk project (2008-2013).

In the area of RBI, he is active last 15 years, starting with participation in the key EU project in the area – RIMAP (Risk based inspection and maintenance procedures for European industry) – work in development and implementation of RBI approach for power plants, work in CEN CWA 15740 (standardization initiative for RBI in Europe), developed and implemented tools for RBI assessment of refining equipment in various projects.

Participation in the implementation project of RBI for NIS Serbia, EnBW Germany, as well as MOL, Hungary, ESKOM in South Africa, QP in Qatar and SINOPEC in China. Teaching RBI techniques and holding courses in RBI for petrochemical and power industry since 2005, with successful courses delivered in Germany, the Netherlands, Serbia, Romania and China.