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COURSE BROCHURE

Advanced Refinery and Plant Damage Mechanisms Training Course

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Registered in the United Kingdom and Saudi Arabia

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API RP 571 Damage Mechanisms is a 2-week training course for inspection engineers, materials specialists and integrity engineers in refining, built around a unit damage mechanism register that ties each process loop to its credible degradation modes and inspection methods. Ageing refinery and petrochemical assets, crude slate changes and longer run lengths are exposing equipment to faster and less familiar attack. Jupiter Prime Training delivers this API RP 571 Damage Mechanisms course for refining integrity professionals.

Why API RP 571 Damage Mechanisms Matters Now

Three forces shape damage mechanism work today. Refiners process heavier, higher-sulphur and higher-acid crudes that shift corrosion rates in crude and vacuum units. Plants run longer between turnarounds, so a missed mechanism grows into a leak or rupture before anyone looks. Experienced metallurgists are retiring, leaving younger inspectors to judge cracking and high-temperature attack alone. Sites that screen mechanisms well target inspection where it matters and avoid loss of containment; sites that do not spend inspection budgets on the wrong locations. The course rests on API Recommended Practice 571 API RP 571, Damage Mechanisms Affecting Fixed Equipment in the Refining Industry.

Who Gains Most from API RP 571 Damage Mechanisms

- Engineers who set inspection scope, intervals and techniques for pressure vessels, piping and heaters
- Materials specialists who select alloys, cladding and heat treatment for corrosive or hot service
- Integrity engineers who own corrosion loops and integrity operating windows for process units
- Specialists who lead failure investigations after leaks, cracks or tube ruptures
- Process engineers who judge how feed and operating changes alter degradation rates

Unit integrity groups gain most when inspection, materials and process engineers from the same plant attend together and build one shared view of each loop.

API RP 571 Damage Mechanisms Capabilities

Participants leave able to link chemistry, temperature, stress and metallurgy in a loop to the mechanism that will attack it and the inspection that will find it.

- Assess which mechanisms are credible for each corrosion loop — inspection scope at turnaround
- Specify inspection techniques matched to each damage morphology — non-destructive testing contractors
- Calculate corrosion rates and remaining life from thickness readings — run-length and repair decisions
- Design integrity operating windows for critical process variables — operations and process engineering
- Apply metallurgical evidence in failure investigations — root cause findings for site leadership
- Weigh alloy upgrades against monitoring and chemical treatment — materials selection for revamps

Key API RP 571 Damage Mechanisms Terms

- Damage Mechanism — a physical, chemical or metallurgical process that degrades equipment, such as thinning, cracking or embrittlement.
- Corrosion Loop — a group of equipment and piping sharing similar materials and process conditions, and therefore similar damage mechanisms.
- High Temperature Hydrogen Attack — reaction of hydrogen with carbon in steel at high temperature, forming methane, fissures and loss of strength.
- Stress Corrosion Cracking — cracking caused by tensile stress acting with a specific corrosive environment on a susceptible material.
- Integrity Operating Window — a set limit on a process variable beyond which damage accelerates, triggering defined responses.
- Remaining Life — the time a component can safely operate before reaching its minimum required thickness or a critical flaw size.

API RP 571 Damage Mechanisms Day by Day

Day 1: Degradation in Refinery Fixed Equipment

- Structure of API RP 571 — Mechanism Descriptions, Affected Units and Prevention
- Damage Morphology Categories — Thinning, Cracking, Metallurgical and Mechanical Effects
- Crude Quality and Run-Length Pressures — Shifting Degradation Profiles in Units
- Loss of Containment Case Histories — Refining and Petrochemical Lessons
- Roles of Inspection, Materials and Process Groups — Accountability for Mechanisms

Day 2: General and Localised Thinning

- Atmospheric and Corrosion Under Insulation — Coating and Insulation Strategy
- Galvanic, Erosion and Erosion-Corrosion — Velocity Limits and Alloy Choice
- Microbiologically Influenced Corrosion — Water Systems and Tankage Monitoring
- Boiler Water and Condensate Corrosion — Water Treatment Limits in Utilities
- Soil Corrosion and Cathodic Protection — Buried Piping and Tank Bottoms

Day 3: Refining-Specific Corrosion

- Sulphidation and Naphthenic Acid Corrosion — Crude and Vacuum Unit Alloys
- Ammonium Bisulphide and Chloride Corrosion — Hydroprocessing Effluent Air Coolers
- Hydrochloric Acid and Overhead Dew Point — Crude Tower Neutraliser Strategy
- Sour Water and Amine Corrosion — Gas Treating Velocity and Loading Limits
- Sulphuric and Hydrofluoric Acid Corrosion — Alkylation Unit Material Choices

Day 4: Environment-Assisted Cracking

- Chloride Stress Corrosion Cracking — Austenitic Stainless Steel Exposure Limits
- Caustic and Amine Cracking — Post-Weld Heat Treatment Requirements
- Wet Hydrogen Sulphide Damage — Blistering, HIC, SOHIC and Sulphide Stress Cracking
- Polythionic Acid Cracking — Shutdown Protection of Sensitised Alloys
- Carbonate and Hydrogen Embrittlement — Fluid Catalytic Cracking and Hydrogen Units

Day 5: High-Temperature Damage

- High Temperature Hydrogen Attack — Operating Limit Curves and Steel Selection
- Creep and Stress Rupture — Heater Tube Life Assessment
- Oxidation, Carburisation and Metal Dusting — Furnace and Reformer Components
- Short-Term Overheating — Flame Impingement and Tube Rupture Prevention
- Thermal Fatigue and Thermal Shock — Coke Drums and Quench Points

Day 6: Metallurgical and Mechanical Degradation

- Temper Embrittlement and Sigma Phase — Start-Up Pressurisation Limits
- Graphitisation and Spheroidisation — Long-Term Service Carbon Steel Changes
- Brittle Fracture — Minimum Design Metal Temperature Checks
- Mechanical and Vibration Fatigue — Small-Bore Connection Assessment
- Cavitation and Mechanical Erosion — Pump and Control Valve Damage

Day 7: Materials Investigation and Failure Analysis

- Failure Investigation Sequence — Evidence Preservation and Sampling Plans
- Fractography and Macro Examination — Distinguishing Fatigue, Ductile and Brittle Modes
- Metallography and Hardness Testing — Microstructure Evidence of Mechanism
- Deposit and Scale Chemistry — Linking Corrosion Products to Process Streams
- Root Cause Reporting — Corrective Actions for Materials and Operations

Day 8: Inspection Techniques for Each Mechanism

- Ultrasonic Thickness and Phased Array — Thinning and Crack Sizing Choices
- Time-of-Flight Diffraction and Advanced Ultrasonics — Hydrogen Damage Detection
- Radiography and Profile Techniques — Insulated Piping Screening
- Wet Fluorescent Magnetic Particle Testing — Surface Cracking in Wet Sour Service
- Positive Material Identification — Alloy Mix-Up Prevention in Hot Service

Day 9: Inspection Planning and Integrity Decisions

- Corrosion Loop Definition and Process Flow Diagrams — Mechanism Assignment
- Risk-Based Inspection Logic — Likelihood, Consequence and Interval Setting
- Integrity Operating Windows — Critical, Standard and Informational Limits
- Corrosion Rate and Remaining Life Calculation — Repair or Replace Choices
- Management of Change Screening — Feed, Catalyst and Temperature Changes

Day 10: Practising the Unit Damage Mechanism Register

- Loop Mapping Exercise — Applying Corrosion Loop Definition to a Hydrotreater
- Mechanism Screening — Applying Thinning, Cracking and High-Temperature Criteria
- Failure Case Analysis — Applying Fractography and Metallography Evidence
- Technique Selection Matrix — Applying Inspection Methods to Each Mechanism
- Unit Damage Mechanism Register — Completing Loops, Mechanisms and Inspection Plans

Applying API RP 571 Damage Mechanisms After the Course

- Revalidate the corrosion loops of one process unit against API RP 571, flagging mechanisms missing from the current inspection plan and the techniques needed to find them.
- Propose integrity operating windows for two critical variables in a high-temperature or wet sour circuit and agree response actions with operations.

API RP 571 Damage Mechanisms Questions FAQ

What are API RP 571 damage mechanisms and why do they matter now?

They are the corrosion, cracking, high-temperature and mechanical processes that degrade refinery fixed equipment, as catalogued in API RP 571. They matter now because heavier crudes, longer run lengths and ageing plants make missed mechanisms a direct cause of leaks and unplanned shutdowns.

Which roles gain most from API RP 571 damage mechanisms training?

Inspection engineers, materials specialists and integrity engineers in refining and petrochemical plants gain most. You benefit if you set inspection plans, select alloys, investigate failures or define operating limits for corrosive and hot service.

How does an API RP 571 damage mechanisms course differ from a general corrosion course?

It is organised around refinery mechanisms and units rather than corrosion science alone. A general corrosion course covers electrochemistry and protection, while this one links each mechanism to affected units, failure evidence, inspection techniques and integrity operating windows.

What do you bring back from API RP 571 damage mechanisms training?

You bring back a damage mechanism register for one of your units. It lists corrosion loops, credible mechanisms, matched inspection techniques and operating limits that your inspection and process colleagues can use straight away.

API RP 571 Damage Mechanisms: The Way Forward

The unit damage mechanism register first informs the scope of the next turnaround inspection, deciding which loops receive advanced techniques and which can rely on routine thickness monitoring. Inspection planners, materials specialists and process engineers use it together. After its first use, revisit the register whenever crude slate, catalyst or operating temperature changes, since each shift can activate a new mechanism.