



**Process Equipment & Piping Systems:
Application, Design, Failure Prevention &
Repairs**



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Introduction

Process equipment and piping systems are the backbone of operations within various industries, most notably within the oil and gas sector. The prolonged and efficient function of this equipment piping is vital, as the process equipment and piping design of the prevention and repair course directly impact the reliability and overall performance of a plant.

Given that these systems often handle hazardous service conditions, understanding their damage mechanisms is crucial in preventing catastrophic equipment failure. Predictive maintenance and risk-based inspection are integral components in preventing equipment failure and ensuring the longevity and reliability of equipment oil and gas facilities depend on.

The process equipment and piping design of the prevention and repair course is essential to inspect the process equipment and piping system to detect any damage, characterize it, and assess its impact on the equipment's integrity. With so many pieces of equipment and extensive piping systems and networks, it is impossible to inspect every piece of equipment or piping in a plant. Therefore, an approach based on criticality, i.e., risk-based, takes into consideration the damage mechanisms and failure risk.

Throughout the process of equipment and piping design of the prevention and repair course, you will ensure relevance and enhancement of the terms of the educational experience.

Targeted Groups

- Process, Mechanical, and Chemical Engineers.
- Operation and Maintenance Engineers.
- Project Engineers.
- Supervisors and Managers.
- Technical Personnel are involved in the inspection.

Course Objectives

By the end of this comprehensive process equipment and piping design of the prevention and repair course, participants will acquire a thorough understanding of:

- Mechanical integrity plays a vital role in the sustained operation of both process piping and process equipment.
- The various forms of degradation mechanisms that are prevalent within these systems over time and the methodologies required to predict, identify, and mitigate their effects.
- Essential knowledge and failure analysis skills necessary to perform advanced damage and failure analysis aimed at the prevention of reoccurrence of similar failures.

Targeted Competencies

By the end of this process equipment and piping design of the prevention and repair course, the competencies will acquire a thorough understanding of the following:

- Learn about proficiency in the mechanical design of pressure equipment and piping systems.
- Learn about knowledge of the synergy between design, operation, and maintenance in securing the mechanical integrity of equipment.
- Understand and decipher the degradation and damage mechanisms that jeopardize the operational fitness of process equipment, thus presenting potential failure risks.
- Application of risk-based inspection strategies conforming to API 580 standards.
- Understand competence in implementing NDT methods for effective maintenance and inspection.
- Conduct efficient fitness-for-service assessments according to API 579.
- Learn about failure investigation techniques and root cause analysis.

Course Content

Unit 1: Failure Mechanics

- Wear and failure mechanisms.
- Imperfections and defects.
- Corrosion mechanisms.
- Failure modes.
- Fatigue.
- Fret.
- Learn about creep and thermal fatigue.
- Understand stress corrosion cracking and other modes.
- Carbon and alloy steels.
- Nickel, titanium, and specialty alloys.
- Aluminum and aluminum alloys.
- Copper and copper alloys.
- Plastic piping.
- Learn about alternative options and cladding.
- Limitations and safeguards.
- Discuss the economics of material selection and its life cycle costing.
- Material properties and selection.

Unit 2: Failure Prevention By Design

- Learn about the causes of failure - design, operation, maintenance, and others.
- Material properties and selection.
- Understand the physical properties and limitations of components.
- Understand the physical properties of steel and alloy piping and tubing.
- Physical properties of fittings.
- Basic design.
- Pressure vessels.
- Piping systems.
- Liquid storage tanks.
- Operate and maintenance of process equipment.
- Damage mechanisms affecting process equipment.

Unit 3: Process Equipment Failures

- Understand failures in pressure vessels, piping, and boilers.
- Strength reduction through material loss.
- Case histories.
- Piping system vibration.
- Mechanical and flow-induced resonance.
- Transient hydraulic pulsation.
- Pipe supports and restraints.
- Wind loading.
- Industry practices for failure prevention.

Unit 4: Inspection, Assessment, and Maintenance

- Understand inspection strategies, plans, and procedures for risk-based inspection API 580.
- Develop an RBI plan.
- Fitness-for-service assessment API 579.
- NDT methods and techniques.
- Probability of detection.
- Damage characterization.
- Select the correct techniques.
- Smart pigging.
- Cleaning.
- Operational procedures.
- Complex piping of pipeline systems.

Unit 5: Operation and Maintenance

- Establish of maintenance programs designed to prolong the life and performance of process equipment.
- Learn about detailed instructions on the repair and alteration of pressure equipment and piping.
- Evaluate rerating procedures for piping and pressure vessels.
- Estimate the consequences of pressure vessels and piping failures.
- Understand techniques for failure analysis and estimation of the consequences of potential failures within process equipment and piping systems.