MERCURY

Process Equipment & Piping Systems: Application, Design & Operation

26 April – 7 May 2027
Rome (Italy)



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Process Equipment & Piping Systems: Application, Design & Operation

Ref: 6036_300725 **Date:** 26 April – 7 May 2027 **Location:** Rome (Italy) **Fees:** 10500 Euro

Introduction

The mechanical integrity and reliability of process equipment and piping systems can only be achieved if they are designed by competent engineers and operated and maintained effectively within the design envelope, namely, the integrity operating window IOW.

This process equipment, piping system design, and operation course provides the appropriate mix of fundamentals, methodologies, best industry practices, and practical tools to enhance the competencies and improve the performance of design, operation, and maintenance technical professionals individually and collectively to add value to the organization and improve plant safety and reliability.

Targeted Groups

- Process, Mechanical, and Chemical Engineers.
- Operation and Maintenance Engineers.
- Project Engineers.
- Supervisors and Managers.
- This process equipment, piping system design, and operation course are for technical personnel involved in the inspection.

Course Objectives

At the end of this process equipment, piping system design, and operation course, the participants will be able to:

- Increasing the awareness and understanding of the mechanical integrity of process equipment and piping systems depends jointly on the proper design, operation, condition assessment, and maintenance of the equipment, underscoring their vital individual and team roles in managing change.
- Get practical and sound methods and tools to enable them to carry out basic design calculations for pressure equipment following applicable industrial codes, standards, and best practices.
- Get a clear understanding of the degradation mechanisms that process equipment could be subjected to over their operating life, how to identify them, predict and determine their impact, and what appropriate measures can be taken to prevent and control the resultant damage.
- Gain the knowledge and failure analysis skills they need to conduct damage and failure analysis to prevent similar failures from happening.
- Enhance the knowledge and skills in hazard identification and analysis and risk assessment and management.

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Targeted Competencies

By the end of this process equipment, piping system design, and operation course, the target competencies will be able to:

- Work knowledge in mechanical design of pressure equipment and piping systems in compliance with applicable codes, standards, and regulations - ASME, BPVC section VIII, B31.3.
- Learn about the interdependence of design, operation, and maintenance for achieving mechanical integrity of pressure equipment and piping systems.
- Understand, predict, Identify, and assess active degradation mechanisms and the failures they may cause.
- Learn about failure investigation techniques and root cause analysis.
- Apply risk-based methodologies in inspection and maintenance - API 580.
- NDT methods and their practical application - ASME BPVC Section V.
- Perform level 1 fitness-for-service assessments to the API 579.
- Understand engineering materials properties and selection criteria for specific applications.
- Hazard identification and risk analysis and management.

Course Content

Unit 1: Key Design Considerations, Guidelines, and Practices

- Overview of process equipment.
- Plant integrity and reliability.
- Understand the interdependence of engineering, operation, and maintenance.
- Management of change.
- Fitness for purpose.
- Learn about service conditions, equipment sizing, and functional performance.
- Business-focused facilities - appropriate quality at the lowest life cycle cost.
- Safety by Design.
- Learn about the worst foreseeable credible scenarios, safeguarding, and best industry practices.
- Learn about codes, standards, and industry practices.
- Understand compliance with regulations and acts - HS&E requirements and considerations.

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Unit 2: Design and Operation of Pressure Equipment

- Understand pressure vessels and reactors.
- Materials of construction and standards.
- Basic design methodology.
- ASME boiler and pressure vessel code sections.
- Storage Tanks.
- Types and applications include cone roof tanks and floating roof tanks.
- Basic design methodology.
- Overview of API 650.
- Piping systems.
- Materials of construction and standards.
- Understand basic design methodology - hydraulic design, pressure integrity, and mechanical integrity.
- ASME B31.1 and B31.3.
- Piping flexibility and support.
- Piping system components - valves and fittings classes, ratings.
- Work examples.
- Overpressure protection.
- Understand the types and applications of pressure-relieving devices.
- Code requirements.
- Sizing methodology: API 520 and 521.
- Understand specific operation and maintenance requirements: API 576.

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Unit 3: Design and Operation of Thermal Equipment

- Process heaters.
- Learn about types and configurations: Box type and vertical cylindrical type.
- Thermal and mechanical design.
- API 560 and API 530.
- Boilers.
- Learn about the types and configurations of water tubes, fire tubes, and waste heat recovery boilers.
- Fundamentals of design and operation.
- Operate efficiency and testing.
- ASME BPVC Section 1 and Section 4, ASME PTC-4.
- Heat exchangers.
- Learn about types and applications: shell and tube heat exchangers, plate heat exchangers, and air-cooled heat exchangers.
- Thermal and mechanical design.
- Overview of TEMA standards API 660 and API 661.
- Operate, fouling, and effectiveness.

Unit 4: Design and Operation of Fluid Handling Equipment

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- Pumps:

  - Learn about types and applications of centrifugal and positive displacement.
  - Performance characteristics.
  - Select design considerations and standards ANSI and API 610.
  - Work examples.

- Compressors:

  - Types and applications centrifugal, screw, reciprocating.
  - Design considerations and standards.
  - Operation and troubleshooting.

- Electric motors:

  - Types and applications.
  - Operation and troubleshooting.

- Condition Monitoring:

  - Vibration monitoring.
  - Lubricant oil analysis.

- Troubleshooting:

  - Methodology and Guidelines.
  - Reliability improvement.

Unit 5: Degradation and Condition Assessment of Process Equipment

- Degradation processes.
- Understand corrosion, erosion, fatigue, and hydrogen attack.
- Overview of API 571.
- Understand industrial failures and failure prevention.
- Inspection and testing.
- Learn about inspection strategies, plans, and coverage - The objective function of inspection.
- Learn about Non-Destructive Testing NDT methods and their characteristics and applicability.
- Risk-Based Inspection RBI.
- Overview of API 580 and API 581.
- Fitness-for-service assessment.
- Overview of API 579.
- Work examples.
- Understand maintenance strategies and best practices.
- Learn about the optimum mix of reactive, preventive, and predictive methods.
- Reliability Centered Maintenance RCM.

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Unit 6: Failure Mechanics

- Wear and failure mechanisms.
- Imperfections and defects.
- Corrosion mechanisms.
- Failure modes.
- Fatigue.
- Fret.
- Understand creep and thermal fatigue.
- Stress corrosion cracking, other modes.
- Material properties and selection.
- Carbon and alloy steels.
- Nickel, titanium, and specialty alloys.
- Learn about aluminum and aluminum alloys.
- Copper and copper alloys.
- Plastic piping.
- Alternative options-linings and cladding.
- Limitations and safeguards.
- Understand material selection in the economic life cycle costing.

Unit 7: Failure Prevention By Design

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

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Unit 8: Process Equipment Failures

- Learn about 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 9: Inspection, Assessment, and Maintenance

- Inspection strategies plan and procedures for risk-based inspection API 580.
- Develop an RBI plan.
- Learn about fitness-for-service assessment API 579.
- NDT methods and techniques.
- Probability of detection.
- Damage characterization.
- Select the correct techniques.
- Pigging of pipelines.
- Smart pigging.
- Cleaning.
- Operational procedures.
- Operation and maintenance.
- Maintenance programs.
- Repair and alteration of pressure equipment and piping.
- Rerat piping and pressure vessels.
- Estimate of consequences of pressure vessels and piping failures.
- Failure analysis techniques.