

Course No. 1353

Process Equipment Design & Sizing course

PROCESS ENGINEERING
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The Process Equipment Design and Sizing course provides a comprehensive professional framework for understanding the engineering and operational principles required to select, design, and appropriately size process equipment in industrial and utility facilities. The course focuses on linking process requirements with fluid properties, production capacity, safety, reliability, maintainability, energy efficiency, and asset life-cycle cost to support well-informed and practical design decisions.

Equipment design and sizing decisions directly affect the performance of oil and gas, petrochemical, power, water, utilities, manufacturing, and critical infrastructure facilities. Inappropriate equipment selection, capacity, materials of construction, or operating assumptions can result in reduced efficiency, process instability, increased energy consumption, recurring maintenance, reduced product or service quality, and constraints that limit production capacity and future expansion.

The course presents a structured methodology that begins with defining process requirements, design data, and operating conditions, followed by mass and energy balances, flow and pressure analysis, temperature evaluation, and physical-property assessment. Participants then progress to equipment selection and the preparation of preliminary technical specifications. The course also covers the design considerations of separation equipment, tanks, heat exchangers, pumps, compressors, valves, piping networks, and utility systems.

The course bridges the gap between theoretical design and actual operating conditions by addressing operating ranges, demand variations, spare capacity, flexibility, field constraints, access requirements, maintenance, inspection, control, and process safety. Participants learn how to review design assumptions and evaluate capacity margins, risks, and alternatives before translating requirements into technical documentation and procurement and execution decisions.

Through case studies, technical exercises, and workshops, participants develop the ability to contribute effectively to design projects, modifications, capacity expansions, and equipment performance improvement initiatives. The course supports leaders in making technically sound investment decisions while providing engineers and specialists with practical tools to improve design quality and support long-term asset performance.

Objectives

- Analyze process requirements and relate flow rates, pressure, temperature, and fluid properties to process equipment selection and sizing.
- Evaluate design and operating data to determine normal, maximum, minimum, upset, and future-capacity conditions for selected equipment.
- Develop preliminary mass and energy balances to support equipment sizing decisions, utility requirements, and energy consumption assessments.
- Apply principles for selecting and sizing separators, tanks, heat exchangers, pumps, compressors, valves, piping, and utility systems.
- Evaluate the effects of density, viscosity, composition, temperature, corrosion, solids, and phase behavior on equipment requirements.
- Develop preliminary technical specifications defining equipment duty, capacity, pressure, temperature, materials, performance, safety, and inspection requirements.
- Analyze the relationship between equipment capacity, production throughput, reliability, redundancy, operability, maintainability, and energy efficiency.
- Evaluate potential equipment and system constraints through flow analysis, pressure-drop calculations, heat-transfer requirements, power requirements, and operational control considerations.
- Improve equipment selection decisions by considering capital, operating, maintenance, risk, and whole-life costs.
- Apply structured technical review practices to process flow diagrams, data sheets, vendor quotations, and design assumptions.
- Strengthen coordination among process, engineering, projects, maintenance, reliability, procurement, and HSE functions during engineering solution development.
- Develop a practical action plan for implementing or improving process equipment design and sizing practices within the participant's organization.

Who Should Attend

The Process Equipment Design and Sizing course is designed for managers of engineering, operations, projects, maintenance, reliability, asset management, facilities, plants, and technical services. It is also suitable for managers of design, production, energy, and utilities, as well as executives and decision-makers responsible for capital investments, capacity expansions, operational modifications, facility performance, asset availability, and technical risk management.

The course is particularly relevant to process, chemical, mechanical, energy, utilities, projects, equipment, piping, instrumentation and control, maintenance, reliability, inspection, technical integrity, and engineering professionals. It is also suitable for technical supervisors and engineering analysts working in oil and gas, petrochemicals, power, water, utilities, manufacturing, mining, food, pharmaceuticals, and facilities involving fluid transportation, separation, heating, cooling, compression, or storage.

The course can additionally benefit professionals in procurement, supply chain, contract management, finance, quality, health, safety and environment, risk management, digital transformation, and operational excellence. It is especially valuable for teams involved in preparing technical specifications, reviewing vendor proposals, assessing modifications, planning expansions, improving equipment efficiency, or resolving constraints affecting productivity, quality, and energy consumption.

Learning Outcomes

- By the end of the course, participants will be able to:
- Explain the relationship between process requirements, process equipment design and sizing, and overall facility performance.
- Identify essential design data, including flow rates, pressure, temperature, composition, physical properties, and operating conditions.
- Prepare preliminary mass and energy balances to support capacity evaluation, utility requirements, and energy assessment.
- Define design cases, maximum conditions, operating ranges, flexibility requirements, and required equipment redundancy and capacity margins.
- Evaluate the suitability of equipment types for separation, fluid transfer, heat transfer, storage, control, and utility services.
- Estimate key sizing requirements for separators, vessels, tanks, heat exchangers, pumps, compressors, piping, and valves.
- Analyze the impact of fluid properties and operating conditions on material selection, performance, operability, and maintainability.
- Evaluate pressure drop, thermal load, power requirements, energy consumption, and constraints affecting equipment and system efficiency.

- Prepare preliminary equipment data sheets and technical specifications covering capacity, duty, design conditions, performance, safety, and inspection requirements.
- Review process flow diagrams, piping and instrumentation diagrams, vendor data, and technical assumptions using structured checklists.
- Integrate safety, reliability, maintainability, accessibility, redundancy, and energy-efficiency considerations into equipment design decisions.
- Develop a preliminary plan for designing or reviewing process equipment within a project, facility, or defined scope of work.
- Training Modules

Course Outline

DAY 01

Fundamentals of Process Equipment Design and Design Data

- The role of equipment design and sizing in operational performance, reliability, safety, quality, energy efficiency, and cost management.
- The engineering design life cycle: requirements definition, conceptual design, basic engineering, detailed design, procurement, construction, commissioning, and performance review.
- Essential design data: flow rate, pressure, temperature, composition, density, viscosity, solids, corrosion, and physical properties.
- Design cases, operating ranges, maximum conditions, flexibility, capacity margins, redundancy, and future capacity requirements.

PRACTICAL EXERCISE / DISCUSSION

Review a process data sheet, identify missing information, and determine key assumptions for a selected piece of equipment.

DAY 02

Mass and Energy Balances and Operating Requirements

- Fundamentals of mass balance: identifying inputs, outputs, recycle streams, losses, and side streams.
- Fundamentals of energy balance: thermal loads, electrical requirements, steam, cooling, and compressed-air requirements.
- The relationship between flow rate, volume, residence time, production capacity, and equipment sizing.
- Fluid properties and their effects on heat transfer, pressure drop, pumping, separation, storage, and material selection.

PRACTICAL EXERCISE / DISCUSSION

Prepare a preliminary mass and energy balance and determine equipment capacity requirements for a representative operating case.

DAY 03

Design and Sizing of Major Process Equipment

- Separation Equipment: Fundamentals of sizing separators, vessels, tanks, filtration units, and fluid-treatment systems.
- Heat Exchangers: Thermal duty, temperature differences, preliminary area estimation, fouling, utility requirements, and maintenance considerations.
- Pumps and Compressors: Flow rate, head, pressure ratio, efficiency, performance curves, power requirements, control, and redundancy.
- Piping and Valves: Flow velocity, pressure drop, control requirements, isolation, materials, accessibility, and safety considerations.

PRACTICAL EXERCISE / DISCUSSION

Select appropriate equipment and establish preliminary capacity and performance requirements for a representative process.

DAY 04

Operational Integration, Reliability, and Energy Efficiency

- The impact of equipment loading, operating sequences, process control, and demand variations on actual system performance and capacity.
- Managing pressure losses, energy consumption, heat recovery, and the efficiency of pumps, compressors, and heat exchangers.
- Integrating maintainability, inspection, accessibility, isolation, spare parts, and reliability requirements into equipment design.
- Identifying bottlenecks and constraints and evaluating technical alternatives for capacity expansion and equipment performance improvement.

PRACTICAL EXERCISE / DISCUSSION

Assess an equipment system to identify operational constraints and opportunities to improve reliability and energy efficiency.

DAY 05

Specifications, Technical Review, and Design Execution

- Preparation of process equipment specifications and data sheets, including performance requirements, materials, testing, inspection, and documentation.
- Review of process flow diagrams, piping and instrumentation diagrams, equipment lists, and vendor documentation.
- Evaluation of vendor proposals, review of technical deviations, verification of specification compliance, and coordination of project interfaces.
- Risk and change management, testing, commissioning, operational readiness, handover, and lessons learned.

FINAL WORKSHOP AND IMPLEMENTATION PLAN

Develop a 90-day action plan for improving process equipment design and sizing practices, including priority equipment, required data, technical reviews, responsibilities, implementation stages, and performance indicators.



Register or Request More Information

Course page: <https://quest-training.com/courses/process-equipment-design-sizing-course>

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