

Heat Exchangers: Design, Operation, Maintenance and Performance Optimisation

Duration: 5 Days

Language: en

Course Code: IND04 - 134

Objective

By the end of this course, participants will be able to:

- Identify and compare the major types of heat exchangers and their industrial applications
- Understand the principles of heat transfer and their influence on exchanger design
- Apply key design parameters to size and evaluate thermal and hydraulic performance
- Diagnose operational issues such as fouling, corrosion, and vibration
- Conduct inspections and apply effective maintenance and cleaning techniques
- Use performance monitoring tools to assess and enhance exchanger efficiency
- Apply international standards and best practices in exchanger design and operation

Audience

This course is ideal for:

- Maintenance and reliability engineers
- Mechanical and process engineers
- Inspection and QA/QC personnel
- Operations supervisors and plant operators
- Engineering consultants and technical managers
- Anyone involved in design, operation, or troubleshooting of thermal systems

Training Methodology

The course follows a workshop-based approach that combines technical presentations, real-world case studies, calculation examples, and interactive problem-solving exercises. Practical scenarios are used to reinforce understanding, and participants are encouraged to bring operational challenges for group discussion and expert feedback.

Summary

Heat exchangers are vital components in energy-intensive industries such as power generation, oil & gas, chemical processing, and HVAC. Their performance directly impacts process efficiency, safety, and equipment longevity. This training course provides a comprehensive overview of the

types, working principles, design considerations, operational behaviour, and maintenance practices of industrial heat exchangers.

Focusing on widely used designs—including shell-and-tube (STHE), air-cooled (ACHE), and plate heat exchangers (PHE)—this course equips engineers, technicians, and plant professionals with the knowledge to select, operate, inspect, and troubleshoot heat exchangers effectively. Special attention is given to thermal and hydraulic design, international standards, fouling mitigation, mechanical integrity, and performance optimisation.

Course Content & Outline

Section 1: Types, Components, and Industrial Applications

- Classification and function of heat exchangers:

1. Shell-and-Tube (STHE)
2. Air-Cooled (ACHE)
3. Plate Heat Exchangers (PHE)
4. Condensers, reboilers, evaporators

- Heat exchanger components: tube bundles, baffles, nozzles, tube sheets
- Heat transfer fundamentals: conduction, convection, and flow arrangements
- TEMA standards and exchanger nomenclature
- Selection criteria based on application, fluids, and performance requirements
- Industry-specific case studies

Section 2: Thermal and Hydraulic Design Principles

- Relationship between temperature difference, flow rate, and heat duty
- Sizing and rating calculations:

1. LMTD and NTU methods
2. Overall heat transfer coefficient

- Hydraulic performance: pressure drop, fluid velocity, pumping power
- Design of air-cooled exchangers: fan sizing, airflow, energy efficiency
- Compact design considerations for PHE and spiral units
- Workshop: sample design calculations and sizing exercises

Section 3: Mechanical Design, Materials, and Fabrication

- Mechanical loading on exchanger components
- Material selection for tubes, shells, gaskets, and plates

- Nozzle loads and allowable stresses
- Mechanical design standards and fabrication codes (ASME, API, TEMA)
- Welding, expansion, and joining technologies
- Common design failures and how to prevent them
- Workshop: evaluating construction methods and mechanical design constraints

Section 4: Operation, Maintenance, and Troubleshooting

- Operational challenges: fouling, scaling, vibration, flow maldistribution
- Monitoring and control of tube-side and shell-side conditions
- Inspection methods: visual, ultrasonic, IR thermography, borescope
- Corrosion and erosion mechanisms and mitigation strategies
- Fitness-for-service assessments and mechanical integrity evaluations
- Maintenance practices: mechanical cleaning, chemical descaling, re-tubing
- Tube plugging criteria and vibration control solutions
- Workshop: troubleshooting scenarios and field failure investigations

Section 5: Performance Monitoring and Enhancement Techniques

- Key performance indicators: thermal efficiency, pressure drop, flow distribution
- Testing procedures and performance benchmarking
- Heat transfer enhancement techniques:

1. Fin-tube designs
2. Surface treatments and turbulator inserts

- Basics of heat integration and energy recovery
- Introduction to Pinch Analysis for process optimisation
- Strategies for extending equipment life and reducing downtime
- Workshop: performance analysis using real operating data

Certificate Description

Upon successful completion of this training course, delegates will be awarded a Holistique Training Certificate of Completion. For those who attend and complete the online training course, a Holistique Training e-Certificate will be provided.

Holistique Training Certificates are accredited by The CPD Certification Service (CPD), and are certified under ISO 9001 and ISO 29993 standards.

CPD credits for this course are granted by our Certificates and will be reflected on the Holistique

Training Certificate of Completion. In accordance with the standards of The CPD Certification Service, one CPD credit is awarded per hour of course attendance. A maximum of 50 CPD credits can be claimed for any single course we currently offer.

Categories

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Tags

Thermal design, Hydraulic Design, Thermal design, Heat Exchangers, Hydraulic Design, Heat Exchangers

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