



# **MUE109**

## **Preventive Maintenance & Troubleshooting of Pumps and Compressors**

## Course Introduction:

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This course is designed to provide delegates with a detailed and up-to-date overview of the fluid mechanic fundamentals and operating practice of pumps, compressors and turbines. It will address aspects of both axial and centrifugal compressors. Upon the successful completion of this course, participants will have acquired the practical knowledge to enable them not only to choose the correct device for a particular application but also and be in a position to resolve many commonly occurring operating problems.

This course is ideal for those personnel in the oil, gas, petrochemical, chemical, power and other process industries who require a wider and deeper appreciation of pumps, compressors and turbines, including their design, performance and operation. No prior knowledge of the topic is required. Participants will be taken through an intensive primer of turbo-machinery principles, using the minimum of mathematics, and will learn how to solve the many and varied practical industrial problems that are encountered.

## Course Objectives:

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**Upon successful completion of this course, the delegates will be able to:**

- ✓ Understand the different types of turbo machinery including basic design aspects and highlighted problem areas
- ✓ Understand the ideal gas equation including its practical application and be familiar with the isentropic processes of ideal gases
- ✓ Know how to minimize compressor work by understanding the processes involved and identifying their efficiency
- ✓ Be able to explain the general relationship between the Momentum and Bernoulli equations for incompressible fluids
- ✓ Be familiar with the axial flow compressor and the corresponding velocity triangles including torque and power calculations
- ✓ Learn the different types of centrifugal machines and pumps including their design, installation, operation, maintenance, re-rate/retrofit and troubleshooting
- ✓ Be aware of the affinity laws and their application to the various effects in pumps, compressors and turbines
- ✓ Understand the concepts of specific speed and radius applied to pumps, compressors and turbines
- ✓ Recognize the various beneficial design aspects of turbo machines and understand the crucial process of cavitation in pumps
- ✓ Be able to carry out the proper methods of centrifugal pumps installation, operation, maintenance and troubleshooting

# Who Should Attend?

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This course is intended for the following:

- Maintenance Managers, engineers, superintendents, supervisors, foremen and senior technicians
- Plant Managers, engineers, superintendents, supervisors, foremen and senior technicians
- Operations Managers, engineers, superintendents, supervisors, foremen and senior technicians
- Production Managers, engineers, superintendents, supervisors, foremen and senior technicians
- Project Managers, engineers, superintendents, supervisors, foremen and senior technicians
- Machinery and rotating equipment engineers, foremen and senior technicians
- Engineering managers, process engineers, mechanical engineers, reliability and technical integrity engineers

## Course Outline:

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### Day 1:

#### **Pump Fundamentals**

- Fluid Principles and Hydraulics
- Classification and Types
- Centrifugal Pumps
- Special Pumps
- Reciprocating Pumps
- Rotary Pumps
- Hydraulic principles
- Static head Vs suction lift
- Momentum equation
- Pumping system and design
- Determination of TDH, NPSH
- Determination of power requirements
- Pump selection

## Centrifugal Pumps

- Types
- Axial Flow
- Mix Flow
- Radial Flow
- Application and performance considerations
- Pump performance curves
- Developing system-head curves
- Developing pump performance curves for parallel/series operation
- Pump components and variations in design
- Centrifugal pump types and selection criteria
- Applicable standards and specification selection
- Centrifugal pump installation
- Piping installation guidelines
- Pump driver considerations
- Limitations, operating/maintenance considerations and trouble-shooting
- Application and performance considerations
- Installation considerations
- Limitations, operating/maintenance considerations and trouble-shooting

### Day 2:

## Reciprocating Pumps

- Types
- Piston/Plunger
- Diaphragm
- Application and performance considerations
- Selection criteria
- Flow characteristics
- Mechanical components
- Piping installation guidelines
- Pulsation and vibration considerations
- Pump driver considerations
- Applicable standards and specification selection
- Limitations, operating/maintenance considerations and trouble-shooting

## Rotary Pumps

- Types
- Vane
- Piston
- Peristaltic

- Gear
- Lobe
- Screw (Progressing Cavity)
- Basic Principles
- Gear Pumps
- Single and Multi-Lobe Pumps
- Single-Lobe Pumps
- Components
- Operation
- Displacement
- Pressure Capability
- Torque and Power Requirements
- Pump Geometric Variations
- Pump Manufacturing Processes
- Designations and Specifications
- Elastomers
- Pump Testing, Sizing and Failure Identification
- System Design Components, Considerations and Processes
- Applications
- Installation and Trouble-shooting
- Applicable standards and specification selection

### **Day 3:**

#### **Energy Reduction in Pumping Systems**

- Opportunities for Potential Savings
- Pump Economics
- Designing a Pumping System for maximum efficiency
- Pump Performance Characteristics
- Avoiding Excessive Capacity and Total Head Margins
- Selecting the most efficient pump
- Using Variable Speed Drives
- Proper Pump Maintenance

#### **Overview of Compressors**

- Terminology and Classification
- Reciprocating compressors
- High-speed "separable" units
- Low-speed "integral" units
- Rotary compressors
- Vane units

- Screw units
- Centrifugal compressors
- Application of compression theory
- How to select a compressor
- Determining BHP, discharge temperature, isentropic head
- Applicable standards and specification selection

#### **Day 4:**

##### **Centrifugal Compressors**

- Major components
- Operating principles
- Typical Compressor Installations
- Process considerations
- Series and parallel operation
- Factors affecting performance
- Performance map interpretation
- Surge control and stonewall considerations
- Piping installation guidelines
- Preventive maintenance and trouble-shooting
- Applicable standards and specification selection

##### **Positive Displacement Compressors**

- Rotary compressors and blowers
- Operating principles
- Lobed blowers
- Sliding-vane
- Screw
- Liquid piston
- Performance considerations
- Reciprocating compressors
- Major components
- Operating principles
- Design considerations
- Process considerations
- Pulsation and vibration considerations
- Piping installation guidelines
- Preventive maintenance and trouble-shooting
- Applicable standards and specification selection



### Day 5:

#### **Application of Compressor Theory and Practical Solutions to Common Problems**

- Determining Compressor Parameters'
- Developing a Compressor Performance Curve
- Determining the Operating Range of a Compressor
- Effects of adding Clearance on Compressor Performance
- Effects of Speed on Compressor Performance
- Determining the Safety Device Set Points
- Designing a Multi-stage Compressor

## **Course Certificate:**

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**International Center for Training & Development (ICTD)** will award an internationally recognized certificate(s) for each delegate on completion of training.

## **Course Methodology:**

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**A variety of methodologies will be used during the course that includes:**

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

## **Course Fees:**

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**To be advised as per the course location.** This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

## Course Timings:

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### Daily Course Timings:

08:00 - 08:20	Morning Coffee/Tea
08:20 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Coffee/Tea/Snacks)
13:30 - 15:00	Last Session

