Training Title

PUMPS AND COMPRESSORS: DESIGN, OPERATION, MAINTENANCE AND TROUBLESHOOTING

Training Duration

5 days

Training Duration & Venue

ME035	Pumps & Compressors- Design, Operation, Maintenance & Troubleshooting	5	28 July - 01 August 2025	$6,000	Kuala Lumpur, Malaysia

Training will be held at any 4 or 5-Star Hotels. The exact venue will be informed of later.

Training Fees

- **$6,000 sper participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Lunch**

Training Certificate

Define Management Consultancy & Training Certificate of course completion will be issued to all attendees.

TRAINING INTRODUCTION:

Pumps and compressors find extensive use in petrochemical process plants, water circulation systems, A/C and heating systems, and many other applications. Keeping these machines running with the least troubles and shutdown decreases the downtime of the whole system. Right machine selection appropriate to the right application, right machine operation, effective maintenance programs, reliable monitoring system, and skilled personnel capable of doing the right trouble shooting are essential requirements for prolong machine life. All the above can be achieved via deeper understanding of the machine's construction and tolerances, the limits and constraints on their operation, and the more effective controlling methods.

This course will offer the opportunity to learn more about pumps and compressors, their design, construction, operation, performance curves, control and troubleshooting and maintenance. During the course participants' discussion, comments, bringing up their own problems are welcomed and encouraged. Short tests on the course material will be performed to examine the degree of delivering the right and quality of the presented material.

TRAINING OBJECTIVES

- **Review the basics of Pumps and Compressors**

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- **Learn how the performance curves of Pumps and Compressors are measured and calculated.**
- **Use the similarity laws to calculate the Pumps/Compressors performance at different speed and rotor size.**
- **Learn methods of troubleshooting and maintaining Pumps/ Compressors**
- **Highlight the importance of the related international codes and standards.**

TRAINING METHODOLOGY:

A highly interactive combination of lectures and discussion sessions will be managed to maximize the amount and quality of information and knowledge transfer. The sessions will start by raising the most relevant questions and motivate everybody to find the right answers. You will also be encouraged to raise your own questions and to share in the development of the right answers using your own analysis and experiences. Tests of the multiple-choice type will be made available on a daily basis to examine the effectiveness of delivering the course.

All presentations are made in excellent colorful power point. Very useful Course Materials will be given.

- **30% Lectures**
- **30% Workshops and work presentation**
- **20% Group Work& Practical Exercises**
- **20% Videos& General Discussions**

WHO SHOULD ATTEND

Supervisors, Engineers & Facility/Utility engineers, Technicians, Operating Personnel or anyone require a working level knowledge of pumps & compressors.

Competencies Emphasized

- **Deepen the understanding of the function of different types of pumps and compressors.**
- **Understanding the characteristics of pumps and compressors**
- **Learning how to read and use the performance curves of Pumps and Compressors.**
- **Understand the limits of operation of pumps and compressors.**
- **Learn more about cavitation in pumps and surge in compressors and methods of avoiding these vital problems.**
- **Ability to carry out troubleshooting of pumps and compressors and learn methods of curing different types of problems.**

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COURSE OUTLINE

Chapter I
Pump Types and Performance

- **Types Of Pumps**
  1. **Centrifugal**
  2. **Displacement**
- **Pumping methods**
  1. **Centrifugal action**
  2. **Displacement action**
  3. **Rotary displacement pumps**
- **Pumps performance curves**
  1. **Head-Capacity curve**
  2. **Power-Capacity curve**
  3. **Efficiency-Capacity curve**
  4. **NPSH-Capacity curve**
  5. **Limits of operation**
  6. **Characteristics curves for different types of pumps**
  7. **How to obtain these curves experimentally**
  8. **How to calculate these characteristic curves**
- **Specific speed and specific diameter**
  1. **The significant of the Specific Speed and the Specific Diameter**
  2. **How to calculate these numbers**
  3. **How to use these number in pumps selection process**
- **Parameters affecting the pump performance.**
  Similarity Laws
  1. **The effect speed variation**
  2. **The effect of impeller trimming**

Chapter II
Pumps Operation

- **Operating conditions**
  1. **Pump curve against Piping system curve**
  2. **System curve calculation**
  3. **NPSH available and required.**
  4. **Suction system configurations**
  5. **NPSH measurement**
- **Design operating conditions**
  1. **Normal operating range**
  2. **Best operating condition**
  3. **Range of pumps operation**

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4. The minimum flow rate limit
5. The maximum capacity limit.

- Off-design operation
  1. Pre-rotation
  2. Re-circulation
  3. Transient operation
  4. Pump surge
- Parameters affecting pump operation.
- Basic requirements for trouble-free operation
  1. Cavitation
  2. Minimum flow rate
- Operation difficulties
  1. NPSH available
  2. Air leakage
  3. System working pressure.
  4. Reduced flow
  5. Parallel operation

Chapter III

Pumps selection

- Pumps standards
  1. Hydraulic Institute Standard
  2. API standard
  3. How to use standards for pumps selection
  4. How standards differ from each other
  5. How to use standards to write the right specification for pumps
- Overall procedure in selecting a pump
- Parameters affecting the pump selections
  1. Properties of liquids being pumped
  2. Material selection
  3. Manufacturer data and curves
  4. Economic consideration
  5. Pumps application
  6. Comparison between different types
  7. Essential data required

Chapter IV

Positive Displacement Compressors

- Compression Methods
  1. Intermittent compression

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2. Reciprocating and Rotary compressors
3. Continuous compression
4. Axial and Centrifugal
5. Features and comparison

- Types of Reciprocating Compressors
  1. Trunk type
  2. Crosshead type
  3. Lubricated & non-lubricated
  4. Single & Double acting
- Compression cycle
  1. Internal compression
  2. Clearance volume
  3. Intercooling effect
  4. Volume ratio
  5. Pressure ratio
- Capacity control
  1. Clearance pockets
  2. External bottles
  3. Valve unloader
  4. Bypass port
- Pulsation control
- Rotary Compressors
  1. Screw compressors
  2. Sliding vane compressors

Chapter V
Centrifugal Compressors

- Basic Components
  1. Rotating elements
  2. Stationary parts
  3. Compressor seals
- Centrifugal classification
- Centrifugal arrangement
- Performance curves
  1. How to read performance curves
  2. Surge line and stone line
  3. Blade curving angle effect
  4. Volume ratio effects
  5. Quadrant curve
- Fan Laws
  1. The effect of speed variation

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2. The effect of trimming the rotor
3. Limit on the speed
4. Multistage
5. Intercooling effect

- Operation of centrifugal Compressors
  1. System Characteristics
  2. Volume ratio effect
  3. Effect of MW variation
  4. Inlet Pressure and Temperature effects
  5. Effect of Rotational speed
- Compressor Control
  1. Motor driven compressors
  2. Turbine Driven Compressors
  3. Automatic control system
  4. Pressure control
  5. Flow control
  6. Parallel flow
- Compressor Surge
  1. What causes surge
  2. Surge control

Chapter VI
Troubleshooting & Maintenance

- Principles of troubleshooting
  1. Principles
  2. Failure modes
  3. Statistics of more frequent troubles
- Maintenance
  1. Maintenance strategies
  2. Measuring methods
  3. Monitoring and Data collection
- Reasons of Failure
- Mechanical seals
  1. Wet and dry type
  2. Compressors versus Pumps shaft seals
  3. Piping systems
  4. Why seals fails
- Bearings
  1. Roller antifriction types
  2. Journal bearings
  3. Range of applications

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4. Lubrication of bearings
5. Lube-oil systems

- Shaft deflection
  1. Critical speed and shaft deflection
  2. Parameters affecting shaft deflection
  3. Effects of shaft deflection on Mechanical seals and Bearings
- Cavitation in pumps
  1. Net Positive Suction Head
  2. Available against required NPSH
  3. Effects of Cavitations
  4. Cures for cavitation
- Surge in compressors
  1. Causes of compressor surge
  2. Surge and compressor performance
  3. Anti-surge methods
- Off-design operating conditions
  1. Variation in inlet conditions
  2. Multistage compressors performance
  3. Compressors in parallel operation

Case Studies

Misalignment Problems
Bearing failures
Mechanical seals failures
Unbalance problems
Thrust bearing balancing system failures

NOTE:
Pre & Post Tests will be conducted
Case Studies, Group Exercises, Group Discussions, Last Day Review &Assessments will be carried out.

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