

**Training Title**

**MECHANICAL EQUIPMENTS: COMPRESSORS, PUMPS, SEALS, SPEED DRIVES, CONTROL VALVES & ACTUATORS & SAFETY RELIEF VALVES**

**Training Duration**

5 days

**Training Venue and Dates**

REF ME059	Mechanical Equipments: Compressors, Pumps, Seals, Speed Drives, Control Valves & Actuators & Safety Relief Valves	5	28 April – 2 May, 2019	\$4,500	Dubai, UAE
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In any of the 5 star hotels. Exact venue will be informed later.

**Training Fees**

- 4,500 US\$ per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Buffet Lunch

**Training Certificate**

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

**TRAINING INTRODUCTION**

The seminar will introduce delegates to the different types of pumps, motors and drives and their associated terminology. Centrifugal and positive-displacement pumps and compressors, packing, mechanical seals and sealing systems, bearings and couplings will all be discussed.

The application of the different types of pumps and compressors will be discussed along with their suitability for different operational duties. Pump operation, troubleshooting and maintenance will be dealt with in depth.

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**TRAINING OBJECTIVES**

At the end of this seminar participants will have:

- Have an understanding of the different types of pumps and compressors.
- Be able to operate pumps and compressors as close as possible to the design efficiency.
- Will be able to monitor pump and compressor efficiency, availability and reliability.
- Have learnt about selection, operation and maintenance strategies.
- Be able to troubleshoot pump and compressor problems.

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## 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 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 multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course.

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?

This seminar is directed towards Supervisors, Team Leaders and Professionals in Maintenance, Engineering and Production. It is suitable for who expects to become involved at any stage in project applications and applicable maintenance technologies. The seminar will also benefit anyone those wishes to update themselves on pump and compressor technology, judge the suitability of different types of pumps and compressors for their needs, and learn how to operate and maintain them for the benefit of their organisations.

## TRAINING OUTCOME

- Understanding of pump and compressor operating and maintenance techniques.
- Ability to put in place measures to quantify equipment condition.
- Interface with pump and compressor equipment providers.
- Identify and specify new and replacement pumps and compressors.
- Enable the delegate to develop a proactive maintenance regime within the organisation.
- Allow tighter control of maintenance budgets by the avoidance of unplanned equipment failures in service.
- Enable the delegate to optimise the operation and maintenance of different types of pumps and compressors.
- Give the delegate confidence to carry out failure analyses on pumps and compressors thereby avoiding repetitive failures

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## DAILY OUTLINE

### Compressors

- Compressor types: positive displacement (reciprocating and rotary), and dynamic (centrifugal and rotary), compressor operation, gas laws
- Compressor performance measurement, inlet conditions, compressor performance, energy available for recovery
- Positive displacement compressors, reciprocating compressors, reciprocating compressors, diaphragm compressors.
- Rotary compressors, rotary screw compressor, lobe type air compressor, sliding vane compressors, liquid ring compressors
- Dynamic compressors, centrifugal compressors, axial compressors
- Air receivers, compressor control, compressor unloading system
- Intercoolers and aftercoolers, filters and air intake screens

### Centrifugal & Axial Compressors

- Principle of operation of centrifugal and axial flow compressors, characteristics of centrifugal and axial flow compressor
- Surging, choking, bleed valves, variable stator vanes, inlet guide vanes

### Compressor Systems Calculations

- Affinity Laws for centrifugal compressors
- Calculations of air leaks from compressed-air systems, annual cost of air leakage
- Centrifugal compressor power requirement
- Compressor selection, calculations of air system requirements
- Characteristics of reciprocating compressors and blowers
- Selection of air distribution system, water cooling requirements for compressors
- Sizing of compressor system components, sizing of air receiver
- Calculations of receiver pump-up time

### Pumps

- Pump definition, pump categories: dynamic and displacement reciprocating & rotary
- Centrifugal pumps: theory of operation of a centrifugal pump, casings and diffusers, radial thrust, hydrostatic pressure tests

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- Impeller, axial thrust, axial thrust in multistage pumps, hydraulic balancing devices, balancing drums, balancing disks
- Centrifugal pumps general performance characteristics, cavitations, net positive suction head and requirements

### Bearings & Lubrication

- Types of bearings, ball and roller bearings, stresses during rolling contacts
- Statistical nature of bearing life, materials and finish, sizes of bearings, types of rolling bearings, thrust bearings
- Used oil Analysis: proper lube oil sampling technique, test description and significance, visual and sensory inspections, chemical and physical tests, water content, viscosity, emission spectrographic analysis, infrared analysis, total base number (TBN), total acid number (TAN), particle count, summary

### Positive Displacement Pumps

- Reciprocating pumps, piston pumps, plunger pumps, rotary pumps, screw pumps, lobe pump
- Cam pumps, vane pumps, metering pumps

### Pump Selection

- Engineering of system requirements, fluid type, system head curves, alternate modes of operation, margins, wear, future system changes
- Selection of pump and driver, pump characteristics, code requirements, fluid characteristics, pump materials, driver type
- Pump specification, specification types, data sheet, codes and standards, bidding documents, technical specification, commercial terms, special considerations, performance testing, pump drivers
- Special control requirements, drawing and data requirements form, quality assurance and quality control, bidding and negotiation
- Public and private sector, bid list, evaluation of bids, cost, efficiency, economic life, spare parts, guarantee/warranty, simple bid evaluation

### Mechanical Seals

- Basic components, temperature control, seal lubrication/leakage, typical single inside pusher seal
- Maintenance recommended on centrifugal pumps, recommended pump maintenance

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- **Vibration Analysis & Predictive Maintenance**
- **Vibration instrumentation, velocity transducer, acceleration transducer, transducer selection, time domain, frequency domain, machinery example, vibration analysis**
- **Vibration causes, forcing frequency causes, unbalance, misalignment, mechanical looseness, bearing defects, gear defects, oil whirl, blade or vane problems, electric motor defects, uneven loading, drive-shaft torsion**

### **Maintenance of Motors**

- **Introduction to AC induction motors and their construction, rotor slip and principles of operation, equivalent circuit, torque-speed characteristics, motoring and regenerative region of operation**
- **Starting of induction motors and associated techniques**
- **Speed control methods of induction motors**
- **Characteristics of motors, enclosures and cooling methods, application data, design characteristics, insulation of AC motors**
- **Failures in three-phase stator windings, predictive maintenance, motor troubleshooting, diagnostic testing for motors**

### **Control Valves:**

- **Types and Construction**
- **Control Valves sizing and selection**
- **Actuators and Control**
- **Safety and Relief Devices:**
- **Setting Pressure**
- **Sizing and Installation**
- **Maintenance and Troubleshooting**

### **Variable Speed Drives**

- **Basic principles of AC Variable-Speed Drives (VSD's), constant power (extended speed) region, four quadrant operation**
- **AC drive applications issues, Line power factor, Cabling details for AC drives, cable details, motor, cable**
- **Summary of application rules for AC drives and selection criteria**
- **Maintenance, common failure modes, motor application guidelines**

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- Control systems, low performance and open loop operation, medium performance and closed loop operation, high performance and closed loop operation, current feedback control, speed control, sensor less drives, evaluation and comparison.
- Industry standards and case studies.

**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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P.O BOX 45304  
ABU DHABI, U.A.E

T +971 2 6264455  
F +971 2 6275344

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