

**Training Title**

**Pumps Operation Maintenance & Troubleshooting Training**

**Training Duration**

5 days

**Training Venue and Date**

Pumps Operation Maintenance & Troubleshooting	5	21-25 February	\$3,300	Abu Dhabi
Pumps Operation Maintenance & Troubleshooting	5	27 June - 1 July	\$3,300	Bahrain
Pumps Operation Maintenance & Troubleshooting	5	November 28 - December 2	\$3,300	Dubai

In any of 5 star hotel. Exact venue will be informed later.

**Training Fees**

- 3300 US\$ per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Buffet Lunch

**Training Certificate**

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

**Who Should Attend**

The course is designed for plant safety specialists, maintenance engineers and technicians, maintenance planners, system engineers and operators in the power generation, oil, chemical, paper and other processing industries involved in pumps selection, specification, procurement, inspection, troubleshooting or repair. Mechanical and operation engineers and senior technicians who are responsible for specifying, selecting, operating, and troubleshooting and maintaining pumps.

**Description**

Pumps Troubleshooting means to find the root cause behind the problems or failures of the pump. Troubleshooting is a complete exercise involves number of activities that need to be practiced carefully and accurately for the troubleshooting to be successful. A good monitoring system, enough instrumentations, adequate data recording system, expert edition process of the accumulated data, right technique and analysis, need to be available. Of course troubleshooter must be deeply understand and familiar with the machine he is troubleshooting, the design, operation, oil systems, flushing systems, bearings, balancing systems, type of mechanical seals, and the application.

The course will discuss all aspects concerning pumps, familiar the participant with the details of pumps, different designs, application, operation, maintenance and potential problems and their possible root causes, and methods of eliminating or reducing the failure causes, methods analysis to find out the root causes of failures, and methods of curing such problems. A successful troubleshooting method increase the uptime of machines, increase the profitability of the plant, and assure more safety for machines and personnel and minimize the cost of maintenance.

### **Training Objectives:**

- Deep understanding of the pumps' different designs for different applications
- Familiarize the participants with different auxiliary systems for pumps, oil system, mechanical seals, flushing systems, balancing systems and alike
- Learn the performance, limit of operations and common causes of failures of pumps
- Learn methods of failure analysis, like oil analysis, vibration measurements, etc...
- Learn the principles and elements of troubleshooting methodology
- Learn the appropriate strategy of maintenance
- Exercise the troubleshooting on real cases

### **Course 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. The delegates will also be encouraged to raise their own questions and to share in the development of the right answers using their own analysis and experiences. Tests of multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course.

### **OUTLINE :-**

#### **Day One**

##### **1. Pumps: Performance, Control and Operation**

###### *Manufacturer Characteristic Curves*

How to obtain pump performance curves experimentally

How to calculate pump performance curves operated at different speed

How to calculate pump performance curves for different impeller size

How to correct pump characteristics for fluid viscosity

Effect of suction conditions on pump characteristics

Positive displacement pumps Metering Feature

###### *Limits of Operation*

ISO and ASME characteristic curves

Preferred range of operation

Allowable range of Operation

Pump cavitation, NPSH<sub>r</sub>  
Pumps minimum flow rate limit  
*Pumps Controls*  
Pump and System interaction  
Variation of operating conditions  
Protective controls  
Capacity control  
Modification by speed variation  
Modification by valve positioning

## Day Two

### 2. Pumps: Selection, Standards, and Specifications

#### *Pumps Standards:*

ANSI, HI, API, ASME, ISO standards

How standards differ

Standards tolerances

#### *Pumps Application*

Boiler Feed Pumps

Pump capacity, suction conditions, and discharge pressure

Condensate Pumps

Extremely low NPSH<sub>A</sub>

Water works

Ground and surface water sources

Petroleum refinery service pumps (API-610)

Production, transportation and refining, high degree of standardization

Chemical pumps

The widest variety of pumping problems, corrosive and corrosive-abrasive liquids

Paper stock and process pumps

Similar to chemical pumps, non-clogging impellers

Sewage and waste water

Submersible pumps

Food and beverage sanitary pumps

Cleanliness and Contamination problems and Dispensing

Air conditioning and refrigeration pumps

Sodium chloride and calcium chloride brines

#### *The piping system to serve*

System Head curve

How to calculate friction loss

Suction system configurations, NPSH<sub>A</sub>

How to calculate NPSH<sub>A</sub>

#### *Pumps ratings*

Head, Capacity and Power

Manufacturer Data

How to read through the manufacturer catalogues

Manufacturer Selector Chart

*Specifications and inquiries*

Preparing pump inquiries

Inquiries for specific services

Water works services

Chemical services

Petroleum services

### **Day Three**

#### **3. Pumps: Design, Materials and Seals**

*Types of Pumps*

Positive displacement pumps

Rotary Pumps

Dispensing Pumps

Metering Feature

Centrifugal pumps

Axial flow pumps

Multistage pumps

*Special design pumps*

Vertical pumps

Seal-less magnetic drive pumps

Submersible wastewater pumps

Multi-phase pumps

*Pumps fittings*

Standard fitted pump

All bronze, all iron, acid-resisting and salt water pumps

*Material Selection, pH value, and galvanic corrosion*

*Mechanical seal selection*

Single seals

Double seals

Cartridge seals

Dry gas seals

*Seal flush and circulation plans*

### **Day Four**

#### **4. Pumps: Failure Analysis, Troubleshooting and Maintenance**

*The six sigma problem solving method 'DMAIC'*

(Development, Measurement, Analysis, Improvement, and Control Phases)

*Pump condition monitoring*

Vibration Analysis

Vibration severity charts

The head-Flow Method  
Shut-off Head Method  
Thermodynamic Method  
Balance Flow Measurement  
*Reasons for Failures*  
Mechanical  
Mechanical seal  
Shaft deflection  
Lubrication system  
Balancing system  
Operational  
Reduced NPSH  
Low flow operation  
Cavitation  
Parallel flow operation  
Maintenance Strategies  
Preventive Maintenance  
Predictive Maintenance  
Proactive Maintenance

## **Day Five**

### **5. Case Studies**

- a. system resistance reduction
- b. system resistance increase
- c. pump internal wear
- d. pump internal leakage
- e. pump foundation deterioration
- f. cavitation effect
- g. erosion and corrosion effect
- h. wearing ring problem

### **6. Delegates case studies**

Each group supposes to bring with them their own cases in order to analyze them and come up with the root cause behind the failure. The case should be supported with the necessary documents: the pump catalogue, the piping system, the type of service, the description of the problem, and the measurement carried out.

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