



## COURSE OVERVIEW ME0615 Operation, Maintenance & Troubleshooting of Pumps & Compressors

### Course Title

Operation, Maintenance & Troubleshooting of Pumps & Compressors

### Course Date/Venue

January 21-25, 2024/Waha Meeting Room, Pullman Doha West Bay, Doha, Qatar

### Course Reference

ME0615

### Course Duration/Credits

Five days/3.0 CEUs/30 PDHs



### Course Description



***This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.***



Pumps and compressors are used extensively in the process industries. There are many types with widely varying configurations and applications. They represent a significant part of the capital and operating costs of most plants, and optimizing their selection, operation and maintenance are therefore, of major economic importance.

The course deals with efficiencies, operating characteristics, reliability, maintenance and troubleshooting implications of pumps and compressors.



The course will cover the operating principles of pumps and compressors, specifications, thermodynamics, effects of efficiency on operating costs, energy usage, and effect on plant costs, materials of construction, selection, troubleshooting and maintenance.

The course will also cover plant run-length extension surveys, organizing for successful turnarounds and on-going reliability improvement, and preventive vs. predictive maintenance strategy decisions.



The course will provide the participant with a basic as well as advanced pump and compressor technology knowledge, inventory required to successfully select, apply, operate, troubleshoot and maintain pumps and compressors.

At the end of this course, participants will have gained a thorough understanding of the various types of pumps and compressors available to most industrial users, including sizing and application criteria, maintainability, reliability, vulnerability and troubleshooting issues. Participants will learn simple techniques and short-cut methods of machinery sizing and selection. This replaces tedious hand or other methods of calculation and will serve as a fast way to arrive at sensitivity or influence of parameter changes on equipment performance.

### **Course Objectives**

Upon the successful completion of this course, each participant will be able to:-

- Apply systematic techniques in the operation, maintenance and troubleshooting of pumps and compressors
- Discuss the concepts of pump types and terminology and introduce the theory and operating characteristics of centrifugal pumps
- Identify the common types of compressors and the ranges of application and limitation and have an overview of centrifugal compressors including its type and function
- Recognize the principles of equipment failure patterns including its type and review the common factors of why equipment fails
- Differentiate between the different aspects of machinery corrosion and to make the correct selection of material for a given application
- Determine the basic approaches to machinery troubleshooting and troubleshoot most possible faults and failures of pumps and compressors and discover the various approaches to be considered in applying corrective actions
- Employ the principles of dry gas, packing and mechanical seals and recognize their components and functions
- Develop a good background on seal support systems including its selection strategies and other applications and explain the features of dry gas seal for centrifugal gas compressor
- Analyze and troubleshoot mechanical seal failure and identify the various maintenance & repair methods used
- Discuss the basic concept of bearing care & maintenance, bearing classification and lubrication management
- Identify the various types of couplings and recognize their purpose & function and list-down the different alignment methods used
- Recognize and implement the various preventive and predictive maintenance techniques and strategies used for pumps & compressors

### **Exclusive Smart Training Kit - H-STK®**



Participants of this course will receive the exclusive “Haward Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.

### **Who Should Attend**

This course provides an overview of all significant aspects and considerations of pumps and compressors for those who are involved in the operation, maintenance and troubleshooting of such equipment. This includes rotating equipment and machinery engineers, plant and maintenance engineers and other technical staff involved in turbomachinery management, operation and maintenance. Further, it is suitable for operations, process and process unit contact, mechanical and project engineers.

### **Training Methodology**

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures
- 20% Practical Workshops & Work Presentations
- 30% Hands-on Practical Exercises & Case Studies
- 20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

### **Course Fee**

**US\$ 6,000** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

### **Accommodation**


Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

### Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

### Certificate Accreditations


Certificates are accredited by the following international accreditation organizations:-

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The International Accreditors for Continuing Education and Training (IACET - USA)

Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.



**Course Instructor(s)**

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:



**Mr. Karl Thanasis, PEng, MSc, MBA, BSc, is Senior Mechanical & Maintenance Engineer** with over **45 years** of extensive industrial experience. His wide expertise includes **Piping & Pipeline, Maintenance, Repair, Shutdown, Turnaround & Outages, Maintenance & Reliability Management, Mechanical Maintenance Planning, Scheduling & Work Control, Advanced Techniques in Maintenance Management, Predictive & Preventive Maintenance, Maintenance & Operation Cost Reduction Techniques, Reliability Centered Maintenance (RCM), Machinery Failure Analysis, Rotating Equipment Reliability Optimization & Continuous Improvement, Material Cataloguing, Mechanical & Rotating Equipment Troubleshooting & Maintenance, Root Cause Analysis & Reliability Improvement, Condition Monitoring, Root Cause Failure Analysis (RCFA), Steam Generation, Steam Turbines, Power Generator Plants, Gas Turbines, Combined Cycle Plants, Boilers, Process Fired Heaters, Air Preheaters, Induced Draft Fans, All Heaters Piping Work, Refractory Casting, Heater Fabrication, Thermal & Fired Heater Design, Heat Exchangers, Heat Transfer, Coolers, Power Plant Performance, Efficiency & Optimization, Storage Tank Design & Fabrication, Thermal Power Plant Management, Boiler & Steam System Management, Pump Operation & Maintenance, Chiller & Chiller Plant Design & Installation, Pressure Vessel, Safety Relief Valve Sizing & Selection, Valve Disassembling & Repair, Pressure Relief Devices (PSV), Hydraulic & Pneumatic Maintenance, Advanced Valve Technology, Pressure Vessel Design & Fabrication, Pumps, Turbo-Generator, Turbine Shaft Alignment, Lubrication, Mechanical Seals, Packing, Blowers, Bearing Installation, Couplings, Clutches and Gears.** Further, he is also versed in **Wastewater Treatment Technology, Networking System, Water Network Design, Industrial Water Treatment in Refineries & Petrochemical Plants, Piping System, Water Movement, Water Filtering, Mud Pumping, Sludge Treatment and Drying, Aerobic Process of Water Treatment** that includes **Aeration, Sedimentation and Chlorination Tanks.** His strong background also includes **Design and Sizing** of all **Waste Water Treatment Plant Associated Equipment** such as **Sludge Pumps, Filters, Metering Pumps, Aerators and Sludge Decanters.**

Mr. Thanasis has acquired his thorough and practical experience as the **Project Manager, Plant Manager, Area Manager - Equipment Construction, Construction Superintendent, Project Engineer and Design Engineer.** His duties covered **Plant Preliminary Design, Plant Operation, Write-up of Capital Proposal, Investment Approval, Bid Evaluation, Technical Contract Write-up, Construction and Sub-contractor Follow up, Lab Analysis, Sludge Drying and Management of Sludge Odor and Removal.** He has worked in various companies worldwide in the **USA, Germany, England and Greece.**

Mr. Thanasis is a **Registered Professional Engineer** in the **USA and Greece** and has a **Master's and Bachelor's degree in Mechanical Engineering with Honours** from the **Purdue University and SIU in USA** respectively as well as an **MBA** from the **University of Phoenix in USA.** Further, he is a **Certified Internal Verifier/Trainer/Assessor** by the **Institute of Leadership & Management (ILM)** a **Certified Instructor/Trainer** and has delivered numerous trainings, courses, seminars, workshops and conferences worldwide.



### **Course Program**

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

#### **Day 1: Sunday, 21<sup>st</sup> January 2024**

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	<b>PRE-TEST</b>
0830 – 0930	<b>Introduction</b> Overview of Rotating Equipment • Understanding How Equipment Works
0930 – 0945	Break
0945 – 1100	<b>Pump Types and Terminology</b> Pump Basics • Pump Terminology • Nomenclature and Definitions
1100 – 1215	<b>Centrifugal Pumps Overview</b> Centrifugal Pump Theory • Operating Characteristics • Centrifugal • Pump Operation • Cavitation and NPSH
1215 – 1230	Break
1230 – 1330	<b>Centrifugal Pumps Overview (cont'd)</b> Minimum Continuous Safe Flow (MCSF) • Types of Centrifugal Pumps • Troubleshooting and Preventive Maintenance for Pumps
1330 – 1420	<b>Compressor Types and Terminology</b> Centrifugal • Axial • Reciprocating • Helical Screw • Ranges of Application and Limitations
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day One

#### **Day 2: Monday, 22<sup>nd</sup> January 2024**

0730 – 0930	<b>Centrifugal Compressors Overview</b> Rotors • Balancing • Rotor Dynamics • Impellers • Casings • Troubleshooting and Preventive Maintenance for Compressors • Bearings • Seals: Labyrinths, Oil Seals & Self Acting Gas Seals • Couplings • Controls
0930 – 0945	Break
0945 – 1100	<b>Equipment Failure Patterns</b> Materials Selection • Types of Corrosion • Bath-Tub Curve • Actual Equipment Failure Patterns • Actions to Minimize Failure Effect
1100 – 1215	<b>Basic Approaches to Machinery Troubleshooting</b> Examples from Recent Failure Incidents Attributed to Design Defects • Processing and Manufacturing Deficiencies
1215 – 1230	Break
1230 – 1245	<b>Case Studies</b>



1245 – 1400	<b>Troubleshooting Faults and Applying Corrective Action</b> Equipment Performance Monitoring • Vibration Analysis • Fast Fault Finding
1400 – 1415	<b>Vibration Analysis DVD's</b>
1415 – 1420	<b>Case Studies</b>
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Two

**Day 3: Tuesday, 23<sup>rd</sup> January 2024**

0730 – 0930	<b>Troubleshooting Faults and Applying Corrective Action (cont'd)</b> Acoustical Troubleshooting • Infra-red Inspection • Oil Analysis
0930 – 0945	Break
0945 – 1100	<b>Introduction to Dry Gas Seals</b> Principle of Operation • Materials of Construction • Manufacturing and Verification Testing
1100 – 1215	<b>Packing and Mechanical Seals</b> Compression Packing • Molded (Automatic) Packing • Basic Principles of Mechanical Seals • Face Materials • Secondary Seal Materials • Single Mechanical Seals • Single Mechanical Seal • Flushing Plans
1215 – 1230	Break
1230 – 1300	<b>Flowserve DVD</b>
1300 – 1330	<b>Case Studies</b>
1330 – 1400	<b>Seal Support Systems</b> Dual Sealing Systems and Flushing Plans • API 682 Reference Guide • Gas Barrier Seal Technology for Pumps • Support Systems for Dry Gas (Self Acting) Compressor Seals • Mechanical Seal Selection Strategies
1400 – 1420	<b>Dry Gas Seal for Centrifugal Gas Compressors</b>
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Three

**Day 4: Wednesday, 24<sup>th</sup> January 2024**

0730 – 0930	<b>Mechanical Seal Failure Analysis and Troubleshooting</b> Failure Analysis • Mechanical Seal Troubleshooting • Determining Leakage Rates • Ascertaining Seal Stability
0930 – 0945	Break
0945-1100	<b>Mechanical Seal Maintenance and Repair</b> Bellows Seal Repair • Cartridge Seal Installation and Management • Seal Face Care
1100 – 1215	<b>Bearing Care and Maintenance</b> Basic Bearing Concepts • Bearing Classifications • Bearing Care and Maintenance • Lubrication Management Break





1215 – 1230	<i>Break</i>
1230 – 1400	<b><i>Couplings and Alignment</i></b> <i>Purpose of Couplings • Types of Couplings • Alignment Methods • Foundation and Grouting Guidelines</i>
1400 – 1415	<b><i>Flowserve DVD</i></b>
1415 – 1420	<b><i>Case Studies</i></b>
1420 – 1430	<b><i>Recap</i></b> <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow</i>
1430	<i>Lunch &amp; End of Day Four</i>

**Day 5: Thursday, 25<sup>th</sup> January 2024**

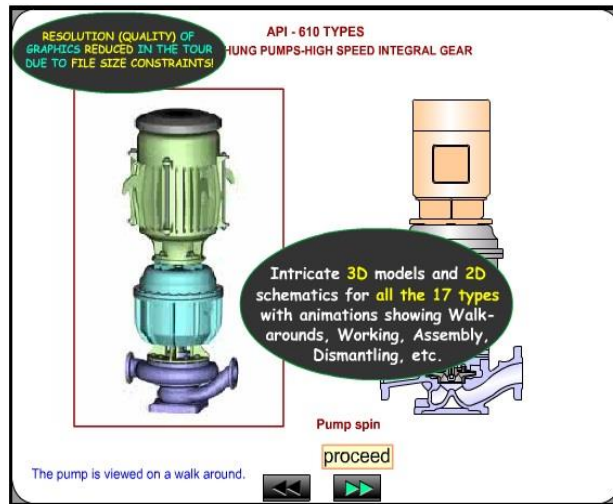
0730 – 0915	<b><i>Preventive Maintenance-Lubrication</i></b> <i>Cost of Poor Lubrication • Fundamentals-Oil &amp; Grease • Storage &amp; Handling Methods</i>
0915 – 0930	<b><i>Flowserve DVD</i></b>
0930 – 0945	<i>Break</i>
0945 – 1200	<b><i>Preventive Maintenance-Lubrication (cont'd)</i></b> <i>Comparative Viscosity • Classifications</i>
1200 – 1215	<b><i>Lubrication DVD</i></b>
1215 – 1230	<i>Break</i>
1230 – 1345	<b><i>Preventive Maintenance</i></b> <i>General Philosophy • Equipment Sparing Factor and Maintenance Approach</i>
1345 – 1400	<b><i>Course Conclusion</i></b> <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course</i>
1400 – 1415	<b><i>POST-TEST</i></b>
1415 – 1430	<i>Presentation of Course Certificates</i>
1430	<i>Lunch &amp; End of Course</i>



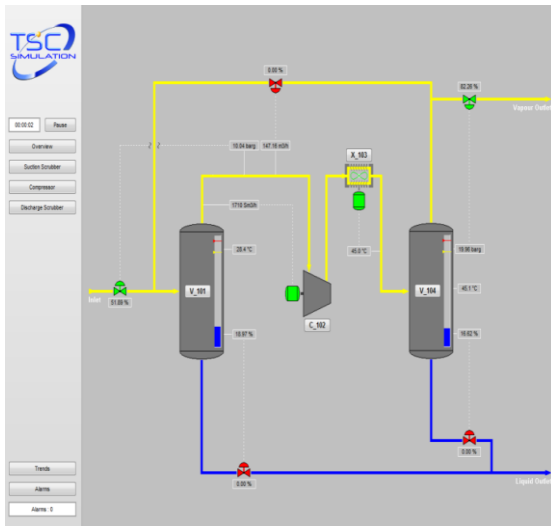


**Simulator (Hands-on Practical Sessions)**

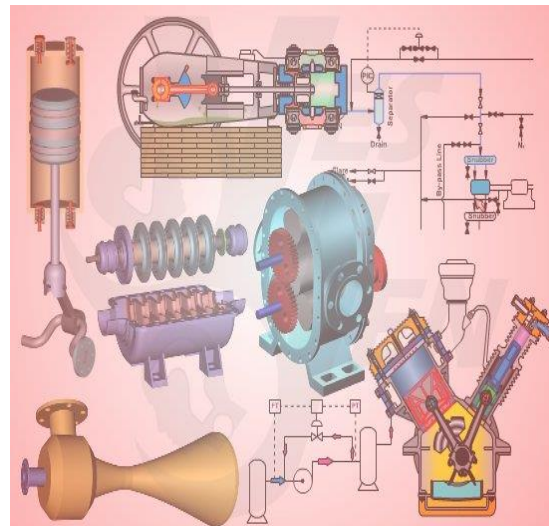
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the simulators “Centrifugal Pumps and Troubleshooting Guide 3.0”, “SIM 3300 Centrifugal Compressor” and “CBT on Compressors”.



**Centrifugal Pumps and Troubleshooting Guide 3.0**



**SIM 3300 Centrifugal Compressor Simulator**



**CBT on Compressors**

**Course Coordinator**

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