

COURSE OVERVIEW ME0615-4D

Pumps & Compressors

Operation, Maintenance & Troubleshooting

Course Title

Pumps & Compressors: Operation, Maintenance & Troubleshooting

Course Reference

ME0615-4D

Course Duration/Credits

Four days/2.4 CEUs/24 PDHs



Course Date/Venue

Session(s)	Date	Venue
1	February 26-29, 2024	Cheops Meeting Room, Radisson Blu Hotel, Istanbul Sisli, Turkey
2	May 13-16, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
3	August 26-29, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
4	November 18-21, 2024	Jubail Hall, Signature Al Khobar Hotel, Al Khobar, KSA

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, sample video clips of the instructor's actual lectures &*

*practical sessions during the course 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

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures
- 20% Workshops & Work Presentations
- 20% Case Studies & Practical Exercises
- 30% Videos, Software & Simulators

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

Virtual Training (If Applicable)

If this course is delivered online as a Virtual Training, the following limitations will be applicable:-

Certificates	Only soft copy certificates will be issued to participants through Haward's Portal. This includes Wallet Card Certificates if applicable
Training Materials	Only soft copy Training Materials (PDF format) will be issued to participant through the Virtual Training Platform
Training Methodology	80% of the program will be theory and 20% will be practical sessions, exercises, case studies, simulators or videos
Training Program	The training will be for 4 hours per day starting at 0930 and ending at 1330
H-STK Smart Training Kit	Not Applicable
Hands-on Practical Workshops	Not Applicable
Site Visit	Not Applicable
Simulators	Only software simulators will be used in the virtual courses. Hardware simulators are not applicable and will not be used in Virtual Training

Course Fee

F2F Classroom: US\$ 4,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.


Online Virtual: US\$ 2,250 per Delegate + **VAT**.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

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 **2.4 CEUs** (Continuing Education Units) or **24 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.

Accommodation

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



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. Dimitry Rovas, CEng, MSc, PMI-PMP, is a **Senior Mechanical Engineer** with extensive industrial experience in **Oil, Gas, Power and Utilities** industries. His expertise includes **Vibration Analysis, Vibration Monitoring, Combustion in Boiler Furnaces, Pump Technology, Pump Selection & Installation, Centrifugal Pumps & Troubleshooting, Reciprocating & Centrifugal Compressors, Compressor Control & Protection, Modern Valve Technology, Bearings & Lubrication, Advanced Machinery Dynamics, Modern Heating, Pumps & Valves Maintenance & Troubleshooting, Ventilation, Air-Conditioning (HVAC) & Refrigeration Systems, Pump & Compressors Maintenance &**

Troubleshooting, Compressors & Turbines Troubleshooting, New Emergency Air Compressors, Boiler Maintenance & Inspection, Hydraulic System Design & Troubleshooting, Pipe Stress Analysis, Gas Conditioning & Processing, Process Plant Optimization, Effective Production Operations in the Oil & Gas Fields, Gas & Steam Turbines, Turbine Operations, Gas Turbine Technology, Gas Turbine Erection & Commissioning (GE 9FA & GE9FB Units), Large Scale Natural Gas Combined Cycle Power Plant Projects (GE Equipment), Large Scale Natural Gas Cogeneration Plant Projects (GE & Siemens Equipment), Gas Turbine Condition Monitoring & Fault Diagnosis, Control & Operations of Industrial Gas Turbines, Gas Turbine Auxiliary System, Gas & Steam Turbines, Turbine Operations, Gas Turbine Technology, Rubber Compounding, Elastomers, Thermoplastic, Industrial Rubber Products, Rubber Manufacturing Systems, Heat Transfer, Vulcanization Methods, Process Plant Shutdown & Turnaround, Maintenance Optimization & Best Practices, Maintenance Auditing & Benchmarking, Reliability Management, Rotating Equipment, Energy Conservation, Energy Loss Management in Electricity Distribution Systems, Energy Saving, Thermal Power Plant Management, Thermal Power Plant Operation & Maintenance, Heat Transfer, Machine Design, Fluid Mechanics, Heating & Cooling Systems, Heat Insulation Systems, Heat Exchanger & Cooling Towers, Mechanical Erection, Heavy Rotating Equipment, Material Unloading & Storage, Commissioning & Start-Up, Process Safety Management (PSM), HAZMAT & HAZCOM, Laboratory Information Management System (LIMS) and Laboratory Quality Management (ISO 17025). Further, he is also well-versed in MS project & AutoCAD, EPC Power Plant, Power Generation, Combined Cycle Powerplant, Leadership & Mentoring, Project Management, Strategic Planning/Analysis, Construction Management, Team Formation, Relationship Building, Communication, Reporting and Six Sigma. He is currently the **Project Manager wherein he is managing, directing and controlling all activities and functions associated with the domestic heating/cooling facilities projects.**

During his life career, Mr. Rovas has gained his practical and field experience through his various significant positions and dedication as the **EPC Project Manager, Project Manager, GE 9FB Units Materials Manager, Field Engineer, Preventive Maintenance Engineer, Gas Turbine & Erection Engineer, Researcher, Instructor/Trainer, Telecom Consultant and Consultant** from various companies such as the Podaras Engineering Studies, Metka and Diadikasia, S.A., **Hellenic Petroleum Oil Refinery** and COSMOTE.

Mr. Rovas is a **Chartered Engineer** of the **Technical Chamber of Greece**. Further, he has **Master** degrees in **Mechanical Engineering** and **Energy Production & Management** from the **National Technical University of Athens**. Moreover, he is a **Certified Instructor/Trainer**, a **Certified Project Management Professional (PMP)**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management (ILM)** and a **Certified Six Sigma Black Belt**. He is an active member of **Project Management Institute (PMI)**, **Technical Chamber of Greece** and **Body of Certified Energy Auditors** and has further



delivered numerous trainings, seminars, courses, workshops and conferences internationally.

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: Monday, 20th of November 2023

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	PRE-TEST
0830 – 0930	Introduction Overview of Rotating Equipment • Understanding How Equipment Works
0930 – 0945	Break
0945 – 1100	Pump Types and Terminology Pump Basics • Pump Terminology • Nomenclature and Definitions
1100 – 1215	Centrifugal Pumps Overview Centrifugal Pump Theory • Operating Characteristics • Centrifugal • Pump



	Operation • Cavitation and NPSH • Minimum Continuous Safe Flow (MCSF) • Types of Centrifugal Pumps • Troubleshooting and Preventive Maintenance for Pumps
1215 – 1230	Break
1230 – 1330	Compressor Types and Terminology Centrifugal • Axial • Reciprocating • Helical Screw • Ranges of Application and Limitations
1330 – 1420	Centrifugal Compressors Overview Rotors • Balancing • Rotor Dynamics • Impellers • Casings • Troubleshooting and Preventive Maintenance for Compressors • Bearings • Seals: Labyrinths, Oil Seals & Self Acting Gas Seals • Couplings • Controls
1420 – 1430	Recap 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: Tuesday, 21st of November 2023

0730 – 0930	Equipment Failure Patterns Materials Selection • Types of Corrosion • Bath-Tub Curve • Actual Equipment Failure Patterns • Actions to Minimize Failure Effect
0930 – 0945	Break
0945 – 1100	Basic Approaches to Machinery Troubleshooting Examples from Recent Failure Incidents Attributed to Design Defects • Processing and Manufacturing Deficiencies
1100 – 1215	Case Studies
1215 – 1230	Break
1230 – 1245	Troubleshooting Faults and Applying Corrective Action Equipment Performance Monitoring • Vibration Analysis • Fast Fault Finding • Acoustical Troubleshooting • Infra-red Inspection • Oil Analysis

1245 – 1400	Vibration Analysis DVD's
1400 – 1415	Introduction to Dry Gas Seals Principle of Operation • Materials of Construction • Manufacturing and Verification
1415 – 1420	Case Studies
1420 – 1430	Recap 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: Wednesday, 22nd of November 2023

0730 – 0930	Packing and Mechanical Seals Compression Packing • Molded (Automatic) Packing • Basic Principles of Mechanical Seals • Face Materials • Secondary Seal Materials • Single Mechanical Seals • Single Mechanical Seal • Flushing Plans
0930 – 0945	Break
0945 – 1100	Flowserve DVD





1100 – 1215	Case Studies
1215 – 1230	Break
1230 – 1300	Seal Support Systems 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
1300 – 1330	Dry Gas Seal for Centrifugal Gas Compressors
1330 – 1400	Mechanical Seal Failure Analysis and Troubleshooting Failure Analysis • Mechanical Seal Troubleshooting • Determining Leakage Rates • Ascertaining Seal Stability
1400 – 1420	Mechanical Seal Maintenance and Repair Bellows Seal Repair • Cartridge Seal Installation and Management • Seal Fa
1420 – 1430	Recap 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: Thursday, 23rd of November 2023

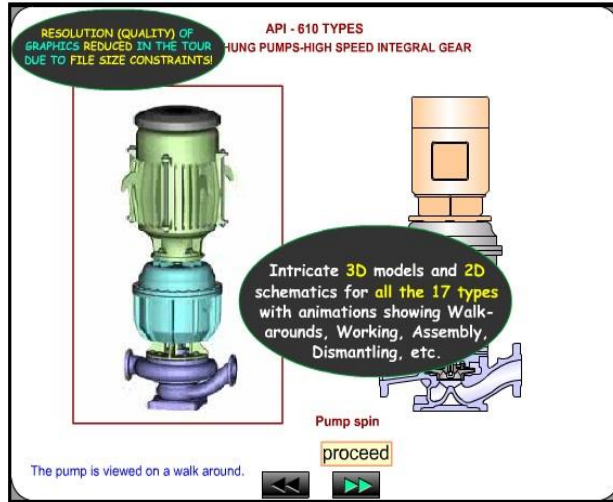
0730 – 0800	Bearing Care and Maintenance Basic Bearing Concepts • Bearing Classifications • Bearing Care and Maintenance • Lubrication Management Break
0800 – 0915	Couplings and Alignment Purpose of Couplings • Types of Couplings • Alignment Methods • Foundation and Grouting Guidelines
0915 – 0930	Preventive Maintenance-Lubrication Cost of Poor Lubrication • Fundamentals-Oil & Grease • Storage & Handling Methods • Comparative Viscosity • Classifications
0930 – 0945	Break
0945 – 1200	Flowserve DVD
1200 – 1215	Lubrication DVD
1215 – 1230	Break

1230 – 1345	Preventive Maintenance General Philosophy • Equipment Sparing Factor and Maintenance Approach
1345 – 1400	Course Conclusion Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course
1400 – 1415	POST-TEST
1415 – 1430	Presentation of Course Certificates
1430	Lunch & End of Course

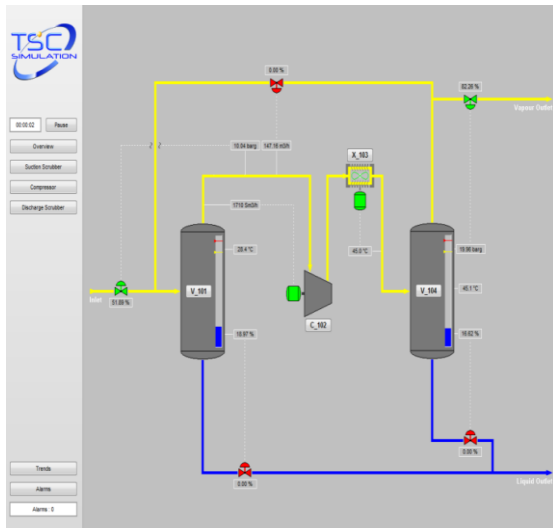
Simulator (Hands-on Practical Sessions)

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”.

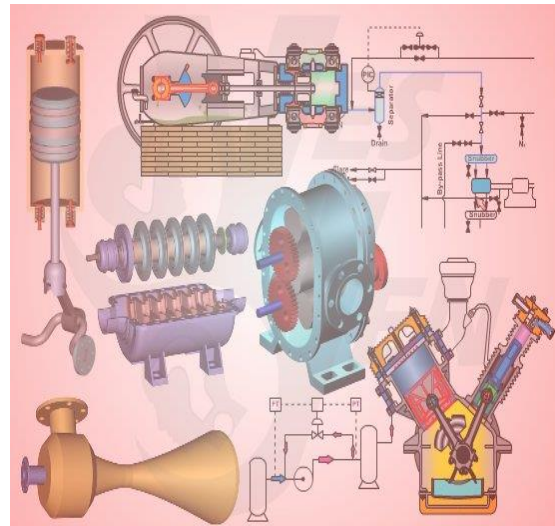




Centrifugal Pumps and Troubleshooting Guide 3.0



SIM 3300 Centrifugal Compressor Simulator



CBT on Compressors

Course Coordinator

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