

## COURSE OVERVIEW ME0616 Compressor Operation, Maintenance & Troubleshooting

**Course Title**

Compressor Operation, Maintenance & Troubleshooting

**Course Reference**

ME0616

**Course Duration/Credits**

Five days/3.0 CEUs/30 PDHs



**Course Date/Venue**

Session(s)	Date	Venue
1	October 06-10, 2024	Horus Meeting Room, Holiday Inn & Suites Maadi, Cairo, Egypt
2	December 08-12, 2024	
3	February 16-20, 2025	

**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.***



This course is designed to provide participants with a good working knowledge on the operation, maintenance and troubleshooting of compressors. It covers the common types, ranges of application, limitation and functions of compressors; the principles of equipment failure patterns; the common factors of why equipment fails; the different aspects of machinery corrosion; and the correct selection of materials for a given application.



At the completion of the course, participants will be able to apply basic approaches to machinery troubleshooting; troubleshoot most possible faults and failures of pumps and compressor; carryout various approaches to be considered in applying corrective action; and employ the principles of dry gas, packing and mechanical seals.

The course will also cover the components and functions of compressors; the features of dry gas seal for centrifugal gas compressor; the troubleshooting of mechanical seal failure; the various maintenance and repair methods used; and the basic concept of bearing care, maintenance, bearing classification and lubrication management.

### **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 compressors
- 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
- Explain the features of dry gas seal for centrifugal gas compressor
- Analyze and troubleshoot mechanical seal failure and identify the various maintenance and repair methods used
- Discuss the basic concept of bearing care and maintenance, bearing classification and lubrication management

### **Who Should Attend**

This course covers systematic techniques and methodologies on the operation, maintenance and troubleshooting of compressors for those who work with mechanical and rotating equipment at industrial plants, petrochemical plants, process plants, utilities, production oil/gas field, or manufacturing facilities. General maintenance personnel, first line supervisors and engineers will find this course extremely useful. Attendees come from a wide variety of industries, skill-levels, company sizes, and job titles.

### **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 accreditation 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 Fee

**US\$ 5,500** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

### 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. Mohamed Refaat, MSc, BSc, is a Senior Mechanical & Maintenance Engineer with almost 30 years of extensive experience in Rotating Equipment and Machinery including Pumps, Compressors, Turbines, Motors, Turbo-expanders, Gears, etc. His wide experience also covers Centrifugal Compressor & Steam Turbine, Centrifugal Pump, Pump Technology, Gas Turbine Technology, Heat Exchanger, Turbines & Motors, Variable Speed Drives, Seals, Control Valves, Advanced Valve Technology, Dry Seal, Fired Heaters, Air Coolers, Crude Desalter, Process Vessels & Valves, Industrial Equipment & Rotating Machinery, Mechanical Engineering, Mechanical Equipment & Turbomachinery, Piping, Pipelines, Valves, Lubrication Technology, Vibration Analysis, Power System Hydraulics, Security Detection Systems & Operation, Process Plant Equipment, Troubleshooting Process Operations, Maintenance Management Best Practices, Rotating Equipment Reliability Optimization, Practical Machinery Vibration, Vibration Techniques, Effective Reliability Maintenance, Excellence in Maintenance & Reliability Management, Preventive & Predictive Maintenance, Machinery Failure Analysis (RCFA), Reliability Optimization & Continuous Improvement, Maintenance Planning, Scheduling & Work Control, Maintenance Management Strategy, Mechanical & Rotating Equipment Troubleshooting, Preventive Maintenance, Predictive Maintenance, Reliability Centered Maintenance (RCM), Condition Based Monitoring (CBM), FMEA and Troubleshooting of machinery and rotating equipment including turbines, bearings, compressors, pumps etc. He is currently the Mechanical Maintenance Section Head of the Arab Petroleum Pipelines Company where he is in charge of planning, scheduling & managing the execution of preventive & corrective mechanical maintenance activities for all equipment. He is responsible for executing the scheduled inspections & major overhauls for gas turbines, valves & pumps, carrying out off-line vibration monitoring plans, troubleshooting, fault diagnosing & investigating failures of machinery.**

During his career life, Mr. Mohamed was able to modify the gas turbines self cleansing system to improve its maintainability and extend the air filters' lifetime. He was responsible for defining & updating the equipment codes and parameters for replacing the old **CMMS** with **MAXIMO**. He also worked as the Operations Supervisor wherein he was closely involved with the operation of the crude oil internal **pipeline** system between the tankers and tank farm, operation & control of the booster pumps for pumping crude oil for main pipelines and the development & implementation of the plans & procedures for draining the main terminal internal lines for maintenance purposes. He also held the position of Measurement Engineer where he was responsible for the crude oil custody transfer, performing loss control analysis and operating the crude oil automatic sampler & related equipment. Prior to that, he was the Design Engineer responsible for the design phase of the Truck Mixer Manufacturing Project of the Mechanical Design Department.

Mr. Refaat has **Master** and **Bachelor** degrees in **Mechanical Engineering** and a General Certificate of Education (**GCE**) from the **University of London, UK**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management (ILM)** and a member of the Engineering Syndicate of Egypt. He has further delivered numerous trainings, courses, workshops, seminars and conferences worldwide.

### 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 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**

0730 – 0800	<i>Registration &amp; Coffee</i>
0800 – 0815	<i>Welcome &amp; Introduction</i>
0815 – 0830	<b>PRE-TEST</b>
0830 – 0930	<b>Introduction</b> <i>Overview of Rotating Equipment • Understanding How Equipment Works</i>
0930 – 0945	<i>Break</i>
0945 – 1100	<b>Compressor Types &amp; Terminology</b> <i>Centrifugal • Axial • Reciprocating • Helical Screw • Ranges of Application &amp; Limitations</i>
1100 – 1215	<b>Centrifugal Compressors Overview</b> <i>Rotors • Balancing Rotor Dynamics • Impellers • Casings</i>
1215 – 1230	<i>Break</i>
1230 – 1420	<b>Centrifugal Compressors Overview (cont'd)</b> <i>Troubleshooting &amp; Preventive Maintenance for Compressors • Bearings • Seals: Labyrinths, Oil Seals &amp; Self-Acting Gas Seals • Couplings • Controls</i>
1420 – 1430	<b>Recap</b> <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today &amp; Advise Them of the Topics to be Discussed Tomorrow</i>
1430	<i>Lunch &amp; End of Day One</i>

#### **Day 2**

0730 – 0930	<b>Equipment Failure Patterns</b> <i>Materials • Types of Corrosion • Bath-Tub Curve • Actual Equipment Failure Patterns • Actions to Minimize Failure Effect</i>
0930 – 0945	<i>Break</i>
0945 – 1100	<b>Basic Approaches to Machinery Troubleshooting</b> <i>Examples from Recent Failure Incidents Attributed to Design Processing &amp; Manufacturing Deficiencies</i>
1100 – 1215	<b>Troubleshooting Faults &amp; Applying Corrective Action</b> <i>Equipment Performance Monitoring • Vibration Analysis • Fast Fault Finding • Acoustical Troubleshooting • Infra-red Inspection • Oil Analysis</i>



1215– 1230	Break
1230 – 1300	<b>Vibration Analysis DVDs</b>
1300 – 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 & Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Two

**Day 3**

0730 – 0830	<b>Introduction to Dry Gas Seals</b> Principle of Operation • Materials of Construction • Manufacturing & Verification Testing
0830 – 0930	<b>Packing &amp; 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
0930 – 0945	Break
0945 – 1045	<b>Flowserve DVD</b>
1045 – 1215	<b>Case Studies</b>
1215 – 1230	Break
1230 – 1330	<b>Seal Support Systems</b> Dual Sealing Systems & 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
1330 – 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 & Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Three

**Day 4**

0730 – 0930	<b>Mechanical Seal Failure Analysis &amp; Troubleshooting</b> Failure Analysis • Mechanical Seal Troubleshooting • Determining Leakage Rates • Ascertaining Seal Stability
0930 – 0945	Break
0945 – 1100	<b>Mechanical Seal Maintenance &amp; Repair</b> Bellows Seal Repair • Cartridge Seal Installation & Management • Seal Face Care
1100 – 1215	<b>Bearing Care &amp; Maintenance</b> Basic Bearing Concepts • Bearing Classifications • Bearing Care & Maintenance • Lubrication Management Break
1215 – 1230	Break
1230 – 1315	<b>Flowserve DVD</b>
1315 – 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 & Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Four

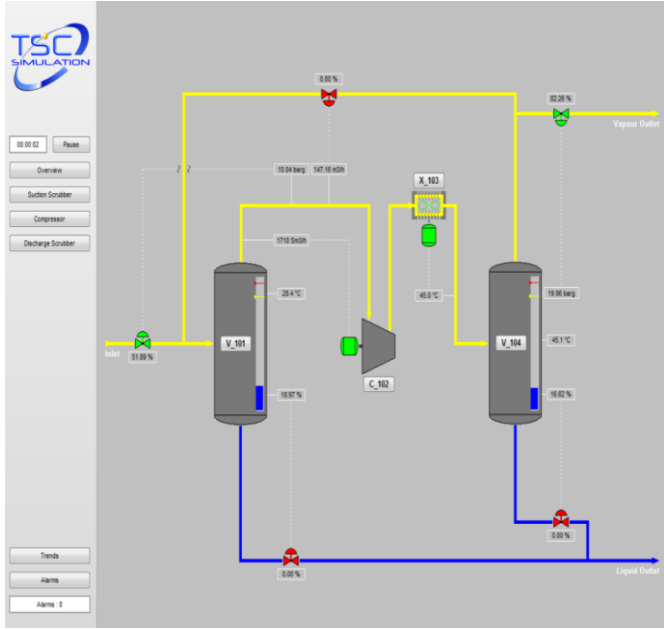


**Day 5**

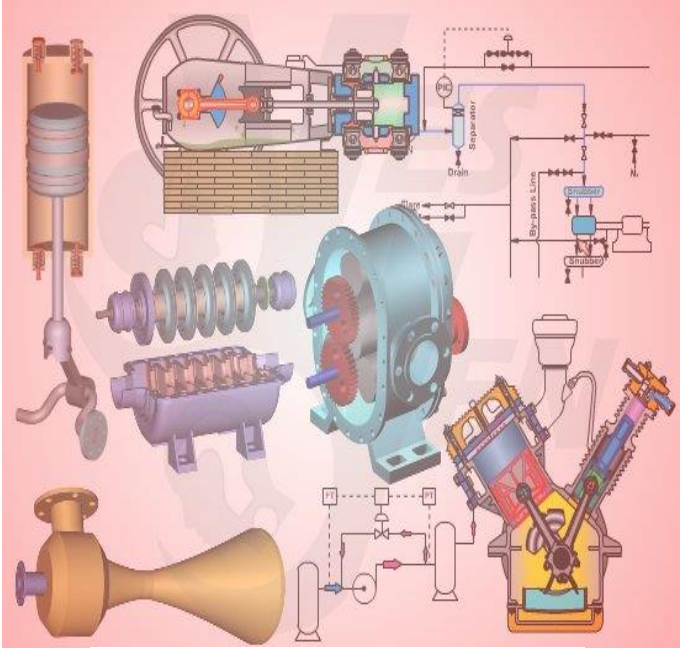
0730 – 0900	<b>Preventive Maintenance-Lubrication</b> <i>Cost of Poor Lubrication • Fundamentals-Oil &amp; Grease • Storage &amp; Handling Methods</i>
0900 – 0930	<b>Flowserve DVD</b>
0930 – 0945	<i>Break</i>
0945 – 1100	<b>Preventive Maintenance-Lubrication (cont'd)</b> <i>Comparative Viscosity • Classifications</i>
1100 – 1215	<b>Lubrication DVD</b>
1215 – 1230	<i>Break</i>
1230 – 1345	<b>Preventive Maintenance</b> <i>General Philosophy • Equipment Sparing Factor &amp; Maintenance Approach</i>
1345 – 1400	<b>Course Conclusion</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>POST-TEST</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 our state-of-the-art simulators “SIM 3300 Centrifugal Compressor” and “CBT on Compressors”.



**SIM 3300 Centrifugal Compressor Simulator**



**CBT on Compressors**

**Course Coordinator**

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