



**COURSE OVERVIEW ME0616**

**Compressor Operation, Maintenance & Troubleshooting**

**Course Title**

Compressor Operation, Maintenance & Troubleshooting

**Course Date/Venue**

Session 1: August 04-08, 2024/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Session 2: December 15-19, 2024/Boardroom, Warwick Hotel Doha, Doha, Qatar



**Course Reference**

ME0616



**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.***



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

## 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 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**

Dubai	<b>US\$ 5,500</b> per Delegate + <b>VAT</b> . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Doha	<b>US\$ 6,000</b> 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. Andrew Ladwig** is a **Senior Process & Mechanical Engineer** with over **25 years** of extensive experience within the **Oil & Gas, Refinery, Petrochemical & Power** industries. His expertise widely covers in the areas of **Ammonia Manufacturing & Process Troubleshooting, Distillation Towers, Crude Oil Distillation, Fundamentals of Distillation** for Engineers, **Distillation Operation** and **Troubleshooting, Advanced Distillation Troubleshooting, Distillation Technology, Vacuum Distillation, Ammonia Storage & Loading Systems, Ammonia Plant Operation, Troubleshooting & Optimization, Ammonia Recovery, Ammonia Plant Safety, Hazard of Ammonia Handling, Storage & Shipping, Operational Excellence in Ammonia Plants, Fertilizer Storage Management (Ammonia & Urea), Fertilizer Manufacturing Process Technology, Sulphur Recovery, Phenol Recovery & Extraction, Wax Sweating & Blending, Petrochemical & Fertilizer Plants, Nitrogen Fertilizer Production, Petroleum Industry Process Engineering, Refining Process & Petroleum Products, Refinery Planning & Economics, Safe Refinery Operations, Hydrotreating & Hydro-processing, Separators in Oil & Gas Industry, Gas Testing & Energy Isolations, Gas Liquor Separation, Industrial Liquid Mixing, Wax Bleachers, Extractors, Fractionation, Operation & Control of Distillation, Process of Crude ATM & Vacuum Distillation Unit, Water Purification, Water Transport & Distribution, Steam & Electricity, Flame Arrestors, Coal Processing, Environmental Emission Control, R&D of Wax Blending, Wax Molding/Slabbing, Industrial Drying, Principles, Selection & Design, Certified Process Plant Operations, Control & Troubleshooting, Operator Responsibilities, Storage Tanks Operations & Measurements, Process Plant Troubleshooting & Engineering Problem Solving, Process Plant Performance, Efficiency & Optimization, Continuous Improvement & Benchmarking, Process Troubleshooting Techniques, Oil & Gas Operation/Introduction to Surface Facilities, Pressure Vessel Operation, Process Equipment Performance & Troubleshooting, Plant Startup & Shutdown, Startup & Shutdown the Plant While Handling Abnormal Conditions, Flare & Relief System, Process Gas Plant Start-up, Commissioning & Problem Solving, Process Liquid and Process Handling & Measuring Equipment. Further, he is also well-versed in **Compressors & Turbines** Operation, Maintenance & Troubleshooting, **Heat Exchanger** Overhaul & Testing Techniques, Balancing of **Rotating Machinery (BRM), Pipe Stress Analysis, Valves & Actuators** Technology, Inspect & Maintain **Safeguarding Vent & Relief System**, Certified Inspectors for **Vehicle & Equipment**, Optimizing **Equipment Maintenance & Replacement Decisions**, Certified Maintenance Planner (**CMP**), Certified Planning and Scheduling Professional (**AACE-PSP**), **Tank Design**, Construction, Inspection & Maintenance, **Material Cataloguing**, Specifications, Handling & Storage, **Steam Trap Design**, Operation, Maintenance & Troubleshooting, **Steam Trapping & Control, Column, Pump & Exchangers**, Troubleshooting & Design, **Rotating Equipment** Operation & Troubleshooting, **Control & ESD System, Detailed Engineering Drawings**, Codes & Standards, **Budget** Preparation, Allocation & Cost Control, Root Cause Analysis (**RCA**), **Production Optimization**, Permit to Work (**PTW**), Project Engineering, **Data Analysis, Process Hazard Analysis (PHA), HAZOP Study, Sampling & Analysis, Training Analysis, Job Analysis** Techniques, Storage & Handling of **Toxic Chemicals & Hazardous Materials, Hazardous Material Classification & Storage/Disposal, Dangerous Goods, Risk Monitoring** Authorized Gas Tester (**AGT**), Confined Space Entry (**CSE**), Personal Protective Equipment (**PPE**), Fire & Gas, First Aid and Occupational Health & Safety.**

During his career life, Mr. Ladwig has gained his practical experience through his various significant positions and dedication as the **Mechanical Engineer, Project Engineer, Reliability & Maintenance Engineer, Maintenance Support Engineer, Process Engineer, HSE Supervisor, Warehouse Manager, Quality Manager, Business Analyst, Senior Process Controller, Process Controller, Safety Officer, Mechanical Technician, Senior Lecturer** and **Senior Consultant/Trainer** for various companies such as the Sasol Ltd., Sasol Wax, Sasol Synfuels, just to name a few.

Mr. Ladwig has a **Bachelor's degree in Chemical Engineering** and a **Diploma in Mechanical Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management (ILM)** and has delivered various trainings, workshops, seminars, courses and conferences internationally.

### 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

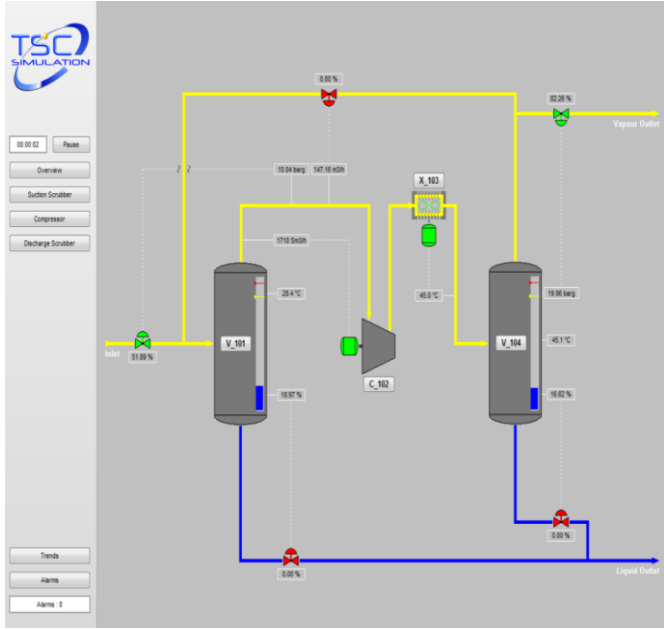


**Day 5**

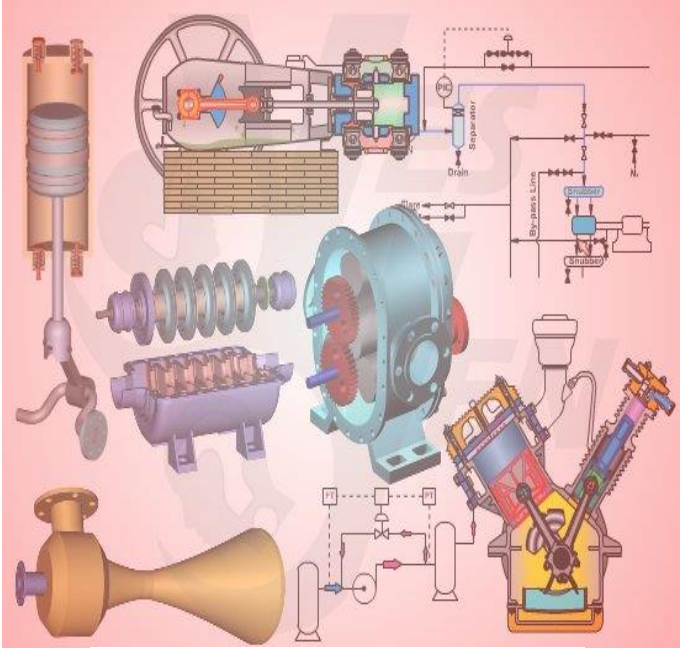
0730 – 0900	<b>Preventive Maintenance-Lubrication</b> Cost of Poor Lubrication • Fundamentals-Oil & Grease • Storage & Handling Methods
0900 – 0930	<b>Flowserve DVD</b>
0930 – 0945	Break
0945 – 1100	<b>Preventive Maintenance-Lubrication (cont'd)</b> Comparative Viscosity • Classifications
1100 – 1215	<b>Lubrication DVD</b>
1215 – 1230	Break
1230 – 1345	<b>Preventive Maintenance</b> General Philosophy • Equipment Sparing Factor & Maintenance Approach
1345 – 1400	<b>Course Conclusion</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course
1400 – 1415	<b>POST-TEST</b>
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 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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