

COURSE OVERVIEW ME0976-4D
Screw Compressor Theory and Troubleshooting

Course Title

Screw Compressor Theory and Troubleshooting

Course Date/Venue

August 05-08, 2024/Al Dhafra Meeting Room,
 Royal Rose Hotel, Abu Dhabi, UAE

Course Reference

ME0976-4D

Course Duration/Credits

Four days/2.4 CEUs/24 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 detailed and up-to-date overview of Screw Compressor Theory and Troubleshooting. It covers the first law and second law of thermodynamics, gas compression, Boyle's law, Charles's law, etc; the twin screw compressors, screw compressors and oil-free screw compressors; the liquid injected screw compressors and oil injected screw compressors; the dry screw compressor seals including screw compressor operation, maintenance and shutdown procedure; the operation and maintenance guidelines; the pre-start procedure, initial starting procedure, normal starting procedure, normal operation and shutdown procedure; and the periodic inspection, condition monitoring, temperature, vibration and troubleshooting of screw compressors.



During this interactive course, participants will learn the oil level measurement, guided wave radar, pressure, magnetostrictive and ultrasonic; the common failure modes in rotary screw sour gas compressors; the classification of bearings with respect to the load; the hydrodynamic bearings, hydrodynamic lubrication, journal bearings and lubrication principles; the journal bearing including the different shapes of bearing failure, failure modes, oil starvation and malfunction in the lubrication system; and the John Crane coupling, heavy-duty drive couplings, comparing machinery couplings and couplings standards.

Course Objectives

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

- Apply and gain a comprehensive knowledge on screw compressor troubleshooting
- Discuss the first law and second law of thermodynamics, gas compression, Boyle's law, Charles's law, etc
- Identify twin screw compressors, screw compressors, oil-free screw compressors, liquid injected screw compressors and oil injected screw compressors
- Recognize dry screw compressor seals and apply screw compressor operation and maintenance and shutdown procedure
- Illustrate periodic inspection, condition monitoring, temperature, vibration and troubleshooting of screw compressors
- Apply operational guidelines, oil level measurement, guided wave radar, pressure, magnetostrictive and ultrasonic
- Recognize the common failure modes in rotary screw sour gas compressors and the classification of bearings with respect to the load
- Discuss the hydrodynamic bearings, hydrodynamic lubrication, journal bearings and lubrication principles
- Identify the journal bearing including the different shapes of bearing failure, failure modes, oil starvation and malfunction in the lubrication system
- Recognize John Crane coupling, heavy-duty drive couplings, comparing machinery couplings and couplings standards

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 compressor maintenance for plant and maintenance engineers, maintenance managers and supervisors and compressor specialists. It should be valuable to senior maintenance mechanics and those who are involved with compressors' operation, maintenance, troubleshooting and overhaul.

Course Fee


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.

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 **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. 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: Monday, 05th of August 2024

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	PRE-TEST
0830 – 0900	Theory of Gas Compression First Law of Thermodynamics • Second Law of Thermodynamics • Gas Compression • Boyle’s Law • Theory of Gas Compression • Charles’s Law • Theory of Gas Compression • Combined Gas Law • Flow Through Pipes
0900 – 0930	Theory of Gas Compression (cont’d) Gas Flow Through a Nozzle • Fluid Flow Basics • Upstream Function of Compressors • Midstream Function of Compressors • Downstream Functions of Compressors • Methods of Compression • Compressors, Blowers, Fans • Types of Compressors
0930 – 0945	Break
0945 – 1200	Theory of Gas Compression (cont’d) Typical Operating Regimes of Compressors • Positive Displacement Compressors • Compressor Selection Factors • Rotary Compressors • Compressor Definitions • Pressure Energy • Vacuum • Pressure Definitions
1200 – 1215	Break
1215 – 1420	Introduction to Screw Compressors General • Screw Compressor Types • Twin Screw Compressors • Screw Compressors • Oil-Free Screw Compressors • Liquid Injected Screw Compressors • Oil Injected Screw Compressors • Fundamentals of Operation • Two-Stage Casing Arrangement • Suction Process • Compression • Discharge Process • Volume Ratio • Constructional Features • Screw Compressor Rotors • Casings • Timing Gears • Capacity Control • Variable Speed • Performance Characteristics
1420 – 1430	Recap Using this Course Overview, the instructor(s) will Brief Participants about the Topics that were Discussed Today and Advice Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day One





Day 2: Tuesday, 06th of August 2024

0730 – 0930	Dry Screw Compressor Seals Seals • Shaft Seals for Dry Screw Compressors • Typical Dry Screw Compressors Seals • Types of Shaft Seals • Centrifugal Compressors – Seals • Oil Sealing System • Centrifugal Compressors – Seals • Application of Labyrinth Seal • Spiral Groove Seals
0930 – 0945	Break
0945 – 1100	Operation & Maintenance Operation & Maintenance Guidelines • Pre-Start Procedure • Initial Starting Procedure • Normal Starting Procedure • Normal Operation • Shutdown Procedure
1100 – 1200	Maintenance & Inspection Periodic Inspection • Condition Monitoring • Temperature • Vibration • Troubleshooting • Dos & Don'ts of Screw Compressors
1200 – 1215	Break
1215 – 1420	Operational Guidelines Capacity Control of Dry Screw Compressors • Starting a Dry Screw Compressor • Liquid Injection of Dry Screw Compressors • Recommended Instrumentation
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, 07th of August 2024

0730 – 0930	Problems & Solutions in Renovation of the Rotors of Screw Compressors by Combined Technologies Technique of Investigations • Results of Studies
0930 – 0945	Break
0945 – 1100	Oil Level Measurement in Oil-Injected Screw Compressor Packages Used in The Petroleum, Petrochemical, Refrigeration & Fuel Gas Markets Abstract • Oil-Injected Screw Compressor Lubrication Oil System • Primary Separator • System Control • Process Dynamics
1100 – 1200	Level Measurement Technologies Guided Wave Radar • Pressure • Magnetostrictive • Ultrasonic • Conclusions
1200 – 1215	Break
1215 – 1420	Common Failure Modes in Rotary Screw Sour Gas Compressors Background • Journal Bearings • Sour Gas Failures of Hydrodynamic Journal Bearings • CPI Inhibited Lubricant Development • Field Testing of CPI Inhibited Lubricants • Conclusions
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





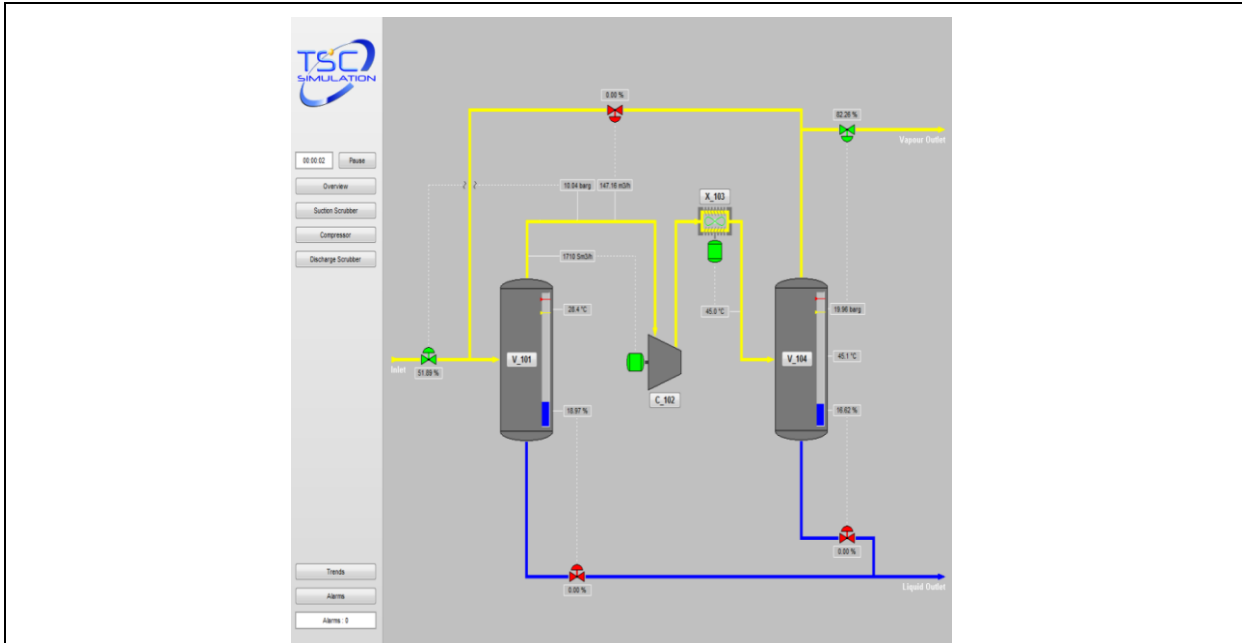
Day 4: Thursday, 08th of August 2024

0730 – 0830	<p>Bearings <i>Introduction • What is the Function of Bearings? • Classification of Bearings with Respect to the Load • Hydrodynamic Bearings • Hydrodynamic Lubrication • Hydrodynamic Theory - Journal Bearings • Lubrication Principles • Journal Bearing - Process at Startup • Sliding Surfaces Bearings (Plain Bearings)- Formation of Oil Film • Pressure Distribution in a Journal Bearing • Elliptical Journal Bearings • Tilting-Pad Journal Bearings • Thrust Bearings</i></p>
0830 - 0930	<p>Bearings (cont'd) <i>Tapered-land Thrust Bearings • Tilting Pad Thrust Bearings • Equalizing Tilting - Pad Thrust Bearings • Non-Equalizing Tilting-Pad Thrust Bearings • Combined Radial and Thrust Bearings • Sliding Surface Bearing Failure • Different Shapes of Bearing Failure • Failure Modes • Oil Starvation • Malfunction in the Lubrication System • Failure Causes of a Rolling & Plain Bearings • Troubleshooting Journal Bearings</i></p>
0930 – 0945	Break
0945 - 1200	<p>Coupling <i>Why are Couplings Needed? • Misalignment • John Crane Coupling • Couplings – Types</i></p>
1200 – 1215	Break
1215 – 1345	<p>Coupling (cont'd) <i>Heavy-Duty Drive Couplings • Comparing Machinery Couplings • Couplings Standards</i></p>
1345 – 1400	<p>Course Conclusion <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course</i></p>
1400 – 1415	POST-TEST
1415 – 1430	<i>Presentation of Course Certificates</i>
1430	<i>Lunch & End of Course</i>

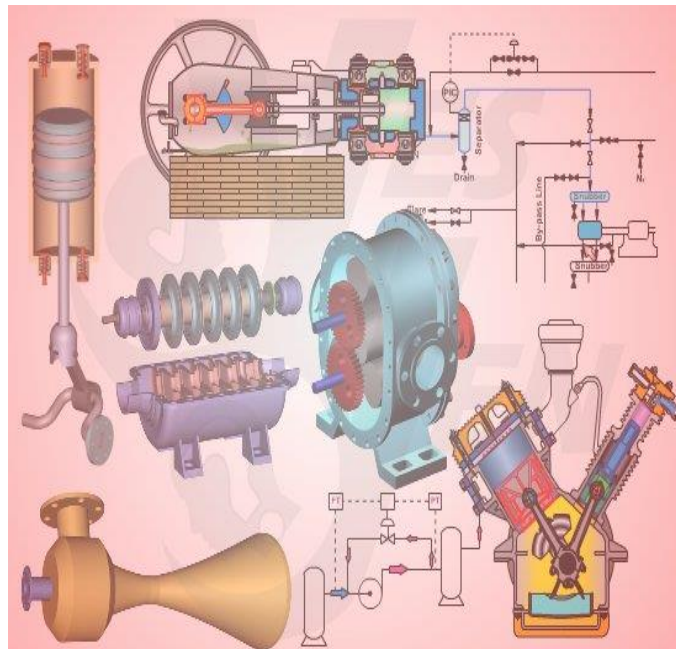


Simulator (Hands-on Practical Sessions)

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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