COURSE OVERVIEW ME0398
Pumps, Compressors, Turbines & Troubleshooting

Course Title
Pumps, Compressors, Turbines & Troubleshooting



Course Date/Venue
Session 1: April 11-15, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar
Session 2: August 08-12, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar

Course Reference
ME0398

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 delegates with a detailed and up-to-date overview of the fluid mechanic fundamentals and operating practice of pumps, compressors and turbines. It will address aspects of both axial and centrifugal compressors. Upon the successful completion of this course, participants will have acquired the practical knowledge to enable them not only to choose the correct device for a particular application but also be in a position to resolve many commonly occurring operating problems.

The course is ideal for those personnel in the oil, gas, petrochemical, chemical, power and other process industries who require a wider and deeper appreciation of pumps, compressors and turbines, including their design, performance and operation. No prior knowledge of the topic is required. Participants will be taken through an intensive primer of turbo-machinery principles, using the minimum of mathematics, and will learn how to solve the many and varied practical industrial problems that are encountered. The course makes use of an extensive collection of VIDEO material.

Course Objectives/Outcomes & Benefits for the Participants

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

- Apply a comprehensive knowledge in pumps, compressors & turbines and troubleshoot rotating equipment in a professional manner
- Identify the different types of turbomachinery including basic design aspects and highlighted problem areas
- Minimize the compressor work by understanding the processes involved and identifying their efficiency
- Discuss the axial flow compressor and the corresponding velocity triangles including torque and power calculations
- List the different types of centrifugal machines including their design, installation, operation, maintenance, re-rate/retrofit and troubleshooting
- Recognize the various beneficial design aspects of turbomachines and understand the crucial process of cavitation in pumps
- Carryout the proper methods of centrifugal pumps installation, operation, maintenance and troubleshooting

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, compressors and turbines for those who are involved in the design, selection, maintenance or troubleshooting of such equipment. This includes maintenance, reliability, integrity, engineering, production and operations managers, engineers and other technical staff. Project managers and engineers will also benefit from this program.

Accommodation

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

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.

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

Haward's certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). 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.

- 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.

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. Rod Larmour, PEng, MSc, BSc, is a **Senior Mechanical Engineer** with over **55 years** of **Onshore & Offshore** practical experience within the **Power**, **Petrochemical**, **Oil & Gas** industries. His expertise greatly covers the application of **Rotating Machinery**, **Mechanical Alignment**, **Stress Analysis**, **Thermodynamics**, **Fluid Mechanics**, **Heat & Mass Transfer Engineering**, **Air Conditioning & Refrigeration Technology**, Cooling Towers, **Gas & Steam Turbines**, **Centrifugal Compressor & Pumps** and the **Design**, **Failure Investigation** and **Maintenance** of **Atmospheric Storage Tanks & Tank Farms** and **Bolted Flanges & Joints**.

Currently, Mr. Larmour is working with Transnet overseeing the performance and safety of several **fuel pipelines** including **pumping stations** and **inland tank farms** locally. He also takes lead in the **planning** of detailed design of a **fuel gas supply system** from a site to the **proposed new power station**, the **management** of an **EPC booster gas compressor station** including an **overland piping**, and **spearheads** the **commercial & contractual management** within the **Ilitha Process Group**.

Throughout Mr. Larmour's lengthy career, he has worked with several international companies like **Mobil**, **Mossgas**, **Stewarts & Lloyds** and **Ilitha** with prime positions such as the **Operations Manager**, **Principal Project Manager**, **Senior Mechanical Engineer**, **Offshore Projects Manager**, **Design Manager**, **Quality Assurance Manager**, **Project Engineer** and **Senior Instructor/Trainer**.

Mr. Larmour's experience was not only confined to the industry alone. He was also able to largely contribute his expertise and impart his knowledge in the academe. He has engaged himself with **researches** and **lectures** in for several international organizations, universities and companies and has held numerous **training courses** on **Thermomechanics** & **Fluid mechanics**, **Engineering Design**, **Refrigeration & Air Conditioning** and **Heat Transfer**.

Mr. Larmour is **Registered Professional Engineer** and has **Master & Bachelor** degrees in **Mechanical Engineering** and has a **Diploma** in **Nuclear Science**. 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

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities in tailoring our courses to the training needs of our valued clients.

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	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Turbomachinery*** *Highlighted Problem Areas*
0930 – 0945	*Break*
0945 – 1000	***Ideal Gas Equation & Practical Application*** *Isentropic Processes • Property Diagrams Involving Entropy*
1000 – 1100	***Isentropic Processes of Ideal Gases*** *Constant Specific Heats • Relative Pressure and Relative Specific Volume*
1100 – 1230	***Minimizing Compressor Work*** *Polytropic Processes • Multi-Stage Compression with Inter-Cooling • Isentropic Efficiency of Turbines • Isentropic Efficiency of Compressors and Pumps*
1230 – 1245	*Break*
1245 – 1330	***Momentum & Bernoulli's Relations*** *General Relationship • Relationships for Incompressible Fluids*
1330 – 1420	***VIDEO: Basic Pump Types & Technology***
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

0730 – 0800	***General Description of Turbomachines*** *Centrifugal Pump • Centrifugal Turbine • Centrifugal Air Compressor*
0800 – 0830	***Impulse Turbine*** *Velocity Triangles*
0830 – 0900	***Axial Flow Compressor*** *Velocity Triangles • Torque Calculation and Torque Coefficient • Power Calculation and Power Coefficient*
0900 – 0930	***Centrifugal Machines*** *Torque Calculation • Head Coefficient • Flow Coefficient • Torque Coefficient*
0930 – 0945	*Break*
0945 – 1015	***Performance Curves***
1015 – 1100	***Centrifugal Pump*** *Centrifugal Multistage Pump • Mixed Flow Machines • Centrifugal Air Compressor*
1100 – 1130	***Affinity Laws*** *Effect of Impeller Speed •Effect of Impeller Diameter*
1130 – 1200	***Specific Speed***
1200 – 1230	***Specific Radius***
1230 – 1245	*Break*
1245 – 1315	***Hydraulic Turbines***
1315 – 1330	***VIDEO: Fundamentals of Pump Performance 1***
1330 – 1400	***Design Aspects of Turbomachines*** *Linear Cascades • Radial Cascades • Three- Dimensional Aspects of Axial- Flow Machines •Elementary Design Considerations*
1400 – 1420	***Cavitation***
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

0730 – 0930	***Centrifugal Pumps Basics*** *Types of Centrifugal Pumps • Self- Priming Pumps • Specific Speeds • Suction Specific Speed • Best Efficiency Point • Affinity Laws*
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Design*** *Balancing Disc • Impeller NPSHR • Impeller Centre-Rib • Mechanical Seals • Velocity Head*
1100 – 1230	***Pump Sales*** *Affinity Laws •Pump Software • Suction Lift • Viscosity • Re-Rate/Retrofit • Head-Rise • Radial/Horizontal Split Case*
1230 – 1245	*Break*
1245 – 1330	***Centrifugal Pump Installation*** *Foundation • Soft Foot • Suction Pipe • Suction Strainer*

1330 – 1420	***VIDEO: Fundamentals of Pump Performance 2*** *Discussion Forum*
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

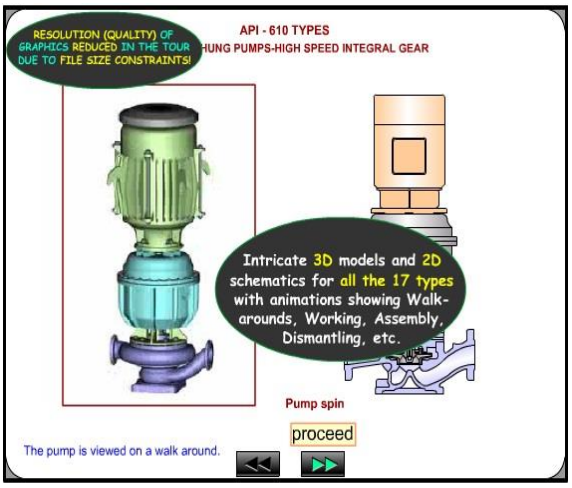
0730 – 0930	***Centrifugal Pump Operation*** *Start-Up • Minimum Flow • Maximum Pump RPM • Motor Amps/Specific Gravity • Entrained Gas*
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Operation (cont'd)*** *Operation at Shut Off • Temperature-Rise • Thermal Shock*
1100 – 1230	***Centrifugal Pump Maintenance*** *Case Gasket • Checking for Wear Clearance • Oil Change • Storage*
1230 – 1245	*Break*
1245 – 1315	***Centrifugal Pump Re-Rate/Retrofit*** *Impeller Cut • NPSH • De-Staging • Electric Motor Sizing • Viscosity Changes*
1315 – 1420	***VIDEO: Hydraulic Loads, Critical Speed & Torque*** *Discussion Forum*
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 Four*

Day 5

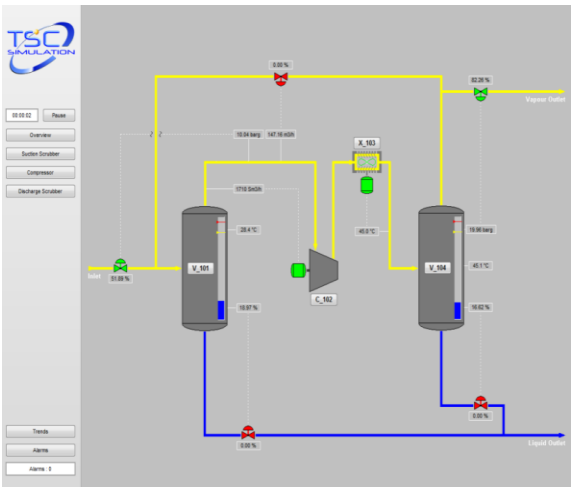
0730 – 0830	***Centrifugal Pump Troubleshooting*** *Bearing Failures • Bearing Housing Oil Leakage • Cavitation Noise and Damage*
0830 – 0930	***VIDEO: Bearings, Seals & Couplings***
0930 – 0945	*Break*
0945 – 1100	***Centrifugal Pump Troubleshooting (cont'd)*** *Impeller Cavitation/Erosion • Vibration • Cracked Volute Tongues • NPSH • Viscosity Effects*
1100 – 1230	***Group Discussions***
1230 – 1245	*Break*
1245 – 1345	***VIDEO: Special Pump Topics & Final Discussion***
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)

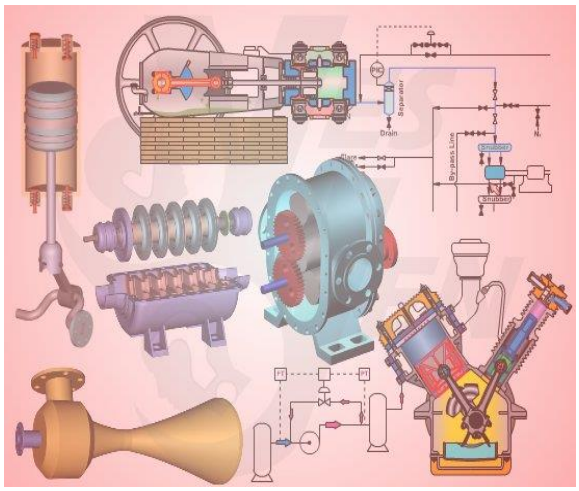
Hands-on practical sessions will be arranged for all participants throughout the course duration using "Centrifugal Pumps and Troubleshooting Guide 3.0", "SIM 3300 Centrifugal Compressor Simulator", "CBT on Compressors" and "Steam Turbine & Governing System CBT" simulators.



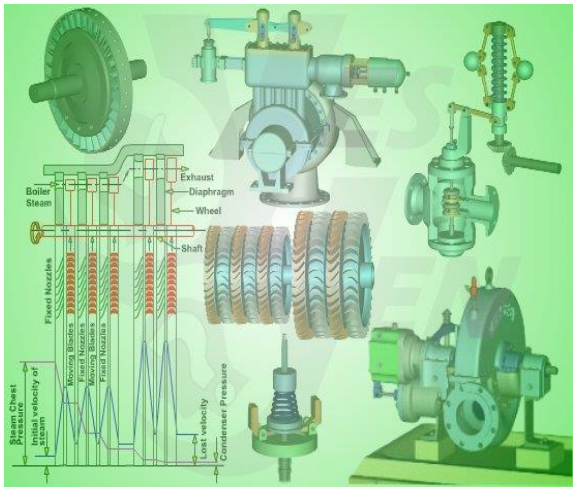
Centrifugal Pumps and Troubleshooting Guide 3.0



SIM 3300 Centrifugal Compressor Simulator



CBT on Compressors



Steam Turbine & Governing System CBT

Course Coordinator

Jaryl Castillo, Tel: +974 6652 9196, Email: jaryl@haward.org