COURSE OVERVIEW ME1135
Dynamic Analysis Reciprocating for a Compressor Systems

Course Title
Dynamic Analysis Reciprocating for a Compressor Systems

Course Date/Venue
October 05-09, 2025/Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

Course Reference
ME1135

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 detailed and up-to-date overview of Dynamic Analysis for a Reciprocating Compressor System. It covers the key components and functions of reciprocating compressor and the differences between reciprocating and centrifugal compressors; the principles of dynamic analysis and compressor operational cycles; the types of dynamic forces in reciprocating compressors and the factors affecting compressor vibration; the modal analysis in mechanical systems, natural frequencies of compressor systems and modal testing techniques and instrumentation; and the vibration sources in reciprocating compressors and techniques for measuring compressor vibrations.

During this interactive course, participants will learn the dynamic modeling of compressor components; the compressor operating conditions using vibration data; the dynamic response analysis and the importance of compressor balancing; the methods of vibration isolation, compressor foundation design and active vibration control techniques; the low vibration operation, dynamic simulation techniques and transient analysis; the advanced vibration modeling and the impact of system modifications on dynamic performance; the dynamic analysis in compressor maintenance; and troubleshooting compressor dynamic issues.

Course Objectives

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

- Apply and gain an in-depth knowledge on dynamic analysis for a reciprocating compressor system
- Discuss the key components and functions of reciprocating compressor and the differences between reciprocating and centrifugal compressors
- Explain the principles of dynamic analysis and compressor operational cycles
- Identify the types of dynamic forces in reciprocating compressors and the factors affecting compressor vibration
- Carryout modal analysis in mechanical systems, identify natural frequencies of compressor systems and apply modal testing techniques and instrumentation
- Recognize vibration sources in reciprocating compressors and techniques for measuring compressor vibrations
- Describe dynamic modeling of compressor components and analyze compressor operating conditions using vibration data
- Employ dynamic response analysis and discuss the importance of compressor balancing and damping mechanisms in reciprocating compressors
- Apply methods of vibration isolation, compressor foundation design and active vibration control techniques
- Discuss design considerations for low vibration operation and apply dynamic simulation techniques and transient analysis in reciprocating compressors
- Identify the advanced vibration modeling for complex systems and the impact of system modifications on dynamic performance
- Predict compressor performance using dynamic analysis and apply dynamic analysis in compressor maintenance
- Troubleshoot compressor dynamic issues, optimize compressor performance using dynamic data and discuss the future trends in reciprocating compressor dynamics

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 dynamic analysis reciprocating for a compressor systems for mechanical and reliability engineers, design engineers, maintenance and operations personnel, project engineers and managers, condition monitoring specialists / vibration analysts, OEMs (original equipment manufacturers), consultants and analysts.

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. Mervyn Frampton is a **Senior Process Engineer** with over **30 years** of industrial experience within the **Oil & Gas**, **Refinery**, **Petrochemical** and **Utilities** industries. His expertise lies extensively in the areas of **Process Troubleshooting**, **Distillation Towers**, **Fundamentals of Distillation** for Engineers, **Distillation** Operation and Troubleshooting, **Advanced Distillation** Troubleshooting, **Distillation** Technology, Vacuum **Distillation**, **Distillation Column** Operation & Control, **Oil Movement** Storage & Troubleshooting, **Process Equipment** Design, **Piping Systems**, Applied **Process Engineering** Elements, **Process Plant** Optimization, **Revamping & Debottlenecking**, **Process Plant** Troubleshooting & Engineering Problem Solving, **Process Plant** Monitoring, **Catalyst** Selection & Production Optimization, Operations Abnormalities & Plant Upset, **Process Plant** Start-up & Commissioning, **Clean Fuel** Technology & Standards, Flare, Blowdown & Pressure Relief Systems, **Oil & Gas Field Commissioning** Techniques, **Pressure Vessel** Operation, **Gas Processing**, **Chemical** Engineering, **Process Reactors** Start-Up & Shutdown, **Gasoline Blending** for Refineries, **Urea Manufacturing** Process Technology, Continuous Catalytic Reformer (**CCR**), **De-Sulfurization** Technology, Advanced Operational & Troubleshooting Skills, Principles of Operations Planning, **Rotating Equipment** Maintenance & Troubleshooting, **Hazardous Waste Management & Pollution Prevention**, **Heat Exchangers & Fired Heaters** Operation & Troubleshooting, **Energy Conservation** Skills, **Catalyst Technology**, **Refinery & Process Industry**, **Chemical Analysis**, **Process Plant**, **Commissioning & Start-Up**, **Alkylation**, **Hydrogenation**, **Dehydrogenation**, **Isomerization**, **Hydrocracking & De-Alkylation**, **Fluidized Catalytic Cracking**, **Catalytic Hydrodesulphuriser**, **Kerosene Hydrotreater**, **Thermal Cracker**, **Catalytic Reforming**, **Polymerization**, **Polyethylene**, **Polypropylene**, Pilot Water Treatment Plant, **Gas Cooling**, **Cooling Water Systems**, Effluent Systems, Material Handling Systems, **Gasifier**, **Gasification**, Coal Feeder System, **Sulphur Extraction Plant**, **Crude Distillation Unit**, **Acid Plant Revamp** and **Crude Pumping**. Further, he is also well-versed in HSE Leadership, Project and Programme Management, Project Coordination, Project Cost & Schedule Monitoring, Control & Analysis, Team Building, Relationship Management, Quality Management, Performance Reporting, Project Change Control, Commercial Awareness and Risk Management.

During his career life, Mr. Frampton held significant positions as the **Site Engineering Manager**, **Senior Project Manager**, **Process Engineering Manager**, **Project Engineering Manager**, **Construction Manager**, **Site Manager**, **Area Manager**, **Procurement Manager**, **Factory Manager**, **Technical Services Manager**, **Senior Project Engineer**, **Process Engineer**, **Project Engineer**, **Assistant Project Manager**, **Handover Coordinator** and **Engineering Coordinator** from various international companies such as the **Fluor Daniel**, **KBR** South Africa, **ESKOM**, MEGAWATT PARK, CHEMEPIC, PDPS, CAKASA, **Worley Parsons**, Lurgi South Africa, **Sasol**, **Foster Wheeler**, **Bosch & Associates**, **BCG** Engineering Contractors, Fina Refinery, Sapref Refinery, Secunda Engine Refinery just to name a few.

Mr. Frampton has a **Bachelor's degree** in **Industrial Chemistry** from **The City University** in **London**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Trainer/Assessor** by the **Institute of Leadership & Management** (**ILM**) and has delivered numerous trainings, courses, workshops, conferences and seminars 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.

Accommodation

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

Course Fee

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

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1: Sunday, 05th of October 2025

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Reciprocating Compressor Systems*** *Definition and Applications of Reciprocating Compressors • Key Components and Their Functions • Differences Between Reciprocating and Centrifugal Compressors • Common Failures in Reciprocating Compressor Systems*
0930 – 0945	*Break*
0945 – 1030	***Principles of Dynamic Analysis*** *Understanding Dynamic Forces in Machinery • Basics of Vibration Analysis • Time-Domain vs. Frequency-Domain Analysis • Importance of Dynamic Analysis in Compressor Reliability*
1030 – 1130	***Compressor Operational Cycles*** *Overview of Compressor Cycle and Its Stages • Effect of Pressure and Temperature on Performance • Impact of Load Variation on Dynamic Behavior • Common Operating Conditions and Their Challenges*
1130 – 1215	***Types of Dynamic Forces in Reciprocating Compressors*** *Piston Dynamics and Its Effect on Compressor Operation • Effect of Crankshaft Motion and Balancing Forces • Load Variation and Reciprocating Load on System Dynamics • Inertia Forces and Vibration Modes*
1215 – 1230	*Break*

1230 – 1330	***Factors Affecting Compressor Vibration*** *Rotor Imbalance and Misalignment • Lubrication Issues Affecting Vibration Levels • Foundation Design and Its Impact on Vibrations • Resonance and Harmonic Frequencies in Compressor Systems*
1330 – 1420	***Basics of Modal Analysis for Compressors*** *Overview of Modal Analysis in Mechanical Systems • How to Identify Natural Frequencies of Compressor Systems • Modal Testing Techniques and Instrumentation • Application of Modal Analysis in Compressor System Design*
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: **Monday, 06th of October 2025**

0730 – 0830	***Vibration Sources in Reciprocating Compressors*** *Radial and Axial Vibrations: Causes and Effects • Impact of Unbalanced Forces on Vibration Patterns • Combustion Pressure and Its Influence on Vibration • Effect of Cylinder Pressure Fluctuation on Vibration*
0830 – 0930	***Techniques for Measuring Compressor Vibrations*** *Introduction to Vibration Sensors and Accelerometers • Types of Vibration Measurements (Displacement, Velocity, Acceleration) • Placement of Sensors for Optimal Vibration Data • Understanding Vibration Spectra*
0930 – 0945	*Break*
0945 – 1100	***Dynamic Modeling of Compressor Components*** *Overview of Compressor Component Modeling • Mathematical Representation of Pistons, Crankshafts, and Valves • Dynamic Load Modeling in Reciprocating Compressor Systems • Software Tools for Dynamic Modeling*
1100 – 1215	***Analysis of Compressor Operating Conditions Using Vibration Data*** *Identifying Abnormal Vibrations and Their Significance • Fault Detection Using Vibration Analysis • Interpreting Vibration Spectra for Fault Diagnosis • Using Vibration Data to Optimize Operational Settings*
1215 – 1230	*Break*
1230 – 1330	***Dynamic Response Analysis*** *Assessing the Response of Compressor Systems to Dynamic Loads • Time-Response Analysis and Its Significance • Techniques for Minimizing Dynamic Response • Analyzing Damping Effects on System Behavior*
1330 – 1420	***Case Study: Dynamic Behavior of a Reciprocating Compressor*** *Review of Real-World Compressor Dynamic Analysis • Common Failure Modes Identified Through Dynamic Analysis • Corrective Actions and Their Impact on Performance • Lessons Learned and Practical Application of Dynamic Analysis*
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: Tuesday, 08th of October 2025

0730 – 0830	***Importance of Compressor Balancing*** *Static vs. Dynamic Balancing: Definitions and Differences • Impact of Unbalanced Components on Compressor Efficiency • Balancing Techniques for Crankshafts and Pistons • Equipment and Methods for Balancing*
0830 – 0930	***Damping Mechanisms in Reciprocating Compressors*** *Types of Damping: Frictional, Viscous, and Hysteretic Damping • Role of Damping in Controlling Vibrations • Materials and Design Techniques for Improving Damping • Calculating Damping Coefficients in Compressor Systems*
0930 – 0945	*Break*
0945 – 1100	***Methods of Vibration Isolation*** *Designing Vibration Isolation Systems for Compressors • Using Isolators, Mounts, and Flexible Foundations • Vibration Transmission and Its Impact on Surrounding Systems • Material Selection for Effective Isolation*
1100 – 1215	***Compressor Foundation Design*** *Importance of Solid Foundations in Vibration Control • Foundation Stiffness and Damping Considerations • Impact of Foundation Resonance on Compressor Operation • Techniques for Improving Foundation Design to Reduce Vibrations*
1215 – 1230	*Break*
1230 – 1330	***Active Vibration Control Techniques*** *Overview of Active Vibration Control Systems • Using Sensors and Actuators for Real-Time Vibration Control • Feedback and Feedforward Control Systems • Benefits and Challenges of Active Vibration Control in Compressors*
1330 – 1420	***Design Considerations for Low Vibration Operation*** *Reducing Mechanical and Electrical Resonance • Optimization of Compressor Geometry for Minimal Vibration • Incorporating Damping into Compressor Design • Practical Steps for Maintaining Low Vibration During Operation*
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: Wednesday, 09th of October 2025

0730 – 0830	***Dynamic Simulation Techniques*** *Overview of Dynamic Simulation in Compressor Systems • Software Tools for Dynamic Simulation (e.g., MATLAB, ANSYS) • Key Parameters for Dynamic Simulation • Validation of Simulation Results with Field Data*
0830 – 0930	***Transient Analysis in Reciprocating Compressors*** *Modeling Compressor Response to Sudden Load Changes • Effects of Start-Up and Shutdown on Compressor Dynamics • Analyzing Transient Pressure and Flow Fluctuations • Techniques for Mitigating Transient Effects on Compressor Systems*
0930 – 0945	*Break*

0945 – 1100	***Advanced Vibration Modeling for Complex Systems*** *Multi-Degree-of-Freedom Models for Compressor Systems • Coupling Effects Between Different Compressor Components • Nonlinear Dynamic Behavior and Its Implications • Advanced Modeling Techniques for Vibration Prediction*
1100 – 1215	***Impact of System Modifications on Dynamic Performance*** *Assessing the Impact of Design Changes on Vibration Characteristics • Modifying Operating Conditions to Improve Dynamic Performance • Retrofitting Systems for Enhanced Dynamic Stability • Case Studies of Compressor System Upgrades*
1215 – 1230	*Break*
1230 – 1330	***Predicting Compressor Performance Using Dynamic Analysis*** *Modeling the Long-Term Performance of Compressors • Predicting Wear and Failure Based on Dynamic Analysis • Dynamic Analysis for Life Cycle Management • Using Simulation Results to Optimize Maintenance Schedules*
1330 – 1420	***Case Study: Predicting Compressor Failures*** *Review of Dynamic Analysis Used to Predict Compressor Failures • Identifying Early Warning Signs of Impending Failure • Corrective Measures to Extend Compressor Life • Applying Simulation Results to Real-World Operations*
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: ***Thursday, 09th of October 2025***

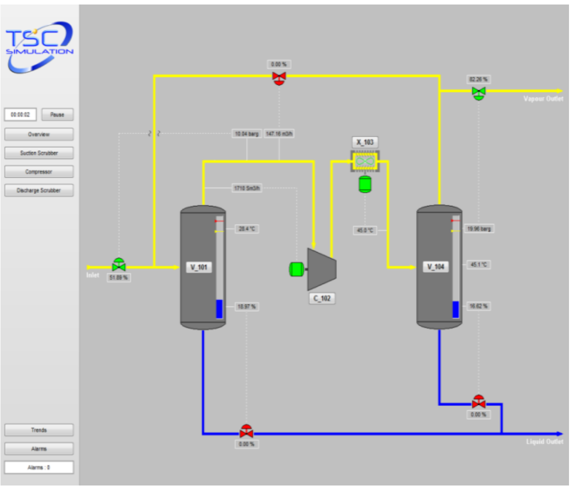
0730 – 0830	***Dynamic Analysis in Compressor Maintenance*** *Using Dynamic Analysis to Optimize Maintenance Schedules • Predictive Maintenance Based on Dynamic Data • Real-Time Monitoring and Its Role in Predictive Maintenance • Minimizing Downtime Through Proactive Dynamic Analysis*
0830 – 0930	***Troubleshooting Compressor Dynamic Issues*** *Identifying Common Dynamic Problems (Misalignment, Imbalance) • Step-by-Step Troubleshooting Guide for Dynamic Issues • Using Diagnostic Tools for Dynamic System Troubleshooting • Practical Tips for Resolving Vibration-Related Issues*
0930 – 0945	*Break*
0945 – 1100	***Optimizing Compressor Performance Using Dynamic Data*** *Using Dynamic Analysis to Improve Compressor Efficiency • Fine-Tuning Compressor Settings Based on Dynamic Feedback • Balancing Performance and Reliability Through Dynamic Data • Integrating Dynamic Analysis into Performance Optimization Strategies*
1100 – 1215	***Real-World Case Studies & Lessons Learned*** *Review of Compressor Performance Optimization Cases • Applying Lessons Learned to Improve System Design • Collaborative Approaches to Dynamic Analysis in Compressor Systems • Post-Analysis Reviews: What Worked and What Didn't*

1215 – 1230	*Break*
1230 – 1345	***Future Trends in Reciprocating Compressor Dynamics*** *Emerging Technologies in Dynamic Analysis (AI, Machine Learning) • Integration of IoT for Real-Time Dynamic Monitoring • Trends in Compressor Design for Reduced Dynamic Impact • The Future of Predictive Maintenance in Compressor Systems*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about t Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

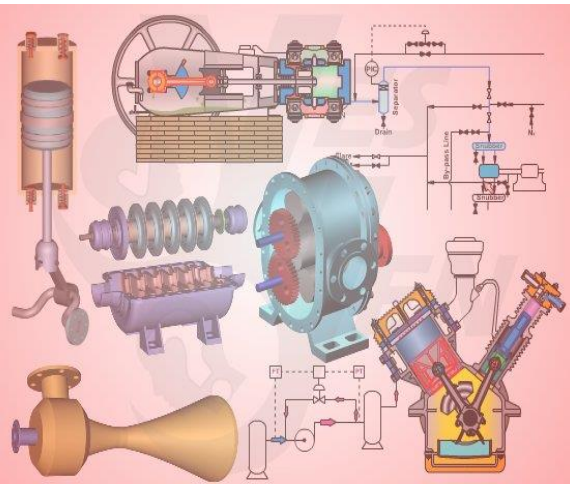
Simulator (Hands-on Practical Sessions)

Practical session 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 state-of-the-art simulators "iLearnVibration", "SIM 3300 Centrifugal Compressor", "CBT on Compressors" and "Steam Turbines & Governing System CBT".

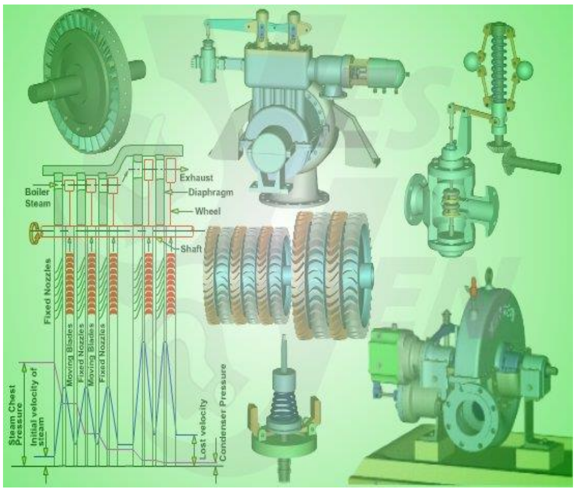
iLearnVibration



SIM 3300 Centrifugal Compressor Simulator



CBT on Compressors



Steam Turbines & Governing System CBT

Course Coordinator
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