COURSE OVERVIEW RE0190
Practical Machinery Vibration Monitoring, Analysis & Predictive Maintenance: Vibration Techniques

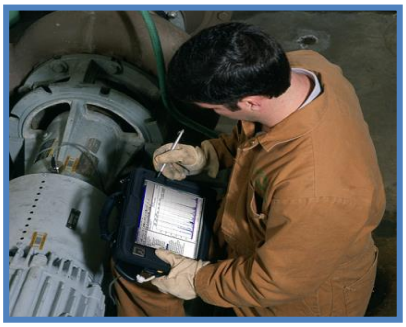
Course Title
Practical Machinery Vibration Monitoring, Analysis & Predictive Maintenance: Vibration Techniques

Course Date/Venue
Session 1: May 25-09, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: October 26-30, 2025/Crowne Meeting Room, Crowne Plaza Al Khobar, KSA

Course Reference
RE0190

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description



This practical and highly-interactive course includes practical sessions and exercises. Theory learnt will be applied using our state-of-the art simulators.

Condition monitoring has evolved as a significant opportunity to increase profits within a wide variety of industries. Vibration Analysis is one of the most powerful condition based maintenance technologies, and the cornerstone of many predictive maintenance programs. It is also widely utilized for troubleshooting and fault diagnosis of machinery and structures. In recent years, much emphasis has been given to on-line or permanently installed vibration monitoring for machinery that is inaccessible, critical to process, and/or very expensive.

The future advancement of equipment condition monitoring technologies is intrinsically tied to the application and development of on-line or permanently installed systems. As the advantages of asset management and reliability strategies become widely accepted and aggressively implemented, significant emphasis is being placed on equipment condition monitoring. In fact, the historic barrier between production and maintenance will soon fall victim to the understanding that equipment condition data is as important as process parameters, and significantly influences production, quality, safety, and profitability.

For many industrial facilities, on-line vibration monitoring systems are used as machinery protection systems, and therefore installed only on critical equipment. The objective is to eliminate process downtime through equipment that is 100% available and reliable. At the same plant, there may also be monitoring of general purpose machinery using portable instruments. The objective of this program is to reduce maintenance expense through early detection of equipment and component defects. As on-line systems become readily available and accepted, walk around monitoring programs are improved using permanently installed sensors and hardware, typically installed at inaccessible or hazardous locations.

This course is designed to provide a practical overview of system components, installation considerations, and benefits of Vibration Monitoring. Key points and an innovative approach will be explained by discussing several **recent** installations. The course will provide a detailed examination of the detection, location and diagnosis of faults in rotating and reciprocating machinery using vibration analysis. It will cover the acquisition and processing of vibration signals followed by a discussion of machinery fault diagnosis using vibration analysis. The course is concluded by a review of the other techniques of predictive maintenance such as oil and particle analysis, acoustic emission and infrared thermography with an introduction to automated machine condition monitoring. The latest approaches and equipment used together with current research techniques in vibration analysis are also highlighted in the course. The lessons will be supplemented with case studies illustrating the practical aspects of vibration analysis and monitoring on a diverse range of applications.

Course Objectives

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

- Apply systematic techniques in machinery vibration monitoring, analysis and implement the predictive maintenance strategies and procedures
- Identify the various maintenance strategies used in vibration analysis and determine the factors which influence maintenance strategies
- Discover the various types & causes for machinery failure and recognize MCMAD philosophy including its tasks & strategies
- Heighten in-depth understanding on machinery vibrations such as the various equipments & processes typically monitored by vibration analysis as well as the typical vibration problems and the simplest form of vibrating system
- Recognize phase & vibration measurement and describe excitation frequencies & mode shapes
- Characterize data acquisition systems & its techniques and determine its importance in vibration analysis
- Perform signal analysis and data collection including aliasing, averaging, band pass analysis & spectrum
- Identify vibration signal analysis for different faults and determine vibration frequencies related to machinery faults
- Illustrate machine condition evaluation by using the different vibration techniques and charts
- Employ machine testing by designing test plans, listing the specifications, presenting data through reporting and record keeping
- Review & improve troubleshooting procedures and conduct periodic monitoring
- Identify the different types of non-vibration based techniques

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 machinery vibration for maintenance, reliability, rotating equipment, process, control and instrumentation personnel who are willing to gain, improve and/or update their knowledge and skills of practical aspects of machinery vibration monitoring, analysis and predictive maintenance. Engineers, maintenance supervisors, mechanical foremen, specialists and other technical staff will also benefit from this course.

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 Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations

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**. 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. Mohamed Refaat, MSc, BSc, is a **Senior Maintenance & Reliability 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 **Modern Maintenance & Reliability** Management, **Maintenance Errors**, **Maintenance Audit & Site Inspection**, **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**), **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**, **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 training, courses, workshops, seminars and conferences worldwide.

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 – 0945	***Maintenance Strategies*** *The Maintenance Organization Mission • Maintenance Strategies Development by Time • Modern Maintenance Strategies • Comparison of Maintenance Strategies • Factors which Influence Maintenance Strategy • Machine Conditioning Monitoring & Fault Diagnostics • Machinery Failure • Causes of Failures • Types of failure • The goal of Machine Conditioning Monitoring & Fault Diagnostics • Frequency of Failure • Wear in Failures*
0945 – 1000	*Break*
1000 – 1100	***Maintenance Strategies (cont'd)*** *Normal Wear (Random Failures) • Wear Out Failures • Frequency of Failure • MCMAD Philosophy • MCMAD Tasks • MCMAD Strategies • Various Techniques of Predictive Maintenance • Vibration Analysis • Vibration Analysis as a Key Technique • Major Parameters used for Detection of Machine Faults • Fault Detected*
1100 – 1200	***Machinery Vibrations*** *Equipment & Processes Typically Monitored by Vibration Analysis • Typical Vibration Problems & their Approximate Percentage of Occurrence • Rotary Mechanical Vibrations • Other Mechanical Vibrations • Non-Mechanical Vibration Problems • Spring-Mass-Damper Model of Vibration • Simplest Form of Vibrating System • Real-world System • Peak vs RMS vs Peak to Peak-to-Peak*
1200 – 1215	*Break*
1215 – 1300	***Machinery Vibrations (cont'd)*** *Frequency • Phase Measurement • Phase Relationship • Measurement Relationships • Vibration Measurement • Vibration Data Type & Formats • Frequency Domain vs Time Domain • Low, Medium & High Frequency Ranges • Excitation Frequencies • Natural Frequencies and Mode Shapes*
1300 – 1420	***Practical Session # 1***
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Data Acquisition Systems & Techniques*** *Choosing an Industrial Sensor • Primary Sensors Considerations • Selecting a Measurement Parameter • Measurement Parameters for Selected Machines • Vibration Transducers • Operation Range of Vibration Transducers • Transducer Application • Transducer Mounting • Transducer Location • Data Display • Linear & Logarithmic Amplitude Scales • Linear Amplitude Scaling*
0930 – 0945	*Break*
0945 – 1100	***Signal Analysis & Data Collection*** *Data Acquisition Systems & Techniques • Data Processing Tools • Oscilloscopes • FFT Analyzers • Electronic Data Collectors • Sampling Rate • Aliasing & Averaging • Anti-aliasing Filters • Windowing • Dynamic Range • Resolution • Averaging • Signal Analysis in the Frequency Domain • Band Pass Analysis • Enveloped Spectrum • Signature Spectrum • Frequency Domain Analysis • Setup of FFT Analyzer & Data Collector*

1100 – 1200	***Vibration Signal Analysis for Different Faults*** *The Process of Machinery Vibration Analysis • Fault Diagnosis Techniques • Spectrum Analysis • Diagnosis Faults from the Vibration Spectrum • Synchronous • Sub-Synchronous • Non-Synchronous • The Most Common Machine Faults • Critical Speed & Resonance • Operating Speed Faults • Types of Unbalance*
1200 – 1215	*Break*
1215 – 1300	***Vibration Signal Analysis for Different Faults (cont'd)*** *Misalignment • Bent Shaft • Mechanical Looseness • Rotor rub • Belt Problem • Rolling Element Bearings • Journal Bearings*
1300 – 1420	***Practical Session # 2***
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Vibration Signal Analysis for Different Faults (cont'd)*** *Gear Boxes • Electric Motors • Flow-related Problems Pumps, Fans & Compressors • Vibration Frequencies Related to Machinery Faults*
0930 – 0945	*Break*
0945 – 1100	***Machine Condition Evaluation*** *Vibration Severity Limits • Shaft Vibration • Bearing Vibration • Casing Vibration • Standards • ISO 2372 Chart • ISO 10816 Chart • The IRD General Machinery Vibration Severity Chart*
1100 – 1200	***Machine Testing*** *Test Plans • Selection of Test Equipment • Site Inspection • Acceptance Tests • Baseline Tests*
1200 – 1215	*Break*
1215 – 1300	***Machine Testing (cont'd)*** *Resonance & Critical Speed Testing • Specifications • Environmental & Mounting • Presentation of Data • Reports • Record Keeping*
1300 – 1420	***Practical Session # 3***
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

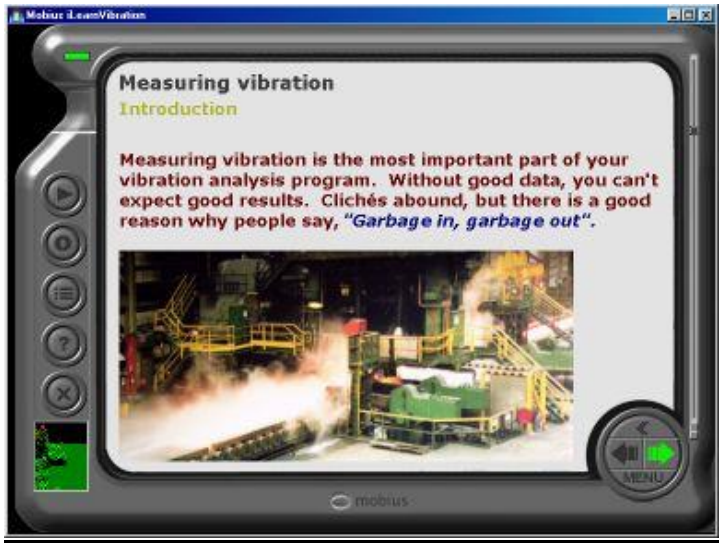
0730 – 0930	***Troubleshooting*** *Vibration Analysis Flowchart • Troubleshooting Procedure*
0930 – 1045	***Periodic Monitoring*** *Documentation • Reference Guide • Listing & Categorization • Machinery Knowledge • Route Selection & Definition • Keeping Track of your maintenance program • Eliminating the Paper Checklist • Vibe Code System • Measurement Parameters & Points*
1045 – 1100	*Break*
1100 – 1215	***Periodic Monitoring (cont'd)*** *Baseline Data • Frequency of Data Collection • Selection of Test Equipment • Screening • Trending • Alarms • Reports*
1215 – 1230	*Break*
1230 – 1420	***Practical Session # 4***
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5

0730 – 0900	***Non-Vibration Based Techniques*** *Visual Monitoring Techniques • Performance Monitoring Techniques*
0900 – 0915	*Break*
0915 – 1100	***Non-Vibration Based Techniques (cont'd)*** *Oil Quality Analysis • Wear Particle Analysis*
1100 – 1200	***Non-Vibration Based Techniques (cont'd)*** *Acoustic Emission • Thermography*
1200 – 1215	*Break*
1215 – 1345	***Practical Session # 5***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
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 the state-of-the-art simulator "iLearnVibration".



iLearnVibration Simulator

Course Coordinator

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