



## COURSE OVERVIEW RE0141

# Certified Machinery Failure Analysis, Vibration & Predictive Maintenance: Machinery Diagnostics & Root Cause Failure Analysis to Improve Equipment Performance

### Course Title

Certified Machinery Failure Analysis, Vibration & Predictive Maintenance: Machinery Diagnostics & Root Cause Failure Analysis to Improve Equipment Performance

### Course Date/Venue

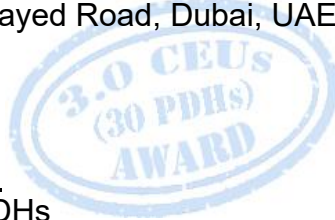
September 07-11, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

### Course Reference

RE0141

### 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.***

The course presents a systematic approach to fault diagnosis and failure prevention in a broad range of machinery used in the Oil/Gas, Petrochemical and other process industries. The key approaches to preventive maintenance are demonstrated through both overview and the study of examples in metallurgical failure analysis, vibration analysis and a sequential approach to machinery troubleshooting and problem solving.



Equipment failure events will be reviewed and participants are encouraged to bring to the course relevant assembly drawings or such components as failed bearings, gears, mechanical seals and similar machine elements for failure analysis and discussion.



The course explores a systematic approach to successful failure analysis and troubleshooting, including the determination of goals, use of checklists and setting up a failure analysis team. By reference to specific case studies, especially dealing with centrifugal pumps, it will be shown that such a systematic program can lead to significant failure reductions in many types of machinery. Through examples dealing with pumps and compressors, guidance is given on vendor selection and methods for reliability review.

A matrix approach to machinery troubleshooting uses illustrative examples in pumps, centrifugal compressors, blowers and fans, reciprocating compressors, engines and gas turbines. Next, a systematic approach to generalized machinery problem-solving is described in terms of situation analysis, cause analysis, action generation, decision making and planning for change. Finally, a highly effective root cause failure analysis (RCFA) method is explained in detail.

At the end of the course, participants will gain an understanding of structured, results-oriented root cause failure analysis methods for all types of machine components and entire machinery systems. Participants will also learn how parts fail, why they fail in a given mode and how to prevent failures. Participants will acquire a thorough understanding of making the best possible use of available failure statistics and how these can be used in a conscientiously applied comprehensive program of specifying, purchasing, installing, commissioning and operating machinery.

### **Course Objectives**

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

- Apply systematic techniques on machinery failure analysis, vibration and predictive maintenance
- Recognize machinery failure patterns covering the nature of failure, the types of equipment failures and its classifications
- Employ machinery diagnostic testing, metallurgical failure analysis methodology, machinery component analysis and reliability improvement
- Carryout machinery troubleshooting and root cause failure analysis (RCFA)
- Analyze vibration signal for different faults and machineries
- Report formalized failure as a teaching tool and examine failed components
- Illustrate process, mechanical and technical interaction
- Evaluate machine condition and implement predictive maintenance and condition-based monitoring
- Improve reliability through optimizing lubrication for pumps and electric motors

### **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 covers systematic techniques and methodologies in machinery failure analysis, prevention and troubleshooting for those who work with mechanical and rotating equipment at industrial plants, utilities, production oil/gas field or manufacturing facilities. General maintenance personnel, engineers and other technical staff from a wide variety of industries, skill-levels, company sizes and job titles will also find this course extremely useful.



### Course Certificate(s)

Internationally recognized Competency Certificates and Plastic Wallet Cards will be issued to participants who completed a minimum of 80% of the total tuition hours and successfully passed the exam at the end of the course. Certificates are valid for 5 years.

**Recertification is FOC for a Lifetime.**

### Sample of Certificates

The following are samples of the certificates that will be awarded to course participants: -





- (2) Official Transcript of Records will be provided to the successful delegates with the equivalent number of ANSI/IACET accredited Continuing Education Units (CEUs) earned during the course.

\* Haward Technology \* CEUs \* Haward Technology \* CEUs \* Haward Technology \* CEUs \* Haward Technology \*

Page 1 of 1

**Haward Technology Middle East**  
Continuing Professional Development (HTME-CPD)

**CEU Official Transcript of Records**

TOR Issuance Date: 28-Apr-17  
HTME No. PAR11317  
Participant Name: Eissa Al Dossari

Program Ref.	Program Title	Program Date	No. of Contact Hours	CEU's
RE141	Certified Machinery Failure Analysis, Vibration & Predictive Maintenance: Machinery Diagnostics & Root Cause Failure Analysis to Improve Equipment Performance	April 24-28, 2017	30	3.0

Total No. of CEU's Earned as of TOR Issuance Date 3.0

TRUE COPY

  
Maricel De Guzman  
Academic Director

Haward Technology has been approved as an Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102, USA. In obtaining this approval, Haward Technology has demonstrated that it complies with the ANSI/IACET 1-2013 Standard which is widely recognized as the standard of good practice internationally. As a result of their Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for programs that qualify under the ANSI/IACET 1-2013 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 Association 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 is accredited by


ANSI ACCREDITED BAC ilm mebsosh AWS ACCREDITED IACET PROVIDER ISO 9001:2015 Certified City & Guilds Approved Centre Proud Provider API

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\* Haward Technology \* CEUs \* Haward Technology \* CEUs \* Haward Technology \* CEUs \* Haward Technology \*

### **Certificate Accreditations**

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

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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**. 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.
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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.

### **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 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. Kyle Bester** is a **Senior Mechanical & Process Engineer** with extensive years of practical experience within the **Oil & Gas, Power & Water Utilities** and other **Energy** sectors. His expertise includes **Vibration Analysis Machine** Inspection; **Vibration** Measurement & Analysis, **Mechanical Shaft Alignment & Vibrational Analysis**, **Machinery Failure** Analysis, **Maintenance** Planning & Scheduling, **Root Cause** Failure Analysis (**RCFA**), **Maintenance** Shutdown & Turnaround, **Reliability-Centered Maintenance (RCM)**, **Rotating Equipment Reliability Optimization**, **Root Cause Analysis (RCA)** and **Asset Integrity Management (AIM)**, **Process Design & Engineering**, **Piping Control Loops & Heat Exchangers**, **Safe Process Units Start-Up/Shutdown**, Development of Equipment Handling Over/Commissioning Procedures, **Process Plant** Troubleshooting & Engineering Problem Solving, **Process Plant** Performance & Efficiency, **Process Plant** Optimization, Rehabilitation, Revamping & Debottlenecking, **Distillation** Operation & Troubleshooting, Operation of the **Hydrocarbon Process** Equipment, Fired Heaters, Air Coolers, Crude Desalter, **Flare, Blowdown & Pressure Relief** Systems Operation, **Separation** Techniques, **Bulk Liquid Storage** Management, **Process Reactors**, **Compressors & Turbines** Troubleshooting, **Pumps & Valves** Installation & Operation, **Bearing & Bearing Failure** Analysis, **Pressure Vessel & High Pressure Boiler** Operation, Mechanical Seals, **Pipe** Maintenance & Repair, **Centrifugal & Positive Displacement Pump**, **Rotating Machinery**, **Tank Farm & Tank**, **Process Piping** Design, **Condition Monitoring** System,. Further, he is also well-versed in **Water Pumping** Station, **Water Distribution & Network** System, **Water Hydraulic** Modelling, **Water Pipelines** Materials & Fittings, **Potable Water** Transmission, **Water Supply & Desalination Plants** Rehabilitation, **Pipes & Fittings**, **Main Water Line** Construction and **Sewage & Industrial Wastewater** Treatment.

During his career life, Mr. Bester has gained his practical and field experience through his various significant positions and dedication as the **Project Manager**, **Asset Manager**, **Process Engineer**, **Water Engineer**, **Maintenance Engineer**, **Mechanical Engineer**, **Team Leader**, **Analyst**, **Process Engineering Dept. Supervisor**, **Landscape Designer** and **Senior Instructor/Trainer** for various international companies as well as infrastructures, water and wastewater treatment plants from New Zealand, UK, Samoa, Zimbabwe and South Africa, just to name a few.

Mr. Bester holds a **Diploma in Wastewater Treatment** and a **National Certificate in Wastewater & Water Treatment**. Further, he is a **Certified Instructor/Trainer**, an **Approved Chemical Handler** and has delivered numerous courses, trainings, conferences, seminars and workshops 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: Sunday, 07<sup>th</sup> of September 2025**

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	<b>PRE-TEST</b>
0830 – 0930	<b>Machinery Failure Patterns</b> <i>Understand the Nature of Failures • Types of Equipment Failures • Failure Classifications &amp; Failure Patterns • Why Equipment Fails • Failure analysis &amp; Root Cause • How Does Most of Your Equipment Fail?</i>
0930 – 0945	Break
0945 – 1100	<b>Machinery Diagnostic Testing</b> <i>Diagnostic Objectives • Mechanical Inspection • Test Plan Development • Data Acquisition &amp; Processing • Data Interpretation • Conclusions &amp; Recommendations • Corrective Action Plan</i>
1100 – 1215	<b>Metallurgical Failure Analysis Methodology</b> <i>Failure Analysis of Bolted Joints • Shaft Failures &amp; their Origins • Ductile vs. Brittle Failures of Shafts • Stress Raisers in Shafts</i>
1215 – 1230	Break
1230 – 1420	<b>Machinery Component Analysis &amp; Reliability Improvement</b> <i>Redesign Opportunities • Analyzing Wear Failures • Bearings in Distress • Rolling Element Bearing (AFB) &amp; Bearing Failure Analysis • Journal &amp; Tilt-Thrust Bearings • Gear Failure Analysis</i>
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day One

#### **Day 2: Monday, 08<sup>th</sup> of September 2025**

0730 – 0930	<b>Machinery Component Analysis &amp; Reliability Improvement (cont'd)</b> <i>Coupling Failure Avoidance • Determining the Cause of Mechanical Seal Distress • Mechanical Seal Selection Strategies • O-Ring Failures &amp; their Causes</i>
0930 – 0945	Break
0945 – 1100	<b>Machinery Troubleshooting</b> <i>The Matrix Approach to Machinery Troubleshooting • Pumps • Centrifugal Compressors • Blowers &amp; Fans • Reciprocating Compressors • Engines • Gas Turbines &amp; Others</i>



1100 – 1215	<b>Machinery Root Cause Failure Analysis (RCFA)</b> Structured Problem Solving & RCFA • Cause Analysis • Two-Track Approach • Failure Types • The Three Levels of Cause • Collecting Failure Data • Parts & Position • The Analysis Process
1215 – 1230	Break
1230 – 1420	<b>Machinery Root Cause Failure Analysis(RCFA) (cont'd)</b> Describing the Process • Data Analysis I • Data Analysis II • Data Analysis III • Another Way • Human Root Causes • Solutions • Stewardship of RCFA Results
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day Two

**Day 3: Tuesday, 09<sup>th</sup> of September 2025**

0730 – 0930	<b>Vibration Analysis – A Management Overview</b> Specific Machinery Problems • Monitoring & Analysis Methods • Future Outlook
0930 – 0945	Break
0945 – 1100	<b>Machinery Vibrations</b> 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
1100 – 1215	<b>Machinery Vibrations (cont'd)</b> 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 & Mode Shapes
1215 – 1230	Break
1230 – 1420	<b>Vibration Signal Analysis for Different Faults</b> Gear Boxes • Electric Motors • Flow-related Problems Pumps, Fans & Compressors • Vibration Frequencies Related to Machinery Faults
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day Three

**Day 4: Wednesday, 10<sup>th</sup> of September 2025**

0730 – 0930	<b>Formalized Failure Reporting as a Teaching Tool</b> Actual Cases Cited & Explained in Detail • High Speed Pump Failure & Bearing Failures
0930 – 0945	Break
0945 – 1100	<b>Examination of Failed Components</b> Bearings • Gears • Mechanical Seals & Others
1100 – 1215	<b>Process/Mechanical/Technical Interaction</b> How PMT Teams Work • Turnaround Management • Preventive vs. Predictive Maintenance Concepts
1215 – 1230	Break
1230 – 1420	<b>Process/Mechanical/Technical Interaction</b> Integrated vs. Separate Maintenance • Centrifugal Pump Failure Reduction Programs
1420 – 1430	<b>Recap</b>
1430	Lunch & End of Day Four



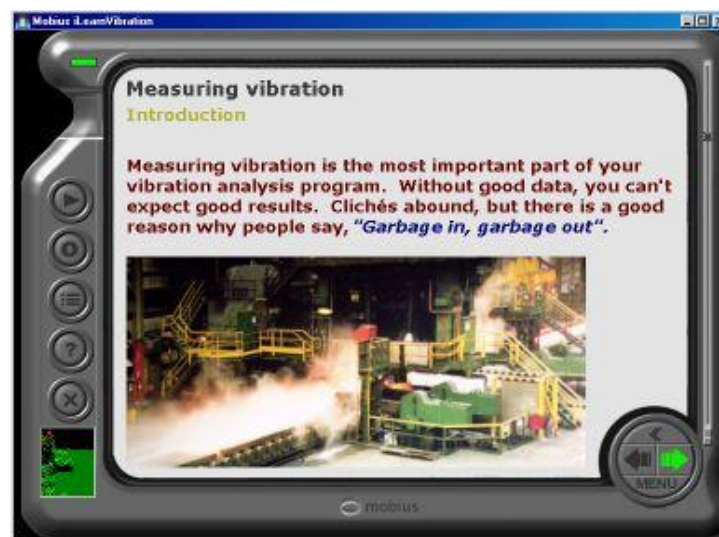


**Day 5: Thursday, 11<sup>th</sup> of September 2025**

0730 – 0930	<b>Machine Condition Evaluation</b> Vibration Severity Limits • Shaft Vibration • Bearing Vibration • Casing Vibration • Standards • ISO 2372 Chart • ISO 10816 Chart • The IRD General Machinery Vibration Severity Chart
0930 – 0945	Break
0945 – 1100	<b>Predictive Maintenance &amp; Condition-Based Monitoring</b> Types of Condition Based Monitoring • Vibration Monitoring • Pump Monitoring Frequency • Infrared Thermography • Physical Effects Monitoring
1100 – 1215	<b>Predictive Maintenance &amp; Condition-Based Monitoring (cont'd)</b> Lube Oil Analysis • What Kinds of Monitoring are Being Used Today? • Has the Monitoring Program Been Effective? • Is the Monitoring Scheduled Being Adhered to?
1215 – 1230	Break
1230 – 1300	<b>Continuous Reliability Improvement</b> Optimized Lubrication for Pumps & Electric Motors • Economics of Dry Sump Oil Mist Lubrication • Lubrication Considerations for Pump & Electric Motors • Major Machinery Lubrication Management
1300 – 1315	<b>Course Conclusion</b>
1315 – 1415	<b>COMPETENCY EXAM</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 the “iLearnVibration” simulator.



**iLearnVibration Simulator**

**Course Coordinator**

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