COURSE OVERVIEW RE0241

Balancing of Machinery Components

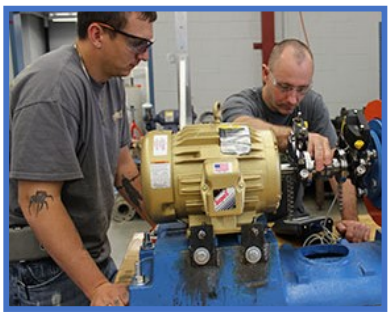
Course Title
Balancing of Machinery Components

Course Date/Venue
Session 1: January 12-16, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: July 14-18, 2025/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
RE0241

Course Duration/Credits
Five days/3.0 CEUs/30.0 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.

This course will provide participants with the working knowledge to achieve alignment on two-shaft systems (e.g. motor and pump) and will emphasize what is involved in the overall alignment process. The aim of the course is to provide the participants with the knowledge to accurately align any type of machinery in a variety of ways. No single alignment method or system is promoted over another. There are advantages and disadvantages to each system. This course helps to insure that the participants are aware of the various techniques to measure and correct misalignment. In addition, it will help participants pick the best method of alignment to suit their individual needs and the needs of their company. Each participant will develop the confidence and ability to do the job correctly.

During this interactive course, participants will learn the detection and measurement of misalignment of rotating machinery; the tolerances in flexible and rigid couplings; the correct flexible coupling; the various alignment methods and techniques; the face and rim method, double radical method, shaft-to-coupling spool method, face-face method and electronic/electro-optical method; and the proper method in aligning V-belt drives, rotating shaft in stationary hollow cylinder, parallel rolls, vertical rolls and lateral rolls.

Course Objectives

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

- Align and balance mechanical systems accurately using different alignment techniques
- Detect and measure misalignment of rotating machinery
- Identify the tolerances in flexible and rigid couplings and specify the flexible coupling correctly
- Apply the various alignment methods and techniques including face and rim method, double radical method, shaft-to-coupling spool method, face-face method and electronic/electro-optical method
- Employ the proper method in aligning V-belt drives, rotating shaft in stationary hollow cylinder, parallel rolls, vertical rolls and lateral rolls
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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

The course covers systematic techniques on rotating equipment alignment for those who are involved in the design, maintenance, inspection or repair of rotating equipment.

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.

Accommodation

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

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 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: -

- 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. 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, **Process Safety** Design, Certified **Process Plant** Operations, Control & Troubleshooting, **Operator** Responsibilities, **Storage Tanks Operations** & Measurements, **Tank Design**, Construction, Inspection & Maintenance, **Atmospheric Tanks**, **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, **Plant & Equipment Integrity**, **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**), **Material Cataloguing**, Specifications, Handling & Storage, **Steam Trap** Design, Operation, Maintenance & Troubleshooting, **Steam Trapping & Control**, **Column**, **Pump** Technology, **Pump** Selection & Installation, **Centrifugal Pumps** Troubleshooting, **Pumps** Design, Selection & Operation, **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**, Environmental Management System (**EMS**), Supply Chain, Purchasing, Procurement, **Logistics** Management & **Transport** & **Warehousing** & **Inventory**, **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.

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 of Shaft Alignment*** *Benefits of Good Machinery Alignment • Consequences of Defective Alignment • Four Basic Ingredients Necessary to Ensure Alignment Success • Eight Basic Steps to Align Machinery • How Qualified are you to Detect and Correct Machinery Misalignment? • Why Should People Be Tested on their Alignment Skills? • Experience Evaluation for Machinery Alignment • Who Needs to be Trained and Qualified in Shaft Alignment? • Assessing a Person's Knowledge and Experience Level in Shaft Alignment • Alignment Qualification or Certification Testing • Periodic Alignment Checks • Alignment Record Keeping*
0930 – 0945	*Break*
0945 – 1100	***Detecting Misalignment on Rotating Machinery*** *The Four Maintenance Philosophies • Types of Forces that Occur on Rotating Machinery*
1100 – 1215	***Foundations, Baseplates, Installation & Piping Strain*** *Varying Composition of Earth's Surface Layer • How do we Hold this Equipment in Place? • Problems to Look For in your Foundations and Baseplates • Checking for Excessive Static Piping Forces on Rotating Equipment • Visual Inspection Checklist • How Long will Rotating Machinery Stayed Accurately Aligned?*
1215 – 1230	*Break*
1230 – 1420	***Flexible & Rigid Couplings*** *Coupling and Shaft Misalignment Tolerances – What is the Difference? • The Role of Flexible Coupling • What to Consider when Specifying a Flexible Coupling • Types of Flexible Couplings • Rigid Coupling Design • Flexible Coupling Lubrication • Coupling Installation • Coupling Hub Attachment Methods • Keys and Keyways*
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 – 0930	***Preliminary Alignment Checks*** *Foundation and Base Plate Checks • Dial Indicator Basics • Damaged, Worn or Improperly Installed Machinery Components Checks • Runout • Machine Housing to Base Plate Interface Problems • Verifying that the Soft Foot has been Eliminated • Other Methods for Correcting Soft Foot Problems*
0930 – 0945	*Break*

0945 – 1100	***Shaft Alignment Measuring Tools*** *Dimensional Measurement • Classes of Dimensional Measurement and Tools and Sensors • Sweeping 90° Arcs Twice to Measure a Misalignment Condition • Why Measurements are Taken at 90° Intervals • Rotating Both Shafts to Override a Runout Condition • Tips for Getting Good Alignment Measurements • Engaged Coupling will Produce Measurement Errors • Rim Indicator Setup Variations • Rim Readings Indicate Twice the Centerline Offset • Validity Rule • Partial Arc Mathematics • Bracket or Bar Sag • Xmas Tree Bracket and Face Sag • Zero Sag Brackets • Dial Indicator Shaft Alignment System Manufacturers • Dial Indicator Manufacturers Hardware Specifications*
1100 – 1215	***Correcting Misalignment*** *Installing Machinery for the First Time • Bolt Bound Conditions • Last Resort Measures for Bolt-Bound Conditions • Machinery Positioning Basics • Types of Movement Tools • What to Do When Thing are not Working • Misalignment Rantings*
1215 – 1230	*Break*
1230 – 1420	***Alignment Modeling Basics*** *Graphing and Modeling Alignment Techniques • Basic Alignment Models • Scaling the Drive System onto the Alignment Model • Cardinal Alignment Graphing and Modeling Rules*
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	***Defining Misalignment: Alignment & Coupling Tolerance*** *What Exactly is Shaft Alignment? • Does Level and Aligned Mean the Same Thing? • Measuring Angles • Types of Misalignment • Definition of Shaft Misalignment Checking the Misalignment Tolerance • Shaft Versus Coupling Alignment • How Straight are Rotating Machinery Shafts?*
0930 – 0945	*Break*
0945 – 1100	***Reverse Indicator Method*** *Basic Mathematical Equations for the Reverse Indicator Method • Modeling Reverse Indicator Method Using the "Point to Point" Technique • Rim Reading are Always Twice the Offset Amount • Modeling the Reverse Indicator Method Using the Line –to –Point Technique*
1100 – 1215	***Face and Rim Methods*** *Mathematical Relationship in Machinery Alignment • Sixteen-Point Method • Twenty-Point Method • Problems with Taking Face Readings • Modeling the Face and Rim Method • Artificial Face Surface*
1215 – 1230	*Break*
1230 – 1330	***Double Radial Method*** *Basic Mathematical Equations for the Double Radial Method • Modeling the Double Radial Method*

1330 – 1420	***Shaft to Coupling Spool Method*** *Basic Mathematical Equations for the Shaft Coupling Spool Method • Modeling the Shaft to Coupling Spool Method*
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	***Face-Face Method*** *Basic Mathematical Equations for the Face-Face Method • Modeling the Face-Face Method*
0930 – 0945	*Break*
0945 – 1100	***Electronic and Electro-Optical Shaft Alignment Systems*** *Optical Encoder System • Laser-Detector Systems • Laser System Manufacturers Hardware Specifications • Laser System Manufacturers Software Specifications*
1100 – 1215	***Measuring and Compensating for Off-Line to Running Machinery Movement*** *What Type of Machinery is Likely to Change Equipment's Position When Running? • What Causes Machinery Movement to Occur? • Conducting the Off-Line to Running Machinery Movement Survey • Taking "Hot" Alignment Measurements Immediately after Shutdown • Four General Categories Of OL2R Measurements • Calculating Machine Case Terminal Expansion using the Strain Equation • Inside Micrometer-Tooling Ball-Angle • Vertical, Lateral and Axial OL2R Movement • Proximity Probes with Water-Cooled Stands • Optical Alignment Equipment*
1215 – 1230	*Break*
1230 – 1420	***Measuring and Compensating For Off-Line to Running Machinery Movement (Cont'd)*** *Optical Parallax • Using Optical Tooling for Measurement Machinery Movement • Establishing Reference Planes • Alignment Bars with Proximity Probes • Applying Laser-Detector Systems for OL2R Measurements • Ball-Rod-Tubing Connector System • Vernier-Strobe System • Instrumented Coupling Systems • Aligning Shafts for Running Conditions (Also Known as Running Alignment or "Hot Operating Alignment")*
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 – 0930	***Aligning Multiple - Element Drive Systems*** *Multiple-Element Drive Train Alignment Laws • Multiple-Element Drive Train: Graphing and Modeling Techniques • Multiple-Element Drive Train Modeling –One Set of Shafts at a Time • Multiple-Element Drive System Graphing –Modeling All the Shafts at One Time • Mixing Different Alignment Measurement Methods • Modeling Right-Angle Drive Systems • Final Comments on Aligning Multiple-Element Drive Trains*
0930 – 0945	*Break*
0945 – 1100	***Aligning V-Belt Drives*** *Belt Drive Systems-Advantages and Disadvantages • V-Belt Standards Information • Sheave Information • V-Belt Recommendation and Rules of Thumbs • Sheave and Belt Wear • Adjusting Belt Tension • Preliminary Alignment Checks for V-Belts and Sheaves • Types of Sheave Misalignment Conditions • Using a Straightedge to Measure Misalignment • Measuring the Misalignment at the Sheaves • V-Belt Machine Measurements • Modeling V-Belt Alignment Problems • V-Belt Alignment Modeling Sample Problem • Laser Alignment Systems For V-Belt and Sheaves*
1100 – 1215	***Bore Alignment*** *Aligning a Rotating Shaft with a Stationary Hollow Cylinder • Aligning Two Hollow Cylinders • Basic Measurement Principles and Nomenclature • Cylinder Alignment Procedure • Bucking in Process • Correcting the Misalignment • Laser Bore Alignment Systems*
1215 – 1230	*Break*
1230 – 1345	***Parallel Alignment*** *Rough Alignment of Parallel Rolls • Using Optical Alignment Equipments for Roll Parallelism • Aligning the Rolls in the Vertical (Up/Down) Direction • Aligning the Rolls in the Lateral (Side to Side) Direction • Using Laser-Detector Systems to Measure Parallelism • Using Roll, Pitch and Yaw Positions of Rolls to Measure Parallelism • Aligning Rolls and Their Drives*
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)

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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