

# <u>COURSE OVERVIEW IE0035-4D</u> <u>Liquid & Gas Flowmetering & Custody Measurement</u> *Multiphase, Ultrasonic & Loss Control*

### Course Title

Liquid & Gas Flowmetering & Custody Measurement: *Multiphase, Ultrasonic & Loss Control* 

## Course Date/Venue

December 09-12, 2024/Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA

Course Reference

Course Duration/Credits Four days/2.4 CEUs/24 PDHs

# Course Description









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

This course is designed to provide delegates with a detailed and up-to-date overview of liquid and gas flowmetering and custody measurement covering multiphase, ultrasonic and loss control.

Participants will be able to select and calibrate an ultrasonic flowmeter for the required application and deal with related operational and measurement concern; choose the correct flowmeter or combination of flowmeters for a particular multiphase application and be able to resolve any ensuing problems in relation to unreliability or inaccuracy of flowmeter readings; and compare the performances of existing multiphase meters such as Agar, Weatherford, Roxar, Schlumberger and Haimo.

The course will also cover the different types, methods and techniques used in custody transfer; the various pipeline meter considerations; systematic techniques in leak detection and loss control during custody transfer; and the various API standards applicable to flowmetrering and custody measurement.



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### **Course Objectives**

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

- Apply an in-depth knowledge and skills in liquid and gas multiphase and single-• phase flowmetering, ultrasonic flowmetering, custody measurement and loss control of petroleum products
- Select and calibrate an ultrasonic flowmeter for the required application and deal with related operational and measurement concerns
- Choose the correct flowmeter or combination of flowmeters for a particular • multiphase application and be able to resolve any ensuing problems in relation to unreliability or inaccuracy of flowmeter readings
- Compare the performances of existing multiphase meters such as Agar, • Weatherford, Roxar, Schlumberger and Haimo and recognize their importance in flowmetering
- Determine the different types, methods and techniques used in custody transfer • and understand the various pipeline meter consideration
- Employ systematic techniques in leak detection and loss control during custody • transfer and list the various API standards applicable to flowmetering and custody measurement

# Exclusive Smart Training Kit - H-STK<sup>®</sup>



Participants of this course will receive the exclusive "Haward Smart Training Kit" (H-STK<sup>®</sup>). The H-STK<sup>®</sup> 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 is intended for instrumentation, inspection, control, custody, metering and process engineers and other technical staff. Further, the course is suitable for piping engineers, pipelines engineers, mechanical engineers, operations engineers, maintenance engineers, plant/field supervisors & foreman and loss control coordinators.

#### Course Fee

US\$ 4,500 per Delegate + VAT. This rate includes H-STK<sup>®</sup> (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.



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# 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:-

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 **2.4 CEUs** (Continuing Education Units) or **24 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.

• \*\*\* \* BAC

# 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.



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### 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:



Dr. Alaa Abdel Kerim, PhD, MSc, BSc, is a Senior Electrical & Instrumentation Engineer with over 35 years of extensive experience in the Power, Petrochemical, Refinery, Oil and Gas industries. He specializes in DCS, PLC, SCADA, HMI, Automation System, Process Control & Instrumentation, Hydrocarbon, Level & Flow Measurements, Analytical Instrumentation, Find Control Elements, Control Loop

Operation, Data Acquisition & Transmission, Electronics Technology, Power Systems Control, Power Systems Security, Power Transmissions, Power Generation, Electrical Substations and MV/LV Electrical System.

During his career life, Dr. Alaa has been practically and academically involved in different **Power System** and **Instrumentation international companies** and **Universities** as a **Senior Professor & Consultant**, **Instrumentation Engineer** and **Electrical Engineer**. His recent practical applications experience includes the design, supply, installation, operation of full DCS, SCADA, PLC, HMI Automation **System** for **Sumid Line Petroleum**, **Siemens USA**, **AREVA USA** to name a few. His experience also includes electrical coordination, protection level adjustments and electrical testing.

Dr. Alaa has a **PhD** degree in **Electrical Engineering** from the **Technical University of Gdansk**, **Poland** and has **Master** and **Bachelor** degrees in **Electrical Machine & Power Engineering** from **Cairo University** and **Helwan University**, respectively. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings and workshops worldwide.

### Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, Stateof-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.



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## 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:	Monday, 09 <sup>th</sup> of December 2024
0730 – 0800	Registration & Coffee
0800 - 0815	Welcome & Introduction
0815 - 0830	PRE-TEST
0830 - 0915	Flowmetering Overview
0850 - 0915	Introduction to Pipeline Flowmetering with Highlighted Problem Areas
	Flow Measurement Accuracy
0915 – 1000	Flow Measurement Uncertainty • Repeatability & Reproducibility • Basic
	Statistics (Average & Standard Deviation) • Calibration Graphs
1000 - 1015	Break
	Fluid Mechanics of Pipe Flows
1015 – 1100	Laminar Flows & Turbulent Flows • Pipe Velocity Distributions • Worked
	Examples • Pipe Fitting Losses
1100 – 1130	DVD on Flow Measurement
	Differential Pressure Type Flowmeters
1130 – 1215	Orifice Meters • Critical Flow Element • Venturi Meters • Flow Nozzles •
	Variable Area Meters • Pitot Tubes & Pitot Static Tubes • Target Flowmeters
1215 – 1230	Break
	Displacement, Rotary-Inferential & Fluid-Oscillatory Flowmeters
1230 – 1315	Helical Gear Meter • Nutating Disc Meter • Piston Meter • Rotary Meter •
	Turbine Flowmeters • Vortex Shedding Meters
	Electromagnetic, Coriolis Mass & Miscellaneous Flowmeters
1315 - 1345	AC & Pulsed DC Types • Cross Correlation Methods • Tracer Methods •
1515 - 1545	Weighing Methods • Velocity Profile Integration Techniques • Laser Doppler
	Systems
	Ultrasonic Flowmeters-Basic Principles
1345 - 1420	General • Transit Time • Doppler • Beam Configuration • Clamp-On Type
	Insertion Type
	Recap
1420 – 1430	Using this Course Overview, the Instructor(s) will Brief Participants about the
1420 - 1400	Topics that were Discussed Today and Advise Them of the Topics to be Discussed
	Tomorrow
1430	Lunch & End of Day One

#### Day 2: Tuesday, 10<sup>th</sup> of December 2024

0730 - 0830	Video Presentation 3 Beam Ultrasonic Flowmeter
0830 - 0930	<i>Ultrasonic Flowmeters–Main Types</i> Elster – Instrument • Emerson – Daniel • Panametrics – Sentinel • Sick – Maihack • Krohne • FMC – Smith Meters • Typical Specification • Future Trends
0930 - 0945	Break



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0945 - 1030	Ultrasonic Flowmeters-Sizing & SelectionSizing NotesPractical ExampleSelection GuidelinesTypicalSpecification
1030 - 1115	<i>Flowmeter Calibration</i> <i>Methods for Liquid Flowmeters</i> • <i>Use of Pipe Provers</i> • <i>Methods for Gas Flowmeters</i> • <i>Methods for Ultrasonic Flowmeters</i> • <i>Critical Flow Nozzle</i>
	Measurement Considerations, Flow Conditioners & Operational IssuesBasic Requirements• Response• Uncertainty• Instrument Specification
1115 - 1215	Accuracy Specifications • Fully Developed Pipeline Flow • Test Results • Types of Flow Conditioners • Contamination • Control Valve Noise • Signal Quality • On-Line Monitoring
1215 - 1230	Break
1230 - 1315	Introduction to Multiphase FlowsMixture Density • Gas Velocity • Homogeneous Flows • Slip • SuperficialPhase Velocities • Velocity Ratio • Void Fraction
1315 - 1345	<b>Flow Patterns in Two &amp; Three-Phase Flows</b> Stratified Flows • Slug Flows • Bubble Flows • Annular Flows • Churn Flows • Transitions
1345 - 1420	Flow Pattern Maps Horizontal Flows & Vertical Flows
1420 - 1430	<b>Recap</b> 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:	Wednesday, 11 <sup>th</sup> of December 2024
	Effect of Flow Patterns on Multiphase Flow Measurement
0730 – 0815	Velocity Differences between Gas & Liquid Phases • Velocity Differences
	between-n Oil & Water Phases
0.015 0000	Modelling of Multiphase Flows
0815 – 0900	Pressure Drop, Mixing & Density Measurement • Errors
0000 0020	Phase Distribution Effects on Measurement
0900 - 0930	Continuous Phase, Viscosity, Single Phase Meters in Multiphase Flows
0930 - 0945	Break
0945 - 1030	Multiphase Meter Operating Principles & Classification
0943 - 1050	Velocity Measurement • Phase Fraction
1030 - 1115	Descriptions of Existing Multiphase Meters
1030 - 1113	Agar • Weatherford • Roxar • Schlumberger • Haimo
	Industrial In-depth Presentation by a Major Manufacturer of Multiphase
1115 - 1215	Meters
1115 - 1215	Detailed Technology • Performance Specification • Field Installation •
	Calibration & Testing
1215 - 1230	Break
	Multiphase Flowmeter Accuracy
1230 - 1315	Uncertainties in Individual Phase Flowrates • Origins of Uncertainties •
	Expression of Multiphase Meter Accuracy
	Verification of Multiphase Flow Meters during Operation
1315 - 1345	Baseline Monitoring • Self Checking/Self Diagnostics • Two Meters in Series
	• Mobile Test Units • Tracer Techniques • Injection • Sampling •
	Reconciliation



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1345 - 1420	Level MeasurementMain TypesBuoyancy Tape SystemsHydrostatic PressureUltrasonicMeasurementRadar MeasurementVibration SwitchesElectricalMeasurementInstallation ConsiderationsImpact on the Control Loop•The Future
1420 – 1430	<b>Recap</b> 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:	Thursday, 12 <sup>th</sup> of December 2024
	OIML Recommendation R117
0730 - 0815	General Requirements • Field of Operation • Accuracy Classes • Case
	<i>Example</i> • <i>API MPMS Chapter 5.8</i>
	Terminal Custody Transfer
0815 - 0845	Methods of Tank Calibration • Tank Gauging Techniques • Tank Management
	Systems
0845 - 0930	Video Presentation
	Tank Gauging System
0930 - 0945	Break
0945 - 1030	Lease Automatic Custody Transfer
0010 1000	System Requirements • Operation • Equipment • Conclusions • Appendix
	Truck Custody Transfer
1030 - 1115	<i>Truck Types</i> • <i>Typical Equipment</i> • <i>Other Considerations</i> • <i>Performance</i> •
	New Developments
	Pipeline Meter Considerations
1115 - 1215	<i>Flow in a Pipeline.</i> • <i>Pipeline Installation Considerations</i> • <i>DP Transmitters</i> •
	Multi-Port Averaging Pitot • Oscillatory Flow Measurement • Ultrasonic
1015 1000	Flow Measurement • Mass Flow Measurement
1215 - 1230	Break
1000 1015	Leak Detection & Loss Control System
1230 – 1315	API 1130 • A Theoretical or Practical Approach • Real Time Transient Model
	Practical Example • Results • Custody Transfer Sampling • Case Studies
1015 1015	API Standards
1315 - 1345	API Gravity • Classification of Grades • Temperature Measurement •
	Measuring the Suspended S&W Content • Calculating Net Volume
1245 1400	Course Conclusion
1345 – 1400	Using this Course Overview, the Instructor(s) will Brief Participants about the
1400 1415	Course Topics that were Covered During the Course
1400 - 1415	POST-TEST
1415 - 1430	Presentation of Course Certificates
1430	Lunch & End of Course



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## Simulators (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 our state-of-the-art "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter Sizing Tool" and "Orifice Flow Calculator" simulators.

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### **Course Coordinator**

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