COURSE OVERVIEW IE0035

Liquid & Gas Flowmetering & Custody Measurement

Multiphase, Ultrasonic & Loss Control

Course Title

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

Course Reference

IE0035

Course Date/Venue

Session 1: June 29-July 03, 2025/ Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Session 2: December 07-11, 2025/ Al Khobar Meeting Room, Hilton Garden Inn, Al Khobar, KSA

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 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.

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®

*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 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.

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:-

- 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.

- 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.

Accommodation

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

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. Sydney Thoresson, PE, BSc, is a **Senior Electrical & Instrumentation Engineer** with over **40 years** of extensive experience within the **Petrochemical**, **Utilities**, **Oil**, **Gas** and **Power** industries. His specialization highly evolves in **Process Control Instrumentation**, **Process Instrumentation & Control**, **Process Control**, **Instrumentation**, **Troubleshooting** & Problem Solving, Process **Instrumentation** and Control Techniques, **Instrumentation** for Process Optimization and Control, Process Automation and **Instrumentation** Systems Integration, Troubleshooting in Process Control Systems**,** Process Control & Safeguarding, **Troubleshooting Instrumentation** and Control Systems, GC Processes **Troubleshooting** and Control Systems, Practical **Troubleshooting** and Repair of Electronic Circuits**,** Process Control, **Troubleshooting** & **Problem Solving.** Process Control (**PCI**) & Safeguarding, **Control Loop & Valve Tuning**, **Controller Maintenance** Procedures, High Integrity Protection Systems (**HIPS**), **Instrument Calibration & Maintenance**, **Instrumented Safety Systems**, **Compressor Control & Protection**, **Control Systems**, Programmable Logic Controllers (**PLC**), **SCADA System**, **PLC & SCADA** - Automation & Process Control, **PLC & SCADA** Systems Application, Technical **DCS/SCADA**, **PLC-SIMATIC S7 300/400**: Configuration, Programming and Troubleshooting, **PLC, Telemetry and SCADA** Technologies, Cyber Security of Industrial Control System (**PLC, DCS, SCADA & IED**), Basics of **Instrumentation Control System, DCS**, **Distributed Control System** - Operations & Techniques, Distributed Control System (**DCS**) Principles, Applications, Selection & Troubleshooting, Distributed Control Systems (**DCS**) especially in **Honeywell DCS**, **H&B DCS**, **Modicon, Siemens**, **Telemecanique**, **Wonderware** and **Adrioit,** Safety Instrumented Systems (**SIS**), Safety Integrity Level (**SIL**), Emergency Shutdown (**ESD**), **Emergency Shutdown** System, Variable Frequency Drive (**VFD**), **Process Control & Safeguarding**, **Field Instrumentation**, **Instrumented Protective Devices** Maintenance & Testing, Instrumented Protective Function (**IPF**), **Refining & Rotating Equipment**, **Equipment Operations**, **Short Circuit Calculation**, **Voltage Drop Calculation**, **Lighting Calculation**, **Hazardous Area Classification**, **Intrinsic Safety**, **Liquid & Gas Flowmetering**, **Custody Measurement**, **Ultrasonic Flowmetering**, **Loss Control**, **Gas Measurement**, **Flowmetering & Custody Measurement**, **Multiphase Flowmetering**, **Measurement and Control**, **Mass Measuring System Batching** (**Philips**), Arc Furnace Automation-Ferro Alloys, Walking Beam Furnace, Blast Furnace, Billet Casting Station, Cement Kiln Automation, Factory Automation and Quality Assurance Accreditation (**ISO 9000** and **Standard BS 5750**). Further, he is also well-versed in **Electrical Safety**, **Electrical Hazards Assessment**, **Electrical Equipment**, **Personal Protective Equipment**, Log-Out & Tag-Out (**LOTO**), **ALARP & LOPA** Methods, Confined Workspaces, Power **Quality**, Power **Network**, Power **Distribution**, **Distribution Systems**, **Power Systems Control**, **Power Systems Security**, Power **Electronics**, Electrical **Substations**, **UPS** & **Battery System**, **Earthing & Grounding**, Power **Generation**, **Protective Systems**, **Electrical Generators**, **Power** & **Distribution Transformers**, **Electrical Motors**, **Switchgears**, **Transformers**, **AC** & **DC Drives**, **Variable Speed Drives** & **Generators** and **Generator Protection**. He is currently the **Projects Manager** wherein he manages projects in the field of electrical and automation engineering and in-charge of various process hazard analysis, fault task analysis, FMEA and HAZOP study.

During Mr. Thoresson's career life, he has gained his thorough and practical experience through various challenging positions and dedication as the **Contracts & Projects Manager**, **Managing Director**, **Technical Director**, **Divisional Manager**, **Plant Automation Engineer**, **Senior Consulting Engineer**, **Senior Systems Engineer**, **Electrical & Instrumentation Engineer**, **Consulting Engineer**, **Service Engineer** and **Section Leader** from several international companies such as **Philips**, **FEDMIS**, **AEG**, **DAVY International**, **BOSCH**, **Billiton** and **Endress/Hauser**.

Mr. Thoresson is a **Registered Professional Engineering Technologist** and has a **Bachelor**'**s** degree in **Electrical & Electronics Engineering** and a **National Diploma** in **Radio Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**) and an active member of the International Society of Automation (**ISA**) and the Society for Automation, Instrumentation, Measurement and Control (**SAIMC**). He has further delivered numerous trainings, courses, seminars, conferences and workshops worldwide.

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 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 – 0915	***Flowmetering Overview*** *Introduction to Pipeline Flowmetering with Highlighted Problem Areas*
0915 – 1000	***Flow Measurement Accuracy*** *Flow Measurement Uncertainty • Repeatability & Reproducibility • Basic Statistics (Average & Standard Deviation) • Calibration Graphs*
1000 – 1015	*Break*
1015 – 1100	***Fluid Mechanics of Pipe Flows*** *Laminar Flows & Turbulent Flows • Pipe Velocity Distributions • Worked Examples • Pipe Fitting Losses*
1100 – 1130	***DVD on Flow Measurement***
1130 – 1215	***Differential Pressure Type Flowmeters*** *Orifice Meters • Critical Flow Element • Venturi Meters • Flow Nozzles • Variable Area Meters • Pitot Tubes & Pitot Static Tubes • Target Flowmeters*
1215 – 1230	*Break*
1230 – 1330	***Displacement, Rotary-Inferential & Fluid-Oscillatory Flowmeters*** *Helical Gear Meter • Nutating Disc Meter • Piston Meter • Rotary Meter • Turbine Flowmeters • Vortex Shedding Meters*
1330 – 1420	***Electromagnetic, Coriolis Mass & Miscellaneous Flowmeters*** *AC & Pulsed DC Types • Cross Correlation Methods • Tracer Methods • Weighing Methods • Velocity Profile Integration Techniques • Laser Doppler Systems*
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 – 0900	***Ultrasonic Flowmeters-Basic Principles*** *General • Transit Time • Doppler • Beam Configuration • Clamp-On Type • Insertion Type*
0900 – 0930	***Video Presentation*** *3 Beam Ultrasonic Flowmeter*
0930 – 0945	*Break*

0945 – 1100	***Ultrasonic Flowmeters–Main Types*** *Elster – Instrument • Emerson – Daniel • Panametrics – Sentinel • Sick – Maihack • Krohne • FMC – Smith Meters • Typical Specification • Future Trends*
1100 – 1215	***Ultrasonic Flowmeters–Sizing & Selection*** *Sizing Notes • Practical Example • Selection Guidelines • Typical Specification*
1215 – 1230	*Break*
1230 – 1330	***Flowmeter Calibration*** *Methods for Liquid Flowmeters • Use of Pipe Provers • Methods for Gas Flowmeters • Methods for Ultrasonic Flowmeters • Critical Flow Nozzle*
1330 – 1420	***Measurement Considerations, Flow Conditioners & Operational Issues*** *Basic Requirements • Response • Uncertainty • Instrument Specification • Accuracy Specifications • Fully Developed Pipeline Flow • Test Results • Types of Flow Conditioners • Contamination • Control Valve Noise • Signal Quality • On-Line Monitoring*
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 – 0830	***Introduction to Multiphase Flows*** *Mixture Density • Gas Velocity • Homogeneous Flows • Slip • Superficial Phase Velocities • Velocity Ratio • Void Fraction*
0830 – 0930	***Flow Patterns in Two & Three-Phase Flows*** *Stratified Flows • Slug Flows • Bubble Flows • Annular Flows • Churn Flows • Transitions*
0930 – 0945	*Break*
0945 – 1100	***Flow Pattern Maps*** *Horizontal Flows & Vertical Flows*
1100 – 1215	***Effect of Flow Patterns on Multiphase Flow Measurement*** *Velocity Differences between Gas & Liquid Phases • Velocity Differences between-n Oil & Water Phases*
1215 – 1230	*Break*
1230 – 1330	***Modelling of Multiphase Flows*** *Pressure Drop, Mixing & Density Measurement • Errors*
1330 – 1420	***Phase Distribution Effects on Measurement*** *Continuous Phase, Viscosity, Single Phase Meters in Multiphase Flows*
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 – 0815	***Multiphase Meter Operating Principles & Classification*** *Velocity Measurement • Phase Fraction*
0815 – 0900	***Descriptions of Existing Multiphase Meters*** *Agar • Weatherford • Roxar • Schlumberger • Haimo*
0900 – 1030	***Industrial In-depth Presentation by a Major Manufacturer of Multiphase Meters*** *Detailed Technology • Performance Specification • Field Installation • Calibration & Testing*
1030 – 1045	*Break*
1045 – 1115	***Multiphase Flowmeter Accuracy*** *Uncertainties in Individual Phase Flowrates • Origins of Uncertainties • Expression of Multiphase Meter Accuracy*
1115 – 1215	***Verification of Multiphase Flow Meters during Operation*** *Baseline Monitoring • Self Checking/Self Diagnostics • Two Meters in Series • Mobile Test Units • Tracer Techniques • Injection • Sampling • Reconciliation*
1215 – 1230	*Break*
1230 – 1330	***Level Measurement*** *Main Types • Buoyancy Tape Systems • Hydrostatic Pressure • Ultrasonic Measurement • Radar Measurement • Vibration Switches • Electrical Measurement • Installation Considerations • Impact on the Control Loop • The Future*
1330 – 1420	***OIML Recommendation R117*** *General Requirements • Field of Operation • Accuracy Classes • Case Example • API MPMS Chapter 5.8*
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*

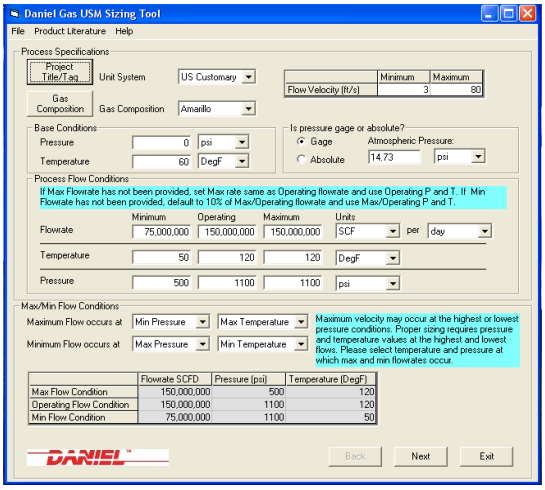
Day 5

0730 – 0815	***Terminal Custody Transfer*** *Methods of Tank Calibration • Tank Gauging Techniques • Tank Management Systems*
0815 – 0845	***Video Presentation*** *Tank Gauging System*
0845 – 0930	***Lease Automatic Custody Transfer*** *System Requirements • Operation • Equipment • Conclusions • Appendix*
0930 – 0945	*Break*
0945 – 1045	***Truck Custody Transfer*** *Truck Types • Typical Equipment • Other Considerations • Performance • New Developments*
1045 – 1145	***Pipeline Meter Considerations*** *Flow in a Pipeline. • Pipeline Installation Considerations • DP Transmitters • Multi-Port Averaging Pitot • Oscillatory Flow Measurement • Ultrasonic Flow Measurement • Mass Flow Measurement*
1145 – 1200	*Break*

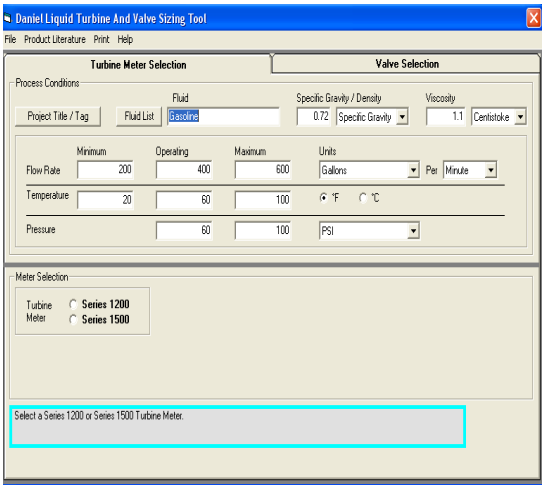
1200 – 1300	***Leak Detection & Loss Control System*** *API 1130 • A Theoretical or Practical Approach • Real Time Transient Model • Practical Example • Results • Custody Transfer Sampling • Case Studies*
1300 – 1345	***API Standards*** *API Gravity • Classification of Grades • Temperature Measurement • Measuring the Suspended S&W Content • Calculating Net Volume*
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*

Simulators (Hands-on Practical Sessions)

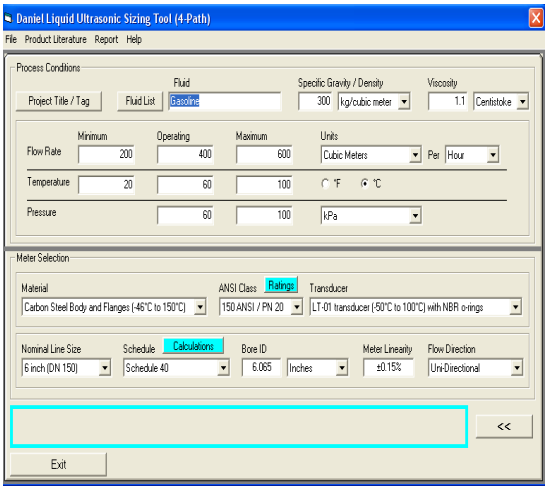
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter Sizing Tool" and "Orifice Flow Calculator" simulators.



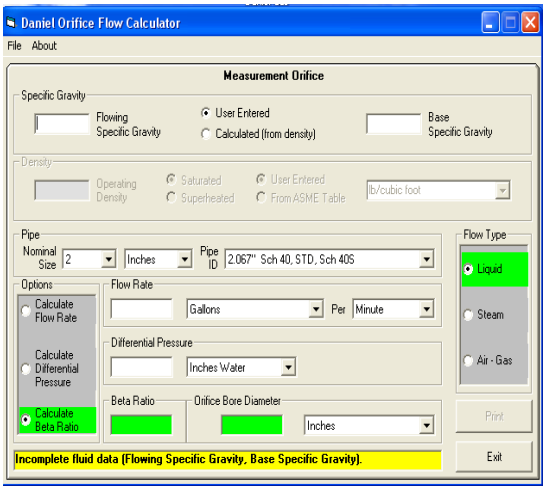
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator

Course Coordinator

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org