COURSE OVERVIEW IE0035

Liquid & Gas Flowmetering & Custody Measurement

Multiphase, Ultrasonic & Loss Control

Course Title

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



Course Date/Venue

Session 1: April 18-22, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar
Session 2: November 07-11, 2027/Meeting Plus 9, City Centre Rotana, Doha, Qatar



Course Reference

IE0035

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/Outcomes & Benefits for the Participants

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

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities in tailoring our courses to the training needs of our valued clients.

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

Haward's 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**. 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.

- 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. Sydney Thoresson, PE, BSc, is a **Senior Electrical & Instrumentation Engineer** with over **30 years** of extensive experience within the **Power & Water Utilities** and Other **Energy Sectors**. His specialization highly evolves in **Electrical Safety**, **Power System Equipment**, **Electrical Drawing**, **Electrical Forecasting**, **Transmission Networks**, **Substation**, **Distribution Networks**, **Substation Automation Systems & Application**, **Electrical** System, **HV/LV Electrical** Authorisation, **Variable Frequency Drives** (VFD), **HV/LV Equipment**, **Circuit Breaker**, **Motor Controllers**, **Hazardous Area Classification**, **Intrinsic Safety**, **Electrical Power Systems** Quality & Troubleshooting, **Protection & Relay**, **Electric & Control** System Commissioning, **Liquid & Gas Flowmetering**, Fault Analysis in **Electrical Networks & Distribution Cables**, **Custody Measurement**, **Ultrasonic Flowmetering**, **Loss Control**, **Gas Measurement**, **Process Control Instrumentation**, **Compressor Control & Protection**, **Control Systems**, Programmable Logic Controllers (**PLC**), **SCADA**, Distributed Control Systems (**DCS**) especially in **Honeywell DCS**, **H&B DCS**, **Modicon, Siemens**, **Telemecanique**, **Wonderware** and **Adrioit**. Moreover, he has vast experience in the field of Safety Instrumented Systems (**SIS**), Safety Integrity Level (**SIL**), Emergency Shutdown (**ESD**), **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**).

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

Mr. Thoresson is a **Registered Professional Engineering Technologist** and has a **National Higher Diploma** (**NHD**) & a **National Diploma** in **Radio Engineering** from the **Witwatersrand Technikon**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), an active member of the International Society of Automation (**ISA**) and the Society for Automation, Instrumentation, Measurement and Control (**SAIMC**).

Course Fee

US$ 6,000 per Delegate. 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.

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*

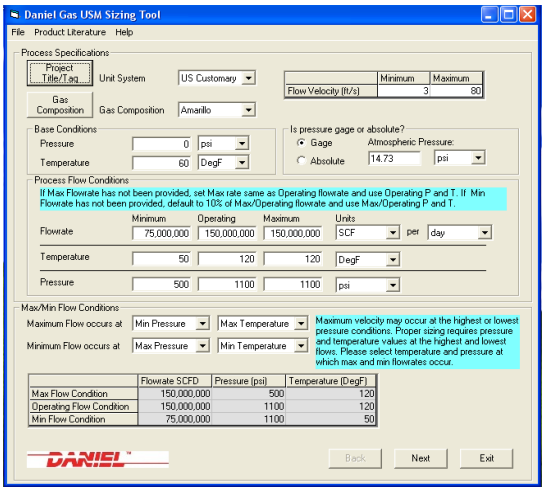
1030 – 1045	Break
1045 – 1115	***Multiphase Flowmeter Accuracy*** Uncertainties in Individual Phase Flowrates • Origins of Uncertainties • Expression of Multiphase Meter Accuracy
1115 – 1215	***Verification of Multiphase Flow Meters during Operation*** Baseline Monitoring • Self Checking/Self Diagnostics • 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

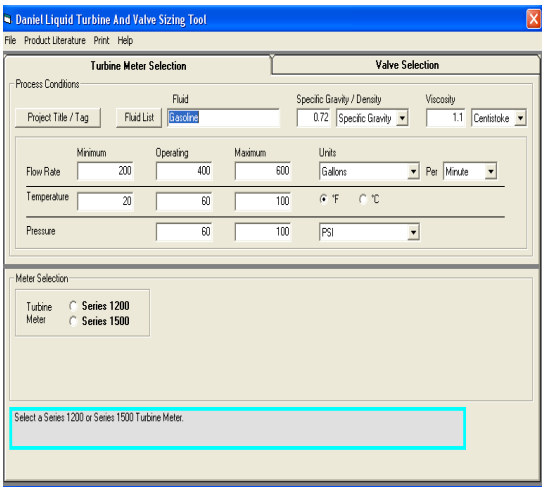
0730 – 0815	***Terminal Custody Transfer*** Methods of Tank Calibration • Tank Gauging Techniques • Tank Management Systems
0815 – 0845	***Video Presentation*** Tank Gauging System
0845 – 0930	***Lease Automatic Custody Transfer*** System Requirements • Operation • Equipment • Conclusions • Appendix
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)

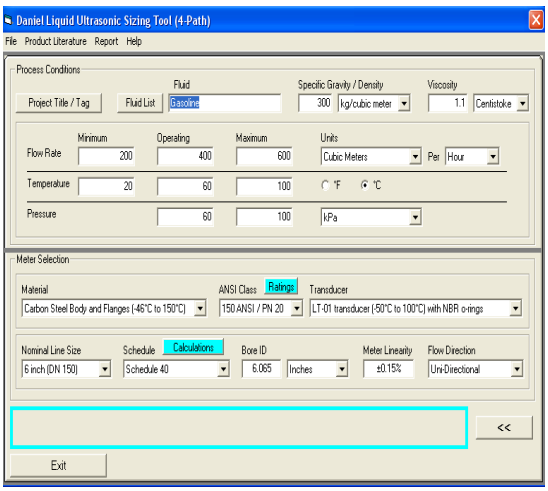
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid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



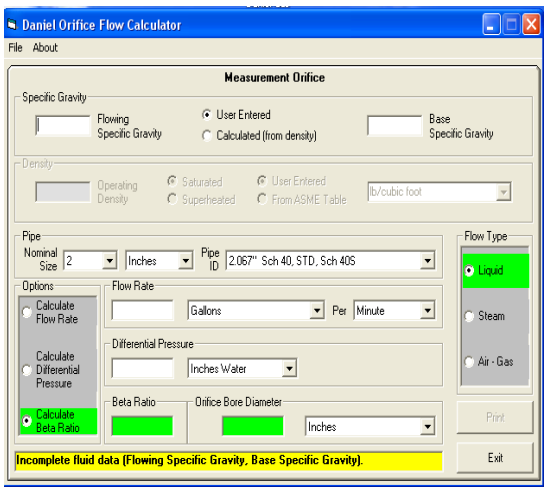
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator

Course Coordinator

Jaryl Castillo, Tel: +974 6652 9196, Email: jaryl@haward.org