COURSE OVERVIEW IE0250-4D
Liquid & Gas Flowmetering & Meter Calibration

Course Title
Liquid & Gas Flowmetering & Meter Calibration

Course Reference
IE0250-4D

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

Course Date/Venue

Session(s)	Date	Venue
1	April 22-25, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
2	October 21-24, 2024	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

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 fundamentals and practice of liquid and gas flowmetering and meter calibration. It covers flowmetering, process measurement, measurement of pressure, measurement of temperature and density and flow measurement.

The course will also discuss the fluid mechanics of pipe flows and flowmeter including differential pressure type, variable area, fluid oscillatory flowmeters, rotary inferential meter, electromagnetic flowmeters, positive displacement flowmeters, ultrasonic flowmeters, mass flow measurement and miscellaneous devices.

Flowmeter calibration, flowmeter installation guidance, flowmeter costs, flowmeter selection and proper methodology of quality assurance in accordance with the international standards will also be carried out during the course.

During the course, participants will be able to define and classify the types, terms and problems of multiphase flow measurement; determine the basic concepts of multiphase flows and multiphase flowmeters; distinguish the current main supplier of multiphase flowmeters; select flowmeters properly; and discuss the future development in flow measurement.

Further, participants will acquire the necessary knowledge in order to choose the correct flowmeter for a particular application and will be able to resolve any ensuing problems in relation to unreliability and inaccuracy of flowmeter readings.

Course Objectives

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

- Apply and gain an in-depth knowledge and skills in liquid and gas flowmetering and meter calibration
- Discuss the flowmetering, process measurement, measurement of pressure, measurement of temperature and density and flow measurement
- Explain fluid mechanics of pipe flows and flowmeter including differential pressure type, variable area, fluid oscillatory flowmeters, rotary inferential meter, electromagnetic flowmeters, positive displacement flowmeters, ultrasonic flowmeters, mass flow measurement and miscellaneous devices
- Recognize the flowmeter calibration and flowmeter installation guidance
- Consider the flowmeter costs and employ the proper procedure of flowmeter selection
- Carryout the proper methodology of quality assurance in accordance with the international standards
- Define and classify the types, terms and problems of multiphase flow measurement
- Determine the basic concepts of multiphase flows and multiphase flowmeters
- Distinguish the current main supplier of multiphase flowmeters and select flowmeters properly
- Discuss the future development in flow 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, sample video clips of the instructor's actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of liquid and gas flowmetering and meter calibration for instrumentation, inspection, mechanical and process engineers and other technical staff. Further, this course is essential for flowmeter users and suppliers.

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 **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.

- 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 **Hazardous Area Classification**, **Intrinsic Safety**, **Liquid & Gas Flowmetering**, **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

Dubai	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dhabi	**US$ 4,500** 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 – 0930	***Flowmetering Overview*** *Introduction to Pipeline Flowmetering with Highlighted Problem Areas*
0930 – 0945	*Break*
0945 – 1030	***Introduction to Process Measurement*** *Accuracy, Hysteresis, Linearity, Repeatability, Response, Traceability, Confidence, Resolution, Calibration, Process Symbols*
1030 – 1130	***Measurement of Pressure*** *Static, Dynamic, Total Pressures, Commercial Pressure Gauges*
1130 – 1230	***Measurement of Temperature & Density*** *Commercial Gauges*
1230 – 1245	*Break*
1245 – 1330	***Flow Measurement*** *Laminar Flows & Turbulent Flows, Velocity Distributions, Reynolds Number Worked Examples, Volume, Mass, Total Flows, Viscosity, Cavitation*
1330 - 1420	***Fluid Mechanics of Pipe Flows*** *Fitting Losses ● Newtonian & Non-Newtonian Flows ● Flowmeter Classification ● Worked Examples*
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	***Flowmeter - Differential Pressure Type*** *Elementary Theory Based on Bernoulli's Equation & Continuity ● Orifice Meters ● Critical Flow Element ● Laminar Flow Element ● Venturi Meters ● Flow Nozzles ● Low Loss Devices ● Variable Orifice Meters ● Variable Area Meters ● Pitot Tubes & Pitot Static Tubes ● Target Flowmeters ● Drain Holes and Vents*
0930 – 0945	*Break*
0945 – 1030	***Flowmeter – Variable Area*** *Operating Constraints & Performances, Advantages and Disadvantages*
1030 – 1130	***Flowmeter - Fluid Oscillatory Flowmeters*** *Fluidic Meters ● Vortex Shedding Meters ● Operating Constraints & Performances ● Advantages & Disadvantages*
1130 – 1230	***Flowmeter - Rotary Inferential Meters*** *Turbine Flowmeters ● Miscellaneous Designs ● Advantages & Disadvantages*
1230 – 1245	*Break*

1245 – 1330	***Flowmeter - Electromagnetic Flowmeters*** *Principle of Operation ● AC & Pulsed DC Types ● Applications & Operating Constraints and Performances ● Advantages & Disadvantages*
1330 - 1420	***Flowmeter – Positive Displacement Flowmeters*** *Helical Gear Meter, Nutating Disc Meter, Piston Meter, Rotary Meter, Advantages & Disadvantages, Applications, Worked Examples*
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	***Flowmeter - Ultrasonic Flowmeters*** *Doppler Type ● Time-of -Flight Type ● Clamp-on Type ● Applications ● Advantages & Disadvantages*
0930 – 0945	*Break*
0945 – 1030	***Flowmeter - Mass Flow Measurement*** *Coriolis Flowmeters ● Hot Wire Anemometer & Thermal Profile Meter ● Applications ● Advantages & Disadvantages*
1030 – 1130	***Flowmeter – Miscellaneous Devices*** *Cross Correlation Methods, Tracer Methods, Weighing Methods Velocity Profile Integration Techniques, Laser Doppler Systems*
1130 – 1230	***Flowmeter Calibration*** *Gravimetric Methods for Liquid Flowmeters ● Volumetric Methods for Liquid Flowmeters ● Use of Pipe Provers ● Methods for Gas Flowmeters ● Critical Flow Nozzle ● Velocity Traversing Technique ● Clamp-on Ultrasonic Flowmeter*
1230 – 1245	*Break*
1245 – 1330	***Flowmeter Installation Guidance*** *Introduction ● Pipe-Flow Disturbances & Other Sources of Error Effects of Installation on Specific Flowmeters ● Remedial Actions & Use of Flow Conditioners*
1330 - 1420	***Flowmeter Costs & Flowmeter Selection*** *Initial Considerations ● Flowmeter Selection Procedure ● Additional Factors*
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*

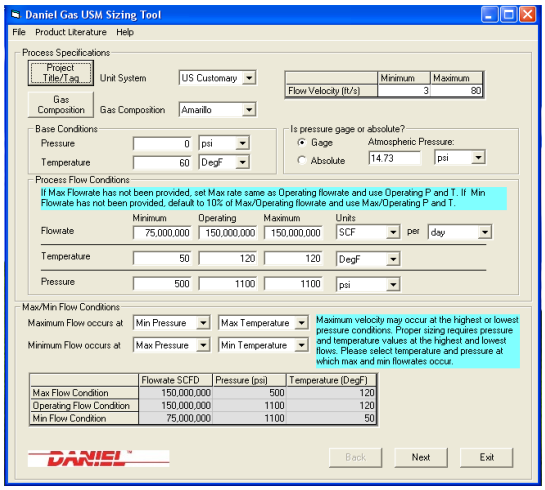
Day 4

0730 – 0830	***Quality Assurance & Standards*** *Traceability & Hard Standards ● Flow Standards ● UK National Measurement Systems ● Accreditation Process*
0830 – 0930	***Introduction to Multiphase Flow Measurement*** *Description of Multiphase Flows, Definitions of Various Associated Terms, Flow Pattern Classification, Flow Regimes, Multiphase Measurement Problems, Multiphase Meter Classification*
0930 – 0945	*Break*

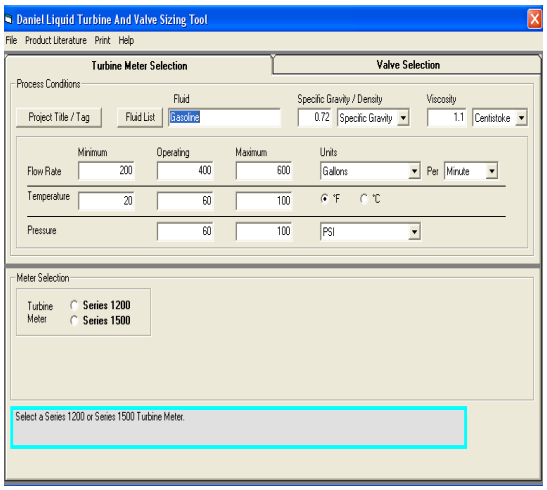
0945 – 1030	***Basic Concepts of Multiphase Flows & Multiphase Flowmeters*** *Response of Single-Phase Flowmeters in Multiphase Flows, Wet Gas Flow Measurement, Application of Two Flowmeters for Multiphase Flows*
1030 – 1130	***Current Main Supplier of Multiphase Flowmeters*** *Overview of Different Devices & their Limitations/Advantages*
1130 – 1230	***Selection of Flowmeters*** *Classification of Flowmeter Types ● Selection Considerations ● Installation Planning & Installation ● Faults & Failures ● Application Tables*
1230 – 1245	*Break*
1245 – 1345	***Future Developments in Flow Measurement*** *Flowmeter Developments ● Secondary Instrumentation ● Signal Acquisition & Processing from Single-Phase Flowmeters ● Utilization of Unconditioned Signals from Single Phase Flowmeters in Multiphase Flows*
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)

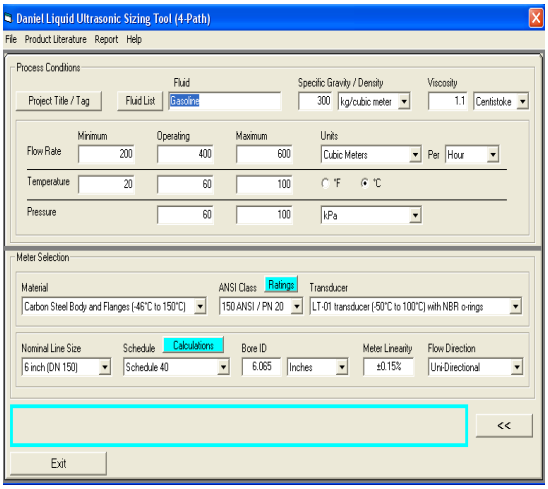
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter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



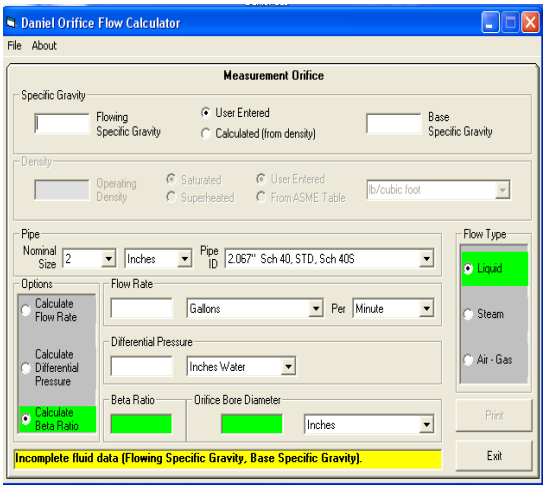
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator

Course Coordinator

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