COURSE OVERVIEW IE0103
Flow Measurement and Custody Transfer

Course Title
Flow Measurement and Custody Transfer

Course Date/Venue
November 09-13, 2025/TBA Meeting, Elite Byblos Hotel, Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Reference
IE0103

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 participants with a detailed and up-to-date overview of Flow Measurement and Custody Transfer. It covers the basic fluid mechanics, gas properties and flow measurement principles; the types of flow measurement devices, installation requirements and meter run design; the international standards, regulatory requirements and differential pressure meters; the orifice plate installation and maintenance, venturi, nozzle and cone meters; the turbine flow meters, flow conditioning, metering accuracy, performance monitoring and error detection; and the ultrasonic flow meter fundamentals, ultrasonic meter installation and calibration.

During this interactive course, participants will learn the coriolis flow meters, vortex flow meters, comparison of metering technologies and digital and smart flow measurement; the calibration, meter proving and verification; the temperature, pressure and density measurement; the gas composition and energy measurement, uncertainty and error analysis, data validation and reconciliation; the custody transfer standards and codes, metering systems and station design; the flow computers and data management, metering audits and verification reports; and the discrepancy management procedures, arbitration and resolution mechanisms.

Course Objectives

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

- Apply and gain an advanced knowledge on flow measurement and custody transfer
- Discuss gas flow measurement, basic fluid mechanics, gas properties and flow measurement principles
- Identify types of flow measurement devices, installation requirements and meter run design
- Recognize international standards and regulatory requirements and differential pressure meters
- Apply orifice plate installation and maintenance and describe venturi, nozzle, and cone meters including turbine flow meters
- Illustrate flow conditioning and metering accuracy, performance monitoring and error detection
- Discuss ultrasonic flow meter fundamentals and apply ultrasonic meter installation and calibration
- Recognize coriolis flow meters, vortex flow meters, comparison of metering technologies and digital and smart flow measurement
- Carryout calibration fundamentals, meter proving and verification as well as temperature, pressure and density measurement
- Employ gas composition and energy measurement, uncertainty and error analysis, data validation and reconciliation
- Discuss custody transfer standards and codes, metering systems and station design
- Apply flow computers and data management covering flow computer functions and algorithms, correction factors and standard volume calculations, real-time data transmission to SCADA, audit trail and data integrity management
- Implement metering audits and verification reports, discrepancy management procedures and arbitration and resolution mechanisms

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 provides an overview of all significant aspects and considerations of flow measurement and custody transfer for instrumentation, inspection, control, custody, metering and process engineers and other technical staff. Further, the course is suitable for senior automation engineers, piping engineers, pipelines engineers, mechanical engineers, operations engineers, maintenance engineers, plant/field supervisors & foreman and loss control coordinators.

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 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.

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. Barry Pretorius is a **Senior Instrumentation Engineer** with almost **30 years** of extensive experience within the **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise widely covers in the areas of **Flowmetering & Custody** Measurement, **Multiphase Flowmetering**, Measurement & Control, Distributed Control System (**DCS**), **DCS** Operations & Techniques, **Plant Control** and Protection Systems, **Process Control & Instrumentation**, **Cascade Control Loops**, **Split-Range Control Loops**, **Capacity Control** & Other Advanced Control Schemes, **Safety Instrumented Systems**, **Plant Automation** Operations & Maintenance, Programmable Logic Controller (**PLC**), **Siemens PLC** Simatic S7-400/S7-300/S7-200, **PLC & SCADA** for Automation & Process Control, **Artificial Intelligence**, **Allen Bradley PLC** Programing and Hardware Trouble Shooting, Schneider **SCADA System**, **Wonder Ware**, **Emerson**, **Honeywell**, **Honeywell** Safety Manager PLC, **Yokogawa**, Advanced **DCS Yokogawa**, **Endress & Hauser**, Field Commissioning and Start up Testing Pre Operations, System Factory Acceptance Test (**FAT**), FactoryLink ECS, Modicon 484, Rockwell Automation, System Site Acceptance Test (**SAT**), **SCADA HMI & PLC** Control Logic, **Cyber Security** Practitioner, **Cyber Security** of Industrial Control System, **IT Cyber Security** Best Practices, **Cybersecurity** Fundamentals, **Ethical Hacking & Penetration Testing**, **Cybersecurity** Risk Management, **Cybersecurity** Threat Intelligence, **OT Whitelisting** for Better Industrial Control System Defense, **NESA** Standard and Compliance Workshop, **OT**, **Cyber Attacks** Awareness - Malware/Ransom Ware / Virus /Trojan/ Philsing, **Information Security Manager**, **Security System** Installation and Maintenance, Implementation, Systems Testing, Commissioning and Startup, **Foxboro DCS & Triconics**, **SIS** Systems, Advanced **DC Drives**, Motion Control, **Hydraulics**, **Pneumatics and Control Systems** Engineering, **Electrical & Automation Control Systems**, **HV/MV Switchgear**, **LV & MV** Switchgears & Circuit Breakers, **High Voltage Electrical Safety**, **LV & HV Electrical System**, **HV Equipment** Inspection & Maintenance, **LV Distribution Switchgear & Equipment**, **Electrical Safety**, **Electrical** Maintenance, **Transformers**, **Medium & High Voltage Equipment**, **Circuit Breakers**, **Cable & Overhead Line** Troubleshooting & Maintenance, **Electrical Drawing & Schematics**, **Voltage Distribution**, **Power Distribution**, **Filters**, **Automation System**, **Electrical Variable Speed Drives**, **Power** Systems, **Power Generation**, **Diesel Generators**, **Power Stations**, Uninterruptible Power Systems (**UPS**), **Battery Chargers**, **AC & DC Transmission**, **CCTV** Installation, **Data & Fire Alarm** System, **Evacuation** Systems and **Electrical Motors & Variable Speed Drives**, & Control of Electrical and Electronic devices.

During Mr. Pretorius's career life, he has gained his practical experience through several significant positions and dedication as the **Senior Technical Analyst, Team Leader, Pre-operations Startup Engineer, Automation System's Software Manager, Automation System's Senior Project Engineer, PLC Specialist, Site Manager, Senior Project & Commissioning Engineer, Technical Director, Project Engineer, Radio Technician**, **A T E Technician** and **Senior Instructor/Trainer** from various companies like the ADNOC Sour Gas, Ras Al Khair Aluminum Smelter, Johnson Matthey Pty. Ltd, Craigcor Engineering, Unitronics South Africa Pty (Ltd), Bridgestone/Firestone South Africa Pty (Ltd) and South African Defense Force.

Mr. Pretorius's has a Higher Diploma in **Electrical Engineering Heavy Current**. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings, courses, workshops, seminars and conferences internationally.

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 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: ***Sunday, 09th of November 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Gas Flow Measurement*** *Overview of Gas Metering in Oil & Gas Industry • Importance of Accurate Flow Measurement • Legal and Fiscal Implications of Measurement Errors • Overview of Metering Station Components*
0930 – 0945	*Break*
0945 – 1030	***Basic Fluid Mechanics & Gas Properties*** *Gas Laws (Boyle's, Charles's, Ideal Gas Law) • Compressibility and Real Gas Behavior • Flow Regimes (Laminar, Turbulent, Transitional) • Reynolds Number and Flow Profiles*
1030 – 1130	***Flow Measurement Principles*** *Differential Pressure (DP) Principles • Velocity-Based Flow Measurement Concepts • Volumetric versus Mass Flow Measurement • Conversion Between Standard and Actual Flow*
1130 – 1215	***Types of Flow Measurement Devices*** *Differential Pressure Meters (Orifice, Cone, Venturi) • Turbine and Ultrasonic Meters • Coriolis and Vortex Meters • Emerging Technologies in Gas Metering*
1215 – 1230	*Break*
1230 – 1330	***Installation Requirements & Meter Run Design*** *Straight Pipe Lengths and Flow Conditioners • Effects of Bends, Valves, and Fittings • Meter Orientation and Support Design • Piping Material and Surface Finish Considerations*
1330 – 1420	***International Standards & Regulatory Requirements*** *ISO 5167, ISO 9951, AGA, API Standards Overview • OIML and ASTM Standards for Custody Transfer • National and Local Regulations in UAE (ADNOC, Dolphin Energy) • Role of Metrological Authorities*
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: Monday, 10th of November 2025

0730 – 0830	***Differential Pressure Meters*** *Principle of Operation • Orifice Plate Design and Types (Concentric, Eccentric, Quadrant) • Flow Coefficient and Beta Ratio Selection • Calculation of Flow Using DP*
0830 – 0930	***Orifice Plate Installation & Maintenance*** *Orifice Plate Installation and Alignment • Inspection, Cleaning, and Wear Considerations • Effects of Erosion and Deposits on Accuracy • Calibration and Verification Methods*
0930 – 0945	*Break*
0945 – 1100	***Venturi, Nozzle, & Cone Meters*** *Comparative Design and Advantages • Pressure Recovery Characteristics • Typical Applications in Gas Systems • Maintenance and Calibration Aspects*
1100 – 1215	***Turbine Flow Meters*** *Mechanical Design and Principle of Operation • Bearing Selection and Rotor Dynamics • Signal Conditioning and Pulse Output • Error Sources and Correction Factors*
1215 – 1230	*Break*
1230 – 1330	***Flow Conditioning & Metering Accuracy*** *Flow Disturbances and Swirl Effects • Flow Straighteners and Conditioners • Meter Run Length Optimization • Uncertainty Analysis*
1330 – 1420	***Performance Monitoring & Error Detection*** *Detecting Mechanical Wear and Fouling • Comparing Meter Outputs • Trending and Diagnostics • Predictive Maintenance Using Digital Tools*
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: Tuesday, 11th of November 2025

0730 – 0830	***Ultrasonic Flow Meter Fundamentals*** *Transit-Time and Doppler Measurement Principles • Path Configurations (1, 4, 6, 8 Paths) • Signal Processing and Sound Velocity Corrections • Influence of Gas Composition and Temperature*
0830 – 0930	***Ultrasonic Meter Installation & Calibration*** *Installation Geometry and Acoustic Path Alignment • Factory and Field Calibration Procedures • Effects of Contamination and Condensation • Verification Using Reference Meters*
0930 – 0945	*Break*
0945 – 1100	***Coriolis Flow Meters*** *Operating Principle and Sensor Design • Mass versus Volume Measurement in Gas Flow • Temperature and Pressure Compensation • Calibration and Accuracy Considerations*
1100 – 1215	***Vortex Flow Meters*** *Principle of Kármán Vortex Shedding • Signal Amplification and Filtering • Rangeability and Gas Composition Effects • Advantages and Limitations*
1215 – 1230	*Break*

1230 – 1330	***Comparison of Metering Technologies*** *Accuracy and Repeatability Differences • Pressure Drop and Maintenance Requirements • Suitability by Gas Type and Pressure Conditions • Cost-Benefit Analysis for Field Applications*
1330 – 1420	***Digital & Smart Flow Measurement*** *Integration with SCADA and DCS Systems • Diagnostics and Self-Monitoring Functions • Digital Twins for Metering Stations • Data Transmission and Cybersecurity*
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*

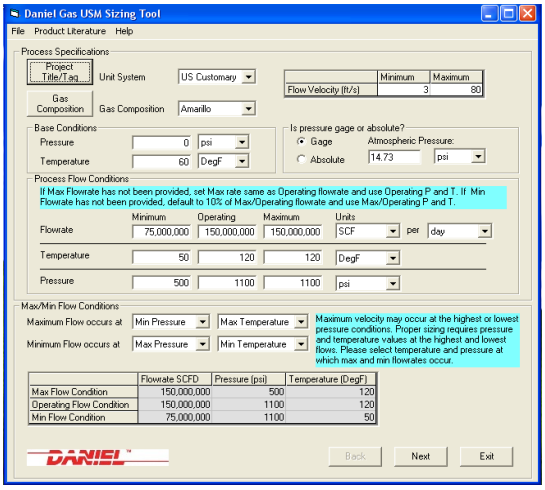
Day 4: Wednesday, 12th of November 2025

0730 – 0830	***Calibration Fundamentals*** *Primary versus Secondary Calibration Standards • Traceability and Reference Systems • Flow Calibration Facilities (Prover, Gravimetric, Bell Prover) • Uncertainty Budget and Error Propagation*
0830 – 0930	***Meter Proving & Verification*** *Working Principle of Gas Provers • Field Proving and Verification Intervals • Use of Master Meters and Transfer Standards • Calibration Documentation and Reporting*
0930 – 0945	*Break*
0945 – 1100	***Temperature, Pressure, & Density Measurement*** *Measurement Instrumentation Types • RTD versus Thermocouple Accuracy • Pressure Transmitter Selection and Calibration • Density Measurement and Gas Compressibility Correction*
1100 – 1215	***Gas Composition & Energy Measurement*** *Chromatograph Operation and Sampling Systems • Calculation of Energy Content (BTU, kWh, Joules) • Use of AGA-8 and ISO 6976 for Gas Properties • Impact of Composition on Metering Accuracy*
1215 – 1230	*Break*
1230 – 1330	***Uncertainty & Error Analysis*** *Statistical Treatment of Uncertainty • Sources of Systematic and Random Errors • Combined Uncertainty Budget Development • Reporting and Traceability Requirements*
1330 – 1420	***Data Validation & Reconciliation*** *Validation of Metering Data • Reconciliation Between Meters and Balance Points • Handling Discrepancies and Adjustments • Reporting in Custody Transfer 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 Four*

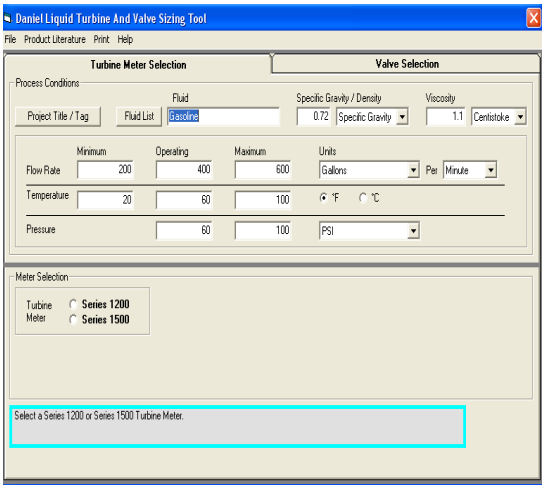
Day 5:	Thursday, 13rd of November 2025
0730 – 0830	***Basics of Custody Transfer*** *Legal and Commercial Importance • Buyer-Seller Agreements and Metering Clauses • Allocation and Balancing Concepts • Contractual Tolerance Limits*
0830 – 0930	***Custody Transfer Standards & Codes*** *AGA 3, AGA 7, AGA 9, AGA 11 Overview • API MPMS (Manual of Petroleum Measurement Standards) • ISO 6976, ISO 5167, ISO 17089 References • Regional Metrology and Audit Standards*
0930 – 0945	*Break*
0945 – 1100	***Metering Systems & Station Design*** *Metering Skid Configuration • Instrumentation and Auxiliary Systems • Bypass Lines and Isolation Valves • Gas Chromatograph and Flow Computer Integration*
1100 – 1215	***Flow Computers & Data Management*** *Flow Computer Functions and Algorithms • Correction Factors and Standard Volume Calculations • Real-Time Data Transmission to SCADA • Audit Trail and Data Integrity Management*
1215 – 1230	*Break*
1230 – 1300	***Custody Transfer Auditing & Dispute Resolution*** *Metering Audits and Verification Reports • Discrepancy Management Procedures • Arbitration and Resolution Mechanisms • Role of Third-Party Inspectors and Certifiers*
1300 – 1345	***Case Studies & Best Practices*** *Dolphin Energy Gas Metering Systems • Lessons Learned from Field Audits • Preventive Maintenance Strategies • Emerging Technologies in Metering and Transfer*
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)

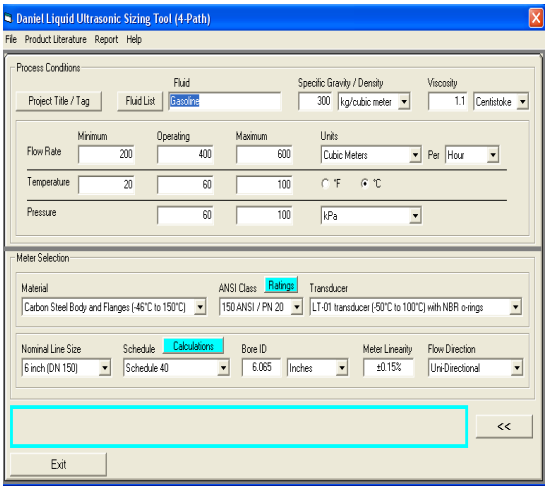
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid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



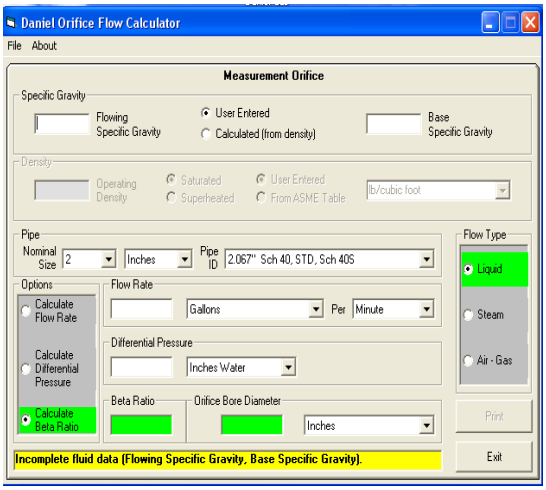
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



Liquid Turbine Meter and Control Valve Sizing Tool Simulator



Liquid Ultrasonic Meter Sizing Tool Simulator



Orifice Flow Calculator Simulator

Course Coordinator

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