COURSE OVERVIEW IE0094
Validations & Proving of Custody Transfer Meters of Oil and Gas

Course Title
Validations & Proving of Custody Transfer Meters of Oil and Gas

Course Date/Venue
October 11-15, 2026/Julnar C Meeting Room, Royal Tulip Muscat Hotel, Muscat, Oman

Course Reference
IE0094

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 one of our state-of-the-art simulators.

This course is designed to provide delegates with a detailed and up-to-date overview of Validations & Proving of Custody Transfer Meters of Oil and Gas. It covers the significance of custody transfer in oil and gas operations; the legal and financial implications of errors, regulatory frameworks and standards and the importance of accurate measurement in upstream and downstream operations; the various types of custody transfer meters, measurement standards and protocols as well as fluid properties and measurement; the uncertainty in measurements and common sources of errors; the importance in custody transfer processes; and the key parameters to monitor during validation, documentation and reporting requirements.

Further, the course will also discuss the flow calibration procedures and interpreting calibration results and adjustments; the proving techniques for different meters, performance verification and simulating measurement conditions; the meter proving systems, meter factor and its significance; the impact of operating conditions on meter factor; and the dynamic proving challenges and importance of compensating for temperature and pressure.

During this interactive course, participants will learn the real-time compensation techniques, standard temperature and pressure (STP) adjustments and tools and equipment for compensation validation; the routine maintenance schedules and procedures and calibration of proving systems; identifying wear and tear in prover components and preventive strategies to ensure system reliability; the common issues in custody transfer meters and root cause analysis for meter failures, data integrity and validation; the SCADA and other monitoring systems, integration of meters with digital tools and cybersecurity considerations in custody transfer systems; the comprehensive validation and proving reports; the key elements of a custody transfer report and archiving and data management practices including auditing and compliance documentation; the QA/QC programs in measurement systems and performance metrics for quality assurance; and the advances in meter technologies including regulatory updates and compliance.

Course Objectives/Outcomes & Benefits for the Participants

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

- Apply and gain an in-depth knowledge on validations and proving of custody transfer meters of oil and gas
- Discuss the significance of custody transfer in oil and gas operations including the legal and financial implications of errors, regulatory frameworks and standards and the importance of accurate measurement in upstream and downstream operations
- Identify the various types of custody transfer meters, measurement standards and protocols as well as fluid properties and measurement
- Calculate the uncertainty in measurements, identify the common sources of errors and minimize and correct errors
- Discuss the importance in custody transfer processes, key parameters to monitor during validation as well as documentation and reporting requirements
- Apply flow calibration procedures and interpret calibration results and adjustments
- Carryout proving techniques for different meters, performance verification and simulating measurement conditions
- Recognize meter proving systems, derive the meter factor and its significance, discuss the impact of operating conditions on meter factor, trend and analyze meter factor variations and adjust based on factor results
- Explain dynamic proving challenges and the importance of compensating for temperature and pressure
- Apply real-time compensation techniques, standard temperature and pressure (STP) adjustments and tools and equipment for compensation validation
- Carryout routine maintenance schedules and procedures, calibration of proving systems, identifying wear and tear in prover components and preventive strategies to ensure system reliability
- Analyze the common issues in custody transfer meters and apply root cause analysis for meter failures, data integrity and validation

- Recognize SCADA and other monitoring systems, integration of meters with digital tools and cybersecurity considerations in custody transfer systems
- Prepare comprehensive validation and proving reports, identify the key elements of a custody transfer report and apply archiving and data management practices including auditing and compliance documentation
- Implement QA/QC programs in measurement systems and apply performance metrics for quality assurance
- Discuss the advances in meter technologies including regulatory updates and compliance

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 validations and proving of custody transfer meters of oil and gas for metering technicians, instrumentation engineers, operations managers and supervisors, quality assurance/control specialists, regulatory compliance officers, project managers, maintenance engineers and technicians, flow measurement engineers, HSE (health, safety, and environment) managers, financial auditors, consultants, regulatory inspectors and other technical staff.

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.

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.

Accommodation

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

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 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 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. Ahmed El-Sayed, PhD, MSc, BSc, is a **Senior Electrical & Instrumentation Engineer** with over **30 years** of extensive experience in the **Oil**, **Gas**, **Power**, **Petroleum**, **Petrochemical** and **Water** & **Utilities**. He specializes in **Fire Fighting** System Instrumentations, **Fire Protection** System, **Fire & Gas Detection** & Alarm System, **Instrumentation Protection Devices** Maintenance & Testing, **Protection Devices** Troubleshooting, Water **Meter Calibration**, Liquid & Gas Flowmetering & **Meter Calibration**, **Testing & Calibration of Energy Meters**, **DCS & ESD** System Architecture, **Distributed Control System**, **DCS** & **SCADA**, Distributed Control System (**DCS**) Selection & Troubleshooting, Advanced **DCS Yokogawa**, **Yokogawa CENTUM VP DCS**, **Modern Distributed Control System** (**DCS**) **& Process Instrumentation**, **Cyber Security** of Industrial System, **DCS System** (**Honeywell**), **DCS Experion** System, **DCS Siemens Telepherm XP**, **Relay Coordination Using ETAP Software**, **Power System Study on ETAP**, **ETAP-Power System Analysis**, **Flow Measurement** Foundation, **Hydrocarbon** Measurement & Sampling, **Gas Dosiers** Preparation, **Gas/Liquid Fuel** Measurement, **Instrumentation Measurement & Control System**, **Flow** Measurement, **Pressure** Measurement, **Level & Temperature** Measurement, **Measurement Devices & Control System**, **Instrumentation & Control** Systems, **Control System** Orientation, Uninterruptible Power Supply (**UPS**) **Battery Charger**, **Industrial UPS Systems Construction & Operation**, **Test Lead-Acid & Ni-cad Battery Systems**, **Hazards & Safe Work Practices**, **Transformer** Operational Principles, Selection & Troubleshooting; **HV & LV Transformers**, **Control Valves & Actuators**, **Electrical Safety**, **Protection Relay Application**, **Maintenance & Testing**, **NEC** (National Electrical Code), **NESC** (National Electrical Safety Code), **Electrical Safety**, **Electrical Hazards Assessment**, **Electrical Equipment**, **Personal Protective Equipment**, Lock-Out & Tag-Out (**LOTO**), Confined Workspaces, Alerting Techniques, Electrical Transient Analysis Program (**ETAP**), Power **Quality**, Power **Network**, Power **Distribution**, **Distribution Systems**, **Power Systems Control**, **Power Systems Security**, Power **Electronics**, Electrical **Substations**, **UPS** & **Battery System**, **Earthing & Grounding**, **Load Forecasting**, Power **Generation**, **Protective Systems**, **Electrical Generators**, **Power** & **Distribution Transformers**, **Electrical Motors**, **Switchgears**, **Transformers**, **AC** & **DC Drives**, **Variable Speed Drives** & **Generators**, **Generator Protection**, **GE Gas Turbines**, PLC, SCADA, DCS, Process Control, Control Systems & Data Communications, Instrumentation, Automation, Valve Tuning, SIS, SIL, ESD, **Alarm Management** Systems, **Energy** Management System, Engine Management System, Bearing & Rotating Machine, Fieldbus Systems and Fiber Optics Technology. He is currently the **Systems Control Manager** of **Siemens** where he is in-charge of Security & Control of Power **Transmission Distribution** & **High Voltage** Systems and he further takes part in the Load Records Evaluation & Transmission Services Pricing.

During his career life, Dr. Ahmed has been actively involved in different Power System Activities including Roles in Power System Planning, Analysis, Engineering, **HV Substation** Design, Electrical Service Pricing, Evaluations & Tariffs, Project Management, Teaching and Consulting. His vast industrial experience was honed greatly when he joined many International and National Companies such as **Siemens**, **Electricity Authority** and **ACETO** industries as the **Instrumentation & Electrical Service Project Manager**, **Instrumentation & Control Engineer**, **Fire Protection Engineer**, **Energy Management Engineer**, **Department Head**, **Assistant Professor**, **Instrumentation & Control Instructor**, **Project Coordinator**, **Project Assistant and Managing Board Member** where he focused more on dealing with Technology Transfer, System Integration Process and Improving Localization. He was further greatly involved in manufacturing some of **Power System** and **Control & Instrumentation Components** such as Series of Digital Protection **Relays**, MV **VFD**, **PLC** and **SCADA** System with intelligent features.

Dr. Ahmed is well-versed in different electrical and instrumentation fields like **ETAP**, Load Management Concepts, **PLC** Programming, Installation, Operation and Troubleshooting, **AC Drives** Theory, Application and Troubleshooting, Industrial Power Systems Analysis, AC & DC **Motors**, Electric Motor **Protection**, **DCS SCADA**, **Control** and Maintenance Techniques, Industrial Intelligent Control System, **Power Quality** Standards, Power Generators and Voltage Regulators, Circuit Breaker and Switchgear Application and Testing Techniques, **Transformer** and **Switchgear** Application, Grounding for Industrial and Commercial Assets, Power Quality and **Harmonics**, **Protective Relays** (O/C Protection, Line Differential, Bus Bar Protection and **Breaker Failure Relay**) and Project Management Basics (PMB).

Dr. Ahmed has **PhD**, **Master's** & **Bachelor's** degree in **Electrical Engineering** from the **University of Wisconsin Madison**, **USA** and **Ain Shams University**, respectively. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/ Assessor/Trainer** by the **Institute of Leadership and Management** (**ILM**), an active member of IEEE and ISA as well as numerous technical and scientific papers published internationally in the areas of Power Quality, Superconductive Magnetic Energy Storage, SMES role in Power Systems, Power System **Blackout** Analysis, and Intelligent Load Shedding Techniques for preventing Power System Blackouts, HV **Substation Automation** and Power System Stability.

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, 11th of October 2026***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Custody Transfer*** *Definition & Significance in Oil & Gas Operations • Legal & Financial Implications of Errors • Regulatory Frameworks & Standards (API, ISO) • Importance of Accurate Measurement in Upstream & Downstream Operations*
0930 – 0945	*Break*
0945 - 1030	***Types of Custody Transfer Meters*** *Overview of Turbine, Coriolis, Ultrasonic, & Positive Displacement Meters • Applications & Suitability for Oil & Gas • Advantages & Limitations of Each Meter Type • Commonly Used Technologies in Company's Operations*
1030 - 1145	***Measurement Standards & Protocols*** *API MPMS (Manual of Petroleum Measurement Standards • ISO Standards Relevant to Custody Transfer • Local & International Regulations • Harmonizing Operations with Global Standards*
1145- 1245	***Fluid Properties & Measurement*** *Influence of Pressure, Temperature, & Density on Measurements • Handling Crude Oil Versus Natural Gas Measurements • Viscosity & Its Effect on Meter Performance • Real-World Examples of Property Variations During Transfer*
1245 – 1300	*Break*
1300 – 1345	***Measurement Uncertainty & Error Sources*** *Definition & Calculation of Uncertainty in Measurements • Common Sources of Errors (Installation, Calibration, Wear) • Minimizing & Correcting Errors • Case Studies of Error Impact in Custody Transfer*
1345 - 1420	***Hands-On Session: Familiarization with Custody Transfer Systems*** *Overview of a Typical Custody Transfer Station • Inspection of Meter Components • Basic Operation Principles & Troubleshooting • Q&A Session to Address Participant Queries*
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, 12th of October 2026***

0730 – 0830	***Overview of Meter Validation*** *Definition & Objectives of Validation • Importance in Custody Transfer Processes • Key Parameters to Monitor During Validation • Documentation & Reporting Requirements*
0830 - 0930	***Flow Calibration Procedures*** *Purpose & Frequency of Flow Calibration • Master Meter Method & its Implementation • Prover Loop Systems: Piston & Ball Prover Methods • Interpreting Calibration Results & Adjustments*

0930 – 0945	Break
0945 – 1045	***Proving Techniques for Different Meters*** *Proving Turbine & Ultrasonic Meters • Special Considerations for Coriolis Meter • Static & Dynamic Proving Techniques • Comparison of Real-Time Versus Batch Proving Methods*
1045 – 1245	***Performance Verification*** *Key Performance Indicators (KPIs) for Custody Meters • Verifying Repeatability & Linearity • Simulated versus Actual Flow Verification • Case Studies: Diagnosing Validation Failures*
1245 – 1300	Break
1300 – 1345	***Simulating Measurement Conditions*** *Influence of Pressure, Temperature, & Flow Rate Changes • Real-World Challenges & Mitigation Strategies • Testing Meters in Simulated versus Live Conditions • Role of Diagnostic Tools in Validations*
1345 - 1420	***Practical Demonstration*** *Participants Conduct a Validation Exercise • Interpretation of Validation Data • Troubleshooting Common Issues During Validation • Group Discussion & Feedback*
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, 13th of October 2026***

0730 – 0830	***Basics of Meter Proving Systems*** *Types of Provers (Small Volume, Bi-Directional, Master Meters) • Design & Operation Principles • Installation Requirements & Best Practices • Challenges & Solutions in Prover Applications*
0830 - 0930	***Meter Factor Calculation & Analysis*** *Deriving the Meter Factor & Its Significance • Impact of Operating Conditions on Meter Factor • Trending & Analyzing Meter Factor Variations •Adjustments Based on Factor Results*
0930 – 0945	Break
0945 – 1045	***Dynamic Proving Challenges*** *Proving Under Fluctuating Flow Conditions • Handling Multiphase Flows in Oil & Gas • Preventing Errors During Dynamic Proving • Advanced Diagnostic Techniques for Troubleshooting*
1045 – 1245	***Temperature & Pressure Compensation*** *Importance of Compensating for Temperature & Pressure • Real-Time Compensation Techniques • Standard Temperature & Pressure (STP) Adjustments • Tools & Equipment for Compensation Validation*
1245 - 1300	Break
1300 - 1330	***Proving System Maintenance & Calibration*** *Routine Maintenance Schedules & Procedures • Calibration of Proving Systems • Identifying Wear & Tear in Prover Components • Preventive Strategies to Ensure System Reliability*

1330 – 1420	***Field Exercise: Advanced Meter Proving*** *Participants Practice Advanced Proving Methods • Analyzing & Correcting Proving Errors • Group Presentation of Findings • Open Discussion on Field Challenges*
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, 14th of October 2026***

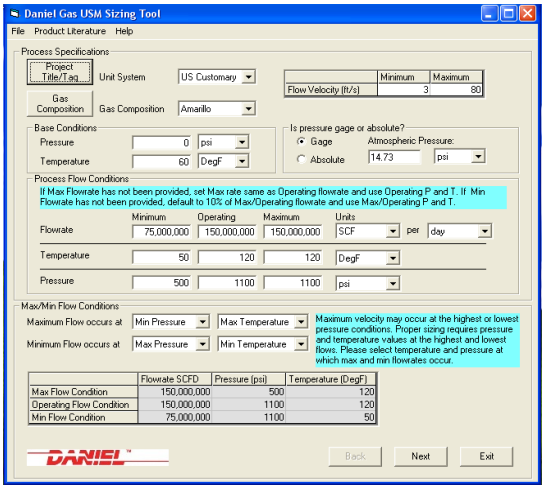
0730 – 0830	***Common Issues in Custody Transfer Meters*** *Identifying & Diagnosing Common Meter Issues • Impact of Wear, Fouling, & Vibration on Accuracy • Real-World Examples & Solutions • Case Studies of Troubleshooting Errors*
0830 - 0930	***Root Cause Analysis for Meter Failures*** *Framework for Conducting Root Cause Analysis (RCA) • Tools & Techniques for RCA (Ishikawa, 5 Whys • Implementing Corrective Actions • Best Practices for Preventing Recurrence*
0930 – 0945	*Break*
0945 – 1045	***Data Integrity & Validation*** *Importance of Accurate Data in Custody Transfer • Validating Measurement Data Against Standards • Using Software Tools for Data Validation • Case Studies of Data Integrity Failures*
1045 – 1245	***Digital Systems in Custody Transfer*** *Overview of SCADA & Other Monitoring Systems • Integration of Meters with Digital Tools • Cybersecurity Considerations in Custody Transfer Systems • Future Trends: IoT & AI in Measurement*
1245 – 1300	*Break*
1300 – 1330	***Reporting & Documentation*** *Preparing Comprehensive Validation & Proving Reports • Key Elements of a Custody Transfer Report • Archiving & Data Management Practices • Auditing & Compliance Documentation*
1330 - 1420	***Practical Session: Troubleshooting Simulated Issues*** *Group Exercise on Simulated Meter Issues • Developing Solutions & Presenting Finding • Peer Feedback & Discussion*
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, 15th of October 2026

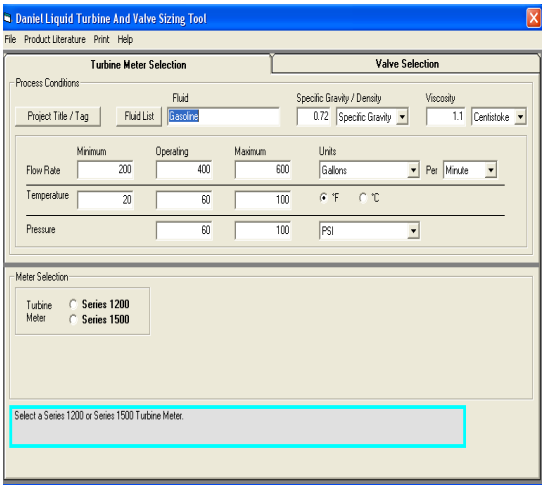
0730 – 0830	***Quality Assurance in Custody Transfer*** *Implementing QA/QC Programs in Measurement Systems • Performance Metrics for Quality Assurance • Auditing & Benchmarking Systems • Role of Third-Party Inspections*
0830 - 0930	***Case Studies in Custody Transfer*** *Real-World Examples of Successful & Failed Custody Transfers • Lessons Learned & Best Practices • Application to Company's Operations • Interactive Discussion on Case Scenarios*
0930 – 0945	*Break*
0945 – 1245	***Emerging Technologies*** *Advances in Meter Technologies (Smart Meters, Non-Intrusive Methods) • Role of AI & Machine Learning in Custody Transfer • Predictive Maintenance for Custody Meters • Industry Outlook for 2030 & Beyond*
1245 – 1300	*Break*
1300 – 1345	***Regulatory Updates & Compliance*** *Latest Updates in API & ISO Standards • Regulatory Framework Developments • Ensuring Compliance with Evolving Regulations • Future Implications for Company's Operations*
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)

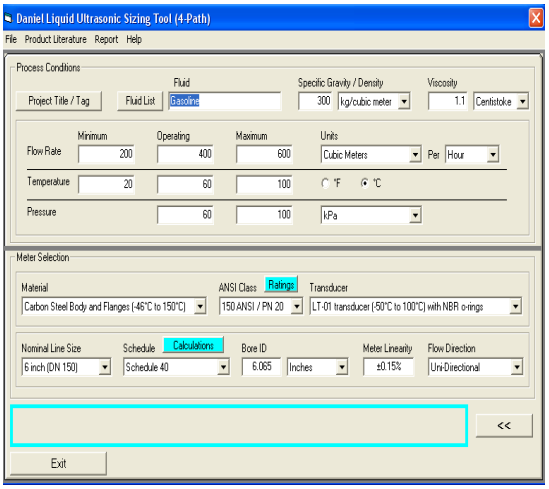
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid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



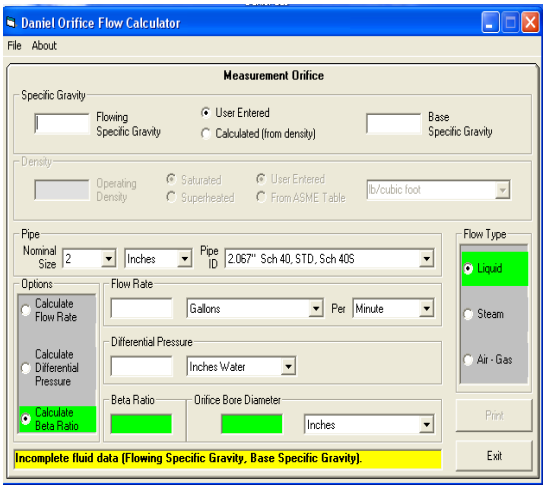
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



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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