COURSE OVERVIEW IE1114
Instrument Calibration & Maintenance

Course Title
Instrument Calibration & Maintenance

Course Reference
IE1114

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	June 22-26, 2025	Safir Meeting Room, Divan Istanbul, Taksim, Turkey
2	August 24-28, 2025	Olivine Meeting Room, Fairmont Nile City, Cairo, Egypt
3	December 14-18, 2025	Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

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 participants with a detailed and up-to-date overview of Instrument Calibration & Maintenance. It covers the calibration fundamentals, types of instrument maintenance, standards and traceability and calibration tolerances and accuracy; the instrument identification and tagging, job hazard analysis for calibration work, PPE and safe practices, lockout/tagout procedures and permit-to-work requirements; and the pressure measuring instruments, temperature measuring instruments and calibration tools and techniques.

Further, the course will also discuss the calibration procedures, interpreting results and adjustments and troubleshooting pressure/temperature devices; the flow meter technologies, level measurement devices and calibration techniques for flow and level; the use of signal injectors for analog/digital output, troubleshooting with simulation, loop verification with simulated values and HART/fieldbus interface simulation; and the error source and corrections, 4-20 mA loop principles, loop calibration tools and signal conditioners and barriers.

During this interactive course, participants will learn the loop testing procedures, troubleshooting techniques, live loop testing and safety and calibration records and reporting; the mandatory fields and formats, tolerance calculation and signatures; the certificates versus field reports and digital versus paper records; the barcode/RFID integration, scheduling and traceability and alerts and compliance reporting; and the internal/external audits, traceability documentation practices and common non-conformities.

Course Objectives

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

- Apply and gain an in-depth knowledge on instrument calibration and maintenance
- Discuss the calibration fundamentals, types of instrument maintenance, standards and traceability and calibration tolerances and accuracy
- Apply instrument identification and tagging, job hazard analysis for calibration work, PPE and safe practices, lockout/tagout procedures and permit-to-work requirements
- Recognize pressure measuring instruments, temperature measuring instruments and calibration tools and techniques
- Carryout calibration procedures, interpreting results and adjustments and troubleshooting pressure/temperature devices
- Discuss flow meter technologies and level measurement devices as well as apply calibration techniques for flow and level
- Use signal injectors for analog/digital output, troubleshoot with simulation and apply loop verification with simulated values and HART/fieldbus interface simulation
- Identity error source and corrections, 4-20 mA loop principles, loop calibration tools and signal conditioners and barriers
- Employ loop testing procedures, troubleshooting techniques, live loop testing and safety and calibration records and reporting
- Review mandatory fields and formats, tolerance calculations and signatures, certificates versus field reports and digital versus paper records
- Apply barcode/RFID integration, scheduling and traceability and alerts and compliance reporting
- Prepare for internal/external audits, apply traceability documentation practices and identify common non-conformities

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 a complete and up-to-date overview of the instrument calibration and maintenance for production supervisors/managers, safety managers/officers, laboratory technicians, quality control/quality assurance personnel, maintenance technicians/engineers, process operators/engineers, calibration technicians, regulatory compliance officers, R&D scientists/engineers, instrumental vendors/service providers and field service technicians.

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.

Accommodation

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

Course Fee

Istanbul	**US$ 6,000** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Cairo	**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.
Dubai	**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

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**. 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. Barry Pretorius is a **Senior Electrical & 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 Distributed Control System (**DCS**), **DCS** Operations & Techniques, **Plant Control** and Protection Systems, **Process Control & Instrumentation**, **Liquid & Gas Flowmetering**, **Custody Measurement**, **Ultrasonic Flowmetering**, **Loss Control**, **Loss Control** & **Multiphase Flowmetering**, **Custody Measurement** & **Loss Control**, **Gas Measurement**, **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, **Fire & Gas Detection** System, 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 **Technical Director**, **Automation System's Software Manager**, **Site Manager**, **Senior Lead Technical Analyst**, **Project Team Leader**, **Automation Team Leader**, **Automation System's Senior Project Engineer**, **Senior Project & Commissioning Engineer**, **Senior Instrumentation & Control Engineer**, **Electrical Engineer**, **Project Engineer**, **Pre-Operations Startup Engineer**, **PLC Specialist**, **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 **Bachelor** of **Technology** in **Electrical Engineering** (**Heavy Current**). Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), received numerous awards from various institutions and delivered numerous trainings, courses, workshops, seminars and conferences internationally.

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***
0815 – 0830	***Calibration Fundamentals*** *Definition and Objectives of Calibration • Importance in Process Control and Product Quality • Calibration Frequency and Intervals • Legal and Industry Compliance*
0830 – 0930	***Types of Instrument Maintenance*** *Preventive versus Corrective Maintenance • Predictive and Condition-Based Strategies • Maintenance Scheduling Tools (CMMS Overview) • Maintenance Best Practices in Harsh Environments*
0930 – 0945	*Break*
0945 – 1100	***Standards & Traceability*** *ISO/IEC 17025 Calibration Requirements • NIST Traceability and Global Equivalence • Role of Calibration Labs and Certificates • Measurement Hierarchy and Uncertainty*
1100 – 1215	***Calibration Tolerances & Accuracy*** *Tolerance Bands and Acceptable Limits • Accuracy, Precision, and Repeatability • Understanding Manufacturer Specs • Impact of Environmental Conditions*
1215 – 1230	*Break*
1230 – 1330	***Instrument Identification & Tagging*** *Tagging and Naming Conventions • Asset Register and Location Tracking • Linking P&IDs with Instrument Data • Importance of Up-to-Date Records*
1330 – 1420	***Safety & Work Permits*** *Job Hazard Analysis for Calibration Work • Use of PPE and Safe Practices • Lockout/Tagout Procedures • Permit-to-Work Requirements*
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 – 0830	***Pressure Measuring Instruments*** *Types: Bourdon Gauge, DP Transmitters, Diaphragm Seals • Pressure Ranges and Unit Conversion • Installation and Mounting Considerations • Static versus Dynamic Pressure Calibration*
0830 – 0930	***Temperature Measuring Instruments*** *Thermocouples (Types J, K, T, etc.) • RTDs (2, 3, 4 Wire Configurations) • Thermowells and Insulation Effects • Common Failure Modes*
0930 – 0945	*Break*
0945 – 1100	***Calibration Tools & Techniques*** *Pressure Calibrators (Deadweight Tester, Pump) • Dry Block Calibrators and Reference Thermometers • Reference Standards and Traceability • Manual versus Automatic Calibration Methods*
1100 – 1215	***Calibration Procedures*** *Performing Zero, Span, and Linearity Checks • HART Communication for Smart Transmitters • As-Found and As-Left Data Logging • Loop Validation During Calibration*

1215 – 1230	*Break*
1230 – 1330	***Interpreting Results & Adjustments*** *Adjusting for Offset and Drift • Recording Calibration Tolerances • Understanding and Correcting Non-Linearity • Repeatability and Hysteresis Evaluation*
1330 – 1420	***Troubleshooting Pressure/Temperature Devices*** *Signal Fluctuation and Spike Analysis • Diagnosing Sensor Failure • Process Condition Impact on Sensors • Case Studies and Fault Finding*
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	***Flow Meter Technologies*** *Differential Pressure, Coriolis, Magnetic • Turbine, Ultrasonic, Vortex Flow Meters • Flow Profile and Reynolds Number Impact • Primary and Secondary Elements*
0830 – 0930	***Level Measurement Devices*** *DP Level Transmitters • Radar, Ultrasonic, Capacitance Types • Displacer and Float Type Systems • Bubbler and Tape-Based Systems*
0930 – 0945	*Break*
0945 – 1100	***Calibration Techniques for Flow*** *Wet Calibration versus Dry Simulation • Flow Test Rigs and Master Meters • Simulating 4–20 mA Flow Signals • Calibration Frequency Based on Criticality*
1100 – 1215	***Calibration Techniques for Level*** *Simulating Tank Height Using Variable Resistors • Hydrostatic Pressure Method • Adjusting Span and URV/LRV • Verifying Against Sight Glass and Indicators*
1215 – 1230	*Break*
1230 – 1330	***Simulators & Signal Generators*** *Using Signal Injectors for Analog/Digital Output • Troubleshooting with Simulation • Loop Verification with Simulated Values • HART/Fieldbus Interface Simulation*
1330 – 1420	***Error Sources & Corrections*** *Temperature, Density, and Pressure Influence • Mounting and Installation Errors • Process Noise and Grounding Issues • Best Practices to Reduce Measurement Error*
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	***4–20 mA Loop Principles*** *Current Loop Fundamentals • Source versus Sink Devices • Loop-Powered versus Externally Powered • Loop Impedance and Voltage Drop*
0830 – 0930	***Loop Calibration Tools*** *Loop Calibrators and Signal Sources • Handheld Communicators and Multimeters • HART Communicator Configuration • Diagnosing with Loop Check Sheets*
0930 – 0945	*Break*

0945 – 1130	***Signal Conditioners & Barriers*** *Isolators and Converters • Intrinsically Safe Barriers • Ground Loops and Interference • Installing Conditioners Properly*
1130 – 1215	***Loop Testing Procedures*** *Testing Transmitters, Wiring, and PLC Inputs • Loop Validation from Field to DCS • Measuring Loop Load and Voltage • Documenting Loop Integrity*
1215 – 1230	*Break*
1230 – 1330	***Troubleshooting Techniques*** *Open Loop and Signal Loss • Noisy or Fluctuating Signals • Ground Fault Isolation • Intermittent Wiring Faults*
1330 - 1420	***Live Loop Testing & Safety*** *Safe Testing without Process Interruption • Isolation, Bypassing, and Simulation • Documentation Before and After Tests • Emergency Procedures for Live Loop Issues*
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 – 0830	***Calibration Records & Reporting*** *As-Found versus As-Left Data • Logging Adjustments and Test Conditions • Data Retention and Traceability • Review of Sample Calibration Records*
0830 – 0930	***Calibration Certificates*** *Mandatory Fields and Formats • Tolerance Calculations and Signatures • Certificates versus Field Reports • Digital versus Paper Records*
0930 – 0945	*Break*
0945 – 1145	***Instrument Management Systems*** *Using CMMS and Calibration Software • Barcode/RFID Integration • Scheduling and Traceability • Alerts and Compliance Reporting*
1145 – 1215	***Hands-on Practical Assessment*** *Pressure Transmitter Calibration • Temperature Loop Check and Adjustment • Flow Meter Simulation • Level Transmitter Test and Verification*
1215 – 1230	*Break*
1230 – 1345	***Audit & Compliance Readiness*** *Preparing for Internal/External Audits • Traceability Documentation Practices • Common Non-Conformities • Compliance with ISO and Regulatory Bodies*
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*

Simulator (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 one of our state-of-the-art simulators "Allen Bradley SLC 500", "AB Micrologix 1000 (Digital or Analog)", "AB SLC5/03", "AB WS5610 PLC", "Siemens S7-1200", Siemens S7-400" "Siemens SIMATIC S7-300", "Siemens S7-200" "GE Fanuc Series 90-30 PLC", "Siemens SIMATIC Step 7 Professional Software", "HMI SCADA", "Gas Ultrasonic Meter Sizing Tool", "Liquid Turbine Meter and Control Valve Sizing Tool", "Liquid Ultrasonic Meter Sizing Tool" and "Orifice Flow Calculator" simulators.

Allen Bradley SLC 500 Simulator

Allen Bradley Micrologix 1000 Simulator (Digital)

Allen Bradley Micrologix 1000 Simulator (Analog)

Allen Bradley SLC 5/03

Allen Bradley WS5610 PLC Simulator PLC5

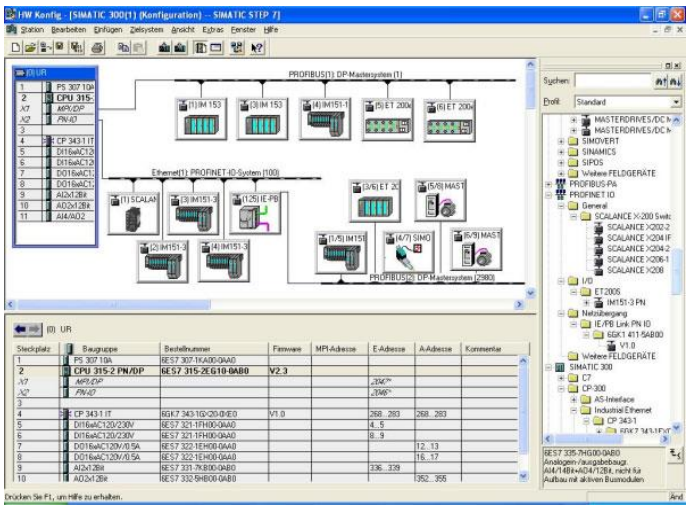
Siemens S7-1200 Simulator

Siemens S7-400 Simulator

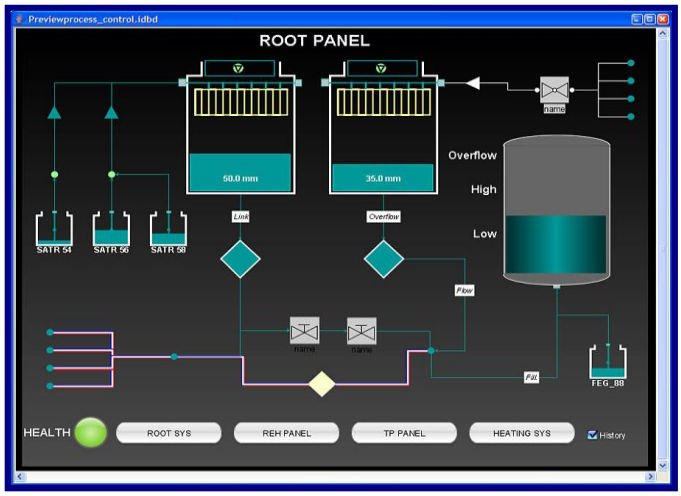
Siemens SIMATIC S7-300

Siemens S7-200 Simulator

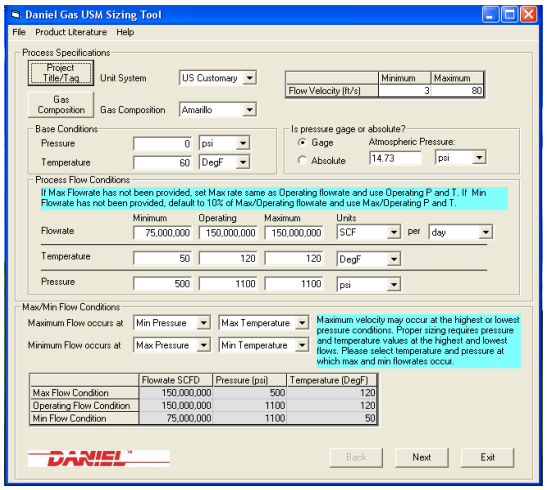
GE Fanuc Series 90-30 PLC Simulator



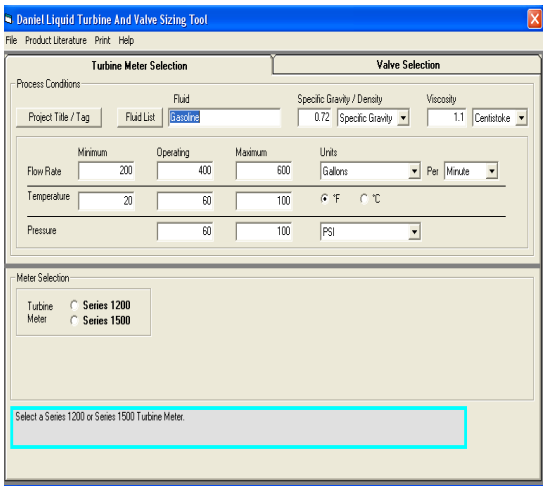
Siemens SIMATIC Step 7
Professional Software



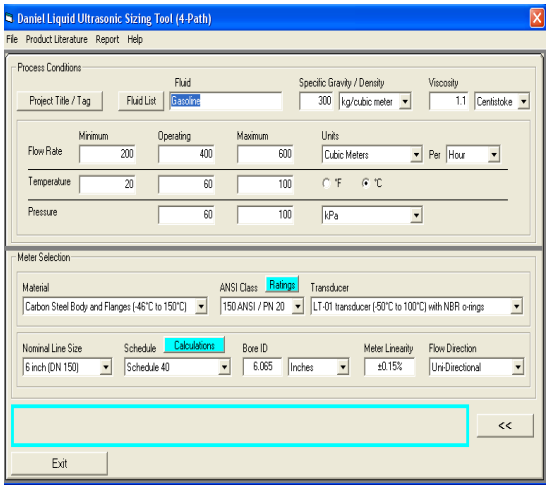
HMI SCADA



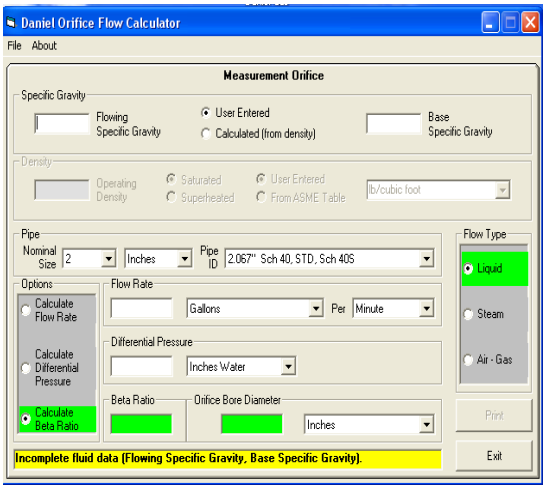
Gas Ultrasonic Meter (USM) Sizing Tool Simulator



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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