+ CALDON Hydrocarbon Calibration Laboratory

Our unique, comprehensive, in-house ultrasonic technology center

sensia
Rockwell Automation + Schlumberger

± 0.04%

The uncertainty within the Hydrocarbon Calibration Laboratory is ± 0.04%. Meters are calibrated in the laboratory with a low measurement uncertainty, for more accuracy in the field.

The Hydrocarbon Calibration Laboratory

The centerpiece of the Ultrasonic Technology Center is our CALDON* Hydrocarbon Calibration Laboratory. This laboratory is unequaled and sets Sensia apart from all other ultrasonic flowmeter suppliers in various ways.

CALDON LEFM* 200 Series ultrasonic flowmeters are calibrated over a Reynolds number range that corresponds to the actual Reynolds number range the meter encounters in the field. This process ensures that once the meter is installed and operating, performance will be unaffected by changes in flow rate and liquid viscosity. The ability to calibrate in-house virtually eliminates the need for Sensia to use independent facilities, thereby dramatically reducing delivery cycles.

One of the most important features of a flow laboratory is accuracy, or as referred to by metrological experts, the laboratory's measurement uncertainty.

To calibrate a meter it is necessary to compare its registration to a known volume. For example, if 1,000 barrels of oil are passed through the meter, does it register 1,000 barrels? The uncertainty of the laboratory deals with the errors that might affect the known volume and how it compares to an international standard. When a meter has been calibrated in a laboratory with a low measurement uncertainty, its measurement in the field will be more accurate. The uncertainty within the Hydrocarbon Calibration Laboratory is ± 0.04% (0.03% using the small volume prover).

The extreme stability of flow rate and temperature achievable at the laboratory provides our engineers with an unsurpassed tool for conducting fundamental research. This has contributed to a better understanding of the phenomena that affect ultrasonic flowmeters.

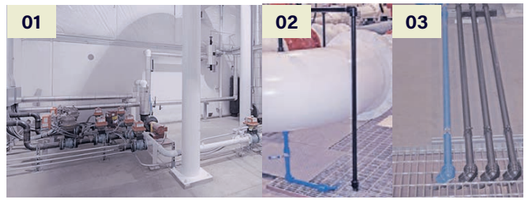
Laboratory Tour

FILLING/DRAINING SYSTEM

Hydrocarbon liquid from any one of the three storage tanks fills the laboratory piping using the automated valve system (Photo 1).

One, two or all three available liquids may be used to calibrate a particular flow meter over a Reynolds number range that approximates that of the actual process. Once filled with liquid, a pressurizer can increase the laboratory piping pressure up to 35 psi.

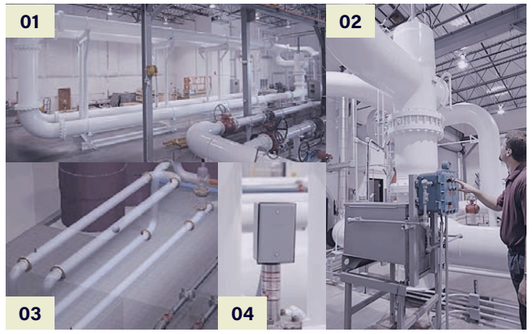
+ Three 12,000-galUS storage tanks hold Exxsol† D80 and two mineral oils (Drakeol 5 and Drakeol 32).
+ Vents, shown in black (Photo 2), are opened as the system is filling to eliminate air.
+ Drains, shown in blue (Photo 3), and vents empty into a sump network (Photo 3). Liquid in the sump is pumped back into the appropriate storage tank.



BALL PROVER

A calibration run is initiated when the ball prover (Photo 1) is launched by the operator (Photo 2). The ball then drops down and is carried by the flow into the prover piping. A glass view of the prover piping illustrates the ball in motion (Photo 3). The position of the ball is monitored by a series of four detector switches (Photo 4).

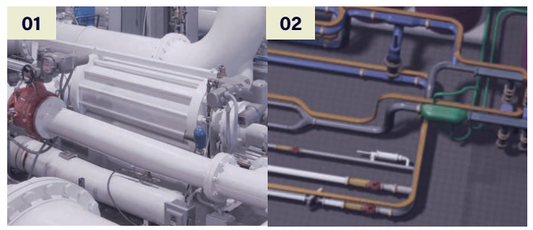
+ 20-in, 63-bbl [10-m3] ball prover with a capacity of 380 to 14,000 bbl/h [60 to 2,200 m3/h]
+ Four detectors, 21 bbl [3.3 m3] between two consecutive detectors
+ Used to calibrate all size meters between 4 and 10 in
+ Uncertainty of ± 0.04%



SMALL VOLUME PROVER

A calibration run is initiated when hydraulic pressure is removed allowing the poppet valve to close. The flowing test liquid causes the piston to move within the precision-machined flow tube of the prover (Photo 1). Highly repeatable optical sensors are used to start and stop pulse and time measurements being made by the laboratory computer system. The piston, moving at the same rate of the test liquid, trips the switches allowing a determination of flow rate based on the measured volume and time (Photo 2).

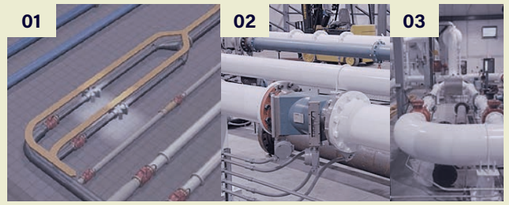
+ 0.72 barrel with a capacity from 62 to 4,654 bbl/h
+ Used for calibration of 2- to 6-in meters (directly or against a master meter)
+ Uncertainty of ± 0.03% (± 0.04% with a master meter)



MASTER METERS

Flow passes through one or both master meter lines and into the calibration lines as shown by the yellow piping (Photo 1).

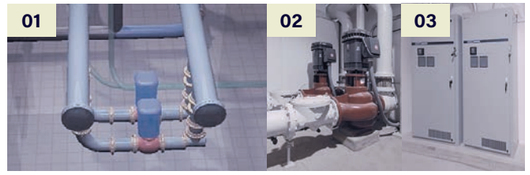
+ Two 10-in LEFM 280C master meters are used to calibrate meters 10 in and larger with flows greater than 12,500 bbl/h [2,000 m³/h]
+ Uncertainty of ±0.08%
+ Calibrated by ball prover



PUMP ROOM

The illustration (Photo 1) shows the location of the laboratory pumps. A third pump will be added in the future to expand the capacity of the laboratory.

+ Two variable speed 250-hp pumps (Photo 2) with adjustable frequency AC drives (Photo 3)
+ Maximum flow rate of 25,000 bbl/h [3,900 m³/h]



MAIN FLOOR CONTROL PANELS

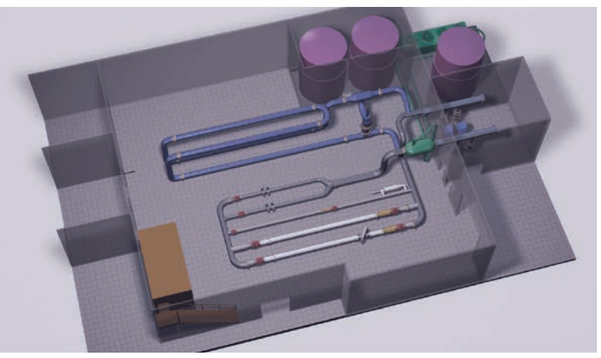
Two panels with touch screen displays permit control of all laboratory operations from the main floor.

+ One of two control panels (Photo 1) with sample display screens (Photo 2 and Photo 3)
+ Emergency stop buttons are on the two panels, as well as at seven other strategic locations in the laboratory

CONTROL ROOM

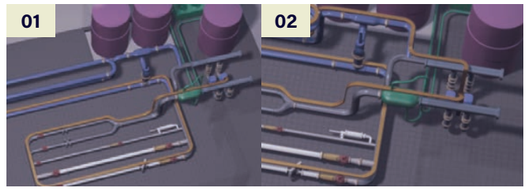
+ Data from all instruments, PLCs and meters are transmitted to two computers in the main control room
+ Visitors can observe calibrations
+ Two control room computers gather and process all calibration data and print the final report

THE FLOOR OF THE LABORATORY IS RECESSED BY 7 IN TO PROVIDE CONTAINMENT IN CASE OF A POSSIBLE SPILL.



ONE LARGE CLOSED LOOP

When using the prover, flow goes from the pump room, through one of the master meter lines, into the feed header, into one of the calibration lines, into the return header and then into the prover (Photo 1). Flow continues through the prover and back into the pump room (Photo 2).

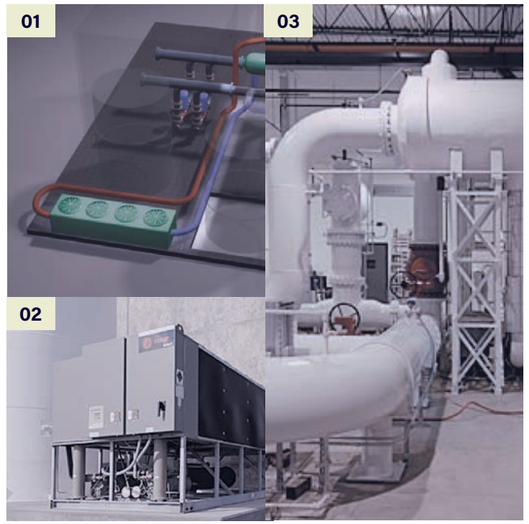


TEMPERATURE CONTROL

The laboratory has a temperature control system that stabilizes liquid temperature at a desired value during a calibration run. This system removes heat added to the liquid by the pumps as it circulates through the laboratory piping loop.

Coolant, shown in blue (Photo 1), is pumped from the outside chiller (Photo 2) into the shell of the lab's heat exchanger (Photo 3). Heated coolant, shown in orange (Photo 1), circulates back to the chiller. The desired temperature set-point for the hydrocarbon liquid being used for the calibration is controlled by varying the rate at which coolant flows to the heat exchanger.

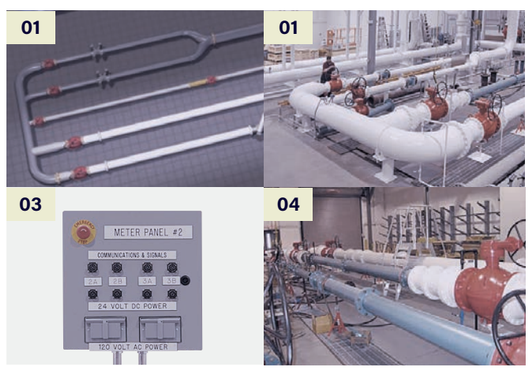
+ Fluid temperature is controlled over a range of 59 to 95 degF [15 to 35 degC] by the 65 ton chiller system
+ Tube and shell heat exchanger contains approximately 2.5 miles of internal tubing
+ Temperature control system stabilizes calibration run conditions and permits hydro-carbon viscosity to be varied over a range of 1.5 to 200 centistokes
+ Controlling hydrocarbon viscosity allows meters to be calibrated over the same Reynolds number range corresponding to installation conditions



CALIBRATION LINES

Three calibration lines are shown in the illustration (Photo 1). Flow of hydrocarbon liquid can be directed from the feed header (Photo 2) into any of the calibration lines. The innermost line is used to calibrate 2- to 8-in meters (Photo 3).

The middle calibration line is for 10- to 16-in meters. The third calibration line is designed for 10- to 24-in meters. Flow meters can be calibrated with customer provided meter runs or with laboratory piping. Meter electronics are connected to one of two panels (Photo 4), which transmits all data to the control room computers.



Calibration Laboratory Specifications†		
Laboratory	Occupies approximately 7,360 ft².	
	Piping pressurized up to 75 psi.	
	Flow is circulated and controlled using two pumps.	
Pumps	Two variable-speed 250 hp pumps located in a separate pump room.	
Maximum flow rate	25,000 bbl/h [3,900 m³/h]	
Minimum flow rate	63 bbl/h [10 m³/h]	
Meter sizes	2 to 24 in [50 to 600 mm] meters can be calibrated using three calibration lines.	
	A 7.5 tonUS crane is used for handling meters and piping.	
Prover	63 bbl [10 m³] unidirectional prover and a 0.75 bbl [0.12 m³] small volume prover.	
Master meters	Two LEFM 280C—10-in meters installed in parallel.	
Calibration fluids	Exxsol D80 and two mineral oils (Drakeol 5 and Drakeol 32) with nominal viscosities of 2 cSt, 15 cSt and 150 cSt. During a calibration, viscosity can be varied and controlled between approximately 1.5 and 200 cSt.	
Storage tanks	The oils are contained in three, double-walled storage tanks.	
	The tanks are 20 ft high and 12 ft in diameter with a 12,000 gallon capacity.	
	Two inside tanks are located in a 5 ft deep containment pit.	
	The third tank is located outside.	
Temperature control	Temperature is controlled within a band of 59–95 degF [15–35 degC] using a 65-tonUS chiller system. Oil passes through a tube and shell heat exchanger as it circulates in the lab. The oil temperature is controlled by adjusting the rate of coolant fed into the shell side of the heat exchanger from the chiller.	
Control	The system is operated from a mezzanine level modular control room with full view of the entire laboratory. The system can also be operated from the laboratory floor via two touch-screen control panels.	
Safety	Goggles and metal tipped shoes are required by personnel on the facility floor	
Uncertainty	±0.04% ball prover	0.03% small volume prover
	±0.08% master meters	0.04% SVP and turbine meter
	±0.09% single-master meter	

† Specifications may change without notice.

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