Precision and accuracy
Liquid Measurement Application

Power and productivity
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ABB

Liquid Measurement Application
High quality measurement of liquid hydrocarbons or water

The Liquid Measurement Application is designed to meet a variety of liquid measurement needs; from basic water measurement, produced oil or water measurement at the wellhead, to high quality liquid hydrocarbon measurement. ABB has an extensive list of standard measurement and automation applications. These are included in the firmware that is installed and shipped with every G4 flow computer or RTU. Liquid Measurement is one of these applications. This application is available in all TotalflowG4 devices: µFLO^{G4}, EX^{G4}, XFC^{G4} and XRC^{G4}. The Linear Liquid Measurement Application is designed for high accuracy measurement of liquid hydrocarbons or water.

How it works

The ABB Liquid Measurement application is designed to interface with a linear liquid primary meter to measure liquid hydrocarbons or water and provide custody quality results. The flow inputs can be either high speed pulse inputs or serial inputs utilizing the MODBUS protocol. The serial input may be RS232, RS485, or MODBUS over TCPIP. Typical primary meter types that may be used with this application are turbine, PD, vortex, ultrasonic, and Coriolis meters. Pulse inputs may be proportional to volume (US gallon) or to mass (kg). Serial flow rates may be either volume flow rate (US gallon/second) or mass flow rate (kg/second). The application supports the K-factor as quantity/pulse or pulse/quantity if using a pulse input. A *meter correction factor* is available as well as placeholders for the serial number of the primary meter and the serial number of applicable primary meter internal components if applicable.

The application utilizes equations from API 11 to determine equations and correction factors for the effects of temperature and pressure on a fluid. The table below shows which standards have been implemented for specific product types.

Product	Pressure Correction (Cpl)	Temperature Correction (Ctl)
Crude oil, refined products, lubricating oils, special applications	API 11.1	API 11.1
Light hydrocarbons	API 11.2.2	API 11.2.4
Water	API 11.4.1	API 11.4.1

The API 11 standard specifies upper and lower limits for pressure, temperature and density of the fluid over which the calculation are considered applicable. ABB Totalflow has implemented two options that are user selectable, regarding how the calculations are performed in the event that any one
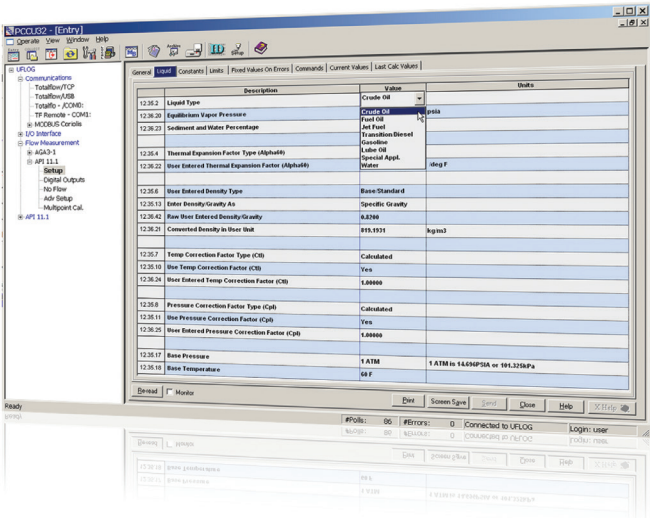
of the limits is exceeded. "Normal" mode will use the upper or lower limit value specified in the specific standard for calculations and logging whenever the variable exceeds that limit. "Extended" mode will continue to calculate using the live variable, even if it exceeds the limits of the standards. Both modes will log an event if any variable exceeds the high or low limits of the standards as well as log an event when the variable returns within the limits of the standards.

The equilibrium vapor pressure may be entered if known or required. The user may enter a fixed percentage for *sediment* and *water* or select the input to be live from an outside source. Use of *sediment* and *water* in the calculations is optional.

CTL and CPL correction factors are individually configurable. The user has the option of enabling or disabling the correction factors as well as using "fixed" values or values calculated by the Liquid Measurement Application. The defaults are "Enabled" and "Calculated". The temperature and pressure inputs can be from a flowing measured source or can be "Fixed" and a user entered value.

Producing results

Double precision math is used in the liquid measurement application and intermediate values as well as calculated results can be viewed in double precision with PCCU software. This is useful for verification of results against 3rd party verification software. The Liquid Measurement Application provides current values and last calculation period values that may be used to monitor or verify flowing conditions, parameters, and calculations. Also included are complete *event records* showing any auditable changes that may have been made to the application, a *characteristics log* that will reflect the current configuration of the application's parameters, as well as hourly and daily logs. The log files contain API 21.2 compliant data (flow measurement using electronic metering systems; electronic liquid volume measurement using positive displacement and turbine meters). If the input from the primary meter is mass, the application will calculate the Indicated Volume, Gross Standard Volume and Net Standard Volume and log both the mass and volumes. If the input from the primary

meter is volume, the application will calculate Indicated Volume, Gross Standard Volume, Net Standard Volume and Mass and log both the volumes and the mass. Logged variables are not rounded and are stored in full single precision resolution.

Current implementation assumes that the observed pressure, temperature and density are the same as the flowing conditions.

All setup and configuration is performed using PCCU32 local interface software. CFX 7 file export is supported from PCCU for customers using Flow-Cal, Inc. software. WinCCU32 remote host software is capable of polling the remote Totalflow devices for current status updates as well as remote data collection and reporting. Third party host software programs that utilize the TCI Toolkit with Totalflow register access capability can also interface to the Totalflow devices running the Liquid Measurement Application.

Flow input types	Liquid types (all densities at 60°F)	Density input options	Logged/Reported Density options	Thermal expansion	CTL and CPL options
Pulse input volume (U.S. gallons): pulse/volume or volume/pulse	Crude oil (-10° to 100° API) API 11.1 for Cpl and Ctl	kg/m3	kg/m3	Manually entered	Enable or disable
Pulse input mass (kg): pulse/mass or mass/pulse	Fuel oils (-10° to 37° API) API 11.1 for Cpl and Ctl	lbs/ft3	lbs/ft3	Calculated	If enable, calculate values
Volume flow rate: serial (U.S. gallons/sec)	Jet fuels (37° to 50° API) API 11.1 for Cpl and Ctl	lbs/US gallon	lbs/US gallon		If enable, use fixed values that are entered by the user
Mass flow rate: serial (kg/sec)	Gasoline (50° to 85° API) API 11.1 for Cpl and Ctl	kg/Sdm3	kg/Sdm3 g/cm3 g/m3		
	Lube oil (-10° to 45° API) API 11.1 for Cpl and Ctl	g/cm3	kg/kL lbm/MMSCF		
	Special application fluids API 11.1 for Cpl and Ctl	g/m3	kg/Mm3		
	Light Hydrocarbons (.350 - .637 Relative Density) API 11.2.2 for Cpl (.350 - .688 Relative Density) API 11.2.4 for Ctl	kg/kL lbm/MMSCF kg/Mm3			
	Water API 11.4.1 for Cpl and Ctl	Degrees API 60F Relative Density	Degrees API 60F Relative Density		

NOTE: Density can be provided from a live density source such as a densitometer/Coriolis or entered as a fixed value. Density input may be at base conditions or flowing conditions. Multiple inputs are supported. The liquid thermal expansion factor (alpha 60) can be calculated by the application or manually entered. If "Special Application Fluids" is selected, the thermal expansion factor must be manually entered by the user.

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