

# Dual Flow Computer Library

## User Manual

### Overview

The Beyond HMI Dual Flow Computer Library (BhiLibDualFc) for Wago e!COCKPIT is the ideal flow computer for production separators. This library provides natural gas and crude oil flow computing features for Wago e!COCKPIT programs. The flow computer features conform to API 21.1 standards for electronic flow measurement. Data is transferred from the PLC using industry-standard CFX files. These files can be directly imported into hydrocarbon accounting systems.

The library supports a single (1) gas meter run and up to two (2) liquid meter runs. The liquid meters can be used to measure either crude oil or water.

The library performs API-compliant calculations for either custody-transfer (API 12) or allocation (API 20.1) meters.

For applications that require multiple gas meter runs, the Beyond HMI Gas Flow Computer library (BhiLibGasFc) is available.

The BhiLibDualFc library uses runtime licensing. A license is required for each PLC which executes the library code. The program will run for approximately 4 days in trial mode before a license is required. Licenses must be purchased from Beyond HMI, Inc.

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## Configuring the Library

Configuration is performed via Codesys Visualizations included in the library. Your program's Visualizations must provide a link to the Dual Flow Computer Menu screen (refer to the most recent version of Beyond HMI document DFC\_DG\_yyyy\_mm\_dd for more details).

This User Manual document describes the features of the library-resident visualizations.

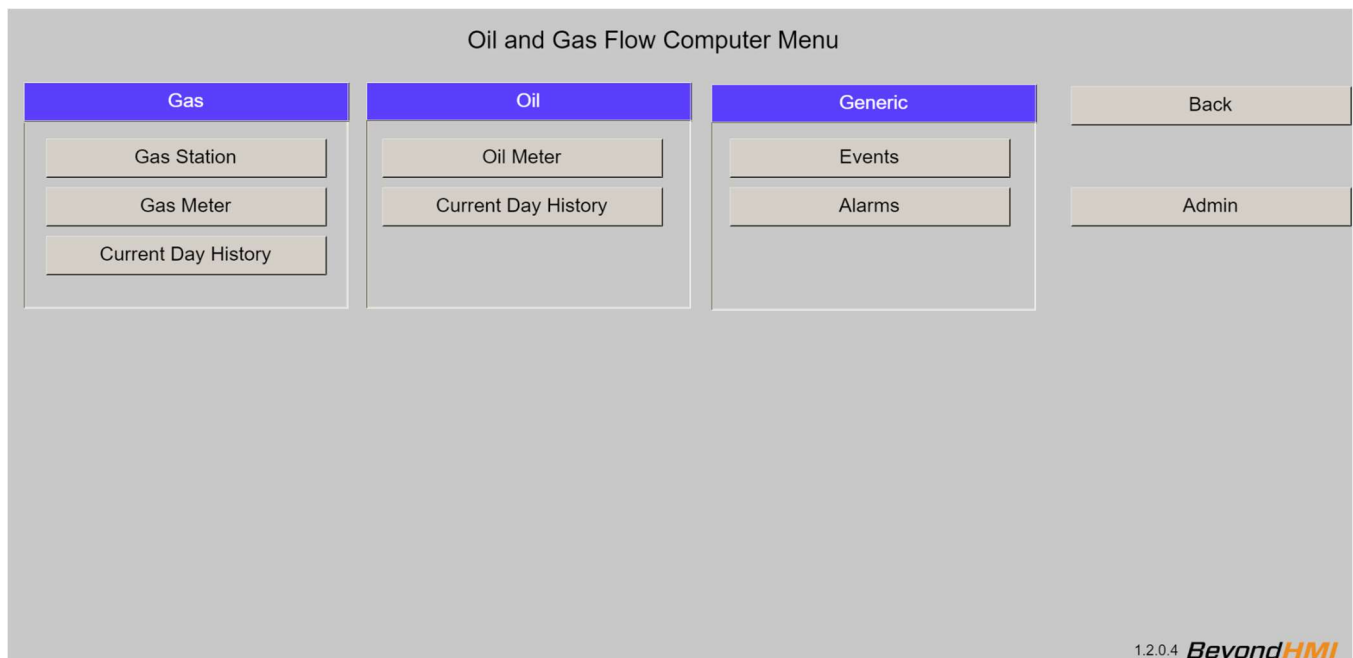
### Formatting Note

The library allows input of two classes of parameters: parameters required for calculations and parameters captured for transmission to the hydrocarbon accounting system through .cfx files.

In the documentation sections below, parameters required for calculations are differentiated using an asterisk\*. For the purposes of the library and its flow computer functions, entry of these parameters is mandatory. Parameters not marked with an asterisk\* are not used by the library, but their values will be included in the .cfx files.

### Main Menu

The main menu provides navigation to all of the features of the library.



*Dual Flow Computer Main Menu Visualization*

### **Gas Section**

#### **Gas Station**

Calls the visualization for status and configuration of gas meter stations

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## **Gas Meter**

Calls the visualization for status and configuration of gas meters

## **Current Day History**

Calls the visualization for reviewing periodic history for gas meters for the current *day*. A *day* can contain up to 25 hours of data, or less – if a configuration change has been made.

## ***Oil Section***

### **Oil Meter**

Calls the visualization for status and configuration of oil meters

### **Current Day History**

Calls the visualization for reviewing periodic history for oil meters for the current *day*. A *day* can contain up to 25 hours of data, or less – if a configuration change has been made.

## ***Generic Section***

### **Events**

Calls the visualization for reviewing meter events

### **Alarms**

Calls the visualization for reviewing meter alarms

## ***Other***

### **Admin**

Calls the visualization for viewing license status information

### **Back**

Returns to the visualization in your PLC program from which the gas flow computer memory was called

## Gas Station Screen - Values

Each meter must be assigned to a station. Stations house shared gas properties and contract conditions. Since BhiLibDualFc only supports a single gas meter, it is only necessary to configure a single station.

The station screen contains several tabs. The **Values** tab displays live calculated results for the station. Since BhiLibDualFc only supports a single gas meter, these values represent the accumulation of quantities from gas meter.

Gas Meter Station Configuration

Station Description **Gas Station 1**  Enabled Back

	Volume [MSCF/Day]	Energy [MMBTU/D]	Mass [M lb/Day]
Flow Rate	0.000	0.000	0.000
	[MSCF]	[MMBTU]	[M lb]
Current Hour	0.00	0.00	0.00
Last Hour	0.00	0.00	0.00
Today	0.00	0.00	0.00
Yesterday	5.06	5.00	0.25
Current Month	31.4	30.9	1.6
Previous Month	0.0	0.0	0.0
Total	31	31	2

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### Station Screen – Values Tab

#### Station Description Text Box

This text box is used to modify the common descriptive name of the currently-selected station.

#### Enabled

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

#### Volume

Values in this column represent volumetric flow rates and accumulations. The screen displays the relevant units of measure.

#### Energy

Values in this column represent energy flow rates and accumulations. The screen displays the relevant units of measure.

## **Mass**

Values in this column represent mass flow rates and accumulations. The screen displays the relevant units of measure.

## **Flow Rate**

Values in this row represent instantaneous flow rates – as of the last successful calculation. The screen displays the relevant units of measure.

## **Current Hour**

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Last Hour**

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Today**

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Yesterday**

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Current Month**

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Previous Month**

Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Total**

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Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.



## Station Screen - Main

The station screen contains several tabs. The **Main** tab is used to adjust the main configuration parameters for the station.

The screenshot displays the 'Gas Meter Station Configuration' interface. At the top, the 'Station Description' is 'Gas Station 1' and the station is 'Enabled'. Below this are four tabs: 'Values', 'Main', 'Quality', and 'Diagnostic'. The 'Main' tab is active. The configuration parameters are as follows:

Parameter	Value	Unit
Flow Computer ID	GasFCID	
Supercompressibility Standard	AGA-8 GERG (2017)	
Heating Value Basis	dry	
Atmospheric Pressure	14.2000	[psia]
Contract Base Pressure	14.7500	[psia]
Contract Base Temperature	60.0000	[F]
Power Source	AC	
Contract Hour	6 AM	
Specific Gravity Basis	dry	
Gravitational Acceleration	32.2000	[Ft/sec^2]
Elevation	123.0	[Ft]
Latitude	32.8700	[degrees]

### *Station Screen – Main Tab*

#### **Station Description Text Box\***

This text box is used to modify the common descriptive name of the currently-selected station.

#### **Enabled\***

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

#### **Flow Computer ID**

Specify the Flow Computer ID to associate with this station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

#### **Supercompressibility Standard**

The flow computer library only supports the AGA-8 GERG (2017) method.

#### **Heating Value Basis**

Specify the heating value basis – as provided on the gas sample analysis report. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

#### **Atmospheric Pressure\***

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Specify the atmospheric pressure to be used. If meters assigned to this station will use **Static Pressure Measurement Type** of *Absolute*, then this value will *not* be used by the flow computer library. If meters assigned to this station use **Static Pressure Measurement Type** of *Gauge*, then this value will be added to the live static pressure values before AGA-3 calculations are performed. In either case, this field is passed to FLOWCAL in the CFX file.

## **Contract Base Pressure\***

Specify the contract base pressure. A common value for this quantity is 14.73.

## **Contract Base Temperature\***

Specify the contract base temperature. A common value for this quantity is 60.0.

## **Power Source Combo Box**

Use this combo box to specify the power source for the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Contract Hour\***

Specify the hour when the contract day changes. The contract day will change at the beginning of the configured hour.

## **Specific Gravity Basis**

Specify the specific gravity (gas relative density) value basis – as provided on the gas sample analysis report. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Gravitational Acceleration**

Specify the local acceleration of gravity for the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Elevation**

Specify the elevation of the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Latitude**

Specify the latitude of the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## Station Screen - Quality

The station screen contains several tabs. The **Quality** tab is used to adjust the gas properties for the station.

**Gas Meter Station Configuration**

Station Description **Gas Station 1**  Enabled Back

Values | Main | **Quality** | Diagnostic

Sample Date: 01 - 19 - 22      Sample Type: spot  
 Heating Value: 987.000 [BTU/FI3]      Specific Gravity: 0.650000  
 Normalization Method: adjust\_methane

Composition		Adjustments	
% CO2	0.4000	% Octane (C8)	0.0000
% N2	0.2000	% Nonane (C9)	0.0000
% Methane (C1)	86.2970	% Decane (C10)	0.0000
% Ethane (C2)	8.0000	% Argon (Ar)	0.0000
% Propane (C3)	5.1000	% CO	0.0000
% iButane (iC4)	0.0000	% Hydrogen (H2)	0.0000
% nButane (nC4)	0.0000	% Oxygen (O2)	0.0000
% iPentane (iC5)	0.0000	% Helium (He)	0.0000
% nPentane (nC5)	0.0000	% Water (H2O)	0.0000
% Hexane (C6)	0.0000	% H2S	0.0030
% Heptane (C7)	0.0000	Total	100.0000

Heptanes+ (C6+) 0.0000

Apply 60% / 30% / 10% split

Normalize

Commit Needed  
 Commit Changes

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### Station Screen – Quality Tab

#### Station Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected station.

#### Enabled\*

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

#### Sample Date

Use this control to specify the date on which the sample was captured. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

#### Sample Type

Use this combo box to specify the sample type. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.


#### Heating Value\*

Enter the heating value from the gas analysis report.

#### Specific Gravity\*

Enter the gas specific gravity (relative density) from the gas analysis report.

## Normalization Method

The functionality associated with this combo box is typically not used. If the gas compositional percentages add up to 100.0 percent, then normalization is not required. When gas compositions do not total to 100.0 percent, they can be normalized to 100 percent by specifying the normalization method here and selecting the  button.

The different normalization methods are described below.

- **adjust\_methane**  
The percentages of all other components will remain unchanged and the percentage of methane will be adjusted to cause the total to be 100.0 percent.
- **adjust\_all**  
The percentages of all of the components will be changed – proportionally – to bring the total to 100.0 percent.

to specify the sample type. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## Normalize

The functionality associated with this button is typically not used. If the gas compositional percentages add up to 100.0 percent, then normalization is not required and pressing this button should have no impact. When gas compositions do not total to 100.0 percent, they can be normalized to 100 percent by specifying the **Normalization Method** and selecting this button.

## Hexanes+ (C6+)

Typically, the gas analysis report will specify percentage for *Hexanes Plus* or *Hexanes+*. There are many regionally-accepted methods for dividing the *Hexanes Plus* percentage between Hexane, Heptane, and Nonane. The library provides this simple tool for performing a 60/30/10 split:

- Hexane % = 60% x *Hexanes Plus*%
- Heptane % = 30% x *Hexanes Plus*%
- Nonane % = 10% x *Hexanes Plus*%

To use this tool, enter the value from the analysis report into this box and check the **Apply 60% / 30% / 10% split** check box. The library will update the % **Hexane(C6)**, % **Heptane(C7)**, and % **Nonane(C8)** values and then uncheck the **Apply 60% / 30% / 10% split** check box.

Note that this is just a utility feature. Its use is optional.

## Apply 60% / 30% 10% split check box

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See description of **Hexanes+ (C6+)**. Note that this is just a utility feature. Its use is optional.

## **Commit Needed check box**

This read-only checkbox indicates that changes to the gas quality or standard conditions have been made and a Commit is necessary.

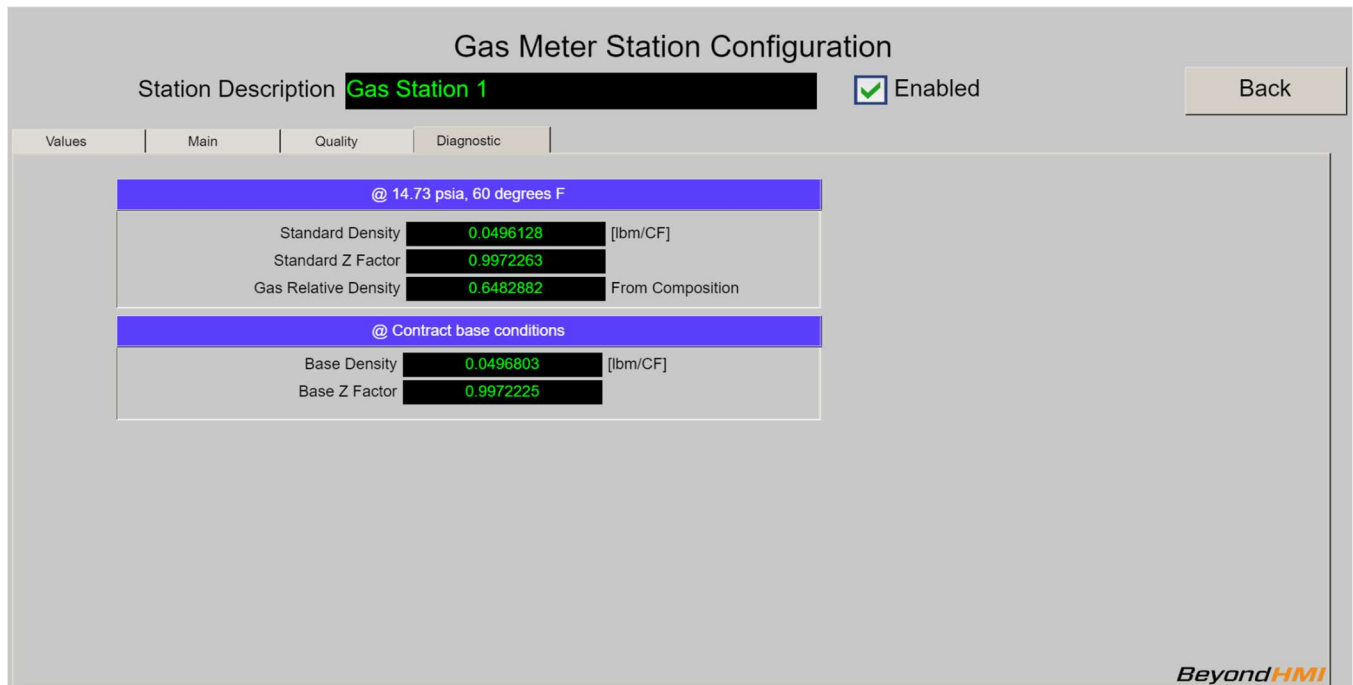
## **Commit Changes check box**

When you have completed changes to the gas composition and the station base conditions, check this box to cause the library to begin using the new values. The library will uncheck this box and the **Commit Needed** checkbox when the commit is completed.

*Note: committing changes is critical to accurate measurement. With other parameters in the visualizations, the new value of the parameter is used by the program immediately after a change. But with station gas properties and station base conditions, you must make changes and then Commit them as a set of changes.*

## Station Screen - Diagnostic

The station screen contains several tabs. The **Diagnostic** tab displays live diagnostic and internal calculation values from the library.



### Station Screen – Diagnostic Tab

#### Station Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected station.

#### Enabled\*

Use this check box to enable/disable the station. Disabled stations – if referenced by a meter – will generate a configuration error.

#### Standard Density

Displays the library-calculated density of the gas at *standard conditions* (14.73 psia, 60 degrees F).

#### Standard Z Factor

Displays the library-calculated Z factor of the gas at *standard conditions* (14.73 psia, 60 degrees F).

#### Gas Relative Density

Displays the library-calculated gas gravity (relative density) of the gas at *standard conditions* (14.73 psia, 60 degrees F). This is calculated using gas compositional information. It may be different from the gas gravity you enter on the Station **Quality** tab.

## **Base Density**

Displays the library-calculated density of the gas at the contract base temperature and pressure specified on the Station **Quality** tab.

## **Base Z Factor**

Displays the library-calculated Z factor of the gas at the contract base temperature and pressure specified on the Station **Quality** tab.

## Gas Meter Screen - Values

The gas meters screen contains several tabs. The **Values** tab displays live calculated results for the meter.

The screenshot shows the 'Gas Meter Configuration' screen with the 'Values' tab selected. The meter is named 'Gas Meter 1' and is 'Enabled'. The screen displays a table of flow and energy data over different time periods, along with sensor readings for Sp, Dp, Temperature, and Pulses.

	Volume [MSCF/Day]	Energy [MMBTU/Day]	Mass [M lb/Day]	Flow Seconds			
Flow Rate	0.000	0.000	0.000				
Current Hour	0.00 [MSCF]	0.00 [MMBTU]	0.00 [M lb]	0			
Last Hour	0.00	0.00	0.00	0			
Today	0.0	0.0	0.0	0			
Yesterday	5.1	5.0	0.3	1723			
Current Month	31	31	2	10012			
Previous Month	0	0	0	0			
Total	31	31	2	10012			
Sp	0.00	Dp	0.00	Temperature	0.00	Pulses	0

*Gas Meter Screen – Values Tab*

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### Volume

Values in this column represent volumetric flow rates and accumulations. The screen displays the relevant units of measure.

### Energy



Values in this column represent energy flow rates and accumulations. The screen displays the relevant units of measure.

## **Mass**

Values in this column represent mass flow rates and accumulations. The screen displays the relevant units of measure.

## **Flow Rate**

Values in this row represent instantaneous flow rate – as of the last successful calculation. The screen displays the relevant units of measure.

## **Current Hour**

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Last Hour**

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Today**

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Yesterday**

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Current Month**

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Previous Month**

Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Total**

Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.

## **Sp**

Displays the live static pressure being used by the library for gas flow calculations. If the static pressure is measured in psig, this value will reflect meter measured pressure plus station atmospheric pressure. The screen displays the relevant units of measure.

## **Dp**

Displays the live differential pressure being used by the library for gas flow calculations. The screen displays the relevant units of measure.

## **Temperature**

Displays the live temperature being used by the library for gas flow calculations. The screen displays the relevant units of measure.

## **Pulses**

Displays the live accumulated pulse quantity used by the library for gas flow calculations. This value is only appropriate for linear meters. The current release of the library only supports orifice meters.

## Gas Meter Screen - Main

The gas meters screen contains several tabs. The **Main** tab is used to configure most of the important meter parameters.

The screenshot shows the 'Gas Meter Configuration' screen with the 'Main' tab selected. At the top, the 'Meter Description' is 'Gas Meter 1', and there is a checked 'Enabled' checkbox and a green status indicator. Below this are tabs for 'Values', 'Main', 'Advanced', 'Ranges', 'Diagnostic', 'Cal Rpt Params', and 'Calibration'. The 'Main' tab contains several sections: 'Meter Serial Nbr' (GasMeterSN) and 'First Delivery Date'. The 'Meter Type' section includes 'Meter Type Orifice' (Static Pressure Measurement Type: absolute), 'Tap Type Flange' (Fitting Type: senior), and 'Static Pressure Tap Location' (upstream). The 'Meter Size' section includes 'Pipe' (Diameter: 2.0670, Material: carbon\_steel, Reference Temperature: 68.0) and 'Orifice' (Diameter: 1.0000, Material: monel, Reference Temperature: 68.0). The 'Meter Misc' section includes checkboxes for 'Meter Has RTD', 'RTD is In Use', 'Meter Temperature is Live', 'Meter is Pressure Compensated', and 'Meter is Temperature Compensated'. The BeyondHMI logo is in the bottom right corner.

### Gas Meter Screen – Main Tab

#### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

#### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

#### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

#### Meter Serial Number\*

Use this field to specify the meter serial number. Meter serial numbers must be unique at each installation. Each meter on the PLC must have a unique serial number.

*Note: CFX files for the different meters are organized on the PLC file system by meter serial number. Therefore, it is important to configure this parameter*

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*correctly and – more importantly – to avoid changing it unless absolutely necessary. Meter serial numbers should not contain spaces.*

## **First Delivery Date**

Specify the first date of gas delivery through this meter. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Meter Type\***

This version of the library only supports orifice meters.

## **Static Pressure Measurement Type\***

Specify whether static pressure values are reported to the library in **absolute** or **gauge** pressure. If the **gauge** option is selected, the library will add the associated station's **atmospheric pressure** to the static pressure values before performing calculations.

*Note: This value defaults to **gauge** for all meters. However, most modern multi-variable sensors report **absolute** pressure. Be sure to configure this parameter correctly.*

## **Tap Type\***

Applies to Orifice meters. The library only supports Flange taps.

## **Fitting Type**

Specify the type of orifice fitting. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Static Pressure Tap Location\***

This version of the library only supports static pressure measured at the upstream tap.

## **Pipe Diameter\***

Specify the inside diameter of the meter tube. The screen displays the relevant units of measure.

## **Pipe Material\***

Specify the type of material from which the meter tube was fabricated.

## **Pipe Reference Temperature\***

Specify the reference temperature at which the meter tube measurement was made. The screen displays the relevant units of measure.

## **Orifice Diameter\***

Specify the inside diameter of the orifice plate. The screen displays the relevant units of measure.

## **Orifice Material\***

Specify the type of material from which the orifice plate was fabricated.

## **Orifice Reference Temperature\***

Specify the reference temperature at which the orifice plate measurement was made. The screen displays the relevant units of measure.

## **Meter Has RTD check box**

Indicates whether the meter is equipped with an RTD (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **RTD in use**

Indicates whether the meter RTD is being used to supply temperature values (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature is Live**

Indicates whether the temperature values are live (usually true). It is not used by the flow computer library.

## **Meter is Pressure Compensated**

Indicate whether the meter is pressure compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Meter is Temperature Compensated**

Indicate whether the meter is temperature compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## Gas Meter Screen - Advanced

The gas meters screen contains several tabs. The **Advanced** tab is used to configure additional meter parameters.

The screenshot displays the 'Gas Meter Configuration' screen with the 'Advanced' tab selected. The 'Meter Description' is 'Gas Meter 1', and the meter is 'Enabled'. The configuration parameters are as follows:

Parameter	Value	Units/Options
Meter Factor	1.0000	
K-Factor	1.0000	Pulses_per_actual_Ft3
Meter Type	Gas	
Viscosity	0.00000689	[lbm/ft-sec]
Ratio of Specific Heats	1.3	
Low Flow Cutoff Setpoint	0.10	[inch H2O]
Backflow Cutoff Setpoint	0.00	[inch H2O]
Input Pulse Count Rolls Over at	0	[Linear Meters Only]
Max Data Retention	35	[Days]
Force Day Rollover	<input type="checkbox"/>	

### Gas Meter Screen – Advanced Tab

#### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

#### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

#### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

#### Meter Factor

Indicate the meter factor derived from meter proving. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

#### K-Factor

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Indicate the factor used to convert linear meter pulses to velocity units. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **K-Factor Units**

Indicate the units of measure represented by the K-factor. Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Low Flow Cutoff Setpoint\***

Indicate the cutoff point to trigger no flow override. For orifice meters, this value pertains to differential pressure. If the differential pressure is below this value, then the meter is considered to be in *no flow* condition and the library will not accumulate volume, energy, or mass while the condition persists.

## **Backflow Cutoff Setpoint**

Indicate the cutoff point to indicate backflow. The screen displays the relevant units of measure. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Viscosity\***

Indicate the gas viscosity to use in calculations. If this value is left at 0.0 for an enabled meter, the library will default it to 0.0000069. The screen displays the relevant units of measure.

## **Ratio of Specific Heats\***

Indicate the ratio of specific heats for the gas to use in calculations. If this value is left at 0.0 for an enabled meter, the library will default it to 1.3.

## **Input Pulse Count Rolls Over At**

Applies to linear meters. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Max Data Retention\***

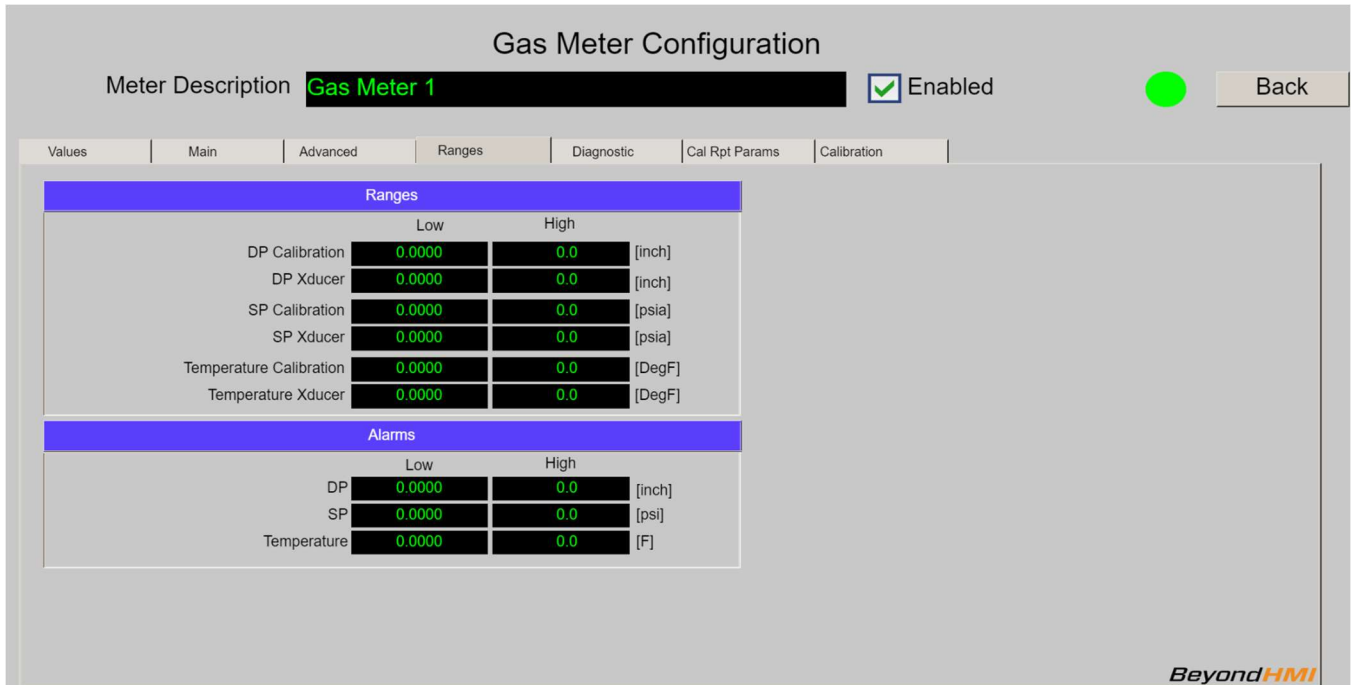
Indicate the number of days of data to save in the PLC file system. If this value is left less than 35 days for an enabled meter, the library will change it to 35. The value can be set larger than 35 days.

## **Force Day Rollover**

Check this box to trigger an immediate “rollover” of data for the current day into a CFX file. Should be used sparingly.

## Gas Meter Screen - Ranges

The gas meters screen contains several tabs. The **Ranges** tab is used configure parameters related to sensor ranges and alarm levels.



*Gas Meter Screen – Ranges Tab*

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### DP Calibrated Range

Enter the low and high ranges for calibration of the meter's differential pressure signal - if applicable. Applies to orifice and cone meters. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

### DP Xducer Range



Enter the low and high ranges for absolute ranges of the meter's differential pressure sensor - if applicable. Applies to orifice and cone meters. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **SP Calibrated Range**

Enter the low and high ranges for calibration of the meter's static pressure signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **SP Xducer Range**

Enter the low and high ranges for absolute ranges of the meter's static pressure sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature Calibrated Range**

Enter the low and high ranges for calibration of the meter's temperature signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature Xducer Range**

Enter the low and high ranges for absolute ranges of the meter's temperature sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **DP Alarm\***

Enter the low and high alarm levels for the differential pressure signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs.

## **SP Alarm\***

Enter the low and high alarm levels for the static pressure signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs. The static pressure alarm uses the calculation static pressure [in psia] as the basis for triggering alarms. If the meter's **Static Pressure Measurement Type** is set to **gauge**, then the static pressure alarm logic will reference the static pressure value provided by the PLC program *plus* atmospheric pressure.

## **Temperature Alarm\***

Enter the low and high alarm levels for the temperature signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs.

## Gas Meter Screen - Diagnostic

The gas meters screen contains several tabs. The **Diagnostic** tab displays live diagnostic and internal calculation values from the library.

The screenshot displays the 'Gas Meter Configuration' screen for 'Gas Meter 1'. The 'Diagnostic' tab is selected, showing various parameters and their values. A green status indicator is visible in the top right corner.

Parameter	Value	Unit
Static Pressure	0.00	[psia]
Flowing Density	0.0000000	[lbm/CF]
Flowing Z Factor	0.0000000	
Orifice Diameter	0.99946	[inch]
Pipe Diameter	2.06613	[inch]
Beta Ratio	0.483735	
Reynolds Number	0	
Cd	0.600000	
Ev	0.000000	
Y1	0.000000	
Fpv	0.000000	
C Prime	0.000000	

The 'Errors' section shows a table with 6 rows, each containing '0' and 'NO ERROR'. A red text label 'No Flow Indicated' is present at the bottom of the errors section.

### Gas Meter Screen – Diagnostic Tab

#### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

#### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

#### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

#### Static Pressure

Displays the static pressure value being used by the library for gas flow calculations.

#### Flowing Density

Displays the library-calculated density of the gas at flowing temperature and pressure.

## **Flowing Z Factor**

Displays the library-calculated Z factor of the gas at flowing temperature and pressure.

## **Orifice Diameter**

Displays the library-calculated, temperature corrected orifice size.

## **Pipe Diameter**

Displays the library-calculated, temperature corrected meter tube size.

## **Beta Ratio**

Displays the library-calculated beta ratio - using temperature corrected orifice and pipe sizes.

## **Reynolds Number**

Displays the library-calculated Reynolds number for the instantaneous meter flow.

## **Cd Number**

Displays the library-calculated Coefficient of Discharge ( $C_d$ ) for the instantaneous meter flow.

## **Ev Number**

Displays the library-calculated Velocity of Approach Factor ( $E_v$ ) for the meter flow.

## **Y1 Number**

Displays the library-calculated Expansion Factor ( $Y_1$ ) for the meter flow.

## **Fpv**

Displays the library-calculated Supercompressibility Factor ( $F_{pv}$ ) for the flowing gas. This value is not used by the library's AGA-3 (2013) calculation, but it is a common factor used in other AGA-3 calculations.

## **C Prime**

Displays the library-calculated CPrime from an orifice flow calculation. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library's AGA-3 (2013) calculation.

## **Error Codes and Messages**

The library reports up to five Errors/Warnings for each meter. If more than five Errors/Warnings exist, only five will be displayed. Each Error/Warning is represented by a code number and a short text message. The table below provides further details for each Error/Warning. Note that

Errors must be corrected before calculations can resume for the meter, whereas Warnings are only for informational purposes.

Code	Text	Error or Warning	Description and Suggestions
0	NO ERROR		Meter is functioning without errors or warnings
1	W:BAD COMPN %	Warning	The gas compositional information for the associated station does not sum to 100%. Correct the station gas composition information or normalize the composition percentages, then commit changes to the station's gas composition.
2	W:STAT PRS GAGE	Warning	The meter's <b>Static Pressure Measurement Type</b> is set to <b>gauge</b> . Modify this configuration parameter if it is not correct. Most modern multivariable sensors report static pressure in psia
3	BAD HEAT VALUE	Warning	The gas heating value for the associated station is out of normal range. Correct this value in the station configuration.
1002	BAD ORIFICE SIZ	Error	The orifice size parameter has an unrealistic value. Correct the orifice size parameter for the meter.
1003	BAD PIPE SIZE	Error	The pipe size parameter has an unrealistic value. Correct the orifice size parameter for the meter.
1004	BAD LIVE TMPR	Error	The live temperature value is unrealistic.
1005	LOW CALCd Re	Error	The calculated Reynolds number is too low for AGA-3 calculations. This is caused by a combination of very low flow and the meter's <b>Low Flow Cutoff Setpoint</b> being set too low. When this error is displayed, the meter will not measure flow or accumulate volume (it is basically in "no flow override" mode). When flow goes above the critical level, the meter will start measuring flow again and this error will disappear.
1006	BAD ORF REF T	Error	The meter's <b>Plate Reference Temperature</b> value is unrealistic
1007	BAD PIPE REF T	Error	The meter's <b>Pipe Reference Temperature</b> value is unrealistic
1008	BAD MTR TYP	Error	The meter type parameter is wrong. This error should not be observed with this version of the library. Contact Beyond HMI, Inc. for help if this error is seen.
1009	INVALID STATN	Error	The meter is assigned to an invalid station number. Correct the meter's configuration so that its <b>Station</b> parameter is realistic.
1010	STATN DISABLED	Error	The station to which this meter is assigned is disabled. Enable the station or disable the meter.
1012	BAD BETA RATIO	Error	The calculated Beta ratio is unrealistic. It is unlikely that this error will ever be displayed. More likely, you will see either error 1002 or 1003 – or both.
1013	DENSITY FN ERR	Error	This indicates an internal error in the AGA-8 calculation code. Contact Beyond HMI, Inc. for help if this error is seen.

1014	BAD RE INPUTS	Error	The meter's viscosity parameter might be set to a number very close to zero. If the viscosity is set to exactly 0.0(repeating zeros) then the library will default the viscosity to a realistic value. If this message is displayed, check the meter's viscosity parameter.
1016	QUALITY COMMIT	Error	Changes have been made to critical gas property information on the associated station but those changes have not been committed. Go to the associated station's Quality configuration tab and trigger a Commit. The program should perform an automatic commit after about 5 minutes. This may result in a different error, so it is best to reconcile this error manually
1017	SERNBR 2 SHORT	Error	The meter's serial number is too short (or may not have been configured). The <b>Meter Serial Number</b> parameter for the meter must be at least 4 characters in length. Meter serial numbers are used to organize .cfx files in the PLC file system. It is important to use a correct (and unique) serial number for each meter.
1018	BAD BASE PRS	Error	The base pressure parameter on the associated station is unrealistic. Correct the base pressure parameter in the station configuration.
1019	BAD BASE TMPR	Error	The base temperature parameter on the associated station is unrealistic. Correct the base temperature parameter in the station configuration.
1020	MTR SN DUPLICT	Error	The meter Serial Number for this meter is the same as at least one other meter. Meter serial numbers must be unique – on any specific PLC.

## No Flow Indicated

Error Codes and Messages

0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR

*No Flow Indicated*

When the input value for the meter is below no flow cutoff threshold, this text will appear – as a warning/notification. Volume does not accumulate and input value averaging is suppressed during *no flow*.



## Gas Meter Screen – Cal Rpt Params

The gas meters screen contains several tabs. The **Cal Rpt Params** tab displays a set of static parameters which will be saved with a calibration or verification report. These fields are for documentation purposes only. They are not used for library calculations or CFX reporting. They are only used when a calibration or verification report is committed to memory.

*Entry of these values is optional. However, if you wish to configure these values for a calibration report, you must Commit the changes using the checkbox described below. If changes are not Committed, they will be lost when the PLC loses power.*

The screenshot shows the 'Gas Meter Configuration' interface. At the top, the title is 'Gas Meter Configuration'. Below it, 'Meter Description' is 'Gas Meter 1', and there is a green checkmark next to 'Enabled' and a green status indicator. A 'Back' button is on the right. Below this is a tabbed interface with tabs for 'Values', 'Main', 'Advanced', 'Ranges', 'Diagnostic', 'Cal Rpt Params' (selected), and 'Calibration'. The 'Cal Rpt Params' tab is active, showing a 'Meter Calibration Parameters' section with the following fields:

Producer Name	ABC Resources
Purchaser Name	XYZ Midstream Partners
Lease Name	State 18-12
Well / Facility Name	Central
Well / Facility Number	T8
DP Transducer Make/Model	N1289FGD
SP Transducer Make/Model	M87152KL
Tmp Transducer Make/Model	XY457

At the bottom of the form are two checkboxes:  Commit Changes and  Cancel / Refresh. The 'BeyondHMI' logo is in the bottom right corner.

### Gas Meter Screen – Cal Rpt Params Tab

#### Commit Changes

After making changes on this screen, check this box to signal the library to save your changes to persistent memory. ***If changes are not committed, they will be lost when the PLC is power-cycled.*** When the library has finished saving the changes, this box will be un-checked.

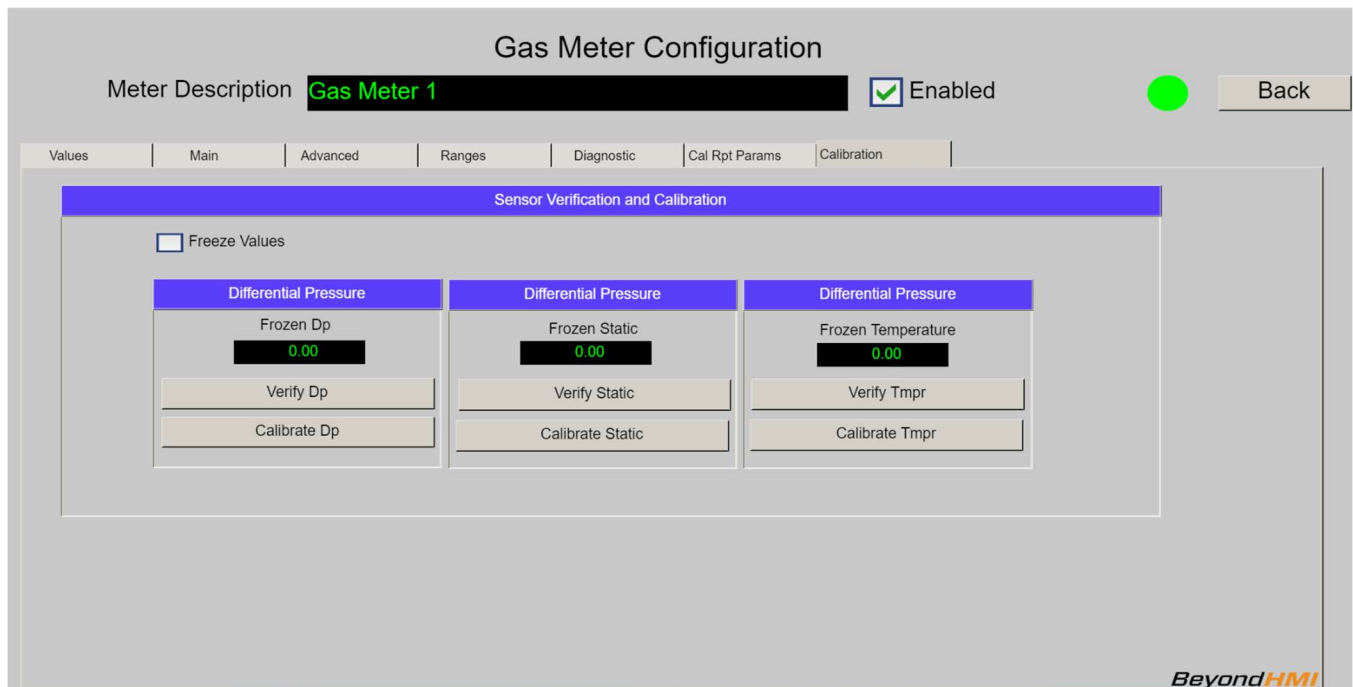
#### Cancel / Refresh

If you wish to cancel changes that you have made, check this box to signal the library to reload values from persistent memory. When the library has finished reloading the screen, this box will be un-checked.

## Gas Meter Screen - Calibration

The gas meters screen contains several tabs. The **Calibration** tab is used to initiate a calibration or a verification of one of the analog input signals.

*By default, all input signals are directly translated to process variables. If calibration is performed in the sensor and a digital interface is used to obtain values from the sensor, it is not necessary to calibrate signals in the BHI library. If calibration is performed in the BHI library, a transfer function will be applied to that signal until another calibration is performed on that signal.*



*Gas Meter Screen – Calibration Tab*

### Freeze Values Checkbox\*

Before calibrating or verifying, check this box to freeze all input signals. After calibration/verification, uncheck this box so the library uses live input values for flow calculations.

### Frozen Dp

This text box displays the frozen differential pressure value being used by the flow calculations.

### Frozen Static

This text box displays the frozen static pressure value being used by the flow calculations.



## **Frozen Tmpr**

This text box displays the frozen temperature value being used by the flow calculations.

## **Verify Dp Button**

Use this button to initiate a verification of the differential pressure signal.

## **Verify Static Button**

Use this button to initiate a verification of the static pressure signal.

## **Verify Tmpr Button**

Use this button to initiate a verification of the temperature signal.

## **Calibrate Dp Button**

Use this button to initiate a calibration of the differential pressure signal.

## **Calibrate Static Button**

Use this button to initiate a calibration of the static pressure signal.

## **Calibrate Tmpr Button**

Use this button to initiate a calibration of the temperature signal.

## Meter Verification Screen

The **Meter Verification** screen is displayed after you select one of the **Verify...** buttons from the **Calibration Tab** of the **Meter** screen. The screen supports up to 6 verification points.

*Meter signals should be set to the Frozen state before performing verifications.*

Meter Verification

	Action	Actual	Expected	Deviation	Deviation %
1		0.00	0.00	0.00	0.00
2		0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	0.00
4		0.00	0.00	0.00	0.00
5		0.00	0.00	0.00	0.00
6		0.00	0.00	0.00	0.00

Normal Value **0.00**

Tester Value **0.00**

Live Reading **0.00**

Deviation **0.00** **0.000** [%]

Meter Values Not Frozen

Log Verify Complete Verification

Cancel Verification

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### *Meter Verification Screen*

#### **Normal Value**

This is a “memo only” field for BLM calibration/verification reports. It is not used by the library – except to display on the verification report.

#### **Tester Value\***

Enter the reference value being applied to the signal.

#### **Log Verify Button\***

Use this button to signal that the verification point is ready to be saved for the verification report.

#### **Complete Verification Button\***

Use this button to signal that you have logged all verification points and you are ready to commit the verification to the database.

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*You must proceed through the Completion process to get the verification points saved to persistent memory – where they will be available for generating a verification report.*

## **Cancel Verification Button**

Use this button to cancel a verification.

*If you cancel a verification, all data related to that verification will be lost.*

## **Meter Values Not Frozen message**

This message will appear if you have not frozen the meter signals prior to attempting a verification. If you see this message, cancel the verification, freeze meter signals, and restart the verification process.

## **Meter Serial Number Not Set message**

This message will appear if you have not configured the meter serial number on the meter screen – main tab. If you see this message, cancel the verification, properly configure the meter, and restart the verification process.

## Meter Calibration Screen

The **Meter Calibration** screen is displayed after you select one of the **Calibrate...** buttons from the **Calibration Tab** of the **Meter** screen. The screen supports up to 6 verification points.

*Meter signals should be set to the Frozen state before performing calibrations.*

Meter Calibration

	Action	As Found	As Left	Deviation	Deviation %
1		0.00	0.00	0.00	0.00
2		0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	0.00
4		0.00	0.00	0.00	0.00
5		0.00	0.00	0.00	0.00
6		0.00	0.00	0.00	0.00

Normal Value

Tester Value

Live Reading

Deviation   [%]

Meter Values Not Frozen

**BeyondHMI**

### *Meter Calibration Screen*

#### **Normal Value**

This is a “memo only” field for BLM calibration/verification reports. It is not used by the library – except to display on the calibration report.

#### **Tester Value\***

Enter the reference value being applied to the signal.

#### **Set Zero Button\***

Use this button to signal that the current live reading and tester values are to be used as the low range calibration point.

#### **Set Span Button\***

Use this button to signal that the current live reading and tester values are to be used as the high range calibration point.

#### **Set Mid Button\***

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Use this button to signal that the current live reading and tester values are to be used as reference mid-points for the calibration.

## **Complete Calibration Button\***

Use this button to signal that you have logged all calibration points and you are ready to commit the calibration to the database.

*You must proceed through the Completion process to get the calibration points saved to persistent memory – where they will be used by the BHI library to scale input values and will be available for generating a calibration report.*

## **Cancel Calibration Button**

Use this button to cancel a calibration.

*If you cancel a calibration, all data related to that calibration will be lost.*

## **Meter Values Not Frozen message**

This message will appear if you have not frozen the meter signals prior to attempting a calibration. If you see this message, cancel the calibration, freeze meter signals, and restart the calibration process.

## **Meter Serial Number Not Set message**

This message will appear if you have not configured the meter serial number on the meter screen – main tab. If you see this message, cancel the calibration, properly configure the meter, and restart the calibration process.

## Verification and Calibration Report Description Screen

The **Verification and Calibration Report Description** screen is displayed after you select one of the **Complete...** buttons on either the **Meter Verification** or the **Meter Calibration** screens. The screen supports up to 6 verification points.

*The information entered on this screen is optional. However, you **MUST** select the **Commit button** to save your verification or calibration data to the database*

Verification and Calibration Report Description

**Tester**

Name: [Redacted] Affiliation: [Redacted]  
Remarks: [Redacted]

**Witness**

Name: [Redacted] Affiliation: [Redacted]  
Remarks: [Redacted]

**Validation Equipment**

Range: [Redacted]  
Last Calibration Date: [Redacted]

Prior Inspection Date/Time: [Redacted]  
Prior Inspection Condition: [Redacted]  
Prior Verification Date/Time: [Redacted] Prior Calibration Date/Time: [Redacted]

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### *Meter Calibration Screen*

#### **Commit Verification/Calibration Button\***

Use this button to signal that you are ready to commit the data to the database.

*You must proceed through the Completion process and Commit changes (even if you do not enter any data on this screen) to get the verification or calibration points saved to persistent memory.*

#### **Cancel Verification/Calibration Button**

Use this button to cancel a verification or calibration.

*If you cancel a verification or calibration, all related data will be discarded.*

## Gas Meter Current Day Periodic History Screen

The gas meter current day periodic history screen can be used to review API 21.1 periodic history for a gas meter for the current day.

Periodic Index	Start Timestamp	End Timestamp	Duration [sec]	Flow [sec]	DP/pulses	Static Prs	Tmpr	Extensn/Raw vol	CPPrime	Volume	Energy	Mass
23	01/19/2022 05:00:00	01/19/2022 06:00:00	3600	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
24	N/A	N/A	0	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
25	N/A	N/A	0	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
0	01/19/2022 06:00:00	01/19/2022 07:00:00	3600	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0

### Gas Current Day Periodic History Screen

The library maintains a buffer 25 periodic history records for each meter. Each periodic history record is meant to contain up to one hour of flow data. However, these history records are broken/changed any time a significant parameter change is made. So, the periodic history log may contain records including less than one hour of data.

The first periodic record for the meter is stored at periodic index zero. Subsequent periods are stored at indices with increasing numbers. The periodic history is not a circular buffer. This data is not overwritten until the previous days' worth of data has been archived to a cfx file.

For long term data retention, periodic history is copied to the .cfx files. A new cfx file is created at least once per day (after contract day change), or when a major configuration change is made to the meter or its station. Once periodic data is archived to a cfx file, the PLC program has no facilities for displaying that data.

The current day periodic history screen can be used to view portions of the current day's periodic history for a meter. Four records are displayed at one time. The user can navigate through the entire 25 record log using this screen – viewing 4 records at one time. The user can change position in the periodic history log by changing the **Index of First Record to Display** parameter on the screen. In the example above, the **Index of First Record to Display** parameter is set to zero. As a result, alarms zero through 3 are displayed. If the **Index of First Record to Display** parameter were changed to 5, for example, the screen would refresh – showing records 5, 6, and 7.

# BeyondHMI

The logic behind this screen can handle “rollover”. For example, if the **Index of First Record to Display** parameter were changed to 23, the screen would refresh and records 23, 24, 25, and zero would be displayed.

If you wish to view the 4 most recent periods, check the **Show Most Recent Periodic History** check box and the screen will refresh – displaying the 4 most recent records (the single most recent record will be at the bottom of the list).

The **Index of Record that program is currently populating** parameter reveals the current position of the periodic history logic – within the buffer.

## **Meter**

This combo box displays the description of the gas meter.

## **Show Most Recent Periodic History check box**

Check this box to force the screen to refresh – showing the most recent periodic history records in the log.

## **Index of First Record to Display**

Enter a number in this box (0 through 25) to cause the screen to update – showing periodic history records at a specific location within the buffer. The refreshed list will start with the periodic history record number you enter.

## **Index of Record that program is currently populating**

This read-only field displays the position where the library is currently accumulating flow information.

## **Periodic Index**

Displays the periodic index number (0-25).

## **Start Timestamp**

Displays the local timestamp at which the period began.

## **End Timestamp**

Displays the local timestamp at which the period ended.

## **Duration**

Displays the elapsed time between Start Timestamp and End Timestamp.

## **Flow Time**

Displays the amount of flowing time accumulated during the period.

## **DP/Pulses**



# BeyondHMI

For Orifice and cone meters, this field displays the flow time weighted average of the differential pressure during the period. For linear meters, this field displays the number of pulses accumulated during the period.

## **Static Pressure**

This field displays the flow time weighted average of the static pressure during the period.

## **Temperature**

This field displays the flow time weighted average of the temperature during the period.

## **Extensn/Raw Volume**

For Orifice and cone meters, this field displays the flow time weighted average of the calculation extension during the period. For linear meters, this field displays the raw volume accumulated during the period.

## **CPrime**

For Orifice and cone meters, this field displays the flow time weighted average CPrime during the period.

## **Volume**

This field displays the accumulated volume during the period.

## **Energy**

This field displays the accumulated energy during the period.

## **Mass**

This field displays the accumulated mass during the period.

## Oil Meter Screen – Custody Transfer (Custody Xfer)

The oil meters screen contains several tabs. The **Custody Xfer** tab displays live calculated results for the meter – when the meter is calculating for custody-transfer.

**Oil Meter Configuration**

Meter:  **Oil Leg**  Enabled

	Indicated Quantity	Indicated Vol [BPD]	Gross Vol [BPD]	Gross Std Vol [BPD]	Net Std Vol [BPD]	S&W Vol [BPD]	Gross Mass [lbm/d]
Flow Rate	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		[BBL]	[BBL]	[BBL]	[BBL]	[BBL]	[lbm]
Current Hour	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Last Hour	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Today	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yesterday	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Current Month	835	835	835	0	0	0	234396
Previous Month	0	0	0	0	0	0	0
Total	835	835	835	0	0	0	234396

Sp  Density  Temperature  S&W  Pulses  Rate

BeyondHMI

*Oil Meter Screen – Values Tab*

### Meter Combo Box\*

Use this combo box to select the liquid meter that you want to view.

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### Indicated Quantity

# BeyondHMI

Values in this column represent the raw meter values. These will be in either barrels or pounds – depending upon whether the meter is providing raw input related to volume or density.

## **Indicated Vol**

Values in this column represent raw meter values – in volume units. If the meter is reporting in volume units, these numbers will be identical to those in the indicated quantity column. The screen displays the relevant units of measure.

## **Gross Vol**

Values in this column represent the indicated volume adjusted for meter factor. The screen displays the relevant units of measure.

## **Gross Std**

Values in this column represent the gross volume – corrected for temperature and pressure. The screen displays the relevant units of measure.

## **Net Std Vol**

Values in this column represent the gross standard volume, minus the amount of S&W. The screen displays the relevant units of measure.

## **S&W Vol**

Values in this column represent the amount of S&W for the meter. The screen displays the relevant units of measure.

## **Gross Mass**

Values in this column represent the gross mass measured through the meter. The screen displays the relevant units of measure.

## **Flow Rate**

Values in this row represent the *ten-second averaged* calculated flow rate – as of the last successful calculation. The screen displays the relevant units of measure.

These values will update at ten-second intervals.

If the meter input is a flow rate (see **Meter Input is a Flow Rate**), these values will be based on the average of the input flow rates over the preceding ten-second period.

If the meter input is an accumulation (see **Meter Input is a Flow Rate**), these values will be based on differentiation of the meter accumulation over the preceding ten-second period.

## **Current Hour**

# BeyondHMI

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Last Hour**

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Today**

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Yesterday**

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Current Month**

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Previous Month**

Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Total**

Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.

## **Sp**

Displays the live static pressure being used by the library for oil correction factor calculations. This is the value used for both density pressure and meter pressure. It should be supplied to the library in psig.

## **Density**

# *Beyond*HMI

Displays the live density for the meter conditions. It should be supplied to the library in API gravity.

## **Temperature**

Displays the live temperature being used by the library for oil correction factor calculations. The screen displays the relevant units of measure. It should be supplied to the library in degrees F.

## **S&W**

Displays the live S&W content of the fluid. It should be supplied to the library in percent.

## **Pulses**

Displays the live raw accumulated pulse quantity used by the library for oil flow calculations – when the meter is providing accumulated pulses. If the input from the meter is in flow rate, this number will be zero.

## **Rate**

Displays the live raw flow rate used by the library for oil flow calculations. When the meter is providing a flow rate, this value is the flow rate from the meter. If the input from the meter is in accumulated pulses, this number is a pseudo-rate calculated by differentiating the change in input units over a ten-second.

## Oil Meter Screen - Main

The oil meters screen contains several tabs. The **Main** tab is used to configure most of the important meter parameters.

Oil Meter Configuration

Meter:    Enabled

Custody Xfer | **Main** | Advanced | Ranges | Diagnostic | Allocation | Cal Rpt Params | Calibration

**Meter Identity**

Meter Serial Nbr   
Flow Computer ID   
First Delivery Date   
CFX Product Code

**Meter Inputs**

Meter Type

Meter Input is in Mass  
 Meter Input is a Flow Rate  
 S&W from Standard Conditions

**Meter Identity**

Contract Hour

Allocation Measurement

BeyondHMI

### *Oil Meter Screen – Main Tab*

#### **Meter Combo Box\***

Use this combo box to select the liquid meter that you want to view.

#### **Meter Description Text Box\***

This text box is used to modify the common descriptive name of the currently-selected meter.

#### **Enabled\***

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

#### **Status Indicator**

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

#### **Meter Serial Number\***

# BeyondHMI

Use this field to specify the meter serial number. Meter serial numbers must be unique at each installation. Each meter on the PLC must have a unique serial number.

*Note: CFX files for the different meters are organized on the PLC file system by meter serial number. Therefore, it is important to configure this parameter correctly and – more importantly – to avoid changing it unless absolutely necessary. Meter serial numbers should not contain spaces.*

## **Flow Computer ID**

Specify the Flow Computer ID to associate with this station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **First Delivery Date**

Specify the first date of oil delivery through this meter. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **CFX Product Code\***

This product name is passed to FLOWCAL through the CFX file. It must match a product code already configured in the end-user's FLOWCAL system. The library defaults to a product code of "Crude Oil".

## **Meter Type**

Specify the type of primary element being used. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Meter Input is in Mass\***

The library will accept meter input in mass or volume. If the meter input is in volume, leave this box unchecked. If the meter input is in mass, check this box.

## **Meter Input is a Flow Rate\***

The library will accept meter input as a flow rate or as accumulated (totalizer) value. If the meter input is an accumulated volume or mass, leave this box unchecked. If the meter input is in volume or mass flow rate, check this box.

## **S&W from Standard Conditions check box\***

Indicates whether the value provided for S&W was derived at standard conditions – such as from a grind out (if checked) or the S&W is a "live" value - derived at/near meter temperature and pressure (if unchecked).

## **Contract Hour\***

Specify the hour when the contract day changes. The contract day will change at the beginning of the configured hour.

# *Beyond***HMI**

## **Allocation Measurement check box\***

Indicates whether the meter should calculate for an allocation meter using API 20.1 (if checked) or for a custody-transfer meter using API 12 (if unchecked).



## Oil Meter Screen - Advanced

The oil meters screen contains several tabs. The **Advanced** tab is used to configure additional meter parameters.

The screenshot displays the 'Oil Meter Configuration' interface with the 'Advanced' tab selected. At the top, a 'Meter:' dropdown menu is set to 'Oil Leg', with a text box containing 'Oil Leg' and a green status indicator. To the right, there is a checked 'Enabled' checkbox and a 'Back' button. Below this, a series of tabs are visible: Custody Xfer, Main, Advanced (selected), Ranges, Diagnostic, Allocation, Cal Rpt Params, and Calibration. The main configuration area is divided into several sections:

- Meter Signal:** Meter Factor (1.0000), K-Factor (10000.0000 [Pulses/BBL]), Pulse Source Roll Over (1000000). Checkboxes for 'Meter is Pressure Compensated' and 'Meter is Temperature Compensated' are present.
- Other Input Factors:** Density Factor (1.0000), Shrink Factor (1.0000), Flash Gas Factor (0.0000 [mscf / BBL]).
- Setpoints:** Low Flow Cutoff Setpoint (0.0), Backflow Cutoff Setpoint (0.0).
- Misc:** Max Data Retention (35 [Days]). Checkboxes for 'Force Day Rollover', 'Meter Has RTD', 'RTD is In Use', and 'Meter Temperature is Live'. A 'Power Source' dropdown menu is set to 'AC'.

The BeyondHMI logo is visible in the bottom right corner of the interface.

*Oil Meter Screen – Advanced Tab*

### Meter Combo Box\*

Use this combo box to select the liquid meter that you want to view.

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### Meter Factor\*

# BeyondHMI

Indicate the meter factor derived from meter proving. This field is used in calculation of gross volume.

## **K-Factor\***

Indicate the factor used to convert linear meter pulses to velocity or accumulation units. The K-factor entered in this field must be in either pulses per barrel or pulses per pound – depending upon how the **Meter Input is in Mass** parameter is set.

## **Pulse Source Rollover**

Enter the value at which the accumulator rolls over to zero. If the meter has an internal accumulator which is being used, enter the value at which the meter accumulator rolls over. If the meter is supplying pulses to a device or module which counts the pulses, enter the value at which this device or module rolls over. If the meter input is a flow rate, this field is not used. If the meter input is an accumulation, this value is used to detect and account for meter accumulator rollover.

## **Meter is Pressure Compensated**

Indicate whether the meter is pressure compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Meter is Temperature Compensated**

Indicate whether the meter is temperature compensated. This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Density Factor\***

Indicate the factor to apply to the input density – as derived during proving. This value is used in both custody-transfer and allocation calculations.

## **Shrink Factor\***

Indicate the shrinkage factor - as derived per API 20.1 - to apply to an allocation meter. The value in this field is ignored for custody-transfer calculations.

## **Flash Gas Factor\***

Indicate the flash gas factor (estimating the amount of gas that will flash out of a theoretical gross barrel of oil) - as derived per API 20.1 - to apply to an allocation meter. The value in this field is ignored for custody-transfer calculations.

## **Low Flow Cutoff Setpoint\***

Indicate the cutoff point to trigger no flow override. For oil meters, this threshold is applied to the indicated quantity flow rate (barrels per day or pounds per day).

# BeyondHMI

If the meter input is a flow rate (see **Meter Input is a Flow Rate**), this threshold is compared to the meter input flow rate. If the meter input is a rate below this setpoint, no volume will accumulate.

If the meter input is an accumulation (see **Meter Input is a Flow Rate**), this threshold is compared to the pseudo-rate calculated by the library (pulse change of a ten second period converted to a daily flow rate). If the meter pseudo-rate below this setpoint, no volume will accumulate.

## **Backflow Cutoff Setpoint**

Indicate the cutoff point to indicate backflow. For oil meters, this threshold is applied to the indicated quantity flow rate (barrels per day or pounds per day). This field is passed to FLOWCAL in the CFX file. It is not used by the current version of the flow computer library.

## **Max Data Retention\***

Indicate the number of days of data to save in the PLC file system. If this value is left less than 35 days for an enabled meter, the library will change it to 35. The value can be set larger than 35 days.

## **Force Day Rollover**

Check this box to trigger an immediate “rollover” of data for the current day into a CFX file. Should be used sparingly.

## **Meter Has RTD check box**

Indicates whether the meter is equipped with an RTD (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **RTD in use**

Indicates whether the meter RTD is being used to supply temperature values (usually true). This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature is Live**

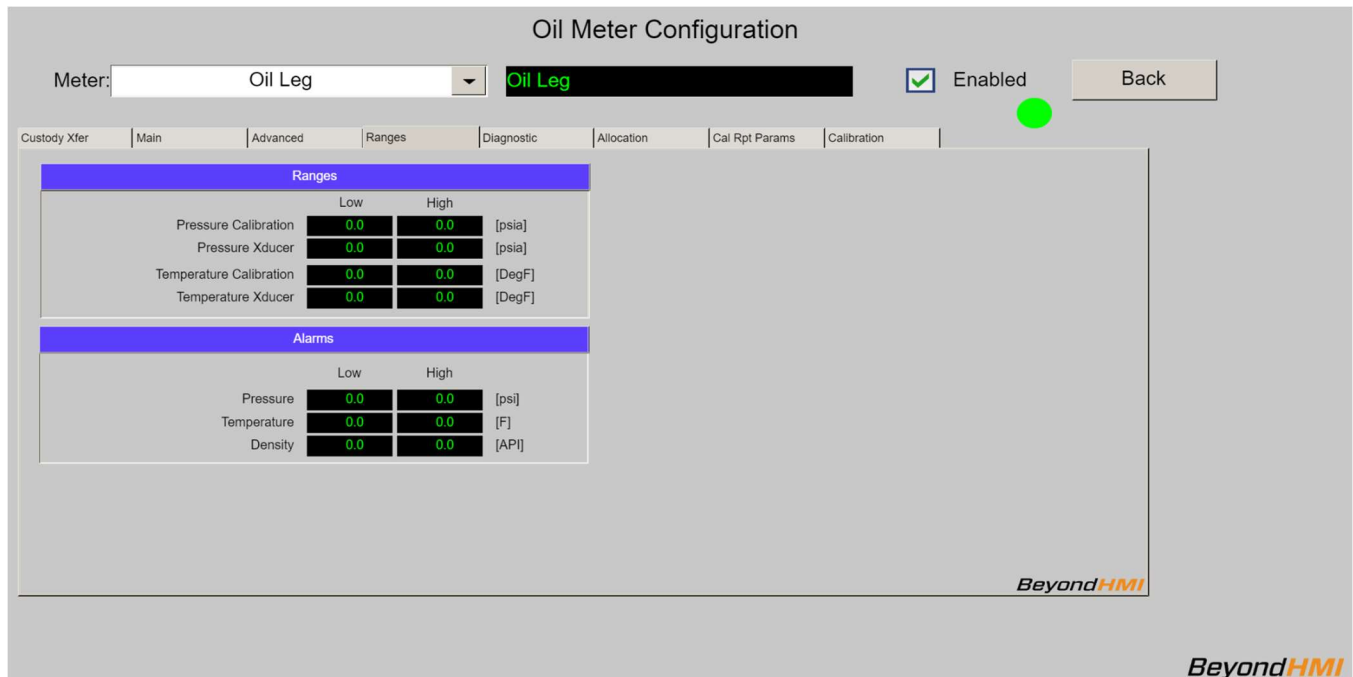
Indicates whether the temperature values are live (usually true). It is not used by the flow computer library.

## **Power Source Combo Box**

Use this combo box to specify the power source for the station. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## Oil Meter Screen - Ranges

The oil meters screen contains several tabs. The **Ranges** tab is used to configure parameters related to sensor ranges and alarm levels.



*Oil Meter Screen – Ranges Tab*

### **Meter Combo Box\***

Use this combo box to select the liquid meter that you want to view.

### **Meter Description Text Box\***

This text box is used to modify the common descriptive name of the currently-selected meter.

### **Enabled\***

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### **Status Indicator**



Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### **Pressure Calibration Ranges**

Enter the low and high ranges for calibration of the meter's static pressure signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Pressure Xducer Ranges**

Enter the low and high ranges for absolute ranges of the meter's static pressure sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature Calibration Ranges**

Enter the low and high ranges for calibration of the meter's temperature signal – if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Temperature Xducer Ranges**

Enter the low and high ranges for absolute ranges of the meter's temperature sensor - if applicable. Applies to most meter types. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## **Pressure Alarms\***

Enter the low and high alarm levels for the static pressure signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs. The static pressure alarm uses the calculation static pressure [in psia] as the basis for triggering alarms. If the meter's **Static Pressure Measurement Type** is set to **gauge**, then the static pressure alarm logic will reference the static pressure value provided by the PLC program *plus* atmospheric pressure.

## **Temperature Alarms\***

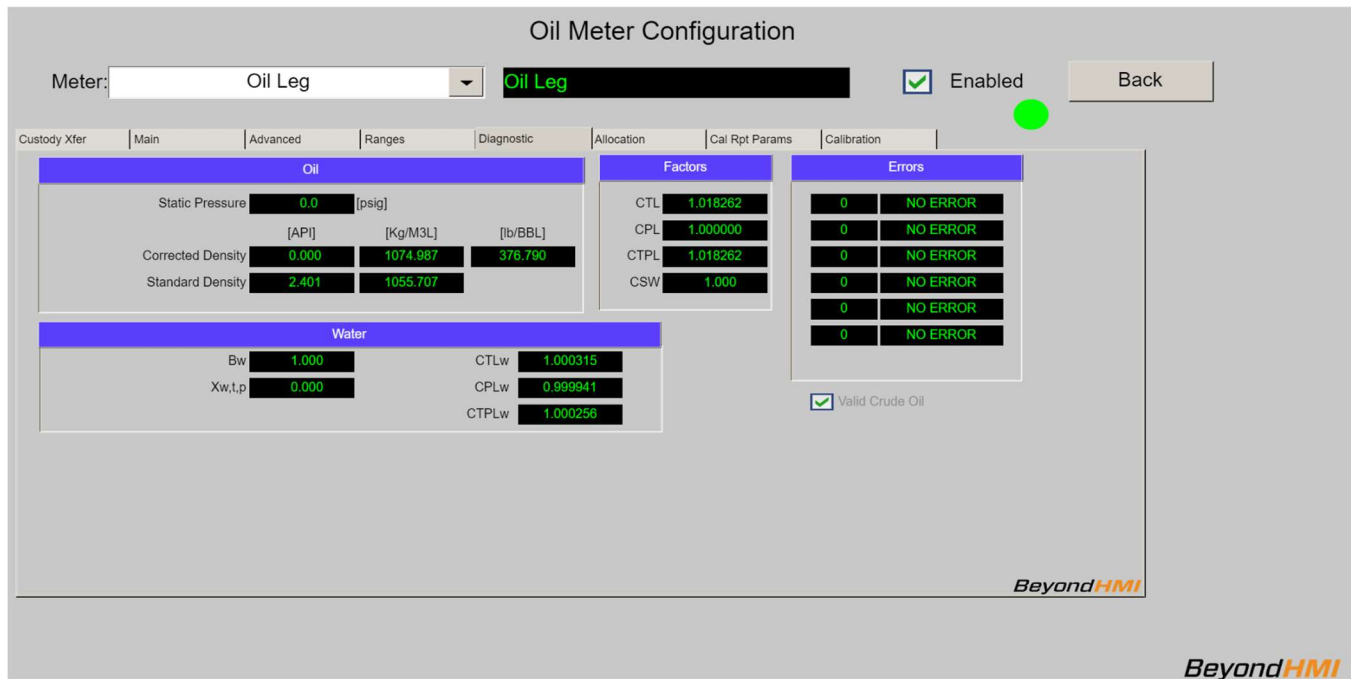
Enter the low and high alarm levels for the temperature signal. These values are used to trigger alarm events in the flow computer's API 21.1 alarm logs.

## **Density Alarms**

Enter the low and high alarm levels for the density signal. This field is passed to FLOWCAL in the CFX file. It is not used by the flow computer library.

## Oil Meter Screen - Diagnostic

The oil meters screen contains several tabs. The **Diagnostic** tab displays live diagnostic and internal calculation values from the library.



*Oil Meter Screen – Diagnostic Tab*

### Meter Combo Box\*

Use this combo box to select the liquid meter that you want to view.

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### Static Pressure

Displays the static pressure value being used by the library for oil flow calculations.

## **Corrected Density**

Displays the input density value – with the density factor applied – in multiple units of measure.

## **Standard Density**

Displays the library-calculated standard density of the oil.

## **CTL**

Displays the library-calculated API 11.1 correction for temperature of the oil.

## **CPL**

Displays the library-calculated API 11.1 correction for pressure of the oil.

## **CTPL**

Displays the combined CTL and CPL

## **CSW**

Displays the library-calculated correction for sediments and water.

## **Bw**

Displays the library-calculated correction factor for allocation meter water.

## **Xw,t,p**

Displays the corrected (for pressure and temperature) water cut as a fraction. If the **S&W from Standard Conditions check box** is NOT checked, this value will be the same as the input S&W percentage – scaled to a fraction. If the **S&W from Standard Conditions check box** IS checked, this value will be the adjusted form of the input S&W percentage – scaled to a fraction. The value will be corrected to account for changes in volume of the water and the mixture from standard conditions to meter pressure and temperature.

## **CTLw**

Displays the library-calculated API 11.1 correction for temperature of the water.

## **CPLw**

Displays the library-calculated API 11.1 correction for pressure of the water.

## **CTPLw**

Displays the combined CTLw and CPLw

## **Valid Crude Oil**

# BeyondHMI

Displays a check when the oil API gravity provided to the library is within the valid range for crude oil – as defined by API 11.1. The valid range is -10 to 100 degrees API.

## Error Codes and Messages

The library reports up to five Errors/Warnings for each meter. If more than five Errors/Warnings exist, only five will be displayed. Each Error/Warning is represented by a code number and a short text message. The table below provides further details for each Error/Warning. Note that Errors must be corrected before calculations can resume for the meter, whereas Warnings are only for informational purposes.

Code	Text	Error or Warning	Description and Suggestions
0	NO ERROR		Meter is functioning without errors or warnings
1021	CONVERGE FAIL	Error	The API 11.1 density calculation failed to converge. Contact Beyond HMI.
1022	OIL CTPL FAIL	Error	The oil correction factor calculations failed. Check that all oil properties and pressure and temperature are realistic.
1023	WTR CTPL FAIL	Error	The water correction factor calculations failed. Check that all S&W percent and pressure and temperature are realistic.
1024	BAD S&W PCNT	Error	The corrected S&W fraction is less than 0.0 or greater than 1.0. Check that all S&W percent and pressure and temperature are realistic.

## No Flow Indicated

Error Codes and Messages

0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR
0	NO ERROR

*No Flow Indicated*

When the input value for the meter is below no flow cutoff threshold, this text will appear – as a warning/notification. See **Low Flow Cutoff Setpoint** for more information about library behavior in this state.



## Oil Meter Screen - Allocation

The oil meters screen contains several tabs. The **Allocation** tab displays calculation results when the library is calculating for an allocation meter.

**Oil Meter Configuration**

Meter:  **Oil Leg**  Enabled

Custody Xfer | Main | Advanced | Ranges | Diagnostic | Allocation | Cal Rpt Params | Calibration

	Indicated Quantity	Indicated Vol [BPD]	Gross Vol [BPD]	GTOV Vol [BPD]	NTOV Vol [BPD]	GTWV Vol [BPD]	Flas Gas Vol [mscfd]				
Flow Rate	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
	[BBL]	[BBL]	[BBL]	[BBL]	[BBL]	[BBL]	[mscf]				
Current Hour	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Last Hour	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Today	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Yesterday	143.8	143.8	143.8	140.9	138.7	2.8	0.0				
Current Month	835	835	835	818	800	16	0				
Previous Month	0	0	0	0	0	0	0				
Total	835	835	835	818	800	16	0				
Sp	0.00	Density	0.000	Temperature	0.00	S&W	0.00	Pulses	0.0	Rate	0.000

BeyondHMI

*Oil Meter Screen – Allocation Tab*

### Meter Combo Box\*

Use this combo box to select the liquid meter that you want to view.

### Meter Description Text Box\*

This text box is used to modify the common descriptive name of the currently-selected meter.

### Enabled\*

Use this check box to enable/disable the meter. Disabled meters are ignored by the library.

### Status Indicator

Displays the configuration status of the meter. When the meter is enabled, the library internally verifies the configuration. If the configuration is correct, the indicator will be green. If the indicator is orange, see the Diagnostic tab for details about identified configuration issues. Note that some of the indicated issues are only warnings.

### Indicated Quantity

# BeyondHMI

Values in this column represent the raw meter values. These will be in either barrels or pounds – depending upon whether the meter is providing raw input related to volume or density.

## **Indicated Vol**

Values in this column represent raw meter values – in volume units. If the meter is reporting in volume units, these numbers will be identical to those in the indicated quantity column. The screen displays the relevant units of measure.

## **Gross Vol**

Values in this column represent the indicated volume adjusted for meter factor. The screen displays the relevant units of measure.

## **GTOV Vol**

Values in this column represent the gross theoretical oil volume – the stabilized stock tank liquid equivalent volume. The screen displays the relevant units of measure.

## **NTOV Vol**

Values in this column represent the net theoretical oil volume – the stabilized stock tank oil equivalent volume. The screen displays the relevant units of measure.

## **GTWV Vol**

Values in this column represent the gross theoretical water volume – the stabilized stock tank wall equivalent volume. The screen displays the relevant units of measure.

## **Flash Gas Vol**

Values in this column represent the estimated gas volume that will flash out of the measured oil as the product moves downstream and stabilizes. The screen displays the relevant units of measure.

## **Flow Rate**

Values in this row represent instantaneous flow rate – as of the last successful calculation. The screen displays the relevant units of measure.

## **Current Hour**

Values in this row represent the accumulated quantity for the current hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Last Hour**

# BeyondHMI

Values in this row represent the accumulated quantity for the previous hour. An hourly period is initiated when the PLC clock indicates a change of hour. The screen displays the relevant units of measure.

## **Today**

Values in this row represent the accumulated quantity for the current contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Yesterday**

Values in this row represent the accumulated quantity for the previous contract day. The hour at which the contract day changes is configurable – by station. The contract day changes at the *beginning* of the configured hour. The screen displays the relevant units of measure.

## **Current Month**

Values in this row represent the accumulated quantity for the current contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Previous Month**

Values in this row represent the accumulated quantity for the previous contract month. The contract month changes on the first day of each calendar month - at the *beginning* of the configured contract hour. The screen displays the relevant units of measure.

## **Total**

Values in this row represent the accumulated quantity for the lifetime of the flow computer installation. This value is not resettable by supported features. The screen displays the relevant units of measure.

## **Sp**

Displays the live static pressure being used by the library for oil correction factor calculations. This is the value used for both density pressure and meter pressure. It should be supplied to the library in psig.

## **Density**

Displays the live density for the meter conditions. It should be supplied to the library in API gravity.

## **Temperature**

# BeyondHMI

Displays the live temperature being used by the library for oil correction factor calculations. The screen displays the relevant units of measure. It should be supplied to the library in degrees F.

## **S&W**

Displays the live S&W content of the fluid. It should be supplied to the library in percent.

## **Pulses**

Displays the live raw accumulated pulse quantity used by the library for oil flow calculations – when the meter is providing accumulated pulses. If the input from the meter is in flow rate, this number will be zero.

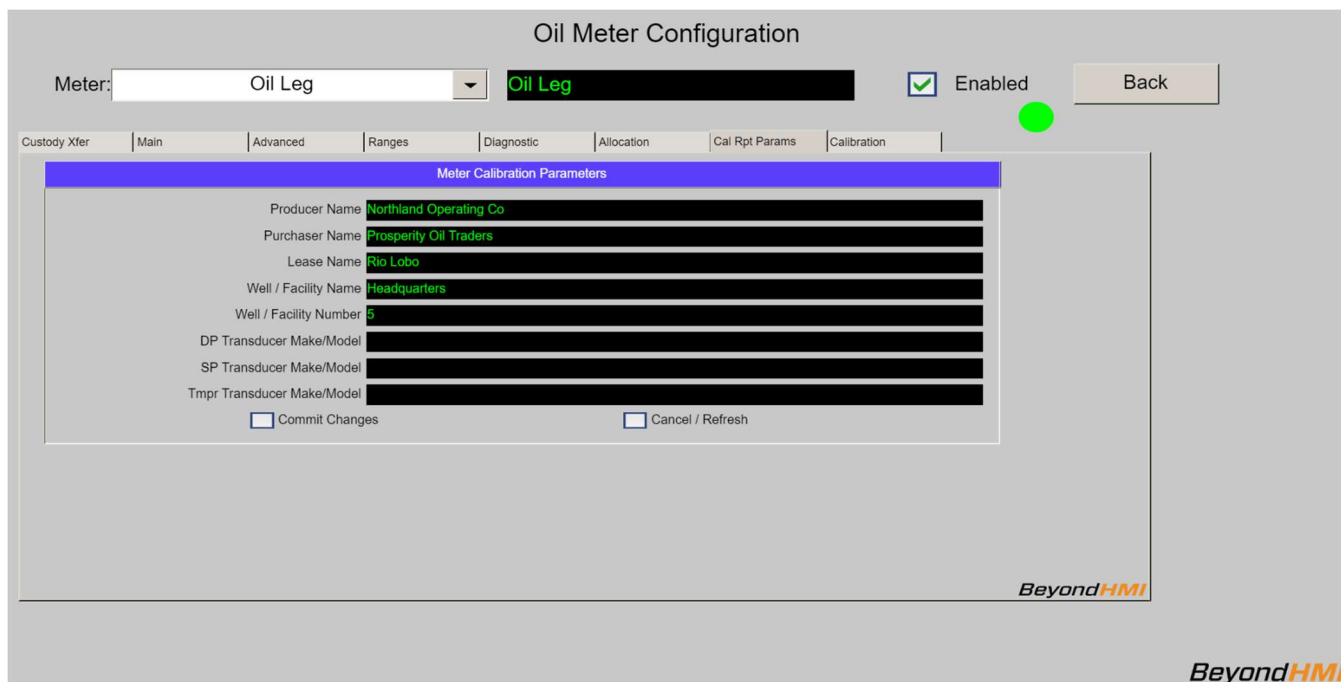
## **Rate**

Displays the live raw flow rate used by the library for oil flow calculations – when the meter is providing a flow rate. If the input from the meter is in accumulated pulses, this number will be zero.

## **Oil Meter Screen – Cal Rpt Params**

The oil meters screen contains several tabs. The **Cal Rpt Params** tab displays a set of static parameters which will be saved with a calibration or verification report. These fields are for documentation purposes only. They are not used for library calculations or CFX reporting. They are only used when a calibration or verification report is committed to memory.

*Entry of these values is optional. However, if you wish to configure these values for a calibration report, you must Commit the changes using the checkbox described below. If changes are not Committed, they will be lost when the PLC loses power.*



*Oil Meter Screen – Cal Rpt Params Tab*

## Commit Changes

After making changes on this screen, check this box to signal the library to save your changes to persistent memory. ***If changes are not committed, they will be lost when the PLC is power-cycled.*** When the library has finished saving the changes, this box will be un-checked.

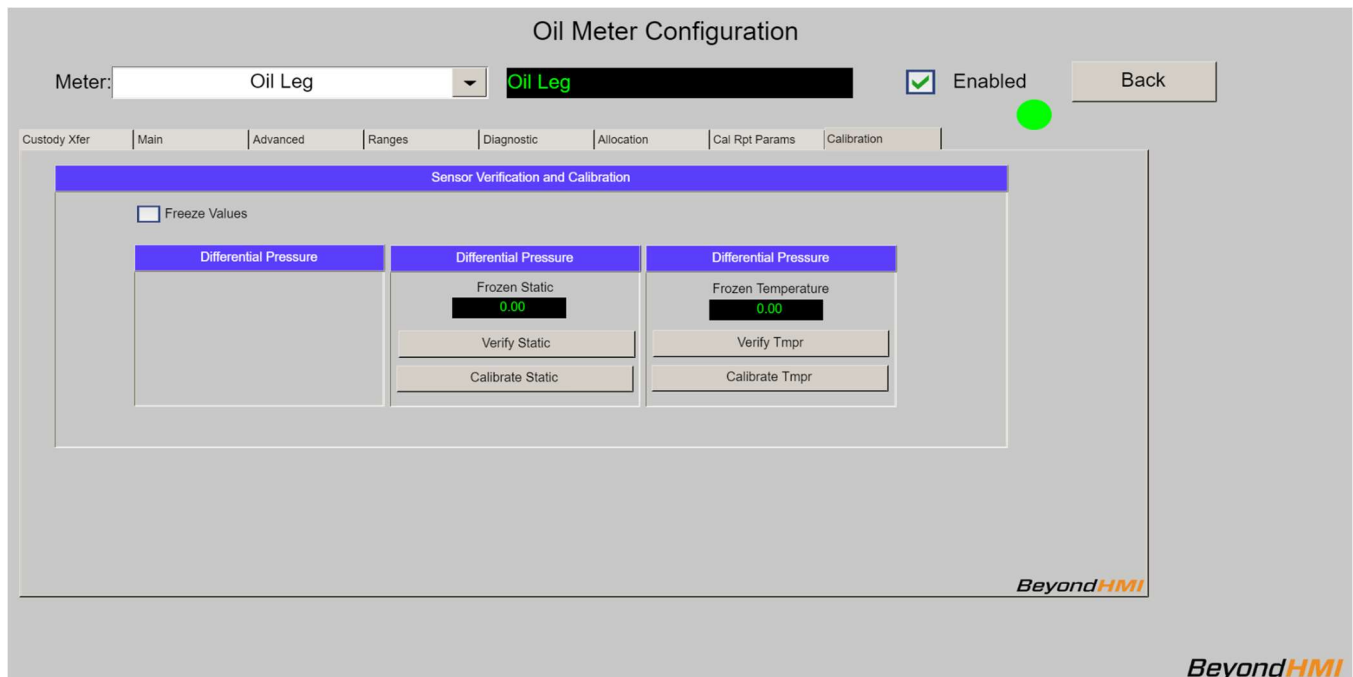
## Cancel / Refresh

If you wish to cancel changes that you have made, check this box to signal the library to reload values from persistent memory. When the library has finished reloading the screen, this box will be un-checked.

## Oil Meter Screen - Calibration

The oil meters screen contains several tabs. The **Calibration** tab is used to initiate a calibration or a verification of one of the analog input signals.

*By default, all input signals are directly translated to process variables. If calibration is performed in the sensor and a digital interface is used to obtain values from the sensor, it is not necessary to calibrate signals in the BHI library. If calibration is performed in the BHI library, a transfer function will be applied to that signal until another calibration is performed on that signal.*



*Oil Meter Screen – Calibration Tab*

### **Freeze Values Checkbox\***

Before calibrating or verifying, check this box to freeze all input signals. After calibration/verification, uncheck this box so the library uses live input values for flow calculations.

### **Frozen Dp**

This text box displays the frozen differential pressure value being used by the flow calculations.

### **Frozen Static**

This text box displays the frozen static pressure value being used by the flow calculations.

### **Frozen Tmpr**

# *Beyond***HMI**

This text box displays the frozen temperature value being used by the flow calculations.

## **Verify Dp Button**

Use this button to initiate a verification of the differential pressure signal.

## **Verify Static Button**

Use this button to initiate a verification of the static pressure signal.

## **Verify Tmpr Button**

Use this button to initiate a verification of the temperature signal.

## **Calibrate Dp Button**

Use this button to initiate a calibration of the differential pressure signal.

## **Calibrate Static Button**

Use this button to initiate a calibration of the static pressure signal.

## **Calibrate Tmpr Button**

Use this button to initiate a calibration of the temperature signal.

## Oil Meter Current Day Periodic History Screen

The oil meter current day periodic history screen can be used to review API 21.1 periodic history for an oil meter for the current day.

Current Day Periodic Oil History

Meter: Water Leg  Show Most Recent Periodic History Back

Index of First Record to Display: 25 Index of Current Active Record: 0

Periodic Index	Start Timestamp	End Timestamp	Flow		S&W		Pulses	IndVol	GVol	NSV	S&W	GTOV	NTOV	GTWW	FlashG
			[sec]	Tmpr	[%]										
25	N/A	N/A	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000	0.00000	0.00000
0	/19/2022 08:16:2	/19/2022 08:19:0	151	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000	0.00000	0.00000
1	/19/2022 07:00:0	/19/2022 08:00:0	3600	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000	0.00000	0.00000
2	/19/2022 08:00:0	/19/2022 08:16:2	976	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00000	0.00000	0.00000	0.00000

BeyondHMI

### Oil Current Day Periodic History Screen

The library maintains a buffer 25 periodic history records for each meter. Each periodic history record is meant to contain up to one hour of flow data. However, these history records are broken/changed any time a significant parameter change is made. So, the periodic history log may contain records including less than one hour of data.

The first periodic record for the meter is stored at periodic index zero. Subsequent periods are stored at indices with increasing numbers. The periodic history is not a circular buffer. This data is not overwritten until the previous days' worth of data has been archived to a cfx file.

For long term data retention, periodic history is copied to the .cfx files. A new cfx file is created at least once per day (after contract day change), or when a major configuration change is made to the meter or its station. Once periodic data is archived to a cfx file, the PLC program has no facilities for displaying that data.

The current day periodic history screen can be used to view portions of the current day's periodic history for a meter. Four records are displayed at one time. The user can navigate through the entire 25 record log using this screen – viewing 4 records at one time. The user can change position in the periodic history log by changing the **Index of First Record to Display** parameter on the screen. In the example above, the **Index of First Record to Display** parameter is set to zero. As a result, alarms zero through 3 are displayed. If the **Index of First Record to**



# BeyondHMI

**Display** parameter were changed to 5, for example, the screen would refresh – showing records 5,6, and 7.

The logic behind this screen can handle “rollover”. For example, if the **Index of First Record to Display** parameter were changed to 23, the screen would refresh and records 23, 24, 25, and zero would be displayed.

If you wish to view the 4 most recent periods, check the **Show Most Recent Periodic History** check box and the screen will refresh – displaying the 4 most recent records (the single most recent record will be at the bottom of the list).

The **Index of Record that program is currently populating** parameter reveals the current position of the periodic history logic – within the buffer.

## **Meter**

Use this combo box to display the meter you want to monitor.

## **Show Most Recent Periodic History check box**

Check this box to force the screen to refresh – showing the most recent periodic history records in the log.

## **Index of First Record to Display**

Enter a number in this box (0 through 25) to cause the screen to update – showing periodic history records at a specific location within the buffer. The refreshed list will start with the periodic history record number you enter.

## **Index of Record that program is currently populating**

This read-only field displays the position where the library is currently accumulating flow information.

## **Periodic Index**

Displays the periodic index number (0-25).

## **Start Timestamp**

Displays the local timestamp at which the period began.

## **End Timestamp**

Displays the local timestamp at which the period ended.

## **Flow Time**

Displays the amount of flowing time accumulated during the period.

## **Tmpr**

This field displays the indicated-volume-average of the temperature during the period.

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## **S&W %**

This field displays the indicated-volume-average of the sediments and water percentage during the period.

## **Pulses**

This field displays the pulses accumulated during the period.

## **IndVol**

This field displays the indicated volume accumulated during the period.

## **GVol**

This field displays the gross volume accumulated during the period.

## **NSV**

This field displays the net standard volume accumulated during the period.

## **S&W**

This field displays the sediments and water volume accumulated during the period.

## **GTOV**

This field displays the gross theoretical oil volume accumulated during the period.

## **NTOV**

This field displays the net theoretical oil volume accumulated during the period.

## **GTWV**

This field displays the gross theoretical water volume accumulated during the period.

## **FlashG**

This field displays the gross flash gas volume accumulated during the period.

## **Event Screen**

The event screen can be used to review API 21.1 events for an oil or gas meter.

## Meter Events

Meter  Back

Show Most Recent Events

Index of First Event to Display **247**      Index of Next Event that program will Populate **30**

Event Index	Timestamp	Table	Item	Old Value	New Value
247	N/A	0	0	N/A	N/A
248	N/A	0	0	N/A	N/A
249	N/A	0	0	N/A	N/A
250	N/A	0	0	N/A	N/A
251	N/A	0	0	N/A	N/A
252	N/A	0	0	N/A	N/A
253	N/A	0	0	N/A	N/A
254	N/A	0	0	N/A	N/A
255	N/A	0	0	N/A	N/A

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### Events Screen

The library maintains a circular buffer 256 events for each meter. The first event is stored at event index zero. Subsequent events are stored at indices with increasing numbers. When event 255 has been populated and another event needs to be logged, event index zero is overwritten.

For long term data retention, events are copied to the .cfx files each time a .cfx file is created. This file creation occurs at least once per day (after contract day change), or when a major configuration change is made to the meter or its station.

The event screen can be used to view portions of the event log for a meter. Ten events are displayed at one time. The user can navigate through the entire 256 event log using this screen – viewing 10 events at one time. The user can change position in the event log by changing the **Index of First Event to Display** parameter on the screen. In the example above, the **Index of First Event to Display** parameter is set to zero. As a result, events zero through 9 are displayed. If the **Index of First Event to Display** parameter were changed to 55, for example, the screen would refresh – showing events 55 through 64.

The logic behind this screen can handle “rollover”. For example, if the **Index of First Event to Display** parameter were changed to 250, the screen would refresh and events 250 through 255 followed by events zero through 3 would be displayed.

If you wish to view the 10 most recent events, check the **Show Most Recent Events** check box and the screen will refresh – displaying the 10 most recent events (the single most recent event will be at the bottom of the list).

The **Index of Next Event that program will Populate** parameter reveals the current position of the Event logic – within the circular buffer.

## **Meter Combo Box**

This combo box is used to specify which meter you wish to view.

## **Show Most Recent Events check box**

Check this box to force the screen to refresh – showing the most recent events in the log.

## **Index of First Event to Display**

Enter a number in this box (0 through 255) to cause the screen to update – showing events at a specific location within the circular buffer. The refreshed list will start with the event number you enter.

## **Index of Next Event that program will Populate**

This read-only field displays the position where the next event will be logged.

## **Event Index**

Displays the event index number (0-255).

## **Timestamp**

Displays the local timestamp at which the event was recorded.

## **Table and Item**

The combination of Table and Item represent a specific parameter. This combination indicates which parameter was changed. The Table/Item combinations are defined by Quorum Software and are part of the CFX file specification. This specification is subject to a Nondisclosure Agreement. Therefore, it cannot be reproduced here. For more information, contact Quorum Software.

## **Old Value and New Value**

These represent the *Before* and *After* values of the parameter which was changed.

## Alarms Screen

The alarms screen can be used to review API 21.1 alarms for a meter.

Meter Alarms

Meter: Gas Meter Back

Show Most Recent Alarms

Index of First Alarm to Display: 54      Index of Next Alarm that program will Populate: 4

Alarm Index	Timestamp	AlarmCode	New State	Value
54	N/A	N/A	N/A	0.0
55	N/A	N/A	N/A	0.0
56	N/A	N/A	N/A	0.0
57	N/A	N/A	N/A	0.0
58	N/A	N/A	N/A	0.0
59	N/A	N/A	N/A	0.0
60	N/A	N/A	N/A	0.0
61	N/A	N/A	N/A	0.0
62	N/A	N/A	N/A	0.0
63	N/A	N/A	N/A	0.0

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### Alarms Screen

The library maintains a circular buffer 64 alarms for each meter. The first alarm is stored at alarm index zero. Subsequent alarms are stored at indices with increasing numbers. When event 63 has been populated and another alarm needs to be logged, alarm index zero is overwritten.

For long term data retention, alarms are copied to the .cfx files each time a .cfx file is created. This file creation occurs at least once per day (after contract day change), or when a major configuration change is made to the meter or its station.

The alarm screen can be used to view portions of the alarm log for a meter. Ten alarms are displayed at one time. The user can navigate through the entire 64 alarm log using this screen – viewing 10 alarms at one time. The user can change position in the alarm log by changing the **Index of First Alarm to Display** parameter on the screen. In the example above, the **Index of First Alarm to Display** parameter is set to zero. As a result, alarms zero through 9 are displayed. If the **Index of First Alarm to Display** parameter were changed to 25, for example, the screen would refresh – showing alarms 25 through 34.

The logic behind this screen can handle “rollover”. For example, if the **Index of First Alarm to Display** parameter were changed to 60, the screen would refresh and alarms 60 through 63 followed by alarms zero through 5 would be displayed.

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If you wish to view the 10 most recent alarms, check the **Show Most Recent Alarms** check box and the screen will refresh – displaying the 10 most recent alarms (the single most recent alarm will be at the bottom of the list).

The **Index of Next Alarm that program will Populate** parameter reveals the current position of the Alarm logic – within the circular buffer.

## **Meter Combo Box**

This combo box is used to specify which meter you wish to view.

## **Show Most Recent Alarm check box**

Check this box to force the screen to refresh – showing the most recent alarms in the log.

## **Index of First Alarm to Display**

Enter a number in this box (0 through 63) to cause the screen to update – showing alarms at a specific location within the circular buffer. The refreshed list will start with the alarm number you enter.

## **Index of Next Alarm that program will Populate**

This read-only field displays the position where the next alarm will be logged.

## **Alarm Index**

Displays the alarm index number (0-63).

## **Timestamp**

Displays the local timestamp at which the alarm was set or cleared.

## **Alarm Code**

Indicates which alarm is involved:

- Diff Prs
- Static Prs
- Tempr
- Low Flow
- Back Flow
- Low Btry

## **New State**

Indicates the state change which triggered the alarm:

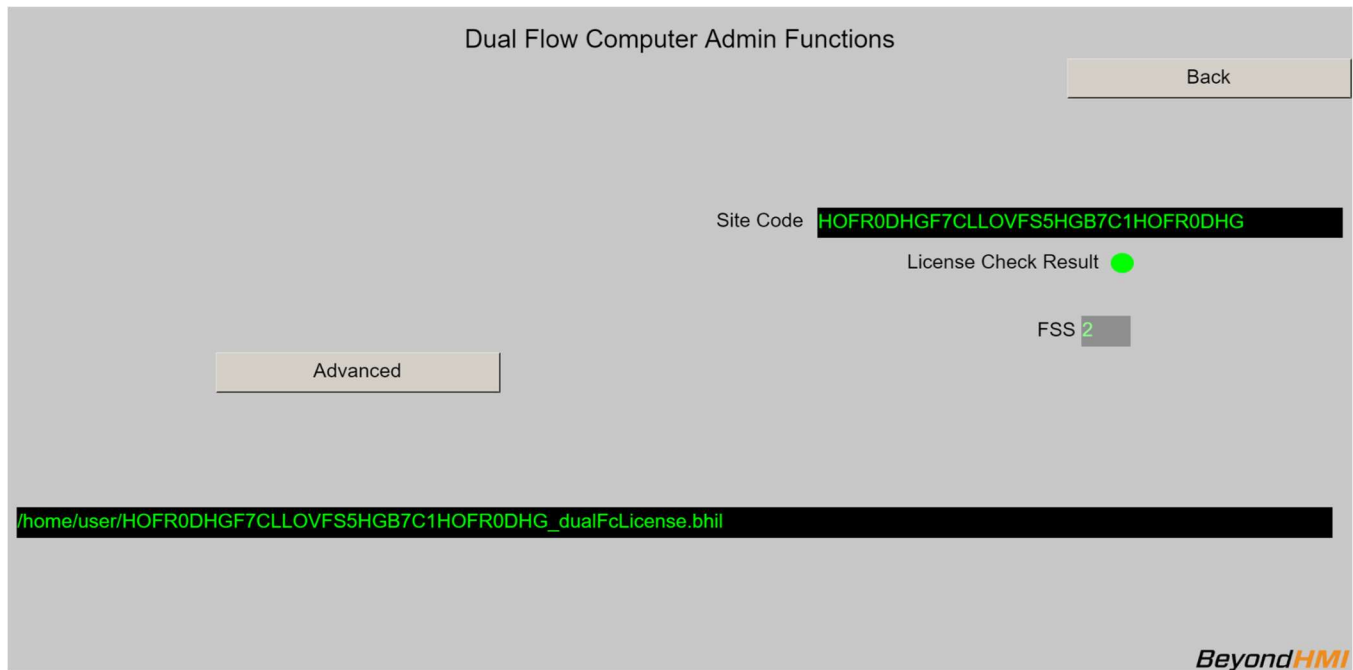
- Off
- On
- High
- Low

## Value

Indicates the value of the relevant parameter at the time of the state change.

## Admin Screen

The admin screen exposes features related to runtime licensing of the BhiLibDualFc library. It also provides links to the screens where library configurations can be saved to file and/or loaded from file.



### *Admin Screen*

*Note: The BhiLibDualFc library utilizes runtime licensing. It must be licensed on every PLC where it runs. Licenses are obtained from beyond HMI, Inc.*

The library reads parameters from the PLC which are unique to each PLC specimen. From these parameters, the library generates a Site Code. This represents a unique identifier for the PLC. The license key is unique to the PLC processor. It is not influenced by installed I/O modules or firmware version.

### **Site Code**

A unique identifier for the PLC specimen. Use this to request a runtime license.

### **License Check Result**

If this indicator is green, then a valid license has been detected. If not green, then the program is either running in *trial* mode or is disabled – awaiting a license.

For more information about runtime licensing of the BhiLibDualFc library, see the *Licensing* section of this document.

## FSS

Displays a value used for advanced troubleshooting. Under normal circumstances, the value displayed here will be changing rapidly.

## License File Name

The text box at the bottom displays the location of the license file required to enable the library.

## Advanced Admin Screen

The Advanced Admin screen exposes functions for PLC program maintenance. Please use caution when using the functions on this screen.

Dual Flow Computer Advanced Admin Functions

Back

DO NOT USE THESE FUNCTIONS UNLESS YOU HAVE FAMILIARIZED YOURSELF WITH THE CONSEQUENCES

Save Maintenance File

Save Maintenance File

Restore Maintenance File

Restore Gas Meter Configuration

Restore First Oil Meter Configuration

Restore Second Oil Meter Configuration

Restore Accums, Events, Alarms

Force Maintenance Recovery

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### *Advanced Admin Screen*

When the Host PLC program needs to be changed, there is potential for loss of accumulator data that the Flow computer library uses. To prevent this loss, a special sequence of events must be followed when changing the host PLC program. The procedure is as follows:

*Note: The following steps must be executed in order. Please read and study the entire procedure list before beginning PLC program maintenance.*

### **Stop physical flow**

In order to prevent loss of accumulated flow, all processes for all meters must be shut-in to prevent flow while the PLC program is being maintained.

Failure to follow this step may result in lost flow accumulation.



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## Save the library configuration to file

### Save a maintenance file

Check the **Save Maintenance File** checkbox on the Advanced Admin screen. Wait for the checkbox to be unchecked. This indicates that a maintenance file has been saved to the PLC file system.

*Note: The process of saving the maintenance file will take 3 to 4 minutes. Be patient. Do not proceed until the box is unchecked by the PLC.*

### Perform PLC program maintenance

At this point, you are free to make changes to the PLC program and load those changes onto the PLC.

### Select options for Recovering various features

When reloading the configuration into the PLC, you have options to load partial configuration or all parameters – including historical flow. Use the check boxes to specify which parameters to restore.

### Force Maintenance Recovery

Check the **Force Maintenance Recovery** checkbox on the Advanced Admin screen. Wait for the checkbox to be unchecked. This indicates that meter accumulators have been recovered from the maintenance file.

*Note: The process of recovering from a maintenance file will take 3 to 4 minutes. Be patient. Do not proceed until the box is unchecked by the PLC.*

### Resume physical flow

At this point, process flow can be resumed without loss of accumulated volume.

## Licensing

The BhiLibDualFc library utilizes runtime licensing. Each PLC upon which it runs must have a license. Licenses are obtained from Beyond HMI, Inc.

### Trial Mode

Upon startup, the library will run in trial mode for approximately 4 days. While in trial mode, the library is fully functional. After the 4 day period passes – and if no license is installed - the library will stop calculating flow.

If the PLC program is stopped and restarted, the 4 day trial period begins again. Therefore, PLC program developers should be able to develop and test programs without needing a license for their development PLCs.

### Steps to Obtain a Runtime License

To fully license the BhiLibDualFc library on a PLC, the following steps must be executed:

- Include library features in a PLC program (*reference other instructions in the DFC\_DG\_yyyy\_mm\_dd document available from Beyond HMI*)
- Install the PLC program on the target PLC specimen
- Open the library's Admin screen and capture the Site Code
- Transmit the site code to Beyond HMI, Inc. and provide payment information
  - Please use [info@beyond-hmi.com](mailto:info@beyond-hmi.com) to initiate contact with us.
- Wait for Beyond HMI, Inc. to return a license file
- Use the free BLT software to log into the PLC as 'root' and install the license file on the PLC
- Open the library's Admin screen and confirm that the license check result is green

Licenses are perpetual. No maintenance fee is required. Licenses are keyed to a site code and are not portable between PLCs. Please contact Beyond HMI if you need to move a license to another PLC.

## Collecting CFX Files from the PLC

The CFX files generated by the BhiLibDualFc library are saved into meter-specific directories underneath the PLC's /home/user/ directory. Each meter is given its own directory. The name of the directory is taken from the **Meter Serial Number** parameter for that meter.

For example, if two meters are configured at a certain PLC installation and one meter is given **Meter Serial Number** 'METER\_1' and the other is given **Meter Serial Number** 'METER\_2', then the following directories will be created:

- /home/user/METER\_1
- /home/user/METER\_2

And the CFX files for each meter will be stored within their respective directories.

The CFX files in these directories will be named using format YYYYMMDDQQ.CFX

Where:

- YYYYMMDD is the year, month, and day of the *gas/oil day* for which the data applies.
- QQ is a sequence number generated by the program/library – beginning with 00.

Any person or local/remote process with the password for the 'user' profile on the PLC should be able to read/copy CFX files from these sub-directories to another computer.

The free BLT software can be used to transfer files from the PLC to your PC.

For a WINDOWS-like interface to the PLC directory system, products like WinSCP can be easily configured to use Secure FTP to interact with the PLC file system. The PLC must be configured to support whichever file transfer protocol you intend to permit field measurement technicians to use.

### Deleting CFX Files From the PLC

There should be no reason to manually delete CFX files from the PLC directories. Files can be copied from the PLC file system to another computer but should not be 'cut' or deleted from the PLC directories. Normally, only a user with access to the 'root' profile would have the ability to delete these files.

The library contains logic to prune the files in the meter subdirectories. By setting the **Max Data Retention** parameter for the meter, you can control this pruning. In order to enforce API 21.1 standards, the **Max Data Retention** parameter cannot be set below 35 days. If you set the parameter to a lower value, it will be overridden later. Data pruning typically occurs once per day – at about 8 minutes after the contract hour.

## FAQ

### Why don't station hourly and daily quantities (Station screen – Values Tab) always show the sum of the same quantities from the Meters Screen – Values Tab)?

Throughout an hour and a day, values for the *station* are accumulated from the *meters* associated with that station. During the hour or day, the hourly and daily accumulations for the *meters* may be reset if a configuration change is made, but the *station* hourly and daily accumulations are not reset. Therefore, the *station* quantities can be larger than the sum of *meter* quantities – if a configuration change has been made during the clock hour or contract day. This is not a concern for the API 21.1 data retention because API 21.1 data is only stored by *meter*.

### Will the library calculate and accumulate flow in the reverse direction for (gas) orifice meters?

No. The library will calculate flow rate and accumulate volume as long as the differential pressure is greater than or equal to the **Low Flow Cutoff Setpoint**. When the differential pressure falls below this threshold, the library will still calculate flow *rate* down to a differential pressure of zero. In the range between zero and **Low Flow Cutoff Setpoint** no volume, mass or energy accumulation occurs. At differential pressure of zero and lower, the library stops calculating rate.

### Will the library calculate and accumulate flow in the reverse direction for oil meters?

No. The library will calculate flow rate and accumulate volume as long as the indicated quantity flow rate is greater than or equal to the **Low Flow Cutoff Setpoint**. When the indicated quantity falls below this rate, the library will continue to accumulate volume and mass – if the meter input is in volume or mass accumulation. If accumulated quantity decreases, the library assumes that the meter has rolled over.

### How can I prevent counting *phantom* volume that accumulates on an oil meter when flow is stopped?

Coriolis meters can produce “pulses” or accumulated volume – even when blocked-in. This results in *phantom* flow and accumulation which is not indicative of real flow.

Your meter manufacturer's technical staff can provide procedures for “zeroing” the meter. Additionally, the meter or meter transmitter may have a “low flow cutoff” feature which causes the meter to report zero flow rate and no accumulation during times when flow is not present.

If you desire additional protection from *phantom* flow readings, configure the low flow cutoff setpoint for the meter within the Beyond HMI library. This feature inhibits accumulation of flow

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when either the actual flow rate - for meters that provide a rate to the library - or the pseudo-rate (differentiated from ten-second change in meter accumulation) – for meters that provide an accumulation to the library – fall below the specified setpoint.