Configuration and Use Manual
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Micro Motion® Heavy Fuel Viscosity Meters (HFVM) Viscomaster™

Configuration and Use Manual

MICRO MOTION™

EMERSON™
Process Management

Safety messages

Safety messages are provided throughout this manual to protect personnel and equipment. Read each safety message carefully before proceeding to the next step.

Emerson Flow customer service

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		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

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Appendices and reference

Part I
Getting Started

Chapters covered in this part:

1 Before you begin

Topics covered in this chapter:

1.1 About this manual

This manual provides information to help you configure, commission, use, maintain, and troubleshoot the Micro Motion Heavy Fuel Viscosity Meter (HFVM).

Important

This manual assumes that the following conditions apply:

- The meter has been installed correctly and completely, according to the instructions in the installation manual.
- The installation complies with all applicable safety requirements.
- The user is trained in all government and corporate safety standards.

1.2 Model codes and device types

Your device can be identified by the model code on the device tag.

Table 1-1: Model codes and device types

Model code	Device nickname	I/O	Electronics mounting
HFVM************[B|X]****	HFVM-B(1)	• Two mA outputs • RS-485 terminals	Integral
HFVM************R****	HFVM-R(2)	• Two mA outputs • RS-485 terminals	Integral

(1) [B|X] represents the Calibration code.

(2) R represents the Calibration code.

Restriction

The HFVM-B supports a complete set of application and configuration options. The HFVM-R supports a subset of application and configuration options.

In this manual, the term *HFVM* is used to apply to both HFVM models. When there are differences between the two models, the device nicknames are used.

Related information

HFVM model comparison

1.3 HFVM model comparison

The HFVM-B and the HFVM-R provide different measurement options and different process variables.

Comparison of process measurement and features by HFVM model

The following table provides an overview of the similarities and differences in features.

Table 1-2: Comparison of process measurement and features by HFVM model

Measurement type	HFVM-B	HFVM-R
Process measurement		
Viscosity measurement	Yes	Yes
Density measurement	Direct	Derived(1)
Density damping	Yes	No
Density cutoff	Yes	No
Two-phase flow detection	Yes	No
Internal (RTD) temperature	Yes	Yes
External or fixed temperature	Yes	No
Ignition quality	Yes	No
Measurement applications		
Referred viscosity(2)	Yes	No
API referral	Yes	No
Measurement support		
Known Density Verification	Yes	No
Viscosity offset	Yes	Yes
Viscosity meter factor	Yes	Manual entry only
Density offset (manual)	Yes	Yes
Density meter factor	Yes	No
Density offset calibration	Yes	No
Temperature calibration	Yes	Yes
User-defined calculations	Yes	Yes

Table 1-2: Comparison of process measurement and features by HFVM model *(continued)*

Measurement type	HFVM-B	HFVM-R
I/O and communications		
Channel A = 4–20 mA + HART	Yes	Yes
Channel B = 4–20 mA	Yes	Yes
Channel C = Modbus/RS-485	Yes	Yes

(1) Calculated from reference density and reference temperature using the API equations for crude oil.

(2) Three methods: ASTM D341 single-curve, ASTM D341 multi-curve, and matrix referral.

Comparison of process variables by HFVM model

The following table provides an overview of the similarities and differences in process variables.

Table 1-3: Comparison of process variables by HFVM model

Measurement type	HFVM-B	HFVM-R
Direct measurement		
Dynamic viscosity	Yes	Yes
Kinematic viscosity	Yes	Yes
Density	Yes	No
Internal (RTD) temperature	Yes	Yes
External temperature	Yes	No
Derived value		
Calculated Carbon Aromaticity Index (CCAI)	Yes	No
Calculated Ignition Index (CII)	Yes	No
Density(1)	No	Yes
Referred viscosity (dynamic or kinematic)(2)	Yes	No
Secondary referred viscosity (dynamic or kinematic)(2)	Yes	No
Referred density (API)	Yes	No
User-defined calculation output	Yes	Yes
Quality factor	Yes	Yes

(1) Calculated from reference density and reference temperature using the API equations for crude oil.

(2) Three methods: ASTM D341 single-curve, ASTM D341 multi-curve, and matrix referral.

1.4 Communications tools and protocols

You can use several different communications tools and protocols to interface with the device. You may use different tools in different locations or for different tasks.

Table 1-4: Communications tools, protocols, and related information

Communications tool	Supported protocols	Scope	In this manual	For more information
Display	Not applicable	Basic configuration and commissioning	Complete user information. See *Appendix B*.	Not applicable
ProLink III	• Modbus/RS-485 • HART/Bell 202 • Service port	Complete configuration and commissioning	Basic user information. See *Appendix C*.	User manual • Installed with software • On Micro Motion user documentation CD • On Micro Motion web site (*www.micromotion.com*)
Field Communicator	• HART/Bell 202	Complete configuration and commissioning	Basic user information. See *Appendix D*.	User manual on Micro Motion web site (*www.micromotion.com*)

Tip

You may be able to use other communications tools from Emerson Process Management, such as AMS Suite: Intelligent Device Manager, or the Smart Wireless THUM™ Adapter. Use of AMS or the Smart Wireless THUM Adapter is not discussed in this manual. For more information on the Smart Wireless THUM Adapter, refer to the documentation available at *www.micromotion.com*.

1.5 Additional documentation and resources

Micro Motion provides additional documentation to support the installation and operation of the device.

Table 1-5: Additional documentation and resources

Topic	Document
Device installation	*Micro Motion Heavy Fuel Viscosity Meters (HFVM): Installation Manual*
Product data sheet	*Micro Motion Heavy Fuel Viscosity Meters: Product Data Sheet*

All documentation resources are available on the Micro Motion web site at *www.micromotion.com* or on the Micro Motion user documentation DVD.

2 Quick start

Topics covered in this chapter:

2.1 Power up the transmitter

The transmitter must be powered up for all configuration and commissioning tasks, or for process measurement.

1. Ensure that all transmitter and sensor covers and seals are closed.

   ⚠ WARNING!

   To prevent ignition of flammable or combustible atmospheres, ensure that all covers and seals are tightly closed. For hazardous area installations, applying power while housing covers are removed or loose can cause an explosion.

2. Turn on the electrical power at the power supply.

   The transmitter will automatically perform diagnostic routines. During this period, Alert 009 is active. The diagnostic routines should complete in approximately 30 seconds.

Postrequisites

Although the sensor is ready to receive process fluid shortly after power-up, the electronics can take up to 10 minutes to reach thermal equilibrium. Therefore, if this is the initial startup, or if power has been off long enough to allow components to reach ambient temperature, allow the electronics to warm up for approximately 10 minutes before relying on process measurements. During this warm-up period, you may observe minor measurement instability or inaccuracy.

2.2 Check meter status

Check the meter for any error conditions that require user action or that affect measurement accuracy.

1. Wait approximately 10 seconds for the power-up sequence to complete.

   Immediately after power-up, the transmitter runs through diagnostic routines and checks for error conditions. During the power-up sequence, Alert A009 is active. This alert should clear automatically when the power-up sequence is complete.

2. Check the status LED on the transmitter.

Table 2-1: Transmitter status reported by status LED

LED state	Description	Recommendation
Green	No alerts are active.	Continue with configuration or process measurement.
Yellow	One or more low-severity alerts are active.	A low-severity alert condition does not affect measurement accuracy or output behavior. You can continue with configuration or process measurement. If you choose, you can identify and resolve the alert condition.
Flashing yellow	Calibration in progress, or Known Density Verification in progress.	The measurement can fluctuate during the calibration process or change as a result of the calibration process. The alert will clear when the calibration is complete. Check the calibration results before continuing.
Red	One or more high-severity alerts are active.	A high-severity alert condition affects measurement accuracy and output behavior. Resolve the alert condition before continuing.

- *View and acknowledge status alerts* (Section 8.3)
- *Status alerts, causes, and recommendations* (Section 10.6)

2.3 Make a startup connection to the transmitter

For all configuration tools except the display, you must have an active connection to the transmitter to configure the transmitter.

Identify the connection type to use, and follow the instructions for that connection type in the appropriate appendix. Use the default communications parameters shown in the appendix.

Communications tool	Connection type to use	Instructions
ProLink III	Modbus/RS-485 HART/Bell 202	*Appendix C*
Field Communicator	HART/Bell 202	*Appendix D*

Postrequisites

(Optional) Change the communications parameters to site-specific values.

- To change the communications parameters using ProLink III, choose Device Tools > Configuration > Communications.
- To change the communications parameters using the Field Communicator, choose Configure > Manual Setup > HART > Communications.

Important

If you are changing communications parameters for the connection type that you are using, you will lose the connection when you write the parameters to the transmitter. Reconnect using the new parameters.

Part II
Configuration and commissioning

Chapters covered in this part:

3 Introduction to configuration and commissioning

Topics covered in this chapter:

- *Default values*
- *Enable access to the off-line menu of the display*
- *Disable HART security*
- *Set the HART lock*
- *Restore the factory configuration*

3.1 Default values

Default values for your meter are configured at the factory.

Important
Default values are based on your purchase order options. Therefore, the default values described in the following tables may not be the factory default values configured for your system. For absolute accuracy, refer to the configuration sheet that was shipped with your meter.

3.1.1 HFVM default values

Table 3-1: HFVM default mA scaling values for calibration code B (and R)

Variable	Default 4 mA	Default 20 mA
Density	0.500 g/cc	1.500 g/cc
Temperature	0.000°C 32.00°F	150.000°C 302.000°F
Drive gain	0.000 %	100.000 %
External temperature	-50.000°C -58.00000°F	150.000°C 302.0000°F
Special equation output	0	100
Dynamic viscosity	0 cP	100 cP
Kinematic viscosity	0 cSt	100 cSt
Base viscosity	0 cP	1000 cSt
CCAI	800	1200
CII	800	1200

Table 3-2: HFVM default mA scaling values for calibration code R

Variable	Default 4 mA	Default 20 mA
Density (calculated)	0.500 g/cc	1.500 g/cc
Temperature	0.000°C 32.00°F	200.000°C 392.000°F
Dynamic viscosity	0 cP	100 cP
Kinematic viscosity	0 cSt	100 cSt

Table 3-3: HFVM default variables for calibration code R

Default variable	mA
Primary Variable (PV), mA1	Kinematic Viscosity
Secondary Variable (SV), mA2	Sample Temperature
Tertiary Variable (TV)	Quality Factor
Quaternary Variable (QV)	Drive Gain

3.2 Enable access to the off-line menu of the display

Display	*Not available*
ProLink III	Device Tools > Configuration > Transmitter Display > Display Security
Field Communicator	Configure > Manual Setup > Display > Display Menus > Offline Menu

Overview

By default, access to the off-line menu of the display is enabled. If it is disabled, you must enable it if you want to use the display to configure the transmitter.

Restriction

You cannot use the display to enable access to the off-line menu. You must make a connection from another tool.

3.3 Disable HART security

If you plan to use HART protocol to configure the device, HART security must be disabled. HART security is disabled by default, so you may not need to do this.

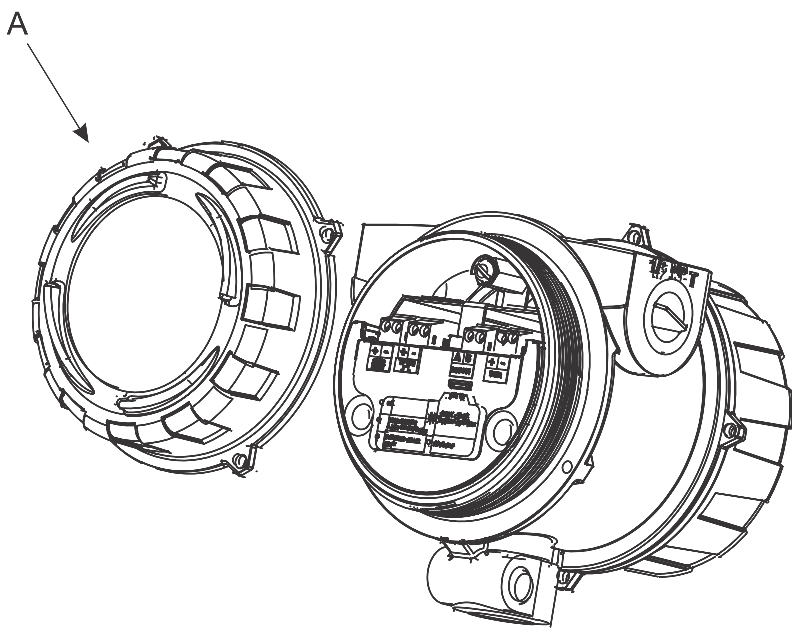
Prerequisites

- Strap wrench
- 3 mm hex key

Procedure

1. Power down the meter.
2. Using the strap wrench, loosen the grub screws and remove the transmitter end-cap.

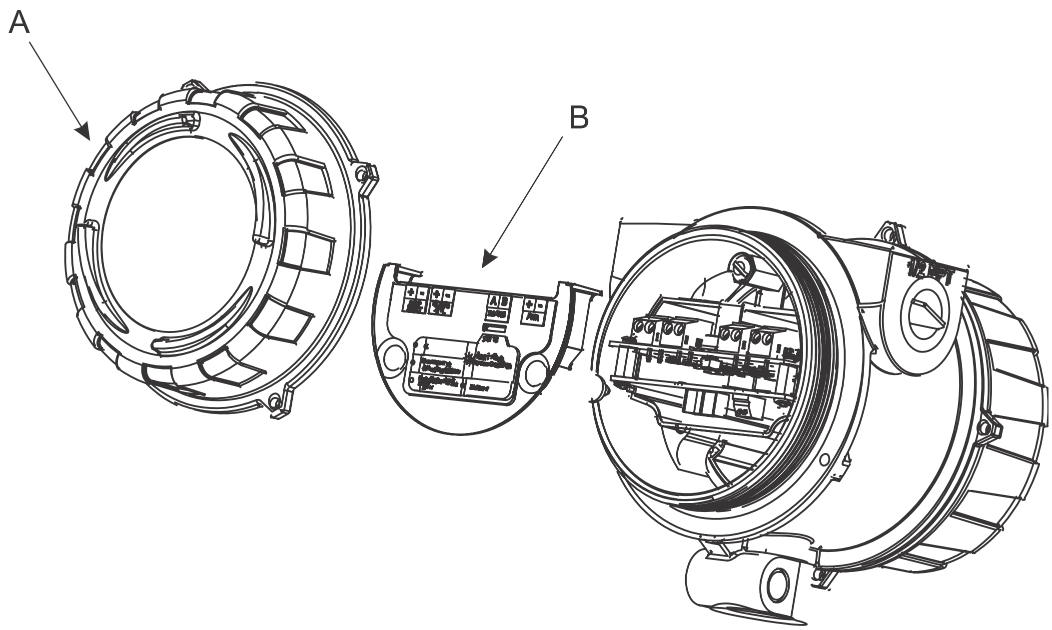
Figure 3-1: Transmitter with end-cap removed



A. Transmitter end-cap

3. Using the hex key, remove the safety spacer.

Figure 3-2: Transmitter with end-cap and safety spacer removed

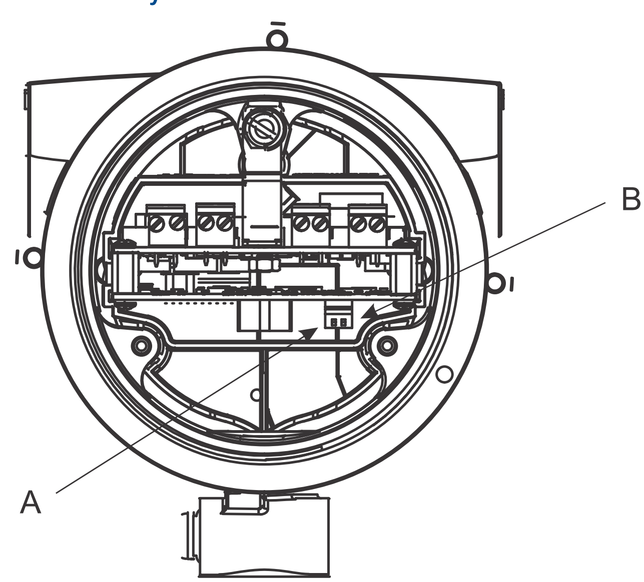


A. Transmitter end-cap
B. Safety spacer

4. Move the HART security switch to the OFF position (up).

   The HART security switch is the switch on the left.

Figure 3-3: HART security switch



A. HART security switch
B. Unused

5. Replace the safety spacer and end-cap.
6. Power up the meter.

3.4 Set the HART lock

If you plan to use a HART connection to configure the device, you can lock out all other HART masters. If you do this, other HART masters will be able to read data from the device but will not be able to write data to the device.

Restrictions

- This feature is available only when you are using the Field Communicator or AMS.
- This feature is available only with a HART 7 host.

Procedure

1. Choose Configure > Manual Setup > Security > Lock/Unlock Device.
2. If you are locking the meter, set Lock Option as desired.

Option	Description
Permanent	Only the current HART master can make changes to the device. The device will remain locked until manually unlocked by a HART master. The HART master can also change Lock Option to Temporary.
Temporary	Only the current HART master can make changes to the device. The device will remain locked until manually unlocked by a HART master, or a power-cycle or device reset is performed. The HART master can also change Lock Option to Permanent.
Lock All	No HART masters are allowed to make changes to the configuration. Before changing Lock Option to Permanent or Temporary, the device must be unlocked. Any HART master can be used to unlock the device.

Postrequisites

To avoid future confusion or difficulties, ensure that the device is unlocked after you have completed your tasks.

3.5 Restore the factory configuration

Display	*Not available*
ProLink III	Device Tools > Configuration Transfer > Restore Factory Configuration
Field Communicator	Service Tools > Maintenance > Reset/Restore > Restore Factory Configuration

Overview

Restoring the factory configuration returns the transmitter to a known operational configuration. This may be useful if you experience problems during configuration.

Tip

Restoring the factory configuration is not a common action. You may want to contact Micro Motion to see if there is a preferred method to resolve any issues.

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4 Configure process measurement

Topics covered in this chapter:

4.1 Verify the calibration factors

Display	*Not available*
ProLink III	Device Tools > Calibration Data
Field Communicator	Configure > Manual Setup > Calibration Factors

Overview

The calibration factors are used to adjust measurement for the unique traits of the sensor. Your device was calibrated at the factory. However, you should verify that the calibration factors that are configured in your device match the factory values.

Prerequisites

You will need the factory values for the calibration factors. These are provided in two locations:

- The calibration certificate shipped with your meter
- The label inside the transmitter's end-cap

Important
If the transmitter is not the original component, do not use the values from the transmitter label.

Procedure

1. View the calibration factors that are stored in the device.
2. Compare them to the factory values.
   - If the values match, no action is required.
   - If the values do not match, contact Micro Motion customer service.

Related information

Sample calibration certificate

4.1.1 Calibration factors

The original calibration factors are obtained from factory calibration, and are unique to each device. They are used to adjust measurements for the specific physical properties of the device.

Related information

Sample calibration certificate

4.2 Configure line viscosity measurement

The viscosity measurement parameters control how viscosity is measured and reported.

- *Configure Viscosity Measurement Unit* (Section 4.2.1)
- *Configure Viscosity Damping* (Section 4.2.2)

4.2.1 Configure Viscosity Measurement Unit

Display	OFF-LINE MAINT > OFF-LINE CONFG > UNITS > DYNV OFF-LINE MAINT > OFF-LINE CONFG > UNITS > KINV
ProLink III	Device Tools > Configuration > Process Measurement > Line Viscosity
Field Communicator	Configure > Manual Setup > Measurements > Viscosity

Overview

The default measurement unit for dynamic viscosity is cP (centiPoise). The default measurement unit for kinematic viscosity is cSt (centiStoke). You can change the measurement unit for dynamic viscosity. You can configure a special measurement unit for both dynamic viscosity and kinematic viscosity.

Procedure

1. Set the unit for dynamic viscosity as desired.

Option	Label		
	Display	ProLink III	Field Communicator
centiPoise (default)	cP	cP	cP
Pascal-seconds	Pa·s	Pa·s	Pa·s

2. Verify that the unit is set correctly for kinematic viscosity.

Define a special measurement unit for dynamic viscosity or kinematic viscosity

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Viscosity > Special Units
Field Communicator	Configure > Manual Setup > Measurements > Special Units

Overview

A special measurement unit is a user-defined unit of measure that allows you to report process data in a unit that is not available in the transmitter. A special measurement unit is calculated from an existing measurement unit using a conversion factor. You can define a special measurement unit for dynamic viscosity, kinematic viscosity, or both.

Procedure

- To define a special unit for dynamic viscosity:
  1. Calculate Dynamic Viscosity Special Unit Conversion Factor as follows:
     a. x base units = y special units
     b. Dynamic Viscosity Special Unit Conversion Factor = x ÷ y
  2. Enter Dynamic Viscosity Special Unit Conversion Factor.

     The original dynamic viscosity value is divided by this conversion factor.
  3. Set User-Defined Label to the name you want to use for the dynamic viscosity unit.
- To define a special unit for kinematic viscosity:
  1. Calculate Kinematic Viscosity Special Unit Conversion Factor as follows:
     a. x base units = y special units
     b. Kinematic Viscosity Special Unit Conversion Factor = x ÷ y
  2. Enter Kinematic Viscosity Special Unit Conversion Factor.

     The original kinematic viscosity value is divided by this conversion factor.
  3. Set User-Defined Label to the name you want to use for the kinematic viscosity unit.

The special measurement unit is stored in the transmitter. You can configure the transmitter to use the special measurement unit at any time.

Example: Defining a special measurement unit for kinematic viscosity

You want to measure kinematic viscosity in Stokes rather than centiStokes.

1. Calculate Kinematic Viscosity Special Unit Conversion Factor: 100 ÷ 1

2. Set Kinematic Viscosity Special Unit Conversion Factor to 100.
3. Set User-Defined Label to Stokes.

4.2.2 Configure Viscosity Damping

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Viscosity > Line Viscosity Damping
Field Communicator	Configure > Manual Setup > Measurements > Viscosity > Viscosity Damping

Overview

Viscosity Damping controls the amount of damping that will be applied to the line viscosity value. It affects both dynamic viscosity and kinematic viscosity measurement.

Damping is used to smooth out small, rapid fluctuations in process measurement. Damping Value specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Tip
Viscosity damping affects all process variables that are calculated from line viscosity.

Procedure

Set Viscosity Damping to the value you want to use.

The default value is 0.8 seconds. The range is 0 to 60 seconds.

Interaction between Viscosity Damping and Added Damping

When the mA output is configured to report either dynamic viscosity or kinematic viscosity, both Viscosity Damping and Added Damping are applied to the reported viscosity value.

Viscosity Damping controls the rate of change in the value of the process variable in transmitter memory. Added Damping controls the rate of change reported via the mA output.

If mA Output Process Variable is set to Dynamic Viscosity or Kinematic Viscosity, and both Viscosity Damping and Added Damping are set to non-zero values, viscosity damping is applied first, and the added damping calculation is applied to the result of the first calculation. This value is reported over the mA output.

Related information

Interaction between mA Output Damping and process variable damping

4.3 Configure line density measurement

The density measurement parameters control how density is measured and reported.

Restriction

Line density measurement is supported only by the HFVM-B. If you are using the HFVM-R, density data is calculated.

- *Configure Density Measurement Unit* (Section 4.3.1)
- *Configure Density Damping* (Section 4.3.2)
- *Configure Density Cutoff* (Section 4.3.3)
- *Configure two-phase flow parameters* (Section 4.3.4)
- *Configure calculated line density measurement* (Section 4.3.5)

4.3.1 Configure Density Measurement Unit

Display	OFF-LINE MAINT > OFF-LINE CONFG > UNITS > DENS
ProLink III	Device Tools > Configuration > Process Measurement > Line Density > Density Unit
Field Communicator	Configure > Manual Setup > Measurements > Density > Density Unit

Overview

Density Measurement Unit controls the measurement units that will be used in density calculations and reporting.

Restriction

If the API referral application is enabled, you cannot change the density measurement unit here. The density measurement unit is controlled by the API table selection.

Procedure

Set Density Measurement Unit to the option you want to use.

The default setting for Density Measurement Unit is g/cm3 (grams per cubic centimeter).

Options for Density Measurement Unit

The transmitter provides a standard set of measurement units for Density Measurement Unit. Different communications tools may use different labels.

Define a special measurement unit for density

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Density > Special Units
Field Communicator	Configure > Manual Setup > Measurements > Special Units

Overview

A special measurement unit is a user-defined unit of measure that allows you to report process data in a unit that is not available in the transmitter. A special measurement unit is calculated from an existing measurement unit using a conversion factor.

Procedure

1. Specify Density Special Unit Base.

   Density Special Unit Base is the existing density unit that the special unit will be based on.
2. Calculate Density Special Unit Conversion Factor as follows:
   a. x base units = y special units
   b. Density Special Unit Conversion Factor = x÷y
3. Enter Density Special Unit Conversion Factor.

   The original density value is divided by this conversion factor.
4. Set User-Defined Label to the name you want to use for the density unit.

The special measurement unit is stored in the transmitter. You can configure the transmitter to use the special measurement unit at any time.

Example: Defining a special measurement unit for density

You want to measure density in ounces per cubic inch.

1. Set Density Special Unit Base to g/cm3.
2. Calculate Density Special Unit Conversion Factor:
   a. 1 g/cm3 = 0.578 oz/in3
   b. 1÷0.578 = 1.73
3. Set Density Special Unit Conversion Factor to 1.73.
4. Set User-Defined Label to oz/in3.

4.3.2 Configure Density Damping

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Density > Density Damping
Field Communicator	Configure > Manual Setup > Measurements > Density > Density Damping

Overview

Density Damping controls the amount of damping that will be applied to the line density value.

Damping is used to smooth out small, rapid fluctuations in process measurement. Damping Value specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Restriction
This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Tip
Density damping affects all process variables that are calculated from line density.

Procedure

Set Density Damping to the value you want to use.

The default value is 1.6 seconds. The range is 0 to 60 seconds.

Interaction between Density Damping and Added Damping

When the mA output is configured to report density, both Density Damping and Added Damping are applied to the reported density value.

Density Damping controls the rate of change in the value of the process variable in transmitter memory. Added Damping controls the rate of change reported via the mA output.

If mA Output Process Variable is set to Density, and both Density Damping and Added Damping are set to non-zero values, density damping is applied first, and the added damping calculation is applied to the result of the first calculation. This value is reported over the mA output.

Related information

Interaction between mA Output Damping and process variable damping

4.3.3 Configure Density Cutoff

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Density > Density Cutoff Low
Field Communicator	Configure > Manual Setup > Measurements > Density > Density Cutoff

Overview

Density Cutoff Low specifies the lowest density value that will be reported as measured. All density values below this cutoff will be reported as 0.

Restriction

This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Procedure

Set Density Cutoff Low to the value you want to use.

The default value is 0.2 g/cm³. The range is 0.0 g/cm³ to 0.5 g/cm³.

4.3.4 Configure two-phase flow parameters

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Density
Field Communicator	Configure > Manual Setup > Measurements > Density

Overview

The two-phase flow parameters control how the transmitter detects and reports two-phase flow (gas in a liquid process or liquid in a gas process).

Note

Two-phase flow is sometimes referred to as *slug flow*.

Restriction

This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Procedure

1. Set Two-Phase Flow Low Limit to the lowest density value that is considered normal in your process.

   Values below this will cause the transmitter to post Alert A105 (Two-Phase Flow).

Tip

Gas entrainment can cause your process density to drop temporarily. To reduce the occurrence of two-phase flow alerts that are not significant to your process, set Two-Phase Flow Low Limit slightly below your expected lowest process density.

You must enter Two-Phase Flow Low Limit in g/cm³, even if you configured another unit for density measurement.

2. Set Two-Phase Flow High Limit to the highest density value that is considered normal in your process.

   Values above this will cause the transmitter to post Alert A105 (Two-Phase Flow).

   Tip

   To reduce the occurrence of two-phase flow alerts that are not significant to your process, set Two-Phase Flow High Limit slightly above your expected highest process density.

   You must enter Two-Phase Flow High Limit in g/cm³, even if you configured another unit for density measurement.

3. Set Two-Phase Flow Timeout to the number of seconds that the transmitter will wait for a two-phase flow condition to clear before posting the alert.

   The default value for Two-Phase Flow Timeout is 0.0 seconds, meaning that the alert will be posted immediately. The range is 0.0 to 60.0 seconds.

Detecting and reporting two-phase flow

Two-phase flow (gas in a liquid process or liquid in a gas process) can cause a variety of process control issues. By configuring the two-phase flow parameters appropriately for your application, you can detect process conditions that require correction.

Tip

To decrease the occurrence of two-phase flow alerts, lower Two-Phase Flow Low Limit or raise Two-Phase Flow High Limit.

A two-phase flow condition occurs whenever the measured density goes below Two-Phase Flow Low Limit or above Two-Phase Flow High Limit. If this occurs:

- A two-phase flow alert is posted to the active alert log.
- Line density is held at its last *pre-alert* value for the number of seconds configured in Two-Phase Flow Timeout.

If the two-phase flow condition clears before Two-Phase Flow Timeout expires:

- Line density reverts to actual process density.
- The two-phase flow alert is deactivated, but remains in the active alert log until it is acknowledged.

If the two-phase flow condition does not clear before Two-Phase Flow Timeout expires, line density reverts to actual process density, but the two-phase flow alert remains active.

If Two-Phase Flow Timeout is set to 0.0 seconds, two-phase flow will cause a two-phase flow alert but will have no effect on how the meter measures or reports line density.

4.3.5 Configure calculated line density measurement

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Density
Field Communicator	Configure > Manual Setup > Measurements > Density Configure > Manual Setup > Calibration Factors > Density (Calculated)

Overview

The HFVM-R calculates line density from the measured viscosity. You must provide site-specific values for reference density and reference temperature.

The measured viscosity and the configured reference values are inserted into the API equations for crude oil, and the equations are then solved for line density.

Restriction
This task applies only to the HFVM-R. If you are using the HFVM-B, line density is measured directly.

Procedure

1. Set Density Unit to the unit to be used for the calculated density value.
2. Set Reference Density to the value to be used in the line density calculation.

   Enter the value using the measurement unit that is configured for density.
3. Set Reference Temperature to the value to be used in the line density calculation.

   Enter the value using the measurement unit that is configured for temperature.

Related information

Configure line density measurement

4.4 Configure temperature measurement

The temperature measurement parameters control how temperature data from the sensor is reported.

- *Configure Temperature Measurement Unit* (Section 4.4.1)
- *Configure Temperature Damping* (Section 4.4.2)

- *Configure Temperature Input* (Section 4.4.3)

4.4.1 Configure Temperature Measurement Unit

Display	OFF-LINE MAINT > OFF-LINE CONFG > UNITS > TEMP
ProLink III	Device Tools > Configuration > Process Measurement > Line Temperature > Temperature Unit
Field Communicator	Configure > Manual Setup > Measurements > Temperature > Temperature Unit

Overview

Temperature Measurement Unit specifies the unit that will be used for temperature measurement.

Restriction

If the API referral application is enabled, the API table selection automatically sets the temperature measurement unit. Configure the API referral application first, then change the temperature measurement unit if desired.

Procedure

Set Temperature Measurement Unit to the option you want to use.

The default setting is Degrees Celsius.

Options for Temperature Measurement Unit

The transmitter provides a standard set of units for Temperature Measurement Unit. Different communications tools may use different labels for the units.

Table 4-1: Options for Temperature Measurement Unit

	Label		
Unit description	**Display**	**ProLink III**	**Field Communicator**
Degrees Celsius	°C	°C	degC
Degrees Fahrenheit	°F	°F	degF
Degrees Rankine	°R	°R	degR
Kelvin	°K	°K	Kelvin

4.4.2 Configure Temperature Damping

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Temperature > Temperature Damping
Field Communicator	Configure > Manual Setup > Measurements > Temperature > Temp Damping

Overview

Temperature Damping controls the amount of damping that will be applied to the line temperature value, when the on-board temperature data is used (RTD).

Damping is used to smooth out small, rapid fluctuations in process measurement. Damping Value specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Tip

Temperature Damping affects all process variables, compensations, and corrections that use temperature data from the sensor.

Procedure

Enter the value you want to use for Temperature Damping.

- Default: 4.8 seconds

Tips

- A high damping value makes the process variable appear smoother because the reported value changes slowly.
- A low damping value makes the process variable appear more erratic because the reported value changes more quickly.
- Whenever the damping value is non-zero, the reported measurement will lag the actual measurement because the reported value is being averaged over time.
- In general, lower damping values are preferable because there is less chance of data loss, and less lag time between the actual measurement and the reported value.

The value you enter is automatically rounded down to the nearest valid value.

4.4.3 Configure Temperature Input

Temperature data from the on-board temperature sensor (RTD) is always available. Optionally, you can set up an external temperature device and use external temperature data.

Restriction

An external temperature or a fixed temperature value is available only on the HFVM-B. The HFVM-R always uses the internal RTD temperature.

Important

Line temperature data is used in several different measurements and calculations. It is possible to use the internal RTD temperature in some areas and an external temperature in others. The transmitter stores the internal RTD temperature and the external temperature separately. However, the transmitter stores only one alternate temperature value, which may be either an external temperature or the configured fixed value. Accordingly, if you set up polling for temperature in one area, and digital communications in another, and configure a fixed temperature value in a third, the fixed value will be overwritten by polling and digital communications, and polling and digital communications will overwrite each other.

- *Configure Temperature Input using ProLink III*
- *Configure Temperature Input using the Field Communicator*

Configure Temperature Input using ProLink III

ProLink III	Device Tools > Configuration > Process Measurement > Line Temperature > Line Temperature Source

Procedure

Choose the method to be used to supply temperature data, and perform the required setup.

Option	Description	Setup
Internal RTD temperature data	Temperature data from the on-board temperature sensor (RTD) is used.	a. Set Line Temperature Source to Internal RTD. b. Click Apply.

<table>
<tr><th>Option</th><th>Description</th><th>Setup</th></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Poll for External Value.
b. Set Polling Slot to an available slot.
c. Set Polling Control to Poll as Primary or Poll as Secondary.
<table><tr><th>Option</th><th>Description</th></tr><tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr><tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr></table>d. Set External Device Tag to the HART tag of the temperature device.
e. Click Apply.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Fixed Value or Digital Communications.
b. Click Apply.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.

Configure Temperature Input using the Field Communicator

Choose the method to be used to supply temperature data, and perform the required setup.

<table>
<tr><th>Method</th><th>Description</th><th>Setup</th></tr>
<tr><td>Internal RTD temperature data</td><td>Temperature data from the on-board temperature sensor (RTD) is used.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature or External Temperature for Viscosity to Disable.</td></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature or External Temperature for Viscosity to Enable.
c. Choose Configure > Manual Setup > Inputs/Outputs > External Device Polling.
d. Choose an unused polling slot.
e. Set Poll Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
f. Set External Device Tag to the HART tag of the external temperature device.
g. Set Polled Variable to Temperature.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature or External Temperature for Viscosity to Enable.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

Postrequisites

Choose Service Tools > Variables > External Variables and verify the value for External Temperature.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.

- Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

4.5 Configure referred viscosity measurement

Referred viscosity is line viscosity corrected to a reference temperature. In other words, this is the viscosity that the device would report if the line temperature matched the reference temperature.

Restriction

This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Important

To achieve the highest accuracy in referred viscosity measurement, consult Micro Motion customer service during configuration. Measurement accuracy is affected by many factors.

Three methods are available to calculate referred viscosity. These methods are described in the following table.

Table 4-2: Configuration methods for referred viscosity

Referred viscosity calculation method	Description
ASTM D341 Single-Curve	• Based on ASTM D341 standards • Applicable only to petroleum products • Used when the meter will measure only one process fluid
ASTM D341 Multi-Curve	• Based on ASTM D341 standards • Applicable only to petroleum products • Supports measurement of two to eight process fluids from one configuration
Matrix Referral	• Not based on ASTM D341 standards • Applicable to all process fluids • Supports measurement of two to six process fluids from one configuration

4.5.1 Configure referred viscosity measurement, ASTM D341 Single-Curve method

Referred viscosity is line viscosity corrected to a reference temperature. In other words, this is the viscosity that the device would report if the line temperature matched the reference temperature. The ASTM D341 single-curve method is used only with petroleum products. It is used when the meter will measure only one process fluid.

- *Configure referred viscosity measurement, ASTM D341 Single-Curve method, using ProLink III*
- *Configure referred viscosity measurement, ASTM D341 Single-Curve method, using the Field Communicator*

Configure referred viscosity measurement, ASTM D341 Single-Curve method, using ProLink III

Important
Use the ASTM D341 Single-Curve method only with petroleum products.

Prerequisites

You must know the viscosity of your process fluid at two temperatures.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > Referred Viscosity.
2. Set Referred Viscosity Method to ASTM D341 Single-Curve, and click Apply to refresh the screen.
3. Define the curve.

   a. Enter two temperature values, one in Lower Temperature and one in Higher Temperature.

      Enter the temperature in the currently configured temperature unit.

   b. For each temperature, enter the viscosity of your process fluid at that temperature.

   Important
   You must enter the viscosity in cSt (centistokes). If cP is displayed rather than cSt, click Apply to refresh the screen.

4. Enter two reference temperatures.

   The first reference temperature will be used to calculate the Referred Viscosity process variable. The second reference temperature will be used to calculate the Referred Viscosity (Secondary) process variable. They do not need to be within the temperature range of the curve.

5. Choose the method to be used to supply temperature data, and perform the required setup.

Option	Description	Setup
Internal RTD temperature data	Temperature data from the on-board temperature sensor (RTD) is used.	a. Set Line Temperature Source to Internal RTD. b. Click Apply.

<table>
<tr><th>Option</th><th>Description</th><th>Setup</th></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Poll for External Value.
b. Set Polling Slot to an available slot.
c. Set Polling Control to Poll as Primary or Poll as Secondary.
<table><tr><th>Option</th><th>Description</th></tr><tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr><tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr></table>d. Set External Device Tag to the HART tag of the temperature device.
e. Click Apply.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Fixed Value or Digital Communications.
b. Click Apply.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

6. Verify that your temperature setup is being applied as intended.
    a. Choose Device Tools > Configuration > I/O > Inputs > External Inputs.
    b. Check or uncheck the checkboxes as desired.

    If a checkbox is checked, the internal RTD temperature is used for that measurement or calculation. If a checkbox is unchecked, the external temperature is used.

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
    - Verify the wiring between the meter and the external device.
    - Verify the HART tag of the external device.
- For digital communications:
    - Verify that the host has access to the required data.
    - Verify that the host is writing to the correct register in memory, using the correct data type.

- If necessary, apply an offset.

Configure referred viscosity measurement, ASTM D341 Single-Curve method, using the Field Communicator

Important

Use the ASTM D341 Single-Curve method only with petroleum products.

Prerequisites

You must know the viscosity of your process fluid at two temperatures.

Procedure

1. Choose Configure > Manual Setup > Measurements > Referred Viscosity.
2. Set Referred Viscosity Calculation Method to ASTM D341 Single.
3. Choose ASTM D341 Single.
4. Define the curve.

    a. Enter two temperature values, one in Temperature 1 and one in Temperature 2.

       Enter the temperature in the currently configured temperature unit.

    b. For each temperature, enter the viscosity of your process fluid at that temperature.

    Important

    You must enter the viscosity in cSt (centistokes). If cP is displayed rather than cSt, send data to the transmitter to refresh the display.

5. Enter two reference temperatures.

    The first reference temperature will be used to calculate the Referred Viscosity process variable. The second reference temperature will be used to calculate the Referred Viscosity (Secondary) process variable. They do not need to be within the temperature range of the curve.

6. Choose the method to be used to supply temperature data, and perform the required setup.

Method	Description	Setup
Internal temperature	Temperature data from the on-board temperature sensor (RTD) will be used for all measurements and calculations. No external temperature data will be available.	a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature. b. Set External Temperature for Viscosity to Disable.

<table>
<tr><th>Method</th><th>Description</th><th>Setup</th></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature for Viscosity to Enable.
c. Choose Configure > Manual Setup > Inputs/Outputs > External Device Polling.
d. Choose an unused polling slot.
e. Set Poll Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
f. Set External Device Tag to the HART tag of the external temperature device.
g. Set Polled Variable to Temperature.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature for Viscosity to Enable.
c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.</td></tr>
</table>

Postrequisites

Choose Service Tools > Variables > External Variables and verify the value for External Temperature.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

4.5.2 Configure referred viscosity measurement, ASTM D341 Multi-Curve method

Referred viscosity is line viscosity corrected to a reference temperature. In other words, this is the viscosity that the device would report if the line temperature matched the reference temperature. The ASTM D341 multi-curve method is used only with petroleum products. It is used when the meter will measure two to eight process fluids.

- *Configure referred viscosity measurement, ASTM D341 Multi-Curve method, using ProLink III*
- *Configure referred viscosity measurement, ASTM D341 Multi-Curve method, using the Field Communicator*

Configure referred viscosity measurement, ASTM D341 Multi-Curve method, using ProLink III

You can set up referred viscosity calculations for up to eight process fluids.

Important
Use the ASTM D341 Multi-Curve method only with petroleum products.

Prerequisites

For each process fluid, you must know its viscosity at two temperatures.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > Referred Viscosity.
2. Set Referred Viscosity Method to ASTM D341 Multi-Curve, and click Apply to refresh the screen.
3. Define the curve for each process fluid.

   a. Enter two temperature values, one in Lower Temperature and one in Higher Temperature.

      Enter the temperature in the currently configured temperature unit.

   b. For each temperature, enter the viscosity of your process fluid at that temperature.

      Important
      You must enter the viscosity in cSt (centistokes). If cP is displayed rather than cSt, click Apply to refresh the screen.

4. Enter two reference temperatures.

   The first reference temperature will be used to calculate the Referred Viscosity process variable. The second reference temperature will be used to calculate the Referred Viscosity (Secondary) process variable. They do not need to be within the temperature range of the curve.

5. Choose the method to be used to supply temperature data, and perform the required setup.

<table>
<tr><th>Option</th><th>Description</th><th>Setup</th></tr>
<tr><td>Internal RTD temperature data</td><td>Temperature data from the on-board temperature sensor (RTD) is used.</td><td>a. Set Line Temperature Source to Internal RTD.
b. Click Apply.</td></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Poll for External Value.
b. Set Polling Slot to an available slot.
c. Set Polling Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
d. Set External Device Tag to the HART tag of the temperature device.
e. Click Apply.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Fixed Value or Digital Communications.
b. Click Apply.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

6. Verify that your temperature setup is being applied as intended.

   a. Choose Device Tools > Configuration > I/O > Inputs > External Inputs.

   b. Check or uncheck the checkboxes as desired.

      If a checkbox is checked, the internal RTD temperature is used for that measurement or calculation. If a checkbox is unchecked, the external temperature is used.

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.

  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

Configure referred viscosity measurement, ASTM D341 Multi-Curve method, using the Field Communicator

You can set up referred viscosity calculations for up to eight process fluids.

Important
Use the ASTM D341 Multi-Curve method only with petroleum products.

Prerequisites

For each process fluid, you must know its viscosity at two temperatures.

Procedure

1. Choose Configure > Manual Setup > Measurements > Referred Viscosity.
2. Set Referred Viscosity Calculation Method to ASTM D341 Multi.
3. Choose ASTM D341 Multi.
4. Define the curve for each process fluid.
   a. Choose Viscosity at Specific Temp.
   b. Choose Fluid 1.
   c. Enter two temperature values, one in Temperature 1 and one in Temperature 2.

      Enter the temperature in the currently configured temperature unit.
   d. For each temperature, enter the viscosity of your process fluid at that temperature.

      Important
      You must enter the viscosity in cSt (centistokes). If cP is displayed rather than cSt, send data to the transmitter to refresh the display.

      ---
   e. Press the back arrow and repeat this step until curves have been defined for all fluids.
5. Enter two reference temperatures.

   The first reference temperature will be used to calculate the Referred Viscosity process variable. The second reference temperature will be used to calculate the Referred Viscosity (Secondary) process variable. They do not need to be within the temperature range of the curve.

6. Choose the method to be used to supply temperature data, and perform the required setup.

Method	Description	Setup
Internal temperature	Temperature data from the on-board temperature sensor (RTD) will be used for all measurements and calculations. No external temperature data will be available.	a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature. b. Set External Temperature for Viscosity to Disable.
Polling	The meter polls an external device for temperature data. This data will be available in addition to the internal temperature data.	a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature. b. Set External Temperature for Viscosity to Enable. c. Choose Configure > Manual Setup > Inputs/Outputs > External Device Polling. d. Choose an unused polling slot. e. Set Poll Control to Poll as Primary or Poll as Secondary. **Option** — **Description** Poll as Primary — No other HART masters will be on the network. The Field Communicator is not a HART master. Poll as Secondary — Other HART masters will be on the network. The Field Communicator is not a HART master. f. Set External Device Tag to the HART tag of the external temperature device. g. Set Polled Variable to Temperature.
Digital communications	A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal temperature data.	a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature. b. Set External Temperature for Viscosity to Enable. c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.

Postrequisites

Choose Service Tools > Variables > External Variables and verify the value for External Temperature.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.

- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

4.5.3 Configure referred viscosity measurement, Matrix Referral method

Referred viscosity is line viscosity corrected to a reference temperature. In other words, this is the viscosity that the device would report if the line temperature matched the reference temperature. The matrix referral method can be used for all process fluids. It is not based on ASTM D341 standards.

- *Configure referred viscosity measurement, Matrix Referral method, using ProLink III*
- *Configure referred viscosity measurement, Matrix Referral method, using the Field Communicator*

Configure referred viscosity measurement, Matrix Referral method, using ProLink III

You can set up referred viscosity calculations for up to six process fluids. You must set up at least two.

Prerequisites

For each process fluid, you must know its viscosity at two or more temperatures. You must use the same temperature values for all process fluids. You can enter up to six temperature–viscosity pairs for each fluid.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > Referred Viscosity.
2. Set Referred Viscosity Method to Matrix Referral, and click Apply to refresh the screen.
3. Set Matrix Data Unit to the viscosity unit that the referred density measurement will be based on, then click Apply to refresh the screen.

   Important

   If you change the setting of Matrix Data Unit after entering viscosity data in the matrix, no conversion is performed. You must re-enter the viscosity data using the new unit.

4. Set Reference Temperature to the temperature to which viscosity will be corrected.

   The reference temperature must be within the temperature range of the matrix. It does not need to match one of the temperature values used to build the matrix.
5. Build the viscosity matrix.

a. In the first column, enter the temperatures for which you will enter viscosity data.
b. In the second column, enter the viscosity of the first process fluid, at each of the specified temperatures.

   Enter viscosity in either cP or cSt, depending on the setting of Matrix Data Unit.
c. In the third column, enter the viscosity of the second process fluid at each of the specified temperatures.
d. Continue until you have entered and sent data for all process fluids at all temperatures.

Important

- You must enter the temperature values in order, either low-to-high or high-to-low.
- You must enter the process fluids in order of viscosity, either low-to-high or high-to-low.
- The matrix must be 2×2 or larger.

6. Click Apply.

   The transmitter processes the matrix data and determines if it can be used for measurement.

7. Check the values displayed for Fit Results and Fit Accuracy.

   Fit Results can be `Good`, `Poor`, or `Empty`. `Good` means that the matrix is mathematically capable of generating data. `Poor` means that the matrix cannot generate data. If Fit Results = `Poor`, adjust the matrix and try again. If Fit Results = `Empty`, ensure that you have entered data for all temperature–viscosity pairs and that the data meets the requirements listed above.

   Fit Accuracy is the maximum difference between the referred viscosity value calculated by the meter and the referred viscosity value that is expected at each of the temperature–viscosity pairs.

8. Choose the method to be used to supply temperature data, and perform the required setup.

Option	Description	Setup
Internal RTD temperature data	Temperature data from the on-board temperature sensor (RTD) is used.	a. Set Line Temperature Source to Internal RTD. b. Click Apply.

<table>
<tr><th>Option</th><th>Description</th><th>Setup</th></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Poll for External Value.
b. Set Polling Slot to an available slot.
c. Set Polling Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
d. Set External Device Tag to the HART tag of the temperature device.
e. Click Apply.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Fixed Value or Digital Communications.
b. Click Apply.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

9. Verify that your temperature setup is being applied as intended.

   a. Choose Device Tools > Configuration > I/O > Inputs > External Inputs.
   b. Check or uncheck the checkboxes as desired.

      If a checkbox is checked, the internal RTD temperature is used for that measurement or calculation. If a checkbox is unchecked, the external temperature is used.

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.

- If necessary, apply an offset.

Related information

Example: Using the Matrix Referral method

Configure referred viscosity measurement, Matrix Referral method, using the Field Communicator

You can set up referred viscosity calculations for up to six process fluids. You must set up at least two.

Prerequisites

For each process fluid, you must know its viscosity at two or more temperatures. You must use the same temperature values for all process fluids. You can enter up to six temperature–viscosity pairs for each fluid.

Procedure

1. Choose Configure > Manual Setup > Measurements > Referred Viscosity.
2. Set Referred Viscosity Calculation Method to Matrix Referral.
3. Choose Matrix Referral.
4. Set Matrix Data Unit to the viscosity unit that the referred density measurement will be based on.

   Important

   - If the correct unit is not displayed, press Send to send the data to the transmitter, then press Home, then return to this screen. This sequence writes the configuration data and refreshes the screen. Dynamic viscosity is measured in cP. Kinematic viscosity is measured in cSt.
   - If you change the setting of Matrix Data Unit after entering viscosity data in the matrix, no conversion is performed. You must re-enter the viscosity data using the new unit.

   ---

5. Set Reference Temperature to the temperature to which viscosity will be corrected.

   The reference temperature must be within the temperature range of the matrix. It does not need to match one of the temperature values used to build the matrix.
6. Build the viscosity matrix.
   a. Choose Viscosity at Specific Temp.
   b. Choose Isotherm 1.
   c. Set the temperature for Isotherm 1.
   d. For each fluid, enter the viscosity value at the specified temperature.

      Enter viscosity in either cP or cSt, depending on the setting of Matrix Data Unit.
   e. Press Send to send this data to the transmitter.
   f. Press the back arrow.

g. Choose Isotherm 2.
h. Set the temperature for Isotherm 2.
i. For each fluid, enter the viscosity value at the specified temperature.
j. Continue until you have entered data for all process fluids.
k. Press the back arrow twice to return to the Matrix Referral menu.

Important

- You must enter the temperature values in order, either low-to-high or high-to-low.
- You must enter the process fluids in order of viscosity, either low-to-high or high-to-low.
- The matrix must be 2×2 or larger.

7. Choose Results and check the values displayed for Fit Results and Fit Accuracy.

   Fit Results can be `Good`, `Poor`, or `Empty`. `Good` means that the matrix is mathematically capable of generating data. `Poor` means that the matrix cannot generate data. If Fit Results = `Poor`, adjust the matrix and try again. If Fit Results = `Empty`, ensure that you have entered data for all temperature–viscosity pairs and that the data meets the requirements listed above.

   Fit Accuracy is the maximum difference between the referred viscosity value calculated by the meter and the referred viscosity value that is expected at each of the temperature–viscosity pairs.

8. Choose Results and check the values displayed for Fit Results and Fit Accuracy.
9. Choose the method to be used to supply temperature data, and perform the required setup.

Method	Description	Setup
Internal temperature	Temperature data from the on-board temperature sensor (RTD) will be used for all measurements and calculations. No external temperature data will be available.	a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature. b. Set External Temperature for Viscosity to Disable.

<table>
<tr><th>Method</th><th>Description</th><th>Setup</th></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature for Viscosity to Enable.
c. Choose Configure > Manual Setup > Inputs/Outputs > External Device Polling.
d. Choose an unused polling slot.
e. Set Poll Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
f. Set External Device Tag to the HART tag of the external temperature device.
g. Set Polled Variable to Temperature.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature for Viscosity to Enable.
c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.</td></tr>
</table>

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

Related information

Example: Using the Matrix Referral method

Example: Using the Matrix Referral method

This example illustrates setting up a matrix to measure four related process fluids.

Viscosity data

For each process fluid, dynamic viscosity data was collected for temperatures ranging from 250 °F to 350 °F. Multiple samples were taken at each temperature, and averaged.

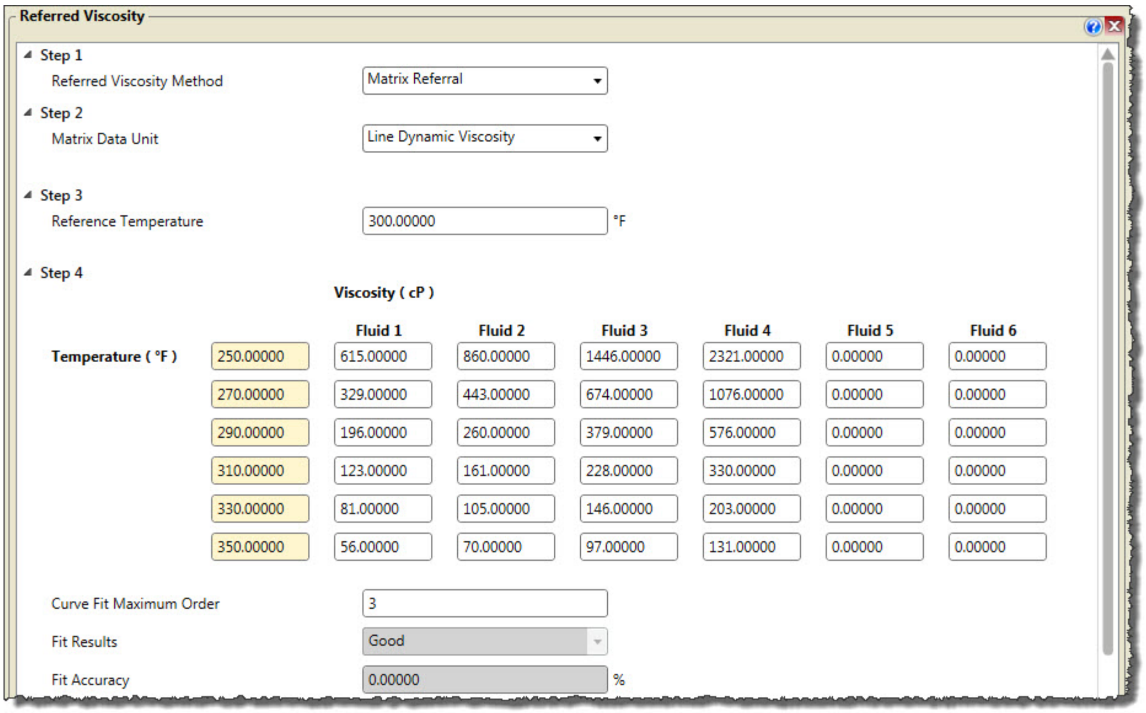
Table 4-3: Viscosity data by process fluid and temperature

	Average viscosity (cP)			
Temperature (°F)	**Fluid 1**	**Fluid 2**	**Fluid 3**	**Fluid 4**
250	615	860	1446	2321
260	435	595	924	1526
270	329	443	674	1076
280	253	336	499	780
290	196	260	379	576
300	154	203	292	430
310	123	161	228	330
320	99	129	181	258
330	81	105	146	203
340	68	85	118	162
350	56	70	97	131

Matrix configuration

If you use ProLink III to enter the matrix, it appears as shown here. If you use a different interface, the concept is the same although the appearance is different.

Figure 4-1: Configuring the matrix using ProLink III



Notes

- The matrix is limited to six temperature points, so this matrix represents a subset of the data.
- This example uses an arbitrary value for Reference Temperature.

Results

Fit Results = Good. This indicates that the matrix is mathematically valid.

Fit Accuracy = 0.0. A low value indicates that the curve fit is good. If the values in the matrix are correct, referred viscosity values will be highly accurate.

4.6 Set up the API referral application

The API referral application corrects line density to reference temperature according to American Petroleum Institute (API) standards. The resulting process variable is *referred density*.

Restriction

This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Related information

Set up the API referral application using ProLink III
Set up the API referral application using the Field Communicator

4.6.1 Set up the API referral application using ProLink III

This section guides you through the tasks required to set up and implement the API referral application.

Enable the API referral application using ProLink III

The API referral application must be enabled before you can perform any setup. If the API referral application was enabled at the factory, you do not need to enable it now.

1. Choose Device Tools > Configuration > Transmitter Options.
2. Enable API Referral and click Apply.

Configure API referral using ProLink III

The API referral parameters specify the API table, measurement units, and reference values to be used in referred density calculations.

Prerequisites

You will need API documentation for the API table that you select.

Depending on your API table, you may need to know the thermal expansion coefficient (TEC) for your process fluid.

You must know the reference temperature that you want to use.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > API Referral.
2. Specify the API table to use.

   Each API table is associated with a specific set of equations.

   a. Set Process Fluid to the API table group that your process fluid belongs to.

API table group	Process fluids
A tables	Generalized crude and JP4
B tables	Generalized products: Gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil
C tables	Liquids with a constant base density or known thermal expansion coefficient (TEC). You will be required to enter the TEC for your process fluid.
D tables	Lubricating oils

API table group	Process fluids
E tables	NGL (Natural Gas Liquids) and LPG (Liquid Petroleum Gas)

Restriction

The API referral application is not appropriate for the following process fluids: propane and propane mixes, butane and butane mixes, butadiene and butadiene mixes, isopentane, LNG, ethylene, propylene, cyclohexane, aeromatics, asphalts, and road tars.

b. Set Referred Density Measurement Unit to the measurement units that you want to use for referred density.

c. Click Apply.

These parameters uniquely identify the API table. The selected API table is displayed, and the meter automatically changes the density unit, temperature unit, and reference temperature to match the API table.

Restriction

Not all combinations are supported by the API referral application. See the list of API tables in this manual.

3. Refer to the API documentation and confirm your table selection.

   a. Verify that your process fluid falls within range for line density and line temperature.

      If your process fluid goes outside any of these limits, the meter will post a status alert and will report extrapolated values for referred density.

   b. Verify that the referred density range of the selected table is adequate for your application.

4. If you chose a C table, enter Thermal Expansion Coefficient (TEC) for your process fluid.

5. Set Reference Temperature to the temperature to which density will be corrected in referred density calculations. If you choose Other, select the temperature measurement unit and enter the reference temperature.

API tables supported by the API referral application

The API tables listed here are supported by the API referral application.

Table 4-4: API tables, process fluids, measurement units, and default reference values

Process fluid	API table	Referred density (API)	Default reference temperature
Generalized crude and JP4	5A	Unit: °API Range: 0 to 100 °API	60 °F
	23A	Unit: SGU Range: 0.6110 to 1.0760 SGU	60 °F

Table 4-4: API tables, process fluids, measurement units, and default reference values *(continued)*

Process fluid	API table	Referred density (API)	Default reference temperature
	53A	Unit: kg/m^3 Range: 610 to 1075 kg/m^3	15 °C
Generalized products (gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil)	5B	Unit: °API Range: 0 to 85 °API	60 °F
	23B	Unit: SGU Range: 0.6535 to 1.0760 SGU	60 °F
	53B	Unit: kg/m^3 Range: 653 to 1075 kg/m^3	15 °C
Liquids with a constant density base or known thermal expansion coefficient	6C	Unit: °API	60 °F
	24C	Unit: SGU	60 °F
	54C	Unit: kg/m^3	15 °C
Lubricating oils	5D	Unit: °API Range: −10 to +40 °API	60 °F
	23D	Unit: SGU Range: 0.8520 to 1.1640 SGU	60 °F
	53D	Unit: kg/m^3 Range: 825 to 1164 kg/m^3	15 °C
NGL (natural gas liquids)	23E	Unit: SGU	60 °F
LPG (liquid petroleum gas)	24E	Unit: SGU	60 °F

Restriction

These tables are not appropriate for the following process fluids: propane and propane mixes, butane and butane mixes, butadiene and butadiene mixes, isopentane, LNG, ethylene, propylene, cyclohexane, aeromatics, asphalts, and road tars.

Set up temperature data for API referral using ProLink III

The API referral application uses temperature data in its calculations. You must decide how to provide this data, then perform the required configuration and setup.

Tip

A fixed value for temperature is not recommended. Using a fixed temperature value may produce inaccurate process data.

Important

Line temperature data is used in several different measurements and calculations. It is possible to use the internal RTD temperature in some areas and an external temperature in others. The transmitter stores the internal RTD temperature and the external temperature separately. However, the transmitter stores only one alternate temperature value, which may be either an external temperature or the configured fixed value. Accordingly, if you set up polling for temperature in one area, and digital communications in another, and configure a fixed temperature value in a third, the fixed value will be overwritten by polling and digital communications, and polling and digital communications will overwrite each other.

Prerequisites

If you plan to poll an external device, the primary mA output (Channel A) must be wired to support HART communications.

If you are using an external temperature device, it must use the temperature unit that is configured in the transmitter.

Procedure

1. Choose Device Tools > Configuration > Process Measurement > API Referral.
2. Choose the method to be used to supply temperature data, and perform the required setup.

<table>
<tr><th>Option</th><th>Description</th><th>Setup</th></tr>
<tr><td>Internal RTD temperature data</td><td>Temperature data from the on-board temperature sensor (RTD) is used.</td><td>a. Set Line Temperature Source to Internal RTD.
b. Click Apply.</td></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Poll for External Value.
b. Set Polling Slot to an available slot.
c. Set Polling Control to Poll as Primary or Poll as Secondary.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
<tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr>
</table>
d. Set External Device Tag to the HART tag of the temperature device.
e. Click Apply.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal RTD temperature data.</td><td>a. Set Line Temperature Source to Fixed Value or Digital Communications.
b. Click Apply.
c. Perform the necessary host programming and communications setup to write temperature data to the meter at appropriate intervals.</td></tr>
</table>

Postrequisites

If you are using external temperature data, verify the external temperature value displayed in the Inputs group on the ProLink III main window.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

4.6.2 Set up the API referral application using the Field Communicator

This section guides you through the tasks required to set up and implement the API referral application.

1. *Enable the API referral application using the Field Communicator*
2. *Configure API referral using the Field Communicator*
3. *Set up temperature data for API referral using the Field Communicator*

Enable the API referral application using the Field Communicator

The API referral application must be enabled before you can perform any setup. If the API referral application was enabled at the factory, you do not need to enable it now.

1. Choose Overview > Device Information > Applications > Enable/Disable Applications.
2. Enable the API referral application.

Configure API referral using the Field Communicator

The API referral parameters specify the API table, measurement units, and reference values to be used in referred density calculations.

Prerequisites

You will need API documentation for the API table that you select.

Depending on your API table, you may need to know the thermal expansion coefficient (TEC) for your process fluid.

You must know the reference temperature that you want to use.

Procedure

1. Choose Configure > Manual Setup > Measurements > API Referral.
2. Choose API Referral Setup.
3. Specify the API table that you want to use for measurement.

   Each API table is associated with a specific set of equations.

   a. Set API Table Number to the number that matches the API table units that you want to use for referred density.

      Your choice also determines the measurement unit to be used for temperature and the default value for reference temperature.

API Table Number	Measurement unit for referred density	Temperature measurement unit	Default reference temperature
5	°API	°F	60 °F
6(1)	°API	°F	60 °F
23	SGU	°F	60 °F
24(1)	SGU	°F	60 °F
53	kg/m^3	°C	15 °C
54(1)	kg/m^3	°C	15 °C

(1) Used only with API Table Letter = C.

   b. Set API Table Letter to the letter of the API table group that is appropriate for your process fluid.

API Table Letter	Process fluids
A	Generalized crude and JP4
B	Generalized products: Gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil
C(1)	Liquids with a constant base density or known thermal expansion coefficient (TEC). You will be required to enter the TEC for your process fluid.
D	Lubricating oils
E	NGL (Natural Gas Liquids) and LPG (Liquid Petroleum Gas)

(1) Used only with API Table Number = 6, 24, or 54.

Restriction

The API referral application is not appropriate for the following process fluids: propane and propane mixes, butane and butane mixes, butadiene and butadiene mixes, isopentane, LNG, ethylene, propylene, cyclohexane, aeromatics, asphalts, and road tars.

API Table Number and API Table Letter uniquely identify the API table. The selected API table is displayed, and the meter automatically changes the density unit, temperature unit, and reference temperature to match the API table.

Restriction

Not all combinations are supported by the API referral application. See the list of API tables in this manual.

4. If you chose a C table, enter Thermal Expansion Coefficient (TEC) for your process fluid.
5. Refer to the API documentation and confirm your table selection.
   a. Verify that your process fluid falls within range for line density and line temperature.

      If your process fluid goes outside any of these limits, the meter will post a status alert and will report extrapolated values for referred density.
   b. Verify that the referred density range of the selected table is adequate for your application.
6. If required, set Ref Temperature to the temperature to which density will be corrected in referred density calculations.

   The default reference temperature is determined by the selected API table.

   a. Choose Service Tools > Maintenance > Modbus Data > Write Modbus Data.
   b. Write the desired reference temperature to Registers 319–320, in the measurement unit required by the selected API table. Use 32-bit IEEE floating-point format.

API tables supported by the API referral application

The API tables listed here are supported by the API referral application.

Table 4-5: API tables, process fluids, measurement units, and default reference values

Process fluid	API table	Referred density (API)	Default reference temperature
Generalized crude and JP4	5A	Unit: °API Range: 0 to 100 °API	60 °F
	23A	Unit: SGU Range: 0.6110 to 1.0760 SGU	60 °F
	53A	Unit: kg/m^3 Range: 610 to 1075 kg/m^3	15 °C
Generalized products (gasoline, jet fuel, aviation fuel, kerosene, heating oils, fuel oils, diesel, gas oil)	5B	Unit: °API Range: 0 to 85 °API	60 °F
	23B	Unit: SGU Range: 0.6535 to 1.0760 SGU	60 °F

Table 4-5: API tables, process fluids, measurement units, and default reference values *(continued)*

Process fluid	API table	Referred density (API)	Default reference temperature
	53B	Unit: kg/m^3 Range: 653 to 1075 kg/m^3	15 °C
Liquids with a constant density base or known thermal expansion coefficient	6C	Unit: °API	60 °F
	24C	Unit: SGU	60 °F
	54C	Unit: kg/m^3	15 °C
Lubricating oils	5D	Unit: °API Range: −10 to +40 °API	60 °F
	23D	Unit: SGU Range: 0.8520 to 1.1640 SGU	60 °F
	53D	Unit: kg/m^3 Range: 825 to 1164 kg/m^3	15 °C
NGL (natural gas liquids)	23E	Unit: SGU	60 °F
LPG (liquid petroleum gas)	24E	Unit: SGU	60 °F

Restriction

These tables are not appropriate for the following process fluids: propane and propane mixes, butane and butane mixes, butadiene and butadiene mixes, isopentane, LNG, ethylene, propylene, cyclohexane, aeromatics, asphalts, and road tars.

Set up temperature data for API referral using the Field Communicator

The API referral application uses temperature data in its calculations. You must decide how to provide this data, then perform the required configuration and setup.

Tip

A fixed value for temperature is not recommended. Using a fixed temperature value may produce inaccurate process data.

Important

Line temperature data is used in several different measurements and calculations. It is possible to use the internal RTD temperature in some areas and an external temperature in others. The transmitter stores the internal RTD temperature and the external temperature separately. However, the transmitter stores only one alternate temperature value, which may be either an external temperature or the configured fixed value. Accordingly, if you set up polling for temperature in one area, and digital communications in another, and configure a fixed temperature value in a third, the fixed value will be overwritten by polling and digital communications, and polling and digital communications will overwrite each other.

Prerequisites

If you plan to poll an external device, the primary mA output (Channel A) must be wired to support HART communications.

If you are using an external temperature device, it must use the temperature unit that is configured in the transmitter.

Procedure

Choose the method to be used to supply temperature data, and perform the required setup.

<table>
<tr><th>Method</th><th>Description</th><th>Setup</th></tr>
<tr><td>Internal temperature</td><td>Temperature data from the on-board temperature sensor (RTD) will be used for all measurements and calculations. No external temperature data will be available.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature to Disable.</td></tr>
<tr><td>Polling</td><td>The meter polls an external device for temperature data. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature to Enable.
c. Choose Configure > Manual Setup > Inputs/Outputs > External Device Polling.
d. Choose an unused polling slot.
e. Set Poll Control to Poll as Primary or Poll as Secondary.
<table><tr><th>Option</th><th>Description</th></tr><tr><td>Poll as Primary</td><td>No other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr><tr><td>Poll as Secondary</td><td>Other HART masters will be on the network. The Field Communicator is not a HART master.</td></tr></table>f. Set External Device Tag to the HART tag of the external temperature device.
g. Set Polled Variable to Temperature.</td></tr>
<tr><td>Digital communications</td><td>A host writes temperature data to the meter at appropriate intervals. This data will be available in addition to the internal temperature data.</td><td>a. Choose Configure > Manual Setup > Measurements > External Inputs > Temperature.
b. Set External Temperature to Enable.
c. Perform the necessary host programming and communications setup to write temperature data to the transmitter at appropriate intervals.</td></tr>
</table>

Postrequisites

Choose Service Tools > Variables > External Variables and verify the value for External Temperature.

Need help? If the value is not correct:

- Ensure that the external device and the meter are using the same measurement unit.
- For polling:
  - Verify the wiring between the meter and the external device.
  - Verify the HART tag of the external device.
- For digital communications:
  - Verify that the host has access to the required data.
  - Verify that the host is writing to the correct register in memory, using the correct data type.
- If necessary, apply an offset.

5 Configure device options and preferences

Topics covered in this chapter:

5.1 Configure the transmitter display

You can control the process variables shown on the display and a variety of display behaviors.

- *Configure the language used for the display* (Section 5.1.1)
- *Configure the process variables and diagnostic variables shown on the display* (Section 5.1.2)
- *Configure the number of decimal places (precision) shown on the display* (Section 5.1.3)
- *Configure the refresh rate of data shown on the display* (Section 5.1.4)
- *Enable or disable automatic scrolling through the display variables* (Section 5.1.5)

5.1.1 Configure the language used for the display

Display	OFF-LINE MAINT > OFF-LINE CONFG > DISPLAY > LANG
ProLink III	Device Tools > Configuration > Transmitter Display > General
Field Communicator	Configure > Manual Setup > Display > Language

Overview

Display Language controls the language used for process data and menus on the display.

Procedure

Select the language you want to use.

The languages available depend on your transmitter model and version.

5.1.2 Configure the process variables and diagnostic variables shown on the display

Display	*Not available*
ProLink III	Device Tools > Configuration > Transmitter Display > Display Variables
Field Communicator	Configure > Manual Setup > Display > Display Variables

Overview

You can control the process variables and diagnostic variables shown on the display, and the order in which they appear. The display can scroll through up to 15 variables in any order you choose. In addition, you can repeat variables or leave slots unassigned.

Restriction

You cannot set Display Variable 1 to None or to a diagnostic variable. Display Variable 1 must be set to a process variable.

Prerequisites

If you plan to configure CCAI (Calculated Carbon Aromaticity Index) or CII (Calculated Ignition Index) as a display variable, the API referral application must be enabled and configured to report referred density at 15 °C. These two process variables require a non-zero value for referred density. If you do not set up API referral, these two process variables will be reported as 0.

Procedure

For each display variable you want to change, assign the process variable you want to use.

5.1.3 Configure the number of decimal places (precision) shown on the display

Display	*Not available*
ProLink III	Device Tools > Configuration > Transmitter Display > Display Variables
Field Communicator	Configure > Manual Setup > Display > Decimal Places

Overview

You can specify the number of decimal places (precision) that are shown on the display for each process variable or diagnostic variable. You can set the precision independently for each variable.

The display precision does not affect the actual value of the variable or the value used in calculations.

Procedure

1. Select a variable.
2. Set Number of Decimal Places to the number of decimal places you want shown when the process variable or diagnostic variable appears on the display.

   For temperature and density process variables, the default value is 2 decimal places. For all other variables, the default value is 4 decimal places. The range is 0 to 5.

   Tip
   The lower the precision, the greater the change must be for it to be reflected on the display. Do not set the precision too low or too high to be useful.

5.1.4 Configure the refresh rate of data shown on the display

Display	OFF-LINE MAINT > OFF-LINE CONFG > DISPLAY > RATE
ProLink III	Device Tools > Configuration > Transmitter Display > Display Variables
Field Communicator	Configure > Manual Setup > Display > Display Behavior > Refresh Rate

Overview

You can set Refresh Rate to control how frequently data is refreshed on the display.

Procedure

Set Refresh Rate to the desired value.

The default value is 1000 milliseconds. The range is 100 milliseconds to 10,000 milliseconds (10 seconds).

5.1.5 Enable or disable automatic scrolling through the display variables

Display	OFF-LINE MAINT > OFF-LINE CONFG > DISPLAY > AUTO SCRLL
ProLink III	Device Tools > Configuration > Transmitter Display > General
Field Communicator	Configure > Manual Setup > Display > Display Behavior > Auto Scroll

Overview

You can configure the display to automatically scroll through the configured display variables or to show a single display variable until the operator activates Scroll. When you set automatic scrolling, you can also configure the length of time each display variable is displayed.

Procedure

1. Enable or disable Auto Scroll as desired.

Option	Description
Enabled	The display automatically scrolls through each display variable as specified by Scroll Rate. The operator can move to the next display variable at any time using Scroll.
Disabled **(default)**	The display shows Display Variable 1 and does not scroll automatically. The operator can move to the next display variable at any time using Scroll.

2. If you enabled Auto Scroll, set Scroll Rate as desired.

   The default value is 10 seconds.

Tip
Scroll Rate may not be available until you apply Auto Scroll.

5.2 Enable or disable the Acknowledge All Alerts display command

Display	OFF-LINE MAINT > OFF-LINE CONFG > DISPLAY > ACK
ProLink III	Device Tools > Configuration > Transmitter Display > Ack All
Field Communicator	Configure > Manual Setup > Display > Display Menus > Acknowledge All

Overview

You can configure whether or not the operator can use a single command to acknowledge all alerts from the display.

Procedure

1. Ensure that the alert menu is accessible from the display.

   To acknowledge alerts from the display, operators must have access to the alert menu.
2. Enable or disable Acknowledge All Alerts as desired.

Option	Description
Enabled **(default)**	Operators can use a single display command to acknowledge all alerts at once.

Option	Description
Disabled	Operators cannot acknowledge all alerts at once. Each alert must be acknowledged separately.

5.3 Configure security for the display menus

Display	OFF-LINE MAINT > OFF-LINE CONFG > DISPLAY
ProLink III	Device Tools > Configuration > Transmitter Display > Display Security
Field Communicator	Configure > Manual Setup > Display > Display Menus

Overview

You can control operator access to different sections of the display off-line menu. You can also configure a passcode to control access.

Procedure

1. To control operator access to the maintenance section of the off-line menu, enable or disable Off-Line Menu.

Option	Description
Enabled **(default)**	Operator can access the maintenance section of the off-line menu. This access is required for configuration and calibration, including Known Density Verification.
Disabled	Operator cannot access the maintenance section of the off-line menu.

2. To control operator access to the alert menu, enable or disable Alert Menu.

Option	Description
Enabled **(default)**	Operator can access the alert menu. This access is required to view and acknowledge alerts, but is not required for Known Density Verification, configuration, or calibration.
Disabled	Operator cannot access the alert menu.

Note
The transmitter status LED changes color to indicate that there are active alerts, but does not show specific alerts.

3. To require a passcode for access to the off-line menu, enable or disable Off-Line Password.

Option	Description
Enabled	Operator is prompted for the off-line passcode at entry to the off-line menu.
Disabled **(default)**	No passcode is required for entry to the off-line menu.

4. Set Off-Line Password to the desired value.

   The default value is 1234. The range is 0000 to 9999.

Tip
Record your passcode for future reference.

5.4 Configure alert handling

The alert handling parameters control the transmitter's response to process and device conditions.

- *Configure Fault Timeout* (Section 5.4.1)
- *Configure Alert Severity* (Section 5.4.2)

5.4.1 Configure Fault Timeout

Display	*Not available*
ProLink III	Device Tools > Configuration > Fault Processing
Field Communicator	Configure > Alert Setup > Alert Severity > Fault Timeout

Overview

Fault Timeout controls the delay before fault actions are performed.

Restriction
Fault Timeout is applied only to the following alerts (listed by Status Alert Code): A003, A004, A008, A016, A033. For all other alerts, fault actions are performed as soon as the alert is detected.

Procedure

Set Fault Timeout as desired.

The default value is 0 seconds. The range is 0 to 60 seconds.

If you set Fault Timeout to 0, fault actions are performed as soon as the alert condition is detected.

The fault timeout period begins when the transmitter detects an alert condition. During the fault timeout period, the transmitter continues to report its last valid measurements.

If the fault timeout period expires while the alert is still active, the fault actions are performed. If the alert condition clears before the fault timeout expires, no fault actions are performed.

5.4.2 Configure Alert Severity

Display	*Not available*
ProLink III	Device Tools > Configuration > Alert Severity
Field Communicator	Configure > Alert Setup > Alert Severity > Change Alert Severity

Overview

Use Alert Severity to control the fault actions that the transmitter performs when it detects an alert condition.

Restrictions

- For some alerts, Alert Severity is not configurable.
- For some alerts, Alert Severity can be set only to two of the three options.

Tip

Micro Motion recommends using the default settings for Alert Severity unless you have a specific requirement to change them.

Procedure

1. Select a status alert.
2. For the selected status alert, set Alert Severity as desired.

Option	Description
Fault	Actions when fault is detected: • The alert is posted to the Alert List. • Outputs go to the configured fault action (after Fault Timeout has expired, if applicable). • Digital communications go to the configured fault action (after Fault Timeout has expired, if applicable). • The status LED (if available) changes to red or yellow (depending on alert severity). Actions when alert clears: • Outputs return to normal behavior. • Digital communications return to normal behavior. • The status LED returns to green.

Option	Description
Informa-tional	Actions when fault is detected: • The alert is posted to the Alert List. • The status LED (if available) changes to red or yellow (depending on alert se-verity). Actions when alert clears: • The status LED returns to green.
Ignore	No action

Status alerts and options for Status Alert Severity

Table 5-1: Status alerts and Status Alert Severity

Alert number	Alert title	Default severity	User can reset severity
A001	EEPROM Error	Fault	No
A002	RAM Error	Fault	No
A003	No Sensor Response	Fault	Yes
A004	Temperature Overrange	Fault	No
A006	Characterization Required	Fault	Yes
A008	Density Overrange	Fault	Yes
A009	Transmitter Initializing/Warming Up or Significant Process Instability	Ignore	Yes
A010	Calibration Failure	Fault	No
A014	Transmitter Failure	Fault	No
A016	Sensor Temperature (RTD) Failure	Fault	Yes
A020	Calibration Factors Missing	Fault	Yes
A021	Transmitter/Sensor/Software Mis-match	Fault	No
A029	Internal Electronics Failure	Fault	No
A030	Incorrect Board Type	Fault	No
A036	Viscosity Overrange	Fault	No
A037	Sensor Check Failed	Fault	Yes
A038	Time Period Signal Out of Range	Fault	No
A100	mA Output 1 Saturated	Informational	To Informational or Ignore only
A101	mA Output 1 Fixed	Informational	To Informational or Ignore only
A102	Drive Overrange	Informational	Yes
A104	Calibration in Progress	Informational	To Informational or Ignore only

Table 5-1: Status alerts and Status Alert Severity *(continued)*

Alert number	Alert title	Default severity	User can reset severity
A105	Two-Phase Flow	Informational	Yes
A106	Burst Mode Enabled	Informational	To Informational or Ignore only
A107	Power Reset Occurred	Informational	Yes
A113	mA Output 2 Saturated	Informational	To Informational or Ignore only
A114	mA Output 2 Fixed	Informational	To Informational or Ignore only
A115	No External Input or Polled Data	Informational	To Informational or Ignore only
A116	Temperature Overrange (API Referral)	Informational	Yes
A117	Density Overrange (API Referral)	Informational	Yes
A118	Discrete Output 1 Fixed	Informational	To Informational or Ignore only
A122	Pressure Overrange (API Referral)	Informational	Yes
A132	Sensor Simulation Active	Informational	Yes
A133	EEPROM Error (Display)	Informational	Yes
A136	Incorrect Display Type	Informational	Yes

5.5 Configure informational parameters

Display	*Not available*
ProLink III	Device Tools > Configuration > Meter Information
Field Communicator	Configure > Manual Setup > Info Parameters

Overview

The informational parameters can be used to identify or describe your meter. They are not used in process measurement and they are not required.

Procedure

Enter data as desired.

Parameter	Description
Meter Serial Number	The serial number of the device. Enter the value from the device tag.

Parameter	Description
Message	A message to be stored in device memory. The message can contain up to 32 characters.
Descriptor	A description of this device. The description can contain up to 16 characters.
Date	A static date (not updated by the meter). Enter the date in the form mm/dd/yyyy.
Flange Type	The sensor flange type for this device. Obtain the value from the documents shipped with the device or from a code in the model number.

Tips

- The Field Communicator does not support all informational parameters. If you need to configure all of the informational parameters, use ProLink III.
- The Field Communicator allows you to configure HART Tag and HART Long Tag from this location. These parameters are replicated from Configure > Manual Setup > HART > Communications. These parameters are used in HART communications.

6 Integrate the meter with the control system

Topics covered in this chapter:

6.1 Configure the mA output

The mA output is used to report the configured process variable. The mA output parameters control how the process variable is reported.

The HFVM device has two mA outputs: Channel A and Channel B. Both outputs are fully configurable.

Important

Whenever you change an mA output parameter, verify all other mA output parameters before returning the meter to service. In some situations, the transmitter automatically loads a set of stored values, and these values may not be appropriate for your application.

- *Configure mA Output Process Variable* (Section 6.1.1)
- *Configure Lower Range Value (LRV) and Upper Range Value (URV)* (Section 6.1.2)
- *Configure Added Damping* (Section 6.1.3)
- *Configure mA Output Fault Action and mA Output Fault Level* (Section 6.1.4)

6.1.1 Configure mA Output Process Variable

Display	OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 1 > AO 1 SRC
	OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 2 > AO 2 SRC
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 1 > Source
	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 2 > Source
Field Communicator	Configure > Manual Setup > Inputs/Outputs > mA Output 1 > Primary Variable
	Configure > Manual Setup > Inputs/Outputs > mA Output 2 > Secondary Variable

Overview

Use mA Output Process Variable to select the variable that is reported over the mA output.

Prerequisites

If you are using the HART variables, be aware that changing the configuration of mA Output Process Variable will change the configuration of the HART Primary Variable (PV) and/or the HART Secondary Variable (SV).

Procedure

Set mA Output Process Variable as desired.

Default settings are shown in the following table.

Table 6-1: Default settings for mA Output Process Variable

Device	Channel	mA output	Default process variable assignment
HFVM	Channel A	Primary mA output	Kinematic viscosity
	Channel B	Secondary mA output	Temperature
HFVM-R	Channel A	Primary mA output	Kinematic viscosity
	Channel B	Secondary mA output	Temperature

Postrequisites

If you changed the setting of mA Output Process Variable, verify the settings of Lower Range Value (LRV) and Upper Range Value (URV).

Options for mA Output Process Variable

The transmitter provides a basic set of options for mA Output Process Variable, plus several application-specific options. Different communications tools may use different labels for the options.

Table 6-2: Options for mA Output Process Variable

Process variable	Label		
	Display	ProLink III	Field Communicator
Standard			
Line Density(1)	DENS	Line Density	Density
Line Temperature	TEMP	Line Temperature	Temperature
Line Temperature (External)(1)	EXT T	Line Temperature (External or Fixed)	External Temperature
Drive Gain	DGAIN	Drive Gain	Drive Gain
User-Defined Calculation Output	UCALC	User-Defined Calculation Output	User-Defined Calculation Output

Table 6-2: Options for mA Output Process Variable *(continued)*

Process variable	Label		
	Display	**ProLink III**	**Field Communicator**
Viscosity measurement			
Dynamic Viscosity	DYNV	Line Dynamic Viscosity	Dynamic Viscosity
Kinematic Viscosity	KINV	Line Kinematic Viscosity	Kinematic Viscosity
Referred Viscosity(1)	RVISC	Referred Viscosity	Referred Viscosity
Secondary Referred Viscosity(1)	SRVIS	Referred Viscosity (Secondary)	Referred Viscosity (Secondary)
API referral(1)			
Referred Density (API)	RDENS	Referred Density (API)	Density at Reference (API)
Ignition quality(1)(2)			
Calculated Carbon Aromaticity Index (CCAI)	CCAI	Calculated Carbon Aromaticity Index (CCAI)	CCAI
Calculated Ignition Index (CII)	CII	Calculated Ignition Index (CII)	Calculated Ignition Index

(1) Not supported on the HFVM-R.
(2) The API referral application must be enabled and configured to report referred density at 15 °C.

6.1.2 Configure Lower Range Value (LRV) and Upper Range Value (URV)

Display	OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 1 > 4 mA OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 1 > 20 mA
	OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 2 > 4 mA OFF-LINE MAINT > OFF-LINE CONFG > IO > CONFIG MAO 2 > 20 mA
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 1 > Lower Range Value Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 1 > Upper Range Vaue
	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 2 > Lower Range Value Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 2 > Upper Range Vaue
Field Communicator	Configure > Manual Setup > Inputs/Outputs > mA Output 1 > mA Output Settings > PV LRV Configure > Manual Setup > Inputs/Outputs > mA Output 1 > mA Output Settings > PV URV
	Configure > Manual Setup > Inputs/Outputs > mA Output 2 > mA Output Settings > SV LRV Configure > Manual Setup > Inputs/Outputs > mA Output 2 > mA Output Settings > SV URV

Overview

The Lower Range Value (LRV) and Upper Range Value (URV) are used to scale the mA output, that is, to define the relationship between mA Output Process Variable and the mA output level.

Prerequisites

Ensure that mA Output Process Variable is set to the desired process variable. Each process variable has its own set of LRV and URV values. When you change the values of LRV and URV, you are configuring values for the currently assigned mA output process variable.

Ensure that the measurement unit for the configured process variable has been set as desired.

Procedure

Set LRV and URV as desired.

- LRV is the value of mA Output Process Variable represented by an output of 4 mA. The default value for LRV depends on the setting of mA Output Process Variable. Enter LRV in the measurement units that are configured for mA Output Process Variable.
- URV is the value of mA Output Process Variable represented by an output of 20 mA. The default value for URV depends on the setting of mA Output Process Variable. Enter URV in the measurement units that are configured for mA Output Process Variable.

Tip

For best performance:

- Set LRV ≥ LSL (lower sensor limit).
- Set URV ≤ USL (upper sensor limit).
- Set these values so that the difference between URV and LRV is ≥ Min Span (minimum span).

Defining URV and LRV within the recommended values for Min Span, LSL, and USL ensures that the resolution of the mA output signal is within the range of the bit precision of the D/A converter.

Note

You can set URV below LRV. For example, you can set URV to 50 and LRV to 100.

The mA output uses a range of 4–20 mA to represent mA Output Process Variable. Between LRV and URV, the mA output is linear with the process variable. If the process variable drops below LRV or rises above URV, the transmitter posts an output saturation alert.

6.1.3 Configure Added Damping

Display	*Not available*	
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 1 > Added Damping	
	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 2 > Added Damping	
Field Communicator	Configure > Manual Setup > Inputs/Outputs > mA Output 1 > mA Output Settings > PV Added Damping	
	Configure > Manual Setup > Inputs/Outputs > mA Output 2 > mA Output Settings > SV Added Damping	

Overview

Added Damping controls the amount of damping that will be applied to the mA output.

Damping is used to smooth out small, rapid fluctuations in process measurement. Damping Value specifies the time period (in seconds) over which the transmitter will spread changes in the process variable. At the end of the interval, the internal value will reflect 63% of the change in the actual measured value.

Added Damping affects the reporting of mA Output Process Variable through the mA output only. It does not affect the reporting of that process variable via any other method (e.g., a frequency output or digital communications), or the value of the process variable used in calculations.

Note

Added Damping is not applied if the mA output is fixed (for example, during loop testing) or if the mA output is reporting a fault. Added Damping is applied while sensor simulation is active.

Procedure

Set Added Damping to the desired value.

The default value is 0.0 seconds. The range is 0.0 to 440 seconds.

When you specify a value for Added Damping, the transmitter automatically rounds the value down to the nearest valid value.

Interaction between mA Output Damping and process variable damping

Related information

Interaction between Density Damping and Added Damping
Interaction between Viscosity Damping and Added Damping

6.1.4 Configure mA Output Fault Action and mA Output Fault Level

Display	*Not available*	
ProLink III	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 1 > Fault Action	
	Device Tools > Configuration > I/O > Outputs > mA Output > mA Output 2 > Fault Action	
Field Communicator	Configure > Manual Setup > Inputs/Outputs > mA Output 1 > mAO1 Fault Settings > MAO1 Fault Action	
	Configure > Manual Setup > Inputs/Outputs > mA Output 2 > MAO2 Fault Settings > MAO2 Fault Action	

Overview

mA Output Fault Action controls the behavior of the mA output if the transmitter encounters an internal fault condition.

Note

For some faults only: If Fault Timeout is set to a non-zero value, the transmitter will not implement the fault action until the timeout has elapsed.

Procedure

1. Set mA Output Fault Action to the desired value.

   The default setting is Downscale.

   Restriction

   If Digital Communications Fault Action is set to NAN (not a number), you cannot set mA Output Fault Action to None. If you try to do this, the device will not accept the configuration.

   ---

2. If you set mA Output Fault Action to Upscale or Downscale, set mA Output Fault Level as desired.

Postrequisites

⚠ CAUTION!

If you set mA Output Fault Action **to** None**, be sure to set** Digital Communications Fault Action **to** None**. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.**

Options for mA Output Fault Action and mA Output Fault Level

Table 6-3: Options for mA Output Fault Action and mA Output Fault Level

Option	mA output behavior	mA Output Fault Level
Upscale	Goes to the configured fault level	Default: 21.5 mA Range: 21.0 to 21.5 mA

Table 6-3: Options for mA Output Fault Action and mA Output Fault Level *(continued)*

Option	mA output behavior	mA Output Fault Level
Downscale (default)	Goes to the configured fault level	Default: 3.2 mA Range: 3.2 to 3.6 mA
Internal Zero	Goes to the mA output level associated with a process variable value of 0 (zero), as determined by Lower Range Value and Upper Range Value settings	Not applicable
None	Tracks data for the assigned process variable; no fault action	Not applicable

6.2 Configure an enhanced event

Display	*Not available*
ProLink III	Device Tools > Configuration > Events > Enhanced Events
Field Communicator	Configure > Alert Setup > Enhanced Events

Overview

An enhanced event is used to provide notification of process changes. An enhanced event occurs (is ON) if the real-time value of a user-specified process variable moves above (HI) or below (LO) a user-defined setpoint, or in range (IN) or out of range (OUT) with respect to two user-defined setpoints. You can define up to five enhanced events.

Procedure

1. Select the event that you want to configure.
2. Specify Event Type.

Options	Description
HI	$x > A$ The event occurs when the value of the assigned process variable (x) is greater than the setpoint (Setpoint A), endpoint not included.
LO	$x < A$ The event occurs when the value of the assigned process variable (x) is less than the setpoint (Setpoint A), endpoint not included.
IN	$A \le x \le B$ The event occurs when the value of the assigned process variable (x) is *in range,* that is, between Setpoint A and Setpoint B, endpoints included.

Options	Description
OUT	$x \le A$ or $x \ge B$ The event occurs when the value of the assigned process variable (x) is *out of range*, that is, less than Setpoint A or greater than Setpoint B, endpoints included.

3. Assign a process variable to the event.
4. Set values for the required setpoints.
   - For HI and LO events, set Setpoint A.
   - For IN and OUT events, set Setpoint A and Setpoint B.
5. (Optional) Configure a discrete output to switch states in response to the event status.

6.3 Configure HART/Bell 202 communications

HART/Bell 202 communications parameters support HART communications with the transmitter's primary mA terminals over a HART/Bell 202 network.

- *Configure basic HART parameters* (Section 6.3.1)
- *Configure HART variables (PV, SV, TV, QV)* (Section 6.3.2)
- *Configure burst communications* (Section 6.3.3)

6.3.1 Configure basic HART parameters

Display	OFF-LINE MAINT > OFF-LINE CONFG > HART
ProLink III	Device Tools > Configuration > Meter Information Device Tools > Configuration > Communications > Communications (HART)
Field Communicator	Configure > Manual Setup > HART > Communications

Overview

Basic HART parameters include the HART address, HART tags, and the operation of the primary mA output.

Restrictions

- Your device supports HART 7. If you are using HART 5, HART Long Tag is not available.
- HART Tag, HART Long Tag, and mA Output Action are not configurable from the display.

Procedure

1. Set HART Address to a unique value on your network.

Valid address values are between 0 and 15. The default address (0) is typically used unless you are in a multidrop environment.

Tip

Devices using HART protocol to communicate with the transmitter may use either HART Address or HART Tag (Software Tag) to identify the transmitter. Configure either or both, as required by your other HART devices.

2. Set HART Long Tag to a unique value on your network.
3. Ensure that mA Output Action is configured appropriately.

Options	Description
Enabled (Live)	The primary mA output reports process data as configured. This is the appropriate setting for most applications.
Disabled (Fixed)	The primary mA output is fixed at 4 mA and does not report process data.

Important

If you use ProLink II or ProLink III to set HART Address to 0, the program automatically enables mA Output Action. If you use ProLink II or ProLink III to set HART Address to any other value, the program automatically disables mA Output Action. This is designed to make it easier to configure the transmitter for legacy behavior. Always verify mA Output Action after setting HART Address.

6.3.2 Configure HART variables (PV, SV, TV, QV)

Display	*Not available*
ProLink III	Device Tools > Configuration > Communications > Communications (HART)
Field Communicator	Configure > Manual Setup > Inputs/Outputs > Variable Mapping

Overview

The HART variables are a set of four variables predefined for HART use. The HART variables include the Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV). You can assign specific process variables to the HART variables, and then use standard HART methods to read or broadcast the assigned process data.

Tip

The Tertiary Variable and Quaternary Variable are also called the Third Variable (TV) and Fourth Variable (FV).

Restriction

On some devices, the PV is fixed to a specific process variable and cannot be changed.

Prerequisites

If you plan to set any of the HART variables to CCAI (Calculated Carbon Aromaticity Index) or CII (Calculated Ignition Index), the API referral application must be enabled and configured to report referred density at 15 °C. These two process variables require a non-zero value for referred density. If you do not set up API referral, these two process variables will be reported as 0.

Options for HART variables

Table 6-4: Options for HART variables

Process variable	Primary Variable (PV)	Secondary Variable (SV)	Third Variable (TV)	Fourth Variable (QV)
Standard				
Line Density	✓	✓(1)	✓	✓
Line Temperature	✓	✓	✓	✓
Line Temperature (External)	✓(1)	✓(1)	✓(1)	✓(1)
Drive Gain	✓(1)	✓(1)	✓	✓
User-Defined Calculation Output	✓(1)	✓(1)	✓	✓
Board Temperature			✓	✓
Input Voltage			✓	✓
Viscosity measurement				
Dynamic Viscosity	✓	✓(1)	✓	✓
Kinematic Viscosity	✓	✓(1)	✓	✓
Referred Viscosity(1)	✓	✓	✓	✓
Secondary Referred Viscosity(1)	✓	✓	✓	✓
Quality Factor (Q Factor) (2)			✓	✓
API referral(1)				
Referred Density (API)	✓	✓	✓	✓
Ignition quality(1)(3)				
Calculated Carbon Aromaticity Index (CCAI)(1)	✓	✓	✓	✓
Calculated Ignition Index (CII)(1)	✓	✓	✓	✓

(1) *Not supported on the HFVM-R.*

(2) *Quality Factor is the ratio of the energy stored in the vibrating tines to the energy lost during each vibration cycle. In other words, it is a measure of the amount of energy required to vibrate the tines. Quality Factor is inversely proportional to viscosity.*

(3) *The API referral application must be enabled and configured to report referred density at 15 °C.*

Interaction of HART variables and transmitter outputs

The HART variables are automatically reported through specific transmitter outputs. They may also be reported through HART burst mode, if enabled on your transmitter.

Restriction

One some devices, the PV and the primary mA output are fixed to a specific process variable and cannot be changed.

Table 6-5: HART variables and transmitter outputs

HART variable	Reported via	Comments
Primary Variable (PV)	Primary mA output	If one assignment is changed, the other is changed automatically, and vice versa.
Secondary Variable (SV)	Secondary mA output, if present on your transmitter	If you have a secondary mA output: If one assignment is changed, the other is changed automatically. If you do not have a secondary mA output: The SV must be configured directly, and the value of the SV is available only via digital communications.
Tertiary Variable (TV)	Not associated with an output	The TV must be configured directly, and the value of the TV is available only via digital communications.
Quaternary Variable (QV)	Not associated with an output	The QV must be configured directly, and the value of the QV is available only via digital communications.

6.3.3 Configure burst communications

Burst mode is a mode of communication during which the transmitter regularly broadcasts HART digital information to the network via the primary mA output.

Restriction

Burst communications, including trigger mode and event notification, are not available on HART/ RS-485. These features are supported only on HART/Bell 202.

- *Configure HART burst messages*
- *Configure HART trigger mode*
- *Configure HART event notification*

Configure HART burst messages

Display	*Not available*
ProLink III	Device Tools > Configuration > Communications > Communications (HART)
Field Communicator	Configure > Manual Setup > HART > Burst Mode

Overview

Burst messages contain information on process variables or transmitter status. You can configure up to three burst messages. Each message can contain different information. Burst messages also provide the mechanism for trigger mode and event notification.

Restriction

If you are using a HART 5 host, only one burst message is supported.

Procedure

1. Navigate to the burst message you want to configure.
2. Enable the burst message.
3. Set Burst Option to the desired content.

Table 6-6: Options for burst message contents

HART command	Label		Description
	ProLink III	Field Communicator	
1	Source (Primary Variable)	Primary Variable	The transmitter sends the primary variable (PV) in the configured measurement units in each burst message (e.g., 14.0 g/sec, 13.5 g/sec, 12.0 g/sec).
2	Primary Variable (Percent Range/Current)	Pct Range/Current	The transmitter sends the PV's actual mA level and the PV's percent of range in each burst message (e.g.,11.0 mA 25%).
3	Process Variables/Current	Process Vars/Current	The transmitter sends the PV's actual milliamp reading and the PV, SV, TV, and QV values in measurement units in each burst message (e.g.,11.8 mA, 50 g/sec, 23 °C, 50 g/sec, 0.0023 g/cm3).
9	Read Device Variables with Status	Device Variables with Status	The transmitter sends up to eight user-specified process variables in each burst message.
33	Transmitter Variables	Field Device Vars	The transmitter sends four user-specified process variables in each burst message.
48	Read Additional Transmitter Status	Read Additional Device Status	The transmitter sends expanded device status information in each burst message.

4. Depending on your choice, select the four or eight user-specified variables for the burst message, or set the HART variables as desired.

Important

If you change the HART Primary Variable (PV) or Secondary Variable (SV), the process variables assigned to the primary mA output and the secondary mA output (if applicable) are automatically changed to match. The PV cannot be changed on devices with fixed mA output assignments.

Configure HART trigger mode

Display	*Not available*
ProLink III	Device Tools > Configuration > Communications > Communications (HART)
Field Communicator	Configure > Manual Setup > HART > Burst Mode > Burst Message x > Configure Update Rate

Overview

Trigger mode uses the burst message mechanism to indicate that a process variable has changed. When trigger mode is implemented, the bursting interval (HART update rate) changes if Primary Variable or Burst Variable 0 moves above or below the user-specified trigger level. You can set up a different trigger on each burst message.

Restriction

This feature is available only with a HART 7 host.

Prerequisites

Before you can configure trigger mode, the corresponding HART burst message must be enabled.

Procedure

1. Select the burst message for which you will set up trigger mode.
2. Set Trigger Mode to the type of trigger you want to use.

Option	Description
Continuous	The burst message is sent at Default Update Rate. The burst interval is not affected by changes in process variables.
Falling	• When the specified process variable is above Trigger Level, the burst message is sent at Default Update Rate. • When the specified process variable is below Trigger Level, the burst message is sent at Update Rate.
Rising	• When the specified process variable is below Trigger Level, the burst message is sent at Default Update Rate. • When the specified process variable is above Trigger Level, the burst message is sent at Update Rate.
Windowed	This option is used to communicate that the process variable is changing rapidly. Trigger Level defines a deadband around the most recently broadcast value. • If the process variable stays within this deadband, the burst message is sent at Default Update Rate. • If the process variable moves outside this deadband in either direction, the burst message is sent at Update Rate.
On Change	• If any value in the burst message changes, the burst message is sent at Update Rate. • If no values change, the burst message is sent at Default Update Rate.

3. Ensure that Primary Variable or Burst Variable 0 is set to the variable that will activate the trigger. If it is not, reconfigure the burst message contents.
4. Set Trigger Level to the value of the process variable at which the trigger will be activated.
5. Set Default Update Rate to the burst interval to be used when the trigger is not active.
6. Set Update Rate to the burst interval to be used when the trigger is active.

Configure HART event notification

Display	*Not available*
ProLink III	Device Tools > Configuration > Communications > Communications (HART) > Event Notification
Field Communicator	Configure > Manual Setup > HART > Event Notification

Overview

Event notification uses the burst message mechanism to indicate that an alert has occurred. When event notification is enabled and one or more of the selected alerts occurs, each active burst message will broadcast HART Command 119 until the condition is acknowledged by a HART master.

Tip

Event notification affects only HART burst messages. Whether an alert is selected for event notification or not, alert severity, alert status (active or inactive), fault timeout, and alert acknowledgment operate as normal.

Restriction

This feature is available only with a HART 7 host.

Prerequisites

If you are using the Field Communicator, you must enable a burst message before you can configure event notification.

Procedure

1. Enable event notification.
2. Select all desired alerts.

   If one or more of the selected alerts occurs, each active burst message will broadcast HART Command 119 until the alert is acknowledged by a HART master.
3. Set Trigger Interval as desired.

   Trigger Interval controls the delay before HART Command 119 is broadcast.

   - Default: 0 seconds
   - Range: 0.5 to 3600 seconds

Trigger Interval begins when the transmitter detects the alert condition. When Trigger Interval expires:

- If the alert is still active, HART Command 119 is broadcast.
- If the alert is not active, no message is broadcast.

Tip

If you set Trigger Interval to 0, HART Command 119 is broadcast as soon as the alert is detected.

4. Set Retry Rate as desired.

   Retry Rate controls the rate at which HART Command 119 is broadcast when event notification is active.

   - Default: 0.5 seconds

5. Set Maximum Update Time as desired.

   Maximum Update Time controls the rate at which HART Command 119 is broadcast when event notification is not active.

   - Default: 60 seconds

6.4 Configure Modbus communications

Display	OFF-LINE MAINT > OFF-LINE CONFG > CONFIG MBUS
ProLink III	Device Tools > Configuration > Communications > Communications (Modbus)
Field Communicator	*Not available*

Overview

Modbus communications parameters control Modbus communications with the transmitter.

Modbus support is implemented on the RS-485 physical layer via the RS-485 terminals.

Important

Your device automatically accepts all connection requests within the following ranges:

- Protocol: Modbus RTU (8-bit) or Modbus ASCII (7-bit) unless Modbus ASCII Support is disabled
- Parity: odd or even
- Stop bits: 1 or 2
- Baud: 1200, 2400, 4800, 9600, 19200, 38400

You do not need to configure these communications parameters on the device.

Procedure

1. Enable or disable Modbus ASCII Support as desired.

   The setting of this parameter controls the range of valid Modbus addresses for your device.

Modbus ASCII support	Available Modbus addresses
Disabled	1–127, excluding 111 (111 is reserved to the service port)
Enabled	1–15, 32–47, 64–79, and 96–110

2. Set Modbus Address to a unique value on the network.
3. Set Floating-Point Byte Order to match the byte order used by your Modbus host.

Code	Byte order
0	1–2 3–4
1	3–4 1–2
2	2–1 4–3
3	4–3 2–1

   See the following table for the bit structure of bytes 1, 2, 3, and 4.

   Table 6-7: Bit structure of floating-point bytes

Byte	Bits	Definition
1	SEEEEEEE	S=Sign E=Exponent
2	EMMMMMMM	E=Exponent M=Mantissa
3–4	MMMMMMMM	M=Mantissa

4. (Optional) Set Additional Communications Response Delay in *delay units*.

   A delay unit is 2/3 of the time required to transmit one character, as calculated for the port currently in use and the character transmission parameters.

   Additional Communications Response Delay is used to synchronize Modbus communications with hosts that operate at a slower speed than the device. The value specified here will be added to each response the device sends to the host.

   - Default: 0
   - Range: 0 to 255

Tip

Do not set Additional Communications Response Delay unless required by your Modbus host.

6.5 Configure Digital Communications Fault Action

Display	*Not available*
ProLink III	Device Tools > Configuration > Fault Processing
Field Communicator	Configure > Alert Setup > I/O Fault Actions > Digital Communication Fault Action

Overview

Digital Communications Fault Action specifies the values that will be reported via digital communications if the device encounters an internal fault condition.

Procedure

Set Digital Communications Fault Action as desired.

The default setting is None.

Restrictions

- If mA Output Fault Action is set to None, Digital Communications Fault Action should also be set to None. If you do not, the output will not report actual process data, and this may result in measurement errors or unintended consequences for your process.
- If you set Digital Communications Fault Action to NAN, you cannot set mA Output Fault Action to None. If you try to do this, the transmitter will not accept the configuration.

6.5.1 Options for Digital Communications Fault Action

Table 6-8: Options for Digital Communications Fault Action

Label		Description
ProLink III	**Field Communicator**	
Upscale	Upscale	• Process variable values indicate that the value is greater than the upper sensor limit.
Downscale	Downscale	• Process variable values indicate that the value is lower than the lower sensor limit.
Zero	IntZero-All 0	• Density is reported as 0. • Temperature is reported as 0 °C, or the equivalent if other units are used (e.g., 32 °F). • Drive gain is reported as measured.

Table 6-8: Options for Digital Communications Fault Action ***(continued)***

Label		
ProLink III	**Field Communicator**	**Description**
Not a Number	Not-a-Number	• Process variables are reported as `IEEE NAN`. • Drive gain is reported as measured. • Modbus scaled integers are reported as `Max Int`.
None	None (default)	• All process variables are reported as measured.

7 Complete the configuration

Topics covered in this chapter:

- *Test or tune the system using sensor simulation*
- *Back up transmitter configuration*
- *Enable HART security*

7.1 Test or tune the system using sensor simulation

Display	*Not available*
ProLink III	Device Tools > Diagnostics > Testing > Sensor Simulation
Field Communicator	Service Tools > Simulate > Simulate Sensor

Overview

Use sensor simulation to test the system's response to a variety of process conditions, including boundary conditions, problem conditions, or alert conditions, or to tune the loop.

Procedure

1. Enable sensor simulation.
2. Set the process variables to the desired test values.
3. Observe the system response to the simulated values and make any appropriate changes to the transmitter configuration or to the system.
4. Modify the simulated values and repeat.
5. When you have finished testing or tuning, disable sensor simulation.

7.2 Back up transmitter configuration

ProLink III provides a configuration upload/download function which allows you to save configuration sets to your PC. This allows you to back up and restore your transmitter configuration. This is also a convenient way to replicate a configuration across multiple devices.

Restriction
This function is not available with any other communications tools.

Procedure

1. Choose Device Tools > Configuration Transfer > Save or Load Configuration Data.
2. In the Configuration groupbox, select the configuration data you want to save.
3. Click Save, then specify a file name and location on your computer.
4. Click Start Save.

The backup file is saved to the specified name and location. It is saved as a text file and can be read using any text editor.

7.3 Enable HART security

When HART security is enabled, HART protocol cannot be used to write any data to the device. This prevents changes to configuration via HART. It does not prevent changes to configuration using any other protocol or method.

Tip
Do not enable HART security unless it is specifically required for your meter. Most installations do not enable HART security.

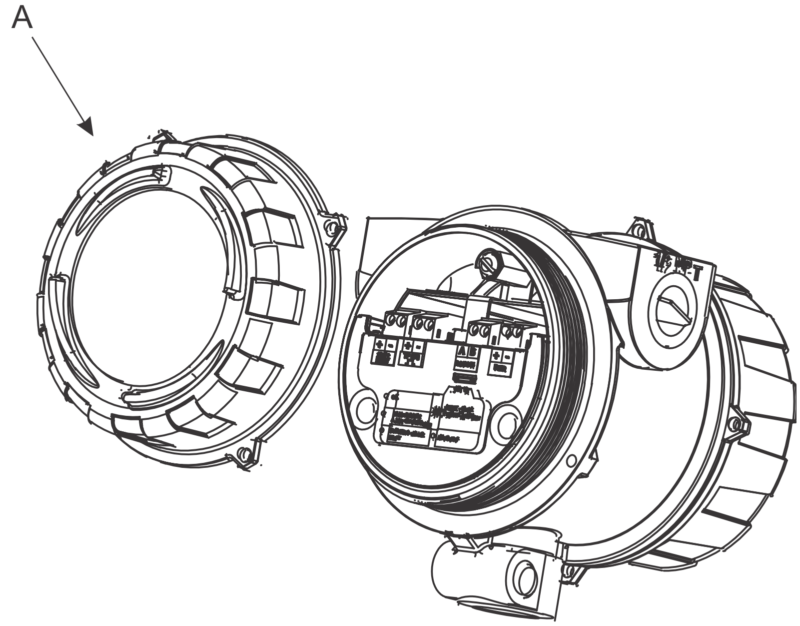
Prerequisites

- Strap wrench
- 3 mm hex key

Procedure

1. Power down the meter.
2. Using the strap wrench, loosen the grub screws and remove the transmitter end-cap.

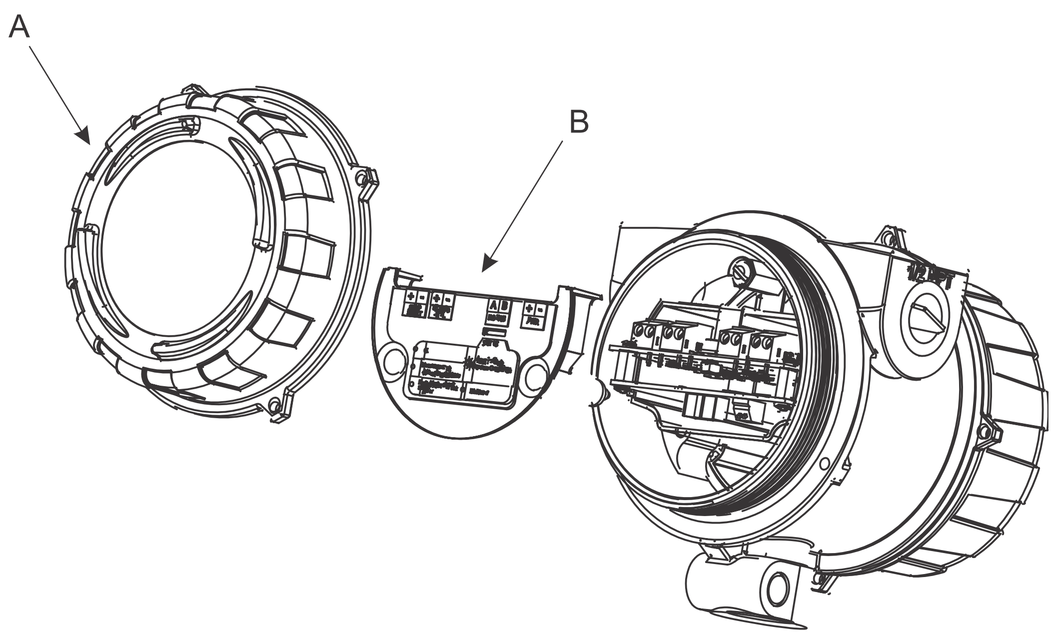
Figure 7-1: Transmitter with end-cap removed



A. Transmitter end-cap

3. Using the hex key, remove the safety spacer.

Figure 7-2: Transmitter with end-cap and safety spacer removed

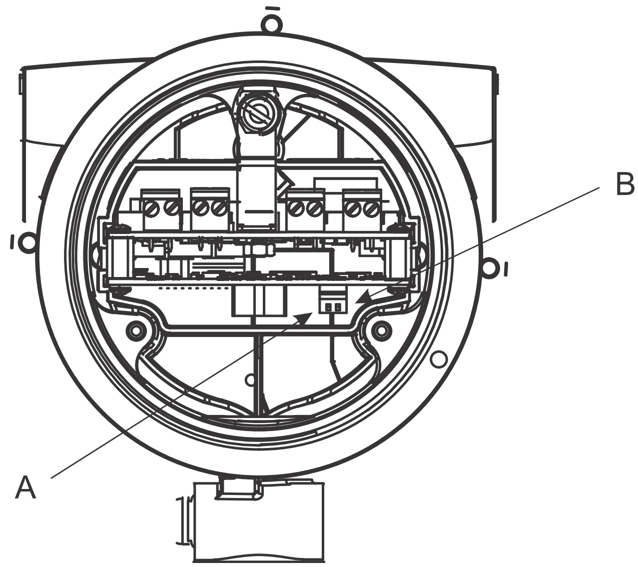


A. Transmitter end-cap
B. Safety spacer

4. Move the HART security switch to the ON position (down).

The HART security switch is the switch on the left.

Figure 7-3: HART security switch



A. HART security switch
B. Unused

5. Replace the safety spacer and end-cap.
6. Power up the meter.

Part III

Operations, maintenance, and troubleshooting

Chapters covered in this part:

8 Transmitter operation

Topics covered in this chapter:

- *Record the process variables*
- *View process variables and diagnostic variables*
- *View and acknowledge status alerts*

8.1 Record the process variables

Micro Motion suggests that you make a record of specific process variable measurements, including the acceptable range of measurements, under normal operating conditions. This data will help you recognize when the process or diagnostic variables are unusually high or low, and may help you diagnose and troubleshoot application issues.

Procedure

Record the following process and diagnostic variables, under normal operating conditions.

	Measurement		
Variable	**Typical average**	**Typical high**	**Typical low**
Line Viscosity			
Line Density			
Line Temperature			
Sensor Time Period			
Sensor Time Period (Upper)			
Drive Gain			

8.2 View process variables and diagnostic variables

Process variables provide information about the state of the process fluid. Diagnostic variables provide data about meter operation. This information can be used to understand and troubleshoot your process.

- *View process variables using the display* (Section 8.2.1)
- *View process variables and other data using ProLink III* (Section 8.2.2)
- *View process variables using the Field Communicator* (Section 8.2.3)

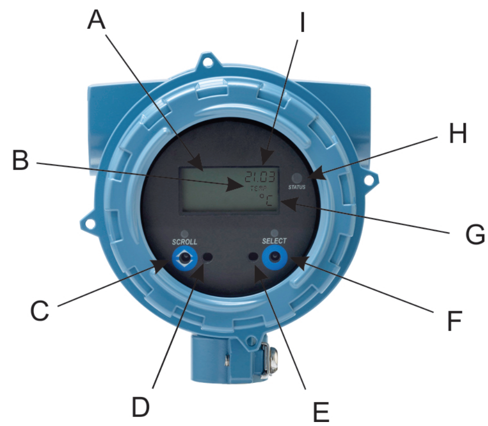
8.2.1 View process variables using the display

View the desired process variable(s).

The display shows the configured display variables. For each display variable, the display reports the abbreviated name of the process variable (for example, DENS for density), the current value of that process variable, and the associated unit of measure (for example, G/CM3).

If Auto Scroll is enabled, the display cycles through the display variables, showing each display variable for a user-specified number of seconds. Whether or not Auto Scroll is enabled, you can activate Select to move to the next display variable.

Figure 8-1: Transmitter display features



A. *Display (LCD panel)*
B. *Process variable*
C. *Scroll optical switch*
D. *Optical switch indicator: turns red when Scroll is activated*
E. *Optical switch indicator: turns red when Select is activated*
F. *Select optical switch*
G. *Unit of measure for process variable*
H. *Status LED*
I. *Current value of process variable*

8.2.2 View process variables and other data using ProLink III

Monitor process variables, diagnostic variables, and other data to maintain process quality.

ProLink III automatically displays process variables, diagnostic variables, and other data on the main screen.

Tip

ProLink III allows you to choose the process variables that appear on the main screen. You can also choose whether to view data in Analog Gauge view or digital view, and you can customize the gauge settings. For more information, see the ProLink III user manual.

8.2.3 View process variables using the Field Communicator

Monitor process variables to maintain process quality.

- To view current values of basic process variables, choose Overview.
- To view a more complete set of process variables, plus the current state of the outputs, choose Service Tools > Variables.

8.3 View and acknowledge status alerts

The transmitter posts status alerts whenever a process variable exceeds its defined limits or the transmitter detects a fault condition. You can view active alerts, and you can acknowledge alerts. Acknowledging alerts is not required.

- *View and acknowledge alerts using the display* (Section 8.3.1)
- *View and acknowledge alerts using ProLink III* (Section 8.3.2)
- *View alerts using the Field Communicator* (Section 8.3.3)

8.3.1 View and acknowledge alerts using the display

You can view a list containing all alerts that are active, or inactive but unacknowledged.

Note

Only Fault and Informational alerts are listed. The transmitter automatically filters out alerts with Status Alert Severity set to Ignore.

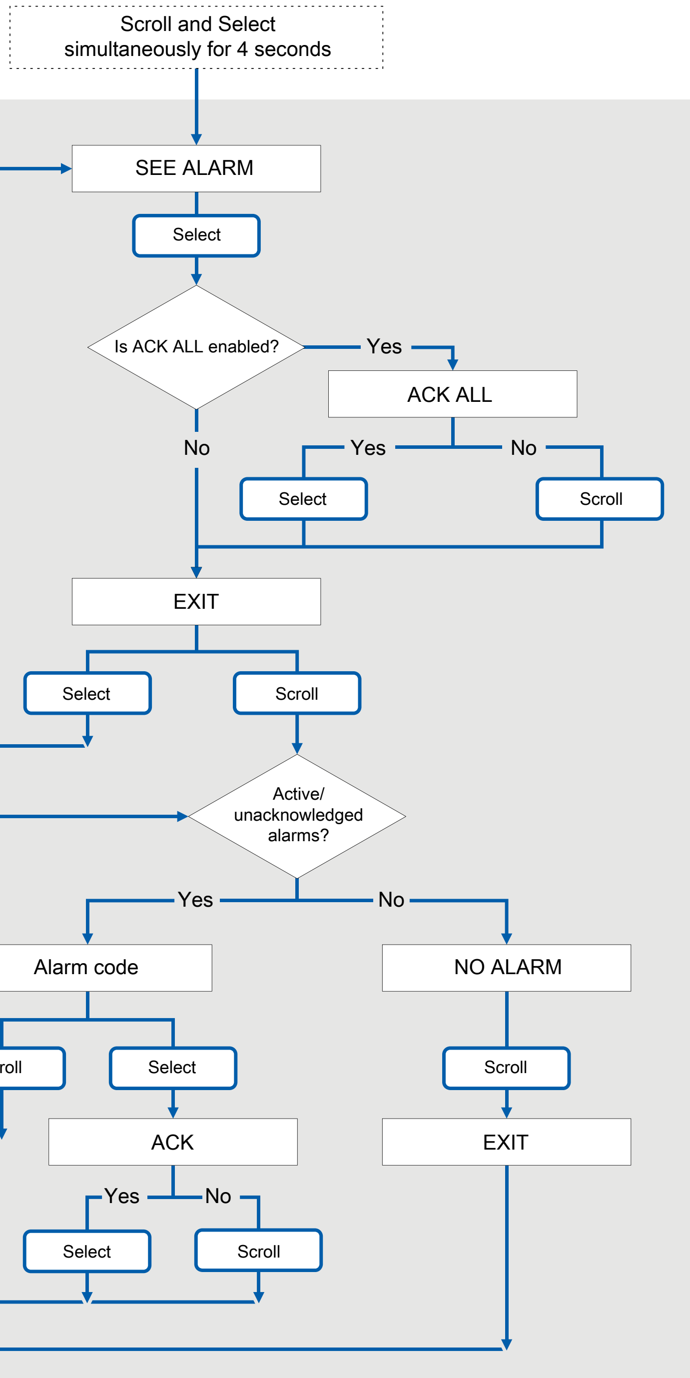
Prerequisites

Operator access to the alert menu must be enabled (default setting). If operator access to the alert menu is disabled, you must use another method to view or acknowledge status alerts.

Procedure

See *Figure 8-2*.

Figure 8-2: Using the display to view and acknowledge the status alerts



Postrequisites

- To clear A010, A011, A012, A013 alerts, you must correct the problem, acknowledge the alert, then repeat the calibration.
- To clear A001, A002, A029, A031 alerts, you must correct the problem, acknowledge the alert, then power-cycle the transmitter.
- For all other alerts:
  - If the alert is inactive when it is acknowledged, it will be removed from the list.
  - If the alert is active when it is acknowledged, it will be removed from the list when the alert condition clears.

Related information

Alert data in transmitter memory

8.3.2 View and acknowledge alerts using ProLink III

You can view a list containing all alerts that are active, or inactive but unacknowledged. From this list, you can acknowledge individual alerts or choose to acknowledge all alerts at once.

1. View alerts on the ProLink III main screen under Alerts. If the alerts are not displayed, choose Device Tools > Alerts.

   All active or unacknowledged alerts are listed, and displayed according to the following categories:

Category	Description
Failed: Fix Now	A meter failure has occurred and must be addressed immediately.
Maintenance: Fix Soon	A condition has occurred that can be fixed at a later time.
Advisory: Informational	A condition has occurred, but requires no maintenance from you.

   Notes
   - All fault alerts are displayed in the Failed: Fix Now category.
   - All information alerts are displayed in either the Maintenance: Fix Soon category or the Advisory: Informational category. The category assignment is hard-coded.
   - The transmitter automatically filters out alerts with Alert Severity set to Ignore.

2. To acknowledge a single alert, check the Ack checkbox for that alert. To acknowledge all alerts at once, click Ack All.

Postrequisites

- To clear A010, A011, A012, A013 alerts, you must correct the problem, acknowledge the alert, then repeat the calibration.
- To clear A001, A002, A029, A031 alerts, you must correct the problem, acknowledge the alert, then power-cycle the transmitter.

- For all other alerts:
  - If the alert is inactive when it is acknowledged, it will be removed from the list.
  - If the alert is active when it is acknowledged, it will be removed from the list when the alert condition clears.

Related information

Alert data in transmitter memory

8.3.3 View alerts using the Field Communicator

You can view a list containing all alerts that are active, or inactive but unacknowledged.

- To view active or unacknowledged alerts, choose Service Tools > Alerts.

  All active alerts and unacknowledged alerts are listed.

  Note
  Only Fault and Informational alerts are listed. The transmitter automatically filters out alerts with Status Alert Severity set to Ignore.

- To refresh the list, choose Service Tools > Alerts > Refresh Alerts.

Related information

Alert data in transmitter memory

8.3.4 Alert data in transmitter memory

The transmitter maintains three sets of data for every alert that is posted.

For each alert occurrence, the following three sets of data are maintained in transmitter memory:

- Alert List
- Alert Statistics
- Recent Alerts

Table 8-1: Alert data in transmitter memory

Alert data structure	Transmitter action if condition occurs	
	Contents	**Clearing**
Alert List	As determined by the alert status bits, a list of: • All currently active alerts • All previously active alerts that have not been acknowledged	Cleared and regenerated with every transmitter power cycle

Table 8-1: Alert data in transmitter memory *(continued)*

Alert data structure	Transmitter action if condition occurs	
	Contents	**Clearing**
Alert Statistics	One record for each alert (by alert number) that has occurred since the last master reset. Each record contains: • A count of the number of occurrences • Timestamps for the most recent posting and clearing	Not cleared; maintained across transmitter power cycles
Recent Alerts	50 most recent alert postings or alert clearings	Not cleared; maintained across transmitter power cycles

9 Measurement support

Topics covered in this chapter:

9.1 Perform the inline calibration check procedure

Use the inline calibration check to compare the meter's calculated density value of a known fluid at process conditions to a lab measurement of the same fluid at reference conditions.

If the meter passes the check, the meter is performing as expected. If the meter fails the check, either a density offset may be required, or there has been a change to the meter that is affecting performance.

If at anytime during this procedure the density measurement fluctuates, remove the meter from the control loop.

Tip

Use the inline calibration check as an initial diagnostic to validate meter performance. If there is a change to the meter that affects performance (such as corrosion, erosion or coating), the inline calibration check will fail. If the check fails, either an offset can be applied, or a more extensive evaluation is recommended.

Restriction

To use the inline calibration check, the fluid measured by the sensor must be either water or a known user fluid with a respective concentration measurement matrix or API table.

Prerequisites

- The fluid being tested must be either water or a known fluid.
- If using water, you need to know the water density, temperature, and pressure that were measured in the laboratory.
- If using a fluid other than water, your meter must have concentration measurement or API referral enabled.
- If using a fluid other than water with API referral:

  - Know the density at reference conditions that was measured in the laboratory.
  - Make sure the correct API table is selected.
- If using a fluid other than water with concentration measurement:
  - Know the density at reference conditions that was measured in the laboratory.
  - Make sure the associated concentration measurement curve is loaded.
  - Make sure that the Active Matrix is set to the matrix for the fluid you want to measure.

CAUTION!

Measured density values will fluctuate while the inline calibration check procedure is running.

Related information

Perform the inline calibration check using ProLink III
Perform the inline calibration check using the Field Communicator

9.1.1 Perform the inline calibration check using ProLink III

1. Read *Section 9.1* if you have not done so already.
2. Choose Device Tools > Diagnostics > Inline Calibration Check.
3. Select Water or User for Fluid, and click Apply.

   To test a fluid other than water, select User.
4. Enter the appropriate laboratory reference values.

   - For Water: Enter the laboratory reference values for Water Density, Reference Temperature, and Reference Pressure.
   - For User with API referral: Enter the value for Laboratory Density at Reference Conditions.

     The values for Reference Temperature and Reference Pressure should already be populated from the API table.
   - For User with concentration measurement: Enter the value for Laboratory Density at Reference Conditions.

     The values for Active Matrix and Reference Temperature should already be populated.
5. Click Check Calibration.
6. Check the results at the bottom of the screen.

   - If the calibration check passed, no action is required.
   - If the calibration check failed, run the Density Offset Calibration wizard to apply the calculated offset at reference conditions.

Tip
If the inline calibration check failed, continue to monitor the density performance on regular intervals. If the inline calibration check continues to fail, further diagnosis is required. Remove the meter from the line and run the Known Density Verification procedure.

Related information

Perform the Known Density Verification procedure using ProLink III
Perform the Known Density Verification procedure using the Field Communicator

9.1.2 Perform the inline calibration check using the Field Communicator

1. Read *Section 9.1* if you have not done so already.
2. Navigate to the inline calibration check: Service Tools > Maintenance > Verification > Inline Calibration Check.
3. Enter the laboratory reference value.
4. Press OK.

   Wait a few seconds while the calibration is performed.
5. Choose Results and check the values.
   - If the calibration check passed, no action is required.
   - If the calibration check failed, run the density offset calibration to apply the calculated offset at reference conditions.

Tip
If the inline calibration check failed, continue to monitor the density performance on regular intervals. If the inline calibration check continues to fail, further diagnosis is required. Remove the meter from the line and run the Known Density Verification procedure.

9.2 Perform the Known Density Verification procedure

The Known Density Verification procedure is used to verify that the meter's current operation matches the factory baseline. If the meter passes the test, the meter does not have any physical problems such as denting, bending, twisting, erosion, or corrosion.

Restriction
This feature is available only on the HFVM-B. It is not available on the HFVM-R.

Prerequisites

Check calibration integrity inline first by running water or a known fluid through the system using the factory measurements. Verify that the reported density is correct. If it is not correct, continue with a KDV check and the following prerequisites.

1. Power down the meter, remove the meter from the process, and place it in a protected stable environment.
2. Minimize variation in ambient temperature.
3. Eliminate or minimize vibration.
4. Ensure that the meter is clean. Check for deposition on the tines.
5. Power up the meter.

- *Perform the Known Density Verification procedure using the display* (Section 9.2.1)
- *Perform the Known Density Verification procedure using ProLink III* (Section 9.2.2)
- *Perform the Known Density Verification procedure using the Field Communicator* (Section 9.2.3)

9.2.1 Perform the Known Density Verification procedure using the display

Procedure

1. Read *Section 9.2* if you have not done so already.
2. Enter the Off-Line Maintenance menu and scroll to RUN KDV.
3. Set Alt to the value that is closest to the altitude of your meter, measured from sea level.

   a. Activate SCROLL to move through the list of options.

      The options are 0000, 1000 feet, 2000 feet, 3000 feet, 4000 feet, 5000 feet, 6000 feet, 500 meters, 1000 meters, and 2000 meters.

   b. When the correct value appears, activate SELECT and save the value to the meter.
4. When START KDV appears, activate SELECT.
5. Wait while the meter collects and analyzes process data.

   This step should be complete in approximately 40 seconds.
6. Check the results in the Results data display.

   - If all process variables passed the tests, no action is required. Click Close to exit the wizard.
   - If one or more process variables failed the test:
     - For problems with Line Temperature, verify that the ambient temperature of the meter is stable, and that the meter temperature has stabilized in the test location. Then retry the Known Density Verification procedure.

- For problems with Verification Time Period Signal or Drive Gain, ensure that the meter is clean and dry. Then retry the Known Density Verification procedure.
- If the Known Density Verification procedure continues to fail, contact Micro Motion customer service.

9.2.2 Perform the Known Density Verification procedure using ProLink III

1. Read *Section 9.2* if you have not done so already.
2. Choose Device Tools > Diagnostics > Known Density Verification.
3. (Optional) Enter identification data.
4. Set Altitude to the value that is closest to the altitude of your meter, measured from sea level.

   Valid values are 0000 to 6000 feet, and 0000 to 2000 meters.
5. Click Start, then wait while the meter collects and analyzes process data.

   This step should be complete in approximately 40 seconds.
6. Check the results in the Results data display.
   - If all process variables passed the tests, no action is required. Click Close to exit the wizard.
   - If one or more process variables failed the test:
     - For problems with Line Temperature, verify that the ambient temperature of the meter is stable, and that the meter temperature has stabilized in the test location. Then retry the Known Density Verification procedure.
     - For problems with Verification Time Period Signal or Drive Gain, ensure that the meter is clean and dry. Then retry the Known Density Verification procedure.
     - If the Known Density Verification procedure continues to fail, contact Micro Motion customer service.

9.2.3 Perform the Known Density Verification procedure using the Field Communicator

1. Read *Section 9.2* if you have not done so already.
2. Choose Service Tools > Maintenance > Verification > Known Density Verification.
3. Set Altitude to the value that is closest to the altitude of your meter, measured from sea level.

   Valid values are 0000 to 6000 feet, and 0000 to 2000 meters.
4. Click Next to start the procedure.
5. Wait while the meter collects and analyzes process data.

This step should be complete in approximately 40 seconds.

6. Check the results in the Results data display.
   - If all process variables passed the tests, no action is required. Click Close to exit the wizard.
   - If one or more process variables failed the test:
     - For problems with Line Temperature, verify that the ambient temperature of the meter is stable, and that the meter temperature has stabilized in the test location. Then retry the Known Density Verification procedure.
     - For problems with Verification Time Period Signal or Drive Gain, ensure that the meter is clean and dry. Then retry the Known Density Verification procedure.
     - If the Known Density Verification procedure continues to fail, contact Micro Motion customer service.

9.3 Adjust viscosity measurement with Viscosity Offset

Display	*Not available*
ProLink III	Device Tools > Configuration > Process Measurement > Line Viscosity > Viscosity Offset
Field Communicator	Configure > Manual Setup > Measurements > Viscosity > Viscosity Offset

Overview

You can adjust viscosity measurement by applying an offset.

Tip

You can adjust line viscosity measurement with Viscosity Meter Factor, Viscosity Offset, or both. Viscosity Meter Factor is applied to the measured dynamic viscosity, and Viscosity Offset is added to the result. Kinematic viscosity is calculated from this value. Referred viscosity may be calculated from either dynamic viscosity or kinematic viscosity, depending on the configuration.

The default value of Viscosity Offset is 0. Accordingly, the default value has no effect on viscosity measurement.

Procedure

Enter the desired viscosity offset, in cP.

The default value is 0. The range is unlimited.

9.4 Adjust viscosity measurement with Viscosity Meter Factor

You can adjust viscosity measurement by applying a viscosity meter factor. The measured dynamic viscosity is always multiplied by the viscosity meter factor. The result is used in further calculations.

The default value of Viscosity Meter Factor is 1.0. Accordingly, the default value has no effect on the line viscosity value.

Your meter is calibrated for two viscosity ranges. There is a separate meter factor for each range. If you are using the HFVM-B, you can calculate or enter a meter factor for either or both of the viscosity ranges. If you are using the HFVM-R, you must enter the meter factor manually.

Tip

You can adjust line viscosity measurement with Viscosity Meter Factor, Viscosity Offset, or both. Viscosity Meter Factor is applied to the measured dynamic viscosity, and Viscosity Offset is added to the result. Kinematic viscosity is calculated from this value. Referred viscosity may be calculated from either dynamic viscosity or kinematic viscosity, depending on the configuration.

Prerequisites

Referred viscosity measurement must be configured before you can use the meter to calculate the viscosity meter factor. If you are not using referred viscosity, you must enter the viscosity meter factor manually.

You must be able to obtain a laboratory value for the dynamic viscosity of your process fluid at Reference Temperature 1. This temperature value was specified during referred viscosity configuration.

- *Adjust viscosity measurement with Viscosity Meter Factor using the display* (Section 9.4.1)
- *Adjust viscosity measurement with Viscosity Meter Factor using ProLink III* (Section 9.4.2)
- *Adjust viscosity measurement with Viscosity Meter Factor using the Field Communicator* (Section 9.4.3)
- *Calculate and enter Viscosity Meter Factor manually* (Section 9.4.4)

9.4.1 Adjust viscosity measurement with Viscosity Meter Factor using the display

1. Read *Section 9.4* if you have not done so already.
2. Activate SCROLL.
3. Check the current viscosity range.

   The meter factor will be calculated for this range, and applied only to viscosity measurements in this range. If you want to calculate a meter factor for a different range, you must change the viscosity of your process fluid.

4. Record the reference temperature.

   This is the temperature specified as Reference Temperature 1 during referred viscosity configuration. It must also be the temperature used for the laboratory measurement of dynamic viscosity.
5. Obtain a laboratory value for the dynamic viscosity of your process fluid at reference temperature.
6. Activate SCROLL.
7. When ENTER DYNV is displayed, activate SELECT and enter the laboratory reference value for the dynamic viscosity of your process fluid at reference temperature.
8. When APPLY SCALE FACT is displayed, activate SELECT.
9. View the results.

   a. The new viscosity meter factor is displayed.
   b. Activate SCROLL.
   c. The adjusted referred viscosity value is displayed.

   The default value for Viscosity Meter Factor is 1.0. The recommended range is 0.8 to 1.2. If your calculated meter factor is outside this range, contact Micro Motion customer service.

9.4.2 Adjust viscosity measurement with Viscosity Meter Factor using ProLink III

1. Read *Section 9.4* if you have not done so already.
2. Choose Device Tools > Calibration > Viscosity > Viscosity Meter Factor.
3. Check the current viscosity range.

   The meter factor will be calculated for this range, and applied only to viscosity measurements in this range. If you want to calculate a meter factor for a different range, you must change the viscosity of your process fluid.
4. Record the reference temperature.

   This is the temperature specified as Reference Temperature 1 during referred viscosity configuration. It must also be the temperature used for the laboratory measurement of dynamic viscosity.
5. Obtain a laboratory value for the dynamic viscosity of your process fluid at reference temperature.
6. Enter the laboratory reference value for the dynamic viscosity of your process fluid at reference temperature.
7. Click Calculate Meter Factor.
8. Wait for a few seconds, then check the results.

   The new viscosity meter factor and the adjusted referred viscosity value are displayed.

The default value for Viscosity Meter Factor is 1.0. The recommended range is 0.8 to 1.2. If your calculated meter factor is outside this range, contact Micro Motion customer service.

Tip
To view all viscosity meter factors, choose Device Tools > Configuration > Process Measurement > Viscosity.

9.4.3 Adjust viscosity measurement with Viscosity Meter Factor using the Field Communicator

1. Read *Section 9.4* if you have not done so already.
2. Choose Service Tools > Maintenance > Calibration > Viscosity Scaling Factor Cal.
3. Record the reference temperature.

   This is the temperature specified as Reference Temperature 1 during referred viscosity configuration. It must also be the temperature used for the laboratory measurement of dynamic viscosity.
4. Obtain a laboratory value for the dynamic viscosity of your process fluid at reference temperature.
5. Choose Start Calibration.
6. Check the current viscosity range.

   The meter factor will be calculated for this range, and applied only to viscosity measurements in this range. If you want to calculate a meter factor for a different range, you must change the viscosity of your process fluid.
7. Choose the current range and enter the laboratory reference value for the dynamic viscosity of your process fluid at reference temperature.
8. Click OK and wait for a few seconds.

   When the calibration is complete, you will be returned to the viscosity calibration menu.
9. Choose Results.

   The new viscosity meter factor and the adjusted referred viscosity value are displayed.

   The default value for Viscosity Meter Factor is 1.0. The recommended range is 0.8 to 1.2. If your calculated meter factor is outside this range, contact Micro Motion customer service.

9.4.4 Calculate and enter Viscosity Meter Factor manually

Prerequisites

You must be able to take a sample of your process fluid at a known temperature, then obtain a laboratory value for the dynamic viscosity of the fluid at that temperature.

You must use ProLink III for this procedure.

Procedure

1. Take a dynamic viscosity reading from the device and record the line temperature.
2. Immediately after the previous step, take a sample from a location as close to the device as possible.
3. Using the external measurement method, measure the viscosity of the sample at line temperature.
4. Use the following equation to calculate an appropriate value for Viscosity Meter Factor.

$$\mu_{\text{Lab}} = (\mu_{\text{Line}} \times \text{ViscosityMeterFactor}) + \text{ViscosityOffset}$$

   The default value for Viscosity Meter Factor is 1.0. The recommended range is 0.8 to 1.2. If your calculated meter factor is outside this range, contact Micro Motion customer service.
5. Enter the meter factor.
   a. Choose Device Tools > Configuration > Process Measurement > Line Viscosity.
   b. Identify the viscosity range for the measured dynamic viscosity.
   c. Enter the calculated meter factor for the identified viscosity range.

9.5 Adjust density measurement with Density Offset or Density Meter Factor

You can adjust the reported density measurement by modifying the value for Density Offset or Density Meter Factor. The measured density value is always multiplied by the density meter factor. The density offset is always added to the result.

Restriction

If you are using the HFVM-R, Density Meter Factor is not available. Density Offset is available.

The default value for Density Meter Factor is 1.0. The default value for Density Offset is 0. Accordingly, the default values have no effect on the reported density value.

Important

Density Offset and Density Meter Factor improve measurement accuracy only when the line temperature and line pressure of the sample are close to the line temperature and line pressure of the process.

Tip

If the density offset calibration procedure is available, use it to calculate a density offset value that is corrected to reference temperature and reference pressure. Density offset calibration is the preferred method to adjust density measurement.

Restriction

You cannot enter a density offset from the display. If you want to change the density offset manually, you must use ProLink III or the Field Communicator.

Prerequisites

You will need an external density measurement method that is highly accurate.

Ensure that your process is stable during the sampling procedure. Minimize variation in density, temperature, flow rate, and fluid composition. Minimize aeration.

Procedure

1. Take a density reading from the device.
   a. Ensure that line temperature and line pressure are at typical operating levels.
   b. Record the line temperature and line pressure.
   c. Record the measured density.
2. Immediately after the previous step, take a sample from a location as close to the device as possible.
3. Using the external measurement method, measure the density of the sample at line temperature and line pressure.
4. Use the following equation to calculate an appropriate value for Density Offset or Density Meter Factor.

$$\rho_{\text{Lab}} = (\rho_{\text{Line}} \times \text{DensityMeterFactor}) + \text{DensityOffset}$$

Tip

In most cases, you will calculate and set only one parameter. Follow the guidelines established for your site.

5. If you are using the offset to adjust density measurement, set Density Offset to the calculated value.
   - Using the display: Not available
   - Using ProLink III: Device Tools > Configuration > Process Measurement > Line Density > Density Offset
   - Using the Field Communicator: Configure > Manual Setup > Measurements > Density > Density Offset

   The default value for Density Offset is 0. The range is unlimited.
6. If you are using the meter factor to adjust density measurement, set Density Meter Factor to the calculated value.
   - Using the display: OFF-LINE MAINT > OFF-LINE CAL > DENS MTR F
   - Using ProLink III: Device Tools > Configuration > Process Measurement > Line Density > Density Meter Factor

- Using the Field Communicator: Configure > Manual Setup > Measurements > Density > Meter Factor

The default value for Density Meter Factor is 1.0. The recommended range is 0.8 to 1.2. If your calculated meter factor is outside this range, contact Micro Motion customer service.

9.6 Perform density offset calibration

Density offset calibration is used to verify or adjust the value of Density Offset. Density Offset is always added to the measured density value after the density meter factor is applied, and before other processing is performed.

Restriction

If you are using the HFVM-R, density offset calibration is not available. You can configure a density offset manually.

The default value of Density Offset is 0.

Restriction

Density offset calibration is available only when API referral or concentration measurement is enabled on your meter. If neither of these is enabled, Density Offset must be entered manually.

Tip

Density offset calibration is the preferred method for calculating a density offset, because the procedure automatically corrects the data to reference temperature and reference pressure. If this procedure is available on your device, use it and do not set Density Offset manually.

Prerequisites

- Ensure that your process is stable during the calibration procedure. Minimize variation in density, temperature, flow rate, and fluid composition. Minimize aeration.
- If concentration measurement is enabled on your meter, ensure that Active Matrix is set to the matrix that you want to calibrate.
- Following the procedures defined in ASTM 1298 or API 555, obtain a laboratory reference value for the density of your process fluid at reference temperature and reference pressure.

- *Perform density offset calibration using the display* (Section 9.6.1)
- *Perform density offset calibration using ProLink III* (Section 9.6.2)
- *Perform density offset calibration using the Field Communicator* (Section 9.6.3)

9.6.1 Perform density offset calibration using the display

1. Read *Section 9.6* if you have not done so already.

2. Navigate to the Density Offset Calibration wizard: OFF-LINE MAINT > OFF-LINE CAL > DENS CAL OFFSET and activate Select.

   If concentration measurement is enabled, the active matrix is displayed. Activate Scroll to continue. The current reference temperature is displayed.

3. Activate Scroll to move to the next step.
4. Enter the laboratory reference density and save it to the transmitter.
5. Activate Select to apply the offset, and wait for a few seconds while the calibration process is performed.

   If the calibration succeeded, the calculated density offset is displayed.

   If the calibration failed, Density Offset is reset to the original value.

   - Verify your laboratory reference value.
   - Ensure that your process was stable during the entire procedure.
   - Repeat the calibration.

6. Activate Scroll to view the referred density value.

   - For concentration measurement, Referred Density (Concentration) is displayed.
   - For API referral, Referred Density (API) is displayed.

7. To exit the calibration, activate Scroll, then activate Select.

9.6.2 Perform density offset calibration using ProLink III

1. Read *Section 9.6* if you have not done so already.
2. Navigate to the Density Offset Calibration wizard: Device Tools > Calibration > Density Offset > Density Offset Calibration.
3. Enter the laboratory reference value for density.
4. Click Apply Offset and wait for a few seconds while the calibration process is performed.
5. For API referral: Check the values displayed in the Density Offset and Referred Density (API) fields.

   If the calibration succeeded:

   - Density Offset displays the updated value for this parameter.
   - Referred Density (API) shows this process variable with the new density offset applied. This value should match the laboratory reference value.

   If the calibration failed, Density Offset is reset to the original value.

   - Verify your laboratory reference value.
   - Ensure that your process was stable during the entire procedure.
   - Repeat the calibration.

9.6.3 Perform density offset calibration using the Field Communicator

1. Read *Section 9.6* if you have not done so already.
2. Navigate to the Density Offset Calibration method: Service Tools > Maintenance > Calibration > Density Offset Calibration.
3. Enter the laboratory reference value.
4. Press OK and wait for a few seconds while the calibration process is performed.
5. Choose Results and check the values.

   If the calibration succeeded, the screen displays the updated value for Density Offset, the reference temperature, and the updated referred density value. This value should match the laboratory reference value.

   If the calibration failed, Density Offset is reset to the original value.
   - Verify your laboratory reference value.
   - Ensure that your process was stable during the entire procedure.
   - Repeat the calibration.

9.7 Perform temperature calibration

Temperature calibration establishes the relationship between the temperature of the calibration fluids and the signal produced by the sensor.

Prerequisites

The temperature calibration is a two-part procedure: temperature offset calibration and temperature slope calibration. The two parts must be performed without interruption, in the order shown. Ensure that you are prepared to complete the process without interruption. You will need a low-temperature calibration fluid and a high-temperature calibration fluid. You will not see the effect of the calibration until both the temperature offset calibration and the temperature slope calibration are complete.

Important
Consult Micro Motion before performing a temperature calibration. Under normal circumstances, the temperature circuit is stable and should not need an adjustment.

- *Perform temperature calibration using the display* (Section 9.7.1)
- *Perform temperature calibration using ProLink III* (Section 9.7.2)
- *Perform temperature calibration using the Field Communicator* (Section 9.7.3)

9.7.1 Perform temperature calibration using the display

1. Read *Section 9.7* if you have not done so already.
2. Immerse the tines in a low-temperature fluid.

- In a pipeline, bypass, or flow-through chamber installation, close an upstream valve and empty the segment. Then close a downstream valve, open the upstream valve, and fill the segment with the low-temperature fluid.
- In a tank installation, empty the tank, then fill it with the low-temperature fluid.

3. Wait until the temperature of the tines matches the temperature of the fluid.
4. Navigate to the calibration menu and enter it.
   a. Activate Scroll and Select simultaneously.
   b. Scroll to OFF-LINE MAINT and activate Select.
   c. Scroll to OFF-LINE CAL and activate Select.
   d. Scroll to CAL TEMP and activate Select.
5. Enter the temperature of the low-temperature fluid.
   a. When CAL OFFSET TEMP is flashing, activate Select.
   b. Enter the temperature value and save it.
6. Immerse the tines in a high-temperature fluid.
7. Wait until the temperature of the tines matches the temperature of the fluid.
8. Enter the temperature of the high-temperature fluid.
   a. When CAL SLOPE TEMP is flashing, activate Select.
   b. Enter the temperature value and save it.
9. Activate Scroll to view the new offset and slope values.
10. Activate Select to exit.

9.7.2 Perform temperature calibration using ProLink III

1. Read *Section 9.7* if you have not done so already.
2. Immerse the tines in a low-temperature fluid.
   - In a pipeline, bypass, or flow-through chamber installation, close an upstream valve and empty the segment. Then close a downstream valve, open the upstream valve, and fill the segment with the low-temperature fluid.
   - In a tank installation, empty the tank, then fill it with the low-temperature fluid.
3. Wait until the temperature of the tines matches the temperature of the fluid.
4. Choose Device Tools > Calibration > Temperature > Temperature Offset.
5. Enter the temperature of the low-temperature fluid.
6. Click Start Calibration.
7. Immerse the tines in a high-temperature fluid.
8. Wait until the temperature of the tines matches the temperature of the fluid.
9. Choose Device Tools > Calibration > Temperature > Temperature Slope.
10. Enter the temperature of the high-temperature fluid.
11. Click Start Calibration.

12. To view the new offset and slope values, choose Device Tools > Configuration > Process Measurement > Line Temperature.

9.7.3 Perform temperature calibration using the Field Communicator

1. Read *Section 9.7* if you have not done so already.
2. Immerse the tines in a low-temperature fluid.
    - In a pipeline, bypass, or flow-through chamber installation, close an upstream valve and empty the segment. Then close a downstream valve, open the upstream valve, and fill the segment with the low-temperature fluid.
    - In a tank installation, empty the tank, then fill it with the low-temperature fluid.
3. Wait until the temperature of the tines matches the temperature of the fluid.
4. Choose Service Tools > Maintenance > Calibration > Temperature Calibration > Temperature Calibration Offset.
5. Enter the temperature of the low-temperature fluid.
6. Wait for the calibration to complete.
7. Immerse the tines in a high-temperature fluid.
8. Wait until the temperature of the tines matches the temperature of the fluid.
9. Choose Service Tools > Maintenance > Calibration > Temperature Calibration > Temperature Calibration Slope.
10. Enter the temperature of the high-temperature fluid.
11. Wait for the calibration to complete.

9.8 Set up user-defined calculations

Display	*Not available*
ProLink III	Device Tools > Configuration > User-Defined Calculations
Field Communicator	Configure > Manual Setup > Measurements > User-Defined Calculations

Overview

User-defined calculations are used to enhance measurement or to adapt the meter to special process conditions.

A user-defined calculation allows you to create a new process variable by inserting constants and existing process variables into an equation. The output of the equation is the new process variable. Depending on your meter, either two or three equations are available.

Procedure

1. Select the user-defined calculation that you want to use.
2. If you selected User-Defined Calculation 1:

   a. Enter the values to be used for the constants: A, B, X, Y.

   b. Enter the values to be used for *a*, *b*, *c*, *d*, *e*, and *f*.

      For these terms:

      - You can specify a constant value.
      - You can specify a process variable. If you choose this, the current value of the process variable is used in the calculation.

   Important

   User-defined calculations are performed using the meter's internal measurement units. Therefore:

   - If a constant represents a process variable, you must enter its value in the internal measurement units.
   - If a constant will be used to modify a process variable, you must use the internal measurement units to derive the constant.

   ---

3. If you selected User-Defined Calculation 2:

   a. Enter the values to be used for the constants: A, B, C.

   b. Enter the value to be used for *t*.

      For this term:

      - You can specify a constant value.
      - You can specify a process variable. If you choose this, the current value of the process variable is used in the calculation.

   Important

   User-defined calculations are performed using the meter's internal measurement units. Therefore:

   - If a constant represents a process variable, you must enter its value in the internal measurement units.
   - If a constant will be used to modify a process variable, you must use the internal measurement units to derive the constant.

   ---

4. Enter a label to be used for the output of the user-defined calculation (the new process variable).
5. (Optional) Set up a reporting method for the new process variable.

   The new process variable can be configured as a display variable or a HART variable, or assigned to an mA output. It can also be read using digital communications.

Important

The output of the user-defined calculation is based on internal measurement units for process variables. You may need to convert this value to the configured units before using it in your application or process.

- *Equations used in user-defined calculations* (Section 9.8.1)
- *Measurement units used in user-defined calculations* (Section 9.8.2)

9.8.1 Equations used in user-defined calculations

Each user-defined calculation has an equation and a set of user-programmable constants and/or user-specified process variables.

Equation 9-1: User-defined calculation 1 (square root)

$$y = A + B \times \left(\frac{a \times (b + (X \times c))}{d \times (e + (Y \times \sqrt{f}))} \right)$$

A, B, X, Y	User-programmable constants
a, b, c, d, e, f	User-programmable constants or user-specified process variables
y	Result of calculation

Equation 9-2: User-defined calculation 2 (exponential)

$$y = e^{(A + (B \times t) + (C \times t^2))}$$

e	Natural logarithm
A, B, C	User-programmable constants
t	User-programmable constant or user-specified process variable
y	Result of calculation

9.8.2 Measurement units used in user-defined calculations

The meter's internal measurement units are used for all process variables referenced by a user-defined calculation. All constants must be entered in the internal measurement units or derived using the internal measurement units.

Table 9-1: Process variables and internal measurement units

Process variable	Internal measurement unit
Density	g/cm^3
Referred Density	g/cm^3
Line Temperature	°C
External Temperature	°C
Board Temperature	°C

Table 9-1: Process variables and internal measurement units *(continued)*

Process variable	Internal measurement unit
Drive Gain	%
Dynamic Viscosity	cP
Kinematic Viscosity	cSt
Referred Viscosity and Secondary Referred Viscosity	cP or cSt, depending on configuration
Sensor Time Period	Microseconds
CII	Unitless
CCAI	Unitless

10 Troubleshooting

Topics covered in this chapter:

10.1 Quick guide to troubleshooting

The meter may report or exhibit issues that are caused by installation problems, wiring problems, configuration problems, process problems, problems with external devices, or mechanical issues with the sensor itself.

To identify and resolve problems as effectively as possible, work through the following list of suggestions:

- If this is a first installation:
  - Verify the power wiring and power supply.
  - Verify the output wiring. The outputs must be powered externally.
  - Verify the grounding.

  - Verify cable shielding.
  - Perform loop tests for each output.
  - Check the sensor installation and orientation. Ensure that it is appropriate for your application.
  - Ensure that the installation meets temperature and/or pressure requirements.
- Check for active status alerts and follow the recommendations.
- If the device appears to be functioning correctly, but the process data is not acceptable, review the symptoms and suggestions in the following sections:
  - Viscosity measurement problems (see *Section 10.7*)
  - Density measurement problems (see *Section 10.8*)
  - Temperature measurement problems (see *Section 10.9*)
  - API referral problems (see *Section 10.10*)
- If the device appears to be functioning correctly, but the control loop is not performing as expected:
  - Verify the output wiring.
  - Ensure that all external devices are operational, are receiving data, and are configured appropriately.
  - Use sensor simulation to test boundary conditions and system response.

10.2 Check power supply wiring

If the power supply wiring is damaged or improperly connected, the transmitter may not receive enough power to operate properly.

Prerequisites

You will need the installation manual for your transmitter.

Procedure

1. Use a voltmeter to test the voltage at the transmitter's power supply terminals.
   - If the voltage is within the specified range, you do not have a power supply problem.
   - If the voltage is low, ensure that the power supply is adequate at the source, the power cable is sized correctly, there is no damage to the power cable, and an appropriate fuse is installed.
   - If there is no power, continue with this procedure.
2. Before inspecting the power supply wiring, disconnect the power source.

⚠ CAUTION!

If the transmitter is in a hazardous area, wait five minutes after disconnecting the power.

3. Ensure that the terminals, wires, and wiring compartment are clean and dry.
4. Ensure that the power supply wires are connected to the correct terminals.
5. Ensure that the power supply wires are making good contact, and are not clamped to the wire insulation.
6. Reapply power to the transmitter.

   ⚠ **CAUTION!**

   If the transmitter is in a hazardous area, do not reapply power to the transmitter with the housing cover removed. Reapplying power to the transmitter while the housing cover is removed could cause an explosion.

7. Test the voltage at the terminals.

   If there is no power, contact Micro Motion customer service.

10.3 Check grounding

The sensor and the transmitter must be grounded.

Prerequisites

You will need:

- Installation manual for your sensor
- Installation manual for your transmitter (remote-mount installations only)

Procedure

Refer to the sensor and transmitter installation manuals for grounding requirements and instructions.

10.4 Perform loop tests

A loop test is a way to verify that the transmitter and the remote device are communicating properly. A loop test also helps you know whether you need to trim mA outputs.

10.4.1 Perform loop tests using the display

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

Test the mA outputs.

a. Choose OFFLINE MAINT > SIM > AO1 SIM or OFFLINE MAINT > SIM > AO2 SIM, and select a low value, e.g., 4 mA.

   Dots traverse the display while the output is fixed.

b. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

c. At the transmitter, activate Select.
d. Scroll to and select a high value, e.g., 20 mA.

   Dots traverse the display while the output is fixed.

e. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

f. At the transmitter, activate Select.

Postrequisites

- If the mA output readings are within 200 microamps of each other, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA output readings is greater than 200 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.

10.4.2 Perform loop tests using ProLink III

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

Test the mA outputs.

a. Choose Device Tools > Diagnostics > Testing > mA Output 1 Test or Device Tools > Diagnostics > Testing > mA Output 2 Test.
b. Enter 4 in Fix to:.
c. Click Fix mA.

d. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

e. Click UnFix mA.
f. Enter 20 in Fix to:.
g. Click Fix mA.
h. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

i. Click UnFix mA.

Postrequisites

- If the mA output readings are within 200 microamps of each other, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA output readings is greater than 200 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.

10.4.3 Perform loop tests using the Field Communicator

Prerequisites

Before performing a loop test, configure the channels for the transmitter inputs and outputs that will be used in your application.

Follow appropriate procedures to ensure that loop testing will not interfere with existing measurement and control loops.

Procedure

Test the mA outputs.

a. Choose Service Tools > Simulate > Simulate Outputs > mA Output 1 Loop Test or Service Tools > Maintenance > Simulate Outputs > mA Output 2 Loop Test, and select 4 mA.
b. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

c. Press OK.
d. Select 20 mA.
e. Read the mA current at the receiving device and compare it to the transmitter output.

   The readings do not need to match exactly. If the values are slightly different, you can correct the discrepancy by trimming the output.

f. Press OK.

g. Choose End.

Postrequisites

- If the mA output readings are within 200 microamps of each other, you can correct this discrepancy by trimming the output.
- If the discrepancy between the mA output readings is greater than 200 microamps, or if at any step the reading was faulty, verify the wiring between the transmitter and the remote device, and try again.

10.5 Status LED states

The status LED on the transmitter indicates whether or not alerts are active. If alerts are active, view the alert list to identify the alerts, then take appropriate action to correct the alert condition.

Your meter has one or two status LEDs:

- A status LED on the display (only if your meter has a display)
- A status LED on the board, beneath the meter housing cover

⚠ CAUTION!

If your meter is in a hazardous area, do not remove the meter housing cover. Use a different method to determine meter status.

The status LEDs use colors and flashing to indicate device status.

Table 10-1: Transmitter status reported by status LED

LED state	Description	Recommendation
Green	No alerts are active.	Continue with configuration or process measurement.
Yellow	One or more low-severity alerts are active.	A low-severity alert condition does not affect measurement accuracy or output behavior. You can continue with configuration or process measurement. If you choose, you can identify and resolve the alert condition.
Flashing yellow	Calibration in progress, or Known Density Verification in progress.	The low-severity alert condition does not affect measurement accuracy or output behavior. You can continue with configuration or process measurement. If you chose, you can identify and resolve the alert condition.
Red	One or more high-severity alerts are active.	A high-severity alert condition affects measurement accuracy and output behavior. Resolve the alert condition before continuing.

Related information

View and acknowledge status alerts

10.6 Status alerts, causes, and recommendations

Table 10-2: Status alerts, causes, and recommendations

Alert number	Alert title	Possible causes	Recommended actions
A001	EEPROM Error	The transmitter has detected a problem communicating with the sensor.	• Cycle power to the meter. • Contact Micro Motion.
A002	RAM Error	The transmitter has detected a problem communicating with the sensor.	• Cycle power to the meter. • Contact Micro Motion.
A003	No Sensor Response	The transmitter is not receiving one or more basic electrical signals from the sensor.	• Check the drive gain. See *Section 10.20*.
A004	Temperature Overrange	The RTD resistance is out of range for the sensor.	• Check your process conditions against the values reported by the device. • Verify temperature characterization or calibration parameters. • Contact Micro Motion.
A006	Characterization Required	Calibration factors have not been entered, or the sensor type is incorrect, or the calibration factors are incorrect for the sensor type.	• Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Contact Micro Motion.
A008	Density Overrange	Applies only to the active calibration. The line density is greater than 3 g/cm³ (3000 kg/m³).	• If other alerts are present, resolve those alert conditions first. If the current alert persists, continue with the recommended actions. • Check for two-phase flow. See *Section 10.19*. • Check for foreign material in the process gas or fluid, coating, or other process problems. • Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Check the drive gain. See *Section 10.20*. • Perform Known Density Verification. • Check the tines for corrosion, erosion, or deposition. • Contact Micro Motion.

Table 10-2: Status alerts, causes, and recommendations *(continued)*

Alert number	Alert title	Possible causes	Recommended actions

A009	Transmitter Initializing/Warming Up or Significant Process Instability	Transmitter is in power-up mode.
		If this occurs after device startup, measurement stability has dropped below acceptable limits and the device is repeating its startup sequence.
			• Allow the meter to complete its power-up sequence. The alert should clear automatically.
			• If other alerts are present, resolve those alert conditions first. If the current alert persists, continue with the recommended actions.
			• Verify that the transmitter is receiving sufficient power.
			  - If it is not, correct the problem and cycle power to the meter.
			  - If it is, this suggests that the transmitter has an internal power issue. Replace the transmitter.
			• Ensure that the process fluid is stable. Check for two-phase flow, high process noise, or a fast transition between two fluids of different densities.

A010	Calibration Failure	Many possible causes. This alert will not clear until you correct the problem, acknowledge the alert, and repeat the calibration.	• Ensure that your calibration procedure meets the documented requirements, cycle power to the meter, then retry the procedure.
A014	Transmitter Failure	Many possible causes.	• Ensure that all wiring compartment covers are installed correctly. • Ensure that all transmitter wiring meets specifications and that all cable shields are properly terminated. • Check the grounding of all components. See *Section 10.3*. • Evaluate the environment for sources of high electromagnetic interference (EMI) and relocate the transmitter or wiring as necessary. • Contact Micro Motion.
A016	Sensor Temperature (RTD) Failure	The value computed for the resistance of the line RTD is outside limits.	• Check your process against the values reported by the device. • Contact Micro Motion.
A020	Calibration Factors Missing	Some calibration factors have not been entered or are incorrect.	• Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Contact Micro Motion.
A021	Transmitter/Sensor/Software Mismatch	The configured board type does not match the physical board.	• Verify all of the characterization or calibration parameters. See the sensor tag or the calibration sheet for your meter. • Ensure that the correct board is installed.
A029	Internal Electronics Failure	This can indicate a loss of communication between the transmitter and the display module.	• Cycle power to the meter. • Replace the display module. • Contact Micro Motion.

Table 10-2: Status alerts, causes, and recommendations *(continued)*

Alert number	Alert title	Possible causes	Recommended actions
A030	Incorrect Board Type	The loaded software is not compatible with the programmed board type.	• Contact Micro Motion.
A033	Insufficient Pickoff Signal	The signal from the sensor pickoff(s) is insufficient. This suggests that the sensor tubes or vibrating elements are not vibrating. This alert often occurs in conjunction with Alert 102.	• Check for foreign material in the process gas or fluid, coating, or other process problems. • Check for fluid separation by monitoring the density value and comparing the results against expected density values. • Ensure that the sensor orientation is appropriate for your application. Settling from a two-phase or three-phase fluid can cause this alert.
A036	Viscosity Overrange	The measured viscosity is above the highest range for which the device is calibrated.	• Check your process against the values reported by the device. • Contact Micro Motion.
A037	Sensor Check Failed	Known Density Verification failed.	• Check the subtest results and perform the recommended actions. • Retry the test. • Contact Micro Motion.
A038	Time Period Signal Out of Range	The time period signal is outside the limits for the sensor type.	• Check your process conditions against the values reported by the device.
A100	mA Output 1 Saturated	The calculated mA output value is outside the configured range.	• Check the settings of Upper Range Value and Lower Range Value. See *Section 10.15*. • Check process conditions. Actual conditions may be outside the normal conditions for which the output is configured. • Check for foreign material in the process gas or fluid, coating, or other process problems. • Verify that the measurement units are configured correctly for your application.
A101	mA Output 1 Fixed	The HART address is set to a non-zero value, or the mA output is configured to send a constant value.	• Check whether the output is in loop test mode. If it is, unfix the output. • Exit mA output trim, if applicable. • Check the HART address. If the HART address is non-zero, you may need to change the setting of mA Output Action (Loop Current Mode). • Check whether the output has been set to a constant value via digital communication.

Table 10-2: Status alerts, causes, and recommendations *(continued)*

Alert number	Alert title	Possible causes	Recommended actions
A102	Drive Over-range	The drive power (current/voltage) is at its maximum.	• Check the drive gain. See Section 10.20. • Check for foreign material in the process gas or fluid, coating, or other process problems. • Check for fluid separation by monitoring the density value and comparing the results against expected density values. • Ensure that the sensor orientation is appropriate for your application. Settling from a two-phase or three-phase fluid can cause this alert.
A104	Calibration in Progress	A calibration procedure is in process.	• Allow the procedure to complete.
A105	Two-Phase Flow	The line density is outside the user-defined two-phase flow limits.	• Check for two-phase flow. See Section 10.19.
A106	Burst Mode Enabled	HART burst mode is enabled.	• No action required. • If desired, you can set Alert Severity Level to Ignore.
A107	Power Reset Occurred	The transmitter has been restarted.	• No action required. • If desired, you can set Alert Severity Level to Ignore.
A113	mA Output 2 Saturated	The calculated mA output value is outside the configured range.	• Check the settings of Upper Range Value and Lower Range Value. See Section 10.15. • Check process conditions. Actual conditions may be outside the normal conditions for which the output is configured. • Check for foreign material in the process gas or fluid, coating, or other process problems. • Verify that the measurement units are configured correctly for your application.
A114	mA Output 2 Fixed	The mA output is configured to send a constant value.	• Check whether the output is in loop test mode. If it is, unfix the output. • Exit mA output trim, if applicable. • Check whether the output has been set to a constant value via digital communication.
A115	No External Input or Polled Data	The connection to an external measurement device has failed. No external data is available.	• Verify that the external device is operating correctly. • Verify the wiring between the transmitter and the external device. • Verify the HART polling configuration.
A116	Temperature Overrange (API Referral)	The measured temperature is outside the range of the API table.	• Check your process conditions against the values reported by the device. • Verify the configuration of the API referral application and related parameters. See Section 10.10.
A117	Density Overrange (API Referral)	The measured density is outside the range of the API table.	• Check your process conditions against the values reported by the device. • Verify the configuration of the API referral application and related parameters. See Section 10.10.

Table 10-2: Status alerts, causes, and recommendations *(continued)*

Alert number	Alert title	Possible causes	Recommended actions
A118	Discrete Output 1 Fixed	The discrete output has been configured to send a constant value.	• Check whether the output is in loop test mode. If it is, unfix the output.
A122	Pressure Overrange (API Referral)	The line pressure is outside the range of the API table.	• Check your process conditions against the values reported by the device. • Verify the configuration of the API referral application and related parameters. See *Section 10.10*.
A132	Sensor Simulation Active	Sensor simulation is enabled.	• Disable sensor simulation.
A133	EEPROM Error (Display)	There is a memory error in the display module.	• Cycle power to the meter. • Replace the display module. • Contact Micro Motion.
A136	Incorrect Display Type	An incorrect display module has been installed on the device. This may cause a safety violation in hazardous areas.	• Replace the installed display module with an appropriate display module.

10.7 Viscosity measurement problems

Table 10-3: Viscosity measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Viscosity reading erratic	• Normal process noise • Two-phase flow • Deposition or coating, especially asphaltenes, on the tines • Contaminants in the process fluid • Vibration in the pipeline	• Increase the viscosity damping value. • Check your process conditions. • Check for two-phase flow, stratification, or settling. Install a pump. Check for environmental conditions that produce stratification (e.g., a heat source). • Increase back pressure to minimize bubble formation. • Clean the tines. • Minimize vibration in the pipeline.

Table 10-3: Viscosity measurement problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Viscosity reading inaccurate	• Incorrect calibration factors • Inappropriate viscosity offset or viscosity meter factor • Flow rate too low or too high • Bypass not fully closed • Deposition or coating, especially asphaltenes, on the tines • Fork laminate damaged • Defective thermal insulation • Boundary effect	• Verify the calibration factors. Ensure that the viscosity ranges are appropriate for your process fluid. • Adjust the viscosity offset or viscosity meter factor. • Adjust the flow rate or the diameter of the flow-through chamber. Refer to the installation manual for flow requirements and best practices. • Ensure that the installation type matches the calibration. Refer to the installation manual. • Close the bypass. • Clean the tines. • Check for physical damage to the tines or laminate. • Repair or replace the thermal insulation. • Check the pump delivery and service the pump as required.
Viscosity reading NaN (Not a Number)	• Viscosity is out of the calibrated range(s)	• Return the device to Micro Motion for recalibration for the ranges you need.
Referred viscosity reading inaccurate	• Inaccurate line viscosity measurement • Inaccurate line temperature measurement • Incorrect referred viscosity configuration • Inaccurate measurement of laboratory sample	• Ensure that line viscosity measurement is as accurate as possible. • Ensure that the temperature value used in referred viscosity measurement is as accurate as possible. • Verify the configuration of referred viscosity measurement. • Repeat the laboratory measurement, ensuring that reference conditions match.

10.8 Density measurement problems

Table 10-4: Density measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Erratic density reading	• Normal process noise • Two-phase flow • Flow rate too high • Deposition on the tines • Contaminants or suspended solids in the process fluid • Vibration in the pipeline • Erosion or corrosion	• Check your process conditions. • Increase the density damping value. • Reduce the flow rate. • Check for two-phase flow. See *Section 10.19*. • Ensure that line pressure or sample pressure meets installation requirements. • Increase back pressure to minimize bubble formation. • Clean the tines. • Minimize vibration in the pipeline. • Install a flow control method (bypass, flow chamber, expander, etc.). • Perform Known Density Verification.
Inaccurate density reading	• Inaccurate temperature measurement • Incorrect calibration factors • Deposition on the tines • Boundary effect (incorrect installation)	• Verify the temperature reading from the RTD (on-board temperature sensor). • Verify the temperature reading from the external temperature device, if applicable. • Verify or adjust the density offset and/or the density meter factor. • Clean the tines. • Increase the flow rate. • Install a thermal insulation jacket. • Verify the calibration factors. • Perform Known Density Verification. • Change the location of the fork.
Inaccurate calculated density	• Incorrect reference density	• Verify the value configured for reference density.
Density reading too high	• Deposition on the tines	• Clean the tines.
Density reading too low	• Leaks in the pipework or fittings • Two-phase flow	• Check for two-phase flow. See *Section 10.19*.
Cyclic inaccuracy in density reading	• Stirrer rotation rate too high • Tank flow rate too high • Fork in poor location • Stirrer creating bubbles • Solids in tank	• Reduce the stirrer rotation rate. • Reduce the tank flow rate. • Move the fork to a location with a lower flow profile. • Install a sample bypass. • Replace the device with a CDM.

Table 10-4: Density measurement problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
Density reading from device does not match laboratory value	• Incorrect calibration factors • Laboratory conditions do not match sample conditions	• Verify the calibration factors. • Verify or adjust the density offset and/or the density meter factor. • Ensure that the two fluids are being compared at the same temperature.

10.9 Temperature measurement problems

Table 10-5: Temperature measurement problems and recommended actions

Problem	Possible causes	Recommended actions
Temperature reading significantly different from process temperature	• RTD failure • Incorrect compensation factors • Line temperature in bypass does not match temperature in main line	• Verify that the temperature compensation factors match the value on the sensor tag or calibration sheet. • If Alert A004, A016, or A017 is active, perform the actions recommended for that alert.
Temperature reading slightly different from process temperature	• Sensor temperature not yet equalized • Sensor leaking heat	• If the error is within the temperature specification for the sensor, there is no problem. If the temperature measurement is outside the specification, contact Micro Motion. • The temperature of the fluid may be changing rapidly. Allow sufficient time for the sensor to equalize with the process fluid. • The electrical connection between the RTD and the sensor may be damaged. This may require replacing the sensor.
Inaccurate temperature data from external device	• Wiring problem • Problem with input configuration • Problem with external device	• Verify the wiring between the transmitter and the external device. • Verify that the external device is operating correctly. • Verify the configuration of the temperature input. • Ensure that both devices are using the same measurement unit.

10.10 API referral problems

Table 10-6: API referral problems and recommended actions

Problem	Possible causes	Recommended actions
No referred density reading	• Line temperature or line density is outside the range of the configured API table	• Check process conditions. • Ensure that the API referral application is configured correctly for your process fluid. See *Set up the API referral application*.
Inaccurate referred density reading	• Inaccurate density measurement • Inaccurate temperature measurement • Incorrect reference conditions • Incorrect API table selection	• Verify the line density value. If it is not accurate, resolve your density measurement problems. • Verify the line temperature value. If it is not accurate, resolve your temperature measurement problems. • Ensure that the application is configured to use the appropriate temperature source. • Ensure that reference temperature and reference pressure, if applicable, are configured correctly. • Ensure that the selected API table is appropriate for the process fluid.

10.11 Milliamp output problems

Table 10-7: Milliamp output problems and recommended actions

Problem	Possible causes	Recommended actions
No mA output	• Output not powered • Wiring problem • Circuit failure	• Verify that the output loop is powered externally. • Check the power supply and power supply wiring. See *Section 10.2*. • Verify the output wiring. • Check the Fault Action settings. See *Section 10.16*. • Contact Micro Motion.
Loop test failed	• Output not powered • Power supply problem • Wiring problem • Circuit failure	• Verify that the output loop is powered externally. • Check the power supply and power supply wiring. See *Section 10.2*. • Verify the output wiring. • Check the Fault Action settings. See *Section 10.16*. • Contact Micro Motion.

Table 10-7: Milliamp output problems and recommended actions *(continued)*

Problem	Possible causes	Recommended actions
mA output below 4 mA	• Open in wiring • Bad output circuit • Process condition below LRV • LRV and URV are not set correctly • Fault condition if Fault Action is set to Internal Zero or Downscale • Bad mA receiving device	• Check your process conditions against the values reported by the device. • Verify the receiving device, and the wiring between the transmitter and the receiving device. • Check the settings of Upper Range Value and Lower Range Value. See *Section 10.15*. • Check the Fault Action settings. See *Section 10.16*.
Constant mA output	• Incorrect process variable assigned to the output • Fault condition exists • Non-zero HART address (mA Output 1) • Output is configured for loop test mode	• Verify the output variable assignments. • View and resolve any existing alert conditions. • Check the HART address. If the HART address is non-zero, you may need to change the setting of mA Output Action (Loop Current Mode). • Check to see if a loop test is in process (the output is fixed). • Check HART burst mode configuration.
mA output below 3.6 mA or above 21.0 ma	• Incorrect process variable or units assigned to output • Fault condition if Fault Action is set to Upscale or Downscale • LRV and URV are not set correctly	• Verify the output variable assignments. • Verify the measurement units configured for the output. • Check the Fault Action settings. See *Section 10.16*. • Check the settings of Upper Range Value and Lower Range Value. See *Section 10.15*. • Check the mA output trim. See *Section 10.13*.
Consistently incorrect mA measurement	• Loop problem • Output not trimmed correctly • Incorrect measurement unit configured for process variable • Incorrect process variable configured • LRV and URV are not set correctly	• Check the mA output trim. See *Section 10.13*. • Verify that the measurement units are configured correctly for your application. • Verify the process variable assigned to the mA output. • Check the settings of Upper Range Value and Lower Range Value. See *Section 10.15*.
mA output correct at lower current, but incorrect at higher current	• mA loop resistance may be set too high	• Verify that the mA output load resistance is below the maximum supported load (see the installation manual for your transmitter).

10.12 Using sensor simulation for troubleshooting

When sensor simulation is enabled, the transmitter reports user-specified values for basic process variables. This allows you to reproduce various process conditions or to test the system.

You can use sensor simulation to help distinguish between legitimate process noise and externally caused variation. For example, consider a receiving device that reports an unexpectedly erratic density value. If sensor simulation is enabled and the observed density value does not match the simulated value, the source of the problem is probably somewhere between the transmitter and the receiving device.

Important

When sensor simulation is active, the simulated value is used in all transmitter outputs and calculations. Disable all automatic functions related to the transmitter outputs and place the loop in manual operation. Do not enable simulation mode unless your application can tolerate these effects, and be sure to disable simulation mode when you have finished testing.

Related information

Test or tune the system using sensor simulation

10.13 Trim mA outputs

Trimming an mA output calibrates the transmitter's mA output to the receiving device. If the current trim values are inaccurate, the transmitter will under-compensate or over-compensate the output.

- *Trim mA outputs using ProLink III* (Section 10.13.1)
- *Trim mA outputs using the Field Communicator* (Section 10.13.2)

10.13.1 Trim mA outputs using ProLink III

Trimming the mA output establishes a common measurement range between the transmitter and the device that receives the mA output.

Important

You must trim the output at both ends (4 mA and 20 mA) to ensure that it is compensated accurately across the entire output range.

Prerequisites

Ensure that the mA output is wired to the receiving device that will be used in production.

Procedure

1. Choose Device Tools > Calibration > MA Output Trim > mA Output 1 Trim or Device Tools > Calibration > MA Output Trim > mA Output 2 Trim.

2. Follow the instructions in the guided method.

Important
If you are using a HART/Bell 202 connection, the HART signal over the primary mA output affects the mA reading. Disconnect the wiring between ProLink III and the transmitter terminals when reading the primary mA output at the receiving device. Reconnect to continue the trim.

3. Check the trim results. If any trim result is less than −200 microamps or greater than +200 microamps, contact Micro Motion customer service.

10.13.2 Trim mA outputs using the Field Communicator

Trimming the mA output establishes a common measurement range between the transmitter and the device that receives the mA output.

Important
You must trim the output at both ends (4 mA and 20 mA) to ensure that it is compensated accurately across the entire output range.

Prerequisites

Ensure that the mA output is wired to the receiving device that will be used in production.

Procedure

1. Choose Service Tools > Maintenance > Routine Maintenance > Trim mA Output 1 or Service Tools > Maintenance > Routine Maintenance > Trim mA Output 2.
2. Follow the instructions in the guided method.

Important
The HART signal over the primary mA output affects the mA reading. Disconnect the wiring between the Field Communicator and the transmitter terminals when reading the primary mA output at the receiving device. Reconnect to continue the trim.

3. Check the trim results. If any trim result is less than −200 microamps or greater than +200 microamps, contact Micro Motion customer service.

10.14 Check HART communications

If you cannot establish or maintain HART communications, or if the primary mA output is producing a fixed value, you may have a wiring problem or a HART configuration problem.

Prerequisites

You may need one or more of the following:

- The installation manual for your meter

- A Field Communicator
- A voltmeter
- Optional: The *HART Application Guide*, available at *www.hartcomm.org*

Procedure

1. Verify the HART address.

   Tip
   The default HART address is 0. This is the recommended value unless the device is in a multidrop network.

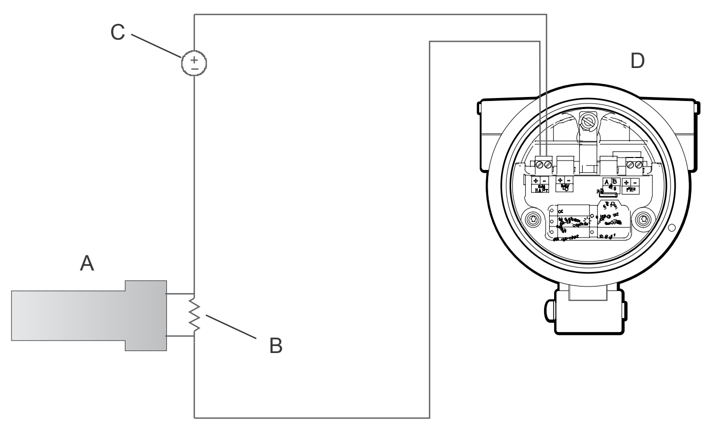
2. If the primary mA output is producing a fixed value of 4 mA, ensure that mA Output Action (Loop Current Mode) is enabled.

   For all HART addresses except 0, mA Output Action must be enabled to allow the primary mA output to report process data.
3. Refer to the wiring diagrams in the installation manual and verify that the primary mA output is correctly wired for HART support.
4. Ensure that the output is powered.
5. Check for electrical problems at the transmitter terminals.

   a. Disconnect the primary mA output wires from the transmitter's MAO1 terminals.

   b. Wire and power the MAO1 terminals as shown in the following figure.

Figure 10-1: Wiring and power to test terminals



A. Voltmeter
B. 250–600 Ω resistance
C. External power supply
D. Transmitter with end-cap removed

   c. Using a voltmeter, check the voltage drop across the resistor.

   For a 250 Ω resistor, 4–20 mA = 1–5 VDC. If the voltage drop is less than 1 VDC, add resistance to achieve a voltage drop within the required range.

d. Connect a Field Communicator directly across the resistor and attempt to communicate (poll).

If this test fails, the transmitter may need service. Contact Micro Motion.

Related information

Configure basic HART parameters
Using the Field Communicator with the transmitter

10.15 Check Lower Range Value and Upper Range Value

If the process variable assigned to the mA output falls below the configured Lower Range Value (LRV) or rises above the configured Upper Range Value (URV), the meter will post a saturation alert (A100 or A113), then perform the configured fault action.

1. Record your current process conditions.
2. Check the configuration of the LRV and URV.

Related information

Configure Lower Range Value (LRV) and Upper Range Value (URV)

10.16 Check mA Output Fault Action

mA Output Fault Action controls the behavior of the mA output if the transmitter encounters an internal fault condition. If the mA output is reporting a constant value below 4 mA or above 20 mA, the transmitter may be in a fault condition.

1. Check the status alerts for active fault conditions.
2. If there are active fault conditions, the transmitter is performing correctly. If you want to change its behavior, consider the following options:
   - Change the setting of mA Output Fault Action.
   - For the relevant status alerts, change the setting of Alert Severity to Ignore.

Restriction
For some status alerts, Alert Severity is not configurable.

3. If there are no active fault conditions, continue troubleshooting.

Related information

Configure mA Output Fault Action and mA Output Fault Level

10.17 Check for radio frequency interference (RFI)

The meter's TPS output or discrete output can be affected by radio frequency interference (RFI). Possible sources of RFI include a source of radio emissions, or a large transformer, pump, or motor that can generate a strong electromagnetic field. Several methods to reduce RFI are available. Use one or more of the following suggestions, as appropriate to your installation.

Procedure

- Use shielded cable between the output and the receiving device.
  - Terminate the shielding at the receiving device. If this is impossible, terminate the shielding at the cable gland or conduit fitting.
  - Do not terminate the shielding inside the wiring compartment.
  - 360-degree termination of shielding is unnecessary.
- Eliminate the RFI source.
- Move the meter.

10.18 Check the cutoffs

If the density cutoff is configured incorrectly for your process, any density process variables and any calculations that rely on density may be based on programmed cutoff values rather than current density data.

Procedure

Verify the configuration of all cutoffs.

Related information

Configure Density Cutoff

10.19 Check for two-phase flow (slug flow)

Two-phase flow can cause rapid changes in the drive gain. This can cause a variety of measurement issues.

1. Check for two-phase flow alerts (e.g., A105).

   If the transmitter is not generating two-phase flow alerts, two-phase flow is not the source of your problem.

2. Check the process for cavitation, flashing, or leaks.
3. Monitor the density of your process fluid output under normal process conditions.
4. Check the settings of Two-Phase Flow Low Limit, Two-Phase Flow High Limit, and Two-Phase Flow Timeout.

Tip

You can reduce the occurrence of two-phase flow alerts by setting Two-Phase Flow Low Limit to a lower value, Two-Phase Flow High Limit to a higher value, or Two-Phase Flow Timeout to a higher value.

Related information

Configure two-phase flow parameters

10.20 Check the drive gain

Use the following table to check drive gain values. If you see a value that is too high or too low, there could be a problem with the process or with the device. Consider other diagnostics along with drive gain values to determine whether or not you have a problem.

Table 10-8: Abnormal drive gain, possible causes, and recommended actions

Drive gain value	Possible causes	Recommended actions
0%	• The transmitter is not connected to the sensor. • The connection between the transmitter and the sensor is damaged.	• For integral installations, inspect the connection between the transmitter and the sensor and check for visible problems. • Contact Micro Motion customer service.
8%	Normal operation	No action required.
100%	The transmitter is unable to drive the sensor. Possible reasons: • Process viscosity is too high. • Vibration is too high. • Flow rate is too high. • The installation is incorrect.	• Ensure that line viscosity is within sensor limits. • Ensure that vibration is within sensor limits. • Ensure that the flow rate is within sensor limits. • Review your installation to ensure that you are complying with all requirements and that you have implemented best practices where possible. • Contact Micro Motion customer service.

10.20.1 Collect drive gain data

Drive gain data can be used to diagnose a variety of process and equipment conditions. Collect drive gain data from a period of normal operation, and use this data as a baseline for troubleshooting.

1. Navigate to the drive gain data.

2. Observe and record drive gain data over an appropriate period of time, under a variety of process conditions.

10.21 Check for internal electrical problems

Shorts between sensor terminals or between the sensor terminals and the sensor case can cause the sensor to stop working.

Table 10-9: Possible causes and recommended actions for electrical shorts

Possible cause	Recommended action
Shorts to the housing created by trapped or damaged wires	Contact Micro Motion.
Loose wires or connectors	Contact Micro Motion.
Liquid or moisture inside the housing	Contact Micro Motion.

10.22 Locate a device using the HART 7 Squawk feature

The Squawk feature causes the device to show a specific pattern on its display. You can use this to locate or identify a device.

Restriction
The Squawk feature is available only with HART 7 connections. It is not available with ProLink III.

Procedure

1. Choose Service Tools > Maintenance.
2. Click Locate Device, then click Next.

An 0-0-0-0 pattern is shown on the display.

To return to the normal display, activate either Scroll or Select, or wait 60 seconds.

Appendix A
Calibration certificate

A.1 Sample calibration certificate

Your meter was shipped with a calibration certificate. The calibration certificate describes the calibrations and configurations that were performed or applied at the factory.

Figure A-1: Sample calibration certificate

Micro Motion	CALIBRATION CERTIFICATE

HFVM VISCOMASTER HEAVY FUEL VISCOSITY METER
HFVM11F729BAC3MEBEZZZ

SERIAL NO	:	14230500
CAL DATE	:	08-May-2013
PRESSURE TEST	:	160 Bar

VISCOSITY CALIBRATION COEFFICIENTS @ 20°C (2" schedule 40 boundary) :

VISCOSITY = V0 + V1*(1/Q²) + V2*(1/Q⁴)

		ULTRA-LOW RANGE (0.50-10.56)cP	LOW RANGE (10.56-107.96)cP
V0	=	-3.145558E-01	-7.444293E-01
V1	=	7.787786E+05	8.187536E+05
V2	=	2.551654E+08	-9.077536E+07

DENSITY CALIBRATION COEFFICIENTS @ 20°C (2" schedule 40 boundary) :

DENSITY, D = K0 + K1*TP + K2*TP²

K0	=	-2.445780E+03
K1	=	-1.327460E-01
K2	=	9.235118E-03

CALIBRATED RANGE = 600-1250 kg/m³

TEMPERATURE COMPENSATION DATA :

Dt = D(1 + K18(t-20)) + K19(t-20)

K18	=	-4.544939E-04
K19	=	-1.071088E+00

VISCOSITY CALIBRATION DATA :

VISCOSITY (cP)	QUALITY FACTOR, Q
1.01	758.96
5.23	375.[illegible]
10.56	26[illegible].16
21.65	191.[illegible]
53.53	122.33
107.96	86.14

DENSITY CALIBRATION DATA :

DENSITY (kg/m³)	TIME PERIOD, TP (µs)
1.2 (AIR)	521.738
804.5	600.436
998.3	617.877

KNOWN DENSITY VERIFICATION DATA

VERIFICATION TIME PERIOD @ 20°C = 521.625 µs

VISCOSITY CALIBRATION OVERCHECK

CALC VISCOSITY (cP)	ERROR (cP)
5.23	0.01
21.65	0.09

DENSITY CALIBRATION OVERCHECK

CALC DENSITY (kg/m³)	ERROR (kg/m³)
997.9	-0.4

D = Density (uncompensated)
Dt = Density (temperature compensated)
TP = Time period (µs)
Q = Quality Factor
t = Temperature (°C)

FINAL TEST & INSPECTION
PASSED

Reference FC V3.0.0.0

Date 09-May-2013

All equipment used for this calibration is calibrated at routine intervals against standards that are traceable to National Standards of Measurement.

Appendix B
Using the transmitter display

Topics covered in this appendix:

- *Components of the transmitter interface*
- *Use the optical switches*
- *Access and use the display menu system*
- *Display codes for process variables*
- *Codes and abbreviations used in display menus*

B.1 Components of the transmitter interface

The transmitter interface includes the status LED, the display (LCD panel), and two optical switches.

B.2 Use the optical switches

Use the optical switches on the transmitter interface to control the transmitter display. The transmitter has two optical switches: Scroll and Select.

To activate an optical switch, block the light by holding your thumb or finger in front of the opening.

Tip
You can activate the optical switch through the lens. Do not remove the transmitter housing cover.

The optical switch indicator lights up when the transmitter senses that an optical switch has been activated.

Table B-1: Optical switch indicator and optical switch states

Optical switch indicator	State of optical switches
Solid red	One optical switch is activated.
Flashing red	Both optical switches are activated.

B.3 Access and use the display menu system

The display menu system is used to perform various configuration, administrative, and maintenance tasks.

Tip

The display menu system does not provide complete configuration, administrative, or maintenance functions. For complete transmitter management, you must use another communications tool.

Prerequisites

To access the display menu system, operator access to either the Off-Line menu or the Alert menu must be enabled. To access the complete menu system, operator access must be enabled for both the Off-Line menu and the Alert menu.

Procedure

1. At the transmitter display, activate the Scroll and Select optical switches simultaneously until the display changes.

   You will enter the Off-Line menu at any of several locations, depending on several factors.

   - If an alert is active and access to the Alert menu is enabled, you will see SEE ALARM.
   - If no alert is active, you will see OFF-LINE MAINT.

2. If CODE? appears on the display when you make a choice, enter the value that is configured for Off-Line Password.

   a. With the cursor flashing on the first digit, activate Scroll until the correct digit is displayed, then activate Select.

   b. Repeat this process for the second, third, and fourth digits.

   Tip

   If you do not know the correct value for Off-Line Password, wait 30 seconds. The password screen will time out automatically and you will be returned to the previous screen.

3. Use the Scroll and Select optical switches to navigate to your destination in the display menu system.

   - Use Scroll to move through a list of options.
   - Use Select to choose the current option.

4. If Scroll flashes on the display, activate the Scroll optical switch, then the Select optical switch, and then the Scroll optical switch again.

   The display will prompt you through this sequence. The Scroll-Select-Scroll sequence is designed to guard against accidental activation of the off-line menu. It is not designed as a security measure.

5. To exit a display menu and return to a higher-level menu:

- Activate Scroll until the EXIT option is displayed, then activate Select.
- If the EXIT option is not available, activate Scroll and Select simultaneously and hold until the screen returns to the previous display.

6. To exit the display menu system, you can use either of the following methods:
   - Exit each menu separately, working your way back to the top of the menu system.
   - Wait until the display times out and returns to displaying process variable data.

B.3.1 Enter a floating-point value using the display

Certain configuration values (for example, Lower Range Value and Upper Range Value) are entered as floating-point values. The display supports both decimal notation and exponential notation for floating-point values.

The display allows you to enter a maximum of 8 characters, including the sign. The decimal point is not counted as a character. Exponential notation is used to enter values that require more than 8 characters.

Enter a floating-point value using decimal notation

Decimal notation allows you to enter values between –9999999 and 99999999. You can use the decimal point to enter values with a precision of 0 through 4 (4 characters to the right of the decimal point).

Decimal values entered via the display must meet the following requirements:

- They can contain a maximum of 8 digits, or 7 digits plus a minus sign (−) to indicate a negative number.
- They can contain a decimal point. The decimal point does not count as a digit. The decimal point must be positioned so that the precision of the value does not exceed 4.

When you first enter the configuration screen, the current configuration value is displayed in decimal notation, and the active character is flashing. If the value is positive, no sign is displayed. If the value is negative, a minus sign is displayed.

Procedure

- To change the value:
  1. Activate Select until the digit you want to change is active (flashing).

     Select moves the cursor one position to the left. From the leftmost position, Select moves the cursor to the rightmost digit.
  2. Activate Scroll to change the value of the active digit.
  3. Repeat until all digits are set as desired.
- To change the sign of the value:
  - If the current value is negative, activate Select until the minus sign is flashing, then activate Scroll until the space is blank.

    - If the current value is positive and there is a blank space at the left of the value, activate Select until the cursor is flashing under the blank space, then activate Scroll until the minus sign appears.
    - If the current value is positive and there is no blank space at the left of the value, activate Select until the cursor is flashing under the leftmost digit, then activate Scroll until the minus sign appears.
- To move the decimal point:
    1. Activate Select until the decimal point is flashing.
    2. Activate Scroll.

       The decimal point is removed from its current position.
    3. Activate Select and watch the position of the decimal point.

       As the cursor moves to the left, the decimal point will flash between each pair of digits, up to a maximum precision of four (four digits to the right of the decimal point).

       Tip

       If the position is not valid, the decimal point is not displayed. Continue to activate Select until the decimal point appears at the right of the displayed value.
    4. When the decimal point is in the desired position, activate Scroll.

       The decimal point is inserted at its current position.
- To save the displayed value to transmitter memory, activate Scroll and Select simultaneously and hold until the display changes.
    - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
    - If the displayed value is not the same as the value in transmitter memory, SAVE/YES? flashes on the display. Activate Select.
- To exit the menu without saving the displayed value to transmitter memory, activate Scroll and Select simultaneously and hold until the display changes.
    - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
    - If the displayed value is not the same as the value in transmitter memory, SAVE/YES? flashes on the display. Activate Scroll.

Enter a floating-point value using exponential notation

Exponential notation is used to enter values that are larger than 99999999 or smaller than −9999999.

Exponential values entered via the display must be in the following form: SX.XXXEYY. In this string:

- S = Sign. A minus sign (−) indicates a negative number. A blank indicates a positive number.
- X.XXX = The 4-digit mantissa.
- E = The exponent indicator.
- YY = The 2-digit exponent.

Procedure

1. Switch from decimal notation to exponential notation.

   a. Activate Select as required until the rightmost digit is flashing.

   b. Activate Scroll until E is displayed.

   c. Activate Select.

   Tip

   If you have modified the value in decimal notation without saving the changes to transmitter memory, the changes will be lost when you switch to exponential notation. Save the decimal value before switching to exponential notation.

   ---

2. Enter the exponent.

   The first character may be a minus sign or any digit between 0 and 3. The second character may be any digit between 0 and 9.

   a. Activate Select to move the cursor to the rightmost character on the display.

   b. Activate Scroll until the desired character is displayed.

   c. Activate Select to move the cursor one position to the left.

   d. Activate Scroll until the desired character is displayed.

3. Enter the mantissa.

   The mantissa must be a 4-digit value with a precision of 3 (that is, all values between 0.000 and 9.999).

   a. Activate Select to move the cursor to the rightmost digit in the mantissa.

   b. Activate Scroll until the desired character is displayed.

   c. Activate Select to move the cursor one digit to the left.

   d. Activate Scroll until the desired character is displayed.

   e. Activate Select to move the cursor one digit to the left.

   f. Activate Scroll until the desired character is displayed.

   g. Activate Select to move the cursor one digit to the left.

   h. Activate Scroll until the desired character is displayed.

4. Enter the sign.

   a. Activate Select to move the cursor one digit to the left.

   b. Activate Scroll until the desired character is displayed.

      For positive numbers, select a blank space.

5. To save the displayed value to transmitter memory, activate Scroll and Select simultaneously and hold until the display changes.
   - If the displayed value is the same as the value in transmitter memory, you will be returned to the previous screen.
   - If the displayed value is not the same as the value in transmitter memory, SAVE/YES? flashes on the display. Activate Select.
6. Switch back from exponential notation to decimal notation.
   a. Activate Select until the E is flashing.
   b. Activate Select until d is displayed.
   c. Activate Select.

B.4 Display codes for process variables

Table B-2: Display codes for process variables

Code	Definition
Standard	
DENS	Line Density
TEMP	Line Temperature
EXT T	Line Temperature (External)
DGAIN	Drive Gain
UCALC	User-Defined Calculation Output
Viscosity measurement	
DYNV	Line Dynamic Viscosity
KINV	Line Kinetic Viscosity
RVISC	Referred Viscosity
SRVIS	Secondary Referred Viscosity
API referral	
RDENS	Referred Density (API)

B.5 Codes and abbreviations used in display menus

Table B-3: Display codes for measurement units

Code	Measurement unit
%	Percent

Table B-3: Display codes for measurement units *(continued)*

Code	Measurement unit
%PLATO	°Plato
%SOL-V	% solution by volume
%SOL-W	% solution by weight
°C	°Celsius
°F	°Fahrenheit
°K	°Kelvin
°R	°Rankine
ATM	Atmospheres
B BBL	Beer barrels
BALL	°Balling
BAR	Bars
BAUMH	°Baumé heavy
BAUML	°Baumé light
BBBL/D	Beer barrels per day
BBBL/H	Beer barrels per hour
BBBL/M	Beer barrels per minute
BBBL/S	Beer barrels per second
BBL	Barrels
BBL/D	Barrels per day
BBL/H	Barrels per hour
BBL/MN	Barrels per minute
BBL/S	Barrels per second
BTU/D	British Thermal Units per day
BTU/H	British Thermal Units per hour
BTU/lb	British Thermal Units per pound
BTU/MN	British Thermal Units per minute
BTU/scf	British Thermal Units per standard cubic foot
CM	Centimeters
CMHG0	Centimeters of mercury at 4 °C
CMW60	Centimeters of water at 60 °F
cP	Centipoise
cSt	Centistoke
CUF/LB	Cubic feet per pound
CUF/MN	Cubic feet per minute
CUFT	Cubic feet
CUFT/D	Cubic feet per day

Table B-3: Display codes for measurement units *(continued)*

Code	Measurement unit
CUFT/H	Cubic feet per hour
CUFT/S	Cubic feet per second
CUIN	Cubic inches
CUYD	Cubic yards
D API	°API
DAY	Days
DBRIX	°Brix
DTWAD	°Twaddle
FT	Feet
FT/S	Feet per second
FTH2O	Feet H20 @ 68 °F
FTW4C	Feet of water at 4 °C
FTW60	Feet of water at 60 °F
G	Grams
G/CM3	Grams per cubic centimeter
G/H	Grams per hour
G/L	Grams per liter
G/MIN	Grams per minute
G/mL	Grams per milliliter
G/MOL	Grams per mole
G/S	Grams per second
G/SCM	Grams per square centimeter
HL	Hectoliters
HOUR	Hours
HPA	Hectopascals
HZ	Hertz
IN	Inches
INH2O	Inches of water at 68 °F
INHG	Inches of mercury at 0 °C
INW4C	Inches of water at 4 °C
INW60	Inches of water at 60 °F
KG	Kilograms
KG/D	Kilograms per day
KG/H	Kilograms per hour
KG/L	Kilograms per liter
KG/M2	Kilograms per square meter

Table B-3: Display codes for measurement units *(continued)*

Code	Measurement unit
KG/M3	Kilograms per cubic meter
KG/MIN	Kilograms per minute
KG/S	Kilograms per second
KG/SCM	Kilograms per square centimeter
KPA	Kilopascals
L	Liters
L/H	Liters per hour
L/MIN	Liters per minute
L/S	Liters per second
LB	Pounds
LB/CUF	Pounds per cubic foot
LB/CUI	Pounds per cubic inch
LB/D	Pounds per day
LB/GAL	Pounds per gallon
LB/H	Pounds per hour
LB/MIN	Pounds per minute
LB/S	Pounds per second
LT/D	Long tons per day
LT/H	Long tons per hour
M/H	Meters per hour
M/S	Meters per second
M3	Cubic meters
M3/D	Cubic meters per day
M3/H	Cubic meters per hour
M3/MIN	Cubic meters per minute
M3/S	Cubic meters per second
mA	Milliamperes
mBAR	Millibars
METER	Meters
MHG0C	Meters of mercury at 0 °C
MILG/D	Million gallons per day
MILL/D	Million liters per day
MIN	Minutes
MJ/DAY	Megajoules per day
MJ/H	MegaJoules per hour
MJ/kg	Megajoules per kilogram

Table B-3: Display codes for measurement units *(continued)*

Code	Measurement unit
MJ/m3	Megajoules per cubic meter
MJ/MIN	Megajoules per minute
mm	Millimeters
mmH2O	Millimeters of water at 68 °F
mmHG	Millimeters of mercury at 0 °C
mmW4C	Millimeters of water at 4 °C
MPA	Megapascals
mV	Millivolts
MW4C	Meters of water at 4 °C
NL	Normal liters
NL/D	Normal liters per day
NL/H	Normal liters per hour
NL/MIN	Normal liters per minute
NL/S	Normal liters per second
NM3	Normal cubic meters
NM3/D	Normal cubic meters per day
NM3/H	Normal cubic meters per hour
NM3/M	Normal cubic meters per minute
NM3/S	Normal cubic meters per second
OHM	Ohms
OUNCE	Ounce
PA	Pascals
PF	Picofarads
PPM	Parts per million
PRF/M	Proof per mass
PRF/V	Proof per volume
PSF	Pounds per square foot
PSI	Pounds per square inch gauge
PSI A	Pounds per square inch absolute
SCF	Standard cubic feet
SCFD	Standard cubic feet per day
SCFH	Standard cubic feet per hour
SCFM	Standard cubic feet per minute
SCFS	Standard cubic feet per second
SEC	Seconds
SGU	Specific gravity units

Table B-3: Display codes for measurement units *(continued)*

Code	Measurement unit
SL	Standard liter
SL/D	Standard liters per day
SL/H	Standard liters per hour
SL/MIN	Standard liters per minute
SL/S	Standard liters per second
SM3	Standard cubic meter
SM3/D	Standard cubic meters per day
SM3/H	Standard cubic meters per hour
SM3/M	Standard cubic meters per minute
SM3/S	Standard cubic meters per second
SPECL	Special
ST/CUY	Short tons per cubic yard
ST/D	Short tons per day
ST/H	Short tons per hour
ST/MIN	Short tons per minute
T	Metric tons
T/D	Metric tons per day
T/H	Metric tons per hour
T/MIN	Metric tons per minute
TONUK	Long tons (2240 pounds)
TONUS	Short tons (2000 pounds)
TORR	Torr at 0 °C
UKGAL	Imperial gallons
UKGPD	Imperial gallons per day
UKGPH	imperial gallons per hour
UKGPM	Imperial gallons per minute
UKGPS	Imperial gallons per second
UMHO	Microsiemens
uSEC	Microseconds
USGAL	Gallons
USGPD	Gallons per day
USGPH	Gallons per hour
USGPM	Gallons per minute
USGPS	Gallons per second
V	Volts

Table B-4: Display codes for menus, controls, and data

Code	Definition
12 mA	12 mA value
20 mA	20 mA value
20 mA	20 mA
4 mA	4 mA value
4 mA	4 mA
ABORT	Abort
ACCPT	Accept
ACK	Acknowledge
ACK ALL?	Acknowledge all
ACTIV	Active
ADDR	Address
ALARM	Alert
ALL	All
ALT	Altitude
ANTHR	Another
AO 1	mA Output 1
AO 1 SRC	mA Output 1 Source
AO 2	mA Output 2
AO 2 SRC	mA Output 2 Source
API	API (American Petroleum Institute)
APPLY	Apply
ASCII	ASCII
AUTO	Auto
AUTOSCRL	Auto Scroll
AVG	Average
BASE	Base
BDENS	Base Density
BRD T	Board temperature
CAL	Calibrate or Calibration
CAL	Calibration result
CALC	Calculate
CCAI	Calculated Carbon Aromaticity Index
CH B	Channel B
CHANGE	Change
CHMBR	Chamber
CII	Calculated Ignition Index

Table B-4: Display codes for menus, controls, and data *(continued)*

Code	Definition
CO	Carbon monoxide
CO2	Carbon dioxide
CODE?	Passcode
CONC	Concentration
CONCENTR	Concentration
CONFG	Configure or Configuration
CONFIG	Configure or Configuration
COR M	Mass flow rate from Coriolis input
COR V	Volume flow rate calculated from Coriolis input
CUR Z	Current zero value
CURVE	Matrix
CUSTD	Custody transfer (Weights & Measures)
CUSTODY XFER	Custody transfer (Weights & Measures)
CV	Calorific value
DENS	Density
DEV	Maximum deviation
DGAIN	Drive gain
DISBL	Disabled
DISPLAY	Display
DO	Discrete Output
DO SRC	Discrete Output Source
DRIVE	Drive gain
DRIVE%	Drive gain
DSPLY	Display
DYNV	Dynamic viscosity
ENABL	Enabled
ENGL	English
ENRGY	Energy
ENTER	Enter
ETO	Engineer To Order
EVNT1	Enhanced event 1
EVNT2	Enhanced event 2
EVNT3	Enhanced event 3
EVNT4	Enhanced event 4
EVNT5	Enhanced event 5
EXIT	Exit

Table B-4: Display codes for menus, controls, and data *(continued)*

Code	Definition
EXT P	External or fixed pressure
EXT T	External or fixed temperature
FAC Z	Factory zero value
FACT	Factor
FACTORY	Factory
FAIL	Fail
FAULT	Fault
FCTOR	Factor
FILL	Fill
FIX	Fix
FREN	French
GAS	Gas
GER	German
GOOD	Good
H2	Hydrogen
HART	HART
HIDE	Hide
HIGH	High
IO	Input/Output
K VAL	K value
K0	K0 calibration factor
K1	K1 calibration factor
K2	K2 calibration factor
KDV	Known Density Verification
KINV	Kinematic viscosity
LANG	Language
LANGUAGE	Language
LOADING	Loading
LOW	Low
MAG M	Mass flow rate calculated from external volume input
MAG V	Volume flow rate from external input
MAINT	Maintenance
MAO 1	mA Output 1
MAO 2	mA Output 2
MASS	Mass
MBUS	Modbus

Table B-4: Display codes for menus, controls, and data *(continued)*

Code	Definition
MDIUM	Medium
MEASR	Measurement
MMI	Micro Motion
mS	Millisecond
MTR F	Meter factor
MW	Molecular weight
N2	Nitrogen
NET M	Net mass flow rate
NET V	Net volume flow rate
NO	No
nSEC	Nanoseconds
NUMBR	Number
OFF	Off
OFF-LINE	Offline
OFFLN	Offline
OFFSET	Offset
OFFST	Offset
ON	On
O-O-O-O	HART Squawk display
OOR	Out of range
PASS	Password or passcode
PASSW	Password or passcode
POLAR	Polarity
POLARITY	Polarity
POOR	Poor
PTS	Time period signal
Q FCTOR	Quality Factor
RANG	Range
RATE	Scroll Rate or Display Rate
RD	Relative density
RDENS	Referred density
REF	Reference or Referred
RESTORE	Restore
RESULT	Result
RTEMP	Reference temperature
RUN	Run

Table B-4: Display codes for menus, controls, and data *(continued)*

Code	Definition
RVISC	Referred viscosity
SAVE	Save
SCALE	Scale
SCL F	Dynamic viscosity scale factor
SCREEN	Screen
SCRLL	Scroll
SCROLL	Scroll
SECURE	Secure mode enabled
SEE	See
SELECT	Select
SET	Set, Set simulated value, Set configuration value
SETPOINT	Setpoint
SG	Specific gravity
SGU	Specific gravity
SHOW	Show
SIM	Simulate, Simulated
SLOPE	Slope
SPAN	Spanish
SRC	Source
SRVIS	Secondary referred viscosity
STAB	Stability
START	Start
STORE	Store
SW	Software
SWREV	Software revision
TCASE	Case temperature
TDIFF	Tube-Case Temperature Difference
TEMP	Temperature
TP	Time Period
TP A	Sensor Time Period (Upper)
TP B	Sensor Time Period
TPS	Time Period Signal
TYPE	Type
UCALC	User-defined calculation
ULTRA	Ultra-low
UNITS	Units

Table B-4: Display codes for menus, controls, and data *(continued)*

Code	Definition
VEL	Velocity
VELSW	Flow switch or velocity switch
VERSION_STRING	Revision or Version
VISC	Viscosity
VOL	Volume
VOLTS	Volts
WOBBE	Wobbe index
XMTR	Transmitter
YES	Yes
YES?	Confirm
Z	Compressibility
ZERO	Zero

Appendix C
Using ProLink III with the transmitter

Topics covered in this appendix:

C.1 Basic information about ProLink III

ProLink III is a configuration and service tool available from Micro Motion. It runs on a Windows platform and provides complete access to transmitter functions and data.

Version requirements

The following version of ProLink III is required: v3.2 or later.

ProLink III requirements

To install ProLink III, you must have:

- The ProLink III installation media
- The ProLink III installation kit for your connection type:
  - Converter: RS-232 to RS-485, or RS-232 to Bell 202
  - Cables and connectors: Serial port or USB port

To obtain ProLink III and the appropriate installation kit, contact Micro Motion.

ProLink III documentation

Most of the instructions in this manual assume that you are already familiar with ProLink III or that you have a general familiarity with Windows programs. If you need more information than this manual provides, see the ProLink III manual (*ProLink® III Configuration and Service Tool for Micro Motion® Transmitters: User Manual*).

In most ProLink III installations, the manual is installed with the ProLink III program. Additionally, the ProLink III manual is available on the Micro Motion documentation CD or the Micro Motion web site (*www.micromotion.com*).

ProLink III features and functions

ProLink III offers complete transmitter configuration and operation functions. ProLink III also offers a number of additional features and functions, including:

- The ability to save the transmitter configuration set to a file on the PC, and reload it or propagate it to other transmitters
- The ability to log specific types of data to a file on the PC
- The ability to view performance trends for various types of data on the PC

- The ability to connect to and view information for more than one device
- A guided connection wizard

These features are documented in the ProLink III manual. They are not documented in the current manual.

ProLink III messages

As you use ProLink III with a Micro Motion transmitter, you will see a number of messages and notes. This manual does not document all of these messages and notes.

Important
The user is responsible for responding to messages and notes and complying with all safety messages.

C.2 Connect with ProLink III

A connection from ProLink III to your transmitter allows you to read process data, configure the transmitter, and perform maintenance and troubleshooting tasks.

- *Connection types supported by ProLink III* (Section C.2.1)
- *Connect with ProLink III over Modbus/RS-485* (Section C.2.2)
- *Connect with ProLink III over HART/Bell 202* (Section C.2.3)

C.2.1 Connection types supported by ProLink III

Different connection types are available for connecting from ProLink III to the transmitter. Choose the connection type appropriate to your network and the tasks you intend to perform.

The transmitter supports the following ProLink III connection types:

- Service port connections
- HART/Bell 202 connections
- Modbus/RS-485 8-bit connections (Modbus RTU)
- Modbus/RS-485 7-bit connections (Modbus ASCII)

When selecting a connection type, consider the following:

- Service port connections are specialized Modbus/RS-485 connections that use standard connection parameters and a standard address that are already defined in ProLink III. Service port connections are typically used by field service personnel for specific maintenance and diagnostic functions. Use a service port connection only when another connection type does not provide the functionality you need.
- Some connection types require opening the wiring compartment or the power supply compartment. These connection types should be used only for temporary connections, and may require extra safety precautions.

- Modbus connections, including service port connections, are typically faster than HART connections.
- When you are using a HART connection, ProLink III will not allow you to open more than one window at a time. This is done to manage network traffic and optimize speed.
- You cannot make concurrent Modbus connections if the connections use the same terminals. You can make concurrent Modbus connections if the connections use different terminals.

C.2.2 Connect with ProLink III over Modbus/RS-485

You can connect directly to the RS-485 terminals on the transmitter or to any point on the network.

⚠ CAUTION!

If the transmitter is in a hazardous area, do not remove the transmitter end-cap while the transmitter is powered up. Removing the end cap while the transmitter is powered up could cause an explosion. To connect to the transmitter in a hazardous environment, use a connection method that does not require removing the transmitter end-cap.

Prerequisites

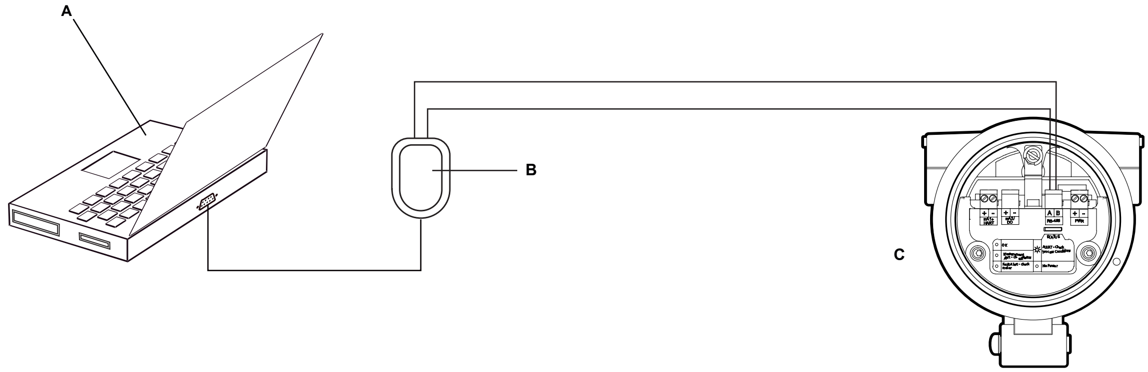
- ProLink III v3.2 or later installed and licensed on your PC
- An available serial port or USB port
- The installation kit appropriate to your connection type (RS-485 or Bell 202, serial port or USB)
- Adapters as required (for example, 9-pin to 25-pin)

Procedure

1. Attach the signal converter to the serial port or USB port on your PC.
2. To connect directly to the transmitter terminals:
   a. Remove the transmitter end-cap to access the wiring compartment.
   b. Connect the leads from the signal converter to the RS-485 terminals.

   Tip
   Usually, but not always, you should connect the black lead to the A terminal and the red lead to the B terminal.

Figure C-1: Connection to RS-485 terminals



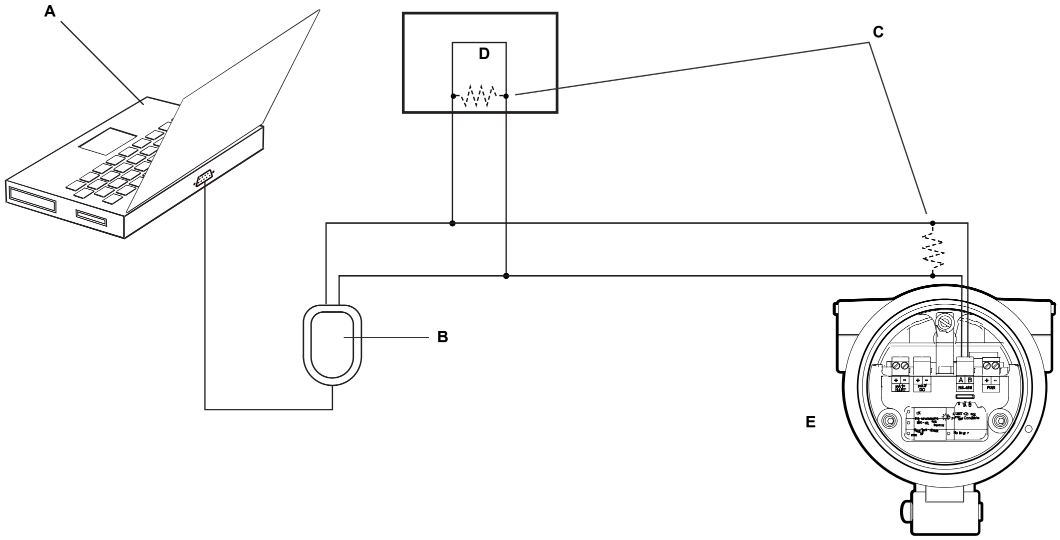
A. PC
B. RS-232 to RS-485 converter
C. Transmitter with end-cap removed

Note
This figure shows a serial port connection. USB connections are also supported.

3. To connect over the RS-485 network:
   a. Attach the leads from the signal converter to any point on the network.
   b. Add resistance as necessary.
   c. Ensure that the PLC or DCS is not trying to communicate to this meter at this time.

   Restriction
   The meter does not support concurrent connections from ProLink III and a PLC or DCS. If another host is already communicating with the meter, ProLink III will not be able to connect, but its connection attempts will corrupt messages from the other host. To make a ProLink III connection, disconnect the cable from the host.

Figure C-2: Connection over network



A. PC
B. RS-232 to RS-485 converter
C. 120-Ω, 1/2-watt resistors at both ends of the segment, if necessary
D. DCS or PLC
E. Transmitter with end-cap removed

Note
This figure shows a serial port connection. USB connections are also supported.

4. Start ProLink III.
5. Choose Connect to Physical Device.
6. Set the parameters that are required for your connection type.

Table C-1: RS-485 connection parameters

Connection type	Parameter	Value	Optional or required?	Auto-detection
Service port	Protocol	Service Port	Required	No
	PC Port	The PC port that you are using for this connection.	Required	No
Modbus/RS-485	Protocol	Modbus RTU or Modbus ASCII	Required	Yes. The device accepts connection requests that use either protocol, and responds using the same protocol.
	PC Port	The PC port that you are using for this connection.	Required	No
	Address	The Modbus address configured for this transmitter. The default is 1.	Required	No

Table C-1: RS-485 connection parameters *(continued)*

Connection type	Parameter	Value	Optional or required?	Auto-detection
	Baud Rate	1200 to 38400	Optional	Yes. The device accepts connection requests that use any valid setting, and responds using the same setting.
	Parity	None, Odd, Even	Optional	Yes. The device accepts connection requests that use any valid setting, and responds using the same setting.
	Stop Bits	1 or 2	Optional	Yes. The device accepts connection requests that use any valid setting, and responds using the same setting.

7. Click Connect.

Need help?

If an error message appears:

- Switch the leads and try again.
- Verify the Modbus address of the transmitter.
- Ensure that you have specified the correct port on your PC.
- Check the wiring between the PC and the transmitter.
- For long-distance communication, or if noise from an external source interferes with the signal, install 120-Ω ½-W terminating resistors in parallel with the output at both ends of the communication segment.
- Ensure that there is no concurrent Modbus communication to the transmitter.

C.2.3 Connect with ProLink III over HART/Bell 202

You can connect directly to the primary mA terminals on the transmitter, to any point in a local HART loop, or to any point in a HART multidrop network.

⚠ CAUTION!

If the transmitter is in a hazardous area, do not remove the transmitter end-cap while the transmitter is powered up. Removing the end cap while the transmitter is powered up could cause an explosion. To connect to the transmitter in a hazardous environment, use a connection method that does not require removing the transmitter end-cap.

⚠ CAUTION!

If you connect directly to the mA terminals, the transmitter's mA output may be affected. If you are using the mA output for process control, set devices for manual control before connecting directly to the mA terminals.

Prerequisites

- ProLink III v3.2 or later installed and licensed on your PC
- An available serial port or USB port
- The installation kit appropriate to your connection type (RS-485 or Bell 202, serial port or USB)
- Adapters as required (for example, 9-pin to 25-pin)

Procedure

1. Attach the signal converter to the serial port or USB port on your PC.
2. To connect directly to the transmitter terminals:

    a. Remove the transmitter end-cap to access the wiring compartment.

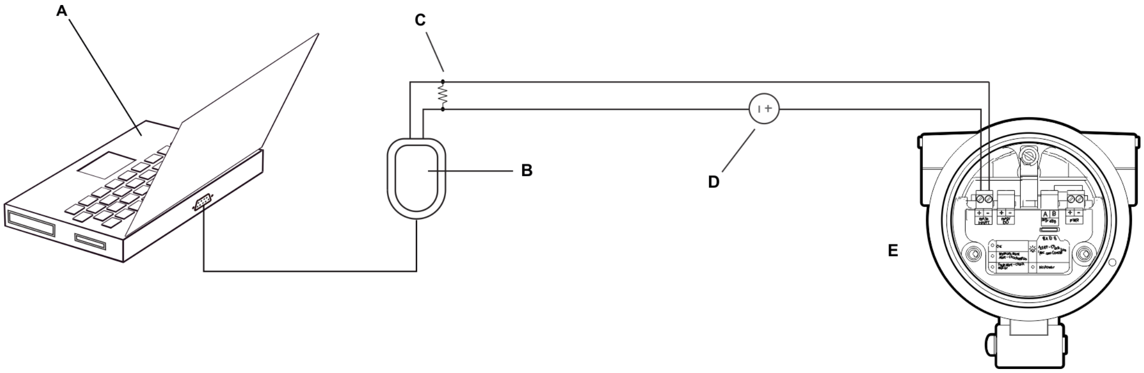
    b. Connect the leads from the signal converter to terminals 1 and 2.

    Note
    HART connections are not polarity-sensitive. It does not matter which lead you attach to which terminal.

    c. Add resistance as necessary to achieve at least one volt across the connection points.

    Important
    HART/Bell 202 connections require a voltage drop of 1 VDC. To achieve this, add resistance of 250–600 Ω to the connection.

Figure C-3: Connection to mA output terminals

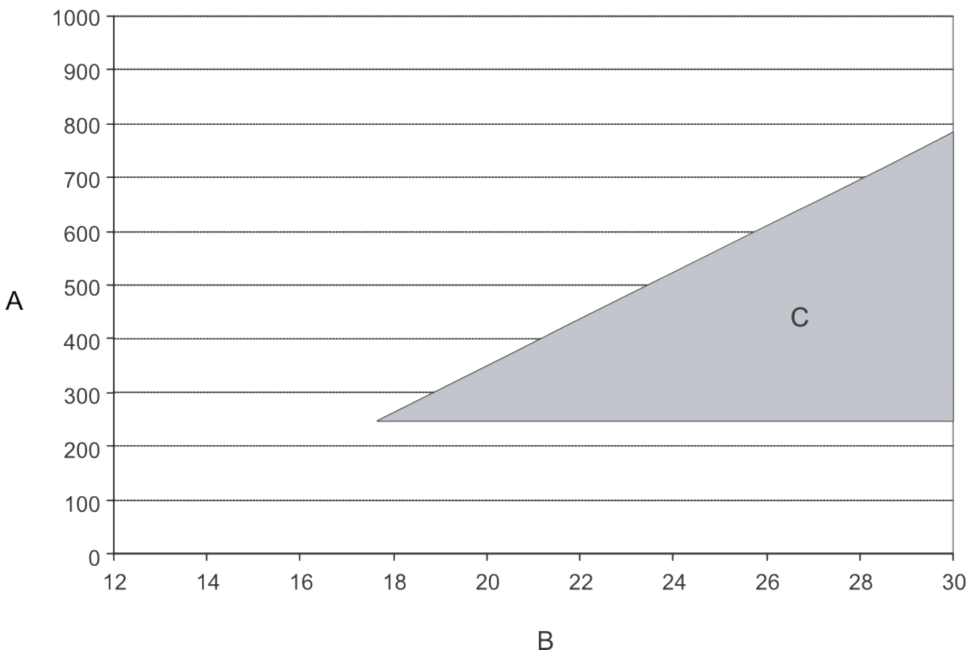


A. PC
B. RS-232 to Bell 202 converter
C. 250–600 Ω resistance
D. External power supply
E. Transmitter with end-cap removed

Note
This figure shows a serial port connection. USB connections are also supported.

The signal converter must be connected across a resistance of 250–600 Ω. The mA output requires an external power supply with a minimum of 250 Ω and 17.5 V. See the following figure to help determine the appropriate combination of voltage and resistance. Note that many PLCs have a built-in 250-Ω resistor. If the PLC is powering the circuit, be sure to take this into consideration.

Figure C-4: Supply voltage and resistance requirements



A. *External resistance (ohms)*
B. *Supply voltage VDC (volts)*
C. *Operating range*

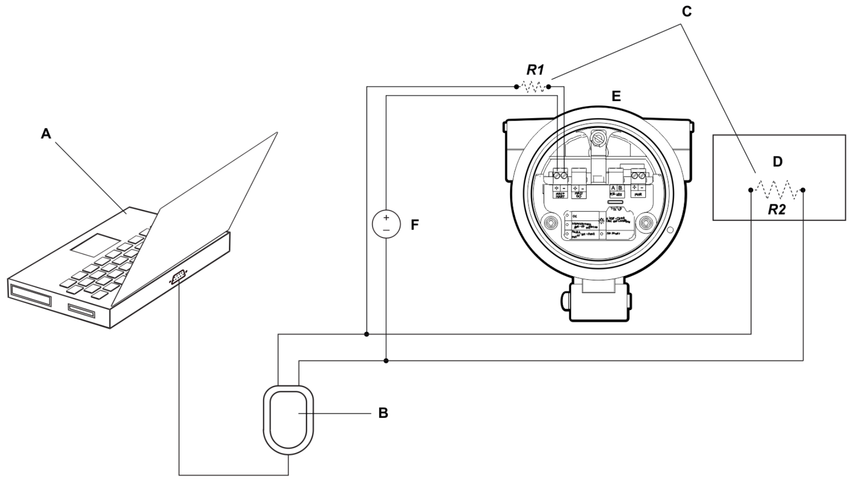
Note

$$R_{max} = \frac{(V_{supply} - 12)}{0.023}$$

3. To connect to a point in the local HART loop:
   a. Attach the leads from the signal converter to any point in the loop, ensuring that the leads are across the resistor.
   b. Add resistance as necessary to achieve at least one volt across the connection points.

Important
HART/Bell 202 connections require a voltage drop of 1 VDC. To achieve this, add resistance of 250–600 Ω to the connection.

Figure C-5: Connection over local loop



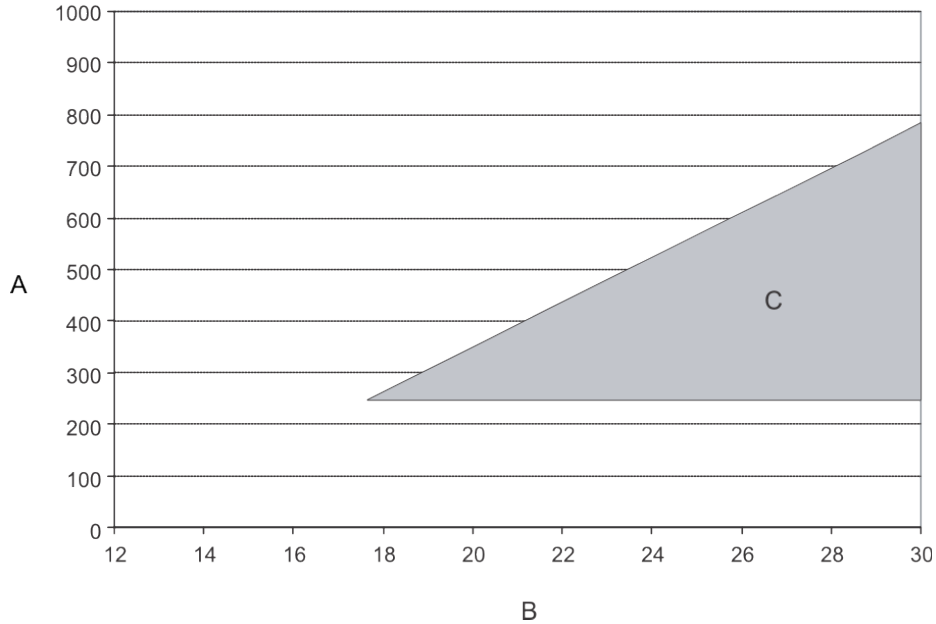
A. PC
B. RS-232 to Bell 202 converter
C. Any combination of resistors R1 and R2 as necessary to meet HART communication resistance requirements
D. DCS or PLC
E. Transmitter with end-cap removed
F. External power supply

Note

This figure shows a serial port connection. USB connections are also supported.

The signal converter must be connected across a resistance of 250–600 Ω. The mA output requires an external power supply with a minimum of 250 Ω and 17.5 V. See the following figure to help determine the appropriate combination of voltage and resistance. Note that many PLCs have a built-in 250-Ω resistor. If the PLC is powering the circuit, be sure to take this into consideration.

Figure C-6: Supply voltage and resistance requirements



A. External resistance (ohms)
B. Supply voltage VDC (volts)
C. Operating range

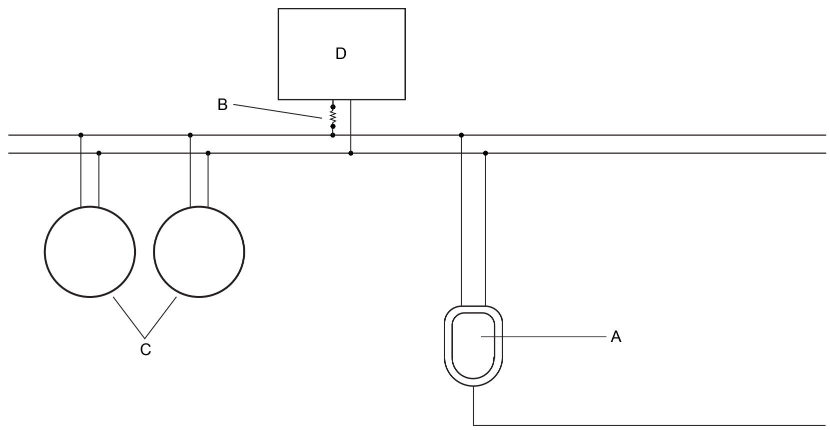
Note

$$R_{max} = \frac{(V_{supply} - 12)}{0.023}$$

4. To connect over a HART multidrop network:
   a. Attach the leads from the signal converter to any point in the loop.
   b. Add resistance as necessary to achieve at least one volt across the connection points.

Important
HART/Bell 202 connections require a voltage drop of 1 VDC. To achieve this, add resistance of 250–600 Ω to the connection.

Figure C-7: Connection over multidrop network



A. RS-232 to Bell 202 converter
B. 250–600 Ω resistance
C. Devices on the network
D. Master device

5. Start ProLink III.
6. Choose Connect to Physical Device.
7. Set Protocol to HART Bell 202.

Tip

HART/Bell 202 connections use standard connection parameters. You do not need to configure them here.

8. If you are using a USB signal converter, enable Toggle RTS.
9. Set Address/Tag to the HART polling address configured in the transmitter.

Tips

- If this is the first time you are connecting to the transmitter, use the default address: 0.
- If you are not in a HART multidrop environment, the HART polling address is typically left at the default value.
- If you are unsure of the transmitter's address, click Poll. The program will search the network and return a list of the transmitters that it detects.

10. Set the PC Port value to the PC COM port that you are using for this connection.
11. Set Master as appropriate.

Option	Description
Secondary	Use this setting if a primary HART host such as a DCS is on the network.
Primary	Use this setting if no other primary host is on the network. The Field Communicator is a secondary host.

12. Click **Connect**.

Need help? If an error message appears:

- Verify the HART address of the transmitter, or poll HART addresses 1–15.
- Ensure that there is at least 1 VDC across the connection terminals. Add resistance as necessary to achieve at least 1 volt.
- Ensure that you have specified the correct port on your PC.
- Check the wiring between the PC and the transmitter.
- Ensure that the mA output is powered.
- Increase or decrease resistance.
- Disable burst mode.
- Ensure that the resistor is installed correctly. If the mA output is internally powered (active), the resistor must be installed in parallel. If the mA output is externally powered (passive), the resistor must be installed in series.
- Ensure that there is no conflict with another HART master. If any other host (DCS or PLC) is connected to the mA output, temporarily disconnect the DCS or PLC wiring.

Appendix D
Using the Field Communicator with the transmitter

Topics covered in this appendix:

- *Basic information about the Field Communicator*
- *Connect with the Field Communicator*

D.1 Basic information about the Field Communicator

The Field Communicator is a handheld configuration and management tool that can be used with a variety of devices, including Micro Motion transmitters. It provides complete access to transmitter functions and data.

Field Communicator documentation

Most of the instructions in this manual assume that you are already familiar with the Field Communicator and can perform the following tasks:

- Turn on the Field Communicator
- Navigate the Field Communicator menus
- Establish communication with HART-compatible devices
- Send configuration data to the device
- Use the alpha keys to enter information

If you are unable to perform these tasks, consult the Field Communicator manual before attempting to use the Field Communicator. The Field Communicator manual is available on the Micro Motion documentation CD or the Micro Motion web site (*www.micromotion.com*).

Device descriptions (DDs)

In order for the Field Communicator to work with your device, the appropriate device description (DD) must be installed. This meter requires the following HART device description: Density Gas Viscosity Meter Dev v2 DD v1 or later.

To view the device descriptions that are installed on your Field Communicator:

1. At the HART application menu, press Utility > Available Device Descriptions.
2. Scroll the list of manufacturers and select Micro Motion, then scroll the list of installed device descriptions.

If Micro Motion is not listed, or you do not see the required device description, use the Field Communicator Easy Upgrade Utility to install the device description, or contact Micro Motion.

Field Communicator menus and messages

Many of the menus in this manual start with the On-Line menu. Ensure that you are able to navigate to the On-Line menu.

As you use the Field Communicator with a Micro Motion transmitter, you will see a number of messages and notes. This manual does not document all of these messages and notes.

Important
The user is responsible for responding to messages and notes and complying with all safety messages.

D.2 Connect with the Field Communicator

A connection from the Field Communicator to your transmitter allows you to read process data, configure the transmitter, and perform maintenance and troubleshooting tasks.

You can connect the Field Communicator to the primary mA terminals on the transmitter, to any point in a local HART loop, or to any point in a HART multidrop network.

⚠ **CAUTION!**

If the transmitter is in a hazardous area, do not connect the Field Communicator to the mA terminals on the transmitter. This connection requires opening the wiring compartment, and opening the wiring compartment in a hazardous area can cause an explosion.

Important
If the HART security switch is set to ON, HART protocol cannot be used to perform any action that requires writing to the transmitter. For example, you cannot change the configuration, reset totalizers, or perform calibration using the Field Communicator or ProLink II with a HART connection. When the HART security switch is set to OFF, no functions are disabled.

Prerequisites

The following HART device description (DD) must be installed on the Field Communicator: Density Gas Viscosity Meter Dev v2 DD v1 or later.

Procedure

1. To connect to the transmitter terminals:

   a. Remove the transmitter end-cap.

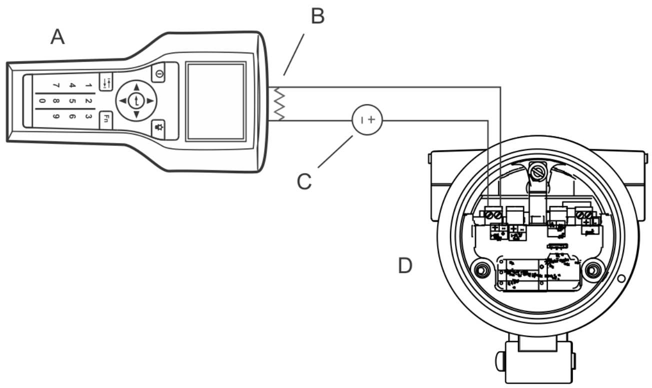
   b. Attach the leads from the Field Communicator to terminals 1 and 2 on the transmitter and add resistance as required.

      The Field Communicator must be connected across a resistance of 250–600 Ω.

Tip

HART connections are not polarity-sensitive. It does not matter which lead you attach to which terminal.

Figure D-1: Field Communicator connection to transmitter terminals

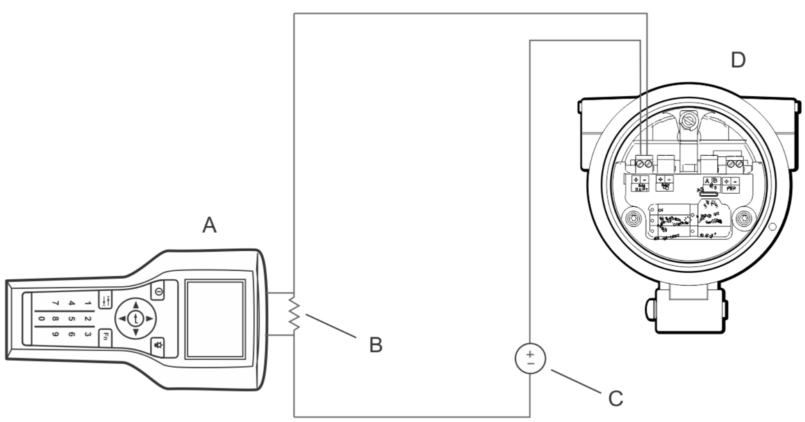


A. Field Communicator
B. 250–600 Ω resistance
C. External power supply
D. Transmitter with end-cap removed

2. To connect to a point in the local HART loop, attach the leads from the Field Communicator to any point in the loop and add resistance as necessary.

   The Field Communicator must be connected across a resistance of 250–600 Ω.

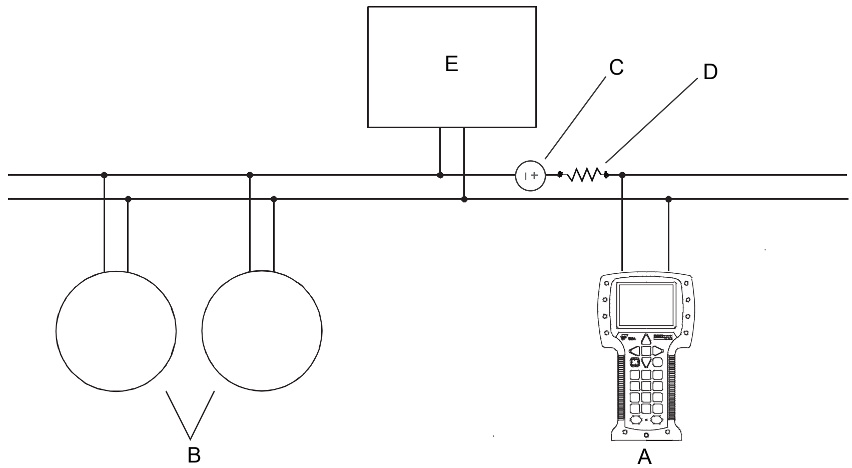
Figure D-2: Field Communicator connection to local HART loop



A. Field Communicator
B. 250–600 Ω resistance
C. External power supply
D. Transmitter with end-cap removed

3. To connect to a point in the HART multidrop network, attach the leads from the Field Communicator to any point on the network.

Figure D-3: Field Communicator connection to multidrop network



A. Field Communicator
B. Devices on the network
C. External power supply (may be provided by the PLC)
D. 250–600 Ω resistance (may be provided by the PLC)
E. Master device

4. Turn on the Field Communicator and wait until the main menu is displayed.
5. If you are connecting across a multidrop network:
   - Set the Field Communicator to poll. The device returns all valid addresses.
   - Enter the HART address of the transmitter. The default HART address is 0. However, in a multidrop network, the HART address has probably been set to a different, unique value.

Postrequisites

To navigate to the Online menu, choose HART Application > Online. Most configuration, maintenance, and troubleshooting tasks are performed from the Online menu.

Tip
You may see messages related to the DD or active alerts. Press the appropriate buttons to ignore the message and continue.

Need help?

The Field Communicator requires a minimum of 1 VDC across the connection leads to communicate. If necessary, increase the resistance at the connection point until 1 VDC is achieved.

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