

Special Documentation

Proline Prosonic Flow P 500

Petroleum and product identification application
packages
HART



Table of contents

1	About this document	4
1.1	Document function	4
1.2	Content and scope	4
1.3	Symbols	4
1.4	Documentation	5
1.5	Registered trademarks	5
2	Product features and availability	6
2.1	Order code	6
2.2	Product features	6
2.3	Activation	6
2.4	Checking availability	6
2.5	Access	6
3	"Petroleum" option	7
3.1	General principles	7
3.2	System integration	8
3.3	Commissioning	8
3.4	Additional measured variables	13
3.5	Register information	14
4	"Product identification" option	15
4.1	General principles	15
4.2	"Product identification" submenu	15
5	Workflow	18

1 About this document

1.1 Document function

This manual is special documentation; it does not replace the Operating Instructions pertaining to the device. It serves as a reference for using the application package integrated in the measuring device.

1.2 Content and scope

This documentation contains a description of the additional parameters and technical data that are provided with the **Petroleum** application package.

It provides detailed information on:

- Application-specific parameters
- Advanced technical specifications

1.3 Symbols

1.3.1 Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.








CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

1.3.2 Symbols for certain types of information


Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed

Symbol	Meaning
1, 2, 3...	Series of steps
↳	Result of a step


1.3.3 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

1.4 Documentation

 For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

 This Special Documentation and other documentation is available:
In the Download Area of the Endress+Hauser website: www.endress.com → Downloads

This documentation is an integral part of the following Operating Instructions:

Measuring device	Documentation code
Prosonic Flow P 500	BA02025D

Certification	Documentation code
Manufacturer declaration Prosonic Flow 300/500	HE_01410

1.5 Registered trademarks

HART®

Registered trademark of the FieldComm Group, Austin, Texas USA

2 Product features and availability

2.1 Order code

- Order code for "Application package", option EJ "Petroleum"
- Order code for "Application package", option EQ "Petroleum & product identification"


The application package can be ordered directly with the device or it can be ordered at a later date as a conversion kit. Detailed information on the relevant order code is available from your local Endress+Hauser sales organization or on the product page of the Endress+Hauser website: www.endress.com.

2.2 Product features

The Petroleum and the Petroleum and Product identification application packages deliver specific algorithms together with device variables and external inputs to calculate additional parameters, options and measured variables that are then available to the user.


The following functions are available with the application package:

- **"Petroleum" option**

Corrections for the corrected volume and reference density, calculated and based on API MPMS, Chapter 11.1 "Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils". →  7

- **"Product identification" option**

Only available with order code "Application package", option EQ "Petroleum & product identification".

The function is used for identifying various liquid hydrocarbons →  15.

2.3 Activation

A conversion kit is supplied if the application package is ordered subsequently. This kit includes a tag plate with device data and an activation code.



For detailed information about this, refer to Installation Instructions EA01164D

2.4 Checking availability

- The order code with a breakdown of the device features can be found on the delivery note.
- In W@M Device Viewer (www.endress.com/deviceviewer), enter the serial number from the nameplate and check in the device information which option appears under the order code for "Application packages".
- The software options currently enabled are displayed in the **Software option overview** parameter (0015) operating menu.
Expert → System → Administration

2.5 Access

The application package is compatible with all the system integration options. Interfaces with digital communication are required to access the data saved in the device. The speed of data transmission depends on the type of communication interface used.

3 "Petroleum" option

3.1 General principles

Using the Petroleum application package, the measuring device can calculate the corrected volume flow and reference density in compliance with the regulations in API MPMS, Chapter 11.1 "Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils".

When the fluid temperature and process pressure change, the density and volume also change. As such, both pressure and temperature are required as input variables in order to calculate the volume flow at standard conditions (e.g. in line with API table 5: $p = 1 \text{ bar}$, $T = 60 \text{ °F}$).

The pressure and temperature can either be read in externally via the interface (4–20 mA, HART) or programmed as fixed values.

Key parameters must be configured before the "Petroleum" application package is fully operational. In petroleum mode, you can select the input variable on which the correction calculations are based. In the "Sound velocity" petroleum mode, the correction calculations are based on the measured speed of sound. For the "Density", "Reference density" and "API gravity" petroleum modes, a value can either be read in via the interface (HART or Modbus) or a fixed value can be programmed as the source.

In addition to the petroleum mode and the configuration of pressure and temperature sources, the API commodity group (4151) of the process fluid and the reference or standard conditions (via the API table number) must be selected.

The options available in the **API commodity group** parameter (4151) and in the **API table selection** parameter (4152) are described below.

Select the corresponding process fluid in the **API commodity group** parameter (4151):

- A - crude oil
- B - refined products
- C - special applications
- D - lubricating oils



The following must be considered when selecting the option in the **API commodity group** parameter (4151):



- The calculation and correction of the corrected volume and standard density depend on the options selected in the **API commodity group** parameter (4151).
- If the **C - special applications** option is selected, the thermal expansion coefficient of the fluid must be specified.
- The calculations and corrections programmed into the device do not apply for the following media:
 - LNG
 - Ethylene
 - Butadiene
 - Cyclohexane
 - Aromas
 - Road tars

Options available in the "API table selection" parameter (4152)

API table selection (4152)	Unit	Standard conditions
API table 5/6	API°	60 °F & 0 psi(g)
API table 23/24	SGU	60 °F & 0 psi(g)
API table 53/54	kg/m ³	15 °C & 0 kPa(g)
API table 59/60	kg/m ³	20 °C & 0 kPa(g)

3.2 System integration

 Overview of the extended range of measured variables available with the **Petroleum** application package: →  13

 For detailed information on system integration, see:
Operating Instructions for the device →  5

3.3 Commissioning















Proceed as follows to configure the measuring device:
















1. Configure the parameters in the **Petroleum** submenu →  8
2. Configure the measuring point for the **Petroleum** application package.
3. Configure the outputs, local display and totalizer →  12

3.3.1 Configuring the measuring device

Navigation

"Expert" menu → Application → Petroleum

▶ Petroleum	
Petroleum mode (4187)	→  9
API commodity group (4151)	→  9
Thermal expansion coefficient (4153)	→  10
API table selection (4152)	→  10
Temperature compensation (3025)	→  10
Fixed value (2925)	→  10
External value (3058)	→  10
Pressure compensation (3023)	→  10
Fixed value (3022)	→  10
External pressure (3059)	→  10
API gravity source (4220)	→  10
Fixed value (4218)	→  10
External value (4219)	→  10
Reference density source (4215)	→  10

Fixed value (4217)	→  10
External value (4216)	→  11
Density source (3048)	→  11
Fixed value (3171)	→  11
External value (3060)	→  11
API slope time constant (4225)	→  11
S&W input mode (4189)	→  11
Fixed value (4156)	→  11
S&W correction value (4194)	→  11
Shrinkage factor (4167)	→  11
Meter factor (4198)	→  11
▶ Sound velocity adjustment	→  12
Sound velocity adjustment (4213)	→  12
Reference sound velocity (4223)	→  12
Sound velocity offset (4224)	→  12

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Petroleum mode	-	Select the process variable to use to calculate the standard volume flow. The calculation is performed at the API ref. conditions (temp. and press.).	<ul style="list-style-type: none"> ■ Off ■ Density ■ Reference density ■ API gravity ■ Sound velocity 	Off
API commodity group	The Off option is not selected in Petroleum mode parameter (4187).	Select the medium's API commodity group.	<ul style="list-style-type: none"> ■ A - crude oil ■ B - refined products ■ C - special applications * ■ D - lubricating oils 	A - crude oil

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
API table selection	The Off option is not selected in Petroleum mode parameter (4187).	Select the API reference conditions (temperature and pressure) that apply for the calculation of the reference density. If the Other option is selected, enter the pressure and temperature values.	<ul style="list-style-type: none"> ■ API table 5/6 ■ API table 23/24 ■ API table 53/54 ■ API table 59/60 ■ Other 	API table 53/54
Thermal expansion coefficient	The C - special applications option is selected in the API commodity group parameter (4151) parameter	Enter the thermal expansion coefficient of the measured medium.	$414 \cdot 10^{-6}$ to $1674 \cdot 10^{-6}$ 1/K	$414 \cdot 10^{-6}$ 1/K
Temperature compensation	The Off option is not selected in Petroleum mode parameter (4187).	Select temperature mode for temperature compensation.	<ul style="list-style-type: none"> ■ Fixed value ■ External value * ■ Current input 1 * ■ Current input 2 * 	Fixed value
Fixed value	The Fixed value option is selected in Temperature compensation parameter (3025).	Enter a fixed value for the process temperature.	-50 to 550 °C	20 °C
External value	The External value option or the Current input 1...n option is selected in the Temperature compensation parameter (3025).	Shows the process temperature read from the external device.	-273.15 to 99 999 °C	-
Pressure compensation	The Off option is not selected in Petroleum mode parameter (4187).	Select pressure compensation type.	<ul style="list-style-type: none"> ■ Fixed value ■ External value * ■ Current input 1 * ■ Current input 2 * 	Fixed value
Fixed value	The Fixed value option is selected in Pressure compensation parameter (3023).	Enter a fixed value for the process pressure. The pressure is 0 bar(g) = 1.01325 bar under standard conditions.	0 to 250 bar	5 bar
External pressure	The External value option or Current input 1...n option is selected in the Pressure compensation parameter (3023).	Shows the process pressure read from the external device. The pressure is 0 bar(g) = 1.01325 bar under standard conditions.	Positive floating-point number	0 bar
API gravity source	The API gravity option is selected in the Petroleum mode parameter (4187).	Select the source for the reference density under "API gravity".	<ul style="list-style-type: none"> ■ Fixed value ■ Current input 1 * ■ Current input 2 * ■ External value * 	Fixed value
Fixed value	The Fixed value option is selected in the API gravity source parameter (4220).	Enter a fixed value for the reference density under "API gravity".	0.0 to 100.0 °API	0.0 °API
External value	The External value option or Current input 1...n option is selected in the API gravity source parameter (4220).	Shows the density in API degree read from the external device.	0.0 to 100.0 °API	-
Reference density source	The Reference density option is selected in the Petroleum mode parameter (4187).	Select the source of the reference density.	<ul style="list-style-type: none"> ■ Fixed value ■ Current input 1 * ■ Current input 2 * ■ External value * 	Fixed value
Fixed value	The Fixed value option is selected in the Reference density source parameter (4215).	Enter a fixed value for the reference density.	0 to 1 500.0 kg/Nm ³	0 kg/Nm ³

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
External value	The External value option or Current input 1...n option is selected in the Reference density source parameter (4215).	Shows the reference density read from the external device.	Signed floating-point number	–
Density source	The Density option is selected in the Petroleum mode parameter (4187).	Select the source of the density.	<ul style="list-style-type: none"> ■ Fixed value ■ External value * ■ Calculated value * ■ Current input 1 * ■ Current input 2 * 	Fixed value
Fixed value	The Fixed value parameter (3171) is selected in the Density source parameter (3048).	Enter fixed value for medium density.	0.01 to 15 000 kg/m ³	1 000 kg/m ³
External value	The External value option or the Current input 1...n option is selected in the Density source parameter (3048).	Shows the density read from the external device.	Positive floating-point number	0 kg/m ³
API slope time constant	The Off option is not selected in the Petroleum mode parameter (4187).	Enter the time constant for the calculation of the API slope.	0 to 30 s	0.5 s
S&W input mode	The Off option is not selected in Petroleum mode parameter (4187).	Select input mode for sediment and water. If the calculated volume flow should be reduced owing to the presence of sediment and water in the fluid, this can be done using a fixed value, a value from an external source or by entering a current value.	<ul style="list-style-type: none"> ■ Off ■ Fixed value ■ Current input 1 * ■ Current input 2 * ■ External value * 	Off
Fixed value	The Fixed value option is selected in the S&W input mode parameter (4189) parameter	Enter a fixed value for sediment and water in %. Use this function to enter a percentage to factor in a reduction in the volume flow due to the presence of sediment and water in the fluid.	0 to 100 %	0 %
S&W correction value	The External value option or Current input 1...n option is selected in the S&W input mode parameter (4189).	Shows the correction value for sediment and water.	Positive floating-point number	–
Shrinkage factor	The Off option is not selected in Petroleum mode parameter (4187).	Enter shrinkage factor. The volume flow can decrease as a result of outgassing between the separation point and the storage tank. A reduction in the volume flow is taken into account by entering a shrinkage factor.	Positive floating-point number	1.0
Meter factor	The Off option is not selected in Petroleum mode parameter (4187).	Enter a calibration factor for the device to adjust the measured value for the volume flow.	Signed floating-point number	1.0

* Visibility depends on order options or device settings

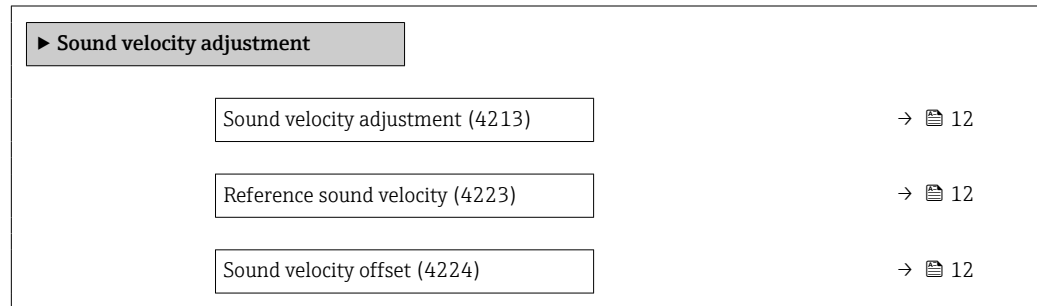
"Sound velocity adjustment" submenu

Compare the measured sound velocity to the Reference sound velocity. The Reference sound velocity can be entered as a fixed value. If the measuring point configuration is changed, the calculated sound velocity is used as the new Reference sound velocity.

The offset is recalculated and can be overwritten: Expert → Sensor → Sensor adjustment → Process variable adjustment **Sound velocity offset** parameter (1848)

Navigation

"Expert" menu → Application → Petroleum → Sound velocity adjustment



Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Sound velocity adjustment	The Off option is not selected in the Petroleum mode parameter (4187).	Perform an adjustment to adjust the sound velocity measured based on the offset calculated.	<ul style="list-style-type: none"> ■ Cancel ■ Start * 	Cancel
Reference sound velocity	The Off option is not selected in the Petroleum mode parameter (4187).	Shows the reference sound velocity (is entered or calculated during installation). Overwrite if required.	200 to 3000 m/s	1482.4 m/s
Sound velocity offset	The Off option is not selected in the Petroleum mode parameter (4187).	Shows the offset calculated during the last adjustment (= average of 100 measurements minus reference sound velocity). Overwrite if required.	-1500 to 1500 m/s	0 m/s

* Visibility depends on order options or device settings

3.3.2 Configuration of the outputs

The following additional measured variables are available for the outputs, the local display and the totalizer once the measuring device is commissioned:

- Reference density
- S&W volume flow
- GSV flow
- NSV flow
- API gravity
- API slope
- Temperature
- Pressure

3.4 Additional measured variables

Additional measured variables are available with the **Petroleum** application package if the **Off** option was not selected in the **Petroleum mode** parameter (4047).

Navigation

"Expert" menu → Sensor → Measured values → Process variables

► Process variables

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface	Factory setting
CPL	The Off option is not selected in Petroleum mode parameter (4187).	Displays the calibration factor which represents the effect of pressure on the fluid. This is used to convert the measured volume flow and the measured density to values at reference pressure.	Positive floating-point number	–
CTL	The Off option is not selected in Petroleum mode parameter (4187).	Displays the calibration factor which represents the effect of temperature on the fluid. This is used to convert the measured volume flow and the measured density to values at reference temperature.	Positive floating-point number	–
CTPL	The Off option is not selected in Petroleum mode parameter (4187).	Displays the combined calibration factor which represents the effect of temperature and pressure on the fluid. This is used to convert the measured volume flow and the measured density to values at reference temperature and reference pressure.	Positive floating-point number	–
GSV flow	The Off option is not selected in Petroleum mode parameter (4187).	Displays the measured total volume flow, corrected to the reference temperature and the reference pressure. <i>Dependency</i> The unit is taken from: Corrected volume flow unit parameter (0558)	Signed floating-point number	–
NSV flow	The Off option is not selected in Petroleum mode parameter (4187).	Displays the net volume flow which is calculated from the measured total volume flow minus the value for sediment & water and minus the shrinkage. <i>Dependency</i> The unit is taken from: Corrected volume flow unit parameter (0558)	Signed floating-point number	–
S&W correction value	The External value option or Current input 1...n option is selected in the S&W input mode parameter (4189).	Shows the correction value for sediment and water.	Positive floating-point number	–

Parameter	Prerequisite	Description	User interface	Factory setting
S&W volume flow	The Off option is not selected in Petroleum mode parameter (4187).	Displays the S&W volume flow which is calculated from the measured total volume flow minus the net volume flow. <i>Dependency</i> The unit is taken from: Volume flow unit parameter (0553)	Signed floating-point number	–
API gravity	The API referenced correction option is selected in Petroleum mode parameter (4187).	Displays the reference density in API degrees (specified depending on the option, or read in by an external device).	0.0 to 100.0 °API	–
API slope	The API referenced correction option is selected in Petroleum mode parameter (4187).	Shows the API slope (change of API over time). Can be used e.g. to detect different products.	–10 to 100 °API/s	–
Reference density	The API referenced correction option is selected in Petroleum mode parameter (4187).	Shows the reference density at the API reference conditions specified for temperature and pressure.	0 to 30 kg/Nm ³	–

3.5 Register information

4 "Product identification" option

4.1 General principles

The measuring device can identify various liquid hydrocarbon process fluids (products) using the **Product identification** option of the Petroleum application package.

Products can be identified either via the currently measured API gravity or via the sound velocity. If the measured value is within the range defined for the relevant product, the product is identified and totalized in the totalizer. Up to five products can be configured independently of each other.

A few application examples are listed below.

Product classification (product A, product B)

For example, differentiating between different types of crude oil. The products can be classified based on their chemical composition, viscosity, density and other properties that all affect the sound velocity. This makes it possible to select the correct crude oil for certain applications and adjust the process accordingly.

Monitoring batches, tank filling and tank storage operations

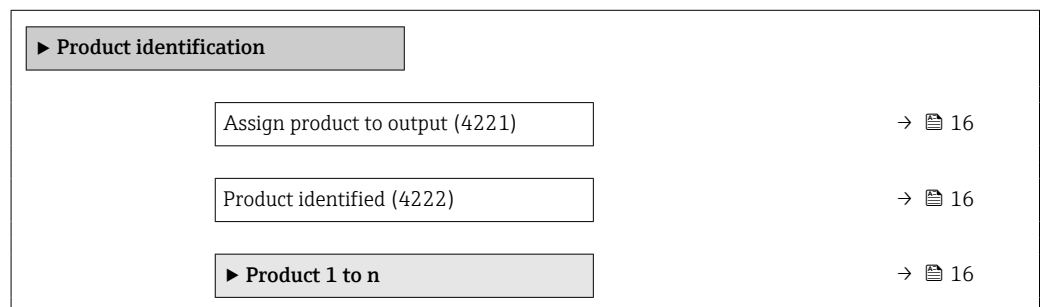
If a product is identified based on its classification, this can be signaled with the status output. This allows the measuring system to ensure that the right products are stored in the right tanks. Comparing the measured data to defined specifications makes it possible to ensure that no contamination or incorrect filling occurs.

4.2 "Product identification" submenu

The products to be identified are defined in the **Product identification** submenu.

Navigation

"Expert" menu → Application → Product identification



Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User interface	Factory setting
Assign product to output	<ul style="list-style-type: none"> ■ The Switch option is selected in the Operating mode parameter (0469). ■ The Status option is selected in the Switch output function parameter (0481). ■ The Product identification option is selected in the Assign status parameter (0805) in the Pulse/frequency/switch output 1 to n submenu and/or the Relay output 1 to n submenu. 	<p>Select the product for which the switch and/or relay output reports the status.</p> <p>"-----": Placeholder for products still to be defined.</p>	<ul style="list-style-type: none"> ■ None ■ -----* ■ -----* ■ -----* ■ -----* ■ -----* 	None
Product identified	-	Shows the product identified. If the measured value is within range for more than one p., the first applicable p. in the list (1-5) is selected.	Character string comprising numbers, letters and special characters	--

* Visibility depends on order options or device settings

4.2.1 Product definition

Up to five hydrocarbon process fluids can be defined in the **Product 1 to n** submenu.

Navigation

"Expert" menu → Application → Product identification → Product 1 to n

▶ **Product 1 to n**

Product name 1 to n (15352-1 to n)
→ 📄 17

API lower range value 1 to n (15354-1 to n)
→ 📄 17

API upper range value 1 to n (15353-1 to n)
→ 📄 17

Sound velocity lower range value 1 to n (15356-1 to n)
→ 📄 17

Sound velocity upper range value 1 to n (15355-1 to n)
→ 📄 17

Parameter overview with brief description

Parameter	Prerequisite	Description	User entry	Factory setting
Product name 1 to n	–	Enter a name for the product.	Character string comprising numbers, letters and special characters (32)	-----
API lower range value 1 to n	Only visible if the API gravity option was selected in the Identification mode parameter (15351-1 to n)	Enter the lower range value for the product's API gravity.	0.0 to 100.0 °API	0.0 °API
API upper range value 1 to n	Only visible if the API gravity option was selected in the Identification mode parameter (15351-1 to n)	Enter the upper range value for the product's API gravity.	0.0 to 100.0 °API	100.0 °API
Sound velocity lower range value 1 to n	Only visible if the Sound velocity option was selected in the Identification mode parameter (15351-1 to n)	Enter the lower range value for the product's sound velocity.	600.0 to 2 100.0 m/s	600.0 m/s
Sound velocity upper range value 1 to n	Only visible if the Sound velocity option was selected in the Identification mode parameter (15351-1 to n)	Enter the upper range value for the product's sound velocity.	600.0 to 2 100.0 m/s	2 100.0 m/s

5 Workflow

The following is a schematic flowchart of the procedure for configuring the **Petroleum** option, the **Product identification** option and a **measuring point**.

Start of petroleum configuration
Select Petroleum mode (4187): Density, Reference density, API gravity, or Sound velocity.
Select the API commodity group (4151): A, B, C, or D
Enter the Thermal expansion coefficient (4153) if the C - special applications option is selected
Select the API table: API table 5/6, API table 23/24, API table 53/54, API table 59/60, or Other.
Enter an alternative user-specific pressure value (when selecting Other)
Enter an alternative user-specific temperature value (when selecting Other)
Select the source for temperature correction: Fixed value, External value, or Current input 1...n
Select the type of pressure compensation: Fixed value, Internal measured value, External value, or Current input 1...n
Select the source for density correction: Fixed value, External value, or Current input 1...n
Enter the time constant for calculating the API gradient
Select the entry mode for sediment and water: Fixed value, External value
Enter the value for sediment and water, if applicable.
Enter the Shrinkage factor (4167).
Enter the Meter factor (4198).
↓
Start of product identification ¹⁾
Select the product to be configured. Up to five products can be created.
Select the type of product identification: API gravity, or Sound velocity
Enter a name for the product.
When selecting API gravity for product identification: Enter the value for the start of the API gravity range in %.
When selecting API gravity for product identification: Enter the value for the end of the API gravity range in %.
When selecting Sound velocity for product identification: Enter the value for the start of the Sound velocity range in m/s.
When selecting Sound velocity for product identification: Enter the value for the end of the Sound velocity range in m/s.
Select the product to be identified. The product status can be output at the switch output and/or relay output.
↓
Start of measuring point selection
Select a configuration for the measuring point: Signal path 1, signal path 2, or 2 signal paths.
Select the medium (process fluid).
Enter the process fluid temperature.
Select the calculation mode for the sound velocity: Density, Reference density, API gravity, or Fixed value
When selecting Fixed value: Enter the process fluid sound velocity
When selecting API gravity: Enter the process fluid API gravity
When selecting Density: Enter the process fluid Density
When selecting Reference density: Enter the process fluid Reference density
Enter the pressure
Select the API commodity group (4151): A, B, or D
Select the API table: API table 5/6, API table 23/24, API table 53/54, API table 59/60, or Other.

Enter an alternative user-specific pressure value (when selecting Other)
Enter an alternative user-specific temperature value (when selecting Other)
When selecting User-specific liquid or Liquid hydrocarbons and selecting Fixed value in the calculation mode: Enter the process fluid viscosity
Select the pipe material.
Select the pipe dimension mode: Pipe diameter or pipe circumference.
Depending on the selection: Pipe diameter or pipe circumference.
Specify the pipeline wall thickness.
Specify the pipeline liner material.
Select the sensor type
Select the coupling medium
Select the mounting type
Specify the sensor cable length
Select the inlet configuration: Elbow type on the inlet side (opposite the flow direction)

- 1) Only available with order code "Application package", option EQ "Petroleum & Product identification".



71639931

www.addresses.endress.com
