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Products | Solutions | Services

Special Documentation
Proline Promass Q 300 and Promass Q 500

Application packages: Extended density function and Premium density

Endress+Hauser
People for Process Automation

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1 About this document

1.1 Document function

This manual is a Special Documentation; it does not replace the Operating Instructions pertaining to the device. It is designed to support the user when measuring the density of liquids with the following Coriolis flowmeters: Proline Promass Q 300 and Proline Promass Q 500

1.2 Content and scope

This Special Documentation contains a description of the additional parameters and technical data that are provided with the following application packages: order code for "Application package", option **EH** "Extended density function" or option **EI** "Premium density, +/- 0.1 kg/m3 + extended density function".

The topics it addresses include:
- Structure of the measuring system
- Mounting and cleaning instructions
- Influence of pressure compensation
- Output versions (e.g. time period signal TPS)
- Density adjustment
- Use of K factors

1.3 Validity of Special Documentation and device documentation

The procedures for installation, configuration, etc. that are described in this Special Documentation may differ from the descriptions in the device documentation.

If the device is used to measure the density of liquids, the procedures described in this Special Documentation must be applied.

1.4 Symbols

1.4.1 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.

1.4.2 Symbols for certain types of information

Symbol	Meaning
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3.…	Series of steps
↳	Result of a step

1.5 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter serial number from nameplate.
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

This Special 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 device documentation:

Device	Communication protocol	Documentation code	
		Operating Instructions	**Description of Device Parameters**
Proline Promass Q 300	Modbus RS485	BA01545D	GP01059D
Proline Promass Q 500	Modbus RS485	BA01501D	GP01062D
Proline Promass Q 300	HART	BA01490D	GP01057D
Proline Promass Q 500	HART	BA01534D	GP01060D

1.6 Registered trademarks

HART®
Registered trademark of the FieldComm Group, Austin, Texas, USA

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

2 Safety instructions

The device safety instructions that are provided in the Operating Instructions for the device must be strictly observed! These include:

- Requirements for the personnel
- Intended use
- Workplace safety, operational safety and product safety
- IT security and device-specific IT security

Operating Instructions for the device → 5

3 Structure of the measuring system

This Special Documentation describes the measuring system structure for:
- Compensation and adjustment of the density in the Promass Q flowmeter
- Compensation and adjustment of the density in the flow computer or automation system (e.g. PLC)

Other hybrid forms for the structure of the measuring system are also possible but are not described in this document.

3.1 Measured variables and measuring devices

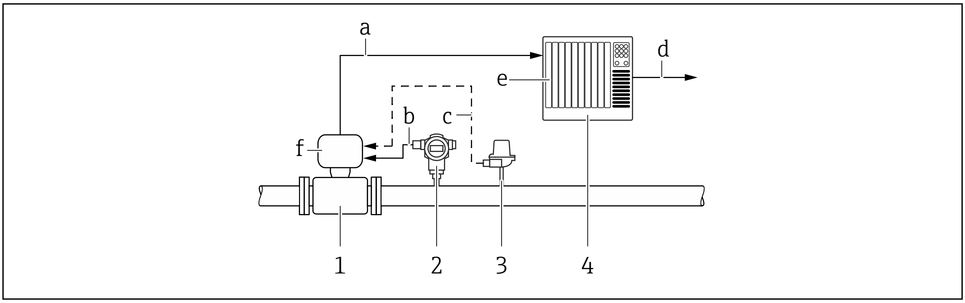
To calculate the temperature- and pressure-compensated density, the pressure and temperature of the medium are needed in addition to the density of the medium that is measured by the Promass Q flowmeter.

Measured variable	Measuring device
Density	Promass Q flowmeter (has integrated density measurement)
Temperature	Promass Q flowmeter (has integrated temperature measurement) If you want to output the reference density according to API, the temperature must be measured with an external temperature measuring device (e.g. iTEMP).
Pressure	External pressure measuring device (e.g. Cerabar M or S)

3.2 Compensation and adjustment in the Promass Q flowmeter

The temperature- and pressure-compensated density is calculated in the Promass Q flowmeter with this measuring system structure.

This measuring system structure **is recommended** and offers maximum density accuracy.



1 System structure, signal processing and parameter configuration

1 *Flowmeter (with integrated density and temperature measurement): Proline Promass Q 300 or Promass Q 500*
2 *Pressure measuring device (e.g. Cerabar M or Cerabar S)*
3 *Optional temperature measuring device (e.g. iTEMP)*
4 *Flow computer or automation system (e.g. PLC)*
a *Fully temperature- and pressure-compensated density*
b *Pressure measured value*
c *Optional temperature measured value*
d *Transmitted fully compensated density*
e *Entry of K-factors: K0, K1 and K2 for the analog transmission of temperature- and pressure-compensated density using the time period signal (TPS) →* *19*
f *Entry of the S-parameters: density equation for extended density adjustment in the Promass Q →* *16*

Density compensation

Density and temperature of the medium
The flowmeter measures the density and temperature of the medium and calculates the partially compensated density using the temperature.

Pressure of the medium
The pressure of the medium is measured by an external pressure measuring device and read in by the flowmeter via the current input.

Calculation of the fully compensated density
The fully compensated density (temperature-compensated and pressure-compensated) is calculated in the flowmeter. The calculation is performed using the partially compensated density (temperature-compensated) that is calculated by the flowmeter and the external pressure measured value that is read in.

Pressure compensation is enabled in the flowmeter: an option has been selected in the **Pressure compensation** parameter → 15.

The flowmeter transmits the fully compensated density to the flow computer or the automation system. Digital or analog transmission is possible → 📄 12.

Density adjustment
With this measuring system structure, the density is adjusted by entering the S-parameters in the Promass Q flowmeter → 📄 16.

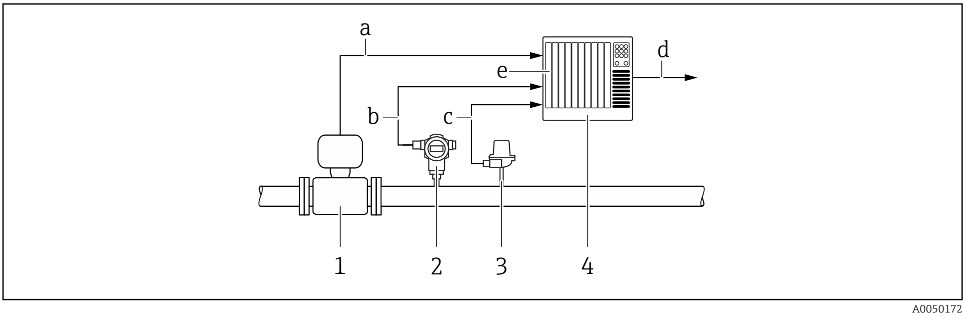
Reference density
A reference density that refers to a reference state is optionally calculated in the flowmeter. The calculation is performed using the fully compensated density that is calculated by the flowmeter, the external pressure measured value and optionally with the temperature, which is read in externally.

- If you want to output the reference density according to API, the temperature must be measured with an external temperature measuring device (e.g. iTEMP).
- The temperature measured by an external temperature measuring device can be read in by the flowmeter via a second current input and be used to calculate the reference density.
- The function to output a reference density in compliance with the regulations in the API MPMS is only available with the additional application packages: order code for "Application package", option **EJ** "Petroleum" or option **EM** "Petroleum & locking function".

If the reference density is to be calculated in the flow computer, the flow computer must read in both the temperature that is measured externally and the pressure that is measured externally: compensation and adjustment in a flow computer → 📄 10.

3.3 Compensation and adjustment in a flow computer

With this measuring system structure, the temperature- and pressure-compensated density is calculated in a flow computer or automation system (e.g. PLC).



2 System structure, signal processing and parameter configuration

1 *Flowmeter (with integrated density and temperature measurement): Proline Promass Q 300 or Promass Q 500*
2 *Pressure measuring device (e.g. Cerabar M or Cerabar S)*
3 *Temperature measuring device (e.g. iTEMP)*
4 *Flow computer or automation system (e.g. PLC)*
a *Partially compensated density (temperature-compensated)*
b *Pressure measured value*
c *Temperature measured value*
d *Calculated fully compensated density*
e *Entry of K-factors: K0, K1, K2, K18, K19, K20A and K21A for the analog transmission of partially compensated density using the time period signal (TPS) → 19*

Density compensation

Density of the medium

The flowmeter measures the density of the medium and transmits it to the flow computer or automation system as the partially compensated density. Digital or analog transmission is possible → 12.

Pressure of the medium

The pressure of the medium is measured by an external pressure measuring device and transmitted to the flow computer or automation system.

Pressure compensation in the flowmeter is disabled (factory setting): **Pressure compensation** parameter, **Off** option → 15.

Temperature of the medium

The temperature of the medium is measured by an external temperature measuring device and transmitted to the flow computer or automation system.

Calculation of the fully compensated density

The fully compensated density (temperature-compensated and pressure-compensated) is calculated in the flow computer or automation system. The calculation is performed using the partially compensated density (temperature-compensated) that is transmitted by the flowmeter and the temperature and pressure measured values that are measured by external measuring devices.

Density adjustment

With this measuring system structure, the density is adjusted by entering the K-factors (K0, K1, K2, K18, K19, K20A and K21A) in the flow computer or automation system → 19.

Reference density

The optional calculation of a reference density that refers to a reference state is performed in the flow computer or automation system. The calculation is performed using the fully compensated density in the flow computer and the temperature and pressure measured values that are measured by external measuring devices.

3.4 Transmission of the density to the flow computer

The density can be transmitted by the flowmeter to the flow computer or automation system by digital or analog means.

- The highest degree of accuracy is achieved using the internal temperature and pressure compensation function in the flowmeter (→ 🗎 8) and digital transmission to the flow computer or automation system.
- Transmission via the current output is not recommended. Lossy digital–analog conversion in the flowmeter followed by analog-digital conversion in the automation system can result in high measuring uncertainties.

3.4.1 Digital transmission of density via HART or Modbus RS485

The density is transmitted by the flowmeter to the flow computer or automation system via HART or Modbus RS485.

3.4.2 Analog transmission of density via the frequency output

The density is transmitted to the flow computer or automation system as a frequency signal or time period signal (TPS) via the frequency output of the flowmeter.

Outputting the density as a time period signal (TPS) via the frequency output enables the easy integration of the Promass Q into an existing measuring system.

With this analog transmission method using the time period signal (TPS):
- K-factors must be entered in the flow computer or automation system → 🗎 19.
- The frequency output of the flowmeter must be configured.

Parameter configuration of the frequency output for transmission using the time period signal (TPS):

1. Open the **"Setup" → Pulse/frequency/switch output 1...n** menu.
2. In the **Operating mode** parameter, select the **Frequency** option.
   ↳ The output functions as a frequency output.
3. In the **Assign frequency output** parameter, select the **Time period signal frequency (TPS)** option.
4. Select the **Minimum frequency value** parameter and enter the value 0 Hz.
5. Select the **Measuring value at minimum frequency** parameter and enter the value 0 Hz.
6. Select the **Maximum frequency value** parameter and enter the value 10 000 Hz.
7. Select the **Measuring value at maximum frequency** parameter and enter the value 10 000 Hz.
   ↳ The frequency output can be used for transmission using the time period signal (TPS).

4 Mounting

The mounting requirements and installation of the flowmeter are described in the Operating Instructions for the device. Operating Instructions for the device → 5

If the flowmeter is used to measure the density of liquids, the pitch and roll angles must also be taken into account during installation.

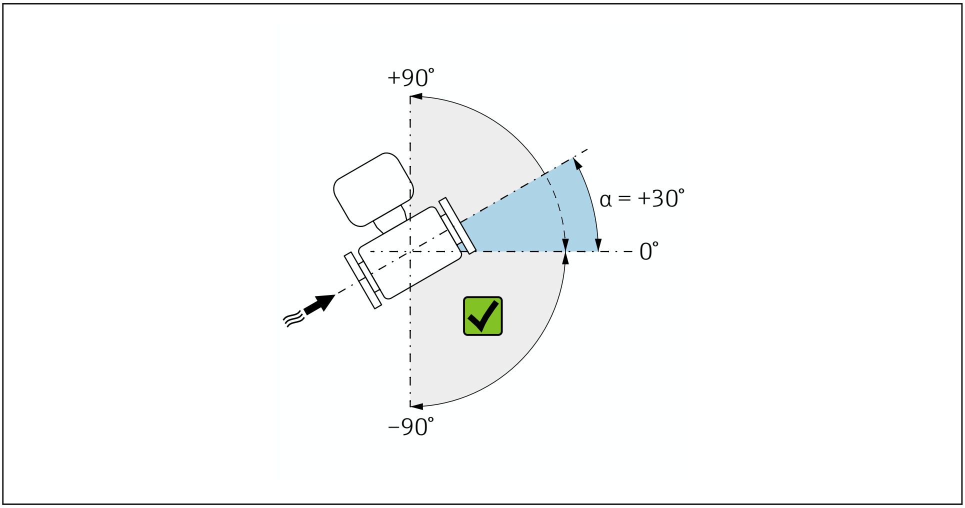
4.1 Pitch and roll angles

For correct measurement, the pitch angle and roll angle must be determined during commissioning (with a tolerance of ±10 °) and entered: **Installation angle pitch** parameter (→ 14) and **Installation angle roll** parameter (→ 14)

4.1.1 Pitch angle

The technically relevant pitch angle is the angle shaded gray = −90 to +90 °.

Example (blue): Installation of the device with a pitch angle α = +30 °



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3 *Side view with flow direction from left to right.*

Entering the pitch angle
For correct measurement, the pitch angle must be determined during commissioning (with a tolerance of ±10 °) and entered.

Navigation
"Setup" menu → Advanced setup → Sensor adjustment

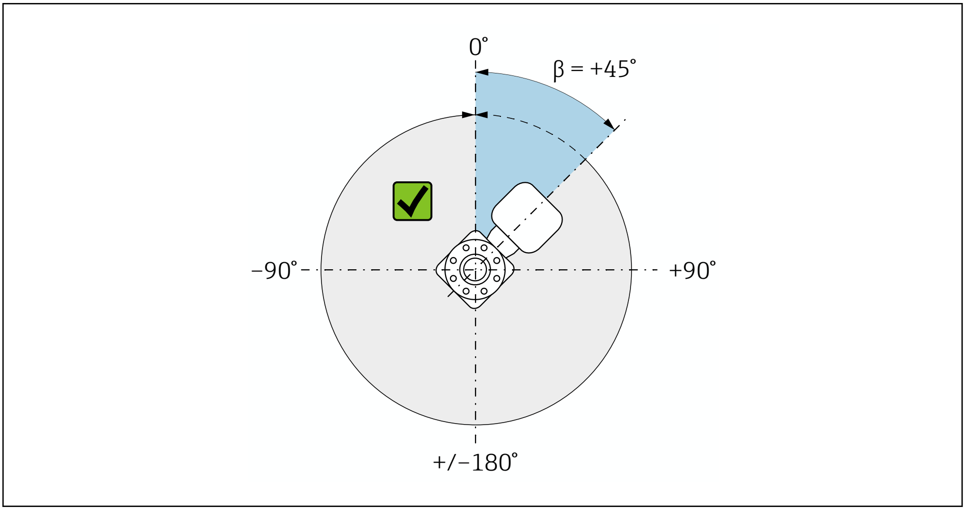
Parameter overview with brief description

Parameter	Description	User entry	Factory setting
Installation angle pitch	Enter the installation angle in degree.	−90 to +90 °	0 °

4.1.2 Roll angle

The technically relevant roll angle is the angle shaded gray = −180 to +180 °.

Example (blue): Installation of the device with a roll angle β = +45 °



4 *Top view in flow direction*

Entering the roll angle
For correct measurement, the roll angle must be determined during commissioning (with a tolerance of ±10 °) and entered.

Navigation

"Setup" menu → Advanced setup → Sensor adjustment

Parameter overview with brief description

Parameter	Description	User entry	Factory setting
Installation angle roll	Enter the installation angle in degree.	−180 to 180 °	0 °

5 Pressure compensation

The use of pressure compensation improves the accuracy of the density measurement at high pressures.

The pressure of the medium can:
- Be specified as a fixed value.
- Be read in via the current input, HART or Modbus RS485.

For detailed information on pressure compensation, see the "Description of Device Parameters" → 5

Navigation
"Expert" menu → Sensor → External compensation

Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Pressure compensation	Select pressure compensation type. If the effect of pressure on the volume and density of the fluid is to be corrected, the type of pressure compensation can be selected here. Pressure compensation can be deactivated if it is not needed for the application. If pressure compensation is deactivated, the measuring device continues to correct the effect of temperature on the volume and density.	■ Off ■ Fixed value ■ External value * ■ Current input 1 * ■ Current input 2 * ■ Current input 3 *	Off

* Visibility depends on order options or device settings

6 Density adjustment and density equations

6.1 Extended density adjustment in the flowmeter

The extended density adjustment function enables the adjustment of the density in the flowmeter using the reference density, pressure and temperature.

The "S-parameters" listed below (i.e. parameters used in the density equation for extended density adjustment) must be determined in a density measuring laboratory, as the temperature and pressure conditions must be precisely controlled and, in particular, an exact density reference must be available. For this reason, the S-parameters for extended density adjustment may **not** be determined in the field.

The density is adjusted with the following formula:

Density equation for extended density adjustment
$\rho\sim = f(\rho, T_m, p)$ $\rho\sim = S_{\rho 0} + S_{\rho\rho 1}\,\rho + S_{\rho T1}\,T_m + S_{\rho p1}\,p + S_{\rho\rho 2}\,\rho^2 + S_{\rho T2}\,T_m{}^2 + S_{\rho p2}\,p^2 + S_{\rho\rho 1T1}\,\rho\,T_m + S_{\rho\rho 1p1}\,\rho\,p + S_{\rho T1p1}\,T_m\,p + S_{\rho T3}\,T_m{}^3$

Symbol in formula	Description	Unit
ρ	Density to be adjusted	kg/m^3
$\rho\sim$	Adjusted density	kg/m^3
T_m	Temperature of measuring tube	°C
p	External pressure or fixed, predefined pressure	bara

Symbol in formula	Description/parameter	Factory setting
$S_{\rho 0}$	Constant offset	0 kg/m^3
$S_{\rho\rho 1}$	Linear density factor	1
$S_{\rho T1}$	Linear temperature factor	0 $(kg/m^3)/°C$
$S_{\rho p1}$	Linear pressure factor	0 $(kg/m^3)/bara$
$S_{\rho\rho 2}$	Quadratic density factor	0 $1/(kg/m^3)$
$S_{\rho T2}$	Quadratic temperature factor	0 $(kg/m^3)/°C^2$
$S_{\rho p2}$	Quadratic pressure factor	0 $(kg/m^3)/bara^2$
$S_{\rho\rho 1T1}$	Combined density-temperature factor	0 1/°C
$S_{\rho\rho 1p1}$	Combined density-pressure factor	0 1/bara
$S_{\rho T1p1}$	Combined temperature-pressure factor	0 $(kg/m^3)/(°C\ bara)$
$S_{\rho T3}$	Cubic temperature factor	0 $(kg/m^3)/°C^3$

Navigation

"Expert" menu → Sensor → Sensor adjustment → Extended density adjustment

▶ **Extended density adjustment**

Constant offset	→ 📄 17
Linear density factor	→ 📄 17
Linear temperature factor	→ 📄 17
Linear pressure factor	→ 📄 18
Quadratic density factor	→ 📄 18
Quadratic temperature factor	→ 📄 18
Quadratic pressure factor	→ 📄 18
Combined density-temperature factor	→ 📄 18
Combined density-pressure factor	→ 📄 18
Combined temperature-pressure factor	→ 📄 18
Cubic temperature factor	→ 📄 18

Parameter overview with brief description

Parameter	Description	User entry	Factory setting
Constant offset	Shows the constant offset.	Signed floating-point number	0 kg/m³
Linear density factor	Shows the linear density factor.	Signed floating-point number	1
Linear temperature factor	Shows the linear temperature factor.	Signed floating-point number	0 (kg/m³)/°C

Parameter	Description	User entry	Factory setting
Linear pressure factor	Shows the linear pressure factor.	Signed floating-point number	0 (kg/m^3)/bara
Quadratic density factor	Shows the quadratic density factor.	Signed floating-point number	0 $1/(kg/m^3)$
Quadratic temperature factor	Shows the quadratic temperature factor.	Signed floating-point number	0 $(kg/m^3)/°C^2$
Quadratic pressure factor	Shows the quadratic pressure factor.	Signed floating-point number	0 $(kg/m^3)/bara^2$
Combined density-temperature factor	Shows the combined density-temperature factor.	Signed floating-point number	0 1/°C
Combined density-pressure factor	Shows the combined density-pressure factor.	Signed floating-point number	0 1/bara
Combined temperature-pressure factor	Shows the combined temperature-pressure factor.	Signed floating-point number	0 (kg/m^3)/(°C bara)
Cubic temperature factor	Shows the cubic temperature factor.	Signed floating-point number	0 $(kg/m^3)/°C^3$

6.2 K-factors in the flow computer

The K-factors used in the flow computer or automation system to process the time period signal (TPS) are default values for the Proline Promass 300 Q and Promass 500 Q flowmeters. To obtain a density in the SI unit kg/m^3 or US unit g/cm^3, the K-factors must be entered in the flow computer or automation system: see the "K-factors" section → 📄 20

The correction values are processed depending on the selected unitary system:
- Temperature: SI unit = °C, US unit = °F
- Pressure: SI unit = bara, US unit = psig

Equations for the calculation and compensation of density in SI units:
- Basic equation for density → 📄 22
- Temperature compensation of density → 📄 22
- Pressure compensation of density → 📄 22

In the event of density deviation, the density supplied by the flow computer or automation system can be adjusted using the K-factors.

Adjustment of the density value via the K-factors (K0, K1, K2, K18, K19, K20A and K21A):

1. If the density deviation is too large, adjust the density value from the flow computer with K-factors K0, K1 and K2 → 📄 22.
2. A density deviation that is too large due to the temperature can be adjusted with K-factors K18 and K19 → 📄 22
3. A density deviation that is too large due to the pressure can be adjusted with K-factors K20A and K21A → 📄 22

6.2.1 K-factors

K-factors valid for devices with the order code for "Application package", option **EH** "Extended density function" or option **EI** "Premium density, +/- 0.1 kg/m3 + extended density function".

Factor	SI units	US units	Comment
K0	-500 kg/m^3	-0.5 g/cm^3	Density adjustment
K1	0.55 (kg/m^3)/μs	0.000 55 (g/m^3)/μs	Density adjustment
K2	0 (kg/m^3)/μs^2	0 (g/cm^3)/μs^2	Density adjustment
K18	0 1/°C	0 1/°F	Adjustment of density compensation via temperature
K19	0 (kg/m^3)/°C	0 (g/cm^3)/°F	Adjustment of density compensation via temperature
K20A 1)	0 1/bara	0 1/psig	Adjustment of density compensation via pressure
K20B	0 1/bara^2	0 1/psig^2	Value always 0, is not used
K21A 1)	0 (kg/m^3)/ bara	0 (g/cm^3)/psig	Adjustment of density compensation via pressure
K21B	0 (kg/m^3)/ bara^2	0 (g/cm^3)/psig^2	Value always 0, is not used
K22	0 1/(°C bara)	0 1/(°F psig)	Value always 0, is not used
K23	0 (kg/m^3)/(°C bara)	0 (g/cm^3)/(°F psig)	Value always 0, is not used

1) If pressure compensation of the density is performed in the flow computer or automation system and not in the flowmeter, the values indicated in the density calibration certificate must be entered there for K20A and K21A.

6.2.2 Value pairs for density and time period signal (TPS)

The table contains a list of value pairs for the time period signal (TPS) and the associated frequency as a function of the density on the basis of the standard K-factors (see the "K-factors" table → 📄 20).

ρ [kg/m^3]	f [Hz]	$τ = 1/f$ [μs]
0.000	1 100.000	909.091
100.000	916.667	1 090.909
200.000	785.714	1 272.727
300.000	687.500	1 454.545
400.000	611.111	1 636.364
500.000	550.000	1 818.182
600.000	500.000	2 000.000
700.000	458.333	2 181.818
800.000	423.077	2 363.636

ρ [kg/m³]	*f* [Hz]	τ = 1/*f* [μs]
900.000	392.857	2 545.455
1 000.000	366.667	2 727.273
1 100.000	343.750	2 909.091
1 200.000	323.529	3 090.909
1 300.000	305.556	3 272.727
1 400.000	289.474	3 454.545
1 500.000	275.000	3 636.364
1 600.000	261.905	3 818.182
1 700.000	250.000	4 000.000
1 800.000	239.130	4 181.818
1 900.000	229.167	4 363.636
2 000.000	220.000	4 545.455

If the time period signal (TPS) does not meet the requirements of the flow computer/ automation system with regard to the value range, it is possible to adjust the value range in the Promass Q flowmeter via the service parameters: please contact your Endress+Hauser service organization.

6.2.3 General density equation

The non-compensated density of the liquid is calculated from the time period in a flow computer using K-factors K0, K1 and K2.

General density equation
$D = K0 + K1\tau + K2\tau^2$

Symbol in formula	Description
D	Non-compensated density of liquid (kg/m^3)
τ	Time period (μs) of the TPS signal = 1/f , where f = frequency (Hz) of the TPS signal

6.2.4 Density equation for temperature compensation

A temperature-compensated density is calculated from the non-compensated density using K-factors K18 and K19.

Density equation for temperature compensation
$D_T = D[1 + K18\ (T - 20°C)] + K19\ (T - 20°C)$

Symbol in formula	Description
D_T	Temperature-compensated density (kg/m^3)
D	Density (kg/m^3), calculated from the general density equation
T	Temperature (°C)

6.2.5 Density equation for pressure compensation

A temperature- and pressure-compensated density is calculated from the temperature-compensated density with K-factors K20A, K20B, K21A and K21B.

Density equation for pressure compensation
$D_P = D_T[1 + K20\ (p - 1\ bar)] + K21\ (p - 1\ bar)$

Symbol in formula	Description
D_p	Fully compensated density (temperature- and pressure-compensated) (kg/m^3)
D_T	Temperature-compensated density (kg/m^3), calculated from the density equation for temperature compensation
p	Absolute pressure (bara)
K20	Pressure factor K20 = K20A + K20B (p - 1 bar)
K21	Pressure factor K21 = K21A + K21B (p - 1 bar)

7 Additional parameters

Additional options are available with the following parameters for devices with the order code for "Application package", option **EH** "Extended density function" or option **EI** "Premium density, +/- 0.1 kg/m3 + extended density function".

Display value

Menu: "Setup" → Display → Display value

For devices with nominal diameters 25 to 100 mm (1 to 4 in): simultaneous display of two density values with different units if **Density 2** option is selected.

Temperature difference measuring tube

Menu "Diagnostics" → Test points → Temperature difference measuring tube

For devices with nominal diameters 25 to 100 mm (1 to 4 in): display of the measuring tube temperature difference between the inlet and outlet.

Temperature difference measuring tube/carrier pipe

Menu "Diagnostics" → Test points → Temperature difference measuring tube/carrier pipe

For devices with nominal diameters 25 to 100 mm (1 to 4 in): display of the temperature difference between the measuring tube and carrier pipe.

8 Maintenance

8.1 Interior cleaning of the measuring tubes

To ensure the best possible density measuring performance, both measuring tubes must be clean and free from deposits and residue.

The inside of the measuring tubes should be cleaned before every recalibration.

The following is required to clean the inside of the measuring tubes:
- A white, professional cleaning cloth (e.g. Kimberly-Clark Kimtech 7624).
  Choose a cleaning cloth size such that the cloth fits snugly in the measuring tube when it is folded once.
- A flexible metal wire (of sufficient length) and insulated with plastic.
- A cleaning agent that is suitable for the deposits.

When cleaning ensure:
- The cleaning agent does not corrode the material of the measuring tube.
- The measuring tube may not be damaged during the cleaning process.

1. Attach the cleaning cloth to the metal wire: knot a loop at one end of the metal wire and pull the cloth half-way through the loop.
2. Wet the cloth with the cleaning agent.
3. Using the metal wire, pull the cloth through both measuring tubes several times.
4. If the tubes are very dirty, you may need to change the cleaning cloth.

The measuring tubes are cleaned if no traces of new dirt are visible on the cleaning cloth.

9 Technical data

9.1 Factory settings

Current output	Standard 4 mA	Standard 20 mA
Density	500 [kg/m³]	1500 [kg/m³]

9.2 Performance characteristics

Performance characteristics for order code for "Application package", option **EI** "Premium density, +/- 0.1 kg/m3 + extended density function".

Density (liquids)	SI units	US units
Accuracy	±0.1 [kg/m³]	±0.000 1 [g/cm³]
Repeatability	±0.02 [kg/m³]	±0.000 02 [g/cm³]
Operating density range	0 to 3 000 [kg/m³]	0 to 3 [g/cm³]
Influence of the process temperature (corrected) 1)	±0.002 5 [(kg/m³)/°C]	±0.000 001 39 [(g/m³)/°F]
Influence of the process pressure (corrected) 2)	±0.003 [(kg/m³)/bar]	±0.000 000 21 [(g/m³)/psi]

1) The influence of the process temperature is the maximum deviation due to the difference between the process temperature and the reference temperature of 20 °C (68 °F). Outside the calibrated temperature range, the influence of the process temperature is ±0.005 (kg/m³)/°C (±0.000 002 78 (g/m³)/°F).

2) The influence of the process pressure is the maximum deviation due to the difference between the process pressure and the reference pressure of 1 bar (14.5 psi).

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