SD02349D/06/EN/02.24-00
71642646
2024-01-31

Valid as of version
01.02.zz (Device firmware)

Special Documentation
Proline Prosonic Flow G 300

Advanced gas analysis application package
HART

Endress+Hauser
People for Process Automation

Table of contents

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 Advanced gas analysis software 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 **Advanced gas analysis** 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.
ℹ	**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 G 300	BA01834D

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 Product features

The **Advanced gas analysis** application package provides specific algorithms together with device variables and external inputs for calculating additional parameters and measured variables, which are then available to the user.

The following six gas types can be used with the application package:
- **Single gas**
- **Gas mixture**
- **Coal gas/biogas**
- **Natural gas - standardized calculation**
- **Natural gas - using sound velocity**
- **User-specific gas**

2.2 Availability

The **Advanced gas analysis** application package can be ordered directly with the device. As a prerequisite for this, the integrated pressure and temperature measurement function must also be ordered: order code for "Measuring tube; Transducer; Sensor version", option AC "316L; titanium gr. 2; pressure + temperature measurement integrated".

The application package is available subsequently via an activation code. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

The availability of the **Advanced gas analysis** application package with the option EF can be checked as follows:
- Order code with breakdown of the device features on the delivery note
- In the W@M Device Viewer (www.endress.com/deviceviewer)
  Enter the serial number from the nameplate and check in the device information whether the option EF "Advanced gas analysis" appears under the order code for "Application packages".
- In the operating menu:
  The software options currently enabled are displayed in the **Software option overview** parameter.
  Expert → System → Administration

2.2.1 Order code

If ordering directly with the device or subsequently as a retrofit kit:
Order code for "Application package", option EF "Advanced gas analysis"

2.2.2 Activation

A retrofit kit is supplied if the application package is ordered subsequently.

This kit includes a tag plate with device data and an activation code.

For details, see Installation Instructions EA01164D

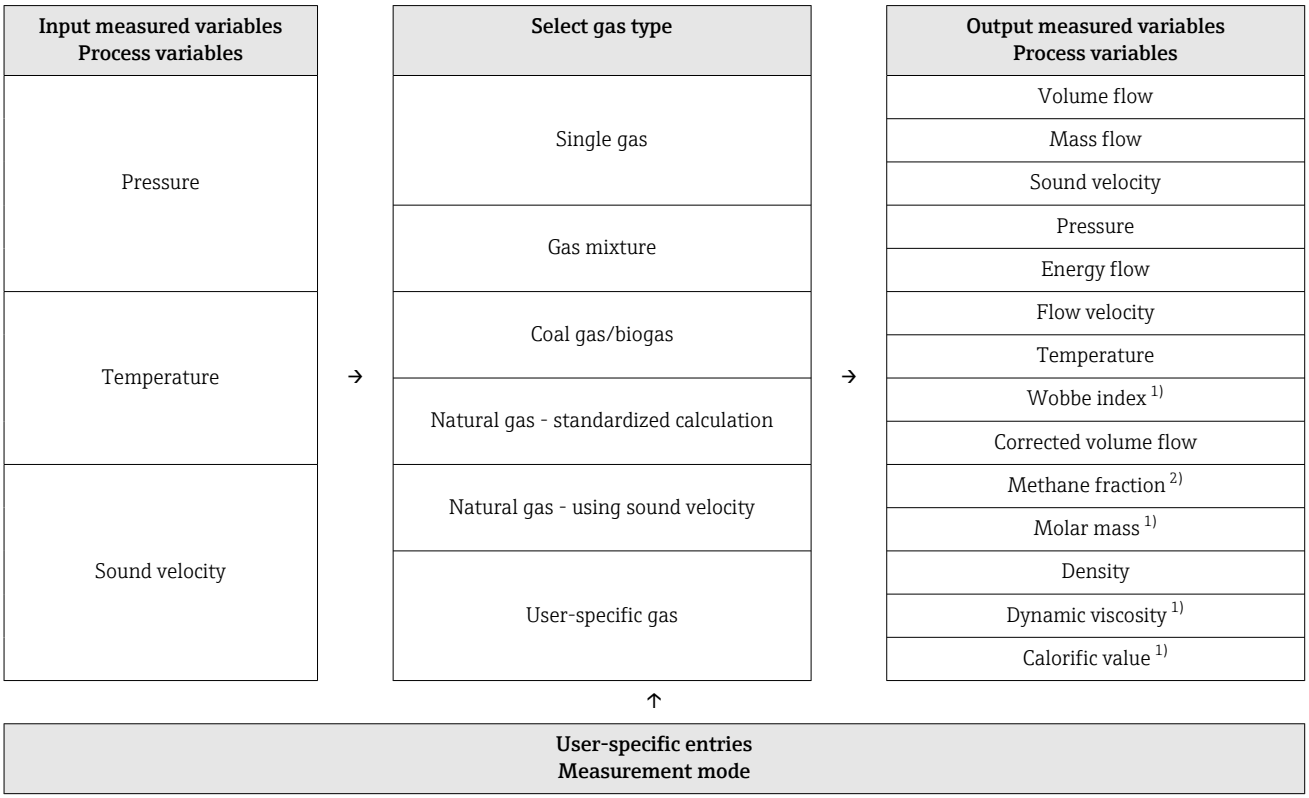
2.2.3 Access

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 "Gas analysis" submenu

3.1 Overview

The following overview shows a schematic representation of the configuration procedure using the "Advanced gas analysis" application package. Different output measured variables/process variables are available depending on the input measured variables/ process variables and the choice of gas type.

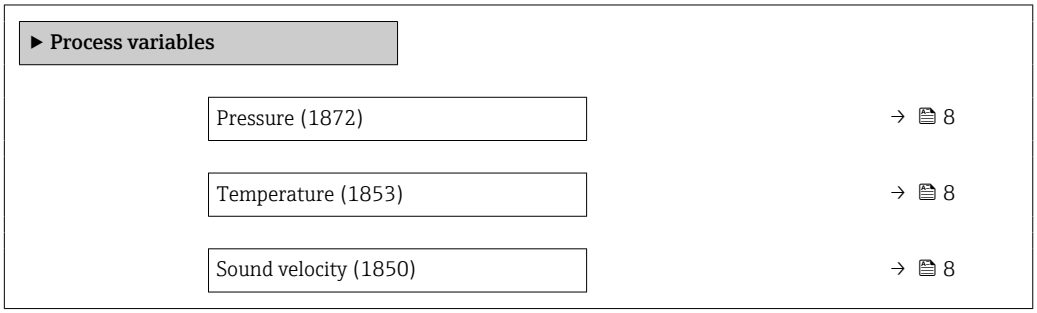


1) Only for **Coal gas/biogas** option and **Natural gas - using sound velocity** option
2) Only for **Coal gas/biogas** option and

3.2 Input measured variables

The gas analysis functions are based on the measurement of the pressure, temperature and sound velocity in the medium. These three measured values are used as the input variables for the mathematic models that describe the properties of the gas mixture.

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



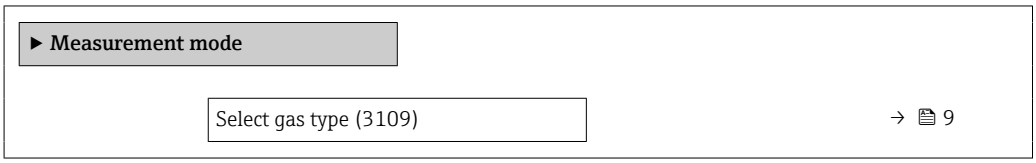
Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Pressure	For the following order code: "Measuring tube; Transducer; Sensor version", option AC "316L; Titanium Gr. 2; pressure + temperature measurement integrated" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the pressure that is currently measured. *Dependency* The unit is taken from: **Pressure unit** parameter	Signed floating-point number
Temperature	For the following order codes: ▪ "Measuring tube; Transducer; Sensor version", option AB "316L; Titanium Gr. 2; temperature measurement integrated" ▪ "Measuring tube; Transducer; Sensor version", option AC "316L; Titanium Gr. 2; pressure + temperature measurement integrated" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the temperature that is currently measured. *Dependency* The unit is taken from: **Temperature unit** parameter	Signed floating-point number
Sound velocity	–	Displays the sound velocity that is currently measured. *Dependency* The unit is taken from the **Velocity unit** parameter.	Signed floating-point number

3.3 Selection of gas type

3.3.1 "Select gas type" parameter

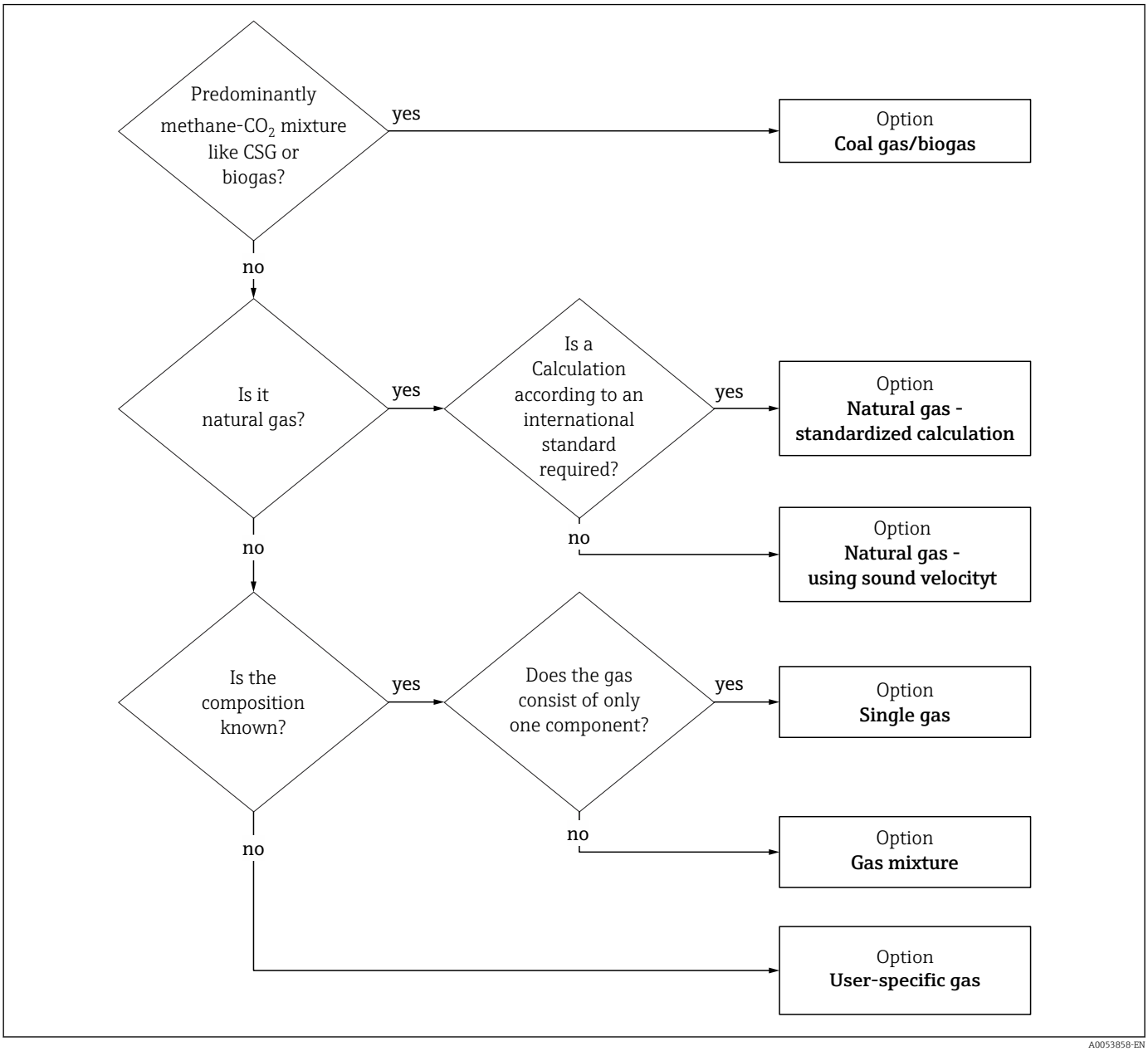
Navigation
"Expert" menu → Sensor → Measurement mode → Select gas type



Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Select gas type	Select measured gas type.	▪ Single gas ▪ Gas mixture ▪ Coal gas/biogas ▪ Natural gas - standardized calculation ▪ Natural gas - using sound velocity ▪ User-specific gas	User-specific gas

Selection of gas type in the "Select gas type" parameter



3.3.2 "Single gas" option

This option is used if the gaseous medium being measured is a known single gas.

Application	▪ Air ▪ Argon Ar ▪ Krypton Kr ▪ Nitrogen N2 ▪ Carbon monoxide CO ▪ Carbon dioxide CO2 ▪ Sulfur dioxide SO2 ▪ Methane CH4 ▪ Ethane C2H6 ▪ Propane C3H8 ▪ Butane C4H10 ▪ Ethylene C2H4 ▪ Vinyl chloride C2H3Cl ▪ Ammonia NH3 ▪ Neon Ne
Calculation	Calculated based on an integrated gas model using the measured temperature and the measured pressure.

The maximum measurement error of the calculated process variables
- Mass flow
- Energy flow
- Density
- Calorific value
- Dynamic viscosity

mainly depends on the accuracy of the input for the gas composition and the accuracy of the gas model used.

3.3.3 "Gas mixture" option

This option is used if the gaseous medium being measured is a known gas mixture. The mixture is defined by specifying the individual constituent parts of the gas and their corresponding molar fractions.

Application	The gas mixture can contain the following components: ▪ Air ▪ Hydrogen H2 ▪ Helium He ▪ Neon Ne ▪ Argon Ar ▪ Krypton Kr ▪ Xenon Xe ▪ Nitrogen N2 ▪ Oxygen O2 ▪ Ammonia NH3 ▪ Carbon monoxide CO ▪ Carbon dioxide CO2 ▪ Sulfur dioxide SO2 ▪ Hydrogen sulfide H2S ▪ Methane CH4 ▪ Propane C3H8 ▪ Ethane C2H6 ▪ Butane C4H10 ▪ Ethylene C2H4 ▪ Vinyl chloride C2H3Cl ▪ Water ▪ Other When the **Other** option is selected: Enter the Reference density and Calorific value.
Calculation	Calculated based on an integrated gas model using the measured temperature and the measured pressure.

The maximum measurement error of the calculated process variables
- Mass flow
- Energy flow
- Density
- Calorific value
- Dynamic viscosity

mainly depends on the accuracy of the input for the gas composition and the accuracy of the gas model used.

3.3.4 "Coal gas/biogas" option

This option is used to measure wet and dry methane/CO_2 mixtures. The mixtures here are non-conventional natural gases (coal gas, coal bed methane, shale gas) and various biogases.

The measuring instrument calculates the Methane fraction and the gas properties of the mixture using an integrated gas model that is based on the sound velocity, temperature and pressure measured in the gas mixture.

It is assumed that the Coal gas/biogas is a mixture of methane, CO_2 and water vapor. Additional components can be taken into consideration if their molar fractions are known and within the defined range:
- N_2 up to 25%
- O_2 up to 10%
- NH_3 up to 5%
- H_2S up to 5%
- H_2 up to 5%

In addition, it is also possible to precisely specify the relative humidity [%], the molar fraction of the water vapor [%] or the dew point. The default value is RH = 100% (saturated mixture).

Process variable	Maximum measurement error (o.r. = of reading; o.f.s. = of full scale value)
Methane fraction	±1 % o.f.s. [1]
Molar mass	±1.5 % o.r.
Density	±1.5 % o.r.
Dynamic viscosity	±3 % o.r.
Calorific value	±1 % o.f.s. [1]
Wobbe index	±1 % o.r. ±1 % o.f.s. [1]
Mass flow	Standard ("Flow calibration" order code, option A) ▪ ±1.9 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±2.5 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s) Optional ("Flow calibration" order code, option C, D) ▪ ±1.6 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±1.9 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)
Energy flow	Standard ("Flow calibration" order code, option A) [2] ▪ ±2.1 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±2.7 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s) Optional ("Flow calibration" order code, option C, D) ▪ ±1.9 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±2.1 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)
The specifications apply for the integrated temperature and pressure measurement ("Measuring pipe; converter; sensor version" order code, option AC) if the pressure sensor is operated in the optimum range $p_t \leq p \leq p_{max}$.	

1) The full scale value corresponds to a Methane fraction of 100%.
2) The energy flow specifications apply for a typical biogas composition (60% methane, 40% CO_2).

The specifications apply for the following area of use:
- Process pressure: 0.7 to 21 bar (10.2 to 304 psi) absolute
- Process temperature: 0 to +80 °C (+32 to +176 °F)

Larger measurement errors may occur outside of these limits of use.

3.3.5 "Natural gas - standardized calculation" option

This option is used if a natural gas of a known composition or with known properties is to be calculated according to international standards.

Standards for calculating the calorific value (energy)
- AGA 5
- ISO 6976

Standards for calculating the compressibility factor (density)
- ISO 12213-2
- ISO 12213-3
- AGA Nx19

Standards for calculating the compressibility factor (density) and associated parameters

Parameter	Natural gas - standardized calculation		
	ISO 12213-2 (AGA8 equation) Natural gas composition as the input variable	ISO 12213-3 (SGERG 88 equation) Natural gas properties as the input variable	AGA Nx19 Natural gas properties as the input variable
Density calculation	x	x	x
Calorific value calculation	x	x	x

Parameter	Natural gas - standardized calculation		
	ISO 12213-2 (AGA8 equation) Natural gas composition as the input variable	ISO 12213-3 (SGERG 88 equation) Natural gas properties as the input variable	AGA Nx19 Natural gas properties as the input variable
Reference conditions	x	x	x
Reference pressure [1]	x	x	x
Reference temperature [1]	x	x	x
Reference combustion temperature [2]	x	x	x
Calorific value type	x	x	x
Humidity type	x	–	–
Reference gross calorific value	–	x	–
Relative density	–	x	x
Specific heat capacity	x	x	x
Mol% Ar	x	–	–
Mol% C2H6	x	–	–
Mol% C3H8	x	–	–
Mol% CH4	x	–	–
Mol% CO	x	–	–
Mol% CO2	x	x	x
Mol% H2	x	x	–
Mol% H2O [3]	x	–	–
Mol% H2S	x	–	–
Mol% He	x	–	–
Mol% i-C4H10	x	–	–
Mol% i-C5H12	x	–	–
Mol% N2	x	–	x
Mol% n-C10H22	x	–	–
Mol% n-C4H10	x	–	–
Mol% n-C5H12	x	–	–
Mol% n-C6H14	x	–	–
Mol% n-C7H16	x	–	–
Mol% n-C8H18	x	–	–
Mol% n-C9H20	x	–	–
Mol% O2	x	–	–
Relative humidity [3]	x	–	–
Dew point [3]	x	–	–

1) Visible if the **Other** option is selected in the **Reference conditions** parameter.
2) ISO 6976 only.
3) Only visible if selected in the **Humidity type** parameter

The maximum measurement error of the calculated process variables
- Mass flow
- Energy flow
- Density
- Calorific value
- Dynamic viscosity

mainly depends on the accuracy of the user inputs required for the relevant standard (e.g. input of natural gas composition for ISO 12213-2). The uncertainty of the gas models used is documented in the relevant standard.

The "Natural gas - standardized calculation" gas type can be used for the following areas of use:

	ISO 12213-2	ISO 12213-3	AGA Nx19
Process pressure	0.7 to 101 bar (10.2 to 1 465 psi)		
Process temperature	−48 to +77 °C (−54 to +171 °F)	−23 to +65 °C (−9 to +149 °F)	−20 to +60 °C (−4 to +140 °F)

Larger measurement errors may occur outside of these limits of use.

3.3.6 "Natural gas - using sound velocity" option

This option is used to measure a natural gas of an unknown or variable composition.

The measuring instrument calculates the properties of the natural gas using an integrated gas model that is based on the sound velocity, temperature and pressure measured in the gas mixture.

It is assumed that the natural gas is a hydrocarbon gas mixture. Additional gas components that are not hydrocarbons can be taken into consideration if their molar fractions are known and within the defined range:
- CO_2 up to 10%
- N_2 up to 10%
- H_2S up to 5%
- H_2 up to 5%
- O_2 up to 5%

In addition, it is also possible to precisely specify the relative humidity [%], the molar fraction of the water vapor [%] or the dew point. The default value is RH = 0% (dry mixture).

Process variable	Maximum measurement error (o.r. = of reading)
Methane fraction	Not applicable
Molar mass	±1 % o.r.
Density	±1 % o.r.
Dynamic viscosity	±3 % o.r.
Calorific value	±1 % o.r.
Wobbe index	±1 % o.r.
Mass flow	Standard ("Flow calibration" order code, option A) ▪ ±1.5 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±2.3 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s) Optional ("Flow calibration" order code, option C, D) ▪ ±1.2 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±1.5 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)

Process variable	Maximum measurement error (o.r. = of reading)
Energy flow	Standard ("Flow calibration" order code, option A) ▪ ±1.6 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±2.4 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s) Optional ("Flow calibration" order code, option C, D) ▪ ±1.3 % o.r. for 3 to 40 m/s (9.84 to 131.2 ft/s) ▪ ±1.6 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)
The specifications apply for the integrated temperature and pressure measurement ("Measuring pipe; converter; sensor version" order code, option AC) if the pressure sensor is operated in the optimum range $p_t \leq p \leq p_{max}$.	

The specifications apply for the following area of use:
- Process pressure: 0.7 to 41 bar (10.2 to 594.5 psi) absolute
- Process temperature: −50 to +150 °C (−58 to +302 °F)

Larger measurement errors may occur outside of these limits of use.

3.3.7 "User-specific gas" option

This basic option is used if no other option is available, e.g. if an unknown gas mixture is being measured. In this case, the gas properties (e.g. reference density and calorific value) are entered directly. If these gas properties are also unknown, the dependent output measured variables (e.g. mass flow and energy flow) are measured using the default values for the gas properties. This compromises the measurement accuracy of these variables.

The maximum measurement error of the calculated process variables
- Mass flow
- Energy flow
- Density
- Calorific value
- Dynamic viscosity

mainly depends on the accuracy of the user inputs (e.g. input for reference density).

3.4 Output measured variables

All flow variables (incl. energy flow) as well as the sound velocity, temperature and pressure are output for all gas types. Other variables are only output if they are directly specified for the selected gas type.

Measured variable	Gas types					
	Single gas	Gas mixture	Coal gas/biogas	Natural gas - standardized calculation	Natural gas - using sound velocity	User-specific gas
Volume flow	x	x	x	x	x	x
Mass flow	x	x	x	x	x	x
Sound velocity	x	x	x	x	x	x
Pressure	x	x	x	x	x	x
Energy flow	x	x	x	x	x	x
Flow velocity	x	x	x	x	x	x
Temperature	x	x	x	x	x	x
Wobbe index	–	–	x	–	x	–
Corrected volume flow	x	x	x	x	x	x
Methane fraction	–	–	x	–	–	–
Molar mass	–	–	x	–	x	–
Density	x	x	x	x	x	x
Dynamic viscosity	x [1)]	x [1)]	x	x [1)]	x	x [1)]
Calorific value	x [1)]	x [1)]	x	x [1)]	x	x [1)]
x = process variable available, – = process variable unavailable						

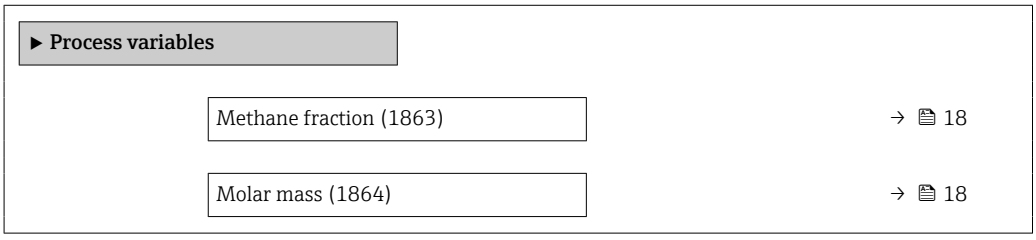
1) No output can be assigned

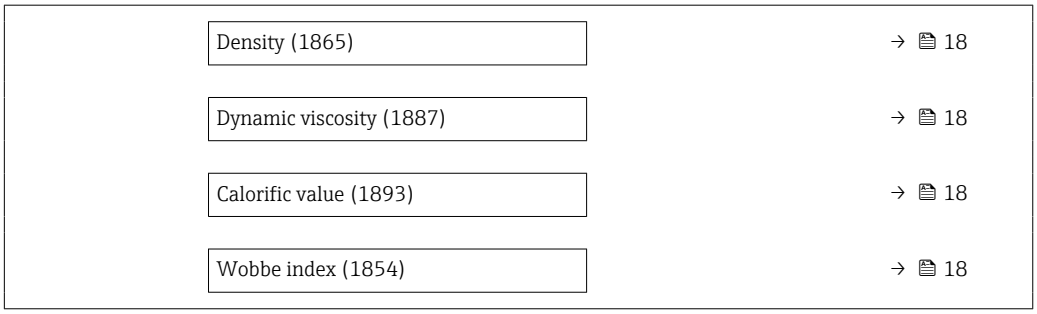
For the Coal gas/biogas gas type: The corrected volume flow can be calculated for the wet gas mixture or the dry gas mixture (after subtracting the water vapor content) (see **Standard volume flow calculation** parameter). The methane content, gross calorific value, and Wobbe index also only refer to the dry mixture (only for the Coal gas/biogas gas type).

All percentage concentration values (methane content, other gas components) are molar fractions.

The reference combustion temperature used for the calculation of the gross calorific value, net calorific value and Wobbe index can be selected from a pre-programmed list. The reference combustion temperature is independent of the reference temperature used to calculate the corrected volume flow. The reference combustion pressure is always 1 atm. The user can switch between the gross calorific value (GCV) and net calorific value (NCV) or between the superior and inferior Wobbe index.

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





Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Methane fraction	For the following order code: "Application package", option EF "Advanced gas analysis" The software options currently enabled are displayed in the **Software option overview** parameter.	Shows the methane fraction of the dry gas currently calculated.	Signed floating-point number
Molar mass	For the following order code: "Application package", option EF "Advanced gas analysis" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the molar mass in g/mol that is currently calculated.	Signed floating-point number
Density	–	Displays the density that is currently calculated. *Dependency* The unit is taken from: **Density unit** parameter	Signed floating-point number
Dynamic viscosity	For the following order code: "Application package", option EF "Advanced gas analysis" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the dynamic viscosity that is currently calculated. *Dependency* The unit is taken from the **Dynamic viscosity unit** parameter.	Signed floating-point number
Calorific value	For the following order code: "Application package", option EF "Advanced gas analysis" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the calorific value that is currently calculated. *Dependency* The unit is taken from the **Calorific value unit** parameter.	Signed floating-point number
Wobbe index	For the following order code: "Application package", option EF "Advanced gas analysis" The software options currently enabled are displayed in the **Software option overview** parameter.	Displays the Wobbe index that is currently calculated. *Dependency* The unit is taken from: **Calorific value unit** parameter	Signed floating-point number

3.5 User-specific entries

The following parameters must be entered depending on the selected gas type:

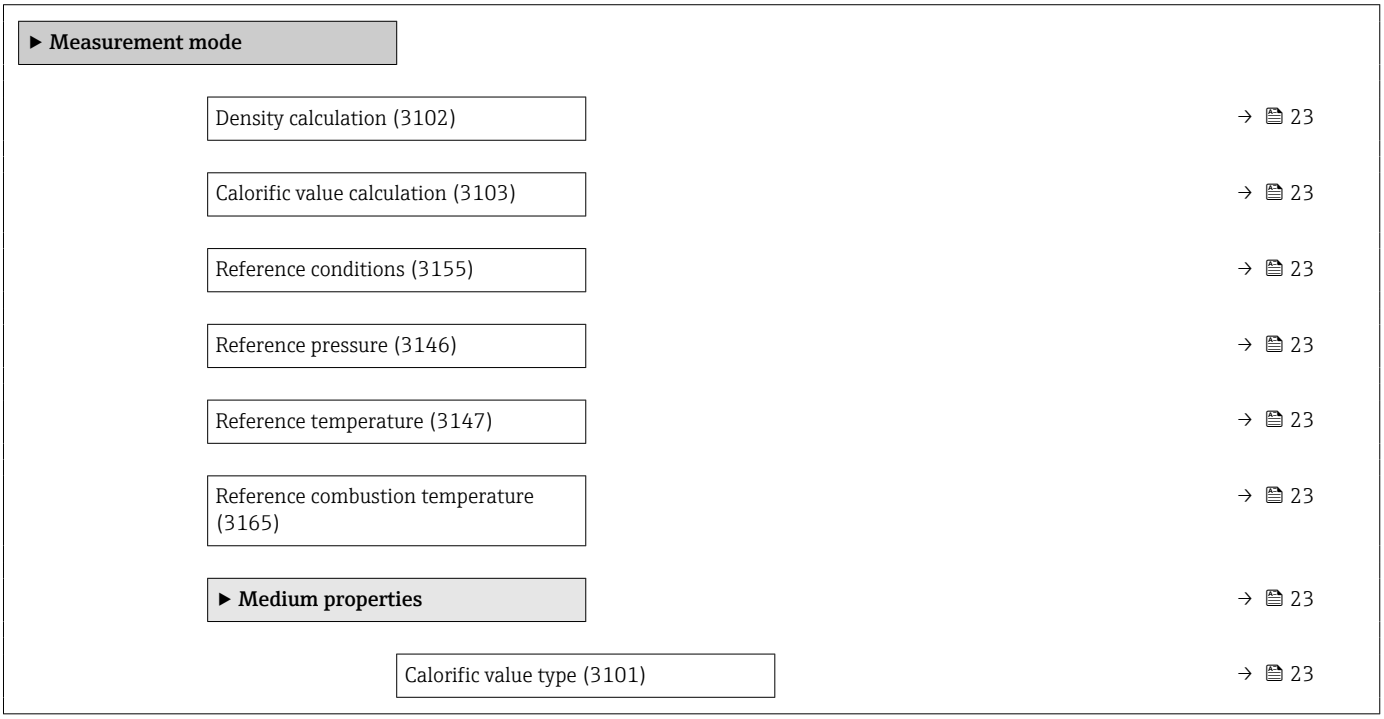
Parameter	Gas types							
	Single gas	Gas mixture	Coal gas/ biogas	Natural gas - standardized calculation			Natural gas - using sound velocity	User-specific gas
				ISO 12213-2	ISO 12213-3	AGA Nx19		
Density calculation	–	–	–	x	x	x	–	–
Calorific value calculation	–	–	–	x	x	x	–	–
Reference conditions	x	x	x	x	x	x	x	x
Reference pressure [1]	x	x	x	x	x	x	x	x
Reference temperature [1]	x	x	x	x	x	x	x	x
Reference combustion temperature	x	x	x	x [2]	x [2]	x [2]	x	–
Calorific value type	x	x	x	x	x	x	x	x
Humidity type	–	–	x	x	–	–	x	–
Reference density	–	–	–	–	–	–	–	x
Reference gross calorific value	–	–	–	–	x	–	–	–
Reference Z-factor	–	–	–	–	–	–	–	x
Relative density	–	–	–	–	x	x	–	–
Specific heat capacity	–	–	–	x	x	x	x	x
Calorific value	–	–	–	–	–	–	–	x
Z-factor	–	–	–	–	–	–	–	x
Dynamic viscosity	–	–	–	–	–	–	–	x
Additional gas component	–	–	x	–	–	–	–	–
Standard volume flow calculation	–	–	x	–	–	–	–	–
Gas	x	–	–	–	–	–	–	–
Gas composition	–	x	–	–	–	–	–	–
Mol% Ar	x	x	–	x	–	–	–	–
Mol% Air	x	x	–	–	–	–	–	–
Mol% C2H3Cl	x	x	–	–	–	–	–	–
Mol% C2H4	x	x	–	–	–	–	–	–
Mol% C2H6	x	x	–	x	–	–	–	–
Mol% C3H8	x	x	–	x	–	–	–	–
Mol% CH4	x	x	–	x	–	–	–	–
Mol% CO	x	x	–	x	–	–	–	–
Mol% CO2	–	x	–	x	x	x	x	–
Mol% H2	–	x	x	x	x	–	x	–
Mol% H2O [3]	–	x	–	x	–	–	x	–
Mol% H2S	–	x	x	x	–	–	x	–
Mol% He	–	x	–	x	–	–	–	–
Mol% i-C4H10	–	–	–	x	–	–	–	–
Mol% i-C5H12	–	–	–	x	–	–	–	–
Mol% Kr	x	x	–	–	–	–	–	–

Parameter	Gas types							
	Single gas	Gas mixture	Coal gas/ biogas	Natural gas - standardized calculation			Natural gas - using sound velocity	User-specific gas
				ISO 12213-2	ISO 12213-3	AGA Nx19		
Mol% N2	x	x	x	x	–	x	x	–
Mol% n-C10H22	–	–	–	x	–	–	–	–
Mol% n-C4H10	x	x	–	x	–	–	–	–
Mol% n-C5H12	–	–	–	x	–	–	–	–
Mol% n-C6H14	–	–	–	x	–	–	–	–
Mol% n-C7H16	–	–	–	x	–	–	–	–
Mol% n-C8H18	–	–	–	x	–	–	–	–
Mol% n-C9H20	–	–	–	x	–	–	–	–
Mol% Ne	x	x	–	–	–	–	–	–
Mol% O2	–	x	x	x	–	–	x	–
Mol% other gas	–	x	–	–	–	–	–	–
Mol% SO2	x	x	–	–	–	–	–	–
Mol% Xe	–	x	–	–	–	–	–	–
Relative humidity [3]	–	–	x	x	–	–	x	–
Dew point [3]	–	–	x	x	–	–	x	–

1) Visible if the **Other** option is selected in the **Reference conditions** parameter.
2) ISO 6976 only.
3) Only visible if selected in the **Humidity type** parameter

3.5.1 "Measurement mode" submenu

Navigation
"Expert" menu → Sensor → Measurement mode



Humidity type (3156)	→ 23
Reference density (3144)	→ 24
Reference gross calorific value (3145)	→ 24
Reference Z-factor (3148)	→ 24
Relative density (3149)	→ 24
Specific heat capacity (3162)	→ 24
Calorific value (3105)	→ 24
Z-factor (3108)	→ 24
Dynamic viscosity (3106)	→ 24
Additional gas component (3154)	→ 24
Standard volume flow calculation (3164)	→ 24
► **Gas composition**	→ 24
Gas (3151)	→ 25
Gas composition (3110)	→ 25
Mol% Ar (3112)	→ 25
Mol% Air (3170)	→ 25
Mol% C2H3Cl (3113)	→ 25
Mol% C2H4 (3114)	→ 25
Mol% C2H6 (3115)	→ 25
Mol% C3H8 (3116)	→ 25
Mol% CH4 (3117)	→ 25
Mol% CO (3119)	→ 26
Mol% CO2 (3120)	→ 26
Mol% H2 (3121)	→ 26

	Mol% H2O (3122)	→ 26
	Mol% H2S (3123)	→ 26
	Mol% He (3125)	→ 26
	Mol% i-C4H10 (3126)	→ 26
	Mol% i-C5H12 (3127)	→ 26
	Mol% Kr (3128)	→ 26
	Mol% N2 (3129)	→ 26
	Mol% n-C10H22 (3130)	→ 26
	Mol% n-C4H10 (3131)	→ 26
	Mol% n-C5H12 (3132)	→ 26
	Mol% n-C6H14 (3133)	→ 26
	Mol% n-C7H16 (3134)	→ 26
	Mol% n-C8H18 (3135)	→ 26
	Mol% n-C9H20 (3136)	→ 26
	Mol% Ne (3137)	→ 27
	Mol% O2 (3139)	→ 27
	Mol% other gas (3140)	→ 27
	Mol% SO2 (3141)	→ 27
	Mol% Xe (3142)	→ 27
	Relative humidity (3150)	→ 27
	Dew point (3157)	→ 27

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Density calculation	–	Select the norm the density calculation is based on.	▪ AGA Nx19 ▪ ISO 12213- 2 ▪ ISO 12213- 3	ISO 12213- 3
Calorific value calculation	–	Select the standard used for calculating the calorific value.	▪ AGA5 ▪ ISO 6976	ISO 6976
Reference conditions	–	Select reference conditions for calculation of the corrected volume flow.	▪ 1013.25 hPa, 0 °C ▪ 1013.25 hPa, 15 °C ▪ 1013.25 hPa, 20 °C ▪ 1013.25 hPa, 25 °C ▪ 1000.00 hPa, 0 °C ▪ 1000.00 hPa, 15 °C ▪ 1000.00 hPa, 20 °C ▪ 1000.00 hPa, 25 °C ▪ 14.696 Psi, 59 °F ▪ 14.696 Psi, 60 °F ▪ 14.730 Psi, 60 °F ▪ Other	1013.25 hPa, 0 °C
Reference pressure	The **Other** option is selected in the **Reference conditions** parameter.	Select reference conditions for the corrected volume flow.	0 to 250 bar	1.01325 bar
Reference temperature	The **Other** option is selected in the **Reference conditions** parameter.	Select reference conditions for the corrected volume flow.	−200 to 450 °C	0 °C
Reference combustion temperature	–	Select ref. temp. (reference combustion temperature) for calculating the gas energy value.	▪ 0 °C ▪ 15 °C ▪ 20 °C ▪ 25 °C ▪ 60 °F	25 °C

"Medium properties" submenu

Navigation
"Expert" menu → Sensor → Measurement mode → Medium properties

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Calorific value type	–	Select calculation based on gross calorific value or net calorific value.	▪ Gross calorific value volume ▪ Net calorific value volume	Net calorific value volume
Humidity type	–	Select the input value for the gas humidity.	▪ Relative humidity ▪ Water fraction ▪ Dew point	▪ **Relative humidity** option for the **Coal gas/biogas** gas type ▪ **Water fraction** option for all other gas types Depends on the selected gas type.

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Reference density	–	Enter fixed value for reference density.	0.01 to 100 kg/m³	1 kg/m³
Reference gross calorific value	–	Enter the reference gross calorific value of the gas.	0 to 1000 MJ/Nm³	40 MJ/Nm³
Reference pressure	The **Other** option is selected in the **Reference conditions** parameter.	Select reference conditions for the corrected volume flow.	0 to 250 bar	1.01325 bar
Reference Z-factor	–	Enter real gas constant Z for gas under reference conditions.	0.1 to 2	1
Relative density	–	Enter the relative density of the gas.	0.5 to 1.0	0.58
Specific heat capacity	–	Enter the specific heat capacity of the medium.	0 to 50000 J/(kgK)	Depends on the selected gas type.
Calorific value	–	Enter gross calorific value to calculate the energy flow.	0 to 1000 MJ/Nm³	40 MJ/Nm³
Z-factor	–	Enter real gas constant Z for gas under operation conditions.	0.1 to 2.0	1
Dynamic viscosity	–	Value of the dynamic viscosity for user-specific gas.	0 to 1000 µPa s	15 µPa s
Additional gas component	The **Coal gas/biogas** option is selected in the **Select gas type** parameter.	Specify the additional gas component of the gas.	▪ None ▪ Hydrogen H2 ▪ Hydrogen sulfide H2S	None
Standard volume flow calculation	The **Coal gas/biogas** option is selected in the **Select gas type** parameter.	Setting specifying how the corrected volume flow is calculated for wet coal gas/ biogas.	▪ Wet gas ▪ Dry gas	Dry gas

"Gas specification" submenu

Navigation

"Expert" menu → Sensor → Measurement mode → Medium properties → Gas specification

Parameter overview with brief description

Parameter	Description	Selection / User entry	Factory setting
Gas	Select measured gas.	▪ Air ▪ Argon Ar ▪ Krypton Kr ▪ Nitrogen N2 ▪ Carbon monoxide CO ▪ Sulfur dioxide SO2 ▪ Methane CH4 ▪ Ethane C2H6 ▪ Propane C3H8 ▪ Butane C4H10 ▪ Ethylene C2H4 ▪ Vinyl chloride C2H3Cl ▪ Ammonia NH3 ▪ Neon Ne ▪ Carbon dioxide CO2	Methane CH4
Gas composition	Select measured gas mixture.	▪ Air ▪ Hydrogen H2 ▪ Helium He ▪ Neon Ne ▪ Argon Ar ▪ Krypton Kr ▪ Xenon Xe ▪ Nitrogen N2 ▪ Oxygen O2 ▪ Ammonia NH3 ▪ Carbon monoxide CO ▪ Carbon dioxide CO2 ▪ Sulfur dioxide SO2 ▪ Hydrogen sulfide H2S ▪ Methane CH4 ▪ Propane C3H8 ▪ Ethane C2H6 ▪ Butane C4H10 ▪ Ethylene C2H4 ▪ Vinyl chloride C2H3Cl ▪ Water ▪ Other	Methane CH4
Mol% Ar	Enter amount of substance for the gas mixture. Ar = Argon	0 to 100 %	0 %
Mol% Air	Enter amount of substance for the gas mixture. Air	0 to 100 %	0 %
Mol% C2H3Cl	Enter amount of substance for the gas mixture. C_2H_3Cl = vinyl chloride	0 to 100 %	0 %
Mol% C2H4	Enter amount of substance for the gas mixture. C_2H_4 = ethylene	0 to 100 %	0 %
Mol% C2H6	Enter amount of substance for the gas mixture. C_2H_6 = ethane	0 to 100 %	0 %
Mol% C3H8	Enter amount of substance for the gas mixture. C_3H_8 = propane	0 to 100 %	0 %
Mol% CH4	Enter amount of substance for the gas mixture. CH_4 = methane	0 to 100 %	100 %

Parameter	Description	Selection / User entry	Factory setting
Mol% CO	Enter amount of substance for the gas mixture. CO = carbon monoxide	0 to 100 %	0 %
Mol% CO2	Enter amount of substance for the gas mixture. CO_2 = carbon dioxide	0 to 100 %	0 %
Mol% H2	Enter amount of substance for the gas mixture. H_2 = hydrogen	0 to 100 %	0 %
Mol% H2O	Enter amount of substance for the gas mixture. H_2O = water	0 to 100 %	0 %
Mol% H2S	Enter amount of substance for the gas mixture. H_2S = hydrogen sulfide	0 to 100 %	0 %
Mol% He	Enter amount of substance for the gas mixture. He = helium	0 to 100 %	0 %
Mol% i-C4H10	Enter amount of substance for the gas mixture. i-C_4H_{10} = isobutane	0 to 100 %	0 %
Mol% i-C5H12	Enter amount of substance for the gas mixture. i-C_5H_{12} = isopentane	0 to 100 %	0 %
Mol% Kr	Enter amount of substance for the gas mixture. Kr = krypton	0 to 100 %	0 %
Mol% N2	Enter amount of substance for the gas mixture. N_2 = nitrogen	0 to 100 %	0 %
Mol% n-C10H22	Enter amount of substance for the gas mixture. n-$C_{10}H_{22}$ = n-decane	0 to 100 %	0 %
Mol% n-C4H10	Enter amount of substance for the gas mixture. n-C_4H_{10} = n-butane	0 to 100 %	0 %
Mol% n-C5H12	Enter amount of substance for the gas mixture. n-C_5H_{12} = n-pentane	0 to 100 %	0 %
Mol% n-C6H14	Enter amount of substance for the gas mixture. n-C_6H_{14} = n-hexane	0 to 100 %	0 %
Mol% n-C7H16	Enter amount of substance for the gas mixture. n-C_7H_{16} = n-heptane	0 to 100 %	0 %
Mol% n-C8H18	Enter amount of substance for the gas mixture. n-C_8H_{18} = n-octane	0 to 100 %	0 %
Mol% n-C9H20	Enter amount of substance for the gas mixture. n-C_9H_{20} = n-nonane	0 to 100 %	0 %

Parameter	Description	Selection / User entry	Factory setting
Mol% Ne	Enter amount of substance for the gas mixture. Ne = neon	0 to 100 %	0 %
Mol% O2	Enter amount of substance for the gas mixture. O_2 = oxygen	0 to 100 %	0 %
Mol% other gas	Enter amount of substance for the gas mixture.	0 to 100 %	0 %
Mol% SO2	Enter amount of substance for the gas mixture. SO_2 = sulfur dioxide	0 to 100 %	0 %
Mol% Xe	Enter amount of substance for the gas mixture. Xe = xenon	0 to 100 %	0 %
Relative humidity	Enter humidity content of air in %.	0 to 100 %	0 %
Dew point	Enter dew point in the selected temperature unit.	−50 to 150 °C	0 °C

3.6 Commissioning

3.6.1 Configuring the measuring device

Configuration of the measuring device when the desired gas type is selected

1. Start with the **Select gas type** parameter→ 📄 9
2. Configure the outputs → 📄 17

3.7 Application examples

You can find application examples for various gas types and their use in the application package for "**Advance gas analysis**" below.

A device without pressure and temperature sensor will indicate the actual Volume flow. The Corrected volume flow, Mass flow and Energy flow can be read out by inputting fixed pressure and temperature values.

Externally measured pressure and temperature values can be input via the HART protocol or the current input.

With the integrated pressure and temperature sensor, current pressure and temperature values are used to improve the measurement accuracy of certain variables or to calculate the Corrected volume flow for gases.

Depending on the gas type, the "**Advanced gas analysis**" application package offers further output variables: See "Output variables" section → 17.

3.7.1 Natural gas

The device is ideally suited for applications in which the natural gas flow is measured.

Measurements are possible at different points:
- At the gas outlet
- At the VRU (vapor recovery unit) outlet
- In the return line
- In the gathering lines
- In the line balancing
- At the gas lift
- In the gas feed line
- At the flaring point
- In the gas compressor controller
- For gas processing

The gas section of the separator often contains wet gas. The device has been tested for measuring wet gas and works reliably in such conditions.

It is ideally suited for bidirectional flow applications such as underground gas storage systems.

Information such as the Wobbe index and Energy flow are useful parameters for controlling and monitoring the furnace/boiler in fuel gas applications.

The following options are available for measuring natural gas:
- Natural gas - standardized calculation
- Natural gas - using sound velocity

"Natural gas - standardized calculation" option

Within these options, three standards are available for calculating the compressibility factor (density):
- AGA NX-19
- ISO 12213-2 (AGA8 equation)
- ISO 12213-3 (SGERG 88 equation)

Users can choose between AGA 5 and ISO 6976 to calculate the Calorific value.

"Natural gas - using sound velocity" option

Users can select this option when the natural gas composition is unknown or variable.

This mode does not require detailed information about the natural gas mixture. The new gas model utilizes the sound velocity measurement and the integrated pressure and temperature measurement to calculate the natural gas properties online. If the natural gas

contains components other than hydrocarbons, e.g. nitrogen, carbon dioxide or hydrogen, users can enter these concentrations.

With the **Natural gas - using sound velocity** option, it is possible to output precise values for Mass flow, Energy flow, Molar mass, Density, Dynamic viscosity, Calorific value and Wobbe index for a natural gas consisting of methane, ethane, propane, butane and carbon dioxide, for example, by entering a medium carbon dioxide concentration.

3.7.2 Coal gas/biogas

Coal gas is a non-conventional natural gas obtained from shale gas and coal bed methane deposits.

Biogas on the other hand, which is also known as renewable natural gas, is obtained from anaerobic digestion. Anaerobic organisms are added to organic material, e.g. agricultural waste, municipal waste or animal waste, to produce biogas in an anaerobic digestion tower, fermenter or bioreactor.

Coal gas and biogas are made up primarily of methane and carbon dioxide. They are typically saturated with water and can contain traces of hydrogen sulfide and other gases.

In this case, the device can be configured with the **Coal gas/biogas** option. If necessary, this option makes it possible to enter the concentration of additional trace components, such as nitrogen, oxygen, ammonia, hydrogen sulfide or hydrogen. This option is used for precisely calculating the Methane fraction, Calorific value, Wobbe index and Molar mass without requiring further user inputs.

The methane content is calculated using an integrated gas model based on the sound velocity measurement and the integrated pressure and temperature measurement. A decrease in the methane content of a digestion tower can point to a problem in the digestion process. The Methane fraction can be set as an output variable to indicate the status of the digestion tower and issue an alarm if the Methane fraction exceeds preset limits.

3.7.3 Gas mixture

Flue gas from a combustion process is a typical example of a gas mixture. The composition varies and depends on the fuel source. In a coal-fired power plant, the flue gas typically consists of 82% nitrogen, 13% carbon dioxide and 5% oxygen. The flue gas composition of a natural gas turbine is different and contains slightly more oxygen, that is around 82% nitrogen, 13% oxygen and 5% carbon dioxide.

With the **Gas mixture** option, the device is precisely adjusted for these applications, resulting in more precise measurements of Corrected volume flow, Mass flow and Density.

The medium properties contained in the gas database with the associated temperature and pressure values are used.

3.7.4 Single gas

Ethane gas is the second-largest component in natural gas and is used to produce ethylene gas. Ethylene gas is an important raw material for the petrochemical industry. It is used for manufacturing many polymer plastics that we frequently use in our everyday lives.

With the **Single gas** option, both gases can be measured by selecting the relevant option from the list of supported gases.

The medium properties contained in the gas database with the associated temperature and pressure values are used.

This method records the Corrected volume flow and precisely determines the Mass flow and Density for monitoring purposes.

Air can also be selected as a predefined gas mixture for the **Single gas** option.

www.addresses.endress.com

Endress+Hauser

People for Process Automation