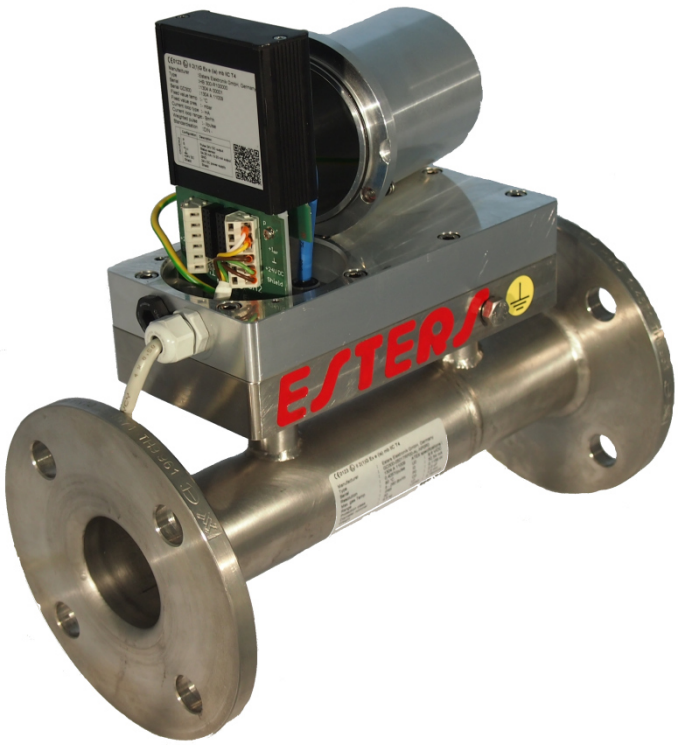
Instruction manual IM 312/313 E

Device: Gas flowmeter GD 300/GD 500
for measuring the flow rate of gases

Content: Installation and operating instructions

Rev.-No.: IM 312/313 E V1.3-2017-06-01



Phone: +49 (0)6021 – 45 807 - 0
Fax: +49 (0)6021 – 45 807 - 20
Esters Elektronik GmbH
Hafenrandstr. 14 · D-63741 Aschaffenburg
email: info@esters.de
Internet: http://www.esters.de

USER INFORMATION

- Prior to installing the equipment or before attempting initial start-up, please read this manual thoroughly.
- Please ensure to observe all information and warnings provided in this manual.
- The serial number of the equipment can be found on the identification plate. You will need this information when ordering spare parts. The plate is attached to the outside of the device.
- In order to guarantee operational safety, only the manufacturer's original spare parts shall be installed.
- Operating the equipment for purposes other than its intended use shall void all warranty claims and product liability. Noncompliance with the intended use refers refers to but is not limited to improper installation, start-up, operation, maintenance and neglecting the information provided in this manual.Installation, commissioning, operation and maintenance must be performed by a qualified electrician. Guidelines according to the installation site are applicable.
- For personal safety reasons installation and maintenance work may only be carried out when the device is not connected to the power supply.
  The device must be integrated into the lightning protection concept of the plant operator

Please ensure to operate this device only in accordance with this manual. Departure from these instructions will void and nullify all warranty claims and jeopardizes the operating safety of the device.

We reserve the right to engineering changes, which may necessitate deviations from the current data provided in this manual. Should you require additional information or questions arise that are not sufficiently covered in this manual, please contact us at the following address:

Esters Elektronik GmbH
Hafenrandstr. 14
D-63741 Aschaffenburg
Tel.: +49 (0)6021 – 45 807 - 0
Fax: +49 (0)6021 – 45 807 - 20
eMail: esters@esters.de
Internet: www.esters.de

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Phone: +49 (0)6021 – 45 807 - 0
Fax: +49 (0)6021 – 45 807 - 20
Esters Elektronik GmbH
Hafenrandstr. 14 · D-63741 Aschaffenburg
email: info@esters.de
Internet: http://www.esters.de

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1 Introduction

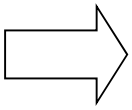
1.1 Operating instructions, general information

These operating instructions are intended for the use of the gas flowmeter GD 300/GD 500 and meant to provide support during the installation, operation, and maintenance.

The structure of the document shall make this easy. Important text is highlighted.

Symbols

The following symbols are used in these operating instructions in order to highlight text that requires special attention.



Notes
This arrow points to features that require your special attention.

Caution
This symbol points to important text.
Noncompliance or disregard may cause damage to components or destruction to parts of the system.

Warning!
This symbol points to important text. Noncompliance will place the life and health of persons at risk.

Reference
This symbol refers to additional information available in other manuals, chapters, or sections.

1.2 Goods receipt inspection, transportation, storage

- Ensure the packaging is not damaged!
- Any damaged packaging must be reported to the supplier.
- Retain any damaged packaging until the matter has been resolved.
- Ensure the content of the package is not damaged!
- Any damaged part received must be reported to the supplier.
- Retain any damaged goods until the matter has been resolved.
- Use the delivery documents to check the received goods and compare the goods with your order to ensure completeness. For storage and transport purposes, the equipment must be packed with care to prevent damage caused by impact or humidity. Only the original packaging can ensure optimal protection. Furthermore, compliance with all allowable ambient conditions is mandatory (section 5. Installation of the measuring device).
- If you have any questions, please contact your supplier or the respective distribution centre.

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1.3 Scope of delivery

- GD 300 / GD 500
- flow sensor
- integrated calculator HB 300
- instruction manual IM 312/313
- factory calibration certificate

1.4 Intended use

This equipment is intended for the following use:

- measurement and forwarding of gaseous substances
- flow rate measurements
- flow rate measurements during fluctuating temperatures/pressures

The following aspects are also considered components of "intended use":

- Compliance with instructions and directions is mandatory.
- The technical limit values must be adhered to, see section 8.1 Technical specifications.
- The permissible measuring mediums must be observed, see section 8.2 Permissible measuring .

1.5 Improper use

The following applications of the device are not permitted:

- use as elastic compensation piece in pipe lines, e.g. as compensation for pipe offsets, pipe oscillation, pipe elongation, etc.
- use as step, e.g. for installation purposes
- use as bracket for external loads, e.g. as bracket for pipelines, etc.
- applying other materials, e.g. painting the identification plate, or welding, or soldering of other parts to the device
- removing material, e.g. drilling holes into the housing
- improper use invalidates the authorization/operating permission

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1.6 Target groups and qualifications

Only properly trained personnel authorised by the owner of the system shall be permitted to install, start up, and maintain the product. The respective technical personnel must have read and understood the instructions and must follow the directions. Before using corrosive or abrasive test fluids, it is the owner's responsibility to verify the resistance of those parts that contact the measuring medium. The owner must comply with the national rules and regulations governed by the country with respect to installation, function testing, repair, and maintenance of electrical products.

Safety instructions

- Only properly trained personnel shall be permitted to work on/with systems containing gases and shall be authorized to install, execute settings, and perform the initial operation of the equipment. In doing so, compliance with all commonly accepted engineering standards and adherence to regulations to the occupational health and safety act is mandatory.
- Prior to installing and/or removing components of gas-carrying systems, ensure the system is shut down and depressurized.
- Before the initial start-up and/or restart of the system, ensure that all personnel and objects are out of reach of moving parts.
- Noncompliance with these instructions or technical advice may lead to personal injuries and/or damage to property.

Installation instructions

Important: Prior to the installation of the measurement module, ensure that all nominal diameters correspond with the actual nominal diameter of the pipe line! Furthermore, ensure the installation direction of the measurement module is correct and corresponds with the information shown on the identification plate.

Remove all packaging residue and follow the instructions as described in section 5. Installation of the measuring device.

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2 Warranty

The devices were built in compliance with current directives and have left the factory in technically flawless condition.
In the unlikely event that you still may have reasons for a complaint and the fault can be traced to a factory error, we shall correct any defects at no additional charge. However, in such case, it is your responsibility to report the damage immediately after detection and/or within our permitted warranty period.

Damage caused due to improper use or as a result of noncompliance with these operating instructions, is excluded from this warranty.

The warranty period is 12 months. Unless otherwise agreed upon, the warranty period for spare parts is 12 months as well. The fulfilment of warranty claims shall not extend the warranty period.

The warranty shall become null and void if the measurement module has been opened, unless otherwise expressly stated in the operating instructions or for maintenance purposes only. This shall also apply if serial numbers have been changed, damaged, or removed.

Unless liability is mandatory by law, further claims, in particular claims based on damages that do not concern the delivered components, are excluded.

Services provided after the warranty period

Of course, we will be pleased to assist you once the warranty has expired. You can reach us directly by calling.

Contact:

Phone: +49 (6021) 45 807 - 0
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3 General information

The flowmeter GD 300/GD 500 is a fluidistor oscillator (oscillating flowmeter) with an oscillating frequency that is proportional to the gas flowing through the meter. The frequency/flow velocity ratio is constant within a predefined flow range. For your individual application we offer flowmeters with the appropriate measurement range.

The gas flows through the GD 300/ GD 500 with its selected orifice plate. The pipe is connected to the measurement labyrinth (stainless steel 1.4571), the so-called Fluidistor Oscillator and the built-in platinum wire sensor. The back pressure generated at the orifice plate causes a portion of the flow volume to be pushed through the channels into the measurement labyrinth. Inside the labyrinth, a column of gas starts oscillating. This frequency of the oscillation is proportional to the flow speed and the overall volumetric flow.

The changing flow through the connecting channel is detected by a platinum wire in the connecting channel.
A constant voltage is applied to the wire, which is permanently monitored. At the moment when the pressure equalization has occurred in the connecting channel, the wire is not circulated around by gas for a short time and heats up due to the current flowing through the wire. This causes a temporary rise of the resistance in the platinum wire (like a Pt100 sensor) and the voltage drop (V=R*I) increases. The integrated signal conditioner (HB 300) converts the sensor signal to a usable measurement signal. The HB 300 is equipped with a 1:1 pulse output with a defined volume-per-pulse number and optionally a variable weighted pulse- and (0)4 – 20 mA current-output. An evaluation electronic of the series GDR 140x can be used to further process the signal of GD 300/ GD 500.

The sensor can be replaced without removing the GD 300/GD 500 from the pipeline. Replacing the sensor does not affect the calibration of the flowmeter.

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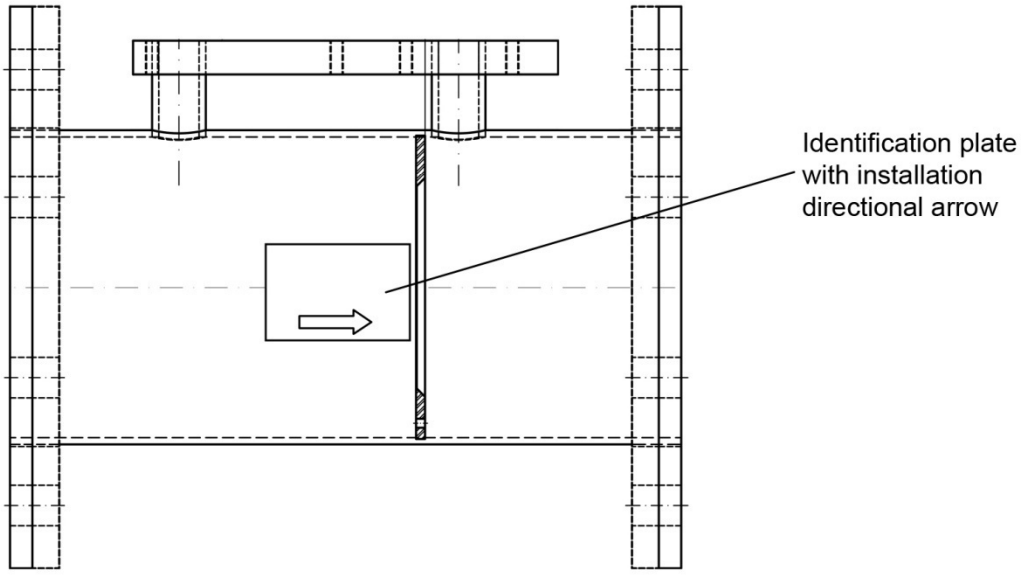
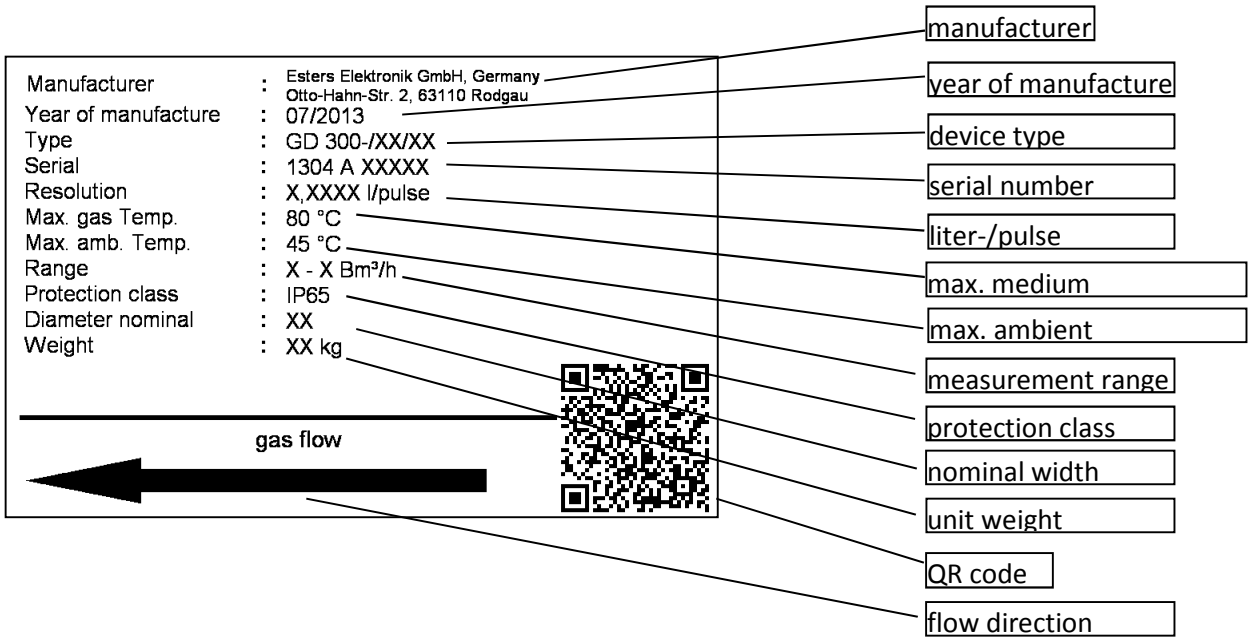
4 Identification plate





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4.1 Equipment identification

The ordering code of the flowmeter is composed of the device type GD 300/GD 500 and a multi-digit code:

4.1.1 GD 300 / GD 500

GD 300- DN 25 to DN 50 with internal pipe thread

GD 300									DESCRIPTION
EX-VERSION	Ex								with ATEX certification
PRESSURE RANGE		-025							DN 25 (thread Rp 1“)
		-032							DN 32 (thread Rp 1 1/4“)
		-040							DN 40 (thread Rp 1 1/2“)
		-050							DN 50 (thread Rp 2“)
ORIFICE			13						measurement range see table page 10
			15						
			17						
PROCESS CONNECTION				RP					internal pipe thread (Rp)
PRESSURE RANGE					00				0,5 bar
					10				10 bar
					16				16 bar
					40				40 bar
MATERIAL						-AL			aluminum
						-V2			V2A stainless steel
						-V4			V4A stainless steel
INTEGRATED PRESSURE AND TEMPERATURE SENSORS							-P0		without
							-P1		press.: -50 ... +200 mbar, temp.: -50 to +150 °C *
							-P2		press.: 0 ... 30 bar, temp.: -50 to +150 °C *
REDUNDANT VERSION								R0	without
								R1	redundant platinum sensor *
								R2	redundant platinum sensor, pressure and temperature sensor *

* only devices without ATEX certification

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GD 300- DN 50 to DN 80 with flange

GD 300												DESCRIPTION
EX-VERSION	Ex											with ATEX certification
NOMINAL SIZE		-050										DN 50
		-065										DN 65
		-080										DN 80
ORIFICE			13									measurement range see table page 10
			15									
			17									
PIPE LENGTH				S								standard pipe length
				L								version with extra length, see dimensions
PROCESS CONNECTION					I							flange acc. to DIN EN-192-2/DIN2576
					A							flange acc. to ASME B 16.5
FLANGE VERSION						R						reduced flange (only ISO flange with a pressure range up to PN 10, bolt circel diameter PN 10)
						F						solid flange
BOLT CIRCEL DIAMETER							10					standard (ISO flange)
							16					(ISO flange)
							20					class 150 (ASME flange)
							50					class 300 (ASME flange)
PRESSURE RANGE								00				0,5 bar
								10				10 bar
								16				16 bar
								40				40 bar
								20				class 150 (ASME-Flansch)
								50				class 300 (ASME-Flansch)
MATERIAL									-AL			aluminum
									-V2			V2A stainless steel
									-V4			V4A stainless steel
INTEGRATED PRES-SURE AND TEMPERA-TURE SENSORS										-P0		without
										-P1		press.: -50 ... +200 mbar, temp.: -50 to +150 °C *
										-P2		press.: 0 ... 30 bar, temp.: -50 to +150 °C *
REDUNDANT VERSION											R0	without
											R1	redundant platinum sensor *
											R2	redundant platinum sensor, pressure and temperature sensor *

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GD 300- DN 100 to DN 400 with flange

GD 300												DESCRIPTION
EX-VERSION	Ex											with ATEX certification
		-100										DN 100
		-125										DN 125
NOMINAL SIZE		-150										DN 150
		-200										DN 200
		-250										DN 250
		-300										DN 300
		-350										DN 350
		-400										DN 400
ORIFICE			25									measurement range see table page 10
			27									
			30									
PIPE LENGTH				S								standard pipe length
				L								version with extra length, see dimensions
PROCESS CONNECTION					I							flange acc. to DIN EN-192-2/DIN2576
					A							flange acc. to ASME B 16.5
FLANGE VERSION						R						reduced flange (only ISO flange with a pressure range up to PN 10, bolt circel diameter PN 10)
						F						solid flange
BOLT CIRCEL DIAMETER							10					standard (ISO flange)
							16					(ISO flange)
							20					class 150 (ASME flange)
							50					class 300 (ASME flange)
PRESSURE RANGE								00				0,5 bar
								10				10 bar
								16				16 bar
								40				40 bar
								20				class 150 (ASME-Flansch)
								50				class 300 (ASME-Flansch)
MATERIAL									-AL			aluminum
									-V2			V2A stainless steel
									-V4			V4A stainless steel
INTEGRATED PRESSURE AND TEMPERATURE SENSORS										-P0		without
										-P1		press.: -50 ... +200 mbar, temp.: -50 to +150 °C *
										-P2		press.: 0 ... 30 bar, temp.: -50 to +150 °C *
REDUNDANT VERSION											R0	without
											R1	redundant platinum sensor *
											R2	redundant platinum sensor, pressure and temperature sensor *

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GD 500 with external pipe thread

GD 500								Description
Ex-version	Ex							with ATEX certification
process connection		-PA1						R 1/2“
		-PA2						G 1“
pressure range			00					0,5 bar
			10					10 bar
			16					16 bar
			40					40 bar
material connection				-V2				V2A stainless steel
				-V4				V4A stainless steel
material measuring head					-AL			aluminum
					-V2			V2A stainless steel
					-V4			V4A stainless steel
integrated pressure and temperature sensors						-P0		without
						-P1		press.: -50 ... +200 mbar, temp.: -50 to +150 °C *
						-P2		press.: 0 ... 30 bar, temp.: -50 to +150 °C *
redundant version							R0	without
							R1	redundant platinum sensor *
							R2	redundant platinum sensor, pressure and temperature sensor *

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4.1.2 HB 300

4.1.2.1 Configuration/order code

HB300							Description
Ex version	Ex						with ATEX certification
Version		-R0					standard
		-R1					redundant sensor*
Standardisation**			0				without standardisation
			1				DIN 1343
			2				DIN 6358
			3				DIN ISO 2533
			4				DIN 102/ISO 1-1975
Current output type				0			without current output
				1			0-20 mA
				2			4-20 mA
Output range for current output					00		without current output
					01		0-5 m³/h or Nm³/h
					02		0-10 m³/h or Nm³/h
					03		0-20 m³/h or Nm³/h
					04		0-50 m³/h or Nm³/h
					05		0-100 m³/h or Nm³/h
					06		0-200 m³/h or Nm³/h
					07		0-400 m³/h or Nm³/h
					08		0-800 m³ or Nm³/h
					09		0-1.000 m³/h/h or Nm³/h
					10		0-1.500 m³/h or Nm³/h
					11		0-2.000 m³/h or Nm³/h
					12		0-3.000 m³/h or Nm³/h
					13		0-5.000 m³/h or Nm³/h
					14		0-7.000 m³/h or Nm³/h
					15		0-10.000 m³/h or Nm³/h
Volume per pulse						0	pulse output (native**)
						1	0,0001 m³ or Nm³
						2	0,001 m³ or Nm³
						3	0,01 m³ or Nm³
						4	0,1 m³ or Nm³
						5	1 m³ or Nm³
						6	10 m³ or Nm³
						7	100 m³ or Nm³
						8	1000 m³ or Nm³

* only devices without ATEX certification

** when choosing a device with pulse weight "native" there can be no current output and no standardization option. The device type is then HB300-XX00000

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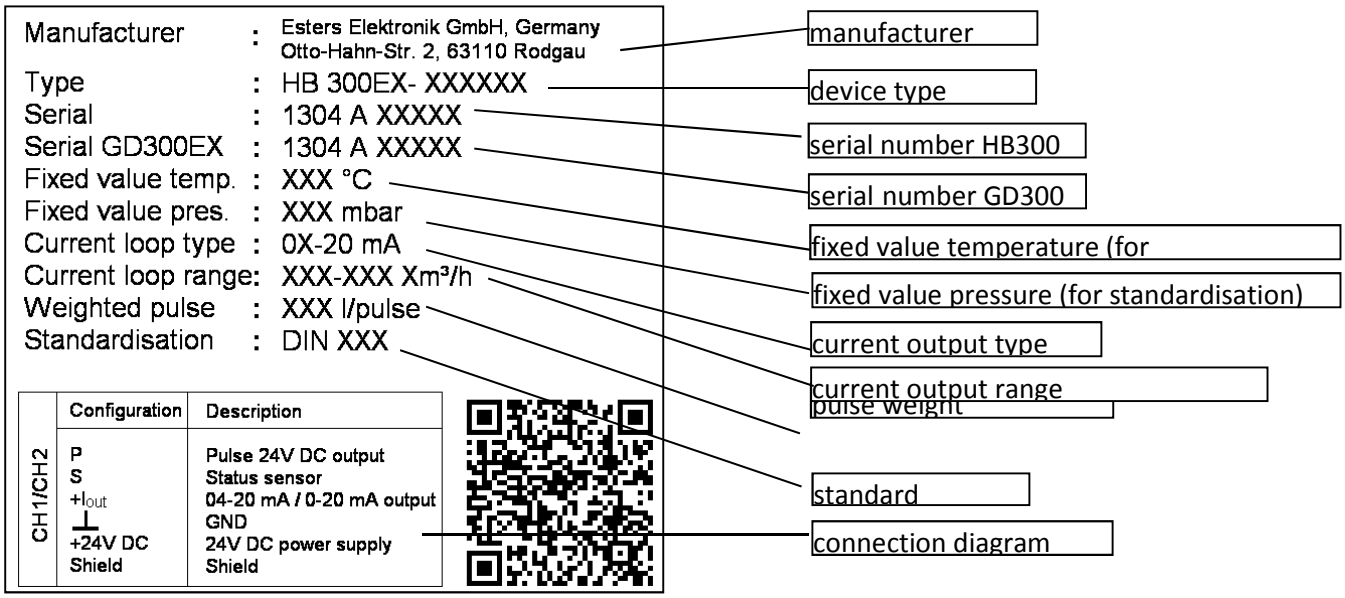
Standardisation

On the basis of fixed values you have the option to calculate the normal flow. For the standardisation of measurement values several standards are available. Upon ordering you can choose between these standard:

STANDARD	DATA ACCORDING TO STANDARD
DIN 1343	0°C 1013mbar
DIN 6358	20°C 1000mbar
DIN ISO 2533	15°C 1013 mbar
DIN 102/ISO 1-1975	20°C 981 mbar

4.1.2.2 Identification



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5 Installation of the measuring device

Please follow the rules and regulations for the installation and operation of gas-carrying systems.

5.1 Preferred mounting location

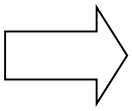
Using dry gases, the flowmeter can be installed horizontally or vertically. Using wet gases, a horizontal or descending direction installation is required.

In order to achieve the specified measurement accuracy, compliance with the following installation rules is mandatory:

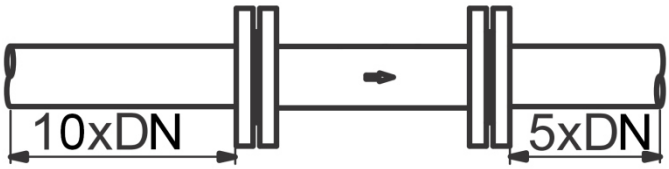
- defined lengths of inlet and outflow zone
- defined flow cross-sectional area
- defined orifices
- correct positional arrangement of the measuring elements

When installing the measuring device, please ensure the directional arrow on the identification plate points in the direction of the flow.

5.2 Inlet and outlet pipe lengths



The following inlet and outlet pipe lengths required in order to obtain a correct measuring result:



example: GD 300 in version DN 80

inlet pipe length: 10 x 80 mm = 800 mm
outlet pipe length: 5 x 80 mm = 400 mm

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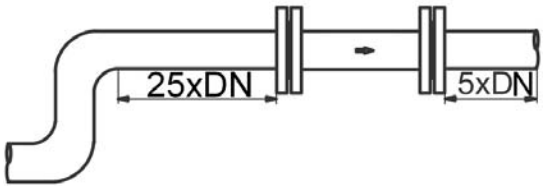
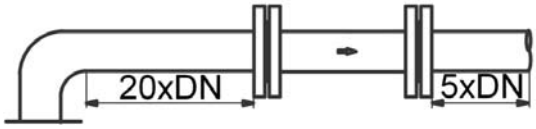
In addition, the following installation lengths are required:

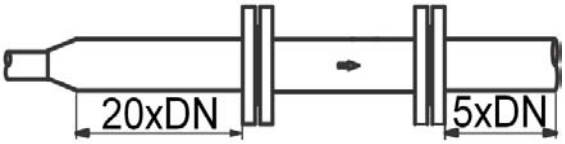
GD300

bends

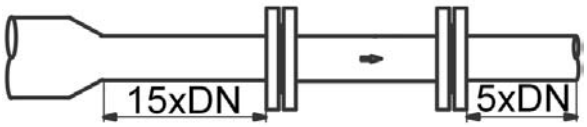




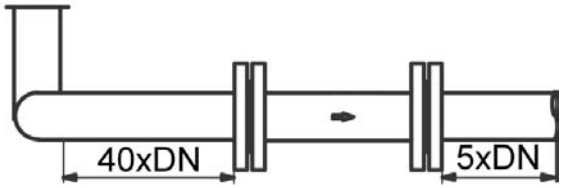
flaring



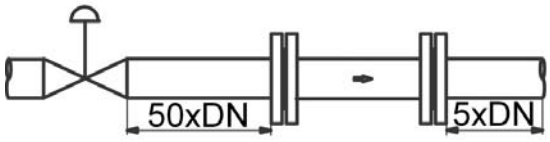
reduction



elbow



shut-off valve



There is no special inlet our outlet pipe length requirement for the GD 500.

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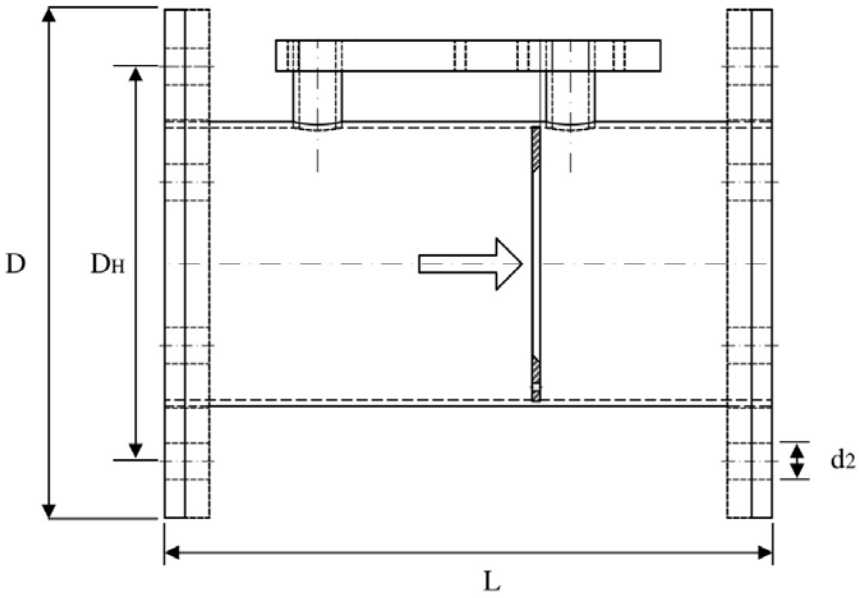
5.3 Dimensions

5.3.1 GD 300 with flange



Important pressure level data:

Connection dimensions PN 6, PN 10, PN 16, PN 25, PN 40 (dimensions in mm (b.c.=bolt circle, o.d. = outer diameter)

Nom. diameter	PN 6				PN 10				PN 16				PN 25				PN 40			
	o.d.: ø	b.c. ø	screws qty.	ø	o.d.: ø	b.c. ø	screws qty.	ø	o.d.: ø	b.c. ø	screws qty.	ø	o.d.: ø	b.c. ø	screws qty.	ø	o.d.: ø	b.c. ø	screws qty.	ø
	D	DH	n	d_2	D	DH	n	d_2	D	DH	n	d_2	D	DH	n	d_2	D	DH	n	d_2
15	80	55	4	11	95	65	4	14	95	65	4	14	95	65	4	14	95	65	4	14
20	90	65	4	11	105	75	4	14	105	75	4	14	105	75	4	14	105	75	4	14
25	100	75	4	11	115	85	4	14	115	85	4	14	115	85	4	14	115	85	4	14
32	120	90	4	14	140	100	4	18	140	100	4	18	140	100	4	18	140	100	4	18
40	130	100	4	14	150	110	4	18	150	110	4	18	150	110	4	18	150	110	4	18
50	140	110	4	14	165	125	4	18	165	125	4	18	165	125	4	18	165	125	4	18
65	160	130	4	14	185	145	8	18	185	145	8	18	185	145	8	18	185	145	8	18
80	190	150	4	18	200	160	8	18	200	160	8	18	200	160	8	18	200	160	8	18
100	210	170	4	18	220	180	8	18	220	180	8	18	235	190	8	22	235	190	8	22
125	240	200	8	18	250	210	8	18	250	210	8	18	270	220	8	26	270	220	8	26
150	265	225	8	18	185	240	8	22	285	240	8	22	300	250	8	26	300	250	8	26
200	320	280	8	18	340	295	8	22	340	395	12	22	360	310	12	26	375	320	12	30
250	375	335	12	18	395	350	12	22	405	355	12	26	425	370	12	30	450	385	12	33
300	440	392	12	22	445	400	12	22	460	410	12	26	485	430	16	30	515	450	16	33
350	490	445	12	22	505	460	16	22	520	470	16	26	555	490	16	33	580	510	16	36
400	540	495	16	22	565	515	16	26	580	525	16	30	620	550	16	36	660	585	16	39

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Nominal width, length and weight of the GD 300:

mm		weight (kg) +- 5 %	
DN (nominal diameter)	L (S/L) mm	reduced flange	solid flange
50	300	11	13
65	300	14	16
80	300	14	16
100	300/360	16/18	17/18
125	300	17	19
150	350/500	21/24	29/31
200	350	25	35
250	450	35	49
300	500	41	51
350	500	55	68
400	500	70	91

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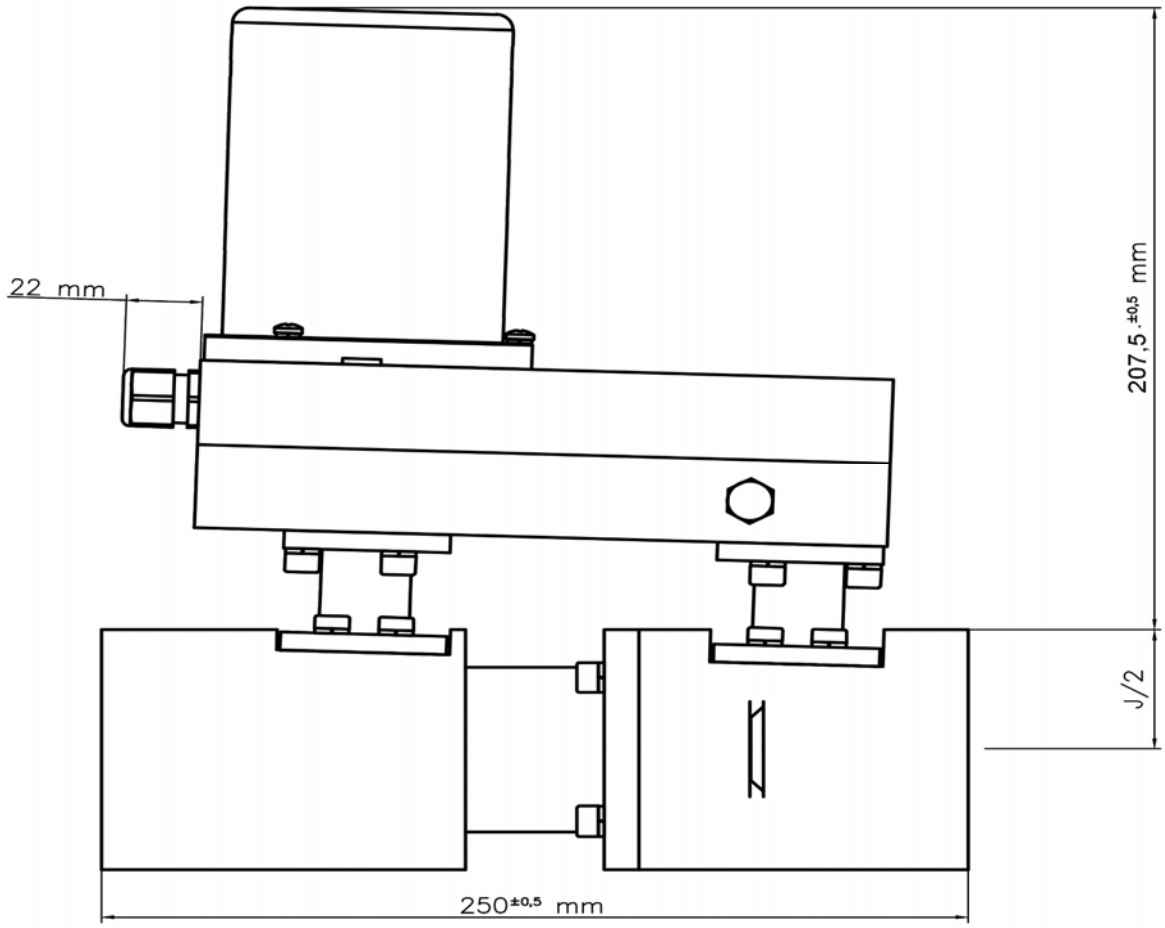
5.3.2 GD 300 with internal pipe thread



mm +0-1	Inches	mm +0-1	weight +- 5 %
DN (NOMINAL DIAMETER)	THREAD	D	KG
25	Rp 1”	80	16
32	Rp ¼”	80	12
40	Rp 1 ½”	100	18
50	Rp 2”	100	14

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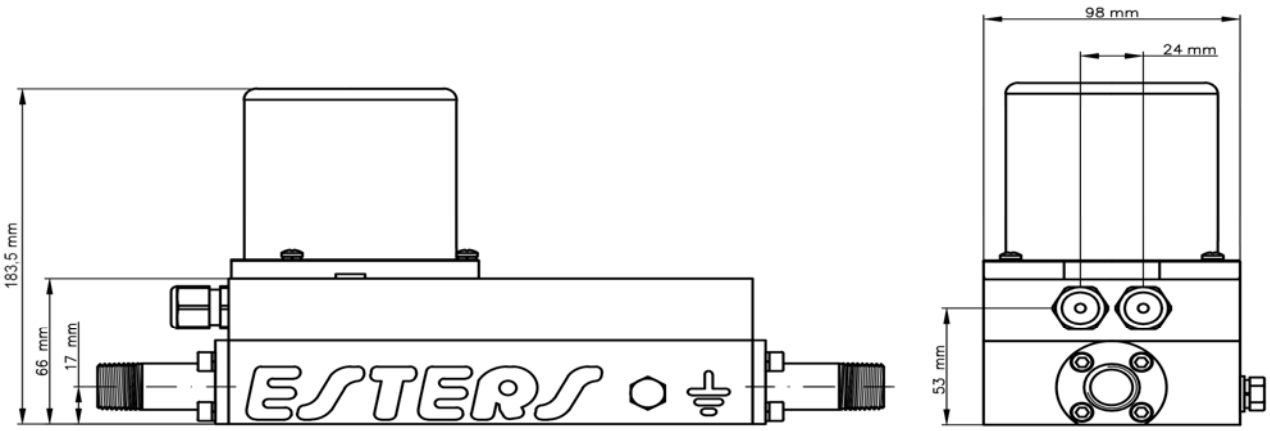
5.3.3 GD 500 with external pipe thread



inches thread	weight (KG) +-5 %
R ½“	8
G1“	8

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5.4 Measurement ranges

5.4.1 GD 500 with external pipe thread

DN (NOMINAL DIAMETER)	INCHES	M^3/H	
		QMIN	QMAX
15	½”	0,06	22
25	1”	0,06	22

5.4.2 GD 300 with internal pipe thread

DN (NOMINAL DIAMETER)	M^3/H					
	ORIFICE 13		ORIFICE 15		ORIFICE 17	
	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}
25	0,20	20	0,35	35	0,70	70
32	0,20	20	0,60	60	1,00	100
40	0,20	20	0,90	90	2,00	200
50	0,20	20	1,10	110	2,50	250

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5.4.3 GD 300 with flange

DN (NOMINAL DIAMETER)	M³/H					
	ORIFICE 13		ORIFICE 15		ORIFICE 17	
	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}
50	0,20	20	1,10	110	2,50	250
65	0,90	90	1,70	170	4,50	450
80	1,40	140	4,50	450	8,00	800

DN (NOMINAL DIAMETER)	M³/H					
	ORIFICE 25		ORIFICE 27		ORIFICE 30	
	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}	Q_{MIN}	Q_{MAX}
100	2,70	270	6,50	650	10,00	1000
125	4,00	400	8,00	800	15,00	1500
150	6,00	600	12,00	1200	30,00	3000
200	12,00	1200	25,00	2500	60,00	6000
250	20,00	2000	40,00	4000	75,00	7500
300	30,00	3000	50,00	5000	113,00	11300
350	40,00	4000	70,00	7000	140,00	14000
400	50,00	5000	100,00	10000	160,00	16000

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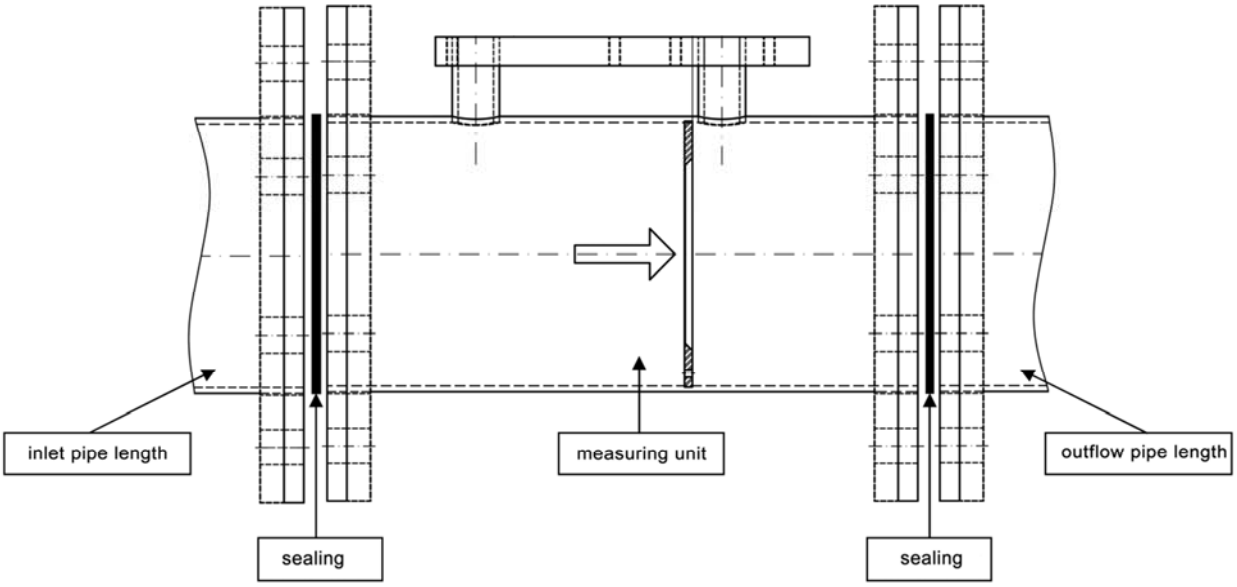
5.5 Installation instructions

5.5.1 GD 300 with flange



Please observe the specifications of the plant manufacturer/operator during the installation. Compliance with the special safety regulations concerning the media used in the pipe system is mandatory.
Unless otherwise specified by the plant manufacturer or authorized personnel, the following rules have to be considered when mounting the GD 300 into the existing pipe system:

In compliance with the installation instructions the flowmeter may be installed at any location within the pipeline.

1. The GD 300 must be installed coplanar and centred between the pipelines.

2. Sealing gaskets must be placed between the flat surfaces of the flowmeter and the counter flange.

Important:

The GD 300 and the sealing gaskets between the GD 300 and the pipeline must be centred. This guarantees optimal measurement results. Please ensure that parts of the sealing ring do not extend into the pipeline. This prevents an imbalanced flow profile.

3. Properly fitting screws must be inserted into the bore holes.

4. The thread bolts have to be lightly greased. For measurements of oxygen or similar gases, a lubricant, which is approved for these gases, has to be used!

5. The nuts have to be tightened in a criss-cross pattern according to the following diagram. Please observe the selected torques!

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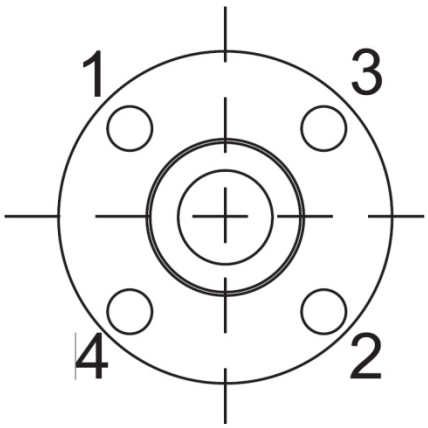
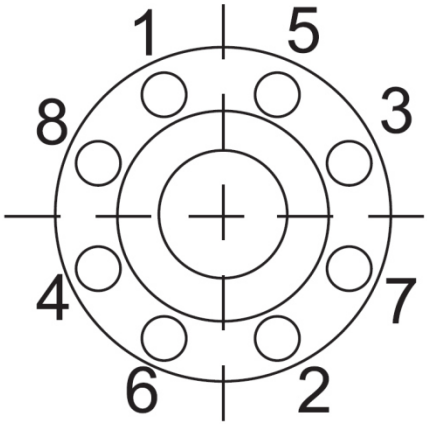
Important:

The bolting torques also depend on temperature, pressure, bolt material and the type of sealing gasket used. Compliance with the applicable rules and regulations is mandatory.
When tightening the bolts, applying 50 % of the maximum torque during the first step is recommended, then the same procedure with 80 % of the max. torque and finally with the maximum allowable torque. The maximum torque must not be exceeded.





Important:

All flange bolts and nuts must be secured to prevent them from loosening. This especially is recommended when vibrations in the pipeline are likely. Pipe vibrations generally should be prevented by bracing/dampers.

Once the GD 300 has been installed, the system should be checked for leaks. Please be advised that **noncompliance with performing a gas tightness inspection** may cause gas leaks leading to an explosion risk and personal endangerment.

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5.5.1.1 Tightening torques

Tightening torques steel screws (regular thread)

Pre-stressed forces and tightening torques for steel shaft screws with head contact dimensions acc. to DIN 912, 931, 933, 934 / ISO 4762, 4014, 4017, 4032 ...*

In the table values accounted for is:
- coefficient friction μ = 0,14*
- utilization of the minimum yield point = 90 %
- torsional moment on tightening (* a friction coefficient of μ = 0,14 is assumed for commercial delivery execution)

*Additional lubrication of threads changes the friction coefficient considerably and leads to unspecified tightening torques! In the following example a friction coefficient of μ = 0,14 is used. Depending on tightening method and tools different friction coefficients and scatterings may occur. All figures are non-binding values for guidance.

table 19: regular thread (tightening torques for steel screws) standard taper

dimension		stress cross section in As/mm²	pre-stressed force F_V (N)					tightening torque M_A (Nm)				
	P**		4.6	5.6	8.8	10.9	12.9	4.6	5.6	8.8	10.9	12.9
M 4	0,7	8,78	1280	1710	4300	6300	7400	1,02	1,37	3,3	4,8	5,6
M 5	0,8	14,2	2100	2790	7000	10300	12000	2	2,7	6,5	9,5	11,2
M 6	1	20,1	2960	3940	9900	14500	17000	3,5	4,6	11,3	16,5	19,3
M 8	1,25	36,6	5420	7230	18100	26600	31100	8,4	11	27,3	40,1	46,9
M 10	1,5	58	8640	11500	28800	42200	49400	17	22	54	79	93
M 12	1,75	84,3	12600	16800	41900	61500	72000	29	39	93	137	160
M 14	2	115	17300	23100	57500	84400	98800	46	62	148	218	255
M 16	2	157	23800	31700	78800	115700	135400	71	95	230	338	395
M 18	2,5	193	28900	38600	99000	141000	165000	97	130	329	469	549
M 20	2,5	245	37200	49600	127000	181000	212000	138	184	464	661	773
M 22	2,5	303	46500	62000	158000	225000	264000	180	250	634	904	1 057
M 24	3	353	53600	71400	183000	260000	305000	235	315	798	1136	1 329
M 27	3	459	70600	94100	240000	342000	400000	350	470	1176	1 674	1 959
M 30	3,5	561	85700	114500	292000	416000	487000	475	635	1597	2274	2662
M 33	3,5	694	107000	142500	363000	517000	605000	645	865	2161	3078	3601
M 36	4	817	125500	167500	427000	608000	711000	1080	1440	2778	3957	4631
M 39	4	976	151000	201000	512000	729000	853000	1330	1780	3597	5123	599

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Tightening torques steel screws (fine thread)

table 20: fine thread (tightening torques for steel screws)

dimension x P	stress cross section in As/mm²	pre-stressed force Fv (N)						tightening torque MA (Nm)		
		8.8		10.9		12.9		8.8	10.9	12.9
M 8 x 1	39,2	19	700	28	900	33	900	29,2	42,8	50,1
M 10 x 1,25	61,2	30	800	45	200	52	900	57	83	98
M 12 x 1,25	92,1	46	800	68	700	80	400	101	149	174
M 12 x 1,5	88,1	44	300	65	100	76	200	97	143	167
M 14 x 1,5	125	63	200	92	900	108	700	159	234	274
M 16 x 1,5	167	85	500	125	500	146	900	244	359	420
M 18 x 1,5	216	115	0	163	0	191	0	368	523	613
M 20 x 1,5	272	144	0	206	0	241	0	511	728	852
M 22 x 1,5	333	178	0	253	0	296	0	692	985	1 153
M 24 x 2	384	204	0	290	0	339	0	865	1 232	1 442
M 27 x 2	496	264	0	375	0	439	0	262	1 797	2 103
M 30 x 2	621	331	0	472	0	552	0	756	2 502	2 927

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Tightening torques for HV-connection

Pre-stressed forces and tightening torques for HV-connections acc. to DIN 6914/7999/6915-10.9/10.

The execution of HV-connections is described in DIN 18800-7 (in the future: EN V 1090). HV-screws DIN 6914 may only be used in conjunction with hexagon nuts acc. to DIN 6915 and HV-washers acc. to DIN 6916, 6917 or 6918.

Galvanized HV-connections have to be treated with lubricant – in Germany the screws are usually delivered pre-lubricated. Additional treatments change the tightening torque – matching values need to be determined in this case!

Assembly procedures:

For the required pre-stressed force HV-screw-sets have to be adjusted acc. to table 21, column 2. For the tensioning process- generally achieved by screwing the nut – the following procedures can be used:

- **Torque-method**
  To achieve the pre-stressed force FV acc. table 21, column 2 the tightening torques MA acc. To column 3 or 4 in table 21 have to be applied in conjunction with the surface condition. This procedure enables a phasing pre-stressing of connections with many screws as well as a retightening of the srew to compensate for pre-load loss after a few days.
- **Angular momentum-method**
  The required pre-stressed force is achieved by angular momentums. To achieve the pre-stressed force FV acc. table 21, column 2 suitable measurement devices have to be used to program the impulse or impact-driver with a 10% higher pre-stressed force acc. to table 21, column 5.
- **Torque- angle tightening method**
  Usage of this method requires a relatively flat surface of the parts to be connected in the region of the screw even before pre-loading. The initial pre-stressing is achieved by a tightening torque MVA, DW and further tightening of the bolt by a defined amount. This amount has to ensure the tightening torque FV in table 21, column 2 is achieved. The required torque-angle is to be determined by a test on the original screwing (e.g. measurement of bolt extension).
- **Combined torque-tightening method**
  First the initial pre-stressed force MVA, KV in conjunction with the surface condition is to be achieved acc. to table 21, columns 7 or 8. After achieving a largely flat contact of the parts to be connected, further tighten the nut to achieve final pre-stressed force.

Important note:

Assembly tools (e.g. drive sockets/socket wrenches) can destroy the anti-corrosion coating on washes and work pieces! Use a depth limiter in the socket wrench (hard rubber or plastic ring).

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table 21: pre-stressed forces and tightening torques per method:

		torque-method		**angular momentum-method**	**torque-angle tightening method**	**combined torque-tightening method**	
dimension	Regular pre-stressed force F_V	tightening torque M_A to achieve regular pre-stressed-force F_V		tightening torque K_V,D_I** to achieve regular pre-stressed-force F_V	tightening torque M_{VA},D_W*	tightening torque M_{VA},K_V	
measured in	kN	Nm		kN	Nm	Nm	
		surface condition					
		galvanized and lubricated*	as manufactured and lightly oiled	As in column 3 or 4**	as in column 3 or 4**	galvanized and lubricated*	as manufactured and lightly oiled
M 12	50	100	120	60	10	75	90
M 16	100	250	350	110	50	190	260
M 20	160	450	600	175	50	340	450
M 22	190	650	900	210	100	490	680
M 24	220	800	1100	240	100	600	825
M 27	290	1250	1650	320	200	940	1240
M 30	350	1650	2200	390	200	1240	1650
M 36	510	2800	3800	560	200	2100	
M 39	610	3500	via				
M 42	710	4500	testing				
M 45	820	5500					
M 48	930	6500					

* nuts with molybdenum disulfide or equal lubricant
** regardless of the lubrication of the thread and the bearing surface of the nut and bolt

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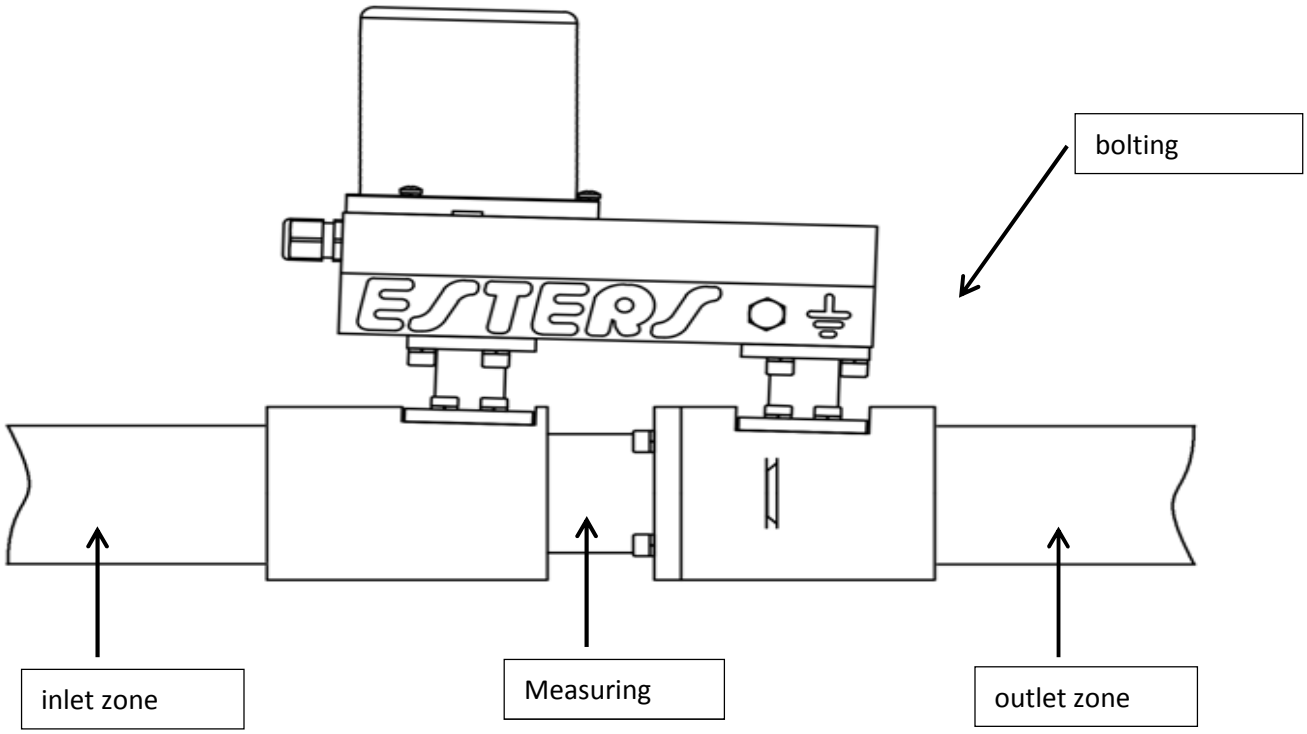
5.5.2 GD 300 with internal pipe-thread



The flowmeter GD 300 with internal thread has a straight screw thread fastening acc. to DIN 2999-1 and DIN 3858 for in the thread sealing connections.

Please note:

This is a cylindrical Whitworth internal thread that guarantees a sealing within the pipe connection by means of a close tolerance combined with an R external thread.

Application: all pipe joints sealing in the thread

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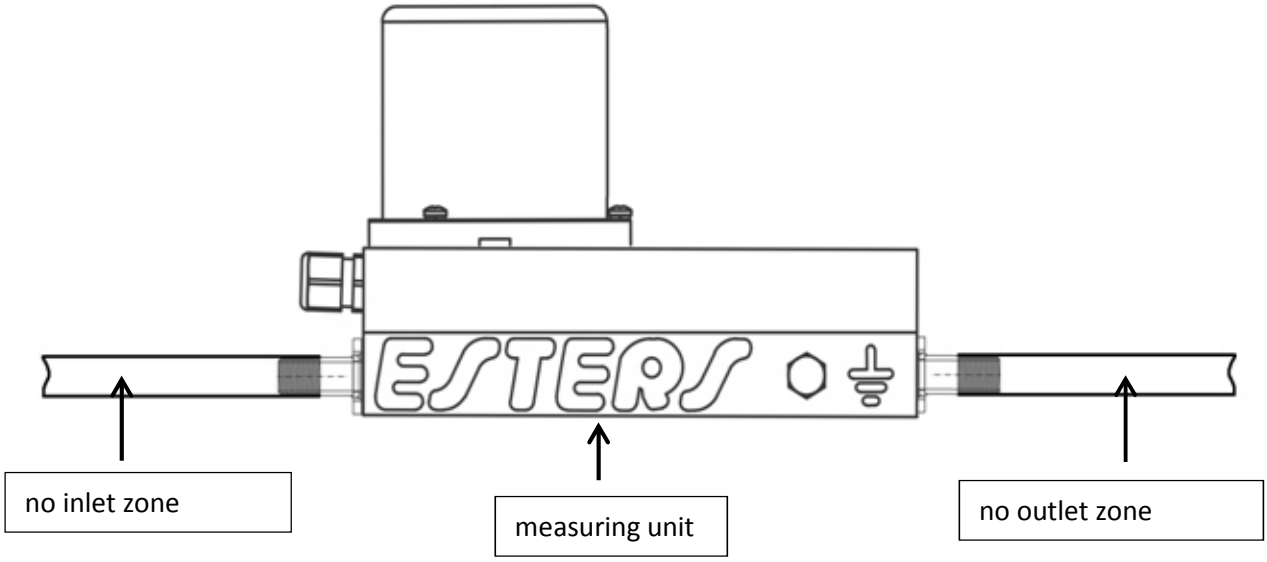
5.6 GD 500 with external thread



External thread R ½“:

The flowmeter GD 500 alternatively is available with an R ½“ external thread acc. to DIN 2999/DIN ISO 7/1. This is a tapered external Whitworth thread, which is cut conically in a ratio of 1:16 on the tube. Combined with the corresponding Rp internal thread, this results in a sealing in the thread of the pipe joint. The sealing effect is achieved by stranding the inner and outer thread.

Application: all in the thread sealing pipe joints

External thread G 1“:

The flowmeter GD 500 alternatively is available with a G 1“ external thread acc. to DIN ISO 228/1. This is a cylindrical external and internal thread. In this pipe joint there is no sealing connection in the thread. Pressure tightness is only achieved by pressing together the two sealing surfaces outside of the thread.

Application: for static and mechanical connections of fittings, plugs, valves, accessories, etc

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Hafenrandstr. 14 · D-63741 Aschaffenburg
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Internet: http://www.esters.de

6 Equipment description

MECHANICAL SPECIFICATION:		
	GD 300	GD 500
NOMINAL DIAMETER:	DN 25 to DN 400	DN 15, DN 25
PROCESS CONNECTION:	DN 50 to DN 400: flange acc. to EN-1092-2 bolt circle diameter: PN 16 up to DN 150 PN 16 or PN 10 from DN 150 DN 50 to DN 400: flange according to ASME B 16.5 DN 25 to DN 50: internal pipe tread Rp 1”, Rp 1 1/4”, Rp 1 1/2”, Rp 2”	external pipe thread R ½“, G 1“
PRESSURE RANGE:	0.5 bar; 10 bar; 16 bar; 40 bar, 63 bar	0.5 bar; 10 bar; 16 bar; 40 bar, 63 bar
TEMPERATURE:	-20°C to +80°C gas temperature and -20°C to +45°C ambient temperature High temperature version without ATEX on request	-20°C to +80°C gas temperature and -20°C to +45°C ambient temperature High temperature version without ATEX on request
MATERIALS:	measurement housing: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum orifice: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum labyrinth: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum sensor: platinum sealing: o-ring FKM 80 protection class: IP65	measurement housing: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum orifice: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum labyrinth: stainless steel 1.4571 (V4A); stainless steel 1.4301 (V2A); aluminum sensor: platinum sealing: o-ring FKM 80 protection class: IP65
The electrical cover on the measurement housing is made out of aluminum. Alternative materials are available on request.		

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The following tables contain electrical specifications and options which are identical for GD 300/GD 500:

ELECTRICAL SPECIFICATIONS:	
OPERATING VOLTAGE [V]	24 V, DC short-circuit-resistant, reverse polarity protection
POWER INPUT (MA)	Max. 100 mA
CERTIFICATION	ATEX as of 07/2013
cable length	max. 300 m
ELECTROMAGNETIC COMPATIBILITY	acc. to EN61326-1 EN61326-2-3 industrial environment
CONNECTION	Wago Serie 136 (ATEX)

OUTPUT:	
PULSE OUTPUT NATIVE	
measurement output	Pulse 24 V, DC
measuring rate	max. 200 Hz
CURRENT OUTPUT 04-20 MA	
measurement output	04 - 20 mA
OPTIONS FLOW IN ACTUAL OR STANDARD CUBIC METERS	
PULSE OUTPUT WITH VARIABLE PULSE WEIGHT	
measurement output	Pulse 24 V, DC
measuring rate	max. 200 Hz
pulse weight	1Pulse = 0,0001;0,001;0,01;0,1;1;10 or 100 Bm^3/Nm^3
CURRENT OUTPUT 04-20 MA	
measurement output	04 - 20 mA
STATUS OUTPUT	
OUTPUT	24V DC
ONLY FOR VERSIONS WITH STANDARDISATION	
standard	DIN 1343, DIN 6358, DIN ISO 2533, DIN 102/ISO 1-1975
fixed value temperature	-50 °C to 400°C
fixed value relative pressure	-0,5 bar to 100 bar
fixed value barometric/hydrostatic pressure	-0,8 bar to 1,2 bar

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OPTIONAL:	
ADDITIONAL SENSORS	integrated pressure and temperature sensors: P1: pressure: -50 ...+200 mbar, temperature: -50 to +150 °C P2: pressure: -0 ... +30 bar, temperature: -50 to +150 °C
REDUNDANT VERSION	redundant sensors in measuring head: R1: redundant platinum sensor R2: redundant platinum, pressure and temperature sensor
PRESSURE LEVEL	depending on version

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7 Electrical installation

7.1 HB 300 - Electrical installation

7.1.1 General notes

Follow the rules and regulations for construction and operation of low-voltage switchgear in accordance with DIN 41 488 part 2.

Intrinsically safe circuit

From the requirements of the ATEX directives, there need to be made special arrangements made in view of the circuit design and assembly of the HB 300. The GD 300/GD 500 is an intrinsically safe device, guaranteed by the HB 300. Safe operation is ensured only by adhering to the operating instructions and the EC type examination certificate. **The potted area of the HB 300 must not be opened and no changes must be made!**

7.1.2 Connecting to the power supply

7.1.2.1 Preparing the connection

Follow the safety instructions

Always observe the following safety instructions:

- connect only in switched-off state
- install overvoltage protection in case of overvoltage or voltage peaks

7.1.2.2 Connection steps

Power supply

Before commissioning, ensure that the power supply matches the specifications on the identification plate.

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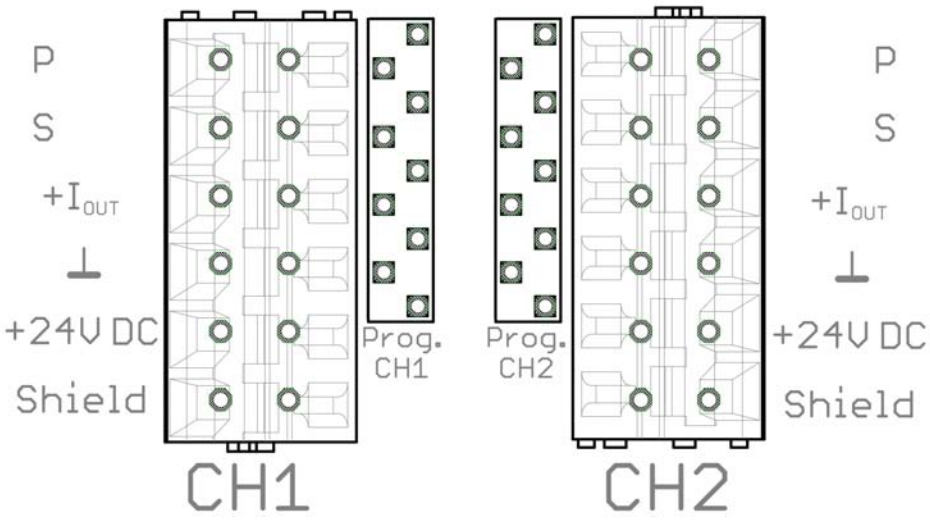
7.1.3 Connection diagram



	STANDARD	
	TERMINAL ASSIGNMENT	**DESCRIPTION**
CH1	**P**	pulse output (depending on version: native with def. liter/pulse, or alternatively with actual or standard cubic meters with variable pulse weight 1 pulse = 0,01L;0,1L;1L;10L;100L
	S	status info
	+IOUT	04-20 mA output
	⊥	ground
	+24V DC	24 V, DC power supply
	SHIELD	shield
	REDUNDANT VERSION	
	TERMINAL ASSIGNMENT	**DESCRIPTION**
CH2	**P**	pulse output (depending on version: native with def. liter/pulse, or alternatively with actual or standard cubic meters with variable pulse weight 1 pulse = 0,01L;0,1L;1L;10L;100L
	S	status info
	+IOUT	04-20 mA output
	⊥	ground
	+24V DC	24 V, DC power supply
	SHIELD	shield

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Programming sockets CH1/CH2:

Programming is not allowed in zone 0 or 1. If the measuring device is already installed, it must be removed from zone 0 or 1 before programming! It must be ensured under all circumstances, that no danger exists. Programming of the two sockets CH1 and CH2 is only allowd for authorized and ATEX trained staff.

7.1.4 Error codes/status info

CODE INDEX	ERROR TYPE
0	no error
1	sensor broken
2	channels asyncronous
3	pulse overrange
4	mA overrange
5	load too high

In case of error the following code periodically occurs according to the weight of the code index: 500 ms on (24V+) 500 ms off (0V). After completion of the sequence there is a pause of 5 seconds. The code is repeated as long as the error is valid.

7.1.5 Special treatment of sensor

Please note that the sensor is sold in conjunction with the GD 300/GD 500. Special safety precautions must be taken into account, since the sensor imay have contact with an explosive medium.

Ensure the HB 300 is disconnected from the power supply. Only then a connection can be made acc. to table 7.1.3. It has to be ensured, that the risk of hazard is minimized. Please refer to the rules of the plant operator and plant manufacturer.

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7.1.6 Safety instructions:

After the power has been disconnected only authorised personnel is permitted to connect the electrical system in compliance with the wiring diagrams.
Please adhere to all instructions when connecting the electrical system otherwise the protection class may
be affected.
The measuring system must be grounded according to the respective requirements.

The electrical connection for in the U.S. and Canada approved equipment must comply with the electrical standards!

USA: Connection of in the USA approved devices must comply with the "National Electrical Code“ (NEC).

Canada: Connection of in Canada approved devices must comply with the "Canadian Electrical Code“ (CEC).

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7.2 Ground connection

Important:

The GD 300 must be integrated into the lightning protection concept of the operator's electrical system:

- Pipelines and other system components with a conductive connection must be installed in a way that they do not build up electrical potential difference against ground, as this may lead to ignitable sparks, hazardous corrosion or may endanger personal.
- Connections, junctions and separations in grounding wires must be secured in order to prevent accidental loosening. Separations should be easily accessible and installed above ground, if possible.
- Pipelines and other system components with a conductive connection must not be used as the only grounding contact for electrical systems.
- Based on the local conditions, system components may be electrically separated or integrated into the grounding method of the entire system.

Please note the following symbol on the measurement head: ⏚
According to the specifications above, the grounding wire has to be connected here.
Being connected correctly, the construction of the flowmeter guarantees a complete protective grounding.

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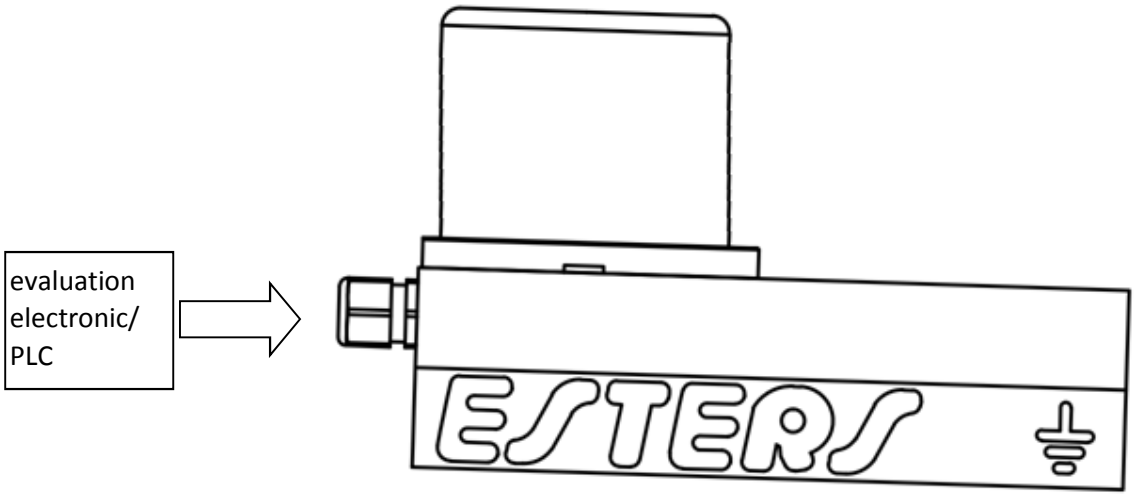
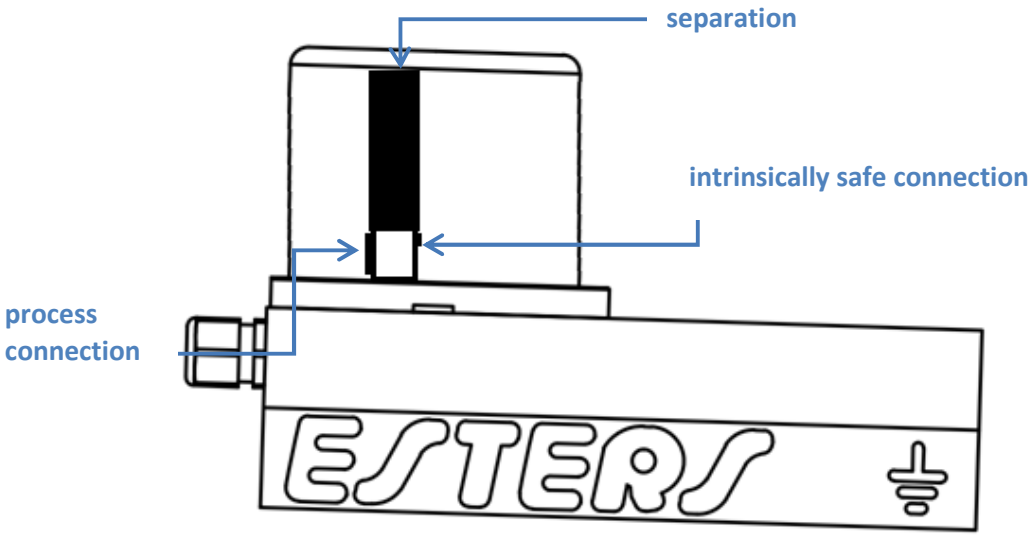
7.3 Connection GD 300/GD 500 ATEX

The GD 300/GD 500 features a 6-pin or 12-pin process connection, depending on version (standard/redundant). In the standard version the cover is equipped with a cable connection and a blank plug. In the redundant version two cable connections are available.



scheme:



- The sensor is connected in the intrinsically safe connection area. Depending on the version (standard/redundant) the 2-pin connection terminal is executed single or double. The terminals are polarity protected. The electrical connection is only allowed in switched off state.
- The separation of the intrinsically safe circuit part inside the HB 300 is realized by a Zener safety barrier, which in addition by the encapsulation type (mb) according to EN60079-18 is separated from the process connection.

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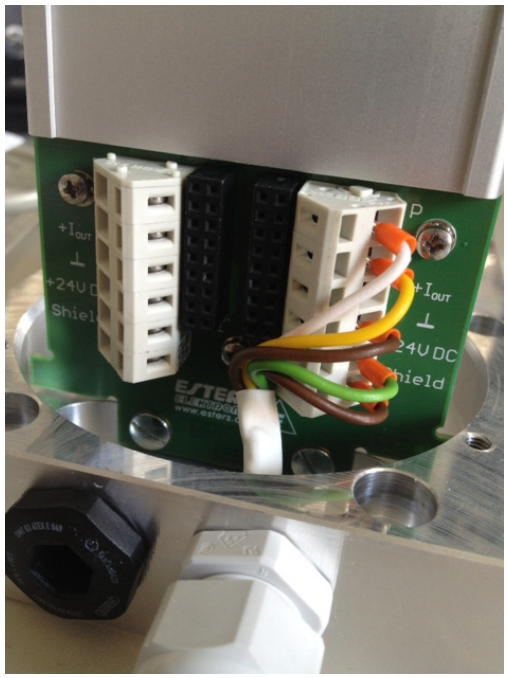
- On the process connection, you can – depending on the desired signal interface - connect the cables according to connection diagram 7.3. For this, use a suitable cable with an outer diameter between 6-8 mm. Only by using this diameter a proper sealing can be ensured.
- On the cable end towards the process connection the insulation may be removed on max. 60 mm length. The wire ends have to be equipped with proper ferrule sleeves. The shielding must be soldered to a wire and then be equipped with a proper ferrule sleeve as well.
- Insert the incoming cable in a loop around the process connection and contact the individual wirings according to diagram 7.3.
- After inserting the cable the cable connection has to be secured.

Please note the following picture:



It is essential to ensure that supplied cables may be routed freely without securing them for a maximum of 300 mm after the cable glands. If you need to cover longer distances freely use cable glands with stress relief. You can purchase those from us on request.

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Recommended cables

In potentially explosive areas with ignition protection type “I” – intrinsic safety, the cables must meet the requirements of VDE 0165-1 (DIN EN 60079-14). The sensor is equipped with a special cable LAPPKABEL ÖLFLEX EB CY (blue).

Depending on the application for connecting the signal outputs to a calculation device or the PLC, we recommend the following cables:

Application	Cable type	Cable cross section	Outer diameter
inside (no UV exposure)	UNITRONIC LiYCY order.no. 0034506 or equivalent	6 x 0,34 mm² with shielding made of tinned copper braid	4-8 mm
outdoors (increased UV exposure)	UNITRONIC LiYCY order.no. 0034506 or equivalent UV resistant cable ducts must be used due to increased UV exposure.	6 x 0,34 mm² with shielding made of tinned copper braid	4-8 mm

Application	Cable type	Cable cross section	Outer diameter
inside (no UV exposure)	UNITRONIC LiYCY order.no. 0034604 or equivalent	4 x 0,5 mm² with shielding made of tinned copper braid	6-8 mm
outdoors (increased UV exposure)	UNITRONIC LiYCY order.no. 0034604 or equivalent UV resistant cable ducts must be used due to increased UV exposure.	4 x 0,5 mm² with shielding made of tinned copper braid	6-8 mm

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7.4 Evaluation electronics

We also offer comprehensive solutions on how to process and evaluate your measurements. We are convinced that you will find the right solutions in our large range of products.
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Go to http://esters.de/en/index.shtml to find more detailed information.

8 Use

8.1 Technical specifications

The equipment is intended to be used exclusively within the technical limits indicated on the identification plate and as stated in the data sheet.

The following limit values are mandatory:

- The allowable operating pressure (bar) and the permissible temperature of the measuring fluid (°C) must not exceed the pressure/temperature values (p/t ratings).
- The maximum operating temperature must not be exceeded.
- The maximum ambient temperature must not be exceeded.
- The housing protection type must be attended to.

8.2 Permissible measuring media

When measuring gas, the following aspects must be observed:

- Only media, that meet the current state of technology or which are based on the experience of the operator, can ensure, that the for the operation safety required chemical and physical characteristics of the measuring media that have contact to the equipment during operation, do not affect these.
- This applies in particular to media containing chloride. Used in combination with stainless steel, this may cause corrosion damage that is not visible from the outside and may destroy media exposed components. As a result, the media may leak. It is the responsibility of the operator to verify the suitability of those materials.
- Media with unknown characteristics or other abrasive materials may only be used, if the operator can ensure regular and appropriate tests to guarantee the safety of the equipment.
- Compliance with the data provided on the identification plate is mandatory.

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9 Initial operation

9.1 Inspection prior to start-up

Prior to starting the device, the following items must be checked:

- Auxiliary power must be switched off.
- The connecting pins must be assigned according to the wiring diagram.
- The equipment must be connected to the ground.
- Temperature limit values must be observed.

9.2 Initial procedure

Important:

Please note the special instructions concerning the initial operation of explosion-proof equipment. They can be found in section 5.5.1.1. ATEX.

9.2.1 Turning on auxiliary power

Turn on the auxiliary power.

9.2.2 Device settings

The flowmeter does not require any settings. All data necessary for the operation, such as liter/pulse, is indicated on the identification plate or can be found in the calibration report.

9.3 Voltage/power consumption

The switch-on response meets the requirements of draft DIN IEC 65C/155/CDV of June 1996. The average power consumption of the device is 10 mA. If a malfunction occurs, the FDE (Fault Disconnection Electronic) function integrated into the device ensures that the power input cannot exceed 13 mA. The upper range of the current is electronically limited. The supply voltage is 7.5 V, DC. By use in combination with the HB 300 the device is intrinsically safe.

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10 ATEX version

Safety note for EX application:

In hazardous areas, the appropriate regulations, conformity and type approval certificates of the sensors and power supply units must be observed.

In combination with the ATEX version of the HB 300, the GD 300 has the following properties:

CE 0123 Ex II 1/2 G Ex ia / e mb IIC T4 Ga / Gb

TPS 13 ATEX 14689 003

CE	=	conformity mark
0123	=	notified body
II	=	device group
1 / 2 G	=	device category
Ex ia / e	=	type of protection
mb	=	device protection class
II C	=	explosion group
T4	=	temperature class
Ga /Gb	=	equipment protection level EPL

TPS	=	TÜV Product Service
13	=	code of notified body
ATEX	=	atmospheric explosion
14689	=	customer number Esters
003	=	certificate number

Special safety precautions must be taken for the connection of the sensor. Make sure the HB 300 is in switched off state and no leakage of media is possible. Only then a connection may be made according to figure 7.3. In addition, ensure the risk of hazard is minimized. Please refer to the rules of the plant operator and plant manufacturer.

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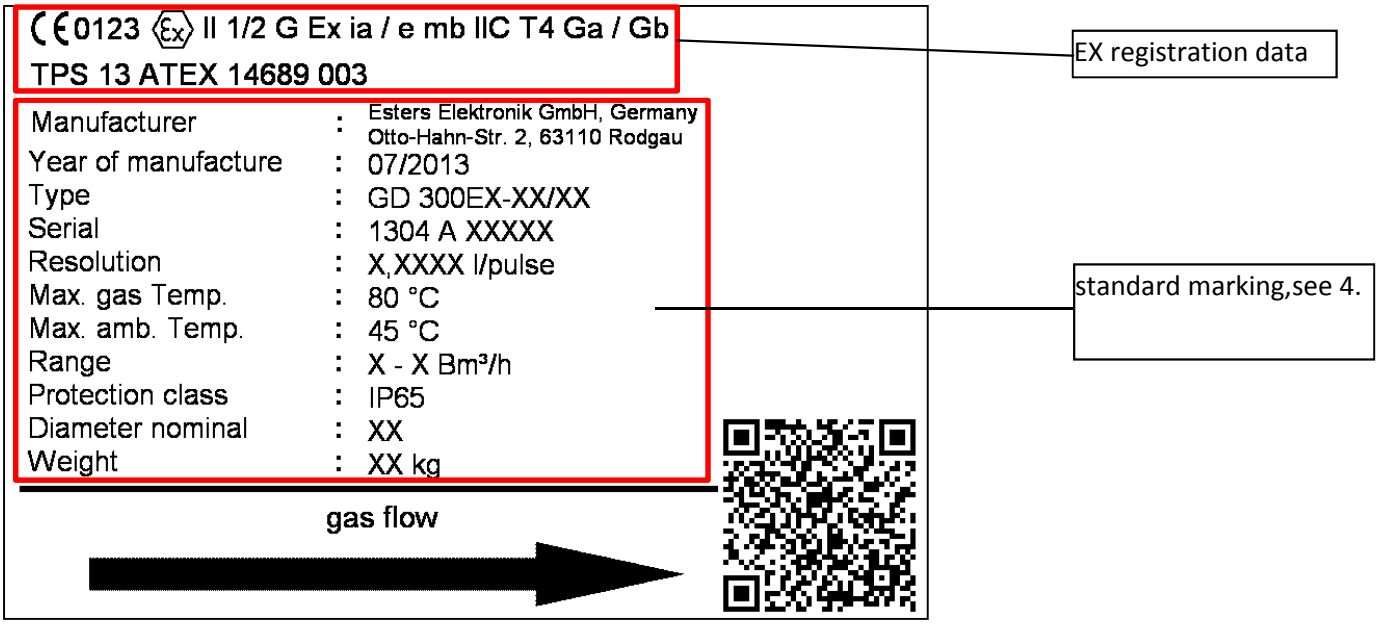
10.1 Identification plate ATEX



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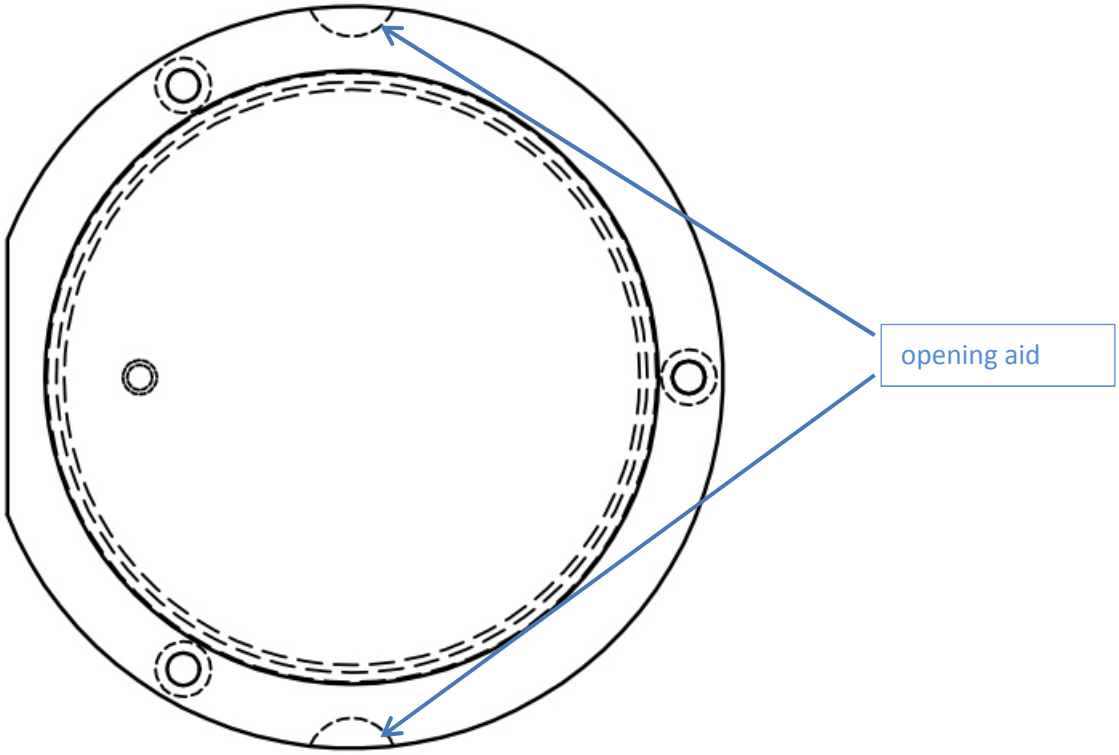
11 Service

11.1 Opening of the flowmeter

Please note that the terminal cover has to be removed before replacing the sensor.

The following diagram shows the cover in plan view:



To open the sensor terminal, the cover has to be lifted up gently at the marking "opening aid" with a suitable tool, e.g. a slotted screwdriver. The cover will come off its seat and can be removed.

Warning

Please note, that the connection terminal may not be damaged in the area of the o-ring and the surrounding metal surfaces. The same applies to the o-ring itself. Damages lead to loss of tightness.

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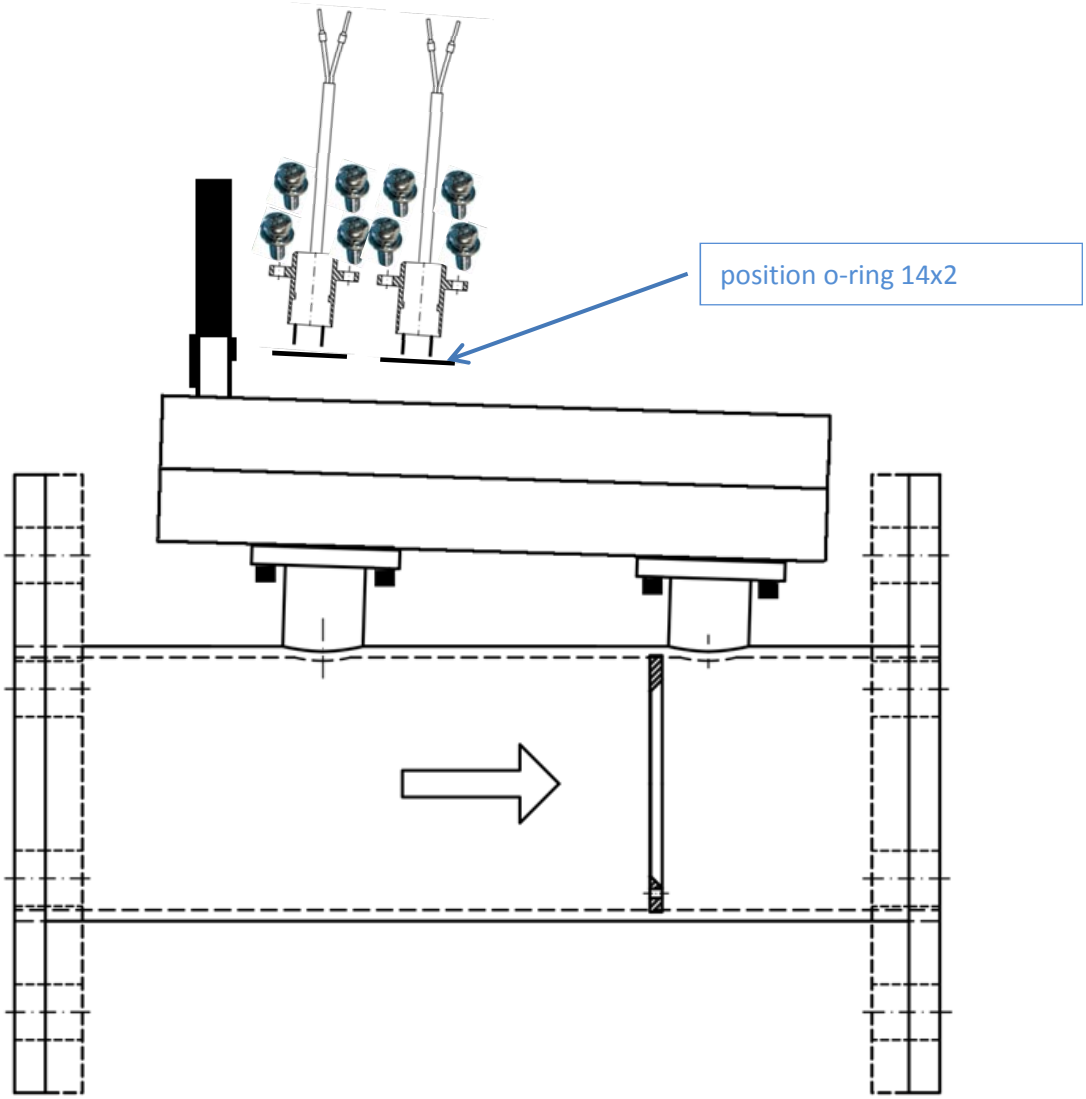
11.2 Removal/installation of the sensor unit



Required components:

- 1 sensor and/or 1 blank plug instead of second sensor
- each sensor/blank plug 1 o-ring FPM80 14x2
- each sensor/ blank plug 4 cylinder head screw with a cross slit V4A M3x10
- each sensor/ blank plug 4 spring washers V4A M3 for cylinder head screw

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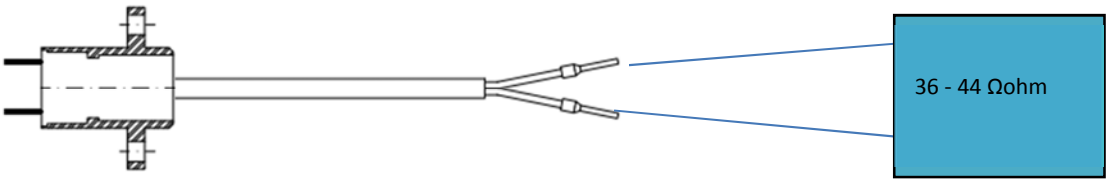
Please note:

Warning

The platinum wire of the sensor can be damaged very easily. It is a platinum wire with a thickness of 15 µm, which is used for the detection of the current. It has to be mounted carefully, so that the wire is not damaged. The sensor must be taken off straight (perpendicular to the sensor center). Being mounted/removed, the sensor pins must NOT touch the metal of the labyrinth lid.

After each installation the function of the sensor has to be checked, using an ohmmeter measuring the resistance between the two pins. The resistance should be 36 – 44 ohm. If a different value is measured, the sensor is damaged and can no longer be used.



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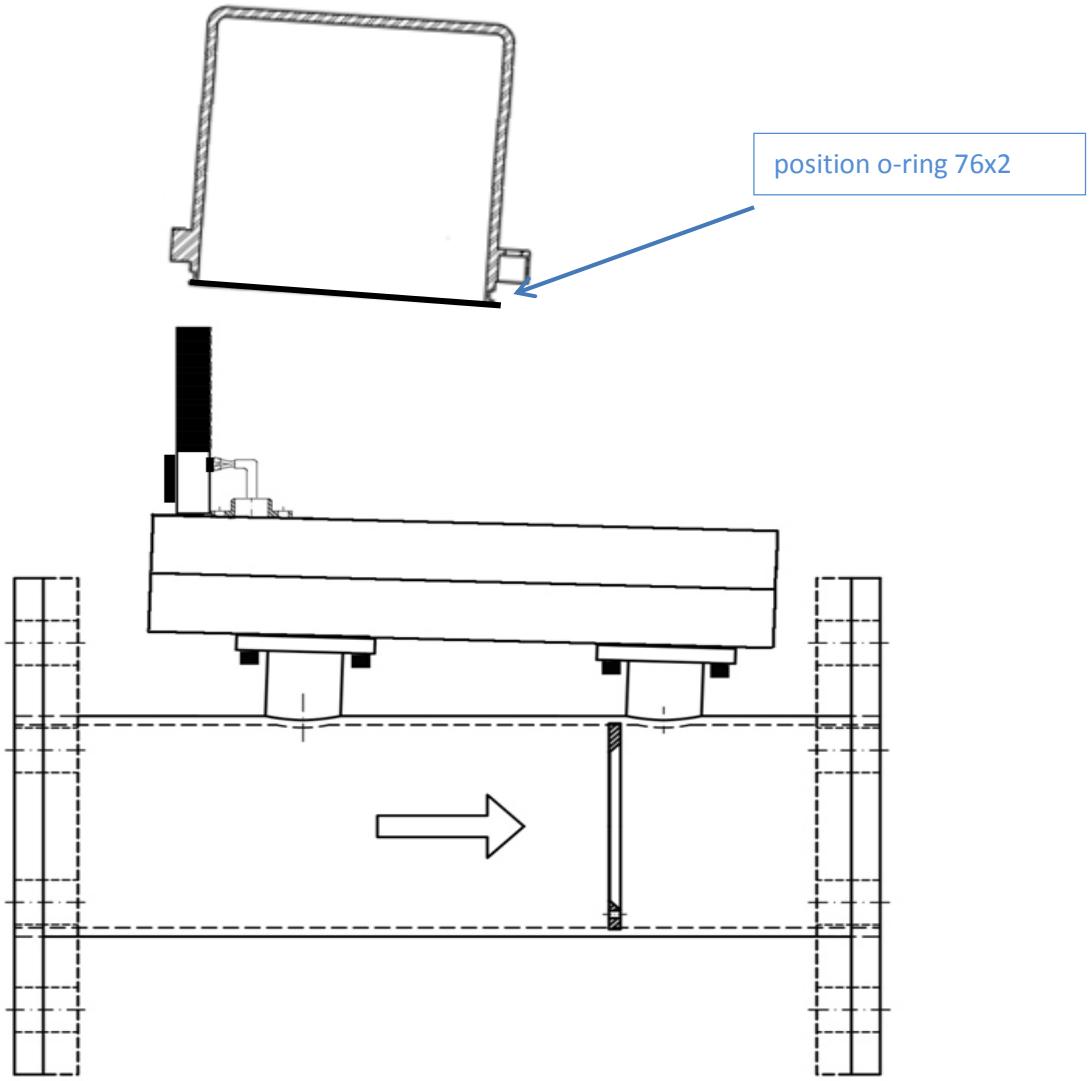
11.3 Mounting of the connection cover



Required components:

- 1 cover
- 1 o-ring FPM80 76x2
- 3 cylinder head screw with a cross slit V4A M4x16
- 3 spring washers V4A M4 for cylinder head screw
- 3 loss washers vulcanized fibre M4

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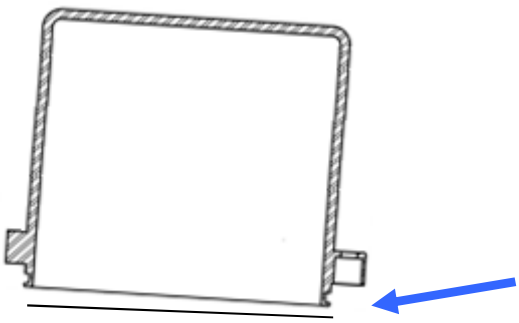
For the tightness of the flowmeter GD 300/GD 500 special o-rings are used. In order to ensure a perfect fit, the o-rings must be treated with a suitable lubricant.

Recommendation: Würth Silicone grease spray, Art.-No. 0893223



Please note:

Aging, temperature and environmental influences can lead to a reduction of the sliding effect of the lubricant. After opening the cover, please check, if it is necessary to lubricate the o-ring. This can be tested as follows: Move over the o-ring with the fingertip with little pressure. If a friction becomes noticeable, the o-ring has to be lubricated again.

The cover can be put back on the flowmeter and be evenly tightened crosswise.

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12 Troubleshooting

12.1 Replacing damaged parts

Damage to the device which affects the pressure safety must only be repaired by authorised technical personnel.
After every repair and maintenance activity, suitable measures must take place. The device must then correspond to the specifications stated in the technical data.

Replace damaged parts immediately. When ordering spare parts, please use the contact information provided in section 2. Warranty.

12.2 Replacing o-rings and seals

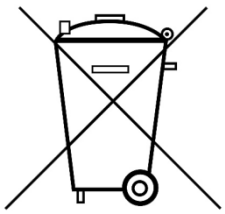
- Always keep the sealing surfaces clean.
- Remove sticky accumulations on a regular basis.
- When leakage occurs, please contact your supplier.

Risk of escaping media!
Only authorised personnel shall be permitted to replace sealing material.

12.3 Returning goods

If repair is needed, please return the unit to the supplier. Only use the original packaging when returning the device.

12.4 Waste disposal



When disposing the device, it must be dismantled and the various materials must be separated. Please comply with your local rules and regulations.
When designing the device, one of the utmost considerations was its environmental compatibility. The measurement units are subject to the European Directive 2002196/EC, which stipulates that electric and electronic equipment must be dismantled and collected separately or may be returned to the supplier for disposal purposes.
Disposing such items as unsorted municipal waste is prohibited.

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Phone: +49 (0)6021 – 45 807 - 0
Fax: +49 (0)6021 – 45 807 - 20
Esters Elektronik GmbH
Hafenrandstr. 14 · D-63741 Aschaffenburg
email: info@esters.de
Internet: http://www.esters.de

Notes

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