



## H250 M40 Supplementary Instructions

Equipment category II 2 G / II 2 D, EPL Gb / Db  
in type of protection Flameproof enclosure Ex d and  
in type of protection Equipment dust-ignition protection through enclosure Ex t



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## 1.1 General notes

This additional instruction applies to explosion-protected versions of variable area flowmeters with electrical built-ins and the marking II 2 G or II 2 D. It completes the standard manual for the non-explosion protected versions.

The information given in this instruction contains only the data relevant to explosion protection of category 2. The technical details given in the standard manual for the non-explosion protected versions remain unchanged unless they will be excluded or replaced by these supplementary instructions.

## 1.2 EU conformity

The manufacturer declares with the EU declaration of conformity on his own responsibility conformity with the protection goals of directive 2014/34/EU for use in hazardous areas.

The EU declaration of conformity is based on the EC type examination certificate of the Physikalisch Technische Bundesanstalt (PTB):

**PTB 12 ATEX 1025**

## 1.3 Approval according to the IECEx scheme

Conformity with IECEx standards was tested in accordance with the "IECEx Certification Scheme for Explosive Atmospheres" according to IEC 60079-0 : 2011, IEC 60079-1 : 2014 and IEC 60079-31 : 2013. The number of the IECEx certificate is:

**IECEx PTB 12.0034**

## 1.4 Safety instructions

If these instructions are not followed, there is a risk of explosion.

Assembly, installation, start-up and maintenance may only be performed by personnel trained in explosion protection!



### **CAUTION!**

*The operator or his agent is responsible for observing any additional standards, directives or laws if required due to operating conditions or place of installation. This applies in particular to the use of easily detachable process connections when measuring flammable media.*

## 2.1 Device description

Variable area flowmeters measure and display the volume flow of flammable and non-flammable gases and liquids. Depending on the device version, electrical limit switch contacts with counter module, Reed contacts, a 4...20 mA signal output with HART® communication, a Foundation Fieldbus interface or a Profibus PA interface can be installed in the indication unit.

## 2.2 Description code

The safety description code consists of the following elements \*:

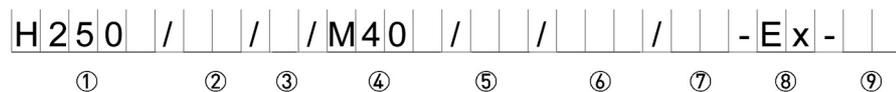


Figure 2-1: Safety description code

- ① Type series of measuring unit H250  
H250 - standard version, vertical upwards  
H250H - horizontal orientation  
H250U - vertical downwards
- ② Measuring unit materials / versions  
RR - Stainless steel  
C - PTFE or PTFE/ceramics  
HC - Hastelloy C  
Ti - Titanium  
F - Food
- ③ Heating jacket version  
blanc - without heating jacket  
B - with heating jacket
- ④ Signal converter version  
M40 - aluminium housing, painted (standard)  
M40S - aluminium housing with increased corrosion protection  
M40R - stainless steel housing
- ⑤ High-temperature version  
blanc - without HT extension  
HT - with HT extension
- ⑥ Electrical signal output  
blanc - without transmitter  
ESK - electrical signal output 4...20 mA (ESK4)  
... - optionally available with counter, I/O module and display (ESK4-T) or  
... - Foundation Fieldbus (ESK4-FF) or  
... - Profibus PA (ESK4-PA)
- ⑦ Limit switches  
blanc - without limit switches  
K1 - one limit switch  
K2 - two limit switches  
R1 - 1 Reed switch  
R2 - 2 Reed switches
- ⑧ Version  
Ex - explosion-protected version
- ⑨ SIL version  
SE - SIL compliant electronic signal output  
SK - SIL compliant limit switch

\* positions which are not needed are omitted (no blank positions)

## 2.3 Marking

The marking of the entire device is on the indication unit, where the following identification plate can be found (refer also to designation code).

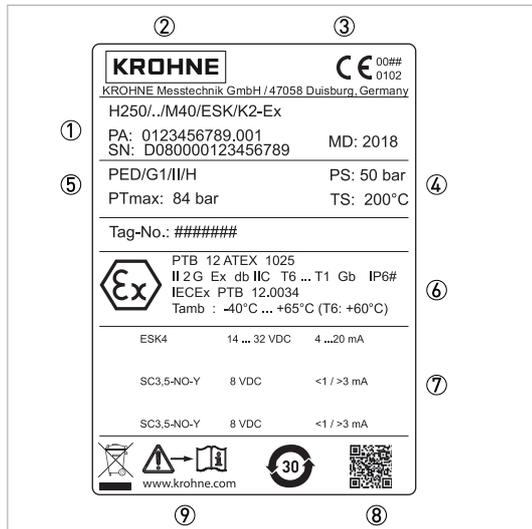


Figure 2-2: Example of a nameplate

- ① Device designation
- ② Manufacturer and manufacturer address
- ③ Identification number of the notified body ATEX & PED
- ④ Rating data: temperature & pressure rating
- ⑤ PED data
- ⑥ Ex data
- ⑦ Electrical connection data
- ⑧ Data matrix code
- ⑨ Note to observe the documentation and for disposal

### Additional markings on the housing cover

- SN - serial number
- SO - sales order / item
- PA - order
- Vxxx / Sxxx - product configurator code
- AC - article code

### Additional plate

The association of the housing cover to the device is confirmed by an additional plate with the serial number on the interior of the indicator part.

## 2.4 Flammable products

### Atmospheric conditions:

The ATEX directive does not stipulate values for atmospheric conditions. However, for determining the explosion characteristic parameters of temperature and pressure range, the following is assumed as a basis:

$T_{\text{atm}} = -20\dots+60^{\circ}\text{C} / -4\dots+140^{\circ}\text{F}$  and  $P_{\text{atm}} = 0.8\dots1.1 \text{ bar} / 11.6\dots15.9 \text{ psi}$

Outside of these ranges, for most mixtures no key figures are available for the ignition behaviour.

### Operating conditions:

Variable area flowmeters operate outside of atmospheric conditions, which means that explosion protection according to the ATEX directive, regardless of the zone assignment, is fundamentally not applicable due to the lack of key safety data for the interior of the measuring unit.



### WARNING!

*Operation with flammable products is only permitted as long as no explosive fuel/air mixture builds up on the inside of the flowmeter under operating conditions. The operator is responsible to ensure that the flowmeter is operated safely in terms of the temperature and pressure of the products used. In case of operation with flammable products the measuring units must be included in the periodic pressure tests of the system. When using the device version H250/C... (PTFE version, non-conductive) the minimum conductivity of the media must be  $10^{-8} \text{ S/m}$ , in order to avoid danger from electrostatic charge.*

## 2.5 Equipment category

Variable area flowmeters are designed in accordance with EN 60079-0 : 2012 + A11 : 2013, EN 60079-1 : 2014 and EN 60079-31 : 2014 in category II 2 G / II 2 D or EPL Gb and EPL Db for use in zone 1 or zone 21.

The inside of the measuring unit is also approved for zone 1.



### INFORMATION!

*Definition of zone 1 according to EN 1127-1, Appendix B:*

*An area in which an explosive atmosphere, as a result of the mixture of flammable substances in the form of gas, steam or mist with air, under normal operation may occasionally occur.*

*Definition of zone 21 according to EN 1127-1, Appendix B:*

*An area in which an explosive atmosphere may occasionally occur in the form of a cloud of flammable dust in the air under normal operation.*

## 2.6 Types of protection

The variable area flowmeter is designed for equipment protection "flameproof enclosure", protection level "Gb" according to EN 60079-1 and "Equipment - dust ignition protection through enclosure", protection level "Db" according to EN 60079-31.

### Marking according to

ATEX

**II 2G Ex db IIC T6...T1 Gb or  
II 2D Ex tb IIIC T70°C...T300°C Db**

IECEX

**Ex db IIC T6...T1 Gb or  
Ex tb IIIC T70°C...T300°C Db**

<b>The marking contains the following information:</b>	
<b>II</b>	Explosion protection, group II
<b>2</b>	Equipment category 2
<b>G</b>	Gas explosion protection
<b>D</b>	Dust ignition protection
<b>Ex d</b>	Protection type "Flameproof enclosure"
<b>Ex t</b>	Protection type "Equipment - dust ignition protection through enclosure"
<b>IIC</b>	Gas group, suitable for gas groups IIC, IIB and IIA
<b>IIIC</b>	Dust areas, suitable for groups IIIC, IIIB and IIIA
<b>T6...T1</b>	Temperature class, suitable for temperature classes T6...T1
<b>T70°C...T300°C</b>	Maximum surface temperature of the flow sensor housing without dust coating at ambient temperature 65°C / 149°F (is determined by the product temperature)
<b>Gb</b>	EPL, suitable for zone 1
<b>Db</b>	EPL, suitable for zone 21

## 2.7 Ambient temperature / temperature classes

Due to the influence of the product temperature, variable area flowmeters with built-in electrical equipment (electric variants) are not assigned to any fixed temperature class. In fact, the temperature class of these devices is a function of the present product temperature and ambient temperature. The classification is outlined in the following tables.

The tables take into account the following parameters:

- Maximum value  $P_i$
- Ambient temperature  $T_{amb}$
- Product temperature  $T_m$
- Nominal size DN
- Standard or high temperature version (HT)
- Standard or heating jacket version
- Heat resistance of the connecting cable



### **INFORMATION!**

*The maximum permissible product temperatures listed in the tables are valid under the following conditions:*

- *The measuring device is installed and operated in accordance with the manufacturer's installation instructions.*
- *It must be ensured that the flowmeter is not heated by the effects of additional heat radiation (sunshine, neighbouring system components) and thus operated above the permissible ambient temperature range.*
- *Insulation must be limited to the piping. Unobstructed ventilation of the indicator part must be ensured. For this purpose, the variant with a projecting indicator (HT version) is preferable.*
- *For device versions with a heating jacket the temperature of the heating medium does not exceed the maximum permissible product temperature.*



### **INFORMATION!**

*The following conditions must be met for all versions:*

- *Standard connecting cable, temperature resistance min. 70°C / 158°F.*
- *Heat-resistant connecting cable, temperature resistance min. 90°C / 194°F.*

The permitted ambient temperature range is indicated on the nameplate; depending on the device version it is  $T_{amb} = -40...+60^{\circ}\text{C} / -40...+140^{\circ}\text{F}$  or  $T_{amb} = -20...+60^{\circ}\text{C} / -4...+140^{\circ}\text{F}$ .

The minimum product temperature is  $-40^{\circ}\text{C} / -40^{\circ}\text{F}$ .

For certain device versions, lower values apply due to differing boundary conditions (e.g. liner materials). Here the user should consult the technical data sheet. The maximum values stated in the standard manual for non-explosion protected device versions must also not be exceeded for explosion-protected versions.

### Maximum permissible temperatures when using a heat resistant connecting cable

				Maximum permissible product temperature $T_m$ [°C]						
Heating jacket			TK ▶	T6	T5	T4	T3		T2, T1	
without	with	HT version	$T_{amb}$ [°C] ▶	≤ 60	≤ 65	≤ 65	≤ 60	≤ 65	≤ 60	≤ 65
DN15 DN25 DN50	DN15 DN25			85	100	135	200	175	200	175
		x		85	100	135	200	200	300	300
DN80 DN100	DN50 DN80			85	100	130	185	165	185	165
		x		85	100	135	200	200	300	300

				Maximum permissible product temperature $T_m$ [°F]						
Heating jacket			TK ▶	T6	T5	T4	T3		T2, T1	
without	with	HT version	$T_{amb}$ [°F] ▶	≤ 140	≤ 149	≤ 149	≤ 140	≤ 149	≤ 140	≤ 149
DN15 DN25 DN50	DN15 DN25			185	212	275	392	347	392	347
		x		185	212	275	392	392	572	572
DN80 DN100	DN50 DN80			185	212	275	365	329	365	329
		x		185	212	275	392	392	572	572

### Maximum permissible temperatures when using a standard connecting cable

				Maximum permissible product temperature $T_m$ [°C]								
Heating jacket			TK ▶	T6	T5		T4		T3		T2, T1	
without	with	HT version	$T_{amb}$ [°C] ▶	≤ 60	≤ 60	≤ 65	≤ 60	≤ 65	≤ 60	≤ 65	≤ 60	≤ 65
DN15 DN25 DN50	DN15 DN25			85	100	75	105	75	105	75	105	75
		x		85	100	95	135	95	175	95	175	95
DN80 DN100	DN50 DN80			85	90	75	90	75	90	75	90	75
		x		85	100	90	135	90	155	90	155	90

				Maximum permissible product temperature $T_m$ [°F]								
Heating jacket			TK ▶	T6	T5		T4		T3		T2, T1	
without	with	HT version	$T_{amb}$ [°F] ▶	≤ 140	≤ 140	≤ 149	≤ 140	≤ 149	≤ 140	≤ 149	≤ 140	≤ 149
DN15 DN25 DN50	DN15 DN25			185	212	167	221	167	221	167	221	167
		x		185	212	203	275	203	347	203	347	203
DN80 DN100	DN50 DN80			185	194	167	194	167	194	167	194	167
		x		185	212	194	275	194	311	194	311	194

### Reference point observation

The permissible product and ambient temperatures may be exceeded or undershot as long as the permissible temperature range of the reference point of the display is not exceeded. The following table contains the permissible maximum values at the reference point. Note:

- Reference point is the connection of the equipotential bonding conductor of the M40 indicator.
- The temperatures at the reference point are to be determined in the most unfavourable operating situation.
- The required measuring uncertainty is max. 2 K.
- Measuring conditions and results are to be permanently recorded in a suitable format.
- The measuring unit should be insulated properly.

### Maximum permitted temperatures at reference point

			Maximum permitted reference point temperature $T_{Ref}$ [°C]		
Heating jacket		TK ▶	T6...T1	T6	T5...T1
without	with	$T_{Connecting\ cable}$ [°C] ▶	Standard (70°C)	Heat resistant (90°C)	
DN15 DN25 DN50 DN80 DN100	DN15 DN25 DN50 DN80		64	74	84

			Maximum permitted reference point temperature $T_{Ref}$ [°F]		
Heating jacket		TK ▶	T6...T1	T6	T5...T1
without	with	$T_{Connecting\ cable}$ [°F] ▶	Standard (158°F)	Heat resistant (194°F)	
DN15 DN25 DN50 DN80 DN100	DN15 DN25 DN50 DN80		147	165	183

The permitted ambient temperature range is indicated on the nameplate; depending on the device version it is

$$T_{amb} = -40...+60^{\circ}\text{C} / -40...+140^{\circ}\text{F} \text{ or } T_{amb} = -20...+60^{\circ}\text{C} / -4...+140^{\circ}\text{F}.$$



#### **WARNING!**

*The permitted lowest temperature at the reference point must not fall below the lowest limit value of the ambient temperature.*

## 2.8 Surface temperature for equipment category II 2 D

For use in areas with flammable dust it should be noted that the indicated maximum surface temperature of T70°C at an ambient temperature of 65°C / 149°F and a product temperature of 65°C / 149°F is valid without a dust coating. For higher product temperatures the maximum surface temperature is defined by the product.

## 2.9 Electrical data

Electrical equipment	Nominal voltage	Nominal current
Limit switch K1 / K2 OC output	10...30 VDC	≤100 mA
Limit switch K1 / K2 NAMUR output	5...25 VDC	≤1 / ≥3 mA
Reed contacts R1 / R2	0...32 VDC	≤100 mA
Signal output ESK4	14...32 VDC	4...20 mA with HART® communication
Switching output ESK4-T OC output	8...32 VDC	1...100 mA
Switching output ESK4-T NAMUR output	8 VDC	≤1 / ≥3 mA
Signal input ESK4-T input	8...32 VDC	≤2 mA
ESK4-FF Foundation Fieldbus transmitter ①	9...32 VDC	16 mA
ESK4-PA Profibus transmitter ②	9...32 VDC	16 mA

① Further information and instructions for operation of the ESK4-FF transmitter are provided in separate supplementary instructions.

② Further information and instructions for operation of the ESK4-PA Profibus transmitter are provided in separate supplementary instructions.

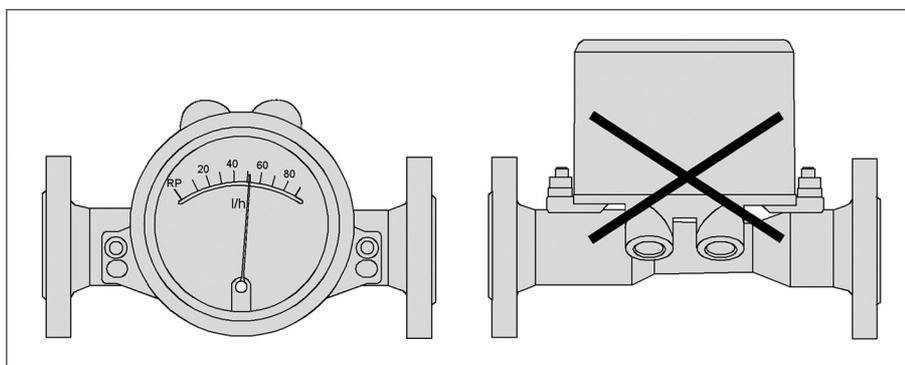
### 3.1 Mounting

Mounting and setup must be carried out according to the applicable installation standards (e.g. EN 60079-14) by qualified personnel trained in explosion protection. The information given in the manual and the supplementary instructions must always be observed.

#### Variable area flowmeters must be installed in such a way that

- no external forces are affecting the indication unit.
- the device is accessible for any necessary visual inspections and can be viewed from all sides.
- the nameplate is clearly visible.
- it can be operated from a location with secure footing.

Take special note of the installation position for the H250/H/... with horizontal flow direction:



In order to comply with thermal parameters and measuring accuracy, flowmeters for horizontal installation are to be installed in the pipeline so that the display is located on the side of the measuring tube. The maximum medium and ambient temperatures indicated as well as the measuring accuracy are based on lateral installation of the display.



#### **CAUTION!**

*The manufacturer is not liable for any damage resulting from improper use or use other than the intended purpose. This applies in particular to hazards due to insufficient corrosion resistance and suitability of the materials in contact with product.*



#### **DANGER!**

##### **Components made of titanium in oxygen applications**

*Variable area flowmeters with titanium components are NOT suitable for use in explosion-protected areas in conjunction with oxygen applications (products with an oxygen content which is significantly above the oxygen content in the earth's atmosphere)!*

## 4.1 General notes

### Rated values for insulation

- The insulation of the H.../.../M40 - Ex variable area flowmeter is rated in compliance with IEC 60664-1. The following rating parameters are taken into account:
- Overvoltage category for signal and instrument loops: II
- Pollution degree of the insulation: 2

### Electronics compartment lock

Lock the dustproof and/or flameproof electronics compartment of the variable area flowmeter during operation. First tighten the cover by hand. Then tighten the cover again by about 90°. The cover for the electronics compartment is secured by means of a lock. Use a WS3 Allen key to turn the screw.

No waiting period is necessary prior to opening the electronics compartment.

### Terminal compartment

The electrical connection for the power supply and I/O functions is made in the electronics compartment of the signal converter. The protection type of the electronics compartment is "d" and/or "t". Unused entries are to be closed in accordance with EN 60079-1 and/or EN 60079-31. The entry of the cables in the electronics compartment is possible in two different ways.

- Direct entry of the connecting cables by way of approved flameproof cable glands (M20x1.5) into the flameproof terminal compartment ( $V \leq 2000 \text{ cm}^3$ ). The cable glands require a separate test certificate in accordance with EN 60079-1. Observe the requirements of the test certificate for the cable glands.
- Direct entry of the connecting cables by way of conduits into the flameproof enclosed terminal compartment of the device. Once the conduit has been screwed in, it must form a flameproof joint with the housing with a minimum thread length of 8 mm / 0.3". A suitable mechanical stopping box must be provided in accordance with installation provisions. The conduit must be installed in compliance with its separate test certificate.
- Direct entry of the connecting cables by way of approved dustproof cable glands (M20x1.5) into the dustproof terminal compartment ( $V \leq 2000 \text{ cm}^3$ ). The cable glands require a separate test certificate in accordance with EN 60079-31. Observe the requirements of the test certificate for the cable glands.

### Connecting cables

The connecting cables should be selected according to the applicable installation standards (e.g. EN 60079-14 / VDE 0165) and the maximum operating temperature.

- The connecting cables must be fixed and laid so they are sufficiently protected against damage.
- Lay cables so as to ensure that there is sufficient distance between surfaces of the measuring unit and the connecting cable.
- Supplied blind plugs / cable entries guarantee protection against foreign objects and water (protection category) IP66/68 according to EN 60529.
- The outer diameter of the connecting cable must be within the sealing range of the cable entry (7...12 mm / 0.27...0.47").
- Unused cable entries are to be closed in accordance with EN 60079-1 and/or EN 60079-31 (>IP66/68).

Ensure that the gaskets and incised gasket ring are tight.



#### **CAUTION!**

*The IP protection category of the signal converter housing is largely determined by the cable gland used and the installation.*

## 4.2 Power supply

The variable area flowmeter does not require a separate power supply. The required supply for the built-in electronics is provided via the 4...20 mA current output or the bus connection.

## 4.3 Inputs/Outputs

The terminal assignment of the built-in electrical equipment is described in the standard documentation. The signal circuits of the variable area flowmeter may only be connected to downstream devices or circuits that satisfy the requirements of protective extra-low voltage (PELV).

### Connecting power supply and I/O functions

- Before connecting or disconnecting the electrical connection cables of the device, make sure that all cables leading to the signal converter are isolated from the ground of the hazardous area. This also applies to protective earth (PE) and equipotential bonding conductors (PA).
- All connecting cable conductors and shields that are not securely connected to the equipotential grounding system of the hazardous area shall be carefully isolated from each other and from ground (test voltage 1500 V<sub>eff</sub> for non-intrinsically safe cables).

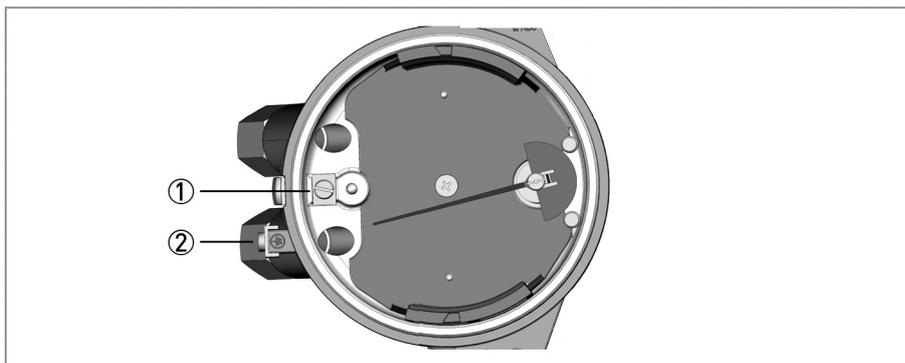
## 4.4 Grounding and equipotential bonding

The signal converter shall be connected to the equipotential bonding system of the hazardous area via the internal or external grounding connection on the signal converter housing. The measuring unit and the signal converter are electrically connected via an equipotential bonding connection.

Any existing cable shields should be connected to ground according to applicable installation regulations (EN 60079-14). A terminal in the terminal compartment permits a short way grounding of the cable shields.

Alternatively, the equipotential bonding of the signal converter can also take place by way of the measuring tube incorporated into the equipotential bonding of the hazardous area.

The measuring tube can be incorporated into the equipotential bonding system of the hazardous area using the U-clamp mounted on the flange if present, or suitable conductive connections (gaskets, etc.).



**Figure 4-1: Grounding connections**

- ① Grounding connection on the indicator
- ② Outer grounding connection

## 5.1 Start-up

**Start-up is only permitted when the variable area flowmeter:**

- is correctly installed in the system and connected.
- has been checked for the proper state with regard to its installation and connection requirements.
- and the electronics compartment have been properly closed (pressure-resistant casing or dustproof housing) and the applicable special lock has been fitted.

The user of the system must have it checked before start-up in compliance with the national regulations for checks before startup.

If the device needs to be configured due to the existence of an explosive atmosphere, this can be done using the supplied bar magnets. There is no need to open the housing as it can be done through the glass window of the electronics compartment or digitally via the signal output (HART<sup>®</sup> interface).

## 5.2 Operation

Variable area flowmeters must be operated in such a way that they remain within the maximum and minimum permissible temperatures and pressures and the electrical limit values.

Variable area flowmeters may only be operated if the equipment parts necessary for safety are effective in the long run, and are not rendered inoperable during operation.

In case of operation with flammable products the measuring units must be included in the periodic pressure tests of the system.

Opening the electronics compartment (protection type "flameproof enclosure" or "dustproof housing") in hazardous areas is only permitted in a de-energised state.



**WARNING!**

*Ignition risks caused by pressure surges, impact or friction must particularly be avoided when titanium measuring units are used.*

## 5.3 Electrostatic charge

**In order to avoid ignition hazards due to electrostatic charge, variable area flowmeters may not be used in areas with:**

- processes that generate strong charges,
- mechanical friction and cutting processes,
- spraying of electrons (e.g. in the vicinity of electrostatic painting systems) or
- pneumatically conveyed dust is exposed.



**WARNING!**

*Electrostatic charging of the housing surface by friction must be avoided. The devices must not be dry cleaned.*

## 6.1 Maintenance

Maintenance work of a safety-relevant nature within the meaning of explosion protection may only be carried out by the manufacturer, his authorised representative or under the supervision of authorised inspectors.

For systems in hazardous areas, regular tests are required in order to maintain the proper condition.

### The following checks are recommended:

- Check the housing, the cable entries and the feed lines for corrosion and/or damage.
- Checking the measuring unit and the piping connections for leakage.
- Check the measuring unit and the indicator for dust deposits.
- Including the flowmeter in the regular pressure test of the process line.

### Flameproof joints in the housing

The flameproof threads between the cover and electronics compartment must be inspected visually after opening.

The housing must be replaced if there is any damage to the joint area. The flameproof joints are not intended for repair.

## 6.2 Dismantling

### General notes

The dismantling and installation is within the responsibility of the operator.

Due to the modular design of the variable area flowmeters, from a safety perspective the complete indicators or their components can be replaced with identical spare parts.



### **WARNING!**

*Only identical displays or components from the manufacturer may be used.*

*The device must be de-energised, if it is absolutely necessary to open the flameproof enclosure or the dustproof electronics compartment in the presence of a potentially explosive atmosphere.*

*Before connecting or disconnecting the electrical connection cables of the device, make sure that all cables leading to the signal converter are isolated from the ground of the hazardous area. This also applies to protective earth (PE) or functional earth (FE) and equipotential bonding conductors (PA).*

After opening the signal converter, treat the ignition-proof cover threads as necessary with UNIMOLY C220<sup>®</sup> lubricating paint. Greased cover threads should be regreased with NONTRIBOS<sup>®</sup> multipurpose grease type Li EP2. Cover seals should be regreased if necessary.

### Replacing the indicator / modules

When exchanging a complete indicator or individual modules, refer to the section "Connecting power and I/O functions". In both cases, the measuring tube of the variable area flowmeter can remain in the pipeline. This also applies to line systems carrying product.



#### **CAUTION!**

*There may be a loss of measuring accuracy!*

*Faulty prisms between the measuring tube and the indicator housing should be replaced.*

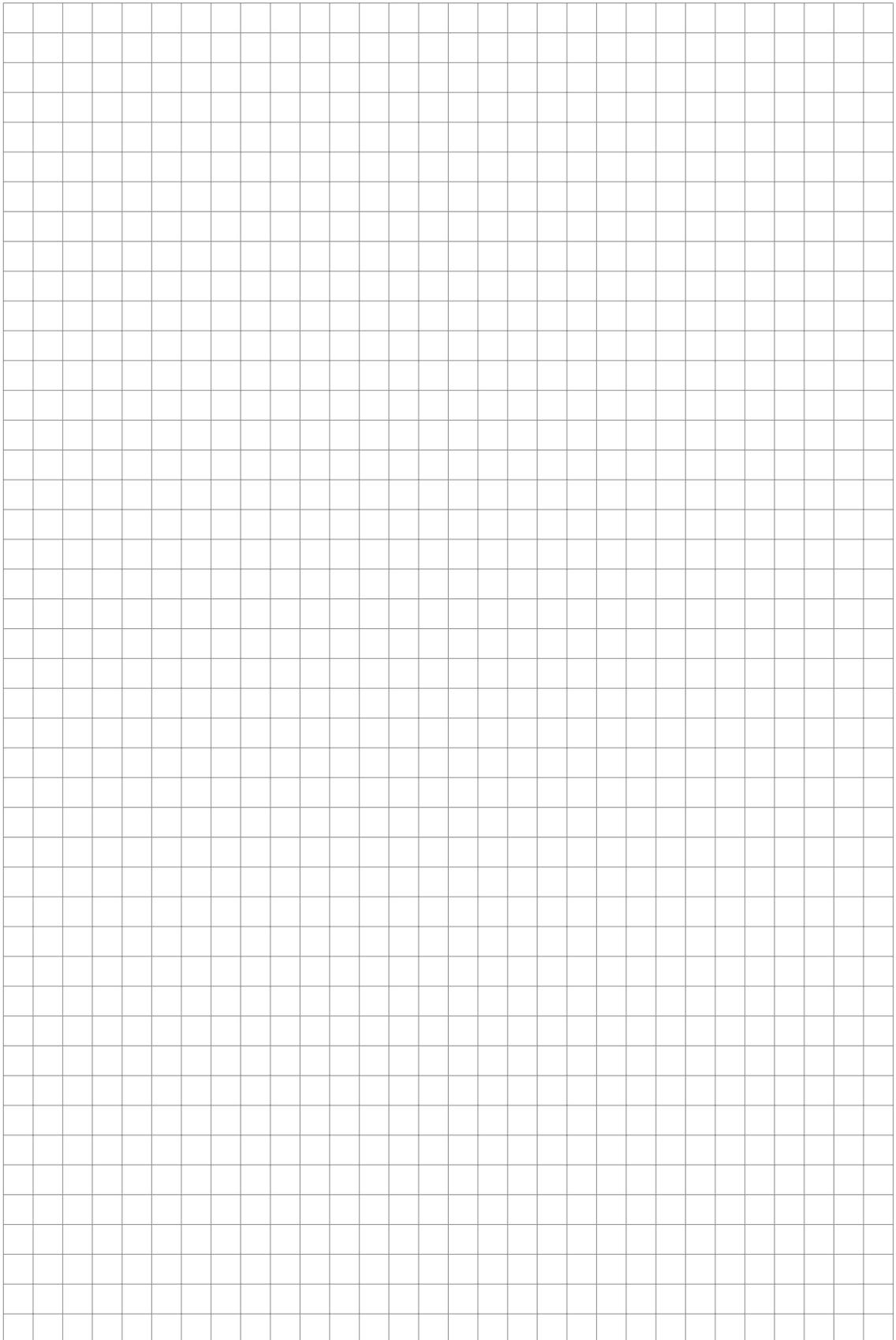
### Exchanging the entire device

Observe the information above. Also, ensure that all process connections and the pipeline are depressurised and free of product. Where environmentally critical products are concerned, carefully decontaminate the wetted parts of the flange system after dismantling.



#### **WARNING!**

- *Pressurised pipes have to be depressurised before removing the measuring unit.*
- *In the case of environmentally critical or hazardous products, appropriate safety precautions must be taken with regard to residual liquids in the measuring unit.*
- *New gaskets have to be used when re-installing the device in the pipeline.*





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