H250 M9 Supplementary Instructions

Variable area flowmeter with electrical built-ins

Equipment category II 2 G

KROHNE

1.1 General notes

These additional instructions apply to explosion-protected versions of variable area flowmeters with electrical built-ins and the marking II 2 G. They complete the standard instructions for the non-explosion protected versions.

The information given in these instructions contains only the data relevant to category 2 explosion protection. The technical details given in the standard instructions for the non-explosion protected versions apply unchanged unless excluded or superseded by these instructions.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 with gas.

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

PTB 01 ATEX 2181

If needed the EC type examination certificate can be downloaded from the manufacturer's website.

1.3 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!

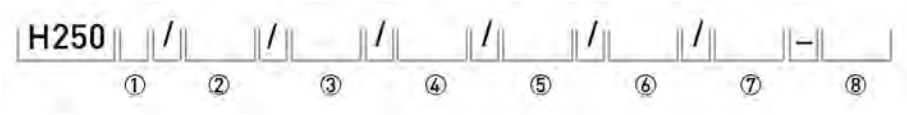
CAUTION!
The operator or his agent is responsible for observing any additional standards, directives or laws if required due to operating conditions or place of installation. This applies in particular to the use of easily detachable process connections when measuring flammable media.

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 and a 4...20 mA signal output or a Profibus PA interface can be installed in the display.

2.2 Description code

The safety description code * consists of the following elements:



① Direction of flow
H - horizontal orientation
U - vertical downwards
no identifier - standard upwards

② Materials / versions
RR - Stainless steel
C - PTFE or PTFE/ceramics
HC - Hastelloy
Ti - Titanium
F - Sterile version (food)

③ Heating jacket version
B - with heating jacket

④ Indicator part series
M9 - Indicator M9 standard indicator
M9S - Indicator with increased protection
M9R - Indicator in stainless steel housing
M9T - Indicator in stainless steel housing with increased protection

⑤ High-temperature version
HT version with HT extension

⑥ Electrical signal output
ESK - Electronic transmitter

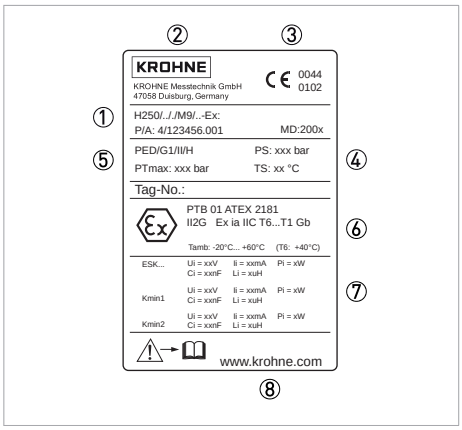
⑦ Limit switch
K1 - One limit switch
K2 - Two limit switches

⑧ Explosion protection
Ex - Explosion-protected equipment

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

2.3 Marking

Type designation of the complete unit is shown on the indicator with the nameplates reproduced below (see also description code).



① Device type
② Manufacturer
③ Identification number of the notified body ATEX & PED
④ Sizing data: temperature & pressure rating
⑤ PED data
⑥ Ex data
⑦ Electrical connection data
⑧ Manufacturer's website

Additional markings on the housing cover:

- SN - serial number
- SO - sales order / item
- PA - order
- Vxxx - 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_{atm} = -20...+60°C / -4...+140°F and P_{atm} = 0.8...1.1 bar / 11.6...15.9 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} S/m, in order to avoid danger from electrostatic charge.

2.5 Device category

Variable area flowmeters are designed according to EN 60079-0 and EN 60079-11 in category II 2 G for use in zone 1. The inside of the measuring unit is also approved for zone 1.

INFORMATION!
Definition of zone 1 acc. to EN 1127-1, Appendix B:
An area in which an explosive atmosphere may occasionally occur as a result of the mixture of flammable substances in the form of gas, steam or mist with air under normal operation.

2.6 Types of protection

The variable area flowmeter is designed with protection type intrinsic safety, protection level "ia" acc. to EN 60079-11.

The marking **II 2G Ex ia IIC T6...T1 Gb** contains the following information:	
II	Explosion protection group II
2	Device category 2
G	Gas explosion protection
Ex ia	Intrinsically safe, protection level "ia"
IIC	Suitable for gas groups IIC, IIB and IIA
T6...T1	Suitable for temperature classes T6...T1
Gb	EPL, suitable for zone 1

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. The temperature class of these devices is rather a function of the product temperature and ambient temperature that is present and the specific device version. Please see the following tables for the assignments.

The tables take into account the following parameters:

- Installed equipment
- Maximum values I_i and P_i for K1, K2
- 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

When there is more than type of built-in equipment, the data of the most unfavourable equipment should be used.

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 installation instructions in the standard documentation.*
- *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.
  To do this, the variant with a projecting indicator (HT version) is preferable.
- *For device versions with a heating jacket, that the temperature of the heating medium does not exceed the maximum permissible product temperature.*

For certain device version, lower values apply due to differing boundary conditions (e.g. liner materials). Here the user should consult the technical data sheet.

Using a heat resistant connecting cable

Temperature table in °C				
Heating jacket			T_m ①	
none	with	HT-version	$T_{amb} \leq 40$	$T_{amb} \leq 60$
DN15, DN25	DN15		-	150
		x	-	236
DN50	DN25		-	127
		x	-	171
DN80, DN100	DN50, DN80		-	109
		x	-	145

Temperature table in °F				
Heating jacket			T_m ①	
none	with	HT-version	$T_{amb} \leq 104$	$T_{amb} \leq 140$
DN15, DN25	DN15		-	302
		x	-	456
DN50	DN25		-	260
		x	-	340
DN80, DN100	DN50, DN80		-	228
		x	-	293

① Maximum value of the product temperature for the use of a standard connecting cable. For higher product temperatures a connecting cable with a temperature resistance of 100°C / 212°F is required.

HT version - high-temperature version with projecting indicator

The permitted ambient temperature range is indicated on the nameplate.

Ambient temperatures

Version	$T_{amb.}$	
	°C	°F
ESK2A, ESK3-PA	-40...+60	-40...+140
SJ3,5-SN / I7S23,5	-40...+60	-40...+140
SC3,5-N0 / SJ3,5-S1N	-25...+60	-13...+140

The minimum product temperature is -40°C / -40°F.

Maximum permitted product temperature in °C

				Maximum permitted product temperature T_m [°C]						
Heating jacket			TK ▸	T6	T5	T4	T3		T2, T1	
without	with	HT version	T_{amb} [°C] ▸	≤ 40	≤ 60	≤ 60	≤ 40	≤ 60	≤ 40	≤ 60
ESK II and ESK2A										
DN15, DN25	DN15			85	100	135	200	183	200	183
		x		85	100	135	200	200	300	300
DN50	DN25			85	100	135	200	165	200	165
		x		85	100	135	200	200	300	300
DN80, DN100	DN50, DN80			85	100	135	200	150	200	150
		x		85	100	135	200	200	300	252
ESK3-PA										
DN15, DN25	DN15			83	76	135	200	183	200	183
		x		85	100	135	200	200	300	300
DN50	DN25			77	74	135	200	165	200	165
		x		85	91	135	200	200	300	300
DN80, DN100	DN50, DN80			71	72	135	200	150	200	150
		x		85	85	135	200	200	300	252
K1/K2 - 64 mW										
DN15, DN25	DN15			85	100	135	200	200	200	200
		x		85	100	135	200	200	300	300
DN50	DN25			85	100	135	200	200	200	200
		x		85	100	135	200	200	300	300
DN80, DN100	DN50, DN80			85	100	135	200	200	200	200
		x		85	100	135	200	200	300	300
K1/K2 (I7S23,5-N / SC3,5-N0) - 169 mW										
DN15, DN25	DN15			not adm.	not adm.	135	200	156	200	156
		x				135	200	200	300	300
DN50	DN25					135	200	141	200	141
		x				135	200	200	300	239
DN80, DN100	DN50, DN80					125	200	125	200	125
		x				135	200	192	300	192
K1/K2 (SJ3,5-SN and SJ3,5-S1N) - 169 mW										
DN15, DN25	DN15			62	100	135	200	200	200	200
		x		85	100	135	200	200	300	300
DN50	DN25			59	100	135	200	200	200	200
		x		81	100	135	200	200	300	300
DN80, DN100	DN50, DN80			55	100	135	200	195	200	195
		x		70	100	135	200	200	300	300

Maximum permitted product temperature in °F

				Maximum permitted product temperature T_m [°F]						
Heating jacket			TK ▸	T6	T5	T4	T3		T2, T1	
without	with	HT version	T_{amb} [°F] ▸	≤ 104	≤ 140	≤ 140	≤ 104	≤ 140	≤ 104	≤ 140
ESK II and ESK2A										
DN15, DN25	DN15			185	212	275	392	361	392	361
		x		185	212	275	392	392	572	572
DN50	DN25			185	212	275	392	329	392	329
		x		185	212	275	392	392	572	572
DN80, DN100	DN50, DN80			185	212	275	392	302	392	302
		x		185	212	275	392	392	572	485
ESK3-PA										
DN15, DN25	DN15			181	169	275	392	361	392	361
		x		185	212	275	392	392	572	572
DN50	DN25			170	165	275	392	329	392	329
		x		185	196	275	392	392	572	572
DN80, DN100	DN50, DN80			160	161	275	392	302	392	302
		x		185	185	275	392	392	572	485
K1/K2 - 64 mW										
DN15, DN25	DN15			185	212	275	392	392	392	392
		x		185	212	275	392	392	572	572
DN50	DN25			185	212	275	392	392	392	392
		x		185	212	275	392	392	572	572
DN80, DN100	DN50, DN80			185	212	275	392	392	392	392
		x		185	212	275	392	392	572	572
K1/K2 (I7S23,5-N / SC3,5-N0) - 169 mW										
DN15, DN25	DN15			not adm.	not adm.	275	392	313	392	313
		x				275	392	392	572	572
DN50	DN25					275	392	286	392	286
		x				275	392	392	572	462
DN80, DN100	DN50, DN80					275	392	257	392	257
		x				275	392	377	572	377
K1/K2 (SJ3,5-SN and SJ3,5-S1N) - 169 mW										
DN15, DN25	DN15			143	212	275	392	392	392	392
		x		185	212	275	392	392	572	572
DN50	DN25			138	212	275	392	392	392	392
		x		178	212	275	392	392	572	572
DN80, DN100	DN50, DN80			131	212	275	392	383	392	383
		x		158	212	275	392	392	572	572

2.8 Electrical data

Electrical equipment	Nominal voltage	Nominal current
Limit switch K1 / K2	8 VDC	1...3 mA
Signal output ESK II and ESK2A	24 VDC ± 25%	4...20 mA with HART® communication
ESK3-PA Profibus transmitter ①	9...24 VDC	12 mA

① Further information and instructions for operation of the ESK3-PA Profibus transmitter are provided in separate supplementary instructions.

Built-in equipment for the variable area flowmeter may only be connected to separate intrinsically safe circuits with the following maximum values:

	Maximum values				
Built-in equipment	U_i [V]	I_i [mA]	P_i [mW]	C_i [nF]	L_i [µH]
ESKII / ESK2A	30	100	1000	20	~ 0
ESK3-PA ①	24	380	5320	~ 0	~ 0
I7S23,5-N SC3,5-N0	16	25	64	150	150
	16	52	169	150	150
SJ3.5-SN SJ3.5-S1N	16	25	64	30	100
	16	52	169	30	100

① FISCO Field device

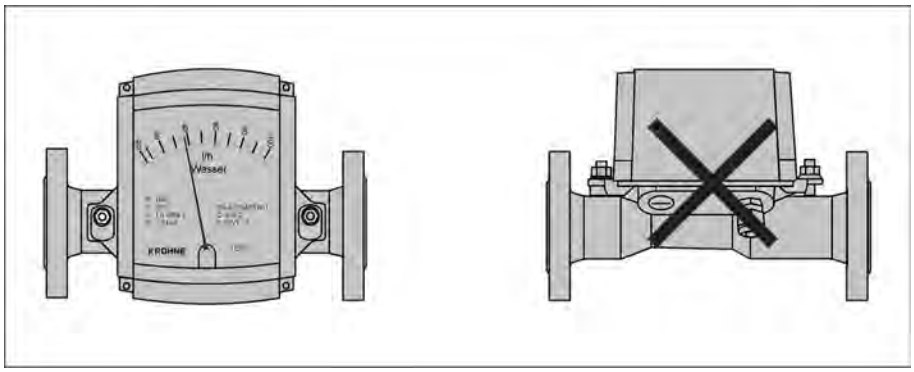
3.1 Installation

Installation and setup must be carried out according to the applicable installation standards by qualified personnel trained in explosion protection.

Variable area flowmeters must be installed in such a way that

- There is no danger from mechanical impact effects.
- There are no external forces affecting the indicator part.
- The device is accessible for any visual inspections that are necessary, 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 product 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 for 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.

4.1 General notes

The connecting cables should be selected according to the applicable installation standards and the maximum operating temperature. The outside diameter of the connecting cables must be matched to the sealing area of the conduit entry/entries. The connecting cables must be laid and fastened securely in such a way that they are adequately protected against damage.
All cores that are not used must be securely connected to the earth potential of the hazardous area or carefully insulated against each other and against earth (test voltage ≥ 500 V_{eff}).
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 product and ambient temperatures indicated as well as the measuring accuracy are based on lateral installation of the display.

Cable entries / Blanking plugs

The variable area flowmeter is equipped with two blanking plugs as standard. These elements guarantee protection from foreign bodies and water (protection type) IP65 acc. to EN 60529. The cable entries provided also ensure protection from foreign bodies and water. The nominal diameter range of the cable entries is 5...10 mm. Suitable blanking plugs are to be used for unused cable entries. Ensure that the seals are tight.

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.

4.3 Inputs/outputs

The terminal assignment of the built-in electrical equipment is described in the product documentation. The variable area flowmeter signal circuits may only be connected to certified intrinsically safe slave units or circuits. For more information refer to chapter "Electrical data".

4.4 Earthing and equipotential bonding

If the device is not sufficiently electrostatically grounded via the process cables, an additional earth connection must be established using the ground terminal. The ground terminal on the back of the display guarantees an electrostatic connection of the device and does not comply with the requirements of an equipotential bonding connection.

Shields should be securely connected to the earth potential of the hazardous area, and connected to the terminal located in the indicator part via the shortest route. In the case of shield earthing at both ends (e.g. for reasons of electromagnetic compatibility), adequate equipotential bonding that reliably prevents potential differences is necessary between the two earthed ends of the shield in order to avoid excessive equalising current.

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.

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

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.

Adjusting the limit switch during operation is permitted. To do so, remove the housing cover. Close the housing cover immediately after adjusting the limit switch.
For more information see chapter "Dismantling"

CAUTION!
Potential risks of sparking caused by pressure surges, external impacts or friction must be avoided especially for Titanium measuring cones.

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).

WARNING!
Electrostatic charging of the housing surface by friction must be avoided.
Variable area flowmeters 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.

To maintain proper condition, regular inspections are required for systems in hazardous areas.

The following checks are recommended:

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

CAUTION!
Avoid electrostatic charges when cleaning the surfaces (e.g. sight window).

6.2 Dismantling

Exchanging the built-in equipment

Due to the modular structure of the variable area flowmeters, from a safety point of view it is possible to exchange the electrical equipment built into the indicator for identical spare parts.

To do this, remove the housing cover. The housing cover must be closed immediately after the spare parts are exchanged. Make sure that the cover seal is properly seated. The fastening screws of the housing cover should be tightened with a torque of 1.2 Nm.

CAUTION!
There may be a loss of measuring accuracy!

Exchanging the entire device

Removal and installation is the user's responsibility.

Before disconnecting the electric connecting cable of the device, it must be ensured that all of the cables leading to the indicator part are de-energised relative to each other and to the reference potential of the hazardous area. This also applies to functional earthing conductors (FE) and equipotential bonding conductors (PA).

CAUTION!

- *Pressurised pipes must be depressurized before removing the measuring section.*
- *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 seals must be used when re-installing the device in the piping.*

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