



DK32 - DK34 Supplementary Instructions

Variable area flowmeter with electrical built-ins

Equipment protection by intrinsic safety Ex i



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1.1 General notes

These supplementary instructions apply to explosion-protected versions of variable area flowmeters with electrical built-ins and the marking Ex i.

It completes the standard documentation for the non-explosion protected versions.

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details given in the standard instructions for the non-explosion protected versions apply unchanged unless excluded or superseded by these supplementary instructions.

1.2 NEPSI conformity

Variable area flowmeters, type DK32 series and DK34 series have been approved by NEPSI (National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation). This product is in accordance with the following standards:

- GB 3836.1-2010 Explosive atmospheres - Part 1: Equipment - General requirements
- GB 3836.4-2010 Explosive atmospheres - Part 4: Equipment protection by intrinsic safety "i"
- GB 12476.1-2013 Electrical apparatus for use in the presence of combustible dust - Part 1: General requirements
- GB 12476.4-2010 Electrical apparatus for use in the presence of combustible dust - Part 4: Protection by intrinsic safety iD

The certificate number is:

GYB20.2472X

This certification together with its boundary conditions is required to be observed without fail.



INFORMATION!

*The Ex marking is **NOT** according to the ATEX directive. Placing the product on the market of the EU for purpose of distribution and/or use in the EU is **NOT** permitted.*

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 60079-0:2017 and IEC 60079-11:2011.

The number of the IEC certificate is:

IECEx KIWA 18.0007X

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.



CAUTION!

When an equipment fault is detected the device shall be de-energised and send back to the manufacturer for repair.

2.1 Device description

Variable area flowmeters measure and display the flow of flammable and non-flammable gases and liquids. Depending on the device version, one or two individually adjustable electrical limit switch contacts can be installed in the indication unit.

The indication unit can also be equipped with a Reed contact or a 4...20 mA signal output with HART® communication.

2.2 Description code

The safety description code consists of the following elements *:

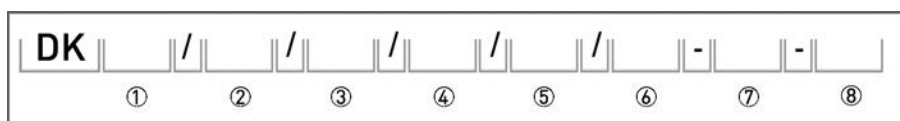


Figure 2-1: Safety description code

- ① 32 - with valve and horizontal connection
34 - without valve and vertical connection
- ② RE - flow regulator for variable inlet pressure
RA - flow regulator for variable outlet pressure
- ③ K1 - one limit switch
K2 - two limit switches
ESK - version with current output
R1 - version with Reed contact
- ④ S - plug connector
L - cable entry including cable
- ⑤ HT - high-temperature version
- ⑥ Marking without influence on the explosion safety protection
- ⑦ Ex - explosion-protected equipment
- ⑧ SK - SIL conformity according to IEC 61508 of the limit switch

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

2.3 Marking

The type marking of the device is realised visibly with the nameplate shown below. The interior of the display has an additional marking with the serial number (P/A).

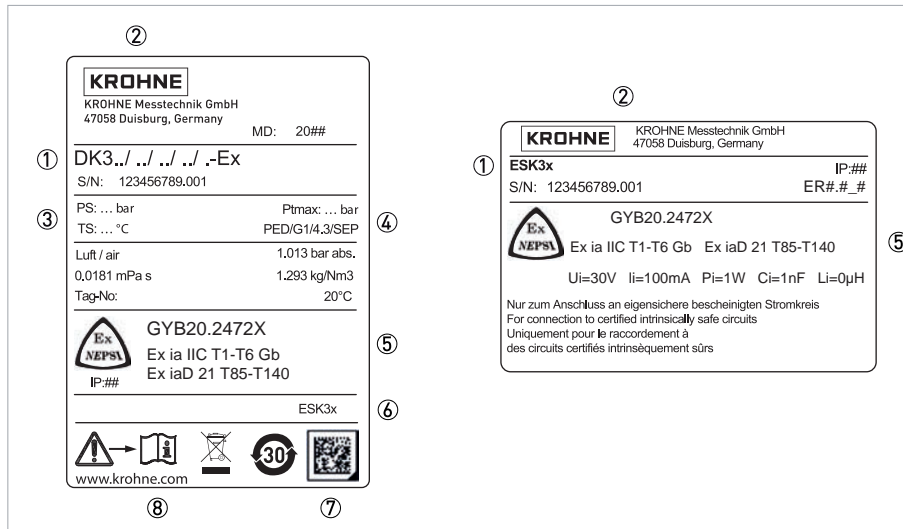


Figure 2-2: Example of a nameplate with current output

- ① Device type
- ② Manufacturer
- ③ Rating data: temperature & pressure rating
- ④ Data according to the pressure equipment directive
- ⑤ Marking according to NEPSI and permissible ambient temperature range
- ⑥ Built-in equipment
- ⑦ Data matrix
- ⑧ Safety instructions, disposal symbol and China RoHS symbol

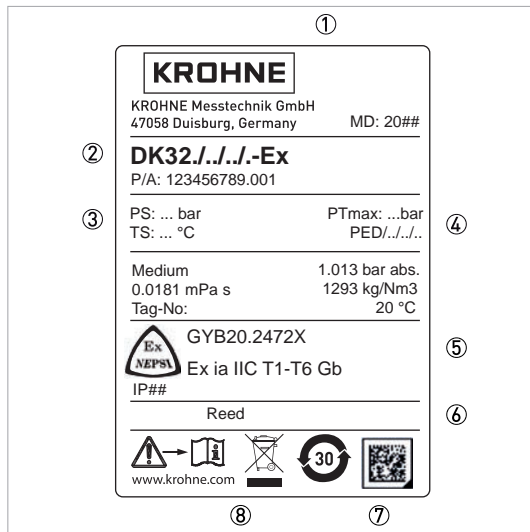


Figure 2-3: Example of a nameplate with Reed contact

- ① Manufacturer
- ② Device type
- ③ Rating data: temperature & pressure rating
- ④ Data according to the pressure equipment directive
- ⑤ Marking according to NEPSI and permissible ambient temperature range
- ⑥ Built-in equipment
- ⑦ Data matrix
- ⑧ Safety instructions, disposal symbol and China RoHs symbol

2.4 Flammable products

Atmospheric conditions:

The standard atmospheric conditions under which it may be assumed that Ex equipment can be operated are:

- Temperature: -20...+60°C / -4...+140°F
- Pressure: 80...110 kPa (0.8...1.1 bar) / 11.6...15.9 psi
- Air with normal oxygen content, typically 21%v/v

Ex equipment operating outside the standard temperature range must be tested and certified (e.g. for ambient temperature range -40...+65°C / -40...+149°F).

Operation outside the specified above standard atmospheric conditions is permitted only via risk assessment of the user and additional measures, as necessary.

Operating conditions:

The measuring unit of variable area flowmeters operate outside the standard atmospheric pressure range, which means that explosion protection, regardless of the zone assignment, is fundamentally not applicable for the measuring unit (piping).



CAUTION!

Operation with flammable products is only permitted as long as no explosive fuel/air mixture builds up inside of the piping at the same time the atmospheric conditions are exceeded.

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 piping.

2.5 Device category

Variable area flowmeters are designed in accordance with GB 3836.1-2010 and GB 3836.4-2010 for use in zone 1.

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

Depending on the device version, variable area flowmeters are also designed in accordance with GB GB 12476.1-2013 and GB GB 12476.4-2010 for use in zone 21.



INFORMATION!

Definition of zone 1:

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:

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 in the type of protection intrinsic safety, level of protection "ia".

The marking for equipment protection level Gb is:

Ex ia IIC T1-T6 Gb

The marking contains the following information:	
Ex ia	Equipment protection by intrinsic safety, level of protection "ia"
IIC	Gas group, suitable for gas groups IIC, IIB and IIA
T1-T6	Temperature class range, suitable for temperature classes T1...T6
Gb	EPL, suitable for zone 1 and zone 2

Table 2-1: Description of the marking



INFORMATION!

For the equipment protection level (EPL) Gb, connection to an intrinsically safe circuit with level of protection "ib" is required.

When connecting the variable area flowmeter to an intrinsically safe circuit with level of protection "ia", a higher protection level is given.

The additional identification of the version for the equipment protection level (EPL) Db is:

Ex iaD 21 T85-T140

The marking contains the following information:	
Ex ia	Equipment protection by intrinsic safety, level of protection "ia"
D 21	Protection for Dust, suitable for zone 21 and zone 22
T85-T140	Maximum surface temperature in °C at +65°C / +149°F ambient temperature

Table 2-2: Description of the marking



INFORMATION!

For the equipment protection level (EPL) Db, connection to an intrinsically safe circuit with protection level "ib" is required.

When connecting the variable area flowmeter to an intrinsically safe circuit with protection level "ia", a higher protection level is given.

2.7 Ambient temperature / temperature classes

Due to the influence of the product temperature, no fixed temperature class is assigned to variable area flowmeters. The temperature class of these devices is rather a function of the present product temperature and ambient temperature. There is no distinction between devices with one or two contacts.

The classification is outlined in the following tables.

The tables take into account the following parameters:

- Ambient temperature T_{amb}
- Product temperature T_m
- Feed power for version K. depending on the limit switches



INFORMATION!

The lowest ambient temperature for the version with limit switch of the type SC2-NO or Reed contact HT is -25°C / -13°F, for all other versions it is -40°C / -40°F.



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 manual.*
- *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.*

	Maximum permissible product temperature T_m [°C]													
	T6			T5			T4				T3...T1			
Ambient temperature	40	50	55	50	65	70	40	60	65	70	40	60	65	70
DK3../ESK/.	85	85	85	100	100 ①	90 ①	135 ①	105 ①	100 ①	90 ①	140 ①	105 ①	100 ①	90 ①

Table 2-3: DK3../ESK/..-Ex permissible product and ambient temperatures in °C

① Heat-resistant cable and cable entry $\geq 90^\circ\text{C}$

	Maximum permissible product temperature T_m [°F]													
	T6			T5			T4				T3...T1			
Ambient temperature	104	122	131	122	149	158	104	140	149	158	104	140	149	158
DK3../ESK/.	185	185	185	212	212 ①	194 ①	275 ①	221 ①	212 ①	194 ①	284 ①	221 ①	212 ①	194 ①

Table 2-4: DK3../ESK/..-Ex permissible product and ambient temperatures in °F

① Heat-resistant cable and cable entry $\geq 194^\circ\text{F}$

Limit switches Feed power	Maximum permissible product temperature T _m [°C] with plug connector (S) or cable entry (L)															
	T6			T5			T4					T3...T1				
Ambient temperature	40	50	55	40	50	55	40	60	65	70	90	40	60	65	70	90
SC2-NO 64 mW	80	70	65	100	100	95	135	125	120 ①	120 ①	100 ①	140 ①	125 ①	120 ①	120 ①	100 ①
SC2-NO 169 mW	-	-	-	55	-	-	90	75	70	-	-	90	75	70	-	-
SJ2-SN 64 mW	80	70	70	100	100	95	135	125	120 ①	120 ①	100 ①	140 ①	125 ①	120 ①	120 ①	100 ①
SJ2-SN 169 mW	-	-	-	60	55	-	95	80	75 ①	70 ①	-	95	80	75 ①	70 ①	-
I7S2002-N 64 mW	85	80	75	100	100	100	135	125	120 ①	120 ①	100 ①	140 ①	125 ①	120 ①	120 ①	100 ①
I7S2002-N 169 mW	55	-	-	80	70	70	135	120	115 ①	110 ①	95 ①	135 ①	120 ①	115 ①	110 ①	95 ①

Table 2-5: DK3./../K./../-Ex permissible product and ambient temperatures in °C

① Heat-resistant cable and cable entry $\geq 90^\circ\text{C}$

Limit switches Feed power	Maximum permissible product temperature T _m [°F] with plug connector (S) or cable entry (L)															
	T6			T5			T4					T3...T1				
Ambient temperature	104	122	131	104	122	131	104	140	149	158	194	104	140	149	158	194
SC2-NO 64 mW	176	158	149	212	212	203	275	257	248 ①	248 ①	212 ①	284 ①	257 ①	248 ①	248 ①	212 ①
SC2-NO 169 mW	-	-	-	131	-	-	194	167	158	-	-	194	167	158	-	-
SJ2-SN 64 mW	176	158	158	212	212	203	275	257	248 ①	248 ①	212 ①	284 ①	257 ①	248 ①	248 ①	212 ①
SJ2-SN 169 mW	-	-	-	140	131	-	203	176	167 ①	158 ①	-	203	176	167 ①	158 ①	-
I7S2002-N 64 mW	185	176	167	212	212	212	275	257	248 ①	248 ①	212 ①	284 ①	257 ①	248 ①	248 ①	212 ①
I7S2002-N 169 mW	131	-	-	176	158	158	275	248	239 ①	230 ①	203 ①	275 ①	248 ①	239 ①	230 ①	203 ①

Table 2-6: DK3./../K./../-Ex permissible product and ambient temperatures in °F

① Heat-resistant cable and cable entry $\geq 194^\circ\text{F}$

DK3x indicator with Reed contact	Maximum permissible product temperature T_m [°C] with plug connector (S) or cable entry (L)			
	T6	T5	T4	T3...T1
Ambient temperature	55	70	70	100
DK3../R1/...	85	100 ①	135 ①	150 ①

Table 2-7: DK3../R1/...-Ex permissible product and ambient temperatures in °C

① Heat-resistant cable and cable entry $\geq 90^\circ\text{C}$

DK3x indicator with Reed contact	Maximum permissible product temperature T_m [°F] with plug connector (S) or cable entry (L)			
	T6	T5	T4	T3...T1
Ambient temperature	131	158	158	212
DK3../R1/...	185	212 ①	275 ①	302 ①

Table 2-8: DK3../R1/...-Ex permissible product and ambient temperatures in °F

① Heat-resistant cable and cable entry $\geq 194^\circ\text{F}$

DK3x high-temperature indicator with Reed contact	Maximum permissible product temperature T_m [°C]				
	T6	T5	T4	T3...T1	
Ambient temperature	55	85	90	145	180
DK3../R1/L/HT	85	100	135	200	180

Table 2-9: DK3../R1/L/HT/...-Ex permissible product and ambient temperatures in °C

DK3x high-temperature indicator with Reed contact	Maximum permissible product temperature T_m [°F]				
	T6	T5	T4	T3...T1	
Ambient temperature	131	185	194	293	356
DK3../R1/L/HT	185	212	275	392	356

Table 2-10: DK3../R1/L/HT/...-Ex permissible product and ambient temperatures in °F

**WARNING!**

Also, when operating the variable area flowmeter outside of the hazardous area, the connection must be made to intrinsically safe circuits.

When connecting to non-intrinsically safe circuits, there is a risk of damage to the safety-defining components.

2.8 Surface temperature for equipment protection level Db

For use in areas with combustible dust it should be noted that the indicated maximum surface temperature of T85°C at an ambient temperature of +65°C / +149°F and a product temperature of +75°C / +167°F is valid without a dust layer.

For higher product temperatures the maximum surface temperature is defined by the product.

At temperatures above +90°C / +194°F, heat-resistant cables and cable entries $\geq +90^\circ\text{C}$ / +194°F must be used.

2.9 Electrical data

The electrical signal circuits may only be connected to separate, intrinsically safe circuits. Depending on the instrument design, the following maximum values apply per circuit:

U_i	16 VDC
I_i	25 mA or 52 mA
P_i	64 mW or 169 mW

Table 2-11: Version DK3./../K./../-Ex

Irrespective of the device version the following values are to be observed for each intrinsically safe circuit in case of interconnection:

C_i	150 nF
L_i	150 μH

Table 2-12: Up to a cable length of 10 m / 32.8 ft

C_i	152 nF
L_i	150 μH

Table 2-13: Starting with a cable length of more than 10 m / 32.8 ft up to 20 m / 65.6 ft

	Version DK3./../ESK./../-Ex	Version DK3./../R1./../-Ex
U_i	30 VDC	30 VDC
I_i	130 mA	100 mA
P_i	1 W	1 W
C_i	10 nF	≈ 0 nF
L_i	≈ 0 μH	≈ 0 μH

Table 2-14: Version DK3./../ESK./../-Ex or version DK3./../R1./../-Ex

3.1 Mounting

Mounting and setup must be carried out according to the applicable installation standards (e.g. IEC 60079-14 or GB/T 3836.15) 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

- there is no danger from mechanical impact effects.
- there are no external forces affecting the indicator part.
- 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.



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)!*

3.2 Special conditions and requirements

Electrostatic charge

Friction on the surface with coating should be avoided in case there will cause the ignition by electrostatic accumulation.

Special requirements

- Only be connected to the certified associated apparatus, the flowmeter could be used in the explosive atmosphere. The connection should be complied with the requirements of the manual of the associated apparatus. The maximum values for connection to a certified associated apparatus are shown in the section "Electrical data".
- The cable between the product and associated apparatus should be shielded cable with insulating sheath. and the shield be grounded.
- The enclosure shall be kept from the dust, but the dust shall not be blown by compressed air.
- Users are forbidden to change the configuration to ensure the explosion protection performance of the equipment. Any faults shall be settled with experts from the manufacturer.
- During installation, operation and maintenance, users shall comply with the relevant requirements of the product instruction manual, GB3836.13-2013 "Explosive atmospheres - Part 13: Equipment repair, overhaul and reclamation", GB/T 3836.15-2017 "Explosive atmospheres - part 15: Electrical installations design, selection and erection", GB/T 3836.16-2017 "Explosive atmospheres - part 16: Electrical installations inspection and maintenance", GB/T 3836.18-2017 "Explosive atmospheres - part 18: Intrinsically safe electrical systems", GB 15577-2018 "Safety regulations for dust explosion prevention and protection" and GB50257-2014 "Code for construction and acceptance of electric device for explosive atmospheres and fire hazard electrical equipment installation engineering".

4.1 General notes

For version DK3./../ESK/../../-Ex (current output), the signal circuits are electrically connected in the terminal compartment of the current output, for version DK3./../S/../../-Ex (plug) in the terminal compartment of the plug housing and for version DK3./../L/../../-Ex (connecting cable) it is the connecting cable as illustrated in the connection diagram. Permissible maximum values (electrical data) must be observed.

Current output

The DK3./../ESK/../../-Ex variable area flowmeter is equipped with a current output.

The current output is delivered with a suitable cable entry.

The cable entry guarantees protection against foreign objects and water (ingress protection) IP6x according to EN 60529 in combination with a suitable connecting cable.

The connecting cable must be selected according to prevailing installation standards (e.g. IEC 60079-14). The outer diameter of the connecting cables must be within the sealing range of the cable entry. The connecting cable must be fixed and laid so they are sufficiently protected against damage.

Connecting cable

The DK3./../L/../../-Ex variable area flowmeter is equipped with a pre-assembled connecting cable.

The connecting cable must be selected according to prevailing installation standards (e.g. IEC 60079-14). The outer diameter of the connecting cables must be within the sealing range of the cable entry. The connecting cable must be fixed and laid so they are sufficiently protected against damage.

All cores that are not used must be securely connected to the ground potential of the hazardous area or carefully insulated against each other and against ground (test voltage $\geq 500 V_{\text{eff}}$).

Cable entries / blanking plugs

The DK3./../S/../../-Ex variable area flowmeter is equipped with a connector.

The connector guarantees protection against foreign objects and water (ingress protection) IP65 according to IEC 60529. The cable entry is closed with a plug. The plug is to be replaced with a suitable connecting cable (nominal diameter range 6...9 mm).

The connecting cable must be selected according to prevailing installation standards (e.g. IEC 60079-14). The outer diameter of the connecting cable must be within the sealing range of the cable entry. The connecting cable must be fixed and laid so they are sufficiently protected against damage.

Connection for indicator with limit switches or Reed contact

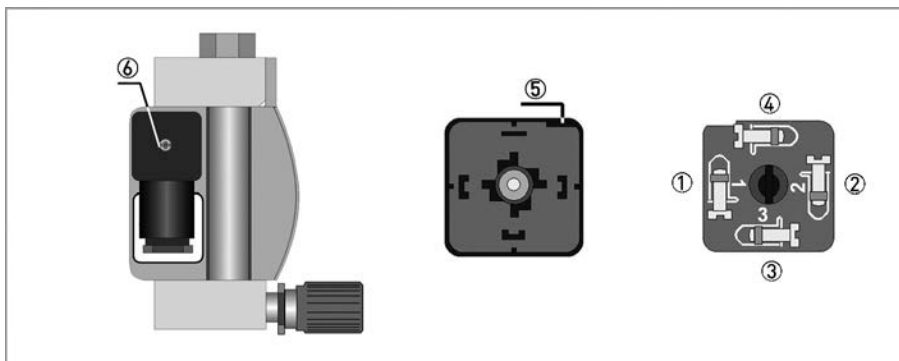


Figure 4-1: Connection for indicator with limit switches or Reed contact

	Contact connection	Stranded wire colour for cable assembly
①	Min minus	white
②	Min plus	yellow
③	Max minus	green
④	Max plus	brown
⑤	Lift slot	
⑥	Fastening screw of connection box	

Table 4-1: Stranded wire colour for cable assembly

Connection for indicator with current output ESK

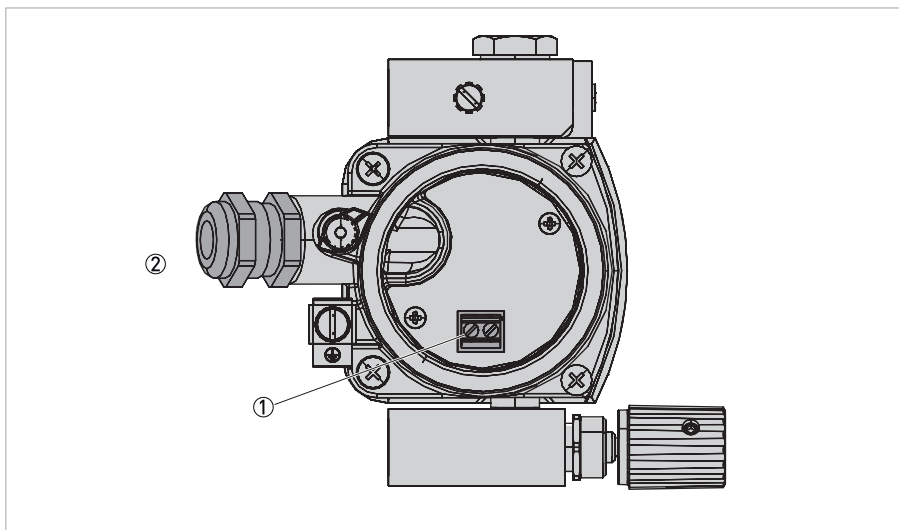


Figure 4-2: Electrical connection ESK

- ① Connection terminals
- ② Cable entry

4.2 Grounding and equipotential bonding

If the device is not sufficiently electrostatically grounded via the process pipes, an additional ground connection must be established using the ground terminal ①. The position of the ground terminal is illustrated below. The connection only ensures an electrostatic connection of the device and does not comply with the requirements of an equipotential bonding connection.

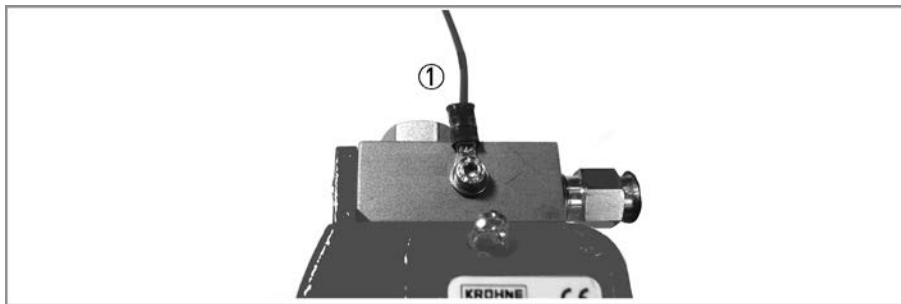


Figure 4-3: Ground terminal for DK32, DK34

For the version with current output, this can also be done at the ground terminal of the housing. The position of the ground terminal is illustrated below.

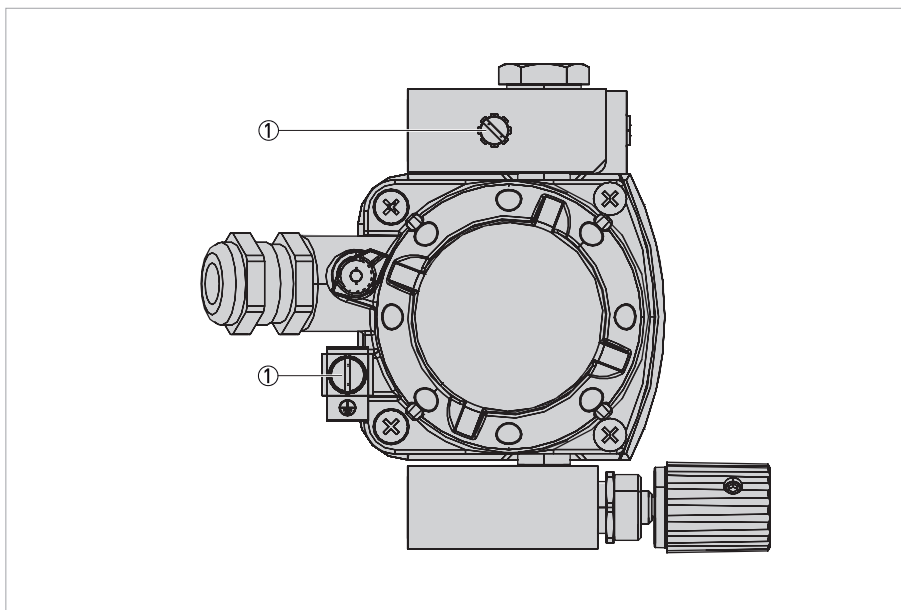


Figure 4-4: Ground terminal for ESK



INFORMATION!

The temperature at the electrostatic equalization connector on the DK32-DK34 measuring unit corresponds to the process temperature. It is thus the responsibility of the operator to select the connecting cable according to the process temperature.

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 operator of the system has to check prior to start-up, if the start-up was in compliance with the national regulations for checks.

5.2 Operation

For the device version with limit switches, adjusting during operation is permitted. To do so, remove the housing cover. Close the housing cover immediately after adjusting the limit switch.



CAUTION!

Ignition risks caused by pressure surges, impact or friction must particularly be avoided when titanium measuring units or floats 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).



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.
- Check the NPT adapter after maintenance work, that this has not become loose on the device.
- Check the measuring unit and the piping connections for leakage.
- Check the measuring unit and the indicator for dust deposits.
- Include the flowmeter in the regular pressure test of the process line.



CAUTION!

When opening the indicator or terminal compartment, the operator must ensure there is a controlled environment that prevents dirt or similar from penetrating into the device.

Following connection or maintenance, the operator must ensure that the inside of the device is cleaned with suitable agents.

During re-assembly after maintenance of the indicator/converter (or replacement) or the flowmeter, the operator must take appropriate measure to ensure that

- no charge is applied to the surface of the housing.
- no charge is applied to the inner surfaces of the housing.
- any damaged gaskets are replaced.

The cover is to be closed following maintenance work on the indicator.

Cleaning the measuring unit

Depending on the application, worst-case operating conditions may lead to reduced measuring performance as a result of fouling of the measuring system. Clean the measuring unit in accordance with the standard manual for non-explosion protected versions.

The measuring unit must be dismantled for cleaning. This dismantling will need to be coordinated with operating conditions (e.g. check for existence of a flammable liquid or explosive atmosphere in or at the tank or pressurised tank) and is within the responsibility of the operator. To do this, follow the instructions for exchanging the entire device (for details refer to *Dismantling* on page 20).

6.2 Dismantling

Replacing the display

Due to the modular design of the variable area flowmeter, from a safety perspective it is possible to replace a complete display with an identical spare part.

**CAUTION!**

There may be a loss of measuring accuracy!

Exchanging the entire device

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

Exchanging and dismantling should take place in a de-energised state, if at all possible. If that is not possible, the basic conditions for intrinsic safety (e.g. no grounding or connection of different intrinsically safe circuits to one another) must be observed during dismantling.

**CAUTION!**

- *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 piping.*







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