



## DK46 - DK800

Supplementary Instructions

Variable area flowmeter

Equipment category II 2 G, EPL Gb  
in protection type intrinsic safety "i"



1	Safety instructions	3
1.1	General notes .....	3
1.2	EU conformity .....	3
1.3	Safety instructions.....	3
2	Device description	4
2.1	Device description .....	4
2.2	Description code .....	4
2.3	Marking .....	5
2.4	Flammable products .....	6
2.5	Equipment category .....	6
2.6	Types of protection .....	7
2.7	Ambient temperature / temperature classes.....	7
2.8	Electrical data.....	9
3	Installation	10
3.1	Mounting .....	10
3.2	Special conditions.....	11
4	Electrical connections	12
4.1	General notes .....	12
4.2	Power supply .....	12
4.3	Inputs / outputs .....	12
4.4	Grounding and equipotential bonding.....	13
5	Operation	14
5.1	Start-up.....	14
5.2	Operation .....	14
5.3	Electrostatic charge .....	15
6	Service	16
6.1	Maintenance .....	16
6.2	Dismantling .....	16
7	Notes	17

## 1.1 General notes

This additional instruction applies to explosion-protected versions of variable area flowmeter with electrical built-ins with protection type intrinsic safety "i", equipment category II 2 G or EPL Gb.

It completes the manual for the non explosion-protected versions.

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

## 1.2 EU conformity

The manufacturer declares with the EU declaration of conformity, in which the applied standard is also specified, 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 for the equipment category II 2 G is based on the EC type examination certificate of the Physikalisch Technische Bundesanstalt (PTB):

**PTB 05 ATEX 2021 X**

The "X" after the certificate number refers to special conditions for safe use of the device, which have been listed in these instructions.

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.*



**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 the volume flow of flammable and non-flammable gases and liquids. Up to two separately adjustable electrical limit switches can be mounted in the local indication.

## 2.2 Description code

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

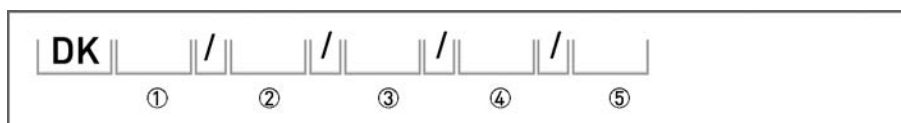


Figure 2-1: Safety description code

- ① R - with integrated inlet pressure regulator (DKR46 only)
- ② **Device type**
  - 46 - Overall length of measuring cone 65 mm / 2.6"
  - 47 - Overall length of measuring cone 150 mm / 5.9"
  - 48 - Overall length of measuring cone 300 mm / 11.8"
  - 800 - Overall length of measuring cone 100 mm / 3.9"
- ③ **Material for top and bottom fittings**
  - N - brass / R - stainless steel / PV - PVDF
- ④ **Differential pressure regulators**
  - RE - inlet pressure regulator / RA - outlet pressure regulator
- ⑤ **Limit switches**
  - K1 - one limit switch / K2 - two limit switches

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

## 2.3 Marking

The marking of the entire device is on the indication unit, in accordance with the description code.

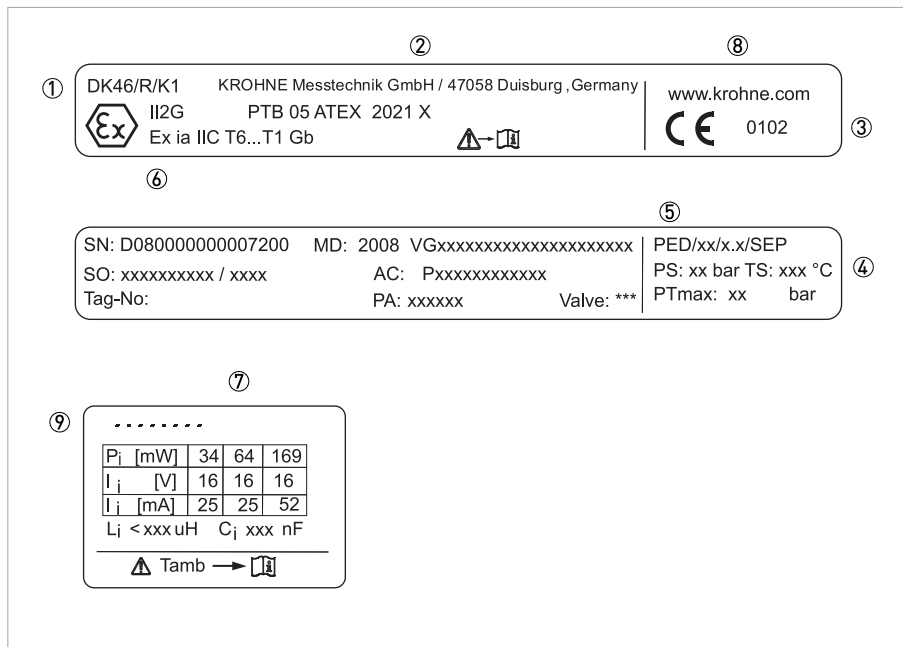


Figure 2-2: Example of an identification plate

- ① Device type
- ② Manufacturer
- ③ Notified body ATEX
- ④ Rating data: temperature & pressure rating
- ⑤ PED data
- ⑥ Ex data
- ⑦ Electrical connection data
- ⑧ Internet site
- ⑨ Type of limit switch

### Additional markings on the measuring device

- SN - serial number
- SO - sales order / item
- Tag No. - measuring point identifier
- MD - manufacturing date
- PA - order number
- Vx - product configurator code
- AC - article code

## 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).

Ex equipment operating outside the standard atmospheric pressure range and standard oxygen content is not permitted.

### 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 Equipment category

Variable area flowmeters are designed according to EN 60079-0:2012 + A11:2013 and EN 60079-11:2012 in category II 2 G or EPL Gb for use in zone 1.

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.*

## 2.6 Types of protection

The variable area flowmeter is designed with protection type intrinsic safety "i" according to EN 60079-11.

The identification for equipment category II 2 G or EPL Gb is:

**II 2G Ex ia IIC T6...T1 Gb**

The marking contains the following information:

<b>II</b>	Explosion protection, group II
<b>2</b>	Equipment category 2
<b>G</b>	Gas explosion protection
<b>Ex ia</b>	Explosion protection through intrinsic safety, protection level "ia"
<b>IIC</b>	Gas group, suitable for gas groups IIC, IIB and IIA
<b>T6...T1</b>	Temperature class range, suitable for temperature classes T6...T1
<b>Gb</b>	EPL, suitable for zone 1

Table 2-1: Description of the marking



### **INFORMATION!**

*For the equipment category II 2 G or EPL Gb, connection to separate intrinsically safe circuits with protection level "ib" is required.*

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

## 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.

The classification is outlined in the following tables.

**The tables take into account the following parameters:**

- Built-in equipment
- Maximum values  $I_i$  and  $P_i$  for K1, K2
- Ambient temperature  $T_{amb}$
- Product temperature  $T_m$

When using more than one 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 manufacturer's installation instructions.*
- *It must be ensured that the measuring device is not heated by the effects of additional heat radiation (sunshine, adjacent plant parts) 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.*

Type of limit switch	Maximum permissible ambient / product temperature in °C								
	Supply								
	Type 1			Type 2			Type 3		
	Temperature class								
	T6	T5	T4...T1	T6	T5	T4...T1	T6	T5	T4...T1
RC10-14.-N0... RC15-14.-N0...	65	65	65	65	65	65	50	65	65
RC10-14.-N3...	70	75	75	65	75	75	50	65	75
RC15-14.-N3...	70	70	70	65	70	70	50	65	70
I7R2010-N*** I7R2015-N***	70	80	80	65	80	80	50	65	80
I7R2010-NL *** I7R2015-NL ***	70	80	80	70	80	80	65	80	80
The lowest permissible ambient temperature is -20°C									

Table 2-2: Temperature table in °C

Type of limit switch	Maximum permissible ambient / product temperature in °F								
	supply								
	Type 1			Type 2			Type 3		
	Temperature class								
	T6	T5	T4...T1	T6	T5	T4...T1	T6	T5	T4...T1
RC10-14.-N0... RC15-14.-N0...	149	149	149	149	149	149	122	149	149
RC10-14.-N3...	158	167	167	149	167	167	122	149	167
RC15-14.-N3...	158	158	158	149	158	158	122	149	158
I7R2010-N*** I7R2015-N***	158	176	176	149	176	176	122	149	176
I7R2010-NL *** I7R2015-NL ***	158	176	176	158	176	176	149	176	176
The lowest permissible ambient temperature is -4°F									

Table 2-3: Temperature table in °F

These values may be limited by the data contained in the manual.

The maximum values listed in the manual must be taken into consideration.



## 2.8 Electrical data

Electrical equipment	Nominal voltage	Nominal current
Electrical data for limit switches K1 / K2	8 VDC	≤1 / ≥3 mA

Table 2-4: Electrical data for limit switches K1 / K2

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

Built-in equipment	Maximum values				
	U <sub>i</sub> [V]	I <sub>i</sub> [mA]	P <sub>i</sub> [mW]	C <sub>i</sub> [nF]	L <sub>i</sub> [μH]
RC10-14.-N0.../RC15-14.-N0... I7R2010-N***/I7R2015-N***	16	25	34	210	100
		25	64		
		52	169		
RC10-14.-N3... I7R2010-NL***	16	25	34	150	120
		25	64		
		52	169		
RC15-14.-N3... I7R2015-NL***	16	25	34	150	70
		25	64		
		52	169		

Table 2-5: Maximum values for intrinsically safe circuits



**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.

### 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.

#### Panel mounting

After installing and adjusting the electrical equipment and/or mounting of the protective cover, tighten the screws with 0.7 Nm on the front ① and back ② of the variable area flowmeter.

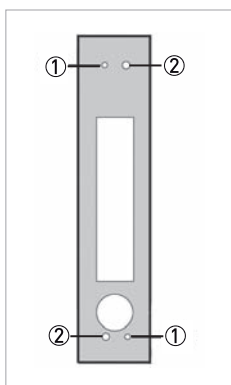


Figure 3-1: Position of screws for panel mounting

#### 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

### Flammable products

Observe the information regarding flammable products.  
For further information refer to *Flammable products* on page 6.

### Thermal data

Observe the maximum ambient and product temperatures.  
For further information refer to *Ambient temperature / temperature classes* on page 7.

### Electrostatics

To avoid electrostatic charging, connect the variable area flowmeters to the equipotential bonding system of the hazardous area.  
Observe additional information regarding electrostatics. For further information refer to *Electrostatic charge* on page 15.

## 4.1 General notes

The built-in equipment is connected electrically in the connection box. The circuits are designed in protection type "intrinsically safe" and galvanically isolated from ground (test voltage  $\geq 500 V_{eff}$ ).

The connecting cables should be selected according to the applicable installation standards (e.g. EN 60079-14) and the maximum operating temperature. Ensure that no residual current can form between separate intrinsically safe signal circuits.

- The connecting cables must be fixed and laid so they are sufficiently protected against damage.
- Not used cores must be securely connected to the earth potential of the hazardous area or carefully insulated against each other and against earth (test voltage  $\geq 500 V_{eff}$ ).
- 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 (ingress protection) IP65 according to EN 60529.
- The outer diameter of the connecting cable must be within the sealing range of the cable entry (3...7 mm / 0.12...0.27").

Ensure that the gaskets and incised gasket ring are tight.

## 4.2 Power supply

The variable area flowmeter does not require a separate power supply.

## 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 flowmeters may only be connected to certified intrinsically safe slave units or circuits. For more information refer to chapter "Electrical data".

## 4.4 Grounding and equipotential bonding

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

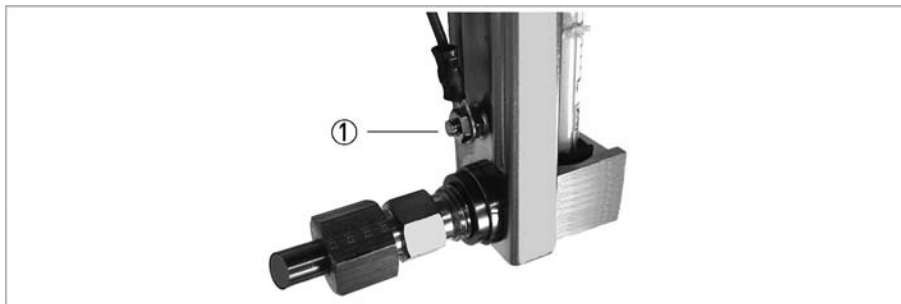


Figure 4-1: Position of the ground terminal

## 5.1 Start-up

**Make the following checks before starting up the device:**

- Suitability of the materials used for the measuring unit and for the gaskets for adequate resistance to corrosion from the product.
- Correct connection of the built-in electrical equipment.
- Visual inspection for damage of the exposed wire lines of the ring initiator inside of the indicator.
- Observe the additional mounting information for the panel mounting versions.  
For further information refer to *Mounting* on page 10.

## 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, first remove the protective cover. Use the two clamping screws ① to fasten the limit switch ② to the back rail ③ of the variable area flowmeter.

Close the protective cover immediately after adjusting the limit switch.

Observe the additional mounting information for the panel mounting versions.  
For further information refer to *Mounting* on page 10.



Figure 5-1: Fastening the limit switch



**CAUTION!**

*Avoid pinching or damaging the wire line of the limit switches when setting the switches and closing the cover. It should be laid in the grooves of the back rail. In case of damage, the variable area flowmeter must be replaced!*

### 5.3 Electrostatic charge

In variable area flowmeters, it is possible under field conditions for charge separation to occur in the measuring tube due to the transport of non-conductive fluids and / or when the flow comes into contact with non-conductive built-ins.

In glass devices, it is basically possible for the electrostatic field generated inside the measuring tube to "punch through" to the outside of the device.

For that reason, variable area flowmeters need to be permanently grounded by the operator via the process connections in order to allow discharge of electrostatic build-up.

The operator is also responsible for continuing the complete grounding of the process line. If grounding cannot be made via the process connections, e.g. top and bottom fittings are made of plastic, the flowmeter should be connected to the local ground potential via the connection to ground. The connection only ensures electrostatic grounding of the device and does not comply with the requirements of an equipotential bonding connection.

When dust-free gases or liquids are measured, the flow rate should not exceed 20 times the nominal flow rate. The max. allowable operating pressure PS printed on the nameplate is to be considered.

**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 entry and the feed lines for corrosion or damage.
- Check the measuring unit and the piping connections for leakage or damages of the glass cone.
- Include the flowmeter in the scheduled periodic inspection the process line and fittings.

## 6.2 Dismantling

### Exchanging the entire device

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

Before disconnecting the electric connecting cable of the device, make sure that all cables leading to the indication unit are isolated from the ground of the hazardous area.

This also applies to functional earth conductors (FE) and equipotential bonding conductors (PA).



### **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.*

### Preventive 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.











## KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

Head Office KROHNE Messtechnik GmbH  
Ludwig-Krohne-Str. 5  
47058 Duisburg (Germany)  
Tel.: +49 203 301 0  
Fax: +49 203 301 10389  
[info@krohne.com](mailto:info@krohne.com)

The current list of all KROHNE contacts and addresses can be found at:  
[www.krohne.com](http://www.krohne.com)

**KROHNE**