Variable area flowmeter

Equipment protection level (EPL) Gb and Db
in protection type intrinsic safety "i"
CONTENTS

1 Safety instructions 3

  1.1 General notes ................................................................. 3
  1.2 INMETRO approval .......................................................... 3
  1.3 Approval according to the IECEx scheme .......................... 3
  1.4 Safety instructions .......................................................... 4

2 Device description 5

  2.1 Device description .......................................................... 5
  2.2 Description code for type series DK37 .............................. 5
  2.3 Marking ............................................................................. 6
  2.4 Flammable products .................................................................. 7
  2.5 Equipment category .......................................................... 8
  2.6 Types of protection ........................................................... 9
  2.7 Ambient temperature / temperature classes / product temperature .................................................. 10
  2.8 Surface temperature for equipment protection level Db ................................................................. 12
  2.9 Electrical data ..................................................................... 12

3 Installation 13

  3.1 Mounting ............................................................................ 13
  3.2 Special conditions ............................................................. 13

4 Electrical connections 14

  4.1 General notes ................................................................. 14
  4.2 Power supply .................................................................... 15
  4.3 Inputs / Outputs ............................................................... 15
  4.4 Grounding and equipotential bonding ................................ 16

5 Operation 17

  5.1 Start-up .............................................................................. 17
  5.2 Operation .......................................................................... 17
  5.3 Electrostatic charge .......................................................... 17

6 Service 18

  6.1 Maintenance ...................................................................... 18
  6.2 Dismantling ....................................................................... 18

7 Notes 19
1.1 General notes

These additional instructions apply to explosion-protected versions of variable area flowmeter with electrical built-ins with protection type intrinsic safety “i”, equipment protection level (EPL) Gb and Db.
They complete the standard manual 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 manual for the non-explosion protected versions apply unchanged unless excluded or superseded by these supplementary instructions.

1.2 INMETRO approval

Conformity for use in hazardous areas with gas and dust was tested in accordance with the “INMETRO Certification Scheme for Explosive Atmospheres” according to ABNT NBR IEC 60079-0:2013 and ABNT NBR IEC 60079-11:2017.

Approval according to governmental regulation INMETRO no. 179/2010:

**DNV 18.0135 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 INMETRO certificate can be downloaded from the manufacturer’s website.

1.3 Approval according to the IECEx scheme

Conformity for use in hazardous areas with gas and dust was tested in accordance with the “IECEx Certification Scheme for Explosive Atmospheres” according to IEC 60079-0:2011, IEC 60079-15:2010 and IEC 60079-31:2013.

The number of the IECEx certificate is:

**IECEx KIWA 15.0020 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 IEC certificate can be downloaded from the manufacturer’s website.
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.

Figure 2-1: Available indicators
① Indicator M8E.: one signal output 4...20 mA with a bargraph indicator
② Indicator M8M.: up to two separately adjustable electrical limit switches

2.2 Description code for type series DK37

The safety description code consists of the following elements *:

Figure 2-2: Safety description code
① Type series of measuring unit DK
② Type series of signal converter 37
③ Type series of indicators
  M8M - mechanical indicator
  M8E - electronic indicator
④ Design of indicator housing
  without - indicator housing in PPS
  R - indicator housing in stainless steel
⑤ Optional differential pressure regulator
  RE - inlet pressure regulator
  RA - outlet pressure regulator
⑥ Limit switch (M8M version)
  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 clearly visible on the indication unit, in accordance with the designation code.

![Diagram of device markings](image)

**Figure 2-3: Examples of the nameplates**

1. Device designation
2. Manufacturer and manufacturer address
3. Manufacturing year
4. Rating data: temperature & pressure rating
5. PED data
6. Ex data according to notified body
7. Electrical connection data (depending on built-in equipment)
8. QR code
9. Safety instructions, disposal and data matrix

**Additional markings on the housing cover:**
- SN - serial number
- SO - sales order / item
- PA - production 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 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).

WARNING!
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 in accordance with the standards ABNT NBR IEC 60079-0 and ABNT NBR IEC 60079-11 in equipment protection level (EPL) Gb for use in zone 1.

Depending on the device version, variable area flowmeters are also designed in equipment protection level (EPL) Db for use in zone 21.

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

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 with protection type intrinsic safety "i" according to ABNT NBR IEC 60079-11.

The identification for equipment protection level (EPL) Gb is:
Ex ia IIC T6...T3 Gb

The marking contains the following information:

<table>
<thead>
<tr>
<th>Ex ia</th>
<th>Explosion protection through intrinsic safety, protection level “ia”</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIC</td>
<td>Gas group, suitable for gas groups IIC, IIB and IIA</td>
</tr>
<tr>
<td>T6...T3</td>
<td>Temperature class range, suitable for temperature classes T6...T1</td>
</tr>
<tr>
<td>Gb</td>
<td>EPL, suitable for zone 1 and zone 2</td>
</tr>
</tbody>
</table>

Table 2-1: Description of the marking

INFORMATION!
For the equipment protection level (EPL) Gb, 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.

The additional identification of the version for the equipment protection level (EPL) Db is:
Ex ia IIIC T75°C...T200°C Db

The marking contains the following information:

<table>
<thead>
<tr>
<th>Ex ia</th>
<th>Explosion protection through intrinsic safety, protection level “ia”</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIIC</td>
<td>Dust group, suitable for groups IIIC, IIIB and IIIA</td>
</tr>
<tr>
<td>T75°C...T200°C</td>
<td>Maximum surface temperature at +65°C / +149°F ambient temperature</td>
</tr>
<tr>
<td>Db</td>
<td>EPL, suitable for zone 21 and zone 22</td>
</tr>
</tbody>
</table>

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 / product temperature

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 shown in the following tables.

The tables take into account the following parameters:

- Built-in equipment
- Maximum values $I_i$ and $P_i$ for $K1$ and $K2$
- Ambient temperature $T_{amb}$
- Product temperature $T_m$
- Heat resistance of the connecting cable

When using more than one installed 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 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 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 product temperature is shown in the following tables.

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>Ambient temperature up to</th>
<th>Maximum permissible product temperature / maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td>Type DK37/M8E/..</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type DK37/M8M/..K. at 64 mW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type DK37/M8M/..K. at 169 mW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td>+40</td>
<td>+104</td>
</tr>
<tr>
<td></td>
<td>+50</td>
<td>+122</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>+140</td>
</tr>
<tr>
<td>T5</td>
<td>+40</td>
<td>+104</td>
</tr>
<tr>
<td></td>
<td>+50</td>
<td>+122</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>+140</td>
</tr>
<tr>
<td></td>
<td>+65</td>
<td>+149</td>
</tr>
<tr>
<td>T4</td>
<td>+40</td>
<td>+104</td>
</tr>
<tr>
<td></td>
<td>+50</td>
<td>+122</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>+140</td>
</tr>
<tr>
<td></td>
<td>+65</td>
<td>+149</td>
</tr>
<tr>
<td>T3</td>
<td>+40</td>
<td>+104</td>
</tr>
<tr>
<td></td>
<td>+50</td>
<td>+122</td>
</tr>
<tr>
<td></td>
<td>+60</td>
<td>+140</td>
</tr>
<tr>
<td></td>
<td>+65</td>
<td>+149</td>
</tr>
</tbody>
</table>

Table 2-3: Maximum permissible product temperature

1. Temperature resistance of the cable ≥ +80°C
2. Temperature resistance of the cable ≥ +176°F
The permissible ambient temperature range is indicated on the nameplate; depending on the device version it is:

\[ T_{\text{amb}} = -40\ldots+65^\circ\text{C} / -40\ldots+149^\circ\text{F} \text{ or } T_{\text{amb}} = -25\ldots+65^\circ\text{C} / -13\ldots+149^\circ\text{F}. \]

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

### 2.8 Surface temperature for equipment protection level Db

For use in areas with flammable dust it should be noted that the indicated maximum surface temperature of \(T_{75}^\circ\text{C}\) at an ambient temperature of \(+65^\circ\text{C} / +149^\circ\text{F}\) and a product temperature of \(+75^\circ\text{C} / +167^\circ\text{F}\) is valid without a dust coating.

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

### 2.9 Electrical data

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

<table>
<thead>
<tr>
<th>Device version</th>
<th>Electrical built-ins</th>
<th>Min. ambient temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK37/M8E/.../..</td>
<td>Signal output 4...20 mA</td>
<td>(-40^\circ\text{C} / -40^\circ\text{F})</td>
</tr>
<tr>
<td>DK37/M8M/.../..</td>
<td>SC2-N0</td>
<td>(-25^\circ\text{C} / -13^\circ\text{F})</td>
</tr>
<tr>
<td>DK37/M8M/.../..</td>
<td>I7S2002-N SJ2-SN</td>
<td>(-40^\circ\text{C} / -40^\circ\text{F})</td>
</tr>
<tr>
<td>DK37/M8M/.../..</td>
<td>Without electrical built-ins</td>
<td>(-40^\circ\text{C} / -40^\circ\text{F})</td>
</tr>
</tbody>
</table>

Table 2-4: Minimum permissible ambient temperature depending on electrical built-ins

<table>
<thead>
<tr>
<th>Maximum values</th>
<th>Device version</th>
<th>(U_i) [V]</th>
<th>(I_i) [mA]</th>
<th>(P_i) [mW]</th>
<th>(C_i) [nF]</th>
<th>(L_i) [(\mu\text{H})]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK37/M8E/.../..</td>
<td>30</td>
<td>120</td>
<td>1000</td>
<td>0</td>
<td>~ 0</td>
<td></td>
</tr>
<tr>
<td>DK37/M8M/.../.. SC2-N0..</td>
<td>16</td>
<td>25</td>
<td>64</td>
<td>165</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>DK37/M8M/.../.. SJ2-SN</td>
<td>52</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DK37/M8M/.../.. I7S2002-N</td>
<td>16</td>
<td>25</td>
<td>64</td>
<td>45</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>DK37/M8M/.../..</td>
<td>52</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 an intrinsically safe circuit. 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 by qualified personnel trained in explosion protection. The information given in the manuals and the supplementary instructions must be observed at all times.

Variable area flowmeters must be installed in such a way that
- there is no danger from mechanical impact effects.
- 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.

**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

Electrostatics
For painted versions, risks due to electrostatic charge must be minimized. Observe additional information regarding electrostatics. For further information refer to Electrostatic charge on page 17.

Thermal and electrical data
Observe the maximum ambient and product temperatures and electrical data. For further information refer to Ambient temperature / temperature classes / product temperature on page 10 and refer to Surface temperature for equipment protection level Db on page 12 and refer to Electrical data on page 12.
4.1 General notes

The built-in equipment is connected electrically in the indication unit. The circuits are designed in protection type “intrinsically safe” and galvanically isolated from ground (test voltage ≥ 500 V_{eff}).

The connecting cables should be selected according to the applicable installation standards 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 ≥ 500 V_{eff}).
- Lay cables so as to ensure that there is sufficient distance between surfaces of the measuring unit and the connecting cable.
- If the blind plugs / cable entries supplied separately on customer request, the influence of the components on the IP protection class of the housing or the thermal data must be validated.

Recommendation:

- IP protection class: ≥ IP66/67 according to IEC 60529
- Temperature range: -40...+80°C / -40...+176°F

- The outer diameter of the connecting cable must be within the sealing range of the cable entry (plastic PG 3...7 mm / 0.12...0.28”, metal PG 6...10 mm / 0.24...0.39”).
- Unused cable entries are to be closed (>IP66/67).

Ensure that the gaskets and incised gasket ring are tight.
Connection diagrams

Figure 4-1: Connection diagram for indicator M8M - M8MG
1. Connection Kmin
2. Connection Kmax

Figure 4-2: Connection diagram for indicator M8E - M8EG
1. Connection signal output 4...20 mA

4.2 Power supply

The variable area flowmeter does not require a separate power supply. The necessary power for the built-in electrical equipment is supplied via the signal circuits.

4.3 Inputs / Outputs

The terminal assignment of the built-in electrical equipment is described in the product 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 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: Position of the ground terminal](image)

Any existing cable shields and all cores that are not used must be carefully insulated against each other and against ground [test voltage \( \geq 500 \ V_{eff} \)] according to applicable installation regulations.
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.
- has been properly sealed in the electronic compartment or there is no explosive atmosphere present.

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

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 and operating the display during operation is permitted. To do so, remove the housing cover. Close the housing cover immediately after the adjustment of the limit switches or the operation of the display.

For more information refer to chapter “Dismantling”.

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

5.3 Electrostatic charge

**INFORMATION!**
Versions with plastic housing are equipped with an electrostatically conductive plastic.

In order to avoid ignition hazards due to electrostatic charge, painted versions of the variable area flowmeter DK37 M8. R.... may not be used in areas where the following appear:
- 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.

**CAUTION!**
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 piping connections and the measuring unit as well as the needle valve, if necessary, for leakage.
- Include the flowmeter in the regular pressure testing of the process line.

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

6.2 Dismantling

**Replacing the display**

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

**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 this 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.
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

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com