Variable area flowmeter with electrical built-ins

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

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Safety instructions</td>
<td>3</td>
</tr>
<tr>
<td>1.1 General notes</td>
<td>3</td>
</tr>
<tr>
<td>1.2 EU conformity</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Approval according to the IECEx scheme</td>
<td>3</td>
</tr>
<tr>
<td>1.4 Safety instructions</td>
<td>4</td>
</tr>
<tr>
<td>2 Device description</td>
<td>5</td>
</tr>
<tr>
<td>2.1 Device description</td>
<td>5</td>
</tr>
<tr>
<td>2.2 Description code</td>
<td>5</td>
</tr>
<tr>
<td>2.3 Marking</td>
<td>6</td>
</tr>
<tr>
<td>2.4 Flammable products</td>
<td>7</td>
</tr>
<tr>
<td>2.5 Equipment category</td>
<td>7</td>
</tr>
<tr>
<td>2.6 Types of protection</td>
<td>8</td>
</tr>
<tr>
<td>2.6.1 Protection type - Flameproof enclosure</td>
<td>8</td>
</tr>
<tr>
<td>2.6.2 Protection type - Protection through enclosure</td>
<td>8</td>
</tr>
<tr>
<td>2.7 Ambient temperature / temperature classes</td>
<td>9</td>
</tr>
<tr>
<td>2.8 Surface temperature for equipment category II 2 D</td>
<td>10</td>
</tr>
<tr>
<td>2.9 Electrical data</td>
<td>10</td>
</tr>
<tr>
<td>3 Installation</td>
<td>11</td>
</tr>
<tr>
<td>3.1 Mounting</td>
<td>11</td>
</tr>
<tr>
<td>3.2 Special conditions</td>
<td>12</td>
</tr>
<tr>
<td>4 Electrical connections</td>
<td>13</td>
</tr>
<tr>
<td>4.1 General notes</td>
<td>13</td>
</tr>
<tr>
<td>4.2 Grounding and equipotential bonding</td>
<td>15</td>
</tr>
<tr>
<td>5 Operation</td>
<td>16</td>
</tr>
<tr>
<td>5.1 Start-up</td>
<td>16</td>
</tr>
<tr>
<td>5.2 Operation</td>
<td>16</td>
</tr>
<tr>
<td>5.3 Electrostatic charge</td>
<td>16</td>
</tr>
<tr>
<td>6 Service</td>
<td>17</td>
</tr>
<tr>
<td>6.1 Maintenance</td>
<td>17</td>
</tr>
<tr>
<td>6.2 Dismantling</td>
<td>18</td>
</tr>
<tr>
<td>7 Notes</td>
<td>19</td>
</tr>
</tbody>
</table>
1.1 General notes

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

The information given in this instruction contains only the data relevant to explosion protection
of category 2.
The technical details given in the 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 on his own responsibility
conformity with the protection goals of directive 2014/34/EU for use in hazardous areas.
Conformity with harmonised standards was checked in accordance with EN 60079-0:2012,

The EU declaration of conformity is based on the EU type examination certificate of the KIWA
ExVision:

KIWA 18ATEX0008 X

If necessary, the EU type examination certificate can be downloaded from the manufacturer’s website.

1.3 Approval according to the IECEx scheme

Conformity with IECEx standards was tested in accordance with the “IECEx Certification Scheme
for Explosive Atmospheres” according to IEC 60079-0:2011, IEC 60079-1:2014 and
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.
The indication unit is equipped with HART® communication.

2.2 Description code

The safety description code consists of the following elements *:

<table>
<thead>
<tr>
<th>DK</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

Figure 2-1: Safety description code

1  32 - with valve and horizontal connection / 34 - without valve and vertical connection
2  RE - inlet pressure regulator / RA - outlet pressure regulator
3  ESK - version with current output
4  Marking without influence on the explosion safety protection
5  Ex - explosion-protected equipment

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

The marking of the entire device is on the indication unit, where the following identification plate can be found. An additional marking with the production number (P/A) is located inside of the indication.

Figure 2-2: Example of a nameplate

1. Device type
2. Manufacturer
3. Notified body ATEX
4. Rating data: temperature & pressure rating
5. Ex data according to KIWA 18ATEX0008 X or IECEx KIWA 18.0007X
6. Built-in equipment
7. Note to observe the documentation and for disposal
8. PED data
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 in category II 2 G / II 2 D or EPL Gb and EPL Db according to EN 60079-0, EN 60079-1 and EN 60079-31 for use in zone 1 or zone 21.
The inside of the measuring unit is also approved for zone 1.

**INFORMATION!**
Definition of zone 1:
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 available in different protection types, depending on the selected indicator version. The markings are listed and explained in the following sub-sections.

2.6.1 Protection type - Flameproof enclosure

The variable area flowmeter is designed with protection type “flameproof enclosure” according to EN 60079-1. The explosion protection is ensured through design measures of the housing.

The marking is:
II 2G Ex db IIC T6...T1 Gb

The marking contains the following information:

<table>
<thead>
<tr>
<th>II</th>
<th>Explosion protection, group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Equipment category 2</td>
</tr>
<tr>
<td>G</td>
<td>Gas explosion protection</td>
</tr>
<tr>
<td>Ex d</td>
<td>Protection type “Flameproof enclosure”</td>
</tr>
<tr>
<td>IIC</td>
<td>Gas group, suitable for gas groups IIA, IIB, IIC</td>
</tr>
<tr>
<td>T6...T1</td>
<td>Temperature class, suitable for T6...T1</td>
</tr>
<tr>
<td>Gb</td>
<td>EPL, suitable for zone 1</td>
</tr>
</tbody>
</table>

Table 2-1: Description of the marking

2.6.2 Protection type - Protection through enclosure

The variable area flowmeter is designed with protection type “protection through enclosure” according to EN 60079-31. Dust protection is guaranteed by the use of a housing which provides appropriate protection against penetration of dust.

The marking is:
II 2D Ex tb IIC T85°C...T140°C Db IP65

The marking contains the following information:

<table>
<thead>
<tr>
<th>II</th>
<th>Explosion protection, group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Equipment category 2</td>
</tr>
<tr>
<td>D</td>
<td>Dust ignition protection</td>
</tr>
<tr>
<td>Ex t</td>
<td>Protection type “Equipment - dust ignition protection through enclosure”</td>
</tr>
<tr>
<td>IIC</td>
<td>Dust group, suitable for dust groups IIIA, IIIB and IIIC</td>
</tr>
<tr>
<td>T85°C...T140°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</td>
</tr>
<tr>
<td>IP65</td>
<td>Foreign bodies and water protection</td>
</tr>
</tbody>
</table>

Table 2-2: Description of the marking
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. The classification is outlined in the following tables.

The tables take into account the following parameters:
- Ambient temperature $T_{\text{amb}}$
- Product temperature $T_m$

**INFORMATION!**
The lowest ambient temperature is $-40^\circ C / -40^\circ F$.

**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.

<table>
<thead>
<tr>
<th>Maximum permissible product temperature $T_m \ [^\circ C]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_6$</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td><strong>DK3./../ESK./.</strong></td>
</tr>
<tr>
<td>85</td>
</tr>
</tbody>
</table>

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

① Heat-resistant cable and cable entry ≥ 90°C

<table>
<thead>
<tr>
<th>Maximum permissible product temperature $T_m \ [^\circ F]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_6$</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
</tr>
<tr>
<td>104</td>
</tr>
<tr>
<td><strong>DK3./../ESK./.</strong></td>
</tr>
<tr>
<td>185</td>
</tr>
</tbody>
</table>

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

① Heat-resistant cable and cable entry ≥ 194°F
2.8 Surface temperature for equipment category II 2 D

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 ≥ +90°C / +194°F must be used.

2.9 Electrical data

The following maximum values apply for connecting the electrical signal circuits:

<table>
<thead>
<tr>
<th>UN</th>
<th>12...32 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN</td>
<td>4...20 mA</td>
</tr>
</tbody>
</table>

Table 2-5: Version DK3./../ESK./../-Ex
3.1 Mounting

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

Variable area flowmeters must be installed in such a way that

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

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

**Equipotential bonding**
Variable area flowmeters must be included in the equipotential bonding of the hazardous area.

**Electronics compartment lock**
Lock the dustproof and/or flameproof electronics compartment of the variable area flowmeter during operation. First tighten the cover by hand. Then tighten the cover again by about 90°. The cover for the electronics compartment is secured by means of a lock. Use a WS3 Allen key to turn the screw. No waiting period is necessary prior to opening the electronics compartment.

**Flameproof joints in the housing**
The flameproof thread gap between the cover and the electronics compartment must be inspected visually after opening. The housing must be replaced if there is any damage to the joint area. The flameproof joints are not intended for repair.
4.1 General notes

Rated values for insulation

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

Terminal compartment

The electrical connection for the power supply and I/O functions is made in the electronics compartment of the signal converter. The protection type of the electronics compartment is “d” and/or “t”. If no cable gland was ordered, the connection thread is simply closed with a blind plug. This must be replaced by a suitable cable gland in accordance with EN 60079-1 and/or EN 60079-31. The cables can enter the electronics compartment in two different ways.

- Direct entry of the connecting cables by way of approved flameproof M16x1.5 cable glands into the flameproof/dust proof terminal compartment (V ≤ 2000 cm³). The cable glands require a separate test certificate in accordance with EN 60079-1/EN 60079-31. Observe the requirements of the test certificate for the cable glands.
- Direct entry of the connecting cables by way of conduits into the flameproof enclosed terminal compartment of the device. Once the conduit has been screwed in, it must form a flameproof joint with the housing with a minimum thread length of 8 mm / 0.3”. A suitable mechanical stopping box must be provided in accordance with installation provisions. The conduit must be installed in compliance with its separate test certificate.

Electrical connection

Figure 4-1: Electrical connection ESK

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

- The connecting cables must be fixed and laid so they are sufficiently protected against damage.
- Lay cables so as to ensure that there is sufficient distance between surfaces of the measuring unit and the connecting cable.
- Supplied cable entries guarantee protection against foreign objects and water (ingress protection) IP66/68 according to EN 60529.
- The outer diameter of the connecting cable must be within the sealing range of the cable entry (e.g. 7...12 mm / 0.27...0.47”).

Ensure that the gaskets and incised gasket ring are tight.

CAUTION!
The IP protection category of the signal converter housing is largely determined by the cable gland used and the installation.
4.2 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.

**INFORMATION!**
The temperature at the electrostatic equalization connection of 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

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.

**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.
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.

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 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 measures 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 pressurized 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 18).
6.2 Dismantling

**General notes**

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

Only identical signal converter from the manufacturer may be used.

**Exchanging the signal converter**

Due to the design of the variable area flowmeters, from a safety perspective the signal converter can be replaced with an identical signal converter.

The measuring unit does not need to be removed from the process connections.

This also applies to pressurised processes.

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

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

After opening the signal converter, treat the ignition-proof cover threads as necessary with UNIMOLY C220® lubricating paint.

After opening the signal converter, grease the cover seals if necessary to avoid dry running.

Use for example the multi-purpose grease NONTRIBOS®, type Li EP2.

Close the housing cover immediately after the spare parts are exchanged. Ensure that the cover seal is tight.

**CAUTION!**

*There may be a loss of measuring accuracy!*

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**Exchanging the entire device**

The same requirements as described in “Exchanging the signal converter” apply for “Exchanging the entire device”.

**CAUTION!**

Pressurised process connections have to be depressurised before removing the process connection.

Where environmentally critical products are concerned, carefully decontaminate the wetted parts of the device after dismantling.

The dismantling and installation is within the responsibility of the operator.
KROHNE – Process instrumentation and measurement solutions

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- Process Analysis
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