Variable area flowmeter
Device category II2G with electrical internals

Additional Ex manual
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1.1 General

These supplementary Ex instructions apply for explosion-protected designs of the variable area flowmeters DK.../..-Ex for the category II2G.
They complete the installation and operating instructions for non-explosion protected versions.

The information in these instructions contains only the data concerning the explosion protection of category 2.
The technical details given in the installation and operation instructions for the non-explosion protected versions apply unchanged unless excluded or superseded by these instructions.

1.2 EC conformity

The manufacturer declares with the EC Declaration of Conformity on his own responsibility conformity with the protection goals of Directive 94/9/EC for use in hazardous areas with gas.

The EC Type Examination Certificate of the Physikalisch Technische Bundesanstalt (PTB) forms the basis of the EC Declaration of Conformity:

PTB 05 ATEX 2021 X

If required the EC Type Test Certificate can be downloaded under www.krohne.com.

1.3 Security information

Assembly, installation, start-up and maintenance may only be performed by personnel trained in explosion protection!

CAUTION!
The operator respectively his agent is responsible to follow further standards, directives or laws if required due to operating conditions or place of installation. This applies particularly for the use of easy detachable process connections such as SMS or Clamp when measuring flammable mediums.
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 to the on-site display.

2.2 Description code

The safety description code * consists of the following elements:

| DK | / | / | / | / | / |
| 1 | 2 | 3 | 4 | 5 |

1. R - with integrated inlet pressure regulator (DKR46 only)

2. Device type:
   46 - Overall length of measuring cone 65 mm
   47 - Overall length of measuring cone 150 mm
   48 - Overall length of measuring cone 300 mm
   800 - Overall length of measuring cone 100 mm

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. K1 - one limit switch / K2 - two limit switches

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

The marking for the entire device is provided on the indicator part with the marking plate shown below.

![Marking Plate Image]

Additional markings on the measuring device
- SN - serial number
- SO - sales order / item
- Tag-No - Measuring point identifier
- MD - manufacturing date
- PA - KROHNE order
- Vx - product configurator code
- AC - article code
2.4 Flammable products

Atmospheric conditions
An explosive atmosphere is defined as a mixture of air and flammable gases, vapours, mists or
dusts under atmospheric conditions with the values
\[ T_{atm} = -20^\circ C...+60^\circ C / -4^\circ F...140^\circ F \] and \[ P_{atm} = 0,8...1,1\text{bar}. \]
Outside of this range, no key data are available as to ignition behaviour for most mixtures.

Operating conditions
Variable area flowmeters operate outside of atmospheric conditions, which means that
explosion protection according to Directive 94/9/EC (ATEX) – regardless of the zone assignment
– is fundamentally not applicable due to the lack of key safety data for the interior of the
measuring unit.

CAUTION!
Operation with flammable products is only permissible if no explosive fuel/air mixture is formed
on the interior of the flowmeter under operating conditions. The user is responsible for the safe
operation of the flowmeter with regard to the temperatures and pressures of the products used.
In case of operation with flammable products the measuring units must be included in the
periodic pressure tests of the system.

2.5 Equipment category

The flowmeters are designed in Category II 2G according to EN 60079-0 and
EN 60079-11 for use in Zone 1.

2.6 Types of protection

The circuits of the limit switches (ring sensors) are designed in Intrinsic Safety type of protection
of Category “ia”. They can also be operated in Category “ib”.

CAUTION!
2.7 Ambient temperature / temperature classes

Because of the influence of the temperature of the product, no permanent temperature class is assigned to variable area flowmeters. In fact, the temperature class of a device is a function of the temperature of both the product and the environment. 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 $T_{\text{amb}}$
- Product temperature $T_m$
- Installed equipment
- Supply type (maximum value for $P_i$)

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 installation and operating 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.
### Temperature table in °C

<table>
<thead>
<tr>
<th>Type of limit switch</th>
<th>Maximum permissible ambient / medium temperature in °C</th>
<th>Supply</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>T6</strong></td>
<td><strong>T5</strong></td>
<td><strong>T4...T1</strong></td>
<td><strong>T6</strong></td>
</tr>
<tr>
<td>RC10-14.-N0...</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>RC15-14.-N0...</td>
<td>70</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>RC10-14.-N3...</td>
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<tr>
<td>I7R2010-N***</td>
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<tr>
<td>I7R2015-N***</td>
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<td>149</td>
<td>149</td>
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</tr>
</tbody>
</table>

The maximum lower ambient temperature is -20°C

### Temperature table in °F

<table>
<thead>
<tr>
<th>Type of limit switch</th>
<th>Maximum permissible ambient / medium temperature in °F</th>
<th>Supply</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td><strong>T6</strong></td>
<td><strong>T5</strong></td>
<td><strong>T4...T1</strong></td>
<td><strong>T6</strong></td>
</tr>
<tr>
<td>RC10-14.-N0...</td>
<td>149</td>
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<tr>
<td>RC15-14.-N0...</td>
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<td>167</td>
<td>167</td>
<td>167</td>
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<tr>
<td>RC10-14.-N3...</td>
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<td>158</td>
<td>158</td>
<td>158</td>
<td>158</td>
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<tr>
<td>RC15-14.-N3...</td>
<td>158</td>
<td>176</td>
<td>176</td>
<td>176</td>
<td>176</td>
</tr>
<tr>
<td>I7R2010-N***</td>
<td>158</td>
<td>176</td>
<td>176</td>
<td>176</td>
<td>176</td>
</tr>
<tr>
<td>I7R2015-N***</td>
<td>158</td>
<td>176</td>
<td>176</td>
<td>176</td>
<td>176</td>
</tr>
</tbody>
</table>

The maximum lower ambient temperature is -4°F

These values may be limited by the data given in the Installation and Operating Instructions. The maximum values given in the Installation and Operating Instructions must be taken into consideration.
3.1 Installation

Installation and setup must be carried out according to the applicable installation installation standards (e.g. EN 60079-14) by qualified personnel trained in explosion protection. The information given in the Installation and Operation Instructions and the Supplementary Installation and Operation 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 visual inspections that are necessary, and can be viewed from all sides.
- The nameplate is clearly visible.
- It can be operated from a location with secure footing.

**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.
4.1 Electrical connection

The built-in intrinsically safe NAMUR limit switches in the variable area flowmeter DK.../.../... may only be connected to isolation switching amplifiers with separated intrinsically safe circuits to DIN 19234 with the following max. values:

**Maximum values of the power supply units**

<table>
<thead>
<tr>
<th>Supply</th>
<th>P_i [mW]</th>
<th>U_i [V]</th>
<th>I_i [mA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>34</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Type 2</td>
<td>64</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Type 3</td>
<td>169</td>
<td>16</td>
<td>52</td>
</tr>
</tbody>
</table>

When connecting to intrinsically safe circuits, take into consideration the following maximum values per circuit as a function of the limit switch (see plate on terminal box) for the energy stores.

<table>
<thead>
<tr>
<th>Type of limit switch</th>
<th>C_i [nF]</th>
<th>L_i [µH]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC10-14.-N0.../RC15-14.-N0...</td>
<td>I7R2010-N***/I7R2015-N***</td>
<td>210</td>
</tr>
<tr>
<td>RC10-14.-N3...</td>
<td>I7R2010-NL***</td>
<td>150</td>
</tr>
<tr>
<td>RC15-14.-N3...</td>
<td>I7R2015-NL***</td>
<td>150</td>
</tr>
</tbody>
</table>

4.2 Terminal assignment

Connect the built-in intrinsically safe components to terminals + / - in accordance with the following illustration and table. Connect one limit switch to each terminal block. Take note of the polarity indicated.

**Connection of limit switch - 2 wire NAMUR**

1. Lower limit switch to terminal 1
2. Upper limit switch to terminal 2

The connection box includes an EMC filter unit.

For devices with just one limit switch, the connection is on terminal 1.
4.3 Connecting cable

Select the connecting cables for the intrinsically safe circuits according to the valid wiring standard (e.g. EN 60079-14). Make sure that no residual current can form between different intrinsically safe circuits of the variable area flowmeter. Lay cables so as to ensure that there is sufficient distance between surfaces of the measuring unit and the connecting cable.

4.4 Earthing and equipotential bonding

If the device is not adequately grounded electrostatically by way of the process piping, make an additional ground connection ① by way of the ground connection. The location of the ground connection on the back rail is shown below. This connection merely ensures electrostatic connection of the device and does not meet the requirements for equipotential bonding.
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 process product.
- Correct connection of the built-in electrical components.
- Visual inspection of the single-core non-sheathed cables of the ring sensors, laid inside the indicator, for signs of damage.

5.2 Operation

The limit switches can be set during operation. To do so, first remove the protective cover. Fix the limit switch 2 to the back rail 3 of the variable area flowmeter using the two clamping screws 1. Close the cover immediately after the limit switches have been set.

CAUTION!

Avoid pinching or damaging the single-core cable of the limit switches when setting the switches and closing the cover. It should be laid in the grooves of the back rail. If the cable is damaged in any way, the variable area flowmeter will need to be replaced!
5.3 Static electricity

Flow-induced static 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 internals.

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 by way of the process connections in order to allow discharge of electrostatic build-up.

The operator is also responsible for extending the ground continuity of the process pipeline. If grounding cannot be made via the process connections, e.g. top and bottom connection blocks are made of plastic, the flowmeter should be connected to the local ground potential via the connection to ground. This connection only ensures electrostatic grounding of the device and does not meet the requirements for equipotential bonding.

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

The variable area flowmeter does not require any maintenance under normal operating conditions and when used for the intended purpose. Within the scope of checks required to be carried out in hazardous areas to maintain systems in proper working order, the following visual inspections should be carried out at regular intervals:

- Inspection of the housing, cable entries and incoming cables for signs of damage.
- Inspection of the measuring unit for leaks and signs of damage to the glass cone.
- Include the flowmeter in the periodic pressure testing of the process piping.

Depending on application, however, the measuring function may in unfavourable cases become impaired through soiling of the measuring cone and/or float. The measuring unit should then be cleaned as described in the Installation and Operating Instructions for the non-hazardous-duty versions. In this connection, refer to the notes on dismantling.

6.2 Dismantling

Electrical connection

If at all possible, dismantling should be carried out after the flowmeter has been disconnected from supply. If not possible, observe the boundary conditions for intrinsic safety [e.g. no grounding or connection of different intrinsically safe circuits] during dismantling.

Process connections

CAUTION!

Pressurized pipes to be depressurized before removing the flowmeter. Avoid uncontrolled discharge of residual fluid from the measuring unit. Where environmentally critical products are concerned, carefully decontaminate the wetted parts of the measuring tube after dismantling.

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 product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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