Variable area flowmeter

Equipment protection level EPL Gb and Db
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1.1 General notes

These additional instructions apply to explosion-protected versions of variable area flowmeter model DK37 with electrical built-ins in type of protection intrinsic safety “i” and without electrical built-ins in type of protection constructional safety “c”, 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details given in the standard manual for the non-explosion protected versions apply unchanged unless excluded or superseded by these supplementary instructions.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 TR CU conformity

Conformity of the variable area flowmeter for use in hazardous areas was tested in accordance with the Custom Union Technical Regulation TR CU 012/2011.

The number of the certificate is:

TC RU C-DE.AA87.B.01261

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 and display the volume flow of flammable and non-flammable gases and liquids.

![Figure 2-1: Available indicators](image)

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](image)

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.

Figure 2-3: Example of a nameplate

1. Device designation
2. Manufacturer and manufacturer address
3. Rating data: temperature & pressure rating
4. Pressure data
5. Ex data according to notified body
6. Electrical connection data (depending on built-in equipment)
7. Symbol for region (e.g. Russia)
8. Internet address of the manufacturer
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.

*When using the device version H250/C... (PTFE version, non-conductive) the minimum conductivity of the media must be $10^{-8}$ S/m, in order to avoid danger from electrostatic charge.*
2.5 Types of protection

The variable area flowmeter type DK37/M8E and type DK37/M8M with electrical built-ins is designed in type of protection intrinsic safety "i" according to GOST 31610.11-2014 / IEC 60079-11:2011.

Type DK37/M8M without electrical built-ins is designed in type of protection constructional safety "c" according to GOST 31441.5-2011 / ISO IEC 80079-37.

The identification for equipment EPL Gb with electrical built-ins is:

1Ex ia IIC T6...T3 Gb X

The marking contains the following information:

<table>
<thead>
<tr>
<th>1</th>
<th>Gas explosion protection for zone 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex ia</td>
<td>Explosion protection through intrinsic safety, level of protection &quot;ia&quot;</td>
</tr>
<tr>
<td>IIC</td>
<td>Gas group, suitable for gas groups IIC, IIIB and IIIA</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>
<tr>
<td>X</td>
<td>Indication of special conditions for safe use</td>
</tr>
</tbody>
</table>

Table 2-1: Identification for equipment EPL Gb with electrical built-ins

**INFORMATION!**

For the equipment 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 EPL Db with electrical built-ins is:

Ex ia IIIC T75°C...T200°C Db X

The marking contains the following information:

<table>
<thead>
<tr>
<th>Ex ia</th>
<th>Explosion protection through intrinsic safety, level of protection &quot;ia&quot;</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</td>
</tr>
<tr>
<td>Db</td>
<td>EPL, suitable for zone 21 and zone 22</td>
</tr>
<tr>
<td>X</td>
<td>Indication of special conditions for safe use</td>
</tr>
</tbody>
</table>

Table 2-2: Identification for equipment EPL Db with electrical built-ins

**INFORMATION!**

For the equipment 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.
The identification for equipment **EPL Gb without electrical built-ins** is:

I I Gb c IIC T6...T3 X

<table>
<thead>
<tr>
<th>The marking contains the following information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>Gb</td>
</tr>
<tr>
<td>c</td>
</tr>
<tr>
<td>IIC</td>
</tr>
<tr>
<td>T6...T3</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

Table 2-3: Identification for equipment EPL Gb without electrical built-ins

The identification for equipment **EPL Db without electrical built-ins** is:

IIIIIIIIIIII

<table>
<thead>
<tr>
<th>The marking contains the following information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
</tr>
<tr>
<td>Db</td>
</tr>
<tr>
<td>c</td>
</tr>
<tr>
<td>T150°C</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

Table 2-4: Identification for equipment EPL Db without electrical built-ins
2.6 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>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>Type DK37/M8M/..K.</td>
<td></td>
<td></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>Type DK37/M8M/..K.</td>
<td></td>
<td></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>Type DK37/M8M/..K.</td>
<td></td>
<td></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 2-5: 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
\[ T_{\text{amb}} = -40...+65^\circ C / -40...+149^\circ F \text{ or } T_{\text{amb}} = -25...+65^\circ C / -13...+149^\circ F. \]

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

### Table 2-6: Minimum permissible ambient temperature depending on electrical built-ins

<table>
<thead>
<tr>
<th>Type</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°C / -40°F</td>
</tr>
<tr>
<td>DK37/M8M/../..</td>
<td>SC2-N0</td>
<td>-25°C / -13°F</td>
</tr>
<tr>
<td>DK37/M8M/../..</td>
<td>I7S2002-N SJ2-SN</td>
<td>-40°C / -40°F</td>
</tr>
<tr>
<td>DK37/M8M/../..</td>
<td>Without electrical built-ins</td>
<td>-40°C / -40°F</td>
</tr>
</tbody>
</table>

2.7 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 \(T_{75}^\circ C\) at an ambient temperature of \(+65^\circ C / +149^\circ F\) and a product temperature of \(+75^\circ C / +167^\circ F\) is valid without a dust coating.

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

2.8 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 2-7: Maximum values for intrinsically safe circuits

<table>
<thead>
<tr>
<th>Device version</th>
<th>Maximum values</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK37/M8E/../.. or H250/../M8EG</td>
<td>(U_i [V] = 30), (I_i [mA] = 120), (P_i [mW] = 1000), (C_i [nF] = 0), (L_i [\mu H] = 0)</td>
</tr>
<tr>
<td>DK37/M8M/../.. or H250/../M8MG SC2-N0...</td>
<td>(U_i [V] = 16), (I_i [mA] = 25), (P_i [mW] = 64), (C_i [nF] = 165), (L_i [\mu H] = 150)</td>
</tr>
<tr>
<td>DK37/M8M/../.. or H250/../M8MG SJ2-SN</td>
<td>(U_i [V] = 16), (I_i [mA] = 25), (P_i [mW] = 64), (C_i [nF] = 45), (L_i [\mu H] = 100)</td>
</tr>
<tr>
<td>DK37/M8M/../.. or H250/../M8MG I7S2002-N</td>
<td>(U_i [V] = 16), (I_i [mA] = 25), (P_i [mW] = 64), (C_i [nF] = 165), (L_i [\mu H] = 120)</td>
</tr>
</tbody>
</table>

**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 minimised. Observe additional information regarding electrostatics. For further information refer to Electrostatic charge on page 16.

Thermal and electrical data
Observe the maximum ambient and product temperatures and electrical data.
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 \( \geq 500 \, V_{\text{eff}} \)).

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 \( \geq 500 \, V_{\text{eff}} \)).
- 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: \( \geq \text{IP66/67} \) according to IEC 60529
- Temperature range: \(-40\ldots+80^\circ\text{C} / -40\ldots+176^\circ\text{F}\)

- 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 (\(>\text{IP66/67}\)).

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.

![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 ≥ 500 V<sub>eff</sub>] 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.... and H250.. M8.. R..Ex 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.
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