



## H250 M40 Handbook

Variable area flowmeter

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## 1.1 Intended use

**CAUTION!**

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

**INFORMATION!**

This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

**INFORMATION!**

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The variable area flowmeters are suitable for measuring clean gases, vapours and liquids.

**Intended use:**

- The product may not contain any ferromagnetic particles or solids. It may be necessary to install magnetic filters or mechanical filters.
- The product must be sufficiently liquid and free of deposits.
- Avoid pressure surges and pulsing flows.
- Open valves slowly. Do not use solenoid valves.

**Use suitable measures to eliminate compression vibrations during gas measurements:**

- Short pipeline lengths to next restriction
- Nominal pipe size not greater than nominal device size
- Use of floats with damping
- Increase in operating pressure (while taking into account the resulting change in density and thus change in scale)

Observe installation conditions according to VDI/VDE 3513-3.

**DANGER!**

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

**CAUTION!**

Do not use any abrasive media containing solid particles or highly viscous media.

## 1.2 Certifications

CE marking



The device fulfils all applicable statutory requirements of the EU directives:

- Pressure equipment directive
- For devices with electrical installations: EMC directive
- Devices for use in hazardous areas: ATEX directive

as well as

- NAMUR recommendations NE 21, NE 43 and NE 107

The manufacturer certifies successful testing of the product by applying the CE marking. An EU declaration of conformity regarding the directives in question and the associated harmonised standards can be downloaded from our internet site.

## 1.3 Pressure equipment directive

A conformity assessment in accordance with pressure equipment directive has been carried out for the devices described. Conformity is certified by applying the CE mark. The number of the notified body is also stated.

The PED key describes the rating of the devices:

Example: PED/G1/III/H

|     |  |
|-----|--|
| G   | Gases and vapours                                  |
| 1   | Fluid group 1                                      |
| III | Category III                                       |
| H   | Conformity assessment method according to Module H |

The PED key identification can be found on the nameplate of the device (for details refer to *Nameplate* on page 16).



### **INFORMATION!**

*The stated pressures (PS) and temperatures (TS) only apply as refers to the pressure resistance of the sensor body. As regards the functionality of the entire device, further restrictions of the maximum temperature may need to be observed (e.g. ATEX approval). Devices rated below category I due to their size, do not receive the CE mark in the scope of the PED. These devices are subject to applicable sound engineering practice (SEP).*

### Residual risk

A risk analysis in accordance with the pressure equipment directive has been carried out for the devices. The residual risk is described as follows:

- The devices are designed according to the valid and applicable rules and standards for static operation and their pressure resistance is calculated for the declared maximum pressure and temperature (no calculation for cyclical change).
- Responsibility for the use of the measuring devices with regard to corrosion resistance of the used materials against the measured fluid lies solely with the operator.
- Avoid abrasion.
- Avoid pulsation and cavitation.
- Protect devices from vibration and high-frequency oscillation.
- Draining (backflow) may be delayed due to the float in the measuring tube.
- Implement appropriate measures to counteract external fire hazards

## 1.4 Safety instructions from the manufacturer

### 1.4.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

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### 1.4.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.



### 1.4.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

### 1.4.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

### 1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



**DANGER!**

*This warning refers to the immediate danger when working with electricity.*



**DANGER!**

*This warning refers to the immediate danger of burns caused by heat or hot surfaces.*



**DANGER!**

*This warning refers to the immediate danger when using this device in a hazardous atmosphere.*



**DANGER!**

*These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.*



**WARNING!**

*Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.*



**CAUTION!**

*Disregarding these instructions can result in damage to the device or to parts of the operator's plant.*



**INFORMATION!**

*These instructions contain important information for the handling of the device.*



**LEGAL NOTICE!**

*This note contains information on statutory directives and standards.*



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➔ **RESULT**

This symbol refers to all important consequences of the previous actions.

## 1.5 Safety instructions for the operator



**WARNING!**

*In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.*

*This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.*

## 2.1 Scope of delivery

**INFORMATION!**

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

**INFORMATION!**

Do a check of the packing list to make sure that you have all the elements given in the order.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

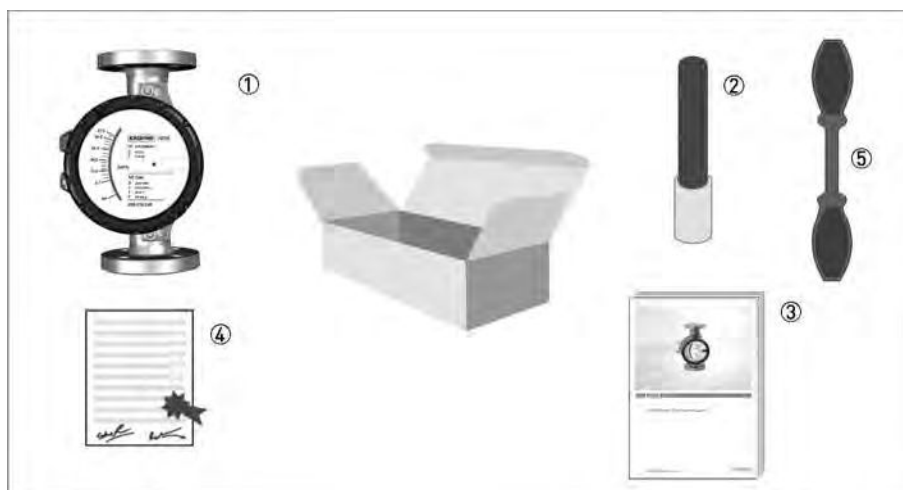


Figure 2-1: Scope of delivery

- ① Measuring device in ordered version
- ② For the ESK4-T version - bar magnet
- ③ Documentation
- ④ Certificates, calibration report (supplied to order only)
- ⑤ Wrench

## 2.2 Device version

- H250 with indicator M40
- H250 with M40 indicator with display cut-out for ESK4-T



Figure 2-2: Device version - H250 with M40 indicator

### Description of the device version

#### 1. H250/RR/M40

- Local indicator without auxiliary power
- Max. 2 limit switches, type NAMUR, NAMUR safety-oriented or transistor (3-wire)
- Electrical signal output 4...20 mA, HART® or Fieldbus communication
- Intrinsically safe (Ex i) or in explosion-proof enclosure (Ex d)

#### 2. H250/RR/M40

- Additional LCD, measured value and/or flow counter
- 2 configurable binary outputs, limit value or pulse output
- 1 binary input, Start / Stop / Reset flow counter
- 2-wire current output 4...20 mA, HART® communication
- Intrinsically safe (Ex i) or in explosion-proof enclosure (Ex d)

### Optional versions:

- H250 with indicator M40 as high temperature version HT
- H250 with indicator M40 with increased corrosion protection (special paint finish)
- H250H for use in horizontal pipelines
- H250U for use in vertical fall pipes
- H250F with hygienic measuring tube design for Food & Pharma
- H250C with PTFE / TFM liner for aggressive media

### Indicator options

- M40 - Aluminium, two-layer powder coating (epoxy / polyester)
- M40R - Stainless steel without coating

Offshore wet coating for aluminium or stainless steel on request

### 2.2.1 Indicator versions

The M40 indicator can be fitted with various modules.

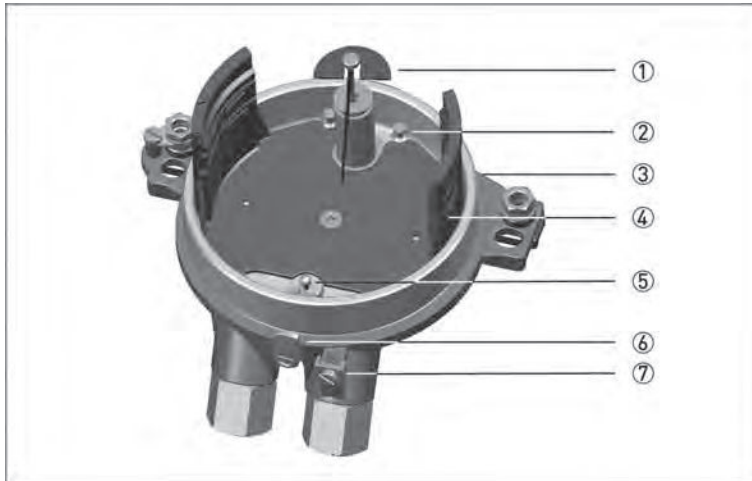


Figure 2-3: Basic version

- ① Pointer module
- ② Bolts for ESK4 / ESK4A attachment
- ③ Base plate
- ④ Module profile
- ⑤ Pressure piece for ESK4 / ESK4A attachment
- ⑥ Housing cover locking device
- ⑦ Ground terminal external

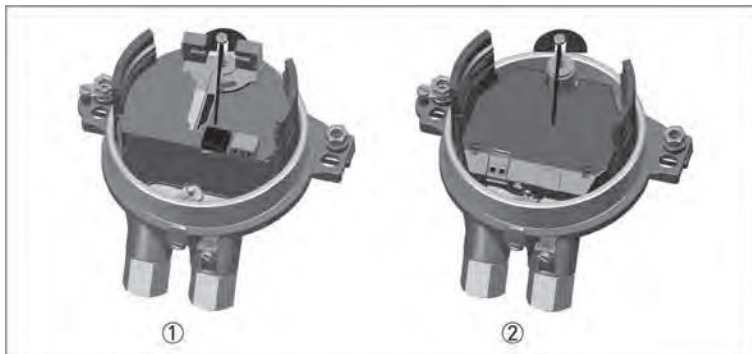


Figure 2-4: Versions K1 / K2 and ESK4 / ESK4A

- ① Indicator with K2 contact module
- ② Indicator with ESK4 / ESK4A current output 4...20 mA

Both versions can be combined with one another.

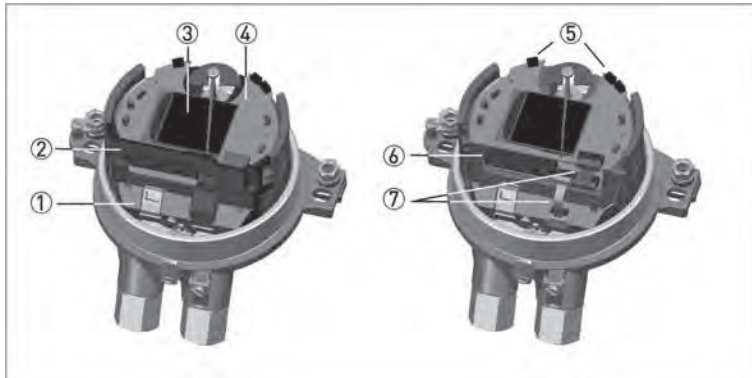


Figure 2-5: Version ESK4-T

- ① ESK4 / ESK4A connection
- ② Module cover
- ③ Display
- ④ Display module ESK4-IO
- ⑤ Operating keys ← ↑
- ⑥ Connection binary outputs and reset input
- ⑦ Module connection cable

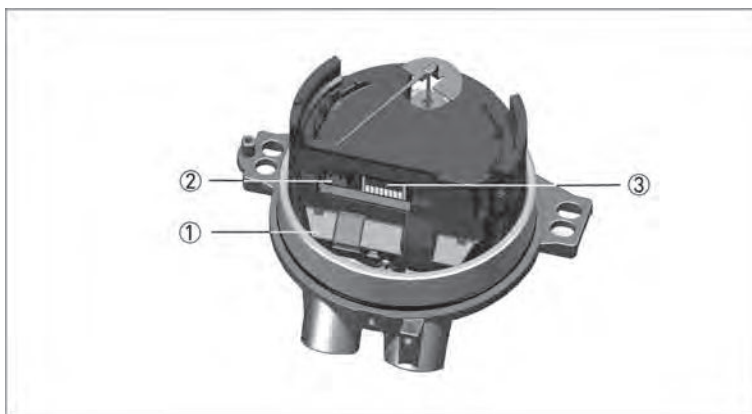


Figure 2-6: Version Fieldbus ESK4-FF / ESK4-PA

- ① Basic module with electronic magnet sensors ESK4 / ESK4A
- ② Connection bus module
- ③ DIP switch for bus settings

For more details refer to the supplementary instructions "H250 M40 Foundation Fieldbus" or "H250 M40 Profibus PA".

## 2.2.2 Float damping

Float damping is characterised by high standstill times and self-centering. The damping sleeve is made of high performance ceramic or PEEK, depending on the medium and the application. Float damping can also be retrofitted for the user (refer to "Service").

### Use of damping

- Generally when CIV and DIV floats are used for gas measurement.
- For TIV floats (H250/RR and H250/HC only) with an operating primary pressure:

| Nominal size according to |            | Operating primary pressure |        |
|---------------------------|------------|----------------------------|--------|
| EN 1092-1                 | ASME B16.5 | [bar]                      | [psig] |
| DN50                      | 1/2"       | ≤0.3                       | ≤4.4   |
| DN25                      | 1"         | ≤0.3                       | ≤4.4   |
| DN50                      | 2"         | ≤0.2                       | ≤2.9   |
| DN80                      | 3"         | ≤0.2                       | ≤2.9   |
| DN100                     | 4"         | ≤0.2                       | ≤2.9   |

## 2.2.3 Pointer damping

In principle, the indicating element with its magnetic system contains indicator damping. An additional eddy current brake is advantageous in the event of fluctuating or pulsing flows. The magnets on the eddy current brake surround the pointer vane without touching it, damping its movement. The result is a much steadier pointer position, without distorting the measured value. The eddy current brake can be retrofitted during operation without recalibration. Note the maximum tightening torque (0.12 Nm) for the turnbuckle!



Figure 2-7: Pointer damping

- ① Eddy current brake
- ② Pointer vane
- ③ Support
- ④ Pointer cylinder
- ⑤ Turnbuckle, max. tightening torque is 0.12 Nm

## 2.3 Nameplate



### INFORMATION!

Check on the device nameplates, that the device is supplied according to your order.

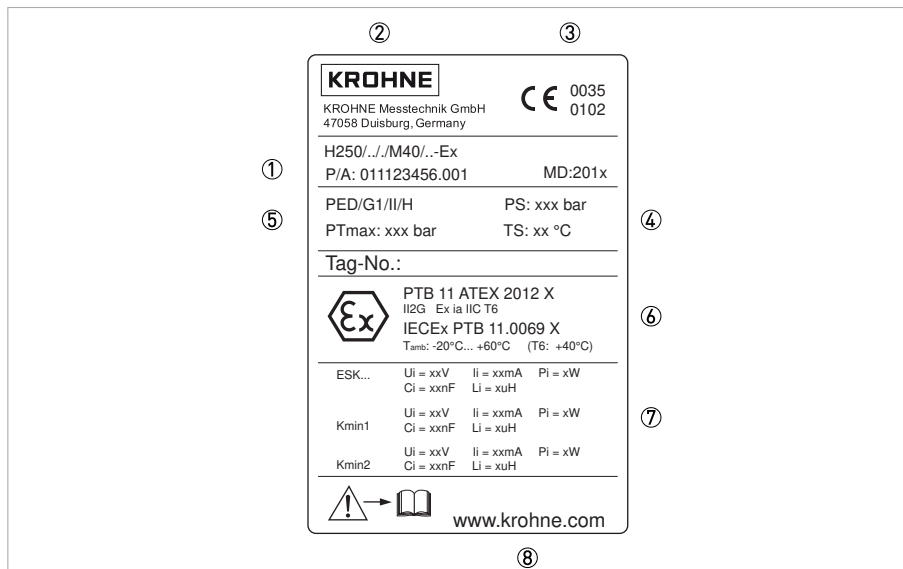


Figure 2-8: Example of a nameplate

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

### Additional markings on the indicator

- SN - serial number
- SO - sales order / item
- PA - production order
- Vx - product configurator code
- AC - article code



## 2.4 Description code

The description code consists of the following elements \*:

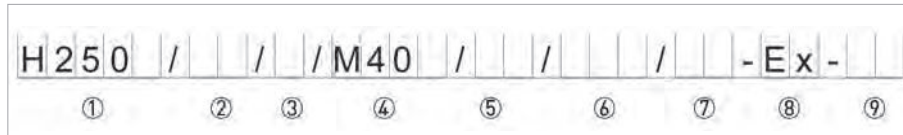


Figure 2-9: Description code

① **Device type**

H250 - standard version

H250H - horizontal flow direction

H250U - flow direction from top to bottom

② **Materials / versions**

RR - stainless steel

C - PTFE or PTFE/ceramics

HC - Hastelloy®

Ti - Titanium

Mo - Monel

In - Inconel

F - aseptic version (food)

③ **Heating jacket version**

B - with heating jacket

④ **Type series of indicators**

M40 - Indicator M40

M40R - indicator in stainless steel housing

⑤ **High-temperature version**

HT - version with HT extension

⑥ **Electrical signal output**

ESK - electrical signal output 4...20 mA (ESK4 / ESK4A)

- optionally available with counter, I/O module and display (ESK4-T)

- Foundation Fieldbus (ESK4-FF)

- Profibus PA (ESK4-PA)

⑦ **Limit switches**

K1 - one limit switch

K2 - two limit switches

⑧ **Explosion protection**

Ex - Explosion-protected equipment

⑨ **SIL version**

SE - SIL compliant electronic signal output

SK - SIL compliant limit switch

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

## 2.5 Electronic revision

The electronic revision (sticker on the base module ESK4 / ESK4A) indicates the respective hardware/software status of the electronics. All add-on modules (ESK4-T, ESK4-FF and ESK4-PA) have an additional sticker indicating their respective firmware version.

| Electronic revision | Explanations  |
|---------------------|---|
| ER 1.1.x            | Basic version (cannot be combined with other indicator versions):<br>ESK4 / current output 4...20 mA with HART® communication<br>(ESK4 HART DD 01.01. AMS10x AMS11x<br>ESK4 HART DD 01.01. PDM6.0<br>ESK4 HART DTM 1.0.3 FDT1.2)  |
| ER 2.0.x            | Functional add-on to ER 1.1.x:<br>can be combined with indicator version ESK4 FF / Foundation Fieldbus;<br>(Firmware version FF module from 1.0.2)  |
| ER 2.1.x            | Functional add-on to ER 2.0.x:<br>can be combined with indicator version ESK4-PA / Profibus PA<br>(Firmware version PA module from 1.0.0)<br>can be combined with indicator version ESK4-T / LCD, binary inputs/outputs<br>(Firmware version T module from 1.1.0)             |
| ER 2.2.x            | Functional add-on to ER 2.1.x:<br>Support of failure signal (low) according to NE 43<br>for the ESK4 current output module  |
| ER 3.0.x            | Functional add-on:<br>Update for HART® communication from 5.9 to 7.4 including new DD/DTM<br>can be combined with ESK4-FF (Firmware version FF module from 1.0.2)<br>Firmware Version ESK4-PA (... PA module from 1.0.0)<br>Firmware Version ESK4-T (... T module from 1.2.0) |

Table 2-1: Electronic revision

### 3.1 General installation notes

**INFORMATION!**

*Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.*

**INFORMATION!**

*Do a check of the packing list to make sure that you have all the elements given in the order.*

**INFORMATION!**

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*

### 3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid direct exposure to the sun.
- Store the measuring device in the original packaging.
- The permissible storage temperatures for standard devices are: -40...+80°C / -40...+176°F

### 3.3 Installation conditions

**CAUTION!**

*When installing the device in the piping, the following points must be observed:*

- *The variable area flowmeter must be installed vertically (measuring principle). Flow direction from bottom to top. For installation recommendations please refer also to directive VDI/VDE 3513, sheet 3.  
H250Hs are installed horizontally and H250U devices are installed vertically with the flow direction from top to bottom.*
- *A straight unimpeded inlet run of  $\geq 5$  DN upstream of the device and a straight outlet run of  $\geq 3$  DN downstream of the device are recommended.*
- *Screws, bolts and gaskets are to be provided by the customer and must be selected in accordance with the pressure rating of the connection or the operating pressure.*
- *The inner diameter of the flange deviates from the standard dimensions. Flange seal standard DIN 2690 or ASME B16.21 can be applied.*
- *Align the gaskets. Tighten the nuts with the tightening torques of the appropriate pressure rating.  
For devices with PTFE liner or ceramic liner and PTFE raised faces, refer to chapter "Tightening torques".*
- *Control devices are to be positioned downstream of the measuring device.*
- *Shutoff devices are preferably to be positioned upstream of the measuring device.*
- *Before connecting, blow or flush out the pipes leading to the device.*
- *Piping for gas flow need to be dried before the device is installed.*
- *Use connectors suitable for the particular device version.*
- *Align the piping centrically with the connection bores on the measuring device so they are free of stresses.*
- *If necessary, the piping has to be supported to reduce the vibrations transmitted to the measuring device.*
- *Do not lay signal cables directly next to cables for the power supply.*

### Minimum distance between devices

When several devices are installed next to each other, a minimum distance of  $> 300 \text{ mm} / 11.8''$  between the devices is necessary.

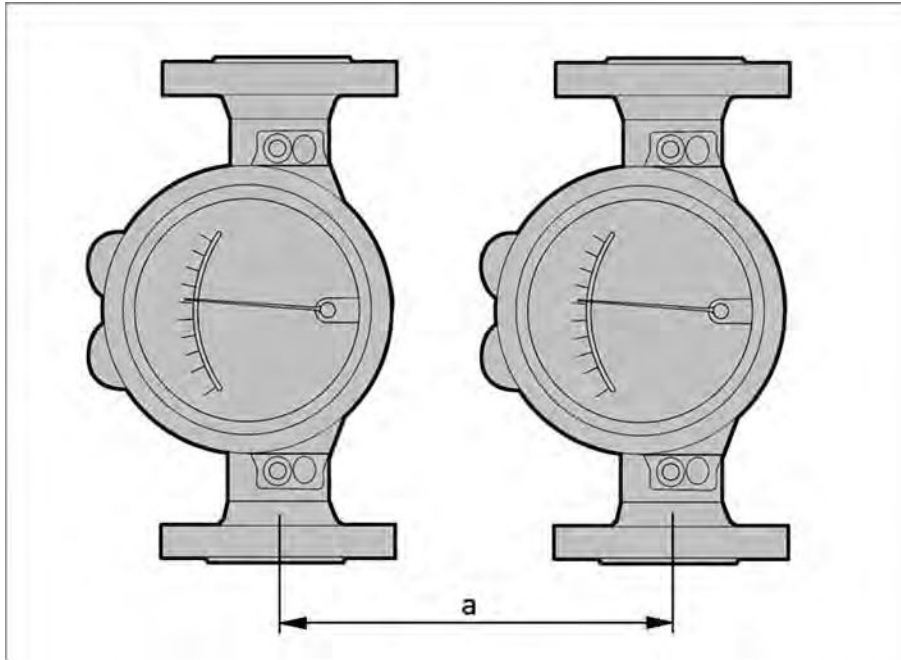


Figure 3-1: Minimum distance between devices

Take special note of the installation position for the H250H with horizontal flow direction:

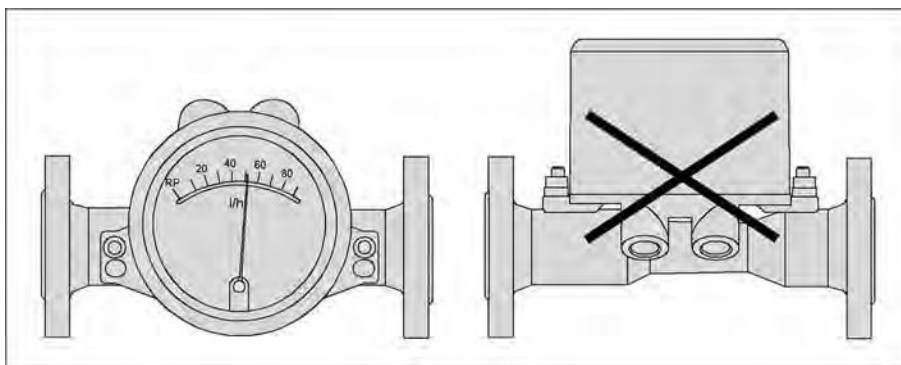


Figure 3-2: Installation position for H250H

In order to comply with thermal parameters and measuring accuracy, H250H flowmeters for horizontal installation are to be installed in the pipeline so that the display is located on the side of the measuring tube. The maximum product and ambient temperatures indicated as well as the measuring accuracy are based on lateral installation of the indicator.

### 3.3.1 Tightening torques

For devices with PTFE liner or ceramic liner and PTFE raised face, tighten the flange threads with the following torques:

| Nominal size according to |    |            |         | Stud bolts |         |         | Max. torque |       |             |       |
|---------------------------|----|------------|---------|------------|---------|---------|-------------|-------|-------------|-------|
| EN 1092-1                 |    | ASME B16.5 |         | EN         | ASME    |         | EN 1092-1   |       | ASME 150 lb |       |
| DN                        | PN | Inch       | lb      |            | 150 lb  | 300 lb  | Nm          | ft*lb | Nm          | ft*lb |
| 15                        | 40 | 1/2"       | 150/300 | 4x M12     | 4x 1/2" | 4x 1/2" | 9.8         | 7.1   | 5.2         | 3.8   |
| 25                        | 40 | 1"         | 150/300 | 4x M12     | 4x 1/2" | 4x 5/8" | 21          | 15    | 10          | 7.2   |
| 50                        | 40 | 2"         | 150/300 | 4x M16     | 4x 5/8" | 8x 5/8" | 57          | 41    | 41          | 30    |
| 80                        | 16 | 3"         | 150/300 | 8x M16     | 4x 5/8" | 8x 3/4" | 47          | 34    | 70          | 51    |
| 100                       | 16 | 4"         | 150/300 | 8x M16     | 8x 5/8" | 8x 3/4" | 67          | 48    | 50          | 36    |

Table 3-1: Tightening torques

### 3.3.2 Magnetic filters

The use of magnetic filters is recommended when the medium contains particles which can be influenced magnetically. The magnetic filter is to be installed in the flow direction upstream of the flowmeter. Bar magnets are positioned helically in the filter to provide optimal efficiency at low pressure loss. All of the magnets are coated individually with PTFE to protect against corrosion. Material: 1.4404 / 316L



Figure 3-3: Types of magnetic filters

- ① Type F - fitting part with flange - overall length 100 mm / 4"
- ② Type FS - fitting part without flange - overall length 50 mm / 2"

### 3.3.3 Heat insulation



**CAUTION!**

The indicator housing may not be heat-insulated.

The heat insulation ③ may only reach as far as the housing fastening ④.

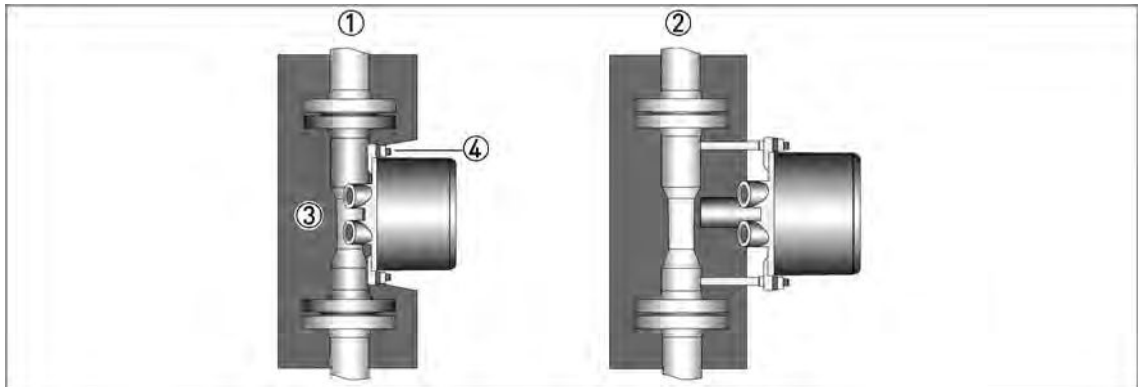


Figure 3-4: Heat insulation

- ① Standard indicator M40
- ② Indicator with HT extension



**CAUTION!**

The heat insulation ① may only reach to the rear of the housing ②. The area around the cable entries ③ must be freely accessible.

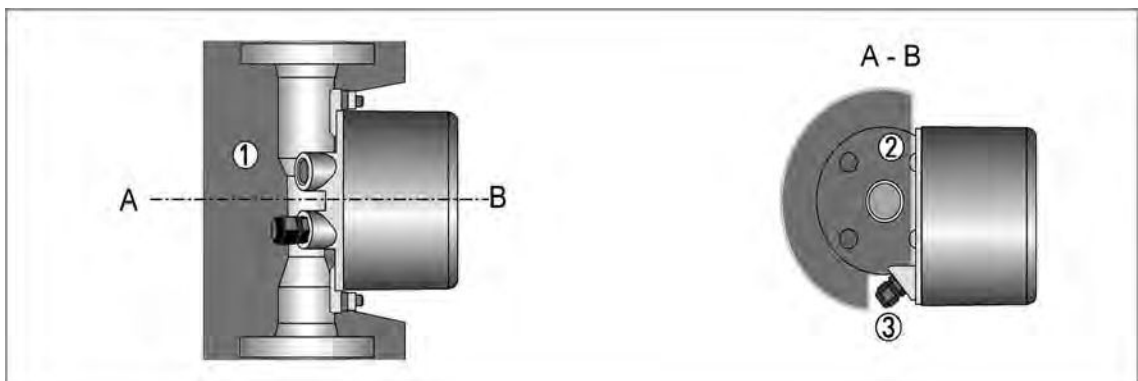


Figure 3-5: Heat insulation - cross-section

## 4.1 Safety instructions

**DANGER!**

*All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!*

**DANGER!**

*Observe the national regulations for electrical installations!*

**DANGER!**

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*

**WARNING!**

*Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.*

**INFORMATION!**

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*



## 4.2 Electrical connection for indicator M40

### 4.2.1 Connection of the limit switches K1/K2

The M40 indicator can be fitted with a maximum of two limit switches.

The limit switch operates as a proximity switch which is activated inductively by the semicircular metal vane of the pointer.

The switching points are set using the contact pointers. The position of the contact pointers is indicated on the scale.

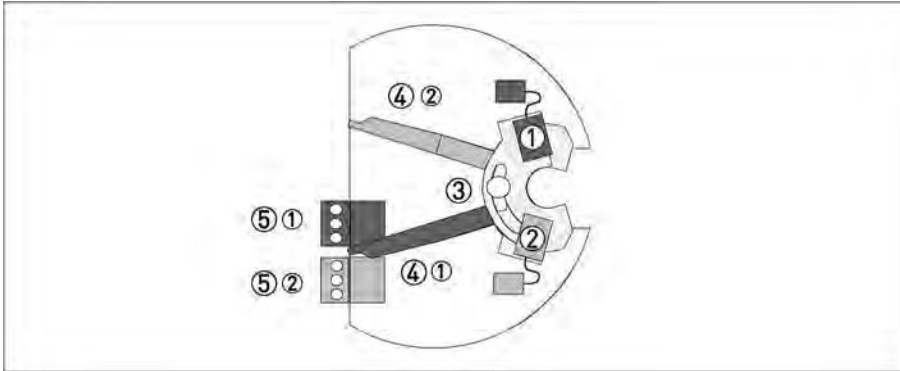


Figure 4-1: Design of limit switch module

- ① MIN contact
- ② MAX contact
- ③ Locking screw
- ④ Peak value
- ⑤ Connection terminal

The connection terminals have a pluggable design and can be removed to connect the cables. The built-in limit switch types are shown on the nameplate of the indicator.



| Contact                 | MIN |   |   | MAX |   |   |
|-------------------------|-----|---|---|-----|---|---|
|                         | 1   | 2   | 3 | 4   | 5   | 6 |
| Connection 2-wire NAMUR | -   | +   |   | -   | +   |   |
| Connection 3-wire       | +   |  | - | +   |  | - |
| Connection Reed SPST    | +   |   | - | +   |   | - |

Table 4-1: Electrical connection of the limit switches

## Connection diagram for the limit switches

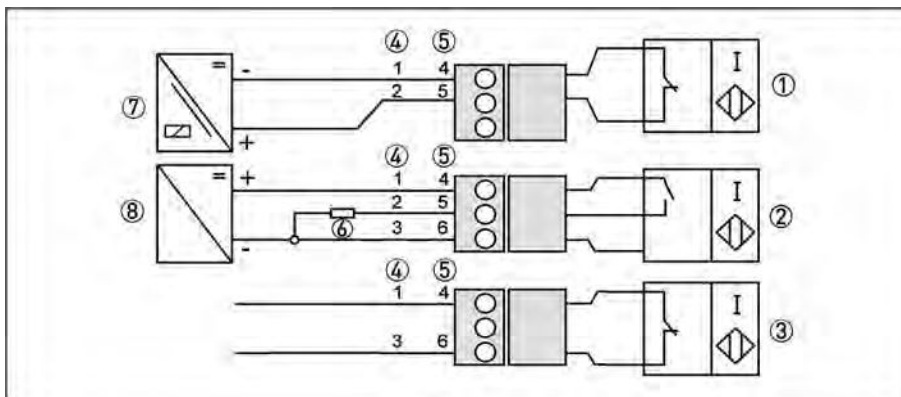


Figure 4-2: Connection terminals for limit switches

- ① Limit switch 2-wire NAMUR
- ② Limit switch 3-wire
- ③ Limit switch Reed SPST
- ④ Terminal connection of Min. contact
- ⑤ Terminal connection of Max. contact
- ⑥ 3-wire load
- ⑦ NAMUR isolated switching amplifier
- ⑧ 3-wire power supply

## Limit setting

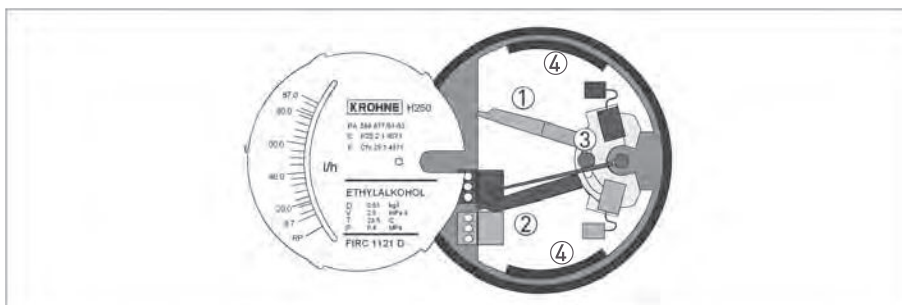


Figure 4-3: Limit setting

- ① Contact pointer MAX
- ② Contact pointer MIN
- ③ Locking screw (max. tightening torque is 0.2 Nm)
- ④ Scale support



## Setting is carried out directly via contact pointers ① and ②:

- Pull the upper scale support 2 mm / 0.08" flexibly upwards and pull out the scale from its locking point to the side.
- Loosen the locking screw ③ slightly.
- Slide in the scale up to the locking point.
- Set contact pointers ① and ② to the desired switching point.



**After the setting:**

- Pull the upper scale support 2 mm / 0.08" flexibly upwards and pull out the scale again from its locking point to the side.
- Tighten the locking screw ③ with max. 0.2 Nm.
- Slide in the scale up to the locking point.



**CAUTION!**

*If the maximum torque (0.2 Nm) is exceeded, the locking screw can be torn off during tightening!*

**Definition of switch contact**

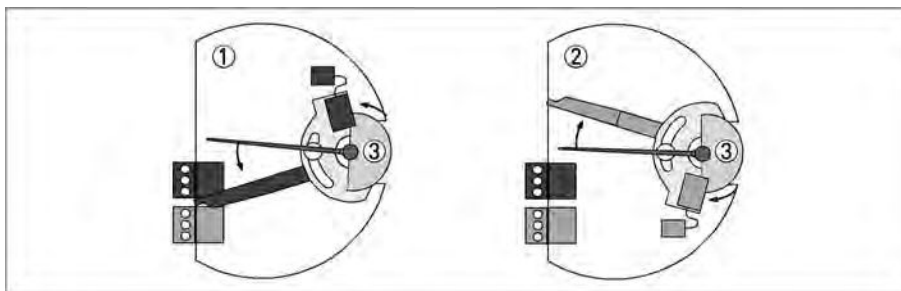


Figure 4-4: Definition of switch contact

- ① MIN contact
- ② MAX contact
- ③ Pointer vane with switching vane

If the pointer vane goes into the slot, an alarm is triggered.

If the pointer vane is outside of the proximity switch, a wire break in a NAMUR contact also triggers the alarm.

The 3-wire limit switch does not have any wire break detection.

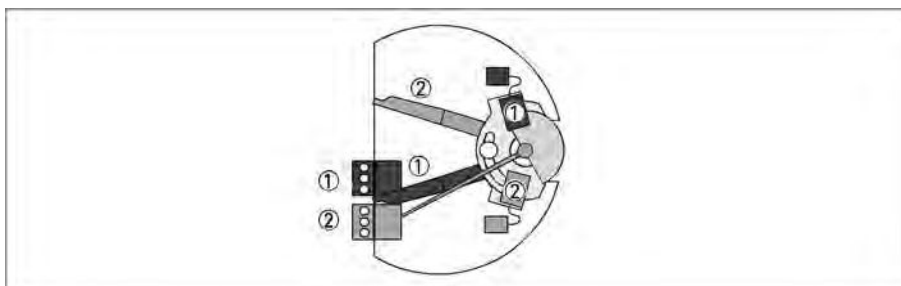


Figure 4-5: Definition MIN-MIN - MAX-MAX

- ① MIN 2 contact or MAX 1 contact
- ② MIN 1 contact or MAX 2 contact

| Contact | Type  | Current consumption |
|---------|-------|---------------------|
| MIN 1   | NAMUR | ≤ 1 mA              |
| MIN 2   | NAMUR | ≤ 1 mA              |
| MAX 1   | NAMUR | ≥ 3 mA              |
| MAX 2   | NAMUR | ≥ 3 mA              |

Table 4-2: Current consumption in the position shown:

### 4.2.2 Current output ESK4 / ESK4A

The connecting terminals of the ESK4 / ESK4A have a pluggable design and can be removed in order to connect the cables.

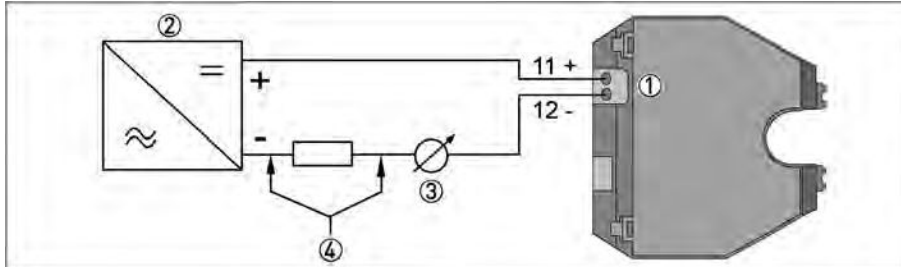


Figure 4-6: ESK4 / ESK4A connection

- ① Current output of ESK4 / ESK4A
- ② Power supply 14...30 VDC
- ③ Measuring signal 4...20 mA
- ④ External load, HART® communication

### Power supply M40 with galvanic isolation

Wiring must be planned with great care when it comes to connecting other devices such as evaluation units or process control. Internal connections in these devices (e.g. GND with PE, mass loops) may lead to non-permitted voltage potentials which could negatively affect the function of the converter itself or that of a device connected to it. In such cases a protected extra-low voltage (PELV) is recommended.

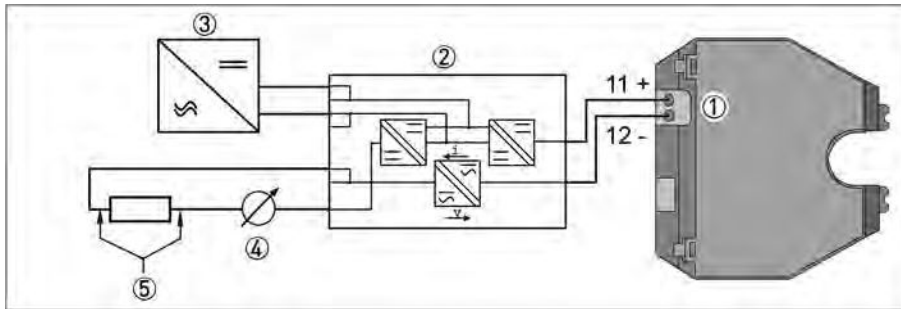


Figure 4-7: Power supply M40 with galvanic isolation

- ① Terminal connection
- ② Converter supply isolator with galvanic isolation
- ③ Power supply (refer to isolator information)
- ④ Measuring signal 4...20 mA
- ⑤ External load, HART® communication

### Power supply

**INFORMATION!**

The supply voltage has to be between 14 VDC and 30 VDC. This is based on the total resistance of the measuring loop. To calculate this, the resistance of each component in the measuring loop (not including the device) must be added up.

The required supply voltage can be calculated using the following formula:

$$U_{\text{ext.}} = R_L * 24 \text{ mA} + 14 \text{ V}$$

with

$U_{\text{ext.}}$  = minimum supply voltage

$R_L$  = total measuring loop resistance

**INFORMATION!**

The power supply has to be able to supply a minimum of 30 mA.

### HART<sup>®</sup> communication

When HART<sup>®</sup> communication is carried out with the ESK4, the analogue measured data transmission (4...20 mA) is not impaired in any way.

Exception for multidrop operation. In multidrop operation a maximum of 15 devices with HART<sup>®</sup> function can be operated in parallel, whereby their current outputs are switched to inactive (I approx. 4 mA per device).



### Load for HART<sup>®</sup> communication

#### INFORMATION!

For HART<sup>®</sup> communication a load of at least 230 Ω is required.

The maximum load resistance is calculated as follows:

$$R_L = \frac{U_{\text{ext.}} - 14V}{24\text{mA}}$$



#### DANGER!

Use a twisted two-core cable to prevent electrical interference from impeding the DC output signal.

In some cases a shielded cable may be necessary, e.g. if noise levels higher than the NE 21 specification are anticipated.

### Configuration

The ESK can be configured via HART<sup>®</sup> communication. DD (Device Description) for AMS and PDM as well as a DTM (Device Type Manager) for PACTware<sup>™</sup> are available for the configuration. They can be downloaded free of charge from the website of the manufacturer.

The current flow rate can be transmitted using the integrated HART<sup>®</sup> communication. A flow counter can be configured. Two limit values can be monitored. The limit values are assigned either to flow values or to the counter overflow.

### Self monitoring - Diagnostics

During both start-up and operation, a wide variety of diagnostic functions are performed cyclically in the ESK4 / ESK4A in order to guarantee function reliability. When an error is detected, a failure signal (high) is activated (current > 21 mA, typically 22 mA) via the analogue output. In addition more detailed information can be requested via HART<sup>®</sup> (CMD#48). The failure signal is not activated for information and warnings.

#### Diagnostic functions (Monitoring):

- Plausibility of FRAM data
- Plausibility of ROM data
- Working range of internal reference voltages
- Signal detection of the measuring range of the internal sensors
- Temperature compensation of the internal sensors
- Calibration based on the application
- Plausibility of counting value
- Plausibility of physical unit, system and selected unit

For ESK4A (HART<sup>®</sup> 7) the diagnosis is reported in compliance with NE 107.

### 4.2.3 ESK4-T limit outputs

Once the housing cover has been unscrewed, the scale can be removed. The connection terminals have a pluggable design and can be removed to connect the cables.

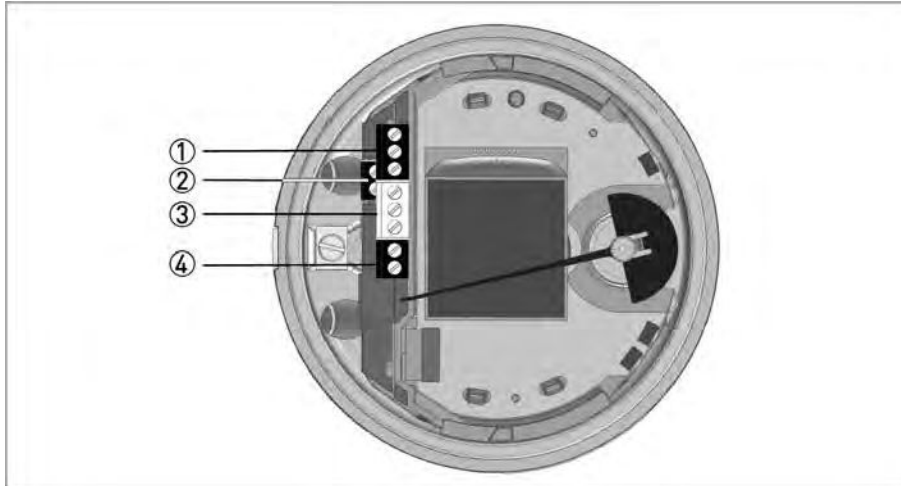


Figure 4-8: Position of the connection terminals

- ① Binary output 1
- ② ESK4 / ESK4A power supply / current output
- ③ Binary output 2
- ④ Binary input

The binary inputs/outputs are electrically isolated from each other and from the ESK4 / ESK4A current output.



#### **INFORMATION!**

*The binary inputs/outputs can only be operated if the power supply is applied to ESK4 / ESK4A terminal 11+ and 12-. The binary inputs/outputs are inactive by default and must thus be activated prior to first use (for details refer to ESK4-T menu on page 46).*

#### **Connection binary outputs**

In accordance with the desired signal transmission, select one of the following connection types for binary outputs B1 and B2:

- NAMUR (DC interface acc. to EN 60947-5-6)
- Transistor output (passive, Open Collector)

| Binary output                | B1 |   |                 | B2 |   |                 |
|------------------------------|----|---|-----------------|----|---|-----------------|
|                              | 1  | 2 | 3               | 4  | 5 | 6               |
| Connection NAMUR             | +  | - |                 | +  | - |                 |
| Connection transistor output | +  |   | B <sub>OC</sub> | +  |   | B <sub>OC</sub> |

Table 4-3: Terminal assignment of the binary output

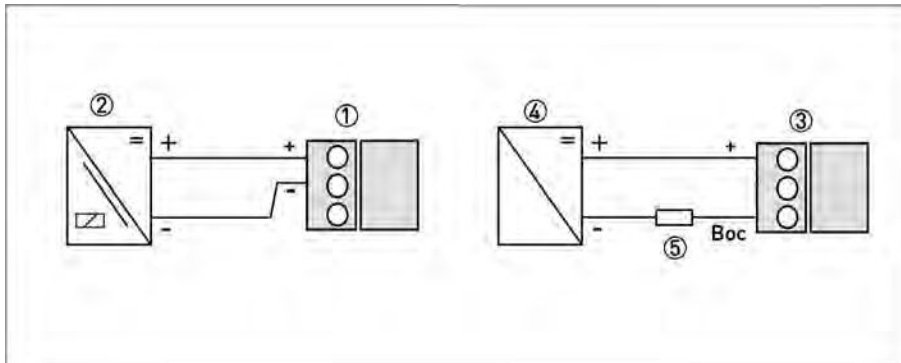


Figure 4-9: Connection switching output

- ① NAMUR terminal connection
- ② Isolated switching amplifier
- ③ OC switch output terminal connection
- ④ Power supply  $U_{ext.}$
- ⑤ Load  $R_L$

|                             | NC contact | NO contact |
|-----------------------------|------------|------------|
| Switching value reached     | < 1 mA     | > 3 mA     |
| Switching value not reached | > 3 mA     | < 1 mA     |

Table 4-4: Value range for NAMUR

Value range applies only when connected to a switching amplifier with the following reference values:

- Open-circuit voltage  $U_0 = 8.2$  VDC
- Internal resistance  $R_i = 1$  k $\Omega$

| Signal voltages | $U_L$ [V]   |             | $U_H$ [V]   |             |
|-----------------|-------------|-------------|-------------|-------------|
|                 | lower limit | upper limit | lower limit | upper limit |
| via load $R_L$  | 0           | 2           | 16          | 30          |

Table 4-5: Value range for transistor output

| Signal currents | $I_L$ [mA]  |             | $I_H$ [mA]  |             |
|-----------------|-------------|-------------|-------------|-------------|
|                 | lower limit | upper limit | lower limit | upper limit |
| Category 2      | 0           | 2           | 20          | 110         |

Table 4-6: Value range for transistor output

To ensure the value ranges, a load  $R_L$  between 250  $\Omega$  and 1 k $\Omega$  is recommended for the passive transistor output with a nominal voltage of 24 VDC.

If other loads are used, caution is advised as the range of values of the signal voltages then no longer corresponds to the range of values for the inputs of process control systems and controls (DIN IEC 946).



**CAUTION!**

The upper limit of the signal current must not be exceeded as this may damage the transistor output.



#### 4.2.4 ESK4-T pulse output



##### INFORMATION!

The binary outputs can also be operated as pulse outputs. When using the binary outputs as a pulse output, two separate signal circuits are required. Each signal circuit requires its own power supply.

The total resistance ④ must be adapted so that the total current  $I_{tot}$  does not exceed 100 mA.

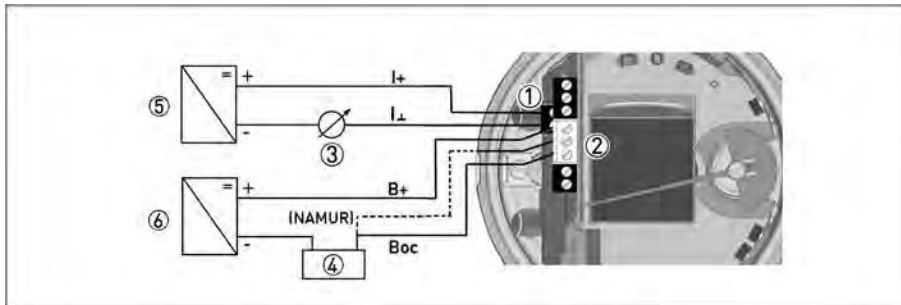


Figure 4-10: Electrical connection of pulse output

- ① Terminal for power supply - current output
- ② Terminal B2
- ③ Flow measurement 4...20 mA
- ④ Pulse output load e.g. counter
- ⑤ Power supply for ESK4
- ⑥ Power supply for pulse output

The pulse output B2 is a passive "open collector" output which is electrically isolated from the current output and output B1. It can be operated as a low-resistance output or as a NAMUR output.

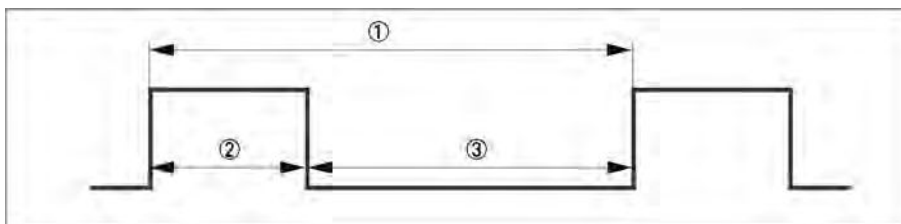


Figure 4-11: Data for pulse output

- ①  $f_{max} = 10 \text{ Hz}$
- ②  $t_{on}$
- ③  $t_{off}$

The pulse width  $t_{on}$  can be configured from 50...500 ms in the indicator menu.

### 4.2.5 ESK4-T binary input

The binary input can be used to control the internal flow counter (start/stop/reset).

| Binary input | B3 |   |
|--------------|----|---|
| Terminal no. | 7  | 8 |
| Connection   | +  | - |

Table 4-7: Value range for NAMUR

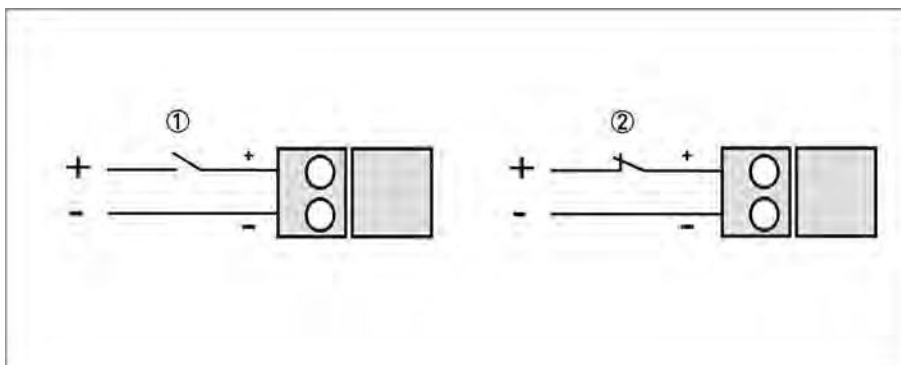


Figure 4-12: Binary input

- ① Function active HI
- ② Function active LO

This binary input can be activated in the menu of the indicator and can be configured to ACTIVE HI or ACTIVE LO.

If the input is set as ACTIVE LO, an interruption causes the counter to be reset.

For further information on configuration of each function refer to *ESK4-T menu* on page 46.

| Input voltage    | U <sub>L</sub> [V] |             | U <sub>H</sub> [V] |             |
|------------------|--------------------|-------------|--------------------|-------------|
|                  | lower limit        | upper limit | lower limit        | upper limit |
| Terminal (7) (8) | 0                  | 2           | 16                 | 30          |

Table 4-8: Value range

The binary input has an internal resistance R<sub>i</sub> of 20 kΩ.

#### 4.2.6 ESK4-FF / ESK4-PA fieldbus communication

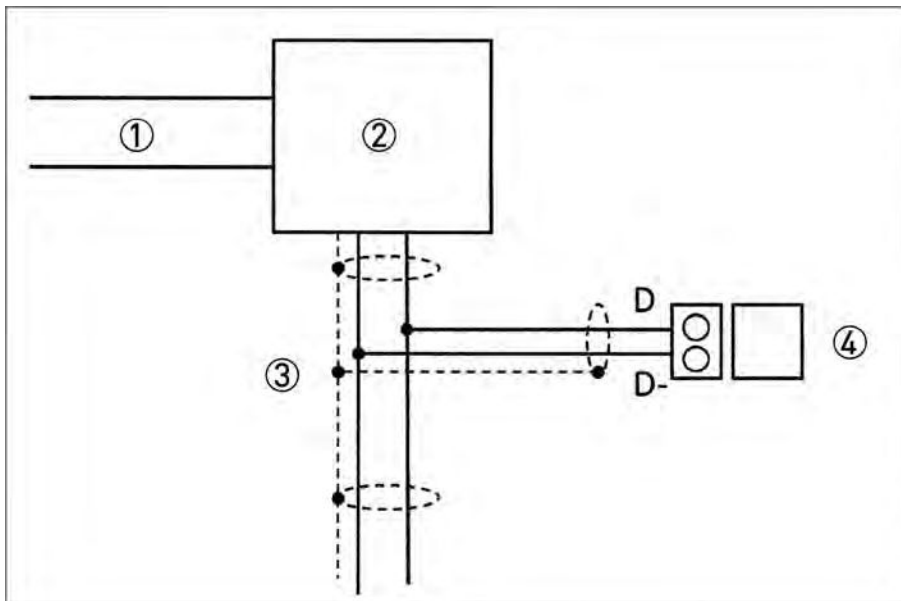


Figure 4-13: ESK4-FF / ESK4-PA fieldbus communication

- ① FF HSE Bus / Profibus DP
- ② Linking device / bus coupler
- ③ FF H1 Bus / Profibus PA, 2-wire with shielding
- ④ H250/M40/ESK4-FF / H250/M40/ESK4-PA

#### ESK4-FF / ESK4-PA

- 2-wire, bus-supplied
- Polarity protected
- Bus voltage 9...32 VDC
- Nominal current 16 mA

4.2.7 Harting HAN 7D connection

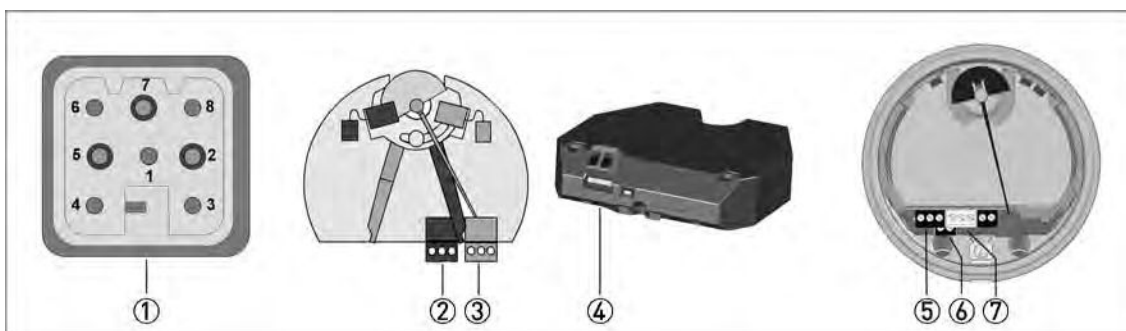


Figure 4-14: Terminal assignment

① Terminal assignment of HAN<sup>®</sup> 7D - View of plug connection

| ① Pin number HAN <sup>®</sup> 7D | K1/K2 NAMUR contacts | R1/R2 Reed contacts | ESK4/ESK4A     | Terminal number |      |
|----------------------------------|----------------------|---------------------|----------------|-----------------|------|
|                                  |                      |                     |                | NAMUR           | Reed |
| 1                                | ② NAMUR MIN (-)      | ② Reed MIN          | -              | 1               | 1    |
| 2                                | ② NAMUR MIN (+)      | ② Reed MIN          | -              | 2               | 3    |
| 3                                | ③ NAMUR MAX (-)      | ③ Reed MAX          | -              | 4               | 4    |
| 4                                | ③ NAMUR MAX (+)      | ③ Reed MAX          | -              | 5               | 6    |
| 5                                | -                    | -                   | ④ 4...20mA (+) | 11              |      |
| 6                                | -                    | -                   | ④ 4...20mA (-) | 12              |      |
| 7                                | -                    | -                   | -              |                 |      |
| 8                                | -                    | -                   | -              |                 |      |

Table 4-9: Terminal assignment - Harting plug to terminal number

Combinations of K1 / K2 and ESK4 / ESK4A are possible.

| ① Pin number HAN <sup>®</sup> 7D | ESK4-T                            | Terminal number |
|----------------------------------|-----------------------------------|-----------------|
| 1                                | ⑤ Binary output B1 open coll. (+) | 1               |
| 2                                | ⑤ Binary output B1 open coll. (-) | 3               |
| 3                                | ⑦ Binary output B2 open coll. (+) | 4               |
| 4                                | ⑦ Binary output B2 open coll. (-) | 6               |
| 5                                | ⑥ 4...20mA (+)                    | 11              |
| 6                                | ⑥ 4...20mA (-)                    | 12              |
| 7                                | -                                 |                 |
| 8                                | -                                 |                 |

Table 4-10: Terminal assignment - Harting plug to terminal number for ESK4-T



**INFORMATION!**

No Harting connection for module ESK4-FF/PA is provided and is only available on request.

### 4.3 Grounding connections



Figure 4-15: Grounding connections

- ① Grounding connection on the indicator
- ② Outer grounding connection



**DANGER!**

*The grounding wire may not transfer any interference voltage.  
Do not use this grounding cable to ground any other electrical devices.*

### 4.4 Ingress protection

The measuring device meets all requirements of ingress protection IP66/68.



**DANGER!**

*After all servicing and maintenance work on the measuring device, the specified protection class must be ensured again.*



**Therefore it is essential to observe the following points.**

- Use only original gaskets. They must be clean and free of any damage. Defective gaskets must be replaced.
- The electrical cables must be undamaged and must comply with regulations.
- The cables must be laid with a loop ③ upstream of the measuring device to prevent water from getting into the housing.
- The cable feedthroughs ② must be tightened.
- Close the unused cable feedthroughs using blanking plugs ①.

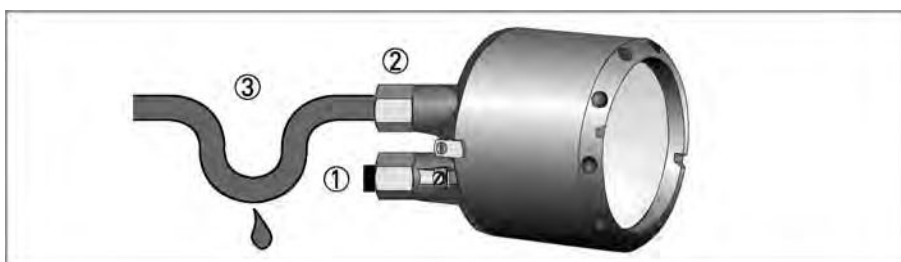


Figure 4-16: Laying the cable

- ① Use blanking plugs if no cable is routed through
- ② Tighten cable feedthrough firmly
- ③ Lay the cable in a loop

## 5.1 Standard device



### **CAUTION!**

**When starting up the device, the following points must be observed:**

- Compare the actual operating pressure and the product temperature of the system with the specifications on the nameplate (PS and TS). These specifications may not be exceeded.
- Make sure materials are compatible.
- Slowly open the shut-off valve.
- When measuring liquids ensure that the pipelines are carefully evacuated.
- When measuring gases, increase pressure slowly.
- Avoid float impact (e.g. caused by solenoid valves), as this is likely to damage the measuring unit or float.

A minimum operating pressure (primary pressure) is necessary to operate the device:

| Medium                      | Pressure loss : operating pressure |
|-----------------------------|------------------------------------|
| Liquids                     | 1 : 2                              |
| Gases without float damping | 1 : 5                              |
| Gases with float damping    | 1 : 2                              |

## 5.2 Indicator ESK4-T



### **INFORMATION!**

*The device is always preset for the user and his application.*

### **Start**

**After the device is switched on, the display shows**

- "INITIALISING"
- Firmwareversion IO-Modul

The device first performs a self-test. Here, all of the parameters preset for the customer are analysed and checked for plausibility. The device then switches to measuring mode and indicates the current measured value.

### **Operation**



### **INFORMATION!**

*The device is low-maintenance*

*Comply with the application limits with regard to temperature of the medium and ambient temperature.*

## 6.1 ESK4 / ESK4A - Loop Check Mode

The ESK4 / ESK4A is equipped with a loop check function, enabling a simple test of the entire 4...20 mA current loop.

It is activated and operated using a microswitch ①.



Figure 6-1: Position of the microswitch



### CAUTION!

When activating the loop check mode, ensure that no alarms are unintentionally triggered in the downstream system components.

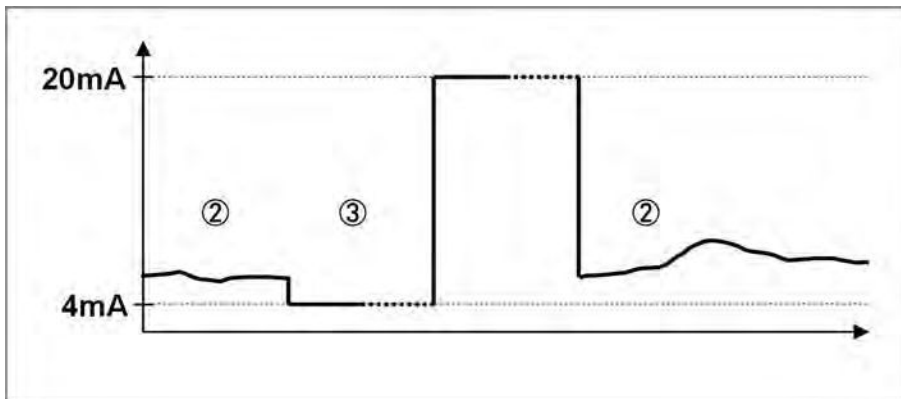


Figure 6-2: Loop Check Mode



- Press and hold the microswitch ① for more than 6 seconds to activate the loop check mode ③. The current output jumps to constant 4 mA.
- Change the current output from constant 4 mA to constant 20 mA as often as you like by briefly pressing it (less than 6 seconds) to check the function of the measuring circuit.
- Exit loop check mode by holding down the microswitch (longer than 6 seconds). The current output jumps back to measuring mode ②.



### INFORMATION!

If the microswitch has not been pressed for longer than 60 seconds, the ESK4 / ESK4A automatically returns to measuring mode ②.

## 6.2 Operating elements ESK4-T

The device is operated with the cover on the front open, using the mechanical **keys**, or with the cover closed using a **bar magnet**.



### CAUTION!

The switching point of the magnetic sensors is directly at the height of the corresponding circle (see figure). Only touch the circle vertically and from the front using the bar magnet. Touching it from the side may cause an error in the measurement as the float position is recorded by the magnetic field sensors.

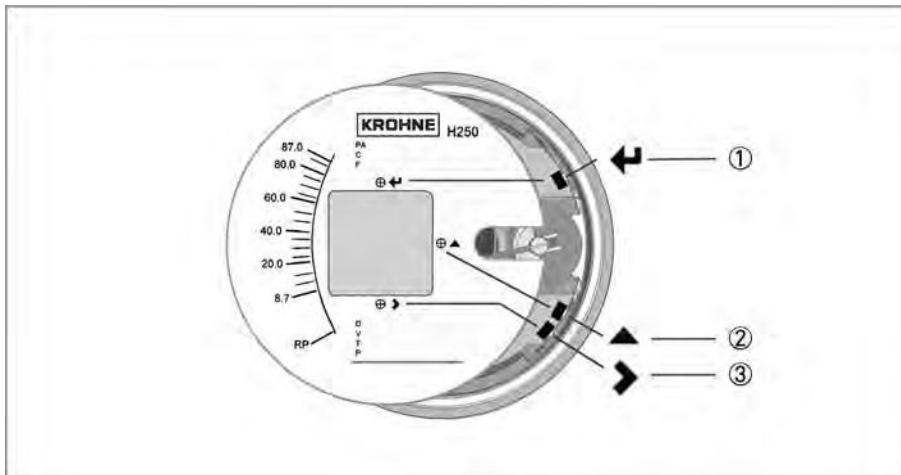


Figure 6-3: Display and operating elements

- ① Enter button (circuit for bar magnet)
- ② Up button (circuit for bar magnet)
- ③ Right button (circuit for bar magnet)

The mechanical keys and keys for the bar magnet have the same functionality. In this documentation the keys are represented as symbols to describe the operating functions:

|   | Key   | Symbol |
|---|-------|--------|
| ① | Enter | ←      |
| ② | up    | ↑      |
| ③ | right | →      |

Table 6-1: ESK4-T operation keys



## 6.3 Basic principles of operation ESK4-T

### 6.3.1 Description of the operating keys

|   |  |
|---|--|
| → | Switch from measuring mode to menu mode  |
|   | Switch to one menu level lower   |
|   | Open menu item and activate change mode  |
|   | Confirm query whether data should be accepted  |
|   | <b>In change mode:</b> Move the input cursor one position to the right. After the last digit the input cursor jumps back to the beginning. |
| ↑ | Change between the menu items within a menu level  |
|   | <b>In measuring mode:</b> Switch between measured values and error messages  |
|   | <b>In change mode:</b> Changing parameters or settings. Run through the available characters (including decimal point).                    |
| ↵ | <b>In measuring mode:</b> Switch between measured value display and error messages / warnings  |
|   | Switch to one menu level higher  |
|   | Return to measuring mode with a query whether the data should be accepted  |
|   | Cancel the query, whether data should be accepted  |

Table 6-2: Description of the operating keys

### 6.3.2 Navigation within the menu structure

Navigate through the menu using the →, ↑ and ↵ keys. Pressing the → key takes you one menu lower. Using the ↑ key takes you one menu item higher (e.g. from 1 to 2). Pressing the ↵ key takes you one menu higher.

If you are already at the lowest level (function level), the ↵ key takes you to the change mode, where you can set data and values.

If you are at the first level (main menu), you can use the ↵ key to exit the menu mode and return to the measuring mode.

If settings were changed, the query whether they should be saved will appear. Confirm this query with the → key or cancel it with the ↵ key.

|                |   |           |   |         |   |          |   |      |
|----------------|---|-----------|---|---------|---|----------|---|------|
| Measuring mode | → | Main menu | → | Submenu | → | Function | → | Edit |
|                | ↵ | ↑         | ↵ | ↑       | ↵ | ↑        | ↵ | →↑↵  |

Table 6-3: Navigation within the menu structure

### 6.3.3 Change the settings in the menu

#### Starting operation

Operation is started using the → key.

If an operation lock is set, the code (→ → → ← ← ← ↑ ↑ ↑) must be entered. The code can be set in menu 3.13. The code shown here is set at the factory but not activated. If no key is activated within 5 seconds or an incorrect code is entered, a warning message is displayed and the indication returns to measuring mode.

#### Exit operation

Operation is exited by pressing the ← key several times.

If data have been changed:

|          |   |   |
|----------|---|---|
| Save Yes | → | Changes are accepted. An update is carried out and the display returns to measuring mode. |
| Save No  | ← | Changes are discarded and the display returns to measuring mode.                          |



#### CAUTION!

*Each time parameters or settings are changed, the measuring device carries out an internal plausibility check.*

*If implausible entries were made, a warning message is shown. If this warning is confirmed with the ← key, the display returns to the respective menu item without saving the relevant change. A new entry can now be made.*

#### Example: Changing the flow unit from m<sup>3</sup>/h to l/h

|          | Display                  |      | Display                      |
|----------|--------------------------|------|------------------------------|
| Example: | 7.2<br>m <sup>3</sup> /h |      | Fct. 3.11.1<br>MEAS'D VALUE  |
| 1x →     | Fct. 1<br>OPERATION      | 1x → | 10.0000<br>m <sup>3</sup> /h |
| 2x ↑     | Fct. 3<br>INSTALLATION   | 4x ↑ | 10000<br>l/h                 |
| 1x →     | Fct 3.1<br>LANGUAGE      |      | Confirm with →<br>deny ←     |
| 10x ↑    | Fct 3.11<br>F.S.& UNIT   | 3x ← | 7200<br>l/h                  |

## 6.4 Overview of the units ESK4-T

Volume units can either represent real operating volumes (no prefix before the unit) or standard volumes virtually converted to reference statuses.


| Prefix | Volume definition  |
|--------|--|
| None   | Operating volume flow e.g. m <sup>3</sup> /h or ft <sup>3</sup> /h                                       |
| N      | Volume flow at standard (norm.) conditions (0°C - 1.013 bara) acc. to DIN 1343 e.g. Nm <sup>3</sup> /h   |
| S      | Volume flow at standard (std.) conditions (15°C - 1.013 bara) acc. to ISO 13443 e.g. Sft <sup>3</sup> /h |

| Measured variables                | Units               |                       |                     |                     |
|-----------------------------------|---------------------|-----------------------|---------------------|---------------------|
| Operating volume flow             | m <sup>3</sup> /s   | m <sup>3</sup> /min   | m <sup>3</sup> /h   | m <sup>3</sup> /d   |
|                                   | L/s                 | L/min                 | L/h                 | -                   |
|                                   | ft <sup>3</sup> /s  | ft <sup>3</sup> /min  | ft <sup>3</sup> /h  | ft <sup>3</sup> /d  |
|                                   | gal/s               | gal/min               | gal/h               | gal/d               |
|                                   | bbl/s               | bbl/min               | bbl/h               | bbl/d               |
|                                   | ImpGal/s            | ImpGal/min            | ImpGal/h            | ImpGal/d            |
| Standard (norm.) volume flow      | Nm <sup>3</sup> /s  | Nm <sup>3</sup> /min  | Nm <sup>3</sup> /h  | Nm <sup>3</sup> /d  |
|                                   | NL/s                | NL/min                | NL/h                | -                   |
| Standard (std.) volume flow       | Sm <sup>3</sup> /s  | Sm <sup>3</sup> /min  | Sm <sup>3</sup> /h  | Sm <sup>3</sup> /d  |
|                                   | SL/s                | SL/min                | SL/h                | -                   |
|                                   | Sft <sup>3</sup> /s | Sft <sup>3</sup> /min | Sft <sup>3</sup> /h | Sft <sup>3</sup> /d |
| Mass flow                         | g/s                 | g/min                 | g/h                 | -                   |
|                                   | kg/s                | kg/min                | kg/h                | kg/d                |
|                                   | -                   | t/min                 | t/h                 | t/d                 |
|                                   | lb/s                | lb/min                | lb/h                | lb/d                |
|                                   | -                   | STon/min              | STon/h              | STon/d              |
|                                   | -                   | -                     | LTon/h              | LTon/d              |
| Operating volume totalizer        | m <sup>3</sup>      | l                     | hl                  | ft <sup>3</sup>     |
|                                   | ImpGal              | gallon                | bbl                 | bbl (liq)           |
| Standard (norm.) volume totalizer | Nm <sup>3</sup>     | NL                    |                     |                     |
| Standard (std.) volume totalizer  | Sft <sup>3</sup>    | SL                    | Sm <sup>3</sup>     |                     |
| Mass totalizer                    | kg                  | g                     | t                   | lb                  |
|                                   | STon                | LTon                  |                     |                     |
| Temperature                       | °C                  | °F                    | K                   |                     |

Table 6-4: Overview of the units ESK4-T

In addition to the predefined units shown here, a user-defined unit can be activated in Menu 3.12 by entering a conversion factor and a unit designation as free text.

## 6.5 Error messages ESK4-T

Error messages and warnings are indicated by one of the following symbols in the bottom left corner of the display. The  key switches from the measured value display to the display of current errors / warnings. The table below contains a description of possible error messages.





| Symbol  | NE107 Category | Description          | Consequence  |
|---|----------------|----------------------|--|
|  | F              | Failure              | No measured value available<br>Output signal invalid.<br>Error current signal is output.                       |
|  | S              | Out of specification | Measurement available but increasing measurement uncertainty. Device must be checked.                          |
|  | M              | Maintenance required | Measurement still sufficiently accurate but maintenance required.  |
|  | C              | Check request        | Device is in test or linearization mode. The output signal temporarily does not correspond to the measurement. |
|   | I              | Information          | No influence on the measurement, information only.   |

Table 6-5: Description of the symbols

| Error message             | Description   | Category | Remedy  |
|---------------------------|---|----------|---|
| NOT LINEARIZED            | Linearization faulty or not activated = measuring error                                       | S        | Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization. |
| NEW LINEARI. TABLE BAD    | Faulty or missing data in the linearization table = measuring error                           | S ①      |   |
| LINEARIZATIO UNDER CONFIG | The device is in linearization mode = measuring error   | S        | Complete the linearization and activate it (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.  |
| UNIT SYSTEM CONFLICT      | The unit for the linearization flow is incompatible with the selected flow type (mass/volume) | S        | Correct error, carry out linearization again if necessary (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.                                   |
| TOO FEW ENTRIES           | The linearization table has too few data points   | S        | Carry out linearization at at least 5 points (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.  |
| NOT MONOTONOUS            | The sequence of the linearization values is not strictly monotonic increasing                 | S        | Check linearization and/or carry it out again (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.   |
| FIRST NOT 0 %             | The first flow value if the linearization table is not 0%                                     |          |   |
| LAST NOT 100 %            | The last flow value if the linearization table is not 100%                                    |          |   |

| Error message         | Description   | Category | Remedy  |
|-----------------------|---|----------|---|
| NO ZERO CAL OF AO     | The current output zero point 4.00mA is not calibrated. = possible measuring error in process control.                                  | S        | Perform calibration using ammeter and menu 3.10 or using standard HART® tools/process control system and poss. external ammeter. Caution: during calibration, switch the measuring point to manual control.               |
| NO F.SC. CAL OF AO    | The current output 100% = 20.00mA is not calibrated. = possible measuring error in process control.                                     | S        | Perform calibration using ammeter and menu item 3.11 or using standard HART® tools and external ammeter if necessary. Caution: during calibration, switch the measuring point to manual control.                          |
| NO TEMP. COMPENSATION | The sensor temperature compensation of the device is faulty or was not carried out = possible measuring error                           | S        | The device, together with an indication of the error, must be sent back to the manufacturer for checking.   |
| WRONG ELEC.REV.       | The ER revision of the ESK4 / ESK4A is not compatible with the add-on module, or the ribbon cable connection is not connected properly. | S        | Check that the ribbon cable fits properly. Check module compatibility (for details refer to <i>Electronic revision</i> on page 18).   |
| OUTPUT NOT LINEARIZED | Linearization is not activated = measuring error  | S        | Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization. |
| COUNTER LOST          | Totalizer value was reset by error/overflow   | S ①      | Because the reset time is not known: Controlled reset of the counter using menu item 1.6.1 or using HART® tools/process control system.   |
| FRAM WRITE FAULT      | Internal communication error  | F        | Check whether the display is plugged in correctly and restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.  |
| ROM/FLASH ERROR       | Memory error detected during self-test.   | F        | Restart device. If the error occurs again: send the device back to the manufacturer with an indication of the error.  |
| RESTART OF DEVICE     | A device restart has taken place  | I        | The device has been restarted using menu item 1.6.2 since the last time the error messages were reset.  |
| MULTIDROP MODE        | The HART® multidrop mode is activated. The current output is set to a fixed value of 4.5 mA.  | I        | The HART® multidrop mode is activated with selection of a polling address not equal to 0 using menu item 3.7. Polling address 0 reactivates the current output.   |
| CRYSTAL OSC FAULT     | Internal error in device  | F        | The device must be sent back to the manufacturer with an indication of the error.   |
| REF VOLTAGE FAULT     | Internal error in device  |          |   |
| SENSOR A FAULT        | Internal error in device  |          |   |
| SENSOR B FAULT        | Internal error in device  |          |   |
| MEMORY CORRUPTION     | Internal memory error, caused by a hardware or software problem   | F ①      | Restart the device; if the error occurs again the device must be sent back to the manufacturer with an indication of the error.   |
| AO FIXED              | The current output is set to a fixed value.   | I        | The current output is fixed and does not reflect the measured value. This is the case in multidrop mode, with current output test/calibration using the menu or HART®.  |
| AO SATURATED          | Current output saturated  | I        | The current output is saturated at >20.4 mA and is no longer linked to the measurement.   |

| Error message   | Description   | Category | Remedy                                    |
|-----------------|---|----------|---|
| ERROR TIMEOUT   | Data not transferred, or transferred incorrectly from the ESK to the counter module | F        | Confirm menu item "1.6.3 WRITE INFO I/O". |
| WARNING TIMEOUT |   | I        |   |

Table 6-6: Error messages ESK4-T

① Category can be changed by user.

## 6.6 ESK4-T menu

### 6.6.1 Factory settings

| Function          | Setting                    |
|-------------------|----------------------------|
| 1.1.1 OUTPUT B1   | INACTIVE                   |
| 1.2.1 OUTPUT B2   | INACTIVE                   |
| 1.3.1 PULSE WIDTH | 50ms                       |
| 1.3.2 PULSE/UNIT  | 1 Pulse/Unit               |
| 1.4 DISPLAY       | MEAS'D VALUE               |
| 1.4.2 ROTATION    | 0°                         |
| 1.5 TIME CONST    | 1.0s                       |
| 1.6.1 COUNTER     | NO                         |
| 1.6.2 ERROR       | NO                         |
| 1.6.3 RE-INIT IO  | NO                         |
| 3.1 LANGUAGE      | ENGLISH                    |
| 3.2 FUNCTION B1   | INACTIVE                   |
| 3.3 CONTACT B1    | NORM.OPEN                  |
| 3.4 FUNCTION B2   | INACTIVE                   |
| 3.5 CONTACT B2    | NORM.OPEN                  |
| 3.6 FUNCTION B3   | INACTIVE                   |
| 3.7 MULTIDROP     | POLLING ADD: 00            |
| 3.8 4mA CALIBR.   | 4.000mA                    |
| 3.9 20mA CALIBR.  | 20.000mA                   |
| 3.10 ALARM CURR.  | ALARM HIGH                 |
| 3.11 F.S.& UNIT   | Application specific       |
| 3.11.2 COUNTER    | Application specific       |
| 3.12 USER DEFINED | User defined unit / factor |
| 3.13 L.FL.CUTOFF  | 4% ON; 6% OFF              |
| 3.14 DESCRIPTOR   | Free text                  |
| 3.15 ENTRY CODE   | OFF                        |
| 3.16 DEFAULT VAL. | NO                         |

Table 6-7: Factory settings



#### **INFORMATION!**

*The measuring device has been preset at the factory in accordance with the customer order. Therefore subsequent configuration via the menu is only necessary if the intended use of the device is changed.*

## 6.6.2 Menu structure

| Main menu       | Submenu 1       | Submenu 2  |
|-----------------|-----------------|--|
| 1 OPERATION     | 1.1 OUTPUT B1   | 1.1.1 INACTIVE, MEAS.VAL. B1, CNT. VAL. B1, PULSE WIDTH      |
|                 |                 | 1.1.2 HYST. B1, PULSE/UNIT                                   |
|                 | 1.2 OUTPUT B2   | 1.2.1 INACTIVE, MEAS.VAL. B2, CNT. VAL. B2, PULSE WIDTH      |
|                 |                 | 1.2.2 HYST. B2, PULSE/UNIT                                   |
|                 | 1.3 PULSE OUTP. | 1.3.1 PULSE WIDTH  |
|                 |                 | 1.3.2 PULSE/UNIT   |
|                 | 1.4 DISPLAY     | 1.4.1 MEAS'D VALUE, COUNTER, MV/COUNTER, MV&COUNTER, PERCENT |
|                 |                 | 1.4.2 ROTATION   |
|                 | 1.5 TIME CONST  | -  |
|                 | 1.6 RESET       | 1.6.1 COUNTER  |
|                 |                 | 1.6.2 ERROR  |
|                 |                 | 1.6.3 WRITE INFO IO  |
|                 | 2 TEST & INFO   | 2.1 4-20mA OUTP  |
| 2.1.2 4.0mA     |                 |  |
| 2.1.3 5.6mA     |                 |  |
| 2.1.4 7.2mA     |                 |  |
| 2.1.5 8.8mA     |                 |  |
| 2.1.6 10.4mA    |                 |  |
| 2.1.7 12.0mA    |                 |  |
| 2.1.8 13.6mA    |                 |  |
| 2.1.9 15.2mA    |                 |  |
| 2.1.10 16.8mA   |                 |  |
| 2.1.11 18.4mA   |                 |  |
| 2.1.12 20.0mA   |                 |  |
| 2.1.13 21.6mA   |                 |  |
| 2.2 ALARM CURR. |                 | ALARM HIGH, ALARM LOW  |
| 2.3 OUTPUT B1   |                 | 2.3.1 NORMAL OP  |
|                 |                 | 2.3.2 OPEN   |
|                 |                 | 2.3.3 CLOSED   |
| 2.4 OUTPUT B2   |                 | 2.4.1 NORMAL OP  |
|                 |                 | 2.4.2 OPEN   |
|                 |                 | 2.4.3 CLOSED   |
| 2.5 INPUT B3    |                 | ACTIVE HI, ACTIVE LO, ON, OFF                                |
| 2.6 DEV. IDENT. |                 | 2.6.1 ELEC. REV.   |
|                 |                 | 2.6.2 SN ESK4  |
|                 |                 | 2.6.3 PROD. ORDER  |
|                 |                 | 2.6.4 DEV. SN.   |

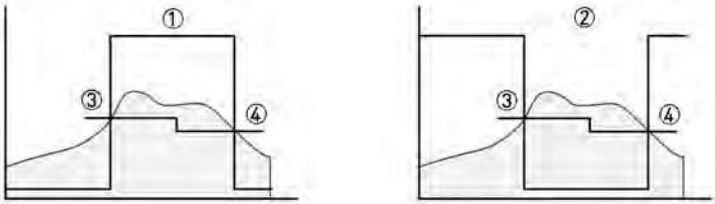
| Main menu         | Submenu 1                      | Submenu 2  |
|-------------------|--------------------------------|--|
| 2 TEST & INFO     | 2.7 SOFT.VERSION               | 2.7.1 FW. ESK4   |
|                   |                                | 2.7.2 FW. ESK4 I/O   |
|                   | 2.8 TAG NB.                    | 8 characters   |
|                   | 2.9 LONG TAG                   | 32 characters  |
| 3 INSTALLATION    | 3.1 LANGUAGE                   | 3.1.1 ENGLISH  |
|                   |                                | 3.1.2 DEUTSCH  |
|                   |                                | 3.1.3 FRANCAIS   |
|                   |                                | 3.1.4 ITALIANO   |
|                   |                                | 3.1.5 ESPANOL  |
|                   |                                | 3.1.6 CESKY  |
|                   |                                | 3.1.7 POLSKI   |
|                   |                                | 3.1.8 NEDERLANDS   |
|                   |                                | 3.1.9 DANSK  |
|                   | 3.2 FUNCTION B1                | INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.          |
|                   | 3.3 CONTACT B1                 | NORM.OPEN, NORM.CLOSED                                     |
|                   | 3.4 FUNCTION B2                | INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.          |
|                   | 3.5 CONTACT B2                 | NORM.OPEN, NORM.CLOSED                                     |
|                   | 3.6 FUNCTION B3                | INACTIVE, ACTIVE HI, ACTIVE LO, STARTH STOPL, STARTL STOPH |
|                   | 3.7 MULTIDROP                  | POLLING ADD.   |
|                   | 3.8 4mA CALIBR.                | 4.000mA  |
|                   | 3.9 20mA CALIBR.               | 20.000mA   |
|                   | 3.10 ALARM CURR.               | OFF, ALARM HIGH, ALARM LOW                                 |
|                   | 3.11 F.S.& UNIT                | 3.11.1 MEAS'D VALUE  |
|                   |                                | 3.11.2 COUNTER   |
| 3.12 USER DEFINED | 3.12.1 MEAS'D VALUE            |  |
|                   | 3.12.2 COUNTER                 |  |
| 3.13 L.FL.CUTOFF  | 3.13.1 CONTROL ON, CONTROL OFF |  |
|                   | 3.13.2 ON VALUE                |  |
|                   | 3.13.3 OFF VALUE               |  |
| 3.14 DESCRIPTOR   | Free text                      |  |
| 3.15 ENTRY CODE   | OFF, ON                        |  |
| 3.16 DEFAULT VAL. | SET ALL                        |  |

Table 6-8: Menu structure



### 6.6.3 Menu description

#### 1 OPERATION

| Selection / Input | Explanation   |
|-------------------|---|
| 1.1 OUTPUT B1     | <p>Output B1 is a binary switching output. In Fct. 3.2, one of the following functions can be selected for this output:<br/>INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.</p> <p>One of the following functions can be selected as contact type in Fct. 3.3:<br/>NORM.OPEN ① / NORM.CLOSED ②</p>    |
| 1.1.1             |   |
| INACTIVE          | -   |
| MEAS.VAL. B1      | <p>Switching point of flow value<br/>Value range: 0.0...full scale range<br/>The switching point is entered in flow units.<br/>If the current flow value exceeds this pre-determined switching point, output B1 changes its binary state ③.</p> <p>In Fct. 1.1.2 a hysteresis can be specified additionally.</p>  |
| CNT. VAL. B1      | <p>Switching point of totaliser value<br/>Value range: 0.0...counter limit<br/>The switching point is entered in volume or mass units.<br/>If the the current counter value exceeds this pre-determined switching point, output B1 changes its binary state ③.<br/>There is no hysteresis setting for the switching point of the counter value.</p>   |
| PULSE WIDTH       | <p>Pulse weight (pulse/unit)<br/>The weight is only displayed here.</p> <p>A configuration takes place in Fct. 1.3.1 PULSE WIDTH, 1.3.2 PULSE/UNIT and 3.11.2 COUNTER.</p>  |
| 1.1.2 HYST. B1    | <p>Hysteresis for the switching point of the flow value<br/>Value range: 0.0...switching point<br/>If the current flow value exceeds the pre-determined switching point from Fct. 1.1.1, output B1 changes its binary state ③.<br/>In order for output B1 to change its binary state back to the initial setting, the switching point made smaller by the hysteresis must be undershot ④.</p> <p><b>Example:</b><br/>In 1.1.1, a switching point of 200 L/h is set.<br/>The possible value range for the hysteresis is then 0.0...200 L/h.<br/>With a hysteresis value of 0, the switching point has no hysteresis (③=④).<br/>If a hysteresis value of 20 L/h is entered, output B1 changes its binary state to the initial setting, if it drops below 180 L/h ④.</p> |

| Selection / Input      | Explanation  |
|------------------------|--|
| <b>1.2 OUTPUT B2</b>   | Output B2 is a binary switching output. In Fct. 3.4, one of the following functions can be selected for this output:<br>INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.<br><br>One of the following functions can be selected as contact type in Fct. 3.5:<br>NORM.OPEN ① / NORM.CLOSED ②  |
|                        |  |
| 1.2.1                  |  |
| INACTIVE               | -  |
| MEAS.VAL. B2           | Refer to MEAS.VAL. B1<br>In Fct. 1.2.2 a hysteresis can be specified additionally.   |
| CNT. VAL. B2           | Refer to CNT. VAL. B1  |
| PULSE WIDTH B2         | Refer to PULSE WIDTH B1<br>A configuration takes place in Fct. 1.3.1 PULSE WIDTH, 1.3.2 PULSE/UNIT and 3.11.2 COUNTER.   |
| 1.2.2 HYST. B2         | Refer to HYST. B1  |
| <b>1.3 PULSE OUTP.</b> | -  |
| 1.3.1 PULSE WIDTH      |  |
| 50ms                   | $T_i = 50 \text{ ms}$ ; $f_{\text{max}} = 10 \text{ Hz}$<br>max. pulses/h = 36000  |
| 100ms                  | $T_i = 100 \text{ ms}$ ; $f_{\text{max}} = 5 \text{ Hz}$<br>max. pulses/h = 18000  |
| 200ms                  | $T_i = 200 \text{ ms}$ ; $f_{\text{max}} = 2.5 \text{ Hz}$<br>max. pulses/h = 9000   |
| 500ms                  | $T_i = 500 \text{ ms}$ ; $f_{\text{max}} = 1 \text{ Hz}$<br>max. pulses/h = 3600   |
| 1.3.2 PULSE/UNIT       | 0.001...1000<br><br>Pulse per volume or mass unit of counter (setting in Fct. 3.11.2), which can be output via one of the binary outputs. The maximum frequency for the pulse output (refer to Fct 1.3.1) cannot be exceeded, even at maximum flow rate (full scale).<br><br><b>Example:</b><br>Final value $Q_{\text{max}} = 1200 \text{ L/h}$ ; volume unit of counter = Litre; pulse width = 100ms;<br>If the factor 1 is entered, 1 pulse/litre = 1200 pulses are generated in one hour at maximum flow rate.<br>Number of max. permissible pulses:<br><br>$\frac{\frac{P_{\text{max}}}{h}}{Q_{\text{max}}} = \frac{18000 \frac{P}{h}}{1200 \frac{l}{h}} = 15 \frac{P}{l}$ |

|                       |   |
|-----------------------|---|
| <b>1.4 DISPLAY</b>    | Different measured values can be selected for permanent or alternating display. The reading on the display can be rotated.  |
| 1.4.1                 |   |
| MEAS'D VALUE          | Permanent display of flow in flow units   |
| COUNTER               | Permanent display of totalizer  |
| MV/COUNTER            | Alternating display of flow value in flow units and totalizer   |
| MV&COUNTER            | Simultaneous display of flow value and totalizer  |
| PERCENT               | Permanent display of flow value in percent  |
| 1.4.2 ROTATION        |   |
| 0°                    | The reading is not rotated.   |
| 90°                   | The reading on the display is rotated by 90°.   |
| 180°                  | The reading on the display is rotated by 180°.  |
| 270°                  | The reading on the display is rotated by 270°.  |
| <b>1.5 TIME CONST</b> | 0.0...20.0s   |
|                       | Given in seconds<br>The output variables (value of the current loop and indicated flow value) follow the current process by the value set here (in seconds) with a time delay.<br><b>Note:</b><br>If the current flow is polled via HART® communication, the transferred measured value is also played back with a delay. |
| <b>1.6 RESET</b>      | Local resetting of totalizer and acknowledgement of warnings. There is always a safety prompt ("YES / NO"), to avoid accidental resetting.<br><b>Note:</b><br>External resetting of the totalizer can be installed with the binary input B3.  |
| 1.6.1 COUNTER         | Confirming with "YES" resets the value of the totalizer to 0.0.   |
| 1.6.2 ERROR           | Confirming with "YES" acknowledges all existing warnings.<br><b>Note:</b><br>Confirming with "YES" acknowledges existing errors and warnings.   |
| 1.6.3 RE-INIT IO      | As a general rule, data is transferred from the counter module to the ESK4 and vice versa when the device starts. For safety, another data transmission can be performed by selecting this menu item and confirming with "YES".   |

Table 6-9: Menu description - 1 OPERATION

## 2 TEST &amp; INFO

| Selection / Input      | Explanation  |
|------------------------|--|
| <b>2.1 4-20mA OUTP</b> | Testing the current loop by setting various current values.<br><br><b>Note:</b><br>The test is not available in HART® multi-drop mode (refer to Fct. 3.7)<br><br><b>Attention:</b><br>During the test, the value of the current loop does not follow the current process.  |
| 2.1.1 NORMAL OP        | The value of the current loop follows the current process.   |
| 2.1.2 4.0mA            | The value of the current loop no longer follows the current process.<br>It is set to the selected current value.   |
| 2.1.3 5.6mA            |  |
| 2.1.4 7.2mA            |  |
| 2.1.5 8.8mA            |  |
| 2.1.6 10.4mA           |  |
| 2.1.7 12.0mA           |  |
| 2.1.8 13.6mA           |  |
| 2.1.9 15.2mA           |  |
| 2.1.10 16.8mA          |  |
| 2.1.11 18.4mA          |  |
| 2.1.12 20.0mA          |  |
| 2.1.13 21.6mA          |  |
| <b>2.2 OUTPUT B1</b>   | <3.6 / >21 mA<br>Testing the alarm current HIGH/LOW according to the settings in Fct. 3.10.  |
| <b>2.3 ALARM CURR.</b> | Testing the binary switching output B1 by changing its binary status.<br><br><b>Attention:</b><br>During the test, the binary status does not correspond to the current process.   |
| 2.3.1 NORMAL OP        | The binary status of the switching output corresponds to the current process.  |
| 2.3.2 OPEN             | The binary status of the switching output no longer corresponds to the current process.<br>The selected status is tested.  |
| 2.3.3 CLOSED           |  |
| <b>2.4 OUTPUT B2</b>   | Refer to 2.2 OUTPUT B1   |
| 2.4.1 NORMAL OP        |  |
| 2.4.2 OPEN             |  |
| 2.4.3 CLOSED           |  |
| <b>2.5 INPUT B3</b>    | The current binary status of the binary input B3 is displayed. External switching of the voltage applied to input B3 activates a change of the displayed binary status.<br><br><b>Note:</b><br>A reaction to the switching of the voltage applied to input B3 only occurs if the function B3 is activated (refer to Fct. 3.6). |

| Selection / Input       | Explanation   |
|-------------------------|---|
| <b>2.6 DEV. IDENT.</b>  | Information for device identification   |
| 2.6.1 ELEC. REV.        | Electronic revision   |
| 2.6.2 SN ESK4           | Serial number ESK4  |
| 2.6.3 PROD. ORDER       | Production order for the complete flowmeter   |
| 2.6.4 DEV. SN.          | Serial number for the complete flowmeter  |
| <b>2.7 SOFT.VERSION</b> | Information about software revision status  |
| 2.7.1 FW. ESK4          | Software revision status for device insert ESK4-Basic   |
| 2.7.2 FW. ESK4 IO       | Software revision status for optional add-on module ESK4-T  |
| <b>2.8 TAG NB.</b>      | 8 digits<br>Measuring point identifier<br>Alphanumerical characters. Up to eight digits are possible. |
| 2.9 LONG TAG            | 32 digits<br>Measuring point identifier<br>Alphanumerical characters. Up to 32 digits are possible.   |

Table 6-10: Menu description - 2 TEST &amp; INFO

### 3 INSTALLATION

| Selection / Input      | Explanation   |
|------------------------|---|
| <b>3.1 LANGUAGE</b>    | Language selection for the displayed menu texts.  |
| 3.1.1 ENGLISH          | The menu texts are displayed in the selected language.  |
| 3.1.2 DEUTSCH          |   |
| 3.1.3 FRANCAIS         |   |
| 3.1.4 ITALIANO         |   |
| 3.1.5 ESPANOL          |   |
| 3.1.6 CESKY            |   |
| 3.1.7 POLSKI           |   |
| 3.1.8 NEDERLANDS       |   |
| 3.1.9 DANSK            |   |
| <b>3.2 FUNCTION B1</b> | -   |
| INACTIVE               | The binary switching output B1 has no function.   |
| SWITCH POINT           | The binary switching point B1 acts as a limit switch depending on the current flow value.<br>Configuration of the switching point is in Fct. 1.1.1 MEAS.VAL. B1.  |
| COUNT. LIMIT           | The binary switching point B1 acts as a limit switch depending on the current counter value.<br>Configuration of the switching point is in Fct. 1.1.1 MEAS.VAL. B1.   |
| PULSE OUTP.            | The binary switching point B1 acts as a pulse output depending on the current flow value. Pulses of a maximum of up to 10 Hz can be generated. The configuration is in Fct. 1.3.1 PULSE WIDTH and 1.3.2 PULSE/UNIT.<br><br><b>Note:</b><br>The configuration in Fct. 1.3.1 and Fct. 1.3.2 applies to both pulse outputs. If both B1 and B2 are configured as pulse outputs, both binary outputs behave in exactly the same way. |
| <b>3.3 CONTACT B1</b>  | -   |
| NORM.OPEN              | The contact type of the binary switching output B1 is "normally open".  |
| NORM.CLOSED            | The contact type of the binary switching output B1 is "normally closed".  |

| Selection / Input       | Explanation   |
|-------------------------|---|
| <b>3.4 FUNCTION B2</b>  | -   |
| INACTIVE                | Refer to FUNCTION B1  |
| SWITCH POINT            | Refer to FUNCTION B1<br>Configuration of the switching point is in Fct. 1.2.1 MEAS.VAL. B2.   |
| COUNT. LIMIT            | Refer to FUNCTION B1<br>Configuration of the switching point is in Fct. 1.2.1 MEAS.VAL. B2.   |
| PULSE OUTP.             | Refer to FUNCTION B1<br>The configuration is in Fct. 1.3.1 PULSE WIDTH and 1.3.2 PULSE/UNIT.  |
| <b>3.5 CONTACT B2</b>   | -   |
| NORM.CLOSED             | Refer to CONTACT B1   |
| NORM.OPEN               | Refer to CONTACT B1   |
| <b>3.6 FUNCTION B3</b>  | -   |
| INACTIVE                | The binary switching input B3 has no function.  |
| ACTIVE HI               | The internal flow counter is reset to 0.0 if there is an H level at input B3 for at least 100 ms.   |
| ACTIVE LO               | The internal flow counter is reset to 0.0 if there is an L level at input B3 for at least 100 ms.   |
| STARTRH STOPL           | The counter is started by creating an H level at input B3 and stopped by creating an L level at input B3.   |
| STARTL STOPH            | The counter is started by creating an L level at input B3 and stopped by creating an H level at input B3.   |
| <b>3.7 MULTIDROP</b>    | 0...15<br>Polling address for HART® multi-drop mode<br>When the address is 0, the HART® multi-drop mode is disabled.<br><b>Attention:</b><br>When the HART® multi-drop mode (Address 1...15) is activated, the current loop is inactive (fixed current value of "4.5mA") and no longer follows the current process.   |
| <b>3.8 4mA CALIBR.</b>  | D/A calibration for lower range value (4mA)<br><b>Note:</b><br>This function is not available in HART® multi-drop mode.<br><b>Attention:</b><br>During calibration, the value of the current loop does not follow the current process.<br>If an ampere meter detects in the 4...20 mA loop a deviation from the desired value of "4.000mA", the measured value must be entered. The correction value is accepted following the query to save and confirm with yes.    |
| <b>3.9 20mA CALIBR.</b> | D/A calibration for the full scale value (20 mA)<br><b>Note:</b><br>This function is not available in HART® multi-drop mode.<br><b>Attention:</b><br>During calibration, the value of the current loop does not follow the current process. If an ampere meter detects in the 4...20 mA loop a deviation from the desired value of "20.000mA", the measured value must be entered. The correction value is accepted following the query to save and confirm with yes. |
| <b>3.10 ALARM CURR.</b> | -   |
| OFF                     | Error indication via the current loop is deactivated. The current loop follows the current process.<br><b>Note:</b><br>This function is not available in HART® multi-drop mode.   |

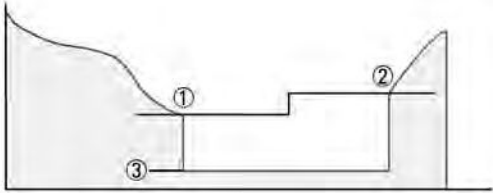
| Selection / Input        | Explanation   |
|--------------------------|---|
| ALARM HIGH               | Error indication via the current loop is activated (failure signal "high" acc. to NE43).<br><b>Note:</b><br>This function is not available in HART® multi-drop mode.  |
| ALARM LOW                | Error indication via the current loop is activated (failure signal "low" acc. to NE43).<br><b>Note:</b><br>1) This function is not available in HART® multi-drop mode.<br>2) This function is supported from ER 2.2.x.  |
| <b>3.11 END&amp;UNIT</b> | By changing the unit, the respective final value is scaled accordingly. Depending on calibration, either units for volume or mass flow measurement are available for selection.   |
| 3.11.1 MEAS'D VALUE      | For units for volume flow or mass flow, refer to <i>Overview of the units ESK4-T</i> on page 43.  |
| 3.11.2 COUNTER           | For units for volume counter or mass counter and pulse output, refer to <i>Overview of the units ESK4-T</i> on page 43.   |
| <b>3.12 USER DEFINED</b> | User-defined unit with conversion to calibrated unit.   |
| <b>3.13 L.FL.CUTOFF</b>  | L.FL.CUTOFF stands for low flow cutoff.<br>To ensure a stable zero point of the current output, the current output can be set to a stable value of "4.00mA" ③ in a selectable range.<br>  |
| 3.13.1                   |   |
| CONTROL OFF              | LFC function is not active.   |
| CONTROL ON               | L.FL.CUTOFF function is active.   |
| 3.13.2 ON VALUE          | Switch-on value ①:<br>Value range 1...19% (of full scale range)<br>The flow is greater than the switch-on value. The current output corresponds to this.<br>If the flow rate falls, the current output follows until the switch-on value ①.<br>If the flow value continues to fall, the current output is switched to "4.00mA" ③.<br><b>Note:</b><br>The switch-on value to be set must be smaller than the previously selected switch-off value. |
| 3.13.3 OFF VALUE         | Switch-off value ②:<br>Value range 2...20% (of full scale range)<br>The flow rate is 0. The current output is "4.00mA" ③.<br>If the flow rate increases, the current output remains at "4.00mA" until it has reached the switch-off value ②.<br><b>Note:</b><br>The switch-off value to be set must be greater than the previously selected switch-on value.  |
| <b>3.14 DESCRIPTOR</b>   | 12 digits<br>Free text input for header in LCD  |
| <b>3.15 ENTRY CODE</b>   | Entry code for the local operating menu.<br>The entry code is not active by default.  |
| 3.15.1 OFF               | The use of an entry code is not activated.  |
| 3.15.2 ON                | If "YES" is selected, the last code that was entered has to be typed in.<br>Factory code: → → → ← ← ← ↑ ↑ ↑<br>If, after confirmation with "YES", the → key is pressed additionally, then a new, individual, nine digits code can be typed in.<br>The display shows the required key combination.   |
| <b>3.16 DEFAULT VAL.</b> | Resetting parameters to factory default.<br>There is always a safety prompt ("YES / NO"), to avoid accidental resetting.  |

Table 6-11: Menu description - 3 INSTALLATION

## 7.1 Maintenance

Within the scope of routine maintenance of the system and pipelines, the flowmeter should also be inspected for signs of fouling, corrosion, mechanical wear and leaks, as well as damage to the measuring tube and the indicator.

We advise that inspections are carried out at least once per year.

The device must be removed from the pipeline before cleaning.



**CAUTION!**

*Pressurised pipes have to be depressurised before removing the device.*

*Empty the pipelines as completely as possible.*

*In the case of devices used for measuring aggressive or hazardous media, 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.*

*Avoid electrostatic charges when cleaning the surfaces (e.g. sight window)!*

## 7.2 Replacement and retrofitting

Some components of the variable area flowmeter can be retrofitted:

- Float damping

**Indicator M40:**

- Limit switch module K1 / K2
- Current output 4..20 mA ESK4 / ESK4A
- Counter module with LCD and I/O ESK4-T
- Fieldbus interface ESK4-PA / FF

### 7.2.1 Replacing floats



- Remove the device from the pipeline.
- Take the upper span ring out of the measuring unit.
- Take the upper float stop and float out of the measuring unit.
- Insert the new float into the centre hole of the lower float stop and push into the measuring unit along with the upper float stop. While doing this, the float's upper guide rod must be guided through the middle hole of the float stop.
- Insert the span ring into the measuring unit.
- Fit the device back into the pipeline.



**CAUTION!**

*Without a recalibration an additional measuring error is to be expected.*



## 7.2.2 Retrofitting of the float damping



- Take the upper span ring ① out of the measuring unit.
- Take the upper float stop ② and float ⑤ out of the measuring unit.
- Fasten the retaining ring ③ into the lower slot of the float's guide rod.
- Slide ceramic sleeve ④ on to the float's guide rod and attach it to the top slot using the retaining ring ③.
- Insert float into the lower float guide in the measuring unit.
- Retrofit the supplied damping cylinder with the integrated float stop ② into the measuring unit.
- Insert upper span ring ①.

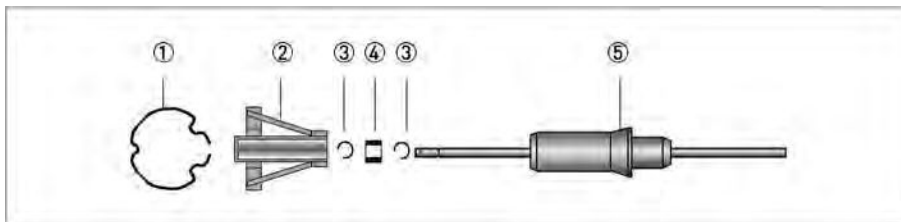


Figure 7-1: Design of the float damping

- ① Span ring
- ② Float stop
- ③ Retaining ring
- ④ Ceramic sleeve
- ⑤ Float

### 7.2.3 Retrofitting of the limit switch



- Remove ESK4 / ESK4A add-on module (if available).
- Merge contact pointer ② in the middle.
- Loosen the locking screw ① on the contact pointer.
- Insert the contact module into slot ③ of the bracket until the semi-circle ① on the contact board surrounds the pointer cylinder.

For the setting of the limits refer to *Connection of the limit switches K1/K2* on page 25.

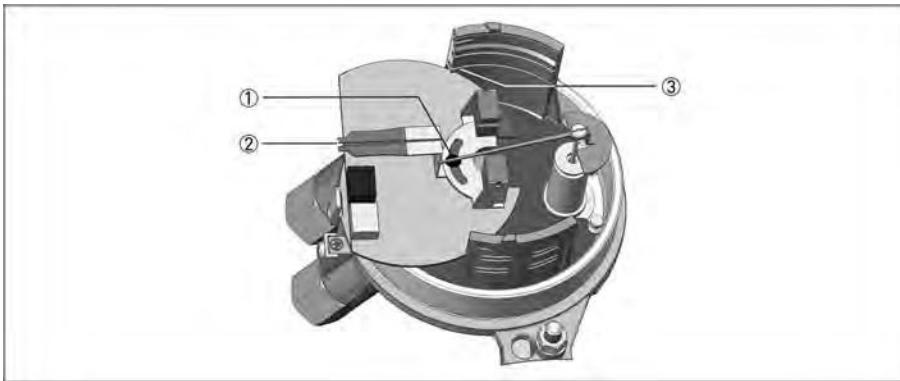


Figure 7-2: Retrofitting of the limit switch

The contact module connecting terminals feature a pluggable design and can be removed in order to connect the cables.



**WARNING!**

*Do not damage the indicating element!*

## 7.2.4 Replacement - Retrofitting ESK4 / ESK4A



### CAUTION!

When replacing or retrofitting an ESK4 / ESK4A, it is mandatory to indicate the serial number (SN) or sales order (SO) when ordering.

This information can be found on the indicator nameplate.

The ESK4 / ESK4A is factory calibrated, making it possible to replace it or retrofit it without recalibrating.



- De-energise the ESK4 / ESK4A.
- Lift and remove the ESK4 / ESK4A with a screwdriver.



### WARNING!

Do not damage the indicating element!

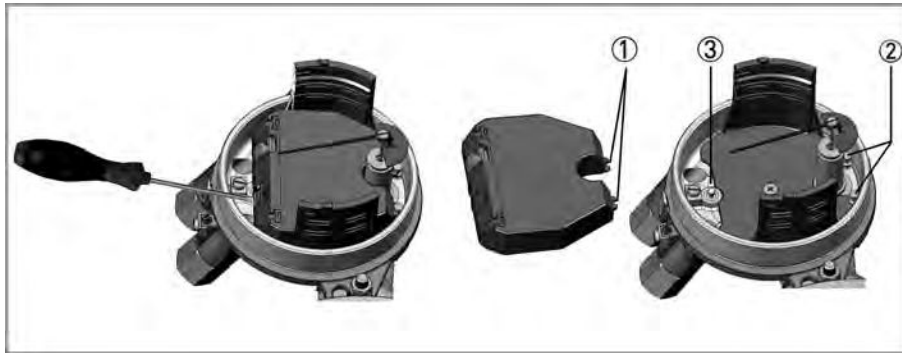


Figure 7-3: Replacement - Retrofitting ESK4 / ESK4A



- The ESK4 / ESK4A plug-in tongues ① are plugged in under the two bolts ② on the base plate.
- Slight pressure is used to press the ESK4 / ESK4A onto the spring pins ③ until it stops, firmly attaching the ESK4 / ESK4A.

If a change in measuring range, product temperature, product, density, viscosity or pressure is desired, this can be done with the help of a variable area calculation program and with a HART<sup>®</sup> modem.

However, each measuring unit is subject to its own physical limits, which the variable area calculation program correctly calculates, and may thus reject the desired change. If a change is performed using the program, the new data is also transmitted to the ESK4 / ESK4A:

- Device identification
- Device address
- Serial number
- Measuring point identifier
- Digital measured value query in flow units, % and mA
- Test / setting functions
- Calibration 4.00 and 20.00 mA
- Set current output to any desired value

### 7.2.5 Replacement - Retrofitting add-on module ESK4-T / PA / FF

The add-on module for the ESK4 / ESK4A can be replaced or retrofitted on-site without removing the device from the process control.

- ESK4-T (Display module with LCD and I/O)
- ESK4-PA (Profibus PA interface)
- ESK4-FF (Foundation Fieldbus interface)

More detailed information can be found in the service manual included with each retrofit or replacement set.

## 7.3 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

### 7.3.1 List of spare parts

| Spare part   | Order number |
|--|--------------|
| <b>DN15</b>  |              |
| Float CIV 15, 1.4404   | X251041000   |
| Float DIV 15, 1.4404   | X251042000   |
| Float TIV 15, 1.4404   | X251043000   |
| Float DIVT 15, 1.4404  | X251044000   |
| Float TIV 15, Aluminium                                      | X251043100   |
| Float TIV 15, Titanium                                       | X251043200   |
| Set float stop; standard (1 float stop, 1 span ring)         | X251050100   |
| Set float stop; gas damping (ZrO <sub>2</sub> )              | X251050200   |
| Set float stop; gas damping (PEEK)                           | X251050300   |
| Damping bush (7x8) ZrO <sub>2</sub> incl. 2 retaining rings  | X251053100   |
| Damping bush (7x8) PEEK incl. 2 retaining rings              | X251053200   |
| <b>DN25</b>  |              |
| Float CIV 25, 1.4404   | X252041000   |
| Float DIV 25, 1.4404   | X252042000   |
| Float TIV 25, 1.4404   | X252043000   |
| Float DIVT 25, 1.4404  | X252044000   |
| Set float stop; standard (1 float stop, 1 span ring)         | X252050100   |
| Set float stop; gas damping (ZrO <sub>2</sub> )              | X252050200   |
| Set float stop; gas damping (PEEK)                           | X252050300   |
| Damping bush (12x8) ZrO <sub>2</sub> incl. 2 retaining rings | X252053100   |
| Damping bush (12x8) PEEK incl. 2 retaining rings             | X252053200   |

| Spare part  | Order number |
|---|--------------|
| <b>DN50</b>   |              |
| Float CIV 55, 1.4404  | X253041000   |
| Float DIV 55, 1.4404  | X253042000   |
| Float TIV55, 1.4404   | X253043000   |
| Float DIVT 55, 1.4404   | X253044000   |
| Set float stop; standard (1 float stop, 1 span ring)                  | X253050100   |
| Set float stop; gas damping (ZrO <sub>2</sub> )                       | X253050200   |
| Set float stop; gas damping (PEEK)                                    | X253050300   |
| Damping bush (14x10) ZrO <sub>2</sub> incl. 2 retaining rings         | X253053100   |
| Damping bush (14x10) PEEK incl. 2 retaining rings                     | X253053200   |
| <b>DN80</b>   |              |
| Float CIV 85, 1.4404  | X254041000   |
| Float DIV 85, 1.4404  | X254042000   |
| Float TIV 85, 1.4404  | X254043000   |
| Float DIVT 85, 1.4404   | X254044000   |
| Set float stop; standard (1 float stop, 1 span ring)                  | X254050100   |
| Set float stop; gas damping (ZrO <sub>2</sub> )                       | X254050200   |
| Set float stop; gas damping (PEEK)                                    | X254050300   |
| Damping bush (18x14) ZrO <sub>2</sub> incl. 2 retaining rings         | X254053100   |
| Damping bush (18x14) PEEK incl. 2 retaining rings                     | X254053200   |
| <b>DN100</b>  |              |
| Float CIV 105, 1.4404   | X255041000   |
| Float DIV 105, 1.4404   | X255042000   |
| Float DIVT 105, 1.4404  | X255044000   |
| Set float stop; standard (1 float stop, 1 span ring) only for bottom! | X255050100   |
| Set float stop; gas damping (ZrO <sub>2</sub> )                       | X255050200   |
| Set float stop; gas damping (PEEK)                                    | X255050300   |
| Damping bush (18x14) ZrO <sub>2</sub> incl. 2 retaining rings         | X254053100   |
| Damping bush (18x14) PEEK incl. 2 retaining rings                     | X254053200   |

| <b>Indicator M40</b>  |            |
|---|------------|
| <b>Housing components</b>   |            |
| Standard indicator housing M40 complete, no scale *                               | X251110000 |
| Standard indicator housing M40R complete, no scale* (stainless steel, non-coated) | X251111000 |
| Standard cover M40  | X251110100 |
| Standard cover M40R (stainless steel, non-coated)                                 | X251110400 |
| Cover seal  | X251112100 |
| M40R standard base plate (stainless steel, non-coated) *                          | X251120300 |
| <b>Standard = not pressure-tight</b>  |            |
| <b>Housing components indicator M40</b>   |            |
| Retrofit kit HT extension   | X251021000 |
| Module carrier (profile rail)   | X251121100 |
| Set housing attachment parts  | X251121300 |
| Pointer system, complete *  | X251122100 |
| Magnetic brake for indicating element   | X251122200 |
| * Accuracy loss without recalibration   |            |
| <b>NAMUR 2-wire limit module</b>  |            |
| Contact module K1 min I7S23,5-N   | X251135100 |
| Contact module K1 max I7S23,5-N   | X251135200 |
| Contact module K2 min / max I7S23,5-N   | X251135300 |
| Contact module K1 min SC3,5 N0  | X251133100 |
| Contact module K1 max SC3,5 N0  | X251133200 |
| Contact module K2 min / max SC3,5 N0  | X251133300 |
| Contact module K2 min / min min - SJ3,5 S1N / SJ 3,5 SN                           | X251133400 |
| Contact module K2 max / max max - SJ3,5 S1N / SJ 3,5 SN                           | X251133500 |
| Contact module K1 min SJ3,5 SN  | X251133600 |
| Contact module K1 max SJ3,5 SN  | X251133700 |
| Contact module K1 min / max SJ3,5 SN  | X251133800 |
| <b>3-wire limit module, normally closed</b>                                       |            |
| Contact module K1 min SB3,5 E2 - act.Low  | X251133900 |
| Contact module K1 max SB3,5 E2 - act.Low  | X251134000 |
| Contact module K1 min / max SB3,5 E2 - act.Low                                    | X251134100 |
| <b>3-wire limit module, normally open</b>   |            |
| Contact module K1 min SB3,5 E2 - act.High   | X251134200 |
| Contact module K1 max SB3,5 E2 - act.High   | X251134300 |
| Contact module K1 min / max SB3,5 E2 - act.High                                   | X251134400 |

| <b>Electronic modules</b>   |            |
|---|------------|
| ESK4, ESK4-FF, ESK4-PA, ESK4-T (serial number required)             |            |
| Cover for add-on modules  | X251121500 |
| Connection cable ESK4 to add-on modules                             | X251121600 |
| Plugs (10 pcs) for ESK4 connection for bus modules                  | X251132500 |
| <b>Replacement connector</b>  |            |
| Replacement connector 11/12 for ESK4                                | X251121700 |
| Replacement connector D/D+ for ESK4-FF or ESK4-PA                   | X251121800 |
| Replacement connectors 1/2/3, 4/5/6, 7/8 for ESK4-T                 | X251121900 |
| <b>Replacement cable gland</b>                                      |            |
| Single cable gland M20x1.5 black, plastic - for non-Ex / Ex-i       | X251150300 |
| Single cable gland M20x1.5 blue, plastic - for non-Ex / Ex-i        | X251150100 |
| Single cable gland M20x1.5 brass - for non-Ex / Ex-i / Ex-nA        | X251151000 |
| Single cable gland M20x1.5 brass Ex-d/t - for Ex-d / Ex-t           | X251152000 |
| Single plug M20x1.5 brass Ex-d/t - for Ex-d / Ex-t                  | X251153000 |
| Single cable gland M20x1.5 stainless steel Ex-d/t - for Ex-d / Ex-t | X251154000 |
| Single plug M20x1.5 stainless steel Ex-d/t - for Ex-d / Ex-t        | X251155000 |

**INFORMATION!**

*Other spare parts on request.*

## 7.4 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

**INFORMATION!**

*For more precise information, please contact your local sales office.*

## 7.5 Returning the device to the manufacturer

### 7.5.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

**WARNING!**

*Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:*

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

**WARNING!**

*If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:*

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*



### 7.5.2 Form (for copying) to accompany a returned device



**CAUTION!**

*To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.*

|   |   |   |  |
|---|---|---|--|
| Company:  |   | Address:  |  |
| Department:   |   | Name:   |  |
| Tel. no.:   |   | Fax no. and/or Email address:   |  |
| Manufacturer's order no. or serial no.:   |   |   |  |
| The device has been operated with the following medium:   |   |   |  |
| This medium is:   | <input type="checkbox"/>  | radioactive   |  |
|   | <input type="checkbox"/>  | water-hazardous   |  |
|   | <input type="checkbox"/>  | toxic   |  |
|   | <input type="checkbox"/>  | caustic   |  |
|   | <input type="checkbox"/>  | flammable   |  |
|   | <input type="checkbox"/>  | We checked that all cavities in the device are free from such substances. |  |
| <input type="checkbox"/>  | We have flushed out and neutralized all cavities in the device. |   |  |
| We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned. |   |   |  |
| Date:   |   | Signature:  |  |
| Stamp:  |   |   |  |

### 7.6 Disposal



**LEGAL NOTICE!**

*Disposal must be carried out in accordance with legislation applicable in your country.*

**Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:**



According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.

The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

## 7.7 Disassembly and recycling

This section describes how to handle and disassemble the device in order to dispose of it following end of use. The information provided enables the end user to identify and separate the main components of the device for the purpose of recycling.



### **INFORMATION!**

- *Wear personal protective equipment*
- *Make sure to use a stable workstation / bench to disassemble*

### 7.7.1 Description of the device components

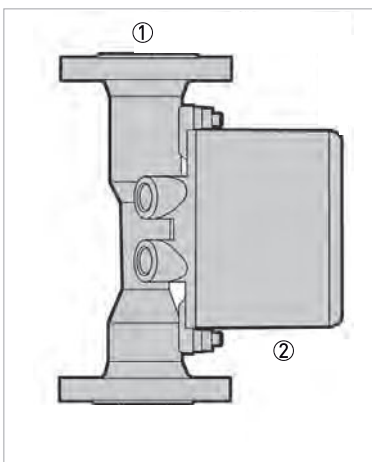


Figure 7-4: Description of the device components

- ① Measuring unit
- ② Indicator housing

The variable area flowmeter consists of a mechanical, metallic measuring unit ① and an indicator housing attached to it ②, which may contain electronic components. The metallic measuring unit can be sent to metal recycling after the indicator housing has been removed. Depending on the version, the measuring unit may weigh between 2...50 kg / 4.4...110.2 lb.



### **CAUTION!**

*Check and ensure that the measuring units, including all cavities, are free of hazardous substances by rinsing or neutralising if required. This should be done especially in the case of devices that have been operated with toxic, corrosive, radioactive, flammable or water-contaminating products to protect both the environment and the health and safety of staff.*

### 7.7.2 Indicator versions

The following discusses the indicator housing and optional electronics in more detail. The indicator housing can be fitted with various electronic modules. These can be easily removed from the housing in order to send them to electronics recycling/disposal.

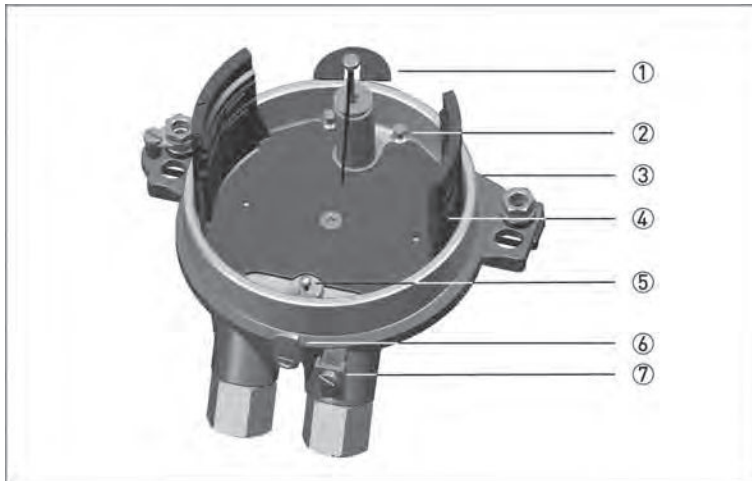


Figure 7-5: Basic version

- ① Pointer module
- ② Bolts for ESK4 / ESK4A attachment
- ③ Base plate
- ④ Module profile
- ⑤ Pressure piece for ESK4 / ESK4A attachment
- ⑥ Housing cover locking device
- ⑦ Ground terminal external

The indicator housing consists of the following components:

| Approx. information  | Weight                                     | Remarks  |
|--|--|--|
| Glass panel  | 135 cm <sup>2</sup> / 20.9 in <sup>2</sup> | -  |
| Coated aluminium, cover + base plate                         | 1.2...1.4 kg / 2.6...3.1 lb                | For M40 indicator type (see nameplate)           |
| Stainless steel, cover + base plate                          | 3.2...3.7 kg / 7.1...8.2 lb                | For M40R indicator type (see nameplate)          |
| Other metal parts, pressure pin, bolts, grounding connection | 50 g / 0.1 lb                              | -  |
| PA module profile  | 75 g / 0.17 lb                             | Can be removed by taking out the screw           |
| Pointer system   |  | Can be removed after removing the module profile |
| Aluminium  | 30 g / 0.07 lb                             |  |
| Plastic  | 1 g / 0.002 lb                             |  |
| Magnetic material  | 10 g / 0.02 lb                             |  |
| Other metals   | 2 g / 0.004 lb                             |  |

The indicator housing may contain optional electronic components which can be seen when the cover is opened. They may be removed individually from the indicator housing.

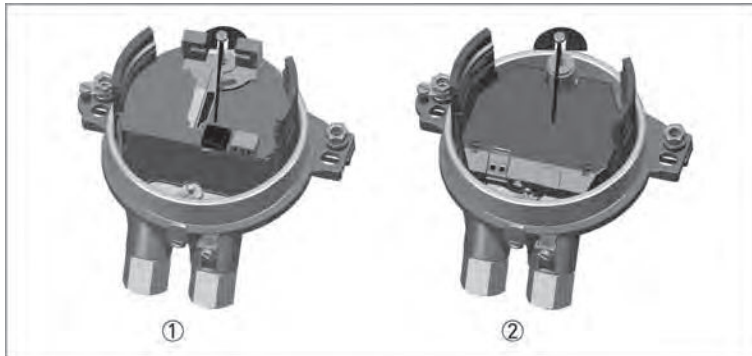


Figure 7-6: Versions K1 / K2 and ESK4 / ESK4A

- ① Indicator with K2 contact module
- ② Indicator with ESK4 / ESK4A current output 4...20 mA

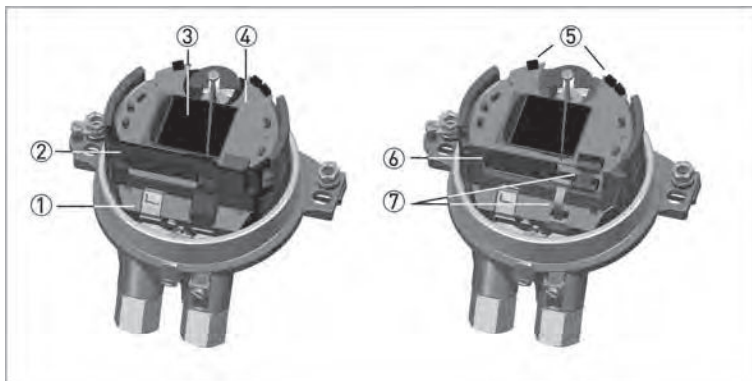


Figure 7-7: Version ESK4-T

- ① ESK4 / ESK4A connection
- ② Module cover
- ③ Display
- ④ Display module ESK4-IO
- ⑤ Operating keys ← ↑
- ⑥ Connection binary outputs and reset input
- ⑦ Module connection cable

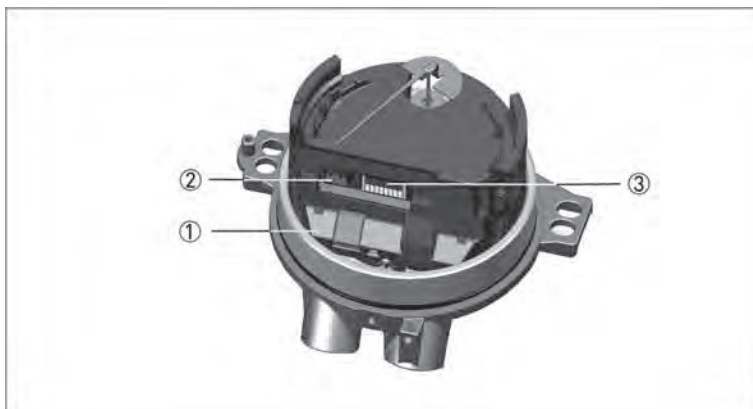


Figure 7-8: Version Fieldbus ESK4-FF / ESK4-PA

- ① Basic module with electronic magnet sensors ESK4 / ESK4A
- ② Connection bus module
- ③ DIP switch for bus settings

The optional electronic modules consist of the following main components:

| All information is approximate | ESK4                                      | ESK4-I/O  | ESK4-FF / ESK4-PA                        | Contact module K1/K2                      |
|--------------------------------|---|---|--|---|
| PCB                            | 68 cm <sup>2</sup> / 10.5 in <sup>2</sup> | 2 x 62 cm <sup>2</sup> /<br>2 x 9.6 in <sup>2</sup> | 62 cm <sup>2</sup> / 9.6 in <sup>2</sup> | 75 cm <sup>2</sup> / 11.6 in <sup>2</sup> |
| PA housing                     | 63 g / 0.14 lb                            | 42 g / 0.09 lb                                      | 42 g / 0.09 lb                           | -   |
| Potting (silicone)             | 135 g / 0.30 lb                           | 100 g / 0.22 lb                                     | 100 g / 0.22 lb                          | 5 g / 0.01 lb                             |
| Batteries                      | -   | -   | -  | -   |
| Electrolytic capacitors        | -   | -   | -  | -   |
| LC display                     | -   | 16 cm <sup>2</sup> / 2.5 in <sup>2</sup>            | -  | -   |



**INFORMATION!**

*Silicone is used when potting the PCBs in the PA housings. It is thus not easy to separate the components by hand.*

## 8.1 Functional principle

The H250 flowmeter operates in accordance with the float measuring principle. The measuring unit consists of a metal cone in which a float can move freely up and down. The medium flows through the flowmeter from bottom to top. The float adjusts itself so that the buoyancy force  $F_1$  acting on it, the form resistance  $F_2$  and its weight  $F_3$  are in equilibrium:  $F_3 = F_1 + F_2$

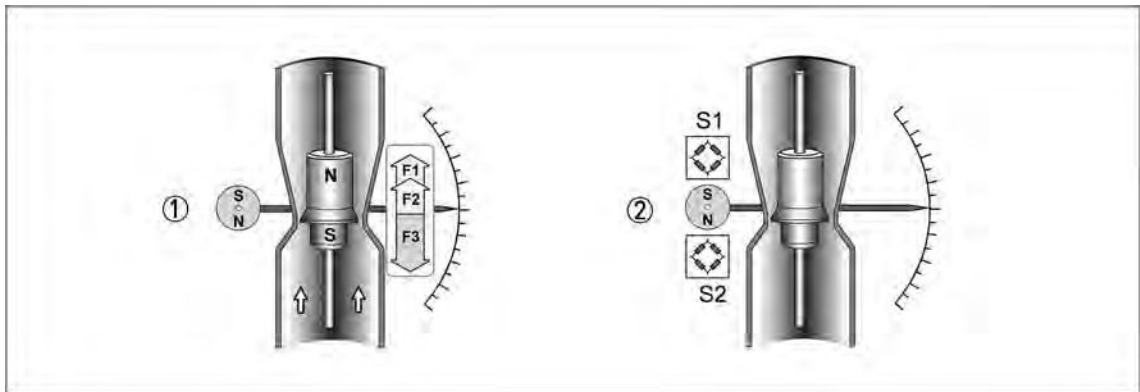


Figure 8-1: Measuring principle - general

- ① Indication principle M40 magnetic coupling
- ② Magnetic coupling sensors

① For the indicator, the flow-dependent height of the float in the measuring unit is transmitted by means of a magnetic coupling and displayed on a scale.

② For a built-in signal converter (ESK4 / ESK4A), the flow-dependent height of the float in the measuring unit is detected by the S1 and S2 magnetic field sensors and electronically processed.

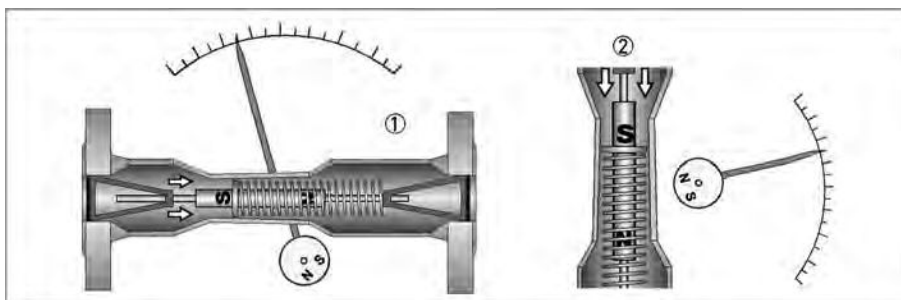


Figure 8-2: Measuring principle for H250H and H250U

- ① H250H - horizontal flow direction
- ② H250U - flow direction from top to bottom

The flowmeter operates in accordance with a modified float measuring principle. The guided float adjusts itself so that the flow force acting on it is in equilibrium with the opposing spring force. The flow-dependent position of the float in the measuring unit is displayed on a scale by means of a magnetic coupling.

## 8.2 Technical data



### INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).

### Measuring system

|                                |  |
|--------------------------------|--|
| Application range              | Flow measurement of liquids, gases and vapours           |
| Function / Measuring principle | Float measuring principle                                |
| Measured value                 |  |
| Primary measured value         | Float position   |
| Secondary measured value       | Operating volume flow, standard volume flow or mass flow |

### Measuring accuracy

|  |  |
|--|--|
| Directive  | VDI/VDE 3513, sheet 2 (q <sub>G</sub> = 50%) |
| H250 /RR /HC /F                                      | 1.6%   |
| H250/C (ceramic, PTFE), H250H, H250U, H250 (100 : 1) | 2.5%   |
| <b>Precision (repeatability)</b>                     |  |
| H250 /RR /HC /F                                      | 0.25%  |
| H250H, H250U, H250 (100 : 1)                         | 0.5%   |

### Operating conditions

|   |  |
|---|--|
| <b>Temperature</b>                                      |  |
| Max. operating temperature TS                           | -196...+300°C / -321...+572°F<br>Depending on the version (refer to nameplate) |
| <b>Pressure</b>   |  |
| Max. operating pressure PS, max. test pressure PT       | Depending on the version (refer to nameplate)                                  |
| Min. required operating pressure                        | 2 times greater than pressure loss (refer to measuring ranges)                 |
| <b>Pressure/temperature heating for measuring cone</b>  |  |
| DN15...DN50   | PS = 40 barg / 580 psig, TS = 300°C / 572°F                                    |
| DN80...DN100  | PS = 25 barg / 363 psig, TS = 300°C / 572°F                                    |
| <b>Ingress protection</b>                               |  |
| M40, M40R   | IP66/68 according to EN 60529, NEMA 4/4X/6 according to NEMA 250               |
| M40R  | IP69K according to DIN 40050-9   |
| <b>Float damping during gas measurement recommended</b> |  |
| DN15...25 / 1/2...1"                                    | Operating pressure <0.3 barg / 4.4 psig  |
| DN50...100 / 2...4"                                     | Operating pressure <0.2 barg / 2.9 psig  |

### Installation conditions according to VDI/VDE 3513, sheet 3

|                |          |
|----------------|----------|
| Inlet section  | ≥ 5 x DN |
| Outlet section | ≥ 3 x DN |

## Materials

| Device                  | Flange  | Measuring tube | Float   | Float guide                             | Ring orifice                   |
|-------------------------|---|----------------|---|---|--------------------------------|
| H250/RR                 | CrNi steel 1.4401 / 1.4404, 316 / 316L (dual certification) |                | 1.4404, 316L  |   |                                |
| H250/HC                 | Hastelloy® C4 (2.4610) solid or plated                      | Hastelloy® C4  |   |   |                                |
| H250/F - Food           | CrNi steel 1.4435   |                | CrNi-steel 1.4435 / 1.4404                              |   |                                |
| H250/C - Ceramic/PTFE ① | CrNi steel 1.4571 with TFM/PTFE ②                           |                | PTFE or Al <sub>2</sub> O <sub>3</sub> with FFKM gasket | Al <sub>2</sub> O <sub>3</sub> and PTFE | Al <sub>2</sub> O <sub>3</sub> |

① DN100/4" only PTFE

② TFM/PTFE liner (electrically non-conductive), conductive PTFE on request

### Other options on request:

- Special materials: e.g. SMO 254/6Mo/1.4547, Titanium Grade 2, Hastelloy® C276/2.4819, Monel®/2.4360, Inconel®/2.4856 a.o.
- Float damping: PEEK (only for gas) or ceramic
- Standard gasket for devices with female thread as insert: O-ring FPM / FKM, others optional e.g. FFKM, EPDM

|          |   |
|----------|---|
| M40      | Aluminium, two-layer powder coating (epoxy / polyester) |
| M40R     | Stainless steel without coating 1.4408 / CF8M           |
| Offshore | Wet coating on request                                  |

## Temperatures

For devices to be used in hazardous areas, special temperature ranges apply. These can be found in the Ex supplementary instructions.

### Temperatures H250/M40 - mechanical indicator without auxiliary power

|                               | Material                               |               | Product temperature |             | Ambient temperature |            |
|-------------------------------|--|---------------|---------------------|-------------|---------------------|------------|
|                               | Float                                  | Liner         | [°C]                | [°F]        | [°C]                | [°F]       |
| H250/RR                       | Stainless steel                        |               | -196...+300         | -321...+572 | -40...+120          | -40...+248 |
| H250/RR screw fitting FPM/FKM |  |               | -20...+200          | -4...+392   | -20...+120          | -4...+248  |
| H250/HC                       | Hastelloy®                             |               | -196...+300         | -321...+572 | -40...+120          | -40...+248 |
| H250/C                        | PTFE                                   |               | -196...+70          | -321...+158 | -40...+70           | -40...+158 |
| H250/C                        | Ceramic                                | PTFE          | -196...+150         | -321...+302 | -40...+70           | -40...+158 |
| H250/C                        | Ceramic                                | TFM / Ceramic | -196...+250         | -321...+482 | -40...+120          | -40...+248 |
| H250 H/U                      | Spring material stainless steel 1.4301 |               | -40...+100          | -40...+212  | -40...+120          | -40...+248 |
|                               | Spring material Hastelloy® 2.4610      |               | -40...+200          | -40...+392  | -40...+120          | -40...+248 |



### Ambient temperatures $T_{amb}$ with electrical components

| Version   | [°C]      | [°F]       |
|---|-----------|------------|
| ESK4, ESK4A, ESK4-FF, ESK4-PA ①                 | -40...+70 | -40...+158 |
| Limit switches SJ3,5-SN / I7S23,5-N / Reed SPST | -40...+70 | -40...+158 |
| Limit switches SC3,5-N0 / SJ3,5-S1N / SB3,5-E2  | -25...+70 | -13...+158 |

① Display contrast out of the temperature range 0...+60°C / +32...+140°F decreasing.



#### INFORMATION!

The device must not be heated by radiated heat (e.g. exposure to the sun) to an electronics housing surface temperature above the maximum permissible ambient temperature. A sunshade is available as option.

### Maximum product temperatures H250/M40 - with electrical components [°C]

| EN             | ASME     | Version with           | $T_{amb} < +40^{\circ}\text{C}$ |      | $T_{amb} < +60^{\circ}\text{C}$ ① |      |
|----------------|----------|------------------------|---------------------------------|------|-----------------------------------|------|
|                |          |                        | Standard                        | HT   | Standard                          | HT   |
| DN15,<br>DN25  | 1/2", 1" | ESK4 / ESK4A, -FF, -PA | +200                            | +300 | +180                              | +300 |
|                |          | ESK4-T                 | +200                            | +300 | +140                              | +290 |
|                |          | Limit switch NAMUR     | +200                            | +300 | +200                              | +300 |
|                |          | Limit switch 3-wire    | +200                            | +300 | +130                              | +295 |
| DN50           | 2"       | ESK4 / ESK4A, -FF, -PA | +200                            | +300 | +165                              | +300 |
|                |          | ESK4-T                 | +200                            | +300 | +140                              | +290 |
|                |          | Limit switch NAMUR     | +200                            | +300 | +200                              | +300 |
|                |          | Limit switch 3-wire    | +200                            | +300 | +120                              | +195 |
| DN80,<br>DN100 | 3", 4"   | ESK4 / ESK4A, -FF, -PA | +200                            | +300 | +150                              | +250 |
|                |          | ESK4-T                 | +200                            | +300 | +130                              | +270 |
|                |          | Limit switch NAMUR     | +200                            | +300 | +200                              | +300 |
|                |          | Limit switch 3-wire    | +190                            | +300 | +110                              | +160 |

## Maximum product temperatures H250/M40 - with electrical components [°F]

|                |          |                        | T <sub>amb</sub> < +104°F |     | T <sub>amb</sub> < +140°F ① |     |
|----------------|----------|------------------------|---------------------------|-----|-----------------------------|-----|
| EN             | ASME     | Version with           | Standard                  | HT  | Standard                    | HT  |
| DN15,<br>DN25  | 1/2", 1" | ESK4 / ESK4A, -FF, -PA | 392                       | 572 | 356                         | 572 |
|                |          | ESK4-T                 | 392                       | 572 | 284                         | 554 |
|                |          | Limit switch NAMUR     | 392                       | 572 | 392                         | 572 |
|                |          | Limit switch 3-wire    | 392                       | 572 | 266                         | 563 |
| DN50           | 2"       | ESK4 / ESK4A, -FF, -PA | 392                       | 572 | 165                         | 572 |
|                |          | ESK4-T                 | 392                       | 572 | 284                         | 554 |
|                |          | Limit switch NAMUR     | 392                       | 572 | 392                         | 572 |
|                |          | Limit switch 3-wire    | 392                       | 572 | 248                         | 383 |
| DN80,<br>DN100 | 3", 4"   | ESK4 / ESK4A, -FF, -PA | 392                       | 572 | 302                         | 482 |
|                |          | ESK4-T                 | 392                       | 572 | 266                         | 518 |
|                |          | Limit switch NAMUR     | 392                       | 572 | 392                         | 572 |
|                |          | Limit switch 3-wire    | 374                       | 572 | 230                         | 320 |

① if there are no heat insulation measures, a heat-resistant cable is necessary (continuous operating temperature of the cable to be used: +100°C / +212°F)

## Abbreviation

|              |  |
|--------------|--|
| HT           | High-temperature version   |
| ESK4 / ESK4A | 2-wire current output 4...20 mA with HART 5 <sup>®</sup> / HART 7 <sup>®</sup> |
| ESK4-T       | ESK4 with LCD, binary status outputs, digital counter and pulse output         |
| ESK4-FF      | FOUNDATION FIELDBUS interface  |
| ESK4-PA      | PROFIBUS PA interface  |

## Cable glands

|                  | Material            | Cable diameter |               |
|------------------|---------------------|----------------|---------------|
|                  |                     | [mm]           | [Inch]        |
| M20x1.5 Standard | PA                  | 8...13         | 0.315...0.512 |
| M20x1.5          | Nickel-plated brass | 10...14        | 0.394...0.552 |
| M20x1.5          | Stainless steel     | 10...14        | 0.394...0.552 |

## Limit switches K1/K2

|                                |                       |                 |               |                        |                  |
|--------------------------------|-----------------------|-----------------|---------------|------------------------|------------------|
| Terminal connection            | 2.5 mm <sup>2</sup>   |                 |               |                        |                  |
| Limit switches                 | I7S23,5-N<br>SC3,5-N0 | SJ3,5-SN ①      | SJ3,5-S1N ①   | SB3,5-E2               | Reed             |
| NAMUR (IEC 60947-5-6)          | Yes                   | Yes             | Yes           | No                     | No               |
| Connection type                | 2-wire                | 2-wire          | 2-wire        | 3-wire                 | 2-wire           |
| Switching element function     | Normally closed       | Normally closed | Normally open | PNP NO                 | NC SPST          |
| Nominal voltage U <sub>0</sub> | 8.2 VDC               | 8.2 VDC         | 8.2 VDC       | 10...30 VDC            | max. 32 VDC<br>② |
| Pointer vane not detected      | ≥ 3 mA                | ≥ 3 mA          | ≤ 1 mA        | ≤ 0.3 VDC              | U <sub>0</sub>   |
| Pointer vane detected          | ≤ 1 mA                | ≤ 1 mA          | ≥ 3 mA        | U <sub>B</sub> - 3 VDC | 0 VDC            |
| Continuous current             | -                     | -               | -             | Max. 100 mA            | Max. 100 mA      |
| No load current I <sub>0</sub> | -                     | -               | -             | ≤ 15 mA                | -                |
| Switching cycles               | -                     | -               | -             | -                      | 100000           |

① safety oriented

② no inductances

## Current output ESK4 / ESK4A

|                                 |   |
|---------------------------------|---|
| Terminal connection             | 2.5 mm <sup>2</sup>   |
| Power supply                    | 14...32 VDC (12...32 VDC without ESK4-T), intrinsically safe<br>max. 30 VDC |
| Min. power supply for HART®     | 20 VDC at 250 Ω load  |
| Measuring signal                | 4.00...20.00 mA = 0...100% flow value in 2-wire technology                  |
| Power supply influence          | <0.1%   |
| External resistance dependency  | <0.1%   |
| Temperature influence           | <5 μA/K   |
| Max. external resistance / load | 650 Ω at 30 VDC   |
| Min. load for HART®             | 250 Ω   |
| NAMUR conformity                | NE43, NE107, NE21   |

**ESK4 HART® configuration**

|                             |                                   |
|-----------------------------|-----------------------------------|
| Manufacturer name (code)    | KROHNE Messtechnik (0x45 = 69)    |
| Model name / HART® revision | ESK4 (214 = 0xD6) / HART 5.9      |
|                             | ESK4A (17854 = 0x45BE) / HART 7.4 |
| Physical Layer              | FSK                               |

**ESK4 / ESK4A process variable**

|                             | Values [%] from full scale range | Signal output [mA]               |
|-----------------------------|----------------------------------|----------------------------------|
| Upper range limit           | +102.5 (±1%)                     | 20.24...20.56                    |
| Device error identification | > 106.25                         | >21.00<br>[changeable to 3.6 mA] |
| Multidrop operation         |                                  | 4.5                              |

**ESK4-FF**

|                             |  |
|-----------------------------|--|
| Physical Layer              | IEC 61158-2 and FISCO model                            |
| Communication standard      | H1 FOUNDATION Fieldbus protocol                        |
| ITK version                 | 6.3 (FW ≥ V 2.01)                                      |
| Power supply                | Bus supply: 9...32 VDC, intrinsically safe max. 30 VDC |
| Nominal current             | 16 mA typical (17 mA rated)                            |
| Error current               | 23 mA  |
| Boot-up current after 10 ms | < Nominal current                                      |

For more details refer to the supplementary instructions "H250 M40 Foundation Fieldbus".

**ESK4-PA**

|                             |  |
|-----------------------------|--|
| Physical Layer              | IEC 61158-2 and FISCO model                            |
| Communication standard      | Profibus PA profile 3.02                               |
| PNO ID                      | 4531 HEX   |
| Power supply                | Bus supply: 9...32 VDC, intrinsically safe max. 30 VDC |
| Nominal current             | 16 mA  |
| Error current               | 23 mA  |
| Boot-up current after 10 ms | < Nominal current                                      |

For more details refer to the supplementary instructions "H250 M40 Profibus PA".

## ESK4-T with LCD, binary inputs and outputs and digital counter

### Binary output

|  |                                     |                                |
|--|-------------------------------------|--------------------------------|
| Two binary outputs                           | Galvanically isolated, passive      |                                |
| Mode   | Switching output                    | NAMUR or transistor (OC)       |
| Configurable as                              | switch contact or pulse output      | NC / NO or max. 10 pulses/s    |
| NAMUR switching output                       |                                     |                                |
| Power supply                                 | 8.2 VDC                             |                                |
| Signal current                               | > 3 mA switching value not reached; | < 1 mA switching value reached |
| Switching output transistor (Open Collector) |                                     |                                |
| Power supply                                 | Nominal 24 VDC, maximum 30 VDC      |                                |
| $P_{max}$                                    | 500 mW                              |                                |
| Continuous current                           | Max. 100 mA                         |                                |
| No load current $I_0$                        | $\leq 2$ mA                         |                                |

### Pulse output

|              |   |
|--------------|---|
| $T_{on}$     | Configurable from 50...500 ms                           |
| $T_{off}$    | Depending on flow rate                                  |
| Pulse weight | Configurable in flow units e.g. 5 pulses/m <sup>3</sup> |

### Binary input

|                           |                                |
|---------------------------|--------------------------------|
| Input                     | Galvanically isolated          |
| Mode                      | Reset counters or Start / Stop |
| Configurable as           | active HI / active LO          |
| H signal                  | 16...30 VDC                    |
| Internal resistance $R_i$ | Typical 20 k $\Omega$          |
| $T_{on}$ (active)         | $\geq 500$ ms                  |

### LC display

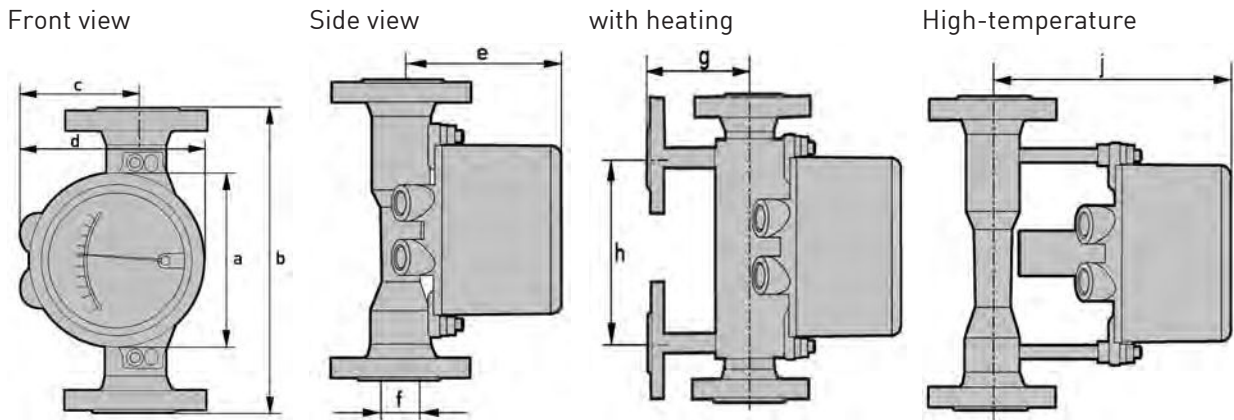
|               |   |
|---------------|---|
| Technology    | Passive graphic LCD   |
| Display       | Measurement with units and/or counter reading with units.<br>Counter reading max. 11-digit with power failure proof storage.<br>Binary flags for limit value status. 0...100% bargraph for measurement.<br>NE 107 diagnostic status symbols. Plain text menu for configuration. |
| Configuration | Local plain text menu navigation via microswitch or bar magnet or using DD/DTM software   |

## Approvals

| Standard                                 | Indicator      | Marking   |
|--|----------------|---|
| ATEX / IECEx                             | M40 mechanical | II2GD IIC<br>II3GD IIC  |
|  | M40 electrical | II2G Ex ia IIC T6 Gb<br>II2G Ex d IIC T6 Gb<br>II3G Ex nA IIC T6 Gc<br>II2D Ex t IIIC T70°C Db<br>II2D Ex ia IIIC T85°C Db  |
| FM (USA) NEC500<br>FM (Canada)<br>NEC505 | M40 electrical | IS Class I Div 1, Class I Zone 1 AEx ia<br>XP Class I Div 1, Class I Zone 1 AEx d<br>NI Class I Div 2, Class I Zone 2 AEx nA<br>DIP Class II / III Div 1, Class II/III Zone 21 AEx tb |
| NEPSI                                    | M40 electrical | Ex ia, Ex d, Ex nA, Ex t  |
| CCOE/PESO                                | M40 electrical | Ex ia, Ex d   |
| EAC                                      | M40 mechanical | Ex c  |
|  | M40 electrical | Ex ia, Ex d, Ex nA, Ex t  |
| INMETRO                                  | M40 electrical | Ex ia, Ex d, Ex nA, Ex t  |
| KGS                                      | M40 electrical | Ex ia, Ex d, Ex nA, Ex t  |

### 8.3 Dimensions and weight

#### Dimensions H250/M40

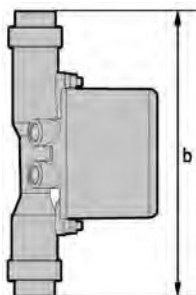


|   | a    |      | b    |       | d    |      | h    |      |
|---|------|------|------|-------|------|------|------|------|
|   | [mm] | ["]  | [mm] | ["]   | [mm] | ["]  | [mm] | ["]  |
| H250/RR flange,<br>H250/F Clamp connection            | 141  | 5.56 | 250  | 9.85  | 150  | 5.91 | 150  | 5.91 |
| H250/RR from 2" 600 lb,<br>ISO 228, ASME B1.20.1, SMS |      |      | 300  | 11.82 |      |      |      |      |

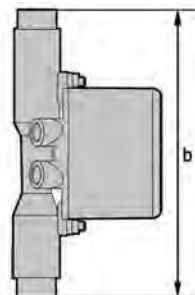
| EN    | ASME | c ①  |      | e ②  |      | Ø f  |      | g    |      | j    |      |
|-------|------|------|------|------|------|------|------|------|------|------|------|
|       |      | [mm] | ["]  | [mm] | ["]  | [mm] | ["]  | [mm] | ["]  | [mm] | ["]  |
| DN15  | ½"   | 94   | 3.70 | 114  | 4.49 | 20   | 0.80 | 97   | 3.82 | 197  | 7.76 |
| DN25  | 1"   | 94   | 3.70 | 127  | 5.00 | 32   | 1.28 | 109  | 4.27 | 209  | 8.23 |
| DN50  | 2"   | 107  | 4.22 | 141  | 5.55 | 65   | 2.57 | 125  | 4.90 | 222  | 8.74 |
| DN80  | 3"   | 107  | 4.22 | 157  | 6.18 | 89   | 3.51 | 143  | 5.61 | 238  | 9.37 |
| DN100 | 4"   | 107  | 4.22 | 167  | 6.57 | 114  | 4.50 | 150  | 5.91 | 248  | 9.76 |

① without cable gland; ② Ex d, Ex t, Ex nA +10 mm / 0.39"

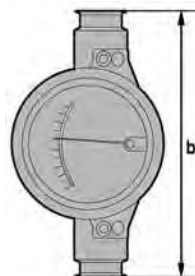
ISO 228 / ASME B1.20.1  
Female thread screwed



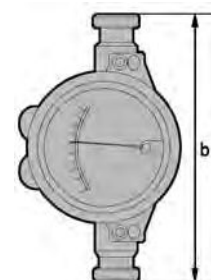
ISO 228 / ASME B1.20.1  
Female thread welded



H250/F ① Clamp  
connection



H250/F screw connection  
DIN 11851



① Stainless steel 1.4435 - wetted surfaces Ra ≤ 0.8 / 0.6 µm

## Weight

|              |      | H250      |      | Heating                |      |                        |      |
|--------------|------|-----------|------|------------------------|------|------------------------|------|
| Nominal size |      | EN 1092-1 |      | with flange connection |      | with Ermeto connection |      |
| EN           | ASME | [kg]      | [lb] | [kg]                   | [lb] | [kg]                   | [lb] |
| DN15         | 1/2" | 3.5       | 7.7  | 5.6                    | 12.6 | 3.9                    | 8.6  |
| DN25         | 1"   | 5         | 11   | 7.5                    | 16.5 | 5.8                    | 12.8 |
| DN50         | 2"   | 8.2       | 18.1 | 11.2                   | 24.7 | 9.5                    | 21   |
| DN80         | 3"   | 12.2      | 26.9 | 14.8                   | 32.6 | 13.1                   | 28.9 |
| DN100        | 4"   | 14        | 30.9 | 17.4                   | 38.4 | 15.7                   | 34.6 |

|              |      | H250/C [Ceramic / PTFE] |      |             |      |             |      | Screw connection |      |
|--------------|------|-------------------------|------|-------------|------|-------------|------|------------------|------|
| Nominal size |      | EN 1092-1               |      | ASME 150 lb |      | ASME 300 lb |      | DIN 11864-1      |      |
| EN           | ASME | [kg]                    | [lb] | [kg]        | [lb] | [kg]        | [lb] | [kg]             | [lb] |
| DN15         | 1/2" | 3.5                     | 7.7  | 3.2         | 7.1  | 3.5         | 7.7  | 2                | 4.4  |
| DN25         | 1"   | 5                       | 11   | 5.2         | 11.5 | 6.8         | 15   | 3.5              | 7.7  |
| DN50         | 2"   | 10                      | 22.1 | 10          | 22.1 | 11          | 24.3 | 5                | 11   |
| DN80         | 3"   | 13                      | 28.7 | 13          | 28.7 | 15          | 33.1 | 7.6              | 16.8 |
| DN100        | 4"   | 15                      | 33.1 | 16          | 35.3 | 17          | 37.5 | 10.3             | 22.7 |

## Process connections

|   | Standard     | Conn. dim.      | Pressure rating      |
|---|--------------|-----------------|----------------------|
| Flanges (H250/RR /HC /C)  | EN 1092-1    | DN15...150      | PN16...250           |
|   | ASME B16.5   | 1/2...6"        | 150...2500 lb        |
|   | JIS B2220    | 15...100        | 10...20K             |
| Clamp connections (H250/RR /F)                                    | DIN 32676    | DN15...100      | 10...16 bar          |
|   | ISO 2852     | Size 25...139.7 | 10...16 bar          |
| Screw connections (H250/RR /HC /F)                                | DIN 11851    | DN15...100      | 25...40 bar          |
|   | SMS 1146     | 1...4"          | 6 barg / 88.2 psig   |
| Female thread welded (H250/RR /HC)                                | ISO 228      | G1/2...G2"      | ≥ 50 barg / 735 psig |
|   | ASME B1.20.1 | 1/2...2" NPT    |                      |
| Female thread (H250/RR /HC) with insert, FPM gasket and union nut | ISO 228      | G1/2...2        | ≤ 50 barg / 735 psig |
|   | ASME B1.20.1 | 1/2...2" NPT    |                      |
| Thread connection aseptic (H250/F)                                | DIN 11864-1  | DN15...50       | PN40                 |
|   |              | DN80...100      | PN16                 |
| Flange aseptic (H250/F)   | DIN 11864-2  | DN15...50       | PN40                 |
|   |              | DN80...DN100    | PN16                 |
| <b>Measuring device (H250/RR /HC) with heating:</b>               |              |                 |                      |
| Heating with flange connection                                    | EN 1092-1    | DN15            | PN40                 |
|   | ASME B16.5   | 1/2"            | 150 lb / RF          |
| Heating pipe connection for Ermeto                                | -            | E12             | PN40                 |

Higher pressure ratings and other connections on request.



## Bolts and tightening torques

For measuring devices with PTFE liner or ceramic liner and PTFE raised face, tighten the flange threads with the following torques:

### Nominal sizes EN

| Nominal size according to EN 1092-1 | Stud bolts      |  | Tightening torques |         |
|-------------------------------------|-----------------|--|--------------------|---------|
|                                     | Quantity x size |  | [Nm]               | [lb-ft] |
| DN15 PN40 ①                         | 4x M12          |  | 9.8                | 7.1     |
| DN25 PN40 ①                         | 4x M12          |  | 21                 | 15      |
| DN50 PN40 ①                         | 4x M16          |  | 57                 | 41      |
| DN80 PN16 ①                         | 8x M16          |  | 47                 | 34      |
| DN100 PN16 ①                        | 8x M16          |  | 67                 | 48      |

① Standard connections; other connections on request

### Nominal size ASME

| Nominal size acc. to ASME B16.5 | Stud bolts      |         | Tightening torques |         |
|---------------------------------|-----------------|---------|--------------------|---------|
|                                 | Quantity x size |         | [Nm]               | [lb-ft] |
|                                 | 150 lb          | 300 lb  |                    |         |
| 1/2" 150 lb / 300 lb ①          | 4x 1/2"         | 4x 1/2" | 5.2                | 3.8     |
| 1" 150 lb / 300 lb ①            | 4x 1/2"         | 4x 5/8" | 10                 | 7.2     |
| 2" 150 lb / 300 lb ①            | 4x 5/8"         | 8x 5/8" | 41                 | 30      |
| 3" 150 lb / 300 lb ①            | 4x 5/8"         | 8x 3/4" | 70                 | 51      |
| 4" 150 lb / 300 lb ①            | 8x 5/8"         | 8x 3/4" | 50                 | 36      |

① Standard connections; other connections on request

### Pressure tightness (vacuum) H250/C

| Max. process temperature ▶ |         |               | +70°C / +158°F          |        | +150°C / +302°F |        | +250°C / +482°F |        |
|----------------------------|---------|---------------|-------------------------|--------|-----------------|--------|-----------------|--------|
|                            |         |               | Min. operating pressure |        |                 |        |                 |        |
| Nominal size               | Float   | Liner         | [mbara]                 | [psia] | [mbara]         | [psia] | [mbara]         | [psia] |
| DN15...100                 | PTFE    | PTFE          | 100                     | 1.45   | -               | -      | -               | -      |
| DN15...80                  | Ceramic | PTFE          | 100                     | 1.45   | 250             | 3.63   | -               | -      |
| DN15...80                  | Ceramic | TFM / Ceramic | 100                     | 1.45   | 100             | 1.45   | 100             | 1.45   |

## 8.4 Measuring ranges

H250/RR - stainless steel, H250/HC - Hastelloy®

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

|              |        | Water |       |         | Air                  |      |        | Max. pressure loss |     |     |       |
|--------------|--------|-------|-------|---------|----------------------|------|--------|--------------------|-----|-----|-------|
| Float ▶      |        | TIV   | CIV   | DIV     | TIV<br>Alu.          | TIV  | DIV    | TIV<br>Alu.        | TIV | CIV | DIV   |
| Nominal size | Cone   | [l/h] |       |         | [Nm <sup>3</sup> /h] |      |        | [mbar]             |     |     |       |
| DN15, 1/2"   | K 15.1 | 18    | 25    | -       | 0.42                 | 0.65 | -      | 12                 | 21  | 26  | -     |
|              | K 15.2 | 30    | 40    | -       | 0.7                  | 1    | -      | 12                 | 21  | 26  | -     |
|              | K 15.3 | 55    | 63    | -       | 1                    | 1.5  | -      | 12                 | 21  | 26  | -     |
|              | K 15.4 | 80    | 100   | -       | 1.7                  | 2.2  | -      | 12                 | 21  | 26  | -     |
|              | K 15.5 | 120   | 160   | -       | 2.5                  | 3.6  | -      | 12                 | 21  | 26  | -     |
|              | K 15.6 | 200   | 250   | -       | 4.2                  | 5.5  | -      | 12                 | 21  | 26  | -     |
|              | K 15.7 | 350   | 400   | 700     | 6.7                  | 10   | 18 ①   | 12                 | 21  | 28  | 38    |
|              | K 15.8 | 500   | 630   | 1000    | 10                   | 14   | 28 ①   | 13                 | 22  | 32  | 50    |
| DN25, 1"     | K 15.8 | -     | -     | 1600 ②  | -                    | -    | 50 ②   | -                  | -   | -   | 85    |
|              | K 25.1 | 480   | 630   | 1000    | 9.5                  | 14   | -      | 11                 | 24  | 32  | 72    |
|              | K 25.2 | 820   | 1000  | 1600    | 15                   | 23   | -      | 11                 | 24  | 33  | 74    |
|              | K 25.3 | 1200  | 1600  | 2500    | 22                   | 35   | -      | 11                 | 25  | 34  | 75    |
|              | K 25.4 | 1700  | 2500  | 4000    | 37                   | 50   | 110 ①  | 12                 | 26  | 38  | 78    |
| DN50, 2"     | K 25.5 | 3200  | 4000  | 6300    | 62                   | 95   | 180 ①  | 13                 | 30  | 45  | 103 ③ |
|              | K 55.1 | 2700  | 6300  | 8400    | 58                   | 80   | 230 ①  | 8                  | 13  | 74  | 60    |
|              | K 55.2 | 3600  | 10000 | 14000   | 77                   | 110  | 350 ①  | 8                  | 13  | 77  | 69    |
| DN80, 3"     | K 55.3 | 5100  | 16000 | 25000   | 110                  | 150  | 700 ①  | 9                  | 13  | 84  | 104   |
|              | K 85.1 | 12000 | 25000 | 37000   | 245                  | 350  | 1000 ① | 8                  | 16  | 68  | 95    |
| DN100, 4"    | K 85.2 | 16000 | 40000 | 64000   | 280                  | 400  | 1800 ① | 9                  | 16  | 89  | 125   |
|              | K105.1 | 19000 | 63000 | 100 000 | -                    | 550  | 2800 ① | -                  | -   | 120 | 220   |

① P &gt; 0.5 bar

② with TR float

③ 300 mbar with damping (gas measurement)

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to:

Nl/h or Nm<sup>3</sup>/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

## H250/RR - stainless steel, H250/HC - Hastelloy®

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

| Float ▶      |        | Water |       |       | Air         |      |        | Max. pressure loss |      |      |        |
|--------------|--------|-------|-------|-------|-------------|------|--------|--------------------|------|------|--------|
|              |        | TIV   | CIV   | DIV   | TIV<br>Alu. | TIV  | DIV    | TIV<br>Alu.        | TIV  | CIV  | DIV    |
| Nominal size | Cone   | [GPH] |       |       | [SCFM]      |      |        | [psig]             |      |      |        |
| DN15, 1/2"   | K 15.1 | 4.76  | 6.60  | -     | 0.26        | 0.40 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.2 | 7.93  | 10.6  | -     | 0.43        | 0.62 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.3 | 14.5  | 16.6  | -     | 0.62        | 0.93 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.4 | 21.1  | 26.4  | -     | 1.05        | 1.36 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.5 | 31.7  | 42.3  | -     | 1.55        | 2.23 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.6 | 52.8  | 66.0  | -     | 2.60        | 3.41 | -      | 0.18               | 0.31 | 0.38 | -      |
|              | K 15.7 | 92.5  | 106   | 185   | 4.15        | 6.20 | 11.2 ① | 0.18               | 0.31 | 0.41 | 0.56   |
|              | K 15.8 | 132   | 166   | 264   | 6.20        | 8.68 | 17.4 ① | 0.19               | 0.32 | 0.47 | 0.74   |
|              | K 15.8 | -     | -     | 423 ② | -           | -    | 31.0 ② | -                  | -    | -    | 1.25   |
| DN25, 1"     | K 25.1 | 127   | 166   | 264   | 5.89        | 8.68 | -      | 0.16               | 0.35 | 0.47 | 1.06   |
|              | K 25.2 | 217   | 264   | 423   | 9.30        | 14.3 | -      | 0.16               | 0.35 | 0.49 | 1.09   |
|              | K 25.3 | 317   | 423   | 660   | 13.6        | 21.7 | -      | 0.16               | 0.37 | 0.50 | 1.10   |
|              | K 25.4 | 449   | 660   | 1057  | 22.9        | 31.0 | 68.2 ① | 0.18               | 0.38 | 0.56 | 1.15   |
|              | K 25.5 | 845   | 1057  | 1664  | 38.4        | 58.9 | 111 ①  | 0.19               | 0.44 | 0.66 | 1.51 ③ |
| DN50, 2"     | K 55.1 | 713   | 1664  | 2219  | 36.0        | 49.6 | 143 ①  | 0.12               | 0.19 | 1.09 | 0.88   |
|              | K 55.2 | 951   | 2642  | 3698  | 47.7        | 68.2 | 217 ①  | 0.12               | 0.19 | 1.13 | 1.01   |
|              | K 55.3 | 1347  | 4227  | 6604  | 68.2        | 93.0 | 434 ①  | 0.13               | 0.19 | 1.23 | 1.53   |
| DN80, 3"     | K 85.1 | 3170  | 6604  | 9774  | 152         | 217  | 620 ①  | 0.12               | 0.24 | 1.00 | 1.40   |
|              | K 85.2 | 4227  | 10567 | 16907 | 174         | 248  | 1116 ① | 0.13               | 0.24 | 1.31 | 1.84   |
| DN100, 4"    | K105.1 | 5019  | 16643 | 26418 | -           | 341  | 1736 ① | -                  | -    | 1.76 | 3.23   |

① P &gt; 7.4 psig

② with TR float

③ 4.4 psig with damping [gas measurement]

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to:

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

## H250/C - Ceramic/PTFE

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

| Liner / Float ▶ |          | Flow rate |        |                      |        | Max. pressure loss |        |      |        |
|-----------------|----------|-----------|--------|----------------------|--------|--------------------|--------|------|--------|
|                 |          | Water     |        | Air                  |        | Water              |        | Air  |        |
| Nominal size    | Cone     | PTFE      | Ceram. | PTFE                 | Ceram. | PTFE               | Ceram. | PTFE | Ceram. |
|                 |          | [l/h]     |        | [Nm <sup>3</sup> /h] |        | [mbar]             |        |      |        |
| DN15, 1/2"      | E 17.2   | 25        | 30     | 0.7                  | -      | 65                 | 62     | 65   | 62     |
|                 | E 17.3   | 40        | 50     | 1.1                  | 1.8    | 66                 | 64     | 66   | 64     |
|                 | E 17.4   | 63        | 70     | 1.8                  | 2.4    | 66                 | 66     | 66   | 66     |
|                 | E 17.5   | 100       | 130    | 2.8                  | 4      | 68                 | 68     | 68   | 68     |
|                 | E 17.6   | 160       | 200    | 4.8                  | 6.5    | 72                 | 70     | 72   | 70     |
|                 | E 17.7   | 250       | 250    | 7                    | 9      | 86                 | 72     | 86   | 72     |
|                 | E 17.8   | 400       | -      | 10                   | -      | 111                | -      | 111  | -      |
|                 | DN25, 1" | E 27.1    | 630    | 500                  | 16     | 18                 | 70     | 55   | 70     |
| E 27.2          |          | 1000      | 700    | 30                   | 22     | 80                 | 60     | 80   | 60     |
| E 27.3          |          | 1600      | 1100   | 45                   | 30     | 108                | 70     | 108  | 70     |
| E 27.4          |          | 2500      | 1600   | 70                   | 50     | 158                | 82     | 158  | 82     |
| E 27.5          |          | 4000 ①    | 2500   | 120                  | 75     | 290                | 100    | 194  | 100    |
| DN50, 2"        | E 57.1   | 4000      | 4500   | 110                  | 140    | 81                 | 70     | 81   | 70     |
|                 | E 57.2   | 6300      | 6300   | 180                  | 200    | 110                | 80     | 110  | 80     |
|                 | E 57.3   | 10000     | 11000  | 250                  | 350    | 170                | 110    | 170  | 110    |
|                 | E 57.4   | 16000 ①   | -      | -                    | -      | 284                | -      | -    | -      |
| DN80, 3"        | E 87.1   | 16000     | 16000  | -                    | -      | 81                 | 70     | -    | -      |
|                 | E 87.2   | 25000     | 25000  | -                    | -      | 95                 | 85     | -    | -      |
|                 | E 87.3   | 40000 ①   | -      | -                    | -      | 243                | -      | -    | -      |
| DN100, 4"       | E 107.1  | 40000     | -      | -                    | -      | 100                | -      | -    | -      |
|                 | E 107.2  | 60000 ①   | -      | -                    | -      | 225                | -      | -    | -      |

① Special float

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to

Nl/h or Nm<sup>3</sup>/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

## H250/C - Ceramic/PTFE

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

|                 |         | Flow rate |        |        |        | Max. pressure loss |        |      |        |
|-----------------|---------|-----------|--------|--------|--------|--------------------|--------|------|--------|
|                 |         | Water     |        | Air    |        | Water              |        | Air  |        |
| Liner / Float ▶ |         | PTFE      | Ceram. | PTFE   | Ceram. | PTFE               | Ceram. | PTFE | Ceram. |
| Nominal size    | Cone    | [GPH]     |        | [SCFM] |        | [psig]             |        |      |        |
| DN15, 1/2"      | E 17.2  | 6.60      | 7.93   | 0.43   | -      | 0.94               | 0.90   | 0.94 | 0.90   |
|                 | E 17.3  | 10.6      | 13.2   | 0.68   | 1.12   | 0.96               | 0.93   | 0.96 | 0.93   |
|                 | E 17.4  | 16.6      | 18.5   | 1.12   | 1.49   | 0.96               | 0.96   | 0.96 | 0.96   |
|                 | E 17.5  | 26.4      | 34.3   | 1.74   | 2.48   | 0.99               | 0.99   | 0.99 | 0.99   |
|                 | E 17.6  | 42.3      | 52.8   | 2.98   | 4.03   | 1.04               | 1.02   | 1.02 | 1.02   |
|                 | E 17.7  | 66.0      | 66.0   | 4.34   | 5.58   | 1.25               | 1.04   | 1.25 | 1.04   |
|                 | E 17.8  | 106       | -      | 6.2    | -      | 1.61               | -      | 1.61 | -      |
| DN25, 1"        | E 27.1  | 166       | 132    | 9.92   | 11.2   | 1.02               | 0.80   | 1.02 | 0.80   |
|                 | E 27.2  | 264       | 185    | 18.6   | 13.6   | 1.16               | 0.87   | 1.16 | 0.87   |
|                 | E 27.3  | 423       | 291    | 27.9   | 18.6   | 1.57               | 1.02   | 1.57 | 1.02   |
|                 | E 27.4  | 660       | 423    | 43.4   | 31.0   | 2.29               | 1.19   | 2.29 | 1.19   |
|                 | E 27.5  | 1056 ①    | 660    | 74.4   | 46.5   | 4.21               | 1.45   | 2.81 | 1.45   |
| DN50, 2"        | E 57.1  | 1057      | 1189   | 68.2   | 86.8   | 1.18               | 1.02   | 1.18 | 1.02   |
|                 | E 57.2  | 1664      | 1664   | 111.6  | 124    | 1.60               | 1.16   | 1.60 | 1.16   |
|                 | E 57.3  | 2642      | 2906   | 155    | 217    | 2.47               | 1.60   | 2.47 | 1.60   |
|                 | E 57.4  | 4226 ①    | -      | -      | -      | 4.12               | -      | -    | -      |
| DN80, 3"        | E 87.1  | 4227      | 4227   | -      | -      | 1.18               | 1.02   | -    | -      |
|                 | E 87.2  | 6604      | 6604   | -      | -      | 1.38               | 1.23   | -    | -      |
|                 | E 87.3  | 10567 ①   | -      | -      | -      | 3.55               | -      | -    | -      |
| DN100, 4"       | E 107.1 | 10567     | -      | -      | -      | 1.45               | -      | -    | -      |
|                 | E 107.2 | 15850 ①   | -      | -      | -      | 3.29               | -      | -    | -      |

① Special float

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to:

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

## H250H - Horizontal installation position

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

| EN    | ASME | Cone    | Water [l/h] | Air [Nm <sup>3</sup> /h] | Pressure loss [mbar] |
|-------|------|---------|-------------|--------------------------|----------------------|
| DN15  | 1/2" | K 15.1  | 70          | 1.8                      | 195                  |
|       |      | K 15.2  | 120         | 3                        | 204                  |
|       |      | K 15.3  | 180         | 4.5                      | 195                  |
|       |      | K 15.4  | 280         | 7.5                      | 225                  |
|       |      | K 15.5  | 450         | 12                       | 250                  |
|       |      | K 15.6  | 700         | 18                       | 325                  |
|       |      | K 15.7  | 1200        | 30                       | 590                  |
|       |      | K 15.8  | 1600        | 40                       | 950                  |
| DN25  | 1"   | K 15.8  | 2400        | 60                       | 1600                 |
|       |      | K 25.1  | 1300        | 35                       | 122                  |
|       |      | K 25.2  | 2000        | 50                       | 105                  |
|       |      | K 25.3  | 3000        | 80                       | 116                  |
|       |      | K 25.4  | 5000        | 130                      | 145                  |
|       |      | K 25.5  | 8500        | 220                      | 217                  |
| DN50  | 2"   | K 25.5  | 10000       | 260                      | 336                  |
|       |      | K 55.1  | 10000       | 260                      | 240                  |
|       |      | K 55.2  | 16000       | 420                      | 230                  |
|       |      | K 55.3  | 22000       | 580                      | 220                  |
| DN80  | 3"   | K 55.3  | 34000       | 900                      | 420                  |
|       |      | K 85.1  | 25000       | 650                      | 130                  |
|       |      | K 85.2  | 35000       | 950                      | 130                  |
| DN100 | 4"   | K 85.2  | 60000       | 1600                     | 290                  |
|       |      | K 105.1 | 80000       | 2200                     | 250                  |
|       |      | K 105.1 | 120000      | 3200                     | 340                  |

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to:

Nl/h or Nm<sup>3</sup>/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

## H250H - Horizontal installation position

|                 |               |                      |  |
|-----------------|---------------|----------------------|--|
| Measuring span: | 10 : 1        |                      |  |
| Flow values:    | Values = 100% | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |

| EN    | ASME | Cone    | Water [GPH] | Air [SCFM] | Pressure loss [psig] |
|-------|------|---------|-------------|------------|----------------------|
| DN15  | 1/2" | K 15.1  | 18.5        | 1.12       | 2.87                 |
|       |      | K 15.2  | 31.7        | 1.86       | 3.00                 |
|       |      | K 15.3  | 47.6        | 2.79       | 2.87                 |
|       |      | K 15.4  | 74.0        | 4.65       | 3.31                 |
|       |      | K 15.5  | 119         | 7.44       | 3.68                 |
|       |      | K 15.6  | 185         | 11.2       | 4.78                 |
|       |      | K 15.7  | 317         | 18.6       | 8.68                 |
|       |      | K 15.8  | 423         | 24.8       | 14.0                 |
| DN25  | 1"   | K 15.8  | 634         | 37.2       | 23.5                 |
|       |      | K 25.1  | 343         | 21.7       | 1.79                 |
|       |      | K 25.2  | 528         | 31.0       | 1.54                 |
|       |      | K 25.3  | 793         | 49.6       | 1.71                 |
|       |      | K 25.4  | 1321        | 80.6       | 2.13                 |
|       |      | K 25.5  | 2245        | 136        | 3.19                 |
|       |      | K 25.5  | 2642        | 161        | 4.94                 |
|       |      | K 25.5  | 2642        | 161        | 4.94                 |
| DN50  | 2"   | K 55.1  | 2642        | 161        | 3.53                 |
|       |      | K 55.2  | 4227        | 260        | 3.38                 |
|       |      | K 55.3  | 5812        | 360        | 3.23                 |
|       |      | K 55.3  | 8982        | 558        | 6.17                 |
| DN80  | 3"   | K 85.1  | 6604        | 403        | 1.91                 |
|       |      | K 85.2  | 9246        | 589        | 1.91                 |
|       |      | K 85.2  | 15851       | 992        | 4.26                 |
| DN100 | 4"   | K 105.1 | 21134       | 1364       | 3.68                 |
|       |      | K 105.1 | 31701       | 1984       | 5.00                 |

**INFORMATION!**

The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to  
SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

## H250U - Vertical installation position

|                 |                    |                      |  |
|-----------------|--------------------|----------------------|--|
| Measuring span: | 10 : 1             |                      |  |
| Flow values:    | Values = 100%      | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |
| Flow direction: | Vertical downwards |                      |  |

| EN   | ASME | Cone   | Water [l/h] | Air [Nm <sup>3</sup> /h] | Pressure loss [mbar] |
|------|------|--------|-------------|--------------------------|----------------------|
| DN15 | 1/2" | K 15.1 | 65          | 1.6                      | 175                  |
|      |      | K 15.2 | 110         | 2.5                      | 178                  |
|      |      | K 15.3 | 170         | 4                        | 180                  |
|      |      | K 15.4 | 260         | 6                        | 200                  |
|      |      | K 15.5 | 420         | 10                       | 220                  |
|      |      | K 15.6 | 650         | 16                       | 290                  |
|      |      | K 15.7 | 1100        | 28                       | 520                  |
|      |      | K 15.8 | 1500        | 40                       | 840                  |
| DN25 | 1"   | K 25.1 | 1150        | 30                       | 97                   |
|      |      | K 25.2 | 1800        | 45                       | 85                   |
|      |      | K 25.3 | 2700        | 70                       | 92                   |
|      |      | K 25.4 | 4500        | 120                      | 115                  |
|      |      | K 25.5 | 7600        | 200                      | 172                  |
| DN50 | 2"   | K 55.1 | 9000        | 240                      | 220                  |
|      |      | K 55.2 | 15000       | 400                      | 230                  |
|      |      | K 55.3 | 21000       | 550                      | 240                  |

**INFORMATION!**

*The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI/VDE directive 3513.*

**Reference condition for gas measurements:**

Flow measurements for gases are attributed to:

Nl/h or Nm<sup>3</sup>/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)



## H250U - Vertical installation position

|                 |                    |                      |  |
|-----------------|--------------------|----------------------|--|
| Measuring span: | 10 : 1             |                      |  |
| Flow values:    | Values = 100%      | Water: +20°C / +68°F | Air: +20°C / +68°F, 1.013 bara / 14.7 psia |
| Flow direction: | Vertical downwards |                      |  |

| EN   | ASME | Cone   | Water [GPH] | Air [SCFM] | Pressure loss [psig] |
|------|------|--------|-------------|------------|----------------------|
| DN15 | 1/2" | K 15.1 | 17.2        | 0.99       | 2.57                 |
|      |      | K 15.2 | 29.1        | 1.55       | 2.62                 |
|      |      | K 15.3 | 44.9        | 2.48       | 2.65                 |
|      |      | K 15.4 | 68.7        | 3.72       | 2.94                 |
|      |      | K 15.5 | 111         | 6.20       | 3.23                 |
|      |      | K 15.6 | 172         | 9.92       | 4.26                 |
|      |      | K 15.7 | 291         | 17.4       | 7.64                 |
|      |      | K 15.8 | 396         | 24.8       | 12.3                 |
| DN25 | 1"   | K 25.1 | 304         | 18.6       | 1.42                 |
|      |      | K 25.2 | 476         | 27.9       | 1.25                 |
|      |      | K 25.3 | 713         | 43.4       | 1.35                 |
|      |      | K 25.4 | 1189        | 74.4       | 1.69                 |
|      |      | K 25.5 | 2008        | 124        | 2.53                 |
| DN50 | 2"   | K 55.1 | 2378        | 149        | 3.23                 |
|      |      | K 55.2 | 3963        | 248        | 3.38                 |
|      |      | K 55.3 | 5548        | 341        | 3.53                 |

**INFORMATION!**

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Flow measurements for gases are attributed to:

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## KROHNE – Process instrumentation and measurement solutions

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