



DK46 - DK800 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 gases and liquids.

**INFORMATION!**

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

The devices are particularly suitable for the measurement of small quantities of:

- Process or carrier gases
- Nitrogen, CO₂ or other industrial gases
- Sample flows for process analysers
- Purge fluids for measuring systems
- Air or water

**DANGER!**

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

**CAUTION!**

Do not use any abrasive or highly viscous media.

1.2 Certifications



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

- Pressure equipment directive
- Devices with contacts: EMC directive
- Devices for use in hazardous areas: ATEX directive

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 website.

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/G1/4.3/SEP	
G	Gases and vapours
1	Fluid group 1
4.3	Article 4.3 of the directive 2014/68/EU
SEP	Sound engineering practice

Table 1-1: Example of PED key

The PED key identification can be found on the nameplate of the device (for details refer to *Nameplate* on page 13).



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. Expect residue around the valve and in the flow regulator.
- 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.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

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.



Figure 2-1: Scope of delivery

- ① Measuring device in ordered version
- ② Product documentation
- ③ Certificates, calibration report (supplied to order only)

2.2 Device versions

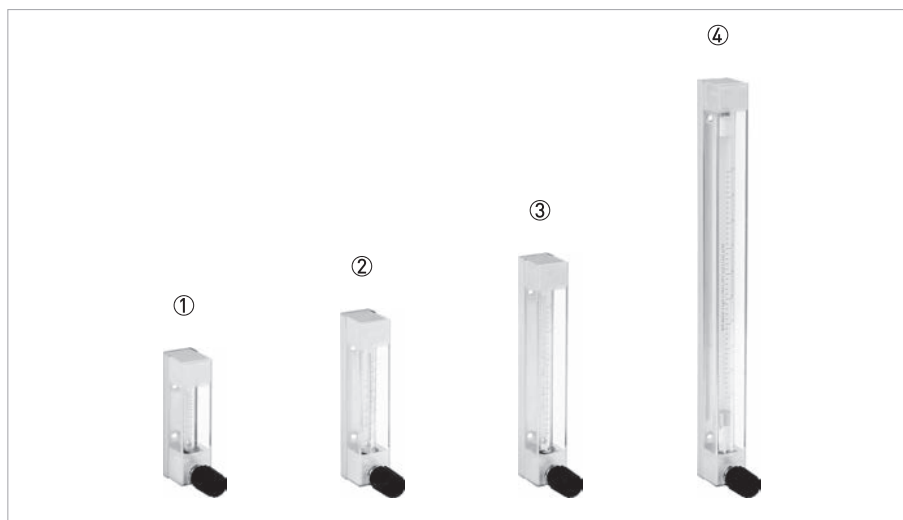


Figure 2-2: Standard versions

- ① DK46 with a connection dimension of 90 mm / 3.55" and 4% maximum measurement error
- ② DK800 with a connection dimension of 125 mm / 4.92" and 2.5% maximum measurement error
- ③ DK47 with a connection dimension of 175 mm / 6.89" and 2.5% maximum measurement error
- ④ DK48 with a connection dimension of 325 mm / 12.8" and 1.0% maximum measurement error



Figure 2-3: Optional versions

- ① DK device with flow regulator for fluctuating inlet and outlet pressures
- ② DK device with limit switch and connection box (SIL2-compliant)
- ③ DK device with valve at top and calibrated to inlet pressure

2.3 Nameplate



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order.

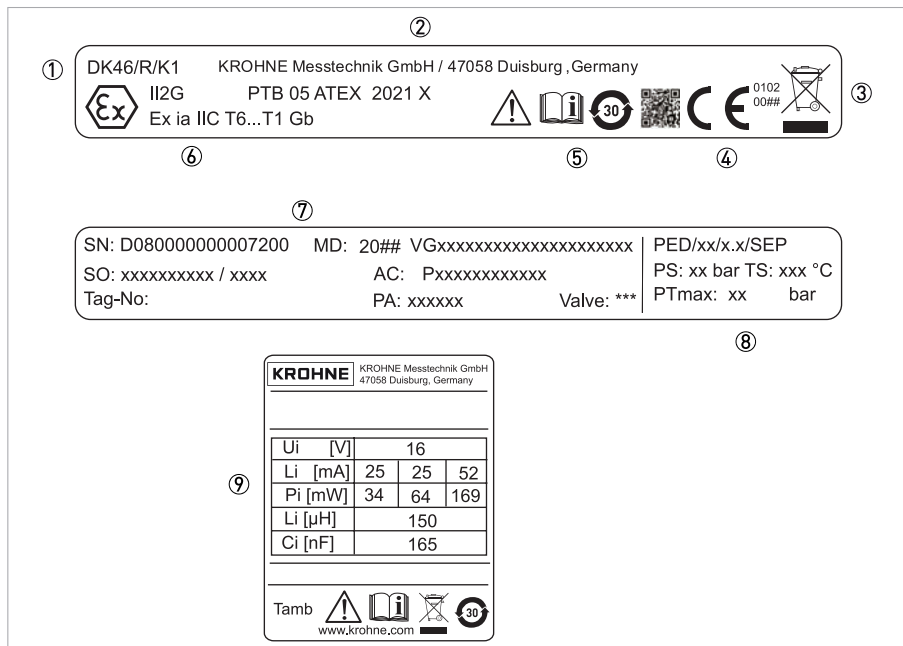


Figure 2-4: Examples of nameplates

- ① Device type
- ② Manufacturer
- ③ Disposal symbol
- ④ Identification number of the notified body
- ⑤ Note to observe the documentation, China RoHs and data matrix code
- ⑥ Marking according to the notified body
- ⑦ Production data
- ⑧ Rating data: temperature & pressure rating
- ⑨ Electrical connection data

Additional markings on the measuring device

- SN - serial number
- SO - sales order / item
- Tag No. - measuring point identifier
- MD - manufacturing date
- PA - production order
- Vx - product configurator code
- AC - article code

2.4 Description code

The description code consists of the following elements *:

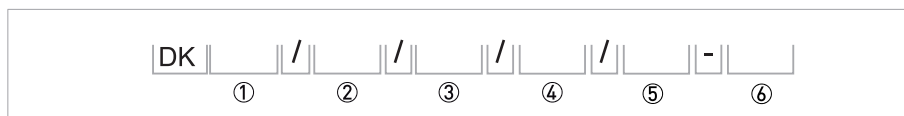


Figure 2-5: Description code

- ① R - with integrated inlet pressure regulator (DKR46 only)
- ② Device type
 - 46 - Overall length of measuring cone 65 mm / 2.6"
 - 47 - Overall length of measuring cone 150 mm / 5.9"
 - 48 - Overall length of measuring cone 300 mm / 11.8"
 - 800 - Overall length of measuring cone 100 mm / 3.9"
- ③ Material for top and bottom fittings
 - N - brass / R - stainless steel / PV - PVDF
- ④ Flow regulator
 - RE - flow regulator for variable inlet pressure
 - RA - flow regulator for variable outlet pressure
- ⑤ Limit switches
 - K1 - one limit switch
 - K2 - two limit switches
- ⑥ SIL compliance
 - SK - SIL conformity according to IEC 61508 of the limit switch

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

3.1 General notes on installation

**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.

3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid lasting 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

3.3.1 Installation in the pipeline



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.*
- *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 centrally with the connection bores on the measuring device so they are free of stresses.*
- *If necessary, the piping has to be supported to avoid the vibrations transmitted to the measuring device.*
- *Do not lay signal cables directly next to cables for the power supply.*

3.3.2 Panel mounting

Prepare the panel cut-out as shown in the drawing (refer to section "Technical data - Dimensions").

For installation in the panel, slightly loosen the two screws ① on the front panel of the measuring device. The measuring device is inserted into the panel cutout from the front. Align the device and fix it with the two screws ② with 0.7 Nm.

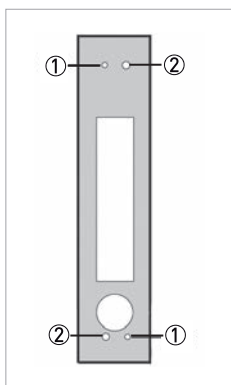


Figure 3-1: Position of screws for panel mounting

- ① Front side
- ② Back side

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.

4.2 Limit switches

The flowmeters can be equipped with a maximum of two limit switches.
The switching function of the limit switch can be designed as monostable or bistable.

Monostable function:	Switching pulse as float passes through switching point, independent of direction of movement.
Bistable function:	Stable changeover as float passes through switching point.
Example (bistable):	Above limit: switching point "High" Below limit: switching point "Low"

For switching performance and electrical data refer to section "Technical data".

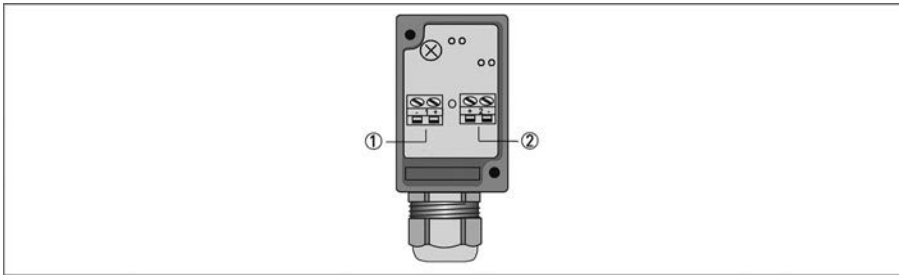


Figure 4-1: Connection of limit switch - 2-wire NAMUR

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

The connection box includes an EMC filter unit.

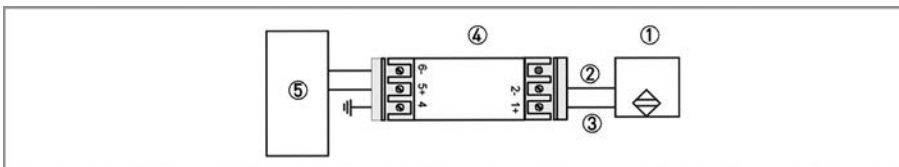


Figure 4-2: Connection of limit switch - 2-wire NAMUR, without connection box

- ① Limit switch (without connection box)
- ② Blue cable -
- ③ Brown cable +
- ④ External EMC filter
- ⑤ Receiver device

When connecting to an EMC filter, the ground terminal must be connected to the back rail of the flowmeter.

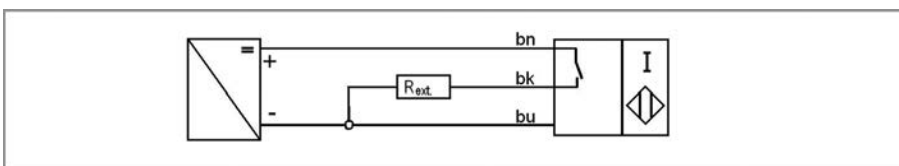


Figure 4-3: Connection of limit switch - 3-wire (transistor)

- bn - brown: supply voltage +
- bk - black: switch
- bu - blue: supply voltage -

4.3 Settings of limit switches

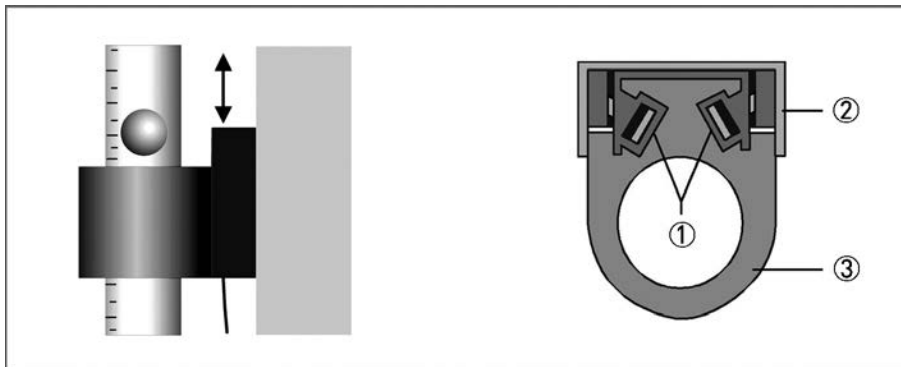


Figure 4-4: Settings of limit switches

- ① Clamping screw
- ② Back rail
- ③ Limit switch



The following procedures are to be performed (DK../../K):

- Remove both clamping screws ①.
- Slide the limit switch over the measuring glass.
- Use the two clamping screws ① to fasten the limit switch ③ to the back rail ② of the measuring device.
- Re-install the protective cover following installation.

For installation after the fact, the measuring glass must be removed. Refer to chapter "Service".



CAUTION!

When setting the limit switch, be careful to lay the cable so that it does not get damaged. Avoid canting of the limit switch during installation: glass breakage

The connecting lead of the limit switch is guided through a hole in the base of the device and sealed.

Observe the following for bistable limit switches with external EMC filters in separate DIN rail housing:
The EMC filter unit and the back rail of the meter must be galvanically connected and grounded.

An isolation switching amplifier with intrinsically safe circuit controls is necessary to operate the NAMUR limit switches.

4.4 Minimum distance between two limit switches

Where two limit switches are used in one device and also where meters with limit switches are in close proximity of each other, minimum distances must be maintained in order to avoid mutual influence of the switches.

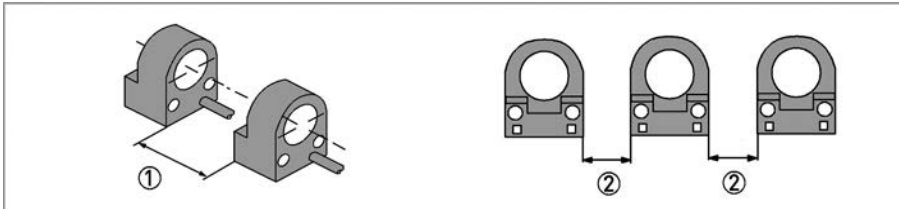


Figure 4-5: Minimum distances

Minimum distance	2-wire		3-wire	
	[mm]	[inch]	[mm]	[inch]
①	16	0.63	45	1.77
②	6	0.24	30	1.18

Table 4-1: Minimum distances

4.5 Switching performance of limit switches

2-wire limit switch NAMUR, monostable

Float outside of the limit switch: signal ≥ 3 mA
 Float inside of the limit switch (centre): signal ≤ 1 mA

2-wire limit switch NAMUR, bistable

Independent of the float position and passage ①: signal ≥ 3 mA
 Prerequisite: the float is outside the limit switch.



INFORMATION!

For the proper initialisation after power up, the bistable NAMUR limit switch should pass through each of ① and ② once.

3-wire limit switch, transistor

Independent of the float position and passage ②: signal ≤ 1 V
 Prerequisite: the float is outside the limit switch.

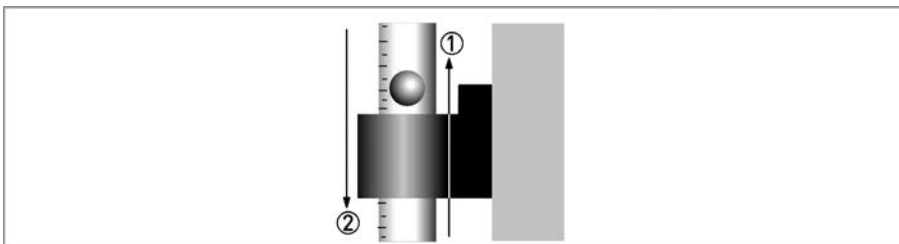


Figure 4-6: Switching performance

4.6 Reversed function of limit switch

The bistable limit switches can be changed from normally open switch to normally closed switch.

The pre-fabricated connection cable must be long enough to do this.

When installing and setting, make sure the cable is not damaged when laid.

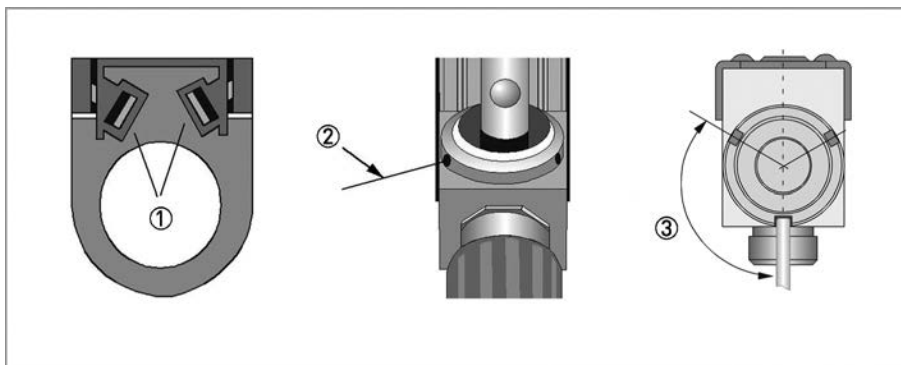


Figure 4-7: Reversed function of limit switch



- Loosen terminal screw ①.
- Turn turnbuckle ② counter-clockwise to loosen.
- Pull out the measuring glass along with the limit switch.
- Turn limit switch 180°.
- Install the measuring glass.
- Tighten turnbuckle ② by hand.
- Use a 3 mm pin to tighten the turnbuckle by turning 4 to max. 5 times in 120° increments ③ in a clockwise direction.



CAUTION!

To avoid breakage, the measuring glass must be positioned centrally between the gaskets.

Test the leak tightness by suitable measures prior to start-up.

4.7 Grounding connection

The measuring unit is grounded on the back rail ① (M4 thread). This connection only ensures electrostatic grounding of the device and does not meet the requirements for equipotential bonding.

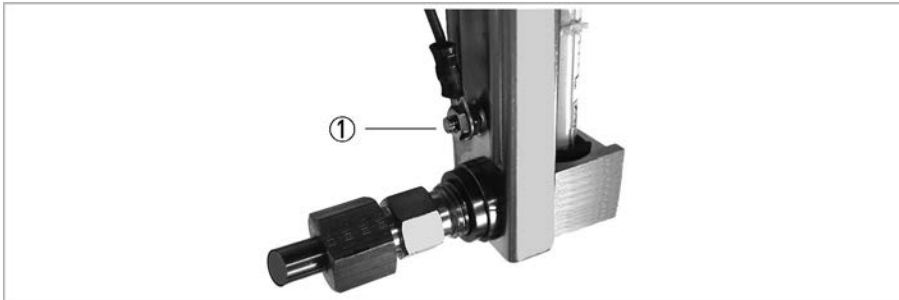


Figure 4-8: Position of the ground terminal



DANGER!

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

4.8 Ingress protection

The limit switches with connection housing meet all requirements of ingress protection IP65.



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 used 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 with blanking plugs ①.



Figure 4-9: Ingress protection



DANGER!

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

5.1 Start-up



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.
- Ensure the material compatibility.
- Close the needle valve at the flowmeter.
- 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.
- Open needle valve at the flowmeters and set the required flow rate.
- The top edge of the float, marks the reading line for flow values.

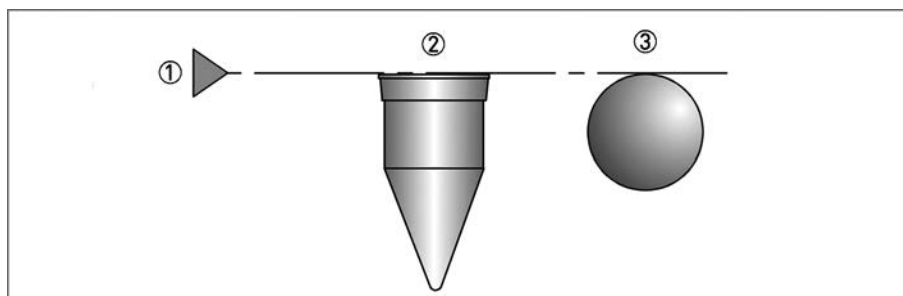


Figure 5-1: Reading line

- ① Reading line
- ② Float shape "Alli"
- ③ Float shape "ball"

6.1 Maintenance

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

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.
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 piping.*



CAUTION!

*The packing seal for the valve may have to be adjusted during the service life. The union nut must be tightened for this.
Comply with a maximum torque of 5 Nm.*



CAUTION!

Valves that have not been used for a longer period of time may exhibit a higher actuating torque.

6.2 Changing the measuring cone



- Close the valves located upstream and downstream of the device.
- Close the needle valve.
- Push the protective cover upwards and remove it towards the front.
- Turn turnbuckle ① counter-clockwise to loosen.

Devices with a top and bottom fitting made of PVDF (DK.../PV) have a turnbuckle in the device head (6 mm Allen key). This can be loosened with approximately one full turn. The measuring glass can be removed to the front.

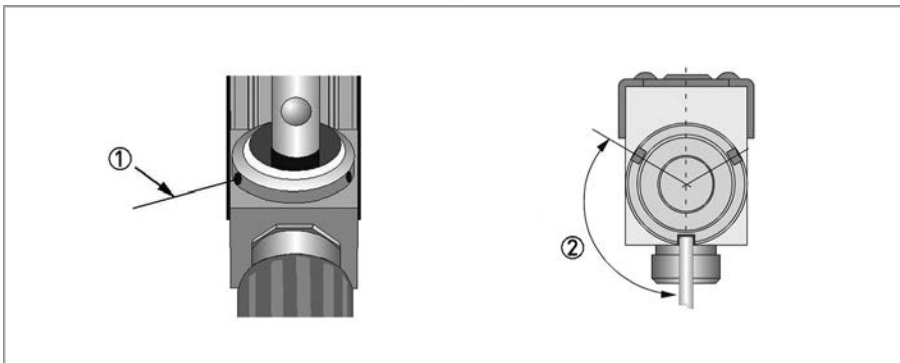


Figure 6-1: Changing the measuring cone



CAUTION!

Residual liquid or gas may leak out!



- Install in the reverse order.
- Tighten turnbuckle ① by hand.
- Use a 3 mm pin to tighten the turnbuckle by turning 4 to max. 5 times in 120° increments ② in a clockwise direction.



CAUTION!

To avoid breakage, the measuring glass must be positioned centrally between the gaskets.

Test the leak tightness by suitable measures prior to start-up.

6.3 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.

6.4 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.

6.5 Returning the device to the manufacturer

6.5.1 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.*

6.5.2 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:	
Telephone number:		Email address:	
Fax number:			
Manufacturer order number or serial number:			
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 caused by any residual media contained in this device when it is returned.			
Date:		Signature:	
Stamp:			

6.6 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.

7.1 Functional principle

The flowmeter operates in accordance with the float measuring principle.

The measuring unit consists of a glass cone in which a float can move freely up and down. The flow goes from bottom to top.

The float adjusts itself so that the buoyancy force A acting on it, the form drag W and weight G are in equilibrium: $G = A + W$.

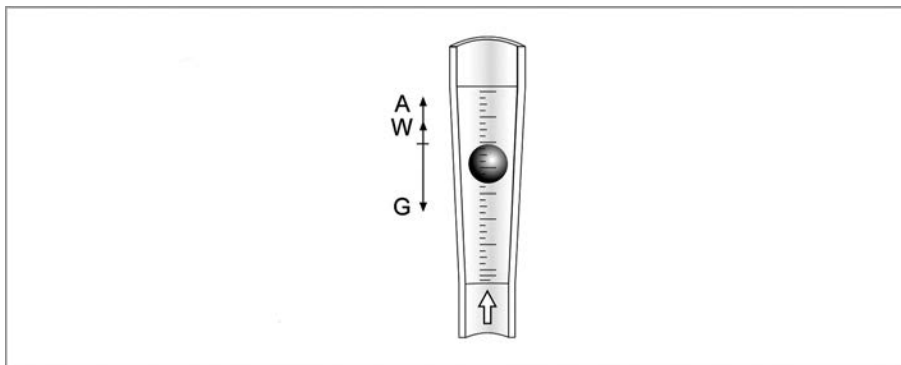


Figure 7-1: Operating principle

The height of the float is read on the scale of the measuring glass and indicates the flow rate.

The top edge of the float marks the reading line for flow values.

7.2 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 and gases
Function / Measuring principle	Float measuring principle
Measured value	
Primary measured value	Float position
Secondary measured value	Operating volume flow, nominal volume flow or mass flow

Measuring accuracy

Maximum measurement error DK46	3.0% of full scale range
	4.0% of measured value according to VDI/VDE 3513-2 ($q_G = 50\%$)
Maximum measurement error DK47 / DK800	2.0% of full scale range
	2.5% of measured value according to VDI/VDE 3513-2 ($q_G = 50\%$)
Maximum measurement error DK48	1.0% of full scale range
	1.0% of measured value according to VDI/VDE 3513-2 ($q_G = 50\%$)

Operating conditions

Temperature	
Max. operating temperature TS	Depending on the version (refer to nameplate)
	-5...+100°C / +23...+212°F
Max. medium temperature	Standard: -5...+100°C / +23...+212°F
	With limit switches: -5...+65°C / +23...+149°F
Max. ambient temperature	Standard: -20...+100°C / -4...+212°F
	With limit switches: -20...+65°C / -4...+149°F
Other temperatures on request	
Pressure	
Max. operating pressure PS	Depending on the version (refer to nameplate)
	DK.../R (stainless steel top and bottom fitting): 10 barg / 145 psig
	DK.../N (brass top and bottom fitting): 10 barg / 145 psig
	DK.../PV (PVDF top and bottom fitting): 4 barg / 58 psig
Test pressure PT	Depending on the version (refer to nameplate)
Higher pressures on request	

Installation conditions

Inlet and outlet sections	None
---------------------------	------

Materials

Top fitting, bottom fitting	Stainless steel 1.4404 / 316 L, nickel-plated brass, PVDF (not available for DK48)
	Option: Hastelloy® C4 / 2.4610
Measuring tube	Borosilicate glass
Float	Ball: stainless steel 1.4401 / 316
	Options: glass, Hastelloy® C4 / 2.4610
	All: stainless steel 1.4404 / 316 L, aluminium, Polypropylene (PP)
Dosing unit	Stainless steel 1.4571 / 316 Ti
Valve stem	Stainless steel 1.4404 / 316 L
Gaskets	Standard: PTFE / FPM
	Option: PTFE / FFKM, PTFE / EPDM, EPDM, FFKM
Protective cover	Polycarbonate

Process connections

Standard	1/4 NPT female
Option	G1/4, Ermeto 6 or 8, tube connection 6 mm or 8 mm, Dilo, Gyrolok, Swagelok
	Other connections on request

Table 7-1: Technical data

7.2.1 Technical data of limit switches

Terminal connection	Connection box M16 x 1.5				
Clamping range	3...7 mm / 0.12...0.28"				
Limit switches	I7R2010-NL	I7R2015-NL	I7R2010-N	I7R2015-N	RB15-14-E2
	RC10-14-N3	RC15-14-N3	RC10-14-N0	RC15-14-N0	
Ring diameter	10 mm / 0.4"	15 mm / 0.6"	10 mm / 0.4"	15 mm / 0.6"	15 mm / 0.6"
Switching function	bistable	bistable	monostable	monostable	bistable
NAMUR	yes	yes	yes	yes	no
SIL2-compliant according to IEC 61508	yes	yes	no	no	no
Connection technology	2-wire	2-wire	2-wire	2-wire	3-wire
Nominal voltage U_0	8 VDC	8 VDC	8 VDC	8 VDC	-
Current consumption	1 mA passage ↓ ①		3 mA - float outside		-
Current consumption	3 mA passage ↑ ①		1 mA - float inside of the limit switch		-
Operating voltage $U_{ext.}$	-				10...30 VDC
Operating current I	-				0...100 mA
No-load current I	-				20 mA
Output U_a - passage ↓	-				≤1 VDC ①
Output U_a - passage ↑	-				≥ U_b - 3 VDC ①

Table 7-2: Technical data of limit switches

① For devices with the valve at the top in the output and devices with flow regulators for variable outlet pressure, the function is inverted!



INFORMATION!

The limit switches with ring diameters of 15 mm / 0.6" as max. contact can only be used up to 60 l/h / 15.8 GPH water or 2400 l/h / 89.3 SCFH air (outer diameter of the measuring glass).

7.2.2 Field of application for limit switches

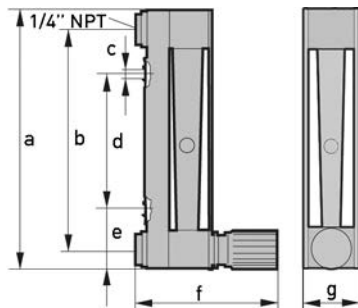
DK46, DK47, DK800		DK48	
Float	Ring diameter	Cone number	Ring diameter
Ø4 mm / 0.16"	10 mm / 0.4"	G13.11	-
Ø6 mm / 0.24"	15 mm / 0.6"	G14.06	-
Ø8 mm / 0.32"	-	G14.08	-
		G15.07	10 mm / 0.4"
		G15.09	10 mm / 0.4"
		G15.12	10 mm / 0.4"
		G16.08	10 mm / 0.4"
		G16.12	10 mm / 0.4"
		G17.08	15 mm / 0.6"
		G17.12	15 mm / 0.6"
		G18.06	-
		G18.08	-
		G18.12	-

**INFORMATION!**

The limit switches with ring diameters of 15 mm / 0.6" as max. contact can only be used up to 60 l/h / 15.8 GPH water or 2400 l/h / 89.3 SCFH air (outer diameter of the measuring glass).

7.3 Dimensions and weights

7.3.1 Device versions

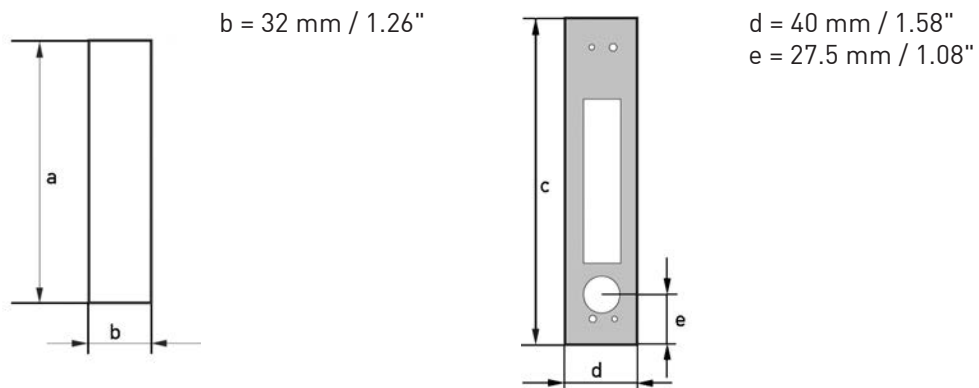


$c = 4.3 \text{ mm} / 0.17''$
 $e = 33 \text{ mm} / 1.3''$
 $g = 28 \text{ mm} / 1.1''$

Device	a		b ± 0.25		d		f approx.	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DK46	111	4.37	90	3.55	45	1.77	82	3.2
DK800	146	5.75	125	4.92	80	3.15	82	3.2
DK47	196	7.72	175	6.89	130	5.12	82	3.2
DK48	346	13.6	325	12.8	280	11.0	82	3.2

Table 7-3: Dimensions in mm and inch

7.3.2 Panel cut-out and orifice plate



Device	a		c	
	[mm]	["]	[mm]	["]
DK46	128	5.04	145	5.71
DK800	163	6.42	180	7.09
DK47	213	8.39	230	9.06
DK48	363	14.3	380	15.0

Table 7-4: Dimensions in mm and inch

7.4 Weights

	DK46		DK800		DK47		DK48	
	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
Weight	0.4	0.88	0.5	1.1	0.6	1.3	0.7	1.5
Weight with regulator	2.1	4.6	2.2	4.9	2.3	5.1	2.4	5.3

Table 7-5: Weights in kg and lb

7.5 Measuring ranges

7.5.1 Measuring ranges for DK46 - DK47 - DK800

Measuring span: 10 : 1
 Flow values: Values = 100%
 Water: +20°C / +68°F
 Air: +20°C / +68°F, 1.2 bara / 17.4 psia

Float shapes:



Ball



AIII 4-H

Float: Stainless steel

Float Ø ▼		Water						Air					
		DK46		DK47		DK800		DK46		DK47		DK800	
[mm]	["]	[l/h]	[GPH]	[l/h]	[GPH]	[l/h]	[GPH]	[Nm ³ /h]	[SCFH]	[Nm ³ /h]	[SCFH]	[Nm ³ /h]	[SCFH]
4	0.158	2.5	0.65	-	-	2.5	0.65	5 ①	0.22 ①	-	-	5 ①	0.18 ①
		-	-	-	-	-	-	8 ①	0.3 ①	-	-	8 ①	0.3 ①
		-	-	-	-	-	-	16	0.6	16 ①	0.6	16	0.6
		-	-	-	-	-	-	40	1.5	40	1.5	40	1.5
		-	-	-	-	-	-	60	2.2	100	3.8	60	2.2
6	0.236	5	1.3	5	1.3	5	1.3	100	3.8	250	9.5	100	3.8
		12	3.0	12	3.0	12	3.0	250	9.5	500	19	250	9.5
		25	6.5	25	6.5	25	6.5	500	19	800	30	500	19
		40	11	40	11	40	11	800	30	-	-	800	30
		60	16	60	16	60	16	1200	45	-	-	1000	38
		100	25	100	25	100	25	-	-	-	-	1800	65
		-	-	-	-	120	30	-	-	-	-	2400	90
		-	-	-	-	160	42	-	-	-	-	3000	110
		-	-	-	-	-	-	-	-	-	-	4000	140
		-	-	-	-	-	-	-	-	-	-	5000	180
8	0.315	120	30	-	-	-	-	-	-	-	-	-	-
		160	42	-	-	-	-	-	-	-	-	-	-

Table 7-6: Measuring ranges for DK46 - DK47 - DK800

① With float AIII 4-H



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 Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

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

7.5.2 Measuring ranges for DK48

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: Stainless steel

Float shapes:



AIII

Float Material ▶	Water		Air					
	Stainless steel		Polypropylene (PP)		Aluminium		Stainless steel	
Cone no. ▼	[l/h]	[GPH]	[NI/h]	[SCFH]	[NI/h]	[SCFH]	[NI/h]	[SCFH]
G13.11 ①	0.4	0.1	-	-	7	0.25	16	0.6
G14.06	0.6	0.16	-	-	12	0.45	25	0.95
G14.08	1	0.25	-	-	20	0.75	40	1.5
G15.07	1.6	0.4	-	-	30	1.1	60	2.2
G15.09	2.5	0.65	-	-	40	1.5	90	3.5
G15.12	4	1.0	-	-	60	2.2	140	5.0
G16.08	6	1.6	-	-	100	3.7	200	7.5
G16.12	10	2.5	-	-	160	6.0	300	11
G17.08	16	4.0	-	-	250	9.0	500	19
G17.12	25	6.5	-	-	400	15	800	30
G18.06	40	10	400	15	600	22	1200	45
G18.08	63	16	600	22	1000	37	2000	75
G18.12	100	25	1000	37	1600	60	3000	110

Table 7-7: Measuring ranges for DK48

① 2.5% maximum measurement error

**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

NI/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

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

7.5.3 Measuring ranges for valves

Flow values: Values = 100%
 Water: +20°C / +68°F
 Air: +20°C / +68°F, 1.013 bara / 14.7 psia

Valve stem		Max. flow rate				Valve characteristic value	
		Water		Air		Kv	Cv
Ø [mm]	Ø ["]	[l/h]	[GPH]	[NI/h]	[SCFH]	[m ³ /h]	[GPM]
1	0.039	5	1.3	100	3.7	0.018	0.02
2.5	0.98	50	13	1000	37	0.15	0.17
4.5	0.177	160	42	4300	160	0.48	0.55

Table 7-8: Measuring ranges for valves

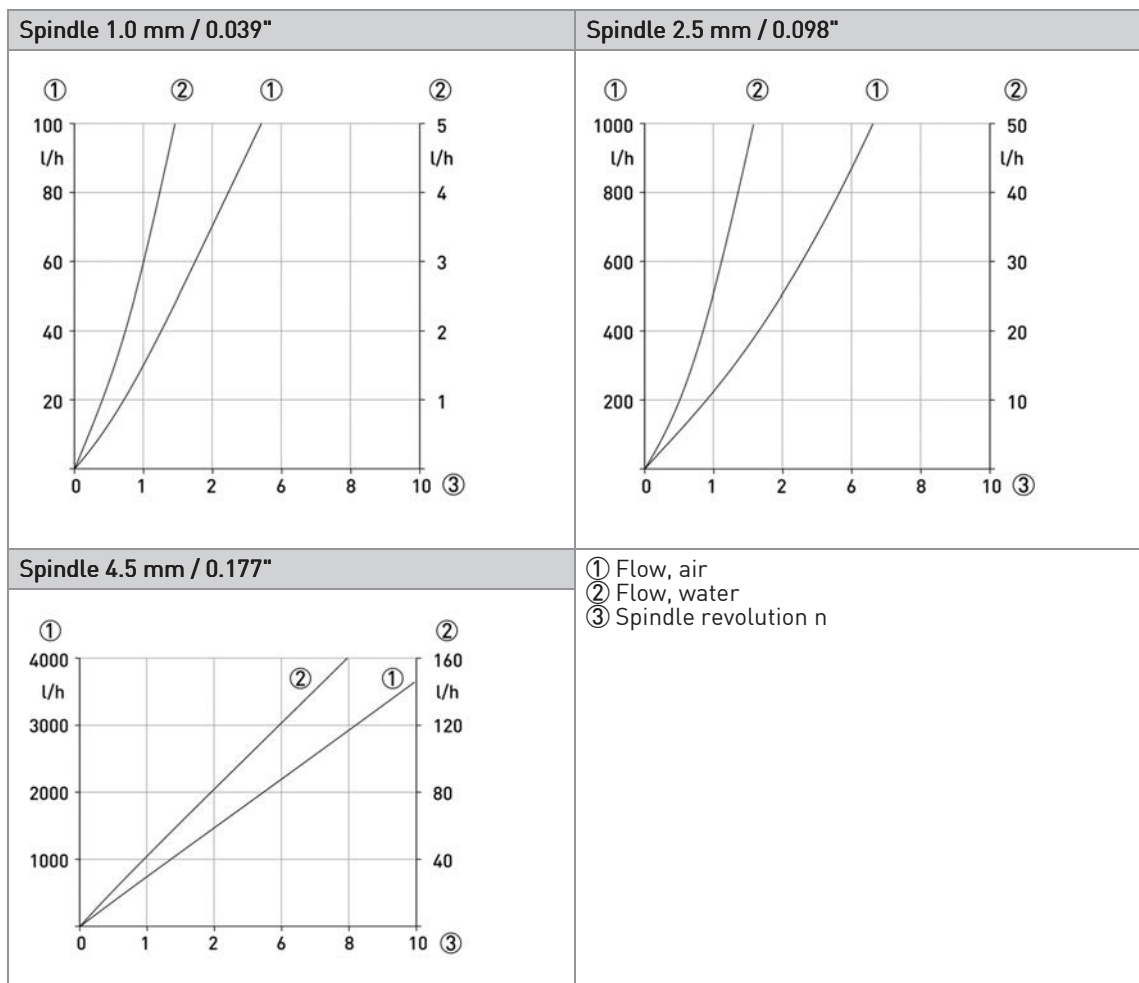


Table 7-9: Valve characteristics

7.6 Flow regulators for variable pressure

The flow regulators are used to provide constant flow rates in the case of variable inlet or outlet pressures. Minimum pressures are required to operate the regulators (refer to regulator characteristics).



INFORMATION!

Flow regulators are not equivalent to pressure regulators / pressure reducing valves!

① Flow regulator for variable inlet pressure, type RE, NRE

The regulators keep the flow rate constant in the case of a variable inlet pressure and a constant outlet pressure.

RE-1000	Current flow rate:	1000 l/h air
	Outlet pressure p2 constant:	1.013 bara / 14.7 psia

Table 7-10: Example for flow regulator for variable inlet pressure

The flow rate in the device remains constant with a fluctuating inlet pressure greater than 0.5 bar / 7.25 psi.

② Flow regulator for variable outlet pressure, type RA, NRA

The regulators keep the flow rate constant in the case of a constant inlet pressure and a variable outlet pressure.

There must be a pressure differential between the inlet and the outlet pressure for the flow regulators to function. The inlet pressure p1 must always be greater than the outlet pressure p2.

NRA-800	Current flow rate:	800 l/h air
	Inlet pressure p1 constant:	6 bar / 87 psi

Table 7-11: Example for flow regulator for variable outlet pressure

The flow rate in the device remains constant with a fluctuating outlet pressure greater than 0...5.5 bar / 0...79.8 psi.

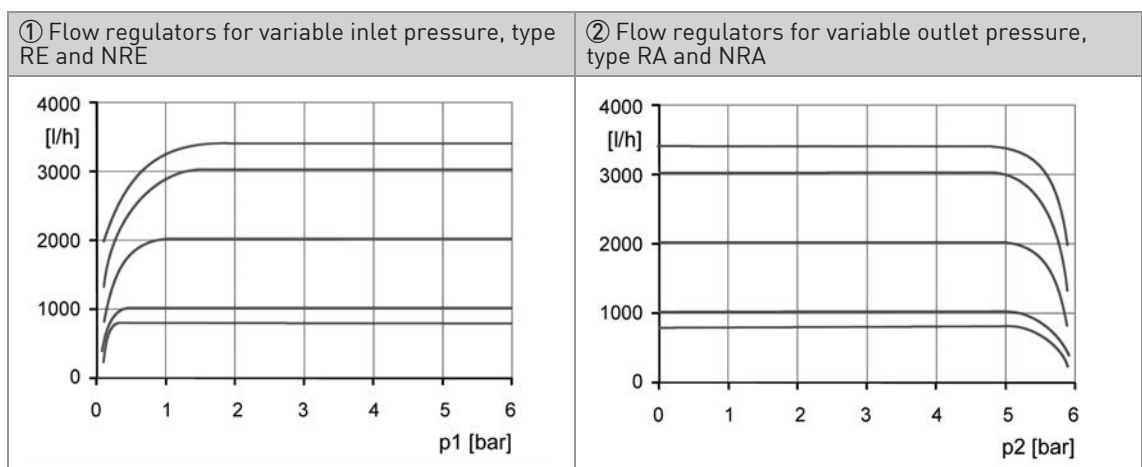


Table 7-12: Regulator characteristics

7.6.1 Control ranges

Measuring span: 10 : 1

Flow values: Values = 100%; Water: +20°C / +68°F; Air: +20°C / +68°F, 1.013 bara / 14.7 psia

	Max. flow rate				Min. inlet pressure	
	Water		Air		p1 [bar]	p1 [psi]
	[l/h]	[GPH]	[NI/h]	[SCFH]		
RE-1000	...40	...11	...1000	...37	0.5	7.25
RE-4000	...80	...20	...2000	...75	1	14.5
	...100	...25	...3000	...110	1.5	21.8
	...160	...42	...4000	...150	2	29
NRE-100	...2.5	...0.6	...100	...3.7	0.1	1.45
NRE-800	-	-	...250	...9.0	0.1	1.45
	-	-	...800	...30	0.2	2.9
	...25	...6.6	-	-	0.4	5.8

Table 7-13: Control ranges for flow regulator for variable inlet pressure ①

	Max. flow rate				Min. inlet pressure		Min. pressure diff. *	
	Water		Air		p1 [bar]	p1 [psi]	Δp [bar]	Δp [psi]
	[l/h]	[GPH]	[NI/h]	[SCFH]				
RA-1000	...40	...11	...1000	...37	0.5	7.25	0.4	5.8
RA-4000	...100	...25	...2000	...75	1.5	21.8	1.2	17.4
	-	-	...3000	...110	1.5	21.8	1.2	17.4
	...160	...42	...4000	...150	2	29	1.5	21.8
NRA-800	...1	...0.25	...250	...9.0	0.1	1.45	0.05	0.73
	-	-	...500	...19	0.2	2.9	0.1	1.45
	-	-	...800	...30	0.4	5.8	0.2	2.9
	...25	...6.6	-	-	0.4	5.8	0.4	5.8

Table 7-14: Control ranges for flow regulator for variable outlet pressure ②

* Differential pressure between inlet and outlet pressure

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

- NI/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)
- SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

7.6.2 Technical data for flow regulators

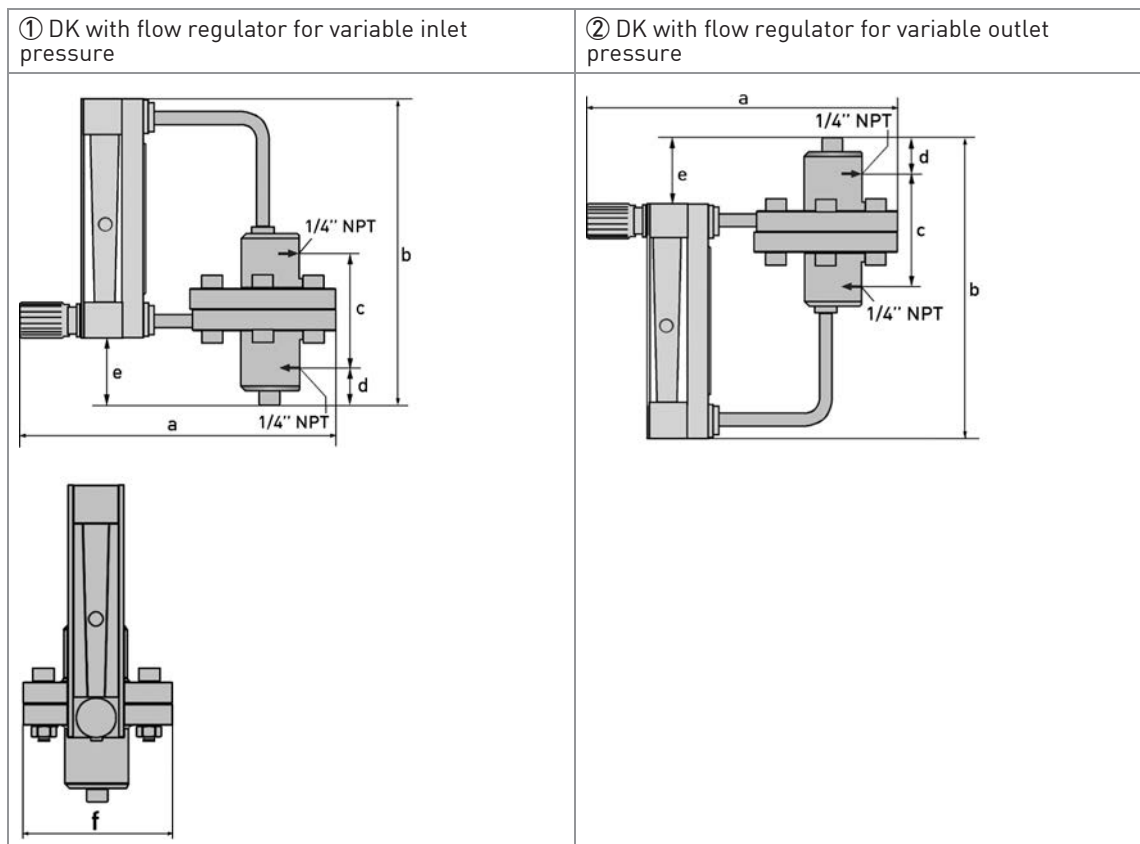
Connection, standard	1/4 NPT
Connection, option	Serto, Ermeto 6 or 8, hose nozzle 6 mm or 8 mm, Dilo, Gyrolok, Swagelok, G1/4
Max. operating gauge pressure (at +20°C / +68°F)	10 barg / 145 psig 4 barg / 58 psig for DK.../PV
Medium temperature	+100°C / +212°F
Material	Stainless steel 1.4404
Gasket	PTFE
Diaphragm	Carbon/graphite-filled PTFE
O-ring	FPM or FFKM

Table 7-15: Technical data

**INFORMATION!**

Higher pressures and temperatures, other connections or materials on request.

7.6.3 Dimensions with flow regulator



	a approx.		b		c		d		e		f approx.	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DK46	210	8.27	163	6.42	70	2.76	19	0.75	39	1.54	90	3.55
DK47	210	8.27	233	9.18	70	2.76	19	0.75	39	1.54	90	3.55
DK48	210	8.27	383	15.1	70	2.76	19	0.75	39	1.54	90	3.55
DK800	210	8.27	183	7.21	70	2.76	19	0.75	39	1.54	90	3.55

Table 7-16: Dimensions in mm and inch





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