



## VA40 - VA45 Technical Datasheet

### Variable area flowmeter

- Local indication without auxiliary power
- Adaptable to meet customers' requirements
- Replaceable mounting parts



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## 1.1 VA40 VA45 Variable-area flowmeters

The VA40 flowmeter is suitable for measuring the flow rate of liquids or gases.

The VA45 flowmeter is suitable for measuring gases at low operating pressures.



Various process connections can be used

## Highlights

- Consistently used overall length concept
- Low loss of pressure for gas applications
- Low maintenance
- Optional limit switches
- Simple installation and start-up
- Simple float guidance
- Shatter protection

## Industries

Can be used in all industrial sectors, for example:

- Chemical
- Food and beverages
- Heating, cooling, and air conditioning
- Iron, steel and metal
- Mining and building materials
- Oil and gas
- Pharmaceutical
- Power plants
- Mechanical engineering
- Pulp and paper
- Water
- Furnace construction

## Applications

- Measuring gas
- Burner controlling
- Water circuits

## 1.2 Options and variants

### Types of connection



- ① Connection V - Screw fitting
- ② Connection S - Tube nozzle
- ③ Connection F - Flange version
- ④ Connection A - Aseptic

### Ring limit switch



Ring type limit switches are used for DN15 devices for small measurement ranges only. The NAMUR ring type switches are available with monostable or bistable characteristics.

Measuring range water: 0,16 l/h up to max. 25 l/h  
 Measuring range air: 6 l/h up to max. 800 l/h

### Limit switch MS14



The limit switch type MS14 can be used for all nominal sizes DN15 to DN50. For devices with a MS14 switch, the float contains a magnet to activate the magnetic Reed switch. The reed switch is a dry contact with bistable characteristics.

Measuring range water: 1,3 l/h up to max. 10000 l/h  
Measuring range air: 50 l/h up to max. 310.000 l/h

### Limit switch TG21



The limit switch type TG21 can be used for the nominal sizes DN25 to DN50. For devices with a TG21 switch, the float contains a magnet to drive the switch mechanism. The switch itself has a bistable NAMUR characteristics.

Measuring range water: 23 l/h up to max. 10000 l/h  
Measuring range air: 700 l/h up to max. 310.000 l/h

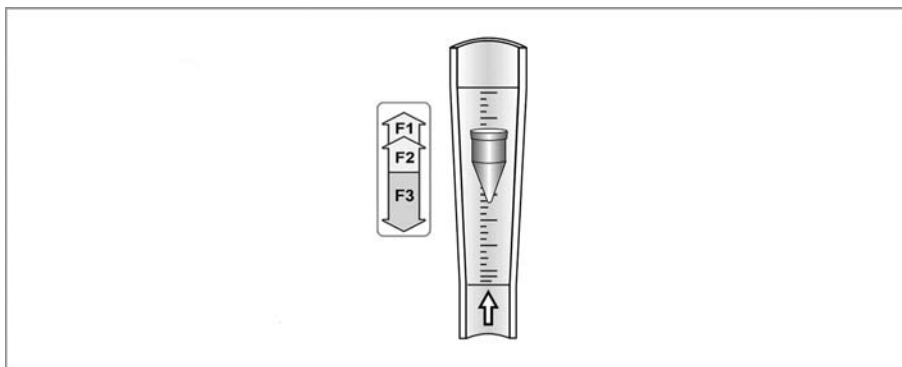
### 1.3 Functional principle

The flowmeter operates with the principle of variable area flowmeters.

A glass cone is installed in the measuring unit of VA40/45, in which a suitably formed float can move freely up and down.

The flowmeter is inserted into a vertical pipeline and the medium flows through it from bottom to top.

The float adjusts itself so that the buoyancy force  $F_1$  acting on it, the flow resistance  $F_2$  and its weight  $F_3$  are in equilibrium:  $F_3 = F_1 + F_2$



The height of the float in the measuring unit, which depends on the flow, is displayed on a scale.

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

## 2.1 Technical data

- *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 (Download Center).*

### Measuring system

Application range VA40	Flow measurement of liquids, gases and vapors
Application range VA45	Flow measurement of gasses
Operating method / measuring principle	Variable area measuring principle
Measured value	
Primary measured value	Float position
Secondary measured value	Operating and standard volumetric flow
Measuring accuracy	
Directive	VDI / VDE 3513, sheet 2 (q <sub>G</sub> = 50%)
VA40	1.0%
VA45	2.5%

### Operating conditions

<b>Temperature</b>	
Max. operating temperature	-20...+100°C / -4...+212°F
<b>Pressure</b>	
Max. permitted operating press. PS at TS = 100°C	Pressure equipment directive 97/23/ EC
Test pressure PT	Pressure equipment directive 97/23/EC or AD 2000-HP30
VA40 - DN15, DN25	10 bar / 145 psig ①
VA40 - DN40	9 bar / 131 psig ①
VA40 - DN50	7 bar / 102 psig ①
VA45	1 bar / 14.5 psig ①

### Installation conditions

Inlet run	≥ 5 x DN
Outlet run	≥ 3 x DN

① other pressures upon request



## Materials

Threaded connection VA.../R	Stainless steel 1.4404 (316 L)
Threaded connection VA.../ST	Steel, galvanized and chromitized
Tube nozzle	Stainless steel 1.4404 (316 L)
Flange connection VA.../R	Stainless steel 1.4404 (316 L)
Threaded connection / tube nozzle VA.../PV	PVDF
Housing	Stainless steel 1.4301 (304), electropolished
Screw cap	Aluminum / powder coated option: Stainless steel
Measuring cone	Borosilicate glass
Float VA45	Aluminum
Float VA40 (also for use with food)	Stainless steel, 1.4571 (316 Ti), Hastelloy® C2000, PTFE/insert
Float VA40 (not for use with food)	TFM (PTFE), Aluminum, Polypropylene (PP)
Float and insert	PVDF (conforms to FDA)
Seals	NBR, EPDM, FPM

## Temperatures

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

Max. measuring temperature $T_m$ (standard)	-20...+100°C ①	-4...+212°F
Max. ambient temperature $T_{amb.}$	-20...+100°C	-4...+212°F

① higher temperatures on request

### Limit switches

(only VA40)

Type	Switching function	Connection	Shape	Note
I7R2010-N RC10-14-N0	monostable	Two-wire NAMUR	Ring type	Non Ex
I7R2010-NL RC10-14-N3	bistable	Two-wire NAMUR	Ring type	Non Ex
I7R2015-N RC15-14-N0	monostable	Two-wire NAMUR	Ring type	Non Ex
I7R2015-NL RC15-14-N3	bistable	Two-wire NAMUR	Ring type	Non Ex
RB15-14-E2	bistable	3-wire open collector	Ring type	Non Ex
MS 14/I	bistable	Two-wire potential-free	Reed contact	float with magnet required
TG 21	bistable	Two-wire NAMUR	Slot-type	float with magnet required

### Use of the limit switch

Nominal width	Cone No.	Limit switch	Nominal width	Cone No.	Limit switch	
DN15	G 13.11	-	DN25	N 21.09	MS14/A	TG21
	G 14.06	-		N 21.13	MS14/A	TG21
	G 14.08	-		N 21.18	MS14/A	TG21
	G 15.07	ring ø10mm		N 21.25	MS14/A	TG21
	G 15.09	ring ø10mm	DN40	N 41.09	MS14/A	TG21
	G 15.12	ring ø10mm		N 41.13	MS14/A	TG21
	G 16.08	ring ø10mm		N 41.19	MS14/A	TG21
	G 16.12	ring ø10mm	DN50	N 51.10	MS14/A	TG21
	G 17.08	ring ø15mm		N 51.15	MS14/A	TG21
	G 17.12	ring ø15mm		N 51.21	MS14/A	TG21
	N 18.07	MS14/A				
	N 18.09	MS14/A				
	N 18.13	MS14/A				
	N 19.09	MS14/A				
	N 19.13	MS14/A				
	N 19.19	MS14/A				
N 19.26	MS14/A					

### Technical data ring type limit switches

Limit switch	I7R2010-NL	I7R2015-NL	I7R2010-N	I7R2015-N	RB15-14-E2
	RC10-14-N3	RC15-14-N3	RC10-14-N0	RC15-14-N0	
Ring $\varnothing$	10mm - 0,39"	15mm - 0,59"	10mm - 0,39"	15mm - 0,59"	15mm - 0,59"
Switching function	bistable	bistable	monostable	monostable	bistable
NAMUR	yes	yes	yes	yes	no
Connection technology	two-wire	two-wire	two-wire	two-wire	three-wire
Rated voltage $U_0$	8VDC	8VDC	8VDC	8VDC	-
Current consumption	1mA passage ↓		3mA - sphere beyond the limit switch		-
Current consumption	3mA passage ↓		1mA - sphere is in limit switch		-
Operating voltage $U_{ext.}$					10...30VDC
Operating current $I_b$					0...100mA
No-load current					20mA
Output $U_a$ - passage ↓					≤ 1 VDC
Output $U_a$ - passage ↑					≥ $U_b - 3VDC$

### Technical data MS14

Contact type	N/C or N/O, can be reversed
Switching reproducibility	< 2% of the measurement range end value
Contact rating	12VA
Max. switching voltage	30VDC
Max. switching current	0.5A
Ambient temperature	- 20°C...+85°C / -4...+185°F
Protection class Acc. to EN 60529 / IEC 529	IP44

### Technical data TG21

Rated voltage	8VDC
Current consumption, inactive	3mA
Current consumption, active	1mA
Ambient temperature	-25°C...+100°C / -13...+212°F
Type of protection according to EN 60529 / IEC 529	IP 67 (NEMA 6)

## 2.2 Dimensions and weights

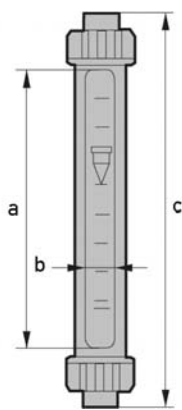
## Dimensions VA40

		a	b	c - Type V	c - Type S	c - Type F	c - Type A
EN	ASME	dimensions [mm]					
DN15	1/2"	239	26	375	400	425 ①	375
DN25	1"	239	36	375	450	425 ①	375
DN40	1 1/2"	235	46	375	450	425 ①	375
DN50	2"	227	62	375	450	425 ①	375
		dimensions ["]					
DN15	1/2"	9,41	1,02	14,8	15,8	16,7 ②	14,8
DN25	1"	9,41	1,42	14,8	17,7	16,7 ②	14,8
DN40	1 1/2"	9,26	1,81	14,8	17,7	16,7 ②	14,8
DN50	2"	8,94	2,44	14,8	17,7	16,7 ②	14,8

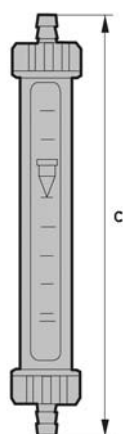
① option 500 mm

② Option 19,7"

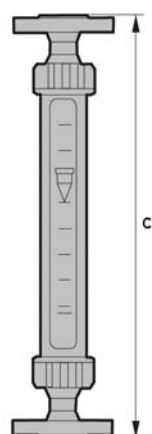
VA40/V



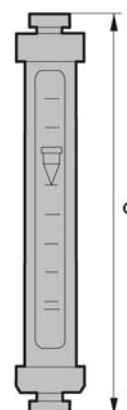
VA40/S



VA40/F



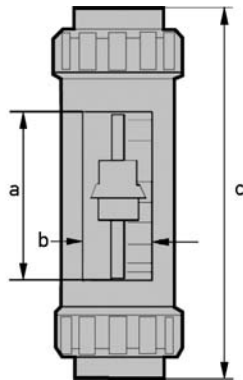
VA40/A



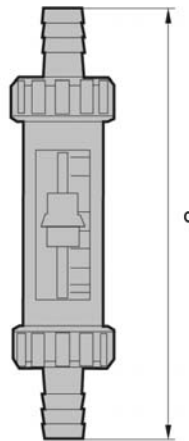
## Dimensions VA45

		a		b		c - Type V		c - Type S		c - Type F	
EN	ASME	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DN15	½"	118	4,65	26	1,02	254	10,0	279	11,0	304	12,0
DN25	1"	118	4,65	36	1,42	254	10,0	329	13,0	304	12,0
DN40	1½"	114	4,49	46	1,81	254	10,0	329	13,0	304	12,0

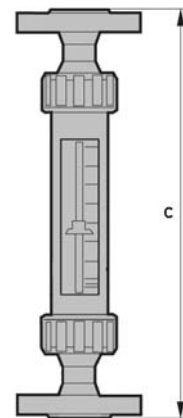
VA45/V



VA45/S



VA45/F



## Weights

	VA40 Type V, S, A		VA40 Type F		VA45 Type V, S		VA45 Type F	
	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
DN15	0,5	1,1	1,8	4,0	0,4	0,88	1,7	3,7
DN25	1,3	2,9	3,8	8,4	1,2	2,6	3,7	8,2
DN40	2,3	5,1	6,8	15,0	2,2	4,9	6,7	14,8
DN50	3,6	7,9	9,2	20,3	-	-	-	-

## Process connection

		Type V		Type S	Type F		Type A	
		Female thread acc. to			Flange acc. to		Pipe	Clamp
EN	ASME	ISO 228	ASME B1.20	Ø [mm]	EN1092-1	ASME B16.5	DIN11851	ISO 2852
DN15	1/2"	G3/8"...G½"	¼" NPT	15	DN15	½"	SC15 ①	17.2 ①
DN25	1"	G¾"...G1"	1" NPT	28	DN25	1"	SC25 ①	25 ①
DN40	1 1/2"	G1½"	1 ½" NPT	42	DN40	1 ½"	SC40 ①	40 ①
DN50 ①	2" ①	G2" ①	2" NPT ①	52 ①	DN50 ①	2" ①	SC50 ①	51 ①

① only VA40

## 2.3 Measuring ranges

### Measuring ranges VA40

Measuring span:	10 : 1		
Declaration of flow:	Values = 100%	Water: 20°C [68°F]	Air: 20°C [68°F], 1.013 bar abs. [14.7 psia]
Float materials:	1 Stainless Steel or Hastelloy® - 2 PTFE with insert - 3 TFM - 4 Aluminium - 5 Polypropylene (PP)		

Materials →		1	2	3	1	3	4	5	1	2	3	4	5
Cone ↓		Water [l/h]			Air [Nm <sup>3</sup> /h]				Max. pressure loss [mbar]				
G 13.11 ①	DN15	0.4	-	-	0.016	-	0.007	-	2	-	-	1	-
G 14.06		0.63	-	-	0.025	-	0.012	-	3	-	-	2	-
G 14.08		1	-	-	0.04	-	0.02	-	4	-	-	3	-
G 15.07		1.6	-	-	0.06	-	0.03	-	4	-	-	3	-
G 15.09		2.5	-	-	0.09	-	0.04	-	5	-	-	4	-
G 15.12		4	-	-	0.14	-	0.06	-	6	-	-	5	-
G 16.08		6.3	-	-	0.2	-	0.1	-	6	-	-	5	-
G 16.12		10	-	-	0.3	-	0.16	-	7	-	-	6	-
G 17.08		16	-	-	0.5	-	0.25	-	7	-	-	6	-
G 17.12		25	-	-	0.8	-	0.4	-	8	-	-	7	-
N 18.07		40	25	13	1.5	0.6	0.8	0.5	9	6	2	3	1
N 18.09		63	40	22	2.2	0.95	1.2	0.7	9	7	3	3	2
N 18.13		100	63	35	3	1.5	1.8	1.2	9	8	3	4	2
N 19.09		160	100	55	5	2.2	2.8	1.8	13	9	4	5	2
N 19.13		250	160	85	8	3.3	4.5	2.8	16	11	4	5	2
N 19.19		400	250	140	-	-	-	-	21	14	5	7	3
N 19.26		630	400	230	-	-	-	-	27	17	6	10	4
N 21.09	DN25	630	400	230	18 ②	9	11	7	22	14	6	8	3
N 21.13		1000	630	350	28 ②	14	18	12	23	17	6	8	4
N 21.18		1600	1000	600	49 ②	-	28 ②	17 ②	26	25	7	10	6
N 21.25		2500	1600	950	70 ②	-	42 ②	26 ②	33	40	8	12	9
N 41.09	DN40	1600	1000	600	45	22	28	18	32	18	9	11	5
N 41.13		2500	1600	900	70 ②	36	45 ②	28 ②	34	20	10	12	5
N 41.19		4000	2500	1500	128 ②	-	76 ②	46 ②	38	24	11	15	8
N 51.10	DN50	4000	2500	1500	120 ②	56	70	45	43	25	12	15	7
N 51.15		6300	4000	2400	190 ②	90	110 ②	70 ②	47	30	13	16	7
N 51.21		10000	6300	3500	310 ②	-	170 ②	118 ②	55	42	14	20	10

① reduced accuracy 2.5%

② only possible with guided float

*The oper. press. should be at least twice the pressure loss for liquids, and at least 5 times the pressure loss for gases! The specified pressure drops are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data (pressure, temperature, density, viscosity) is performed using the calculation method in accordance with VDI/VDE Directive 3513*

## Measuring ranges VA40

Measuring span:	10 : 1		
Declaration of flow:	Values = 100%	Water: 20°C [68°F]	Air: 20°C [68°F], 1.013 bar abs. [14.7 psia]
Float materials:	1 Stainless Steel or Hastelloy® - 2 PTFE with insert - 3 TFM - 4 Aluminium - 5 Polypropylene (PP)		

Materials →		1	2	3	1	3	4	5	1	2	3	4	5
Cone ↓		Water [GPH]			Air [SCFM]				Max. pressure loss [psi]				
G 13.11 ①	DN15	0,11	-	-	0,01	-	0,004	-	0,03	-	-	0,02	-
G 14.06		0,17	-	-	0,015	-	0,007	-	0,04	-	-	0,03	-
G 14.08		0,26	-	-	0,025	-	0,012	-	0,06	-	-	0,04	-
G 15.07		0,42	-	-	0,037	-	0,018	-	0,06	-	-	0,04	-
G 15.09		0,66	-	-	0,056	-	0,025	-	0,07	-	-	0,06	-
G 15.12		1,06	-	-	0,087	-	0,037	-	0,09	-	-	0,07	-
G 16.08		1,66	-	-	0,12	-	0,062	-	0,09	-	-	0,07	-
G 16.12		2,64	-	-	0,19	-	0,09	-	0,1	-	-	0,09	-
G 17.08		4,23	-	-	0,31	-	0,16	-	0,1	-	-	0,09	-
G 17.12		6,60	-	-	0,5	-	0,25	-	0,1	-	-	0,1	-
N 18.07		10,6	6,6	3,43	0,93	0,37	0,5	0,31	0,1	0,1	0,03	0,04	0,02
N 18.09		16,6	10,6	5,81	1,36	0,59	1,2	0,43	0,1	0,1	0,04	0,04	0,03
N 18.13		26,4	16,6	9,25	1,86	0,93	0,74	0,74	0,1	0,1	0,04	0,06	0,03
N 19.09		42,3	26,4	14,5	3,1	1,36	1,7	1,1	0,19	0,13	0,06	0,07	0,03
N 19.13		66,0	42,3	22,5	4,96	2,05	2,8	1,7	0,2	0,16	0,06	0,07	0,03
N 19.19		105	66,0	37	-	-	-	-	0,3	0,2	0,07	-	-
N 19.26		166	106	60,8	-	-	-	-	0,4	0,25	0,09	-	-
N 21.09	DN25	166	106	60,8	11,2 ②	5,58	6,8	4,3	0,3	0,2	0,09	0,1	0,06
N 21.13		264	166	92,5	17,4 ②	8,68	11	7,4	0,3	0,25	0,09	0,1	0,06
N 21.18		423	264	158	30,4 ②	-	17 ②	10,5 ②	0,3	0,3	0,1	0,15	0,9
N 21.25		660	423	251	43,4 ②	-	26 ②	16 ②	0,48	0,58	0,1	0,17	0,13
N 41.09	DN40	423	264	158	27,9 ②	13,6	17	11	0,48	0,26	0,1	0,16	0,07
N 41.13		660	423	238	43,4 ②	22,3	28 ②	17,4 ②	0,49	0,29	0,15	0,17	0,07
N 41.19		1057	660	396	79,4 ②	-	47 ②	28,5 ②	0,55	0,35	0,16	0,22	0,1
N 51.10	DN50	1057	660	396	74,4 ②	34,7	43,4	27,9	0,62	0,36	0,17	0,22	0,1
N 51.15		1664	1057	634	118 ②	55,8	68 ②	43,4 ②	0,68	0,44	0,19	0,23	0,1
N 51.21		2642	1664	925	192 ②	-	105 ②	73 ②	0,8	0,61	0,2	0,29	0,15

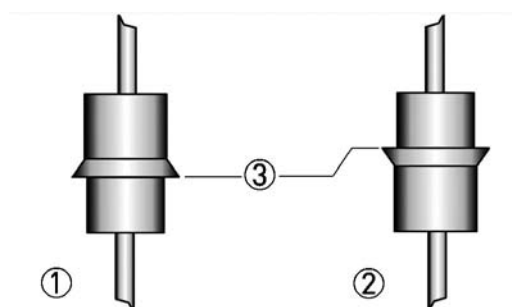
① reduced accuracy 2.5%

② only possible with guided float

*The operating pressure should be at least twice the pressure loss for liquids, and at least 5 times the pressure loss for gases! The specified pressure drops are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data (pressure, temperature, density, viscosity) is performed using the calculation method in accordance with VDI /VDE Directive 3513*

Measuring ranges VA45

Measuring span:	10 : 1	
Declaration of flow::	Values = 100%	Air 20°C [68°F], 1.013 bar abs. [14,7 psia]



- ① float form C
- ② float form D
- ③ reading line

	Cone no.	Float form	Flow air		Max. pressure loss	
			[l/h]	[SCFH]	[mbar]	[psi]
DN15	N -15.01	C	1500...2300	55,8...85,6	3	0,044
		D	2300...4800	85,6...179	3	0,044
	N -15.02	C	5500...9000	205...335	3	0,044
		D	9000...16000	335...595	3	0,044
DN25	N -25.01	C	3000...5000	112...186	3	0,044
		D	5000...7500	186...279	3	0,044
	N -25.02	C	7500...16500	279...614	3	0,044
		D	16500...25000	614...930	4	0,058
DN40	N -40.01	C	17000...26000	632...967	4	0,058
		D	26000...34000	967...1265	4	0,058
	N -40.02	C	34000...60000	1265...2232	4	0,058
		D	60000...75000	2232...2790	4	0,058

*The operating pressure should be at least 5 times the pressure loss for gases! The specified pressure drops are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data (pressure, temperature, density, viscosity) is performed using the calculation method in accordance with VDI /VDE Directive 3513*

**Reference condition for gas measurements:**

The flow measurement of gases are referred to

Nl/h or Nm<sup>3</sup>/h: Volume flow in Normal state 0°C, 1.013 bar abs. (DIN 1343)

SCFM or SCFH: Volume flow in Standard state 15°C, 1.013 bar abs. (ISO 13443)



### 3.1 Intended use

*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.*

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

The variable area flowmeters manufactured by KROHNE Messtechnik GmbH & Co. KG are suitable for measuring gases, vapours and liquids.

**These devices are particularly suitable for measuring:**

- Liquids
- Hydrocarbons
- Water
- Chemicals with low corrosiveness
- Industrial gases

*In case of instruments which are used in explosive endangered areas please consider the supplementary installation and operating instructions mentioned in the Ex-manual.*

*The operator shall bear sole responsibility for the use of the flowmeters with regard to suitability, intended use and corrosion resistance of the materials used to the medium. The manufacturer shall not be liable for any damage resulting from improper use or use for other than the intended purpose. Do not use any abrasive or highly viscous media.*

## 3.2 Installation conditions

*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 VDI/VDE 3513 Sheet 3.*
- *Before connecting, blow or flush out the pipes leading to the device.*
- *Pipes for gas flow need to be dried before the device is installed.*
- *Use connectors suitable for the particular device version.*
- *Align the pipes centrally with the connection bores on the measuring device so they are free of stresses.*
- *If necessary, support the pipeline to reduce vibrations being transmitted to the measuring device.*
- *Do not lay signal cables directly next to cables for the power supply.*

## 4.1 VA40 limit switches

The flowmeter VA40 can be equipped with a maximum of two limit switches:

Type bistable (stable changeover from NC to NO contact and vice versa)

Type monostable (switching pulse at operating point)

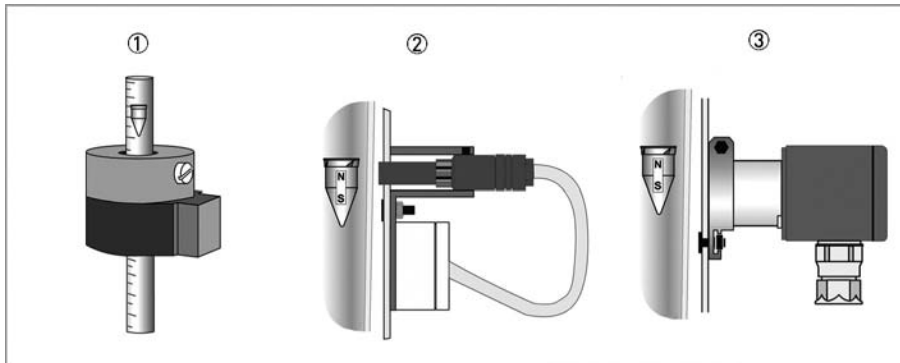


Figure 4-1: Types of limit switches

- ① Ring type limit switch
- ② MS 14/1 - potential-free Reed contact
- ③ TG21 - with integrated slot sensor

Operation and Technical data of the limit switches see Technical data.

4.1.1 Connection ring type limit switch

The connecting cables of the limit switch are guided through the long slot on the back.

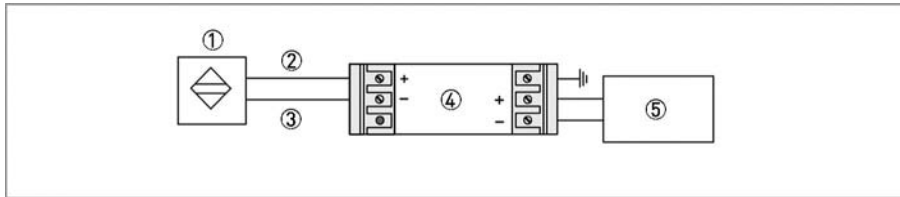


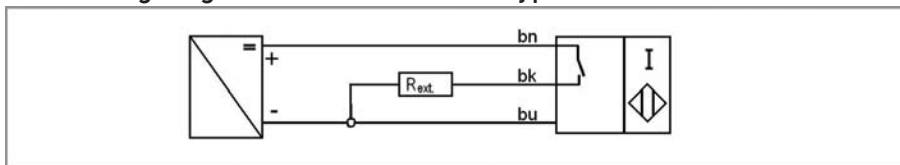
Figure 4-2: Connection of the limit switch type NAMUR

- ① Limit switch 2-wire NAMUR
- ② Colour coding +
- ③ Colour coding blue -
- ④ External EMC filter
- ⑤ Receiver device

EMC filter unit and back rail of the flowmeter must be galvanically connected and grounded.

The monostable types do not need an EMC filter.

Connecting diagram 3-wire transistor type



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

4.1.2 Connection limit switch type MS14

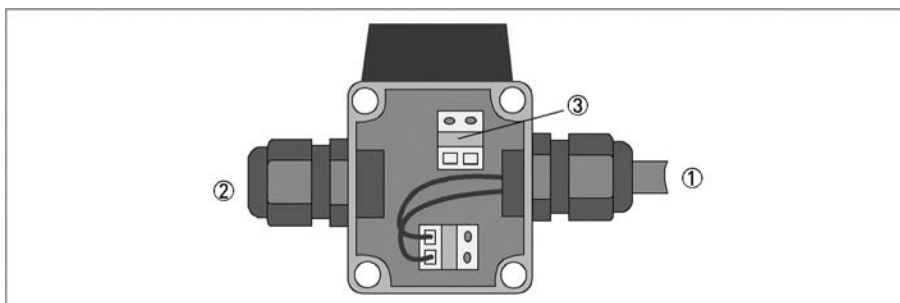


Figure 4-3: Connection limit switch type MS14

- ① Connection Reed-switch
- ② Connection Receiver device
- ③ Terminal connection (potential-free)

### 4.1.3 Connection limit switch type TG21

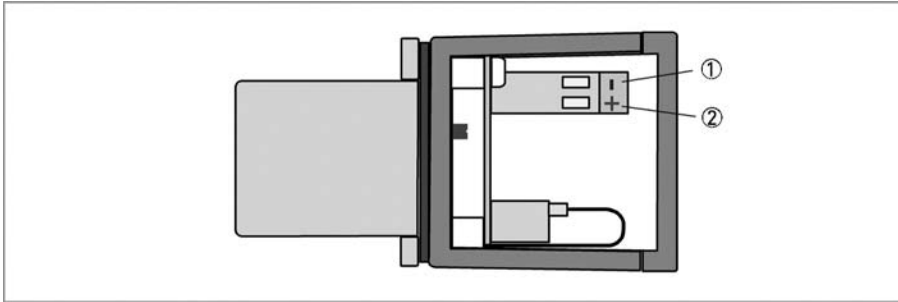


Figure 4-4: Connection limit switch type TG21

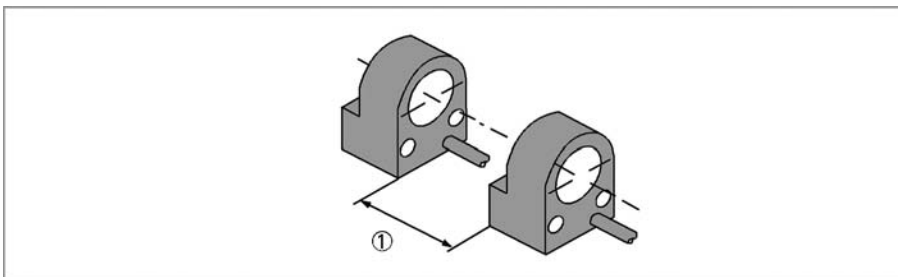
- ① Terminal -
- ② Terminal +

The type TG21 is adapted to switch amplifiers for intrinsical safe circuits in accordance to EN 60947-5-6 NAMUR.

The TG21 includes an inductive slot sensor with bistable switching performance. The slot sensor is actuated by the dipping action of an aluminium vane. The magnet on the dipping vane is moved by the magnet in the float and follows its movement. A magnet float is required.

## 4.2 Minimum clearance between two ring initiators

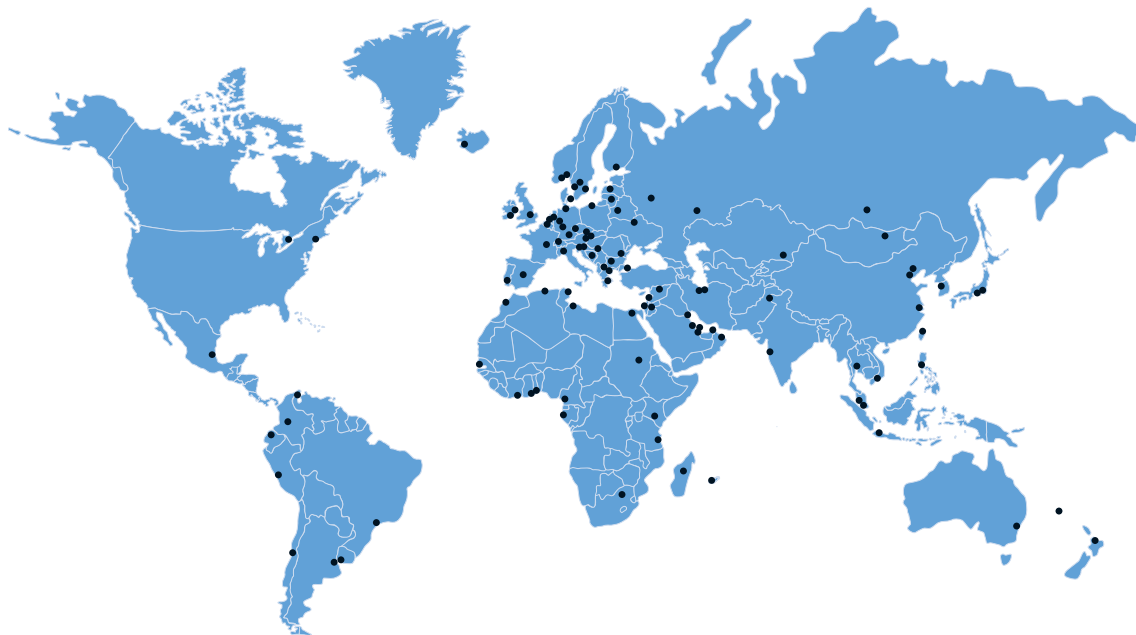
Where two limit switches are in one device, and also where devices with ring limit switch are arranged close together, minimum clearances must be maintained in order to avoid mutual influence of the switches.



Minimum clearance	2-wire NAMUR		3-wire transistor	
①	16 mm	0,63"	45 mm	1,77"







## KROHNE product overview

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

Head Office KROHNE Messtechnik GmbH  
Ludwig-Krohne-Str. 5  
47058 Duisburg (Germany)  
Tel.: +49 (0)203 301 0  
Fax: +49 (0)203 301 10389  
info@krohne.de

The current list of all KROHNE contacts and addresses can be found at:  
[www.krohne.com](http://www.krohne.com)

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