

## Series 1015

### Bypass Level Indicators:

Indicators, By Means of Two Process Connections

### BNA, BMG

Product Types

### 1/2" and up

NPT, ANSI, DIN

### 0-5800 psig

Operating Pressure



## ABOUT SERIES 1015 Bypass Level Indicators

The bypass indicators form an integral part of a tank. A pipe is mounted on the side of the tank by means of two process connections. This ensures that the level in the tank corresponds exactly to the level in the pipe. Red/white magnetic rollers show the level visually. Level sensors mounted on the unit will give a 4-20mA output or 0 to 100% output. Magnetic switches will give a high or low alarm.

### Unique Series Features

- Continuous level measurement
- Punctual level measurement
- Visual level indication
- Interface measurement
- Up to 840°F working temperature
- Lowest specific gravity of 21 lb/in<sup>3</sup>
- Up to 5800 psi working pressure
- Durable building method
- Customized applications

### Material Options:

- Stainless Steel
- PVC
- Titanium
- Alloy C
- Polypropylene
- PVDF
- E-CTFE coated
- PFA coated

### Approvals:

- ✓ ATEX 94/9/EG
- ✓ Germanisch Lloyd
- ✓ Bureau Veritas
- ✓ Registro Navale Italiano
- ✓ Det Norsk Veritas
- ✓ PED 97/23/EG
- ✓ NEPSI

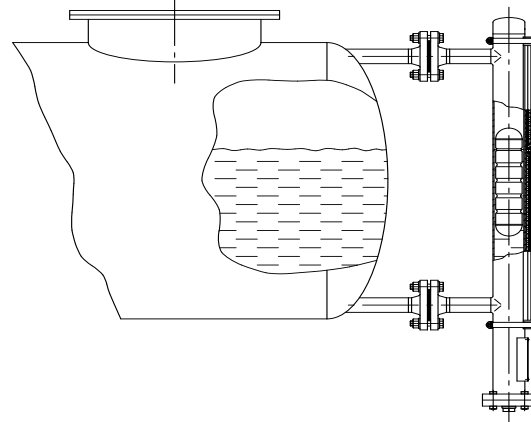
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## Description and function

The bypass level indicator forms an integral part of a pressure vessel. A chamber is mounted on the side of a tank or container by means of two process connections. This direct connection ensures that the level in the chamber corresponds precisely to the level of the liquid in the tank or container (communicating pipes). Inside the bypass chamber is a cylindrical float with a built-in magnetic system. The concentrated magnetic field produced by the permanent magnet gives a precise reading for the level of liquid in the chamber. A signal is transmitted by the magnetic field through the wall of the chamber to an externally mounted indicator, as well as to recording and switchgear elements.



### Magnetic Roller Indicators

are used for displaying the level visually. Small plastic or aluminium rollers with inlaid bar magnets are held in an aluminium or stainless steel profile bar. Depending on the level in the chamber, these rollers turn from white to red as the level rises and from red to white as the level falls. The level inside the vessel can thus be indicated continually without requiring any outside power source.

### Level Sensors

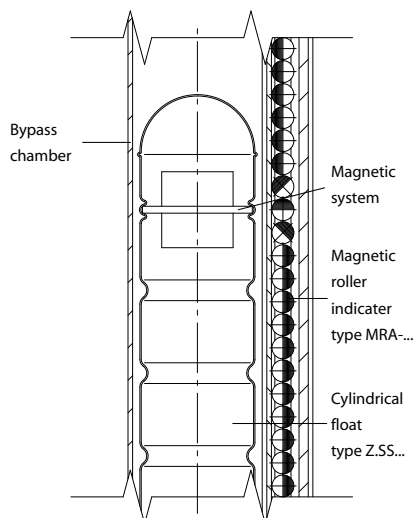
are used for the electrical continuous remote indicator of levels. The magnetic field of the permanent magnet in the cylindrical float acts through the wall to activate very small reed contacts that continually register the measurement voltage on a resistance measurement chain. This measurement voltage is proportional to the level (3-wire potentiometer circuit). The resolution of the reed contacts is produced with spacings of 5, 10 and 15mm. When used in connection with a control unit, the resistance value can be converted into a standardized analog signal.

### Magnetic Switches

are used as limit value switches for various filling levels. The permanent magnet in the cylindrical float activates a potential-free bistable reed contact. Completely contactless, it sends out a binary signal that can be used as a „full/empty“, a „pump on/off“ or a „valve open/close“ signal. However, reed contacts are also ideally suited for forwarding signals directly to SPS control units.

### Technical advantages

- Simple, robust and unbreakable design
- Pressure- and gas-proof separation between the measurement and the indicator chambers
- Detection and indication of the filling levels of aggressive, combustible, poisonous, hot, turbulent and severely contaminated media
- Guaranteed operation of the magnetic roller indicator without requiring an auxiliary power source, even in the case of power system failures
- Usable in all fields of industry thanks to the use of a wide range of corrosion-proof materials
- Designs available for pressure ranges from a vacuum up to 400 bar
- Designs available for temperature ranges from -160°C to +400°C
- Designs available for density as of 350 kg/m<sup>3</sup>



### Certificates / Approvals

#### Certificates



#### **SCHWEIZERISCHER VEREIN FÜR QUALITÄTS- UND MANagementsYSTEME**

Certified according to ISO 9000 rev. 2000



#### **SWISS TECHNICAL SERVICES AG**

Approval as production factory, welding examination and procedure qualification incl. restamping certificate for the production of pressure tanks according to SVTI-regulation 501, 201

#### Approvals

The company Heinrich Kübler AG can manufacture bypass-level indicators to most national and industrial approvals. Therefore a wide range of instruments with approvals requirements can be produced according to customer's requests.



#### **TECHNISCHER ÜBERWACHUNGSVEREIN DEUTSCHLAND (PED)**

Approval as production factory for manufacture of pressure tanks according to AD HP 0, PED Pressure Equipment Directive 97/23/EG



#### **SOCIETE NATIONALE DE CERTIFICATION ET D'HOMOLOGATION (ATEX)**

Approval for the production of bypass-level indicators according to EU-Directive 94/9/EG



#### **GERMANISCHER LLOYD (Building of ships)**

Approval for the production of bypass-level indicators according to GL-regulations



#### **BUREAU VERITAS (Building of ships)**

Approval for the production of bypass-level indicators according to BV-regulations



#### **REGISTRO ITALIANO NAVALE (Building of ships)**

Approval for the production of bypass-level indicators according to RINA-regulations



#### **DET NORSKE VERITAS (Building of ships)**

Approval for the production of bypass-level indicators according to DNV-regulations

## Approvals

As an innovative manufacturer of instruments for level control, we can offer to our customers systems according to different directives. The types of approval, applications and limits of use can be taken from the following specifications.

### Approvals

#### Ex

A large number of bypass-level indicators from our standard range, or to customer requests, can be built according to the ATEX-Directive 94/9/EG with the protection types EEx ia IIC T1 to T6, according to the corresponding electrical components in EEx d T4 to T6 or dust Ex/D. By the combination of the instruments with the type key the catalogue shows with the Ex hexagonal logo which components can be used for Ex-instruments.

#### Medium temperature:

##### EEx ia-instruments

T1	300 °C
T3	180 °C
T4	130 °C
T5	95 °C
T6	80 °C

##### EEx d-instruments

T4	120 °C
T5	95 °C
T6	80 °C

#### PED

Under the Pressure Equipment Directive 97/23/EG, any pressure vessel or instrument used within a pressurised system at 0,5 bar or above, has to conform to various categories. Depending on the design data or customer needs, manufacture of instruments is to either of the categories below.

##### Category II

Module	A1
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##### Category IV

Module	B+D
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#### GL / BV / RINA / DNV

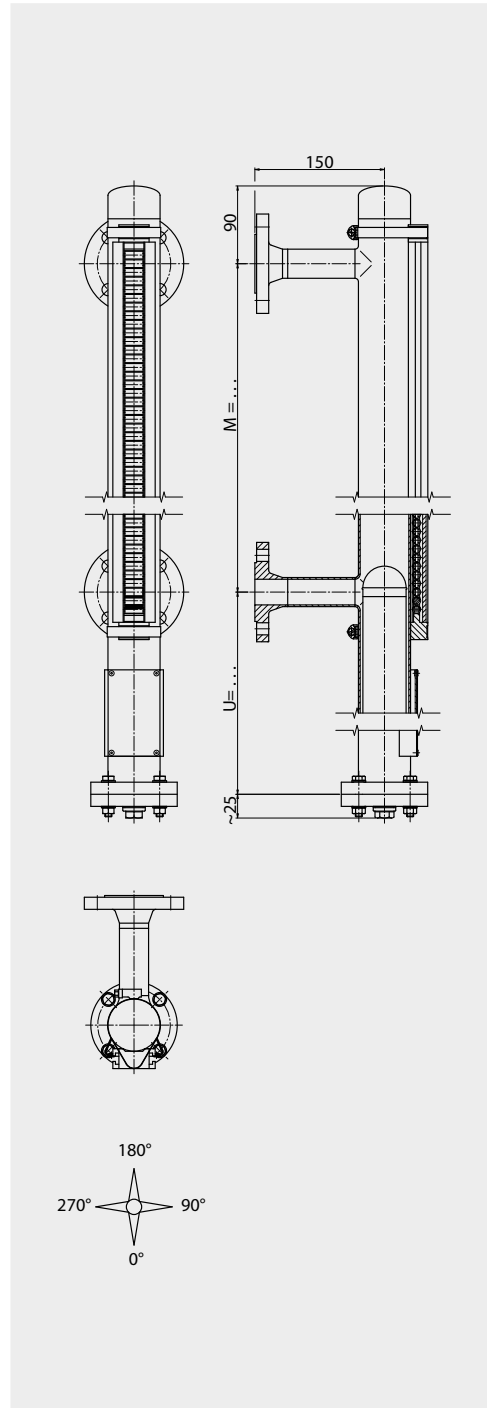
Bypass-level indicators for use in shipping can be manufactured to GL (Germanischer Lloyd), BV (Bureau Veritas), RINA (Registro Italiano Navale) or DNV (Det Norske Veritas) standards in large variety of design possibilities complete with controllers.

## Stainless steel PN16 and PN40

Technical data	
<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	∅ 60.3 mm x 2 mm ∅ 63.5 mm x 2 mm
<b>Chamber end top:</b>	- Welding cap (standard) - Flat top with venting - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends
<b>Distance centre to centre:</b>	M = 150 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MKAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to table (standard) page 203 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

Operating parameters	
<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure:</b>	-1 ... 16 bar -1 ... 40 bar
<b>Specific gravity:</b>	≥ 460 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - V .. - .. - Z.S ..  
BMG - .. / .. - .. - .. - .. K .. - M .. - V .. - .. - Z.S ..



Type combination see type key Bypass - Level Indicators

### Cylindrical float PN16 and PN40

#### Technical data

Material:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

#### Stainless steel PN16

Stainless steel  
-40 °C ... +250 °C  
max. 20 bar  
max. 33 bar  
50 mm  
ZVSS ...

#### Titanium PN16

Titanium  
-10 °C ... +150 °C  
max. 16 bar  
max. 29 bar  
50.8 mm  
ZTSS ...

450	400	350	300	250	200	150	150	200	250	300	350	400	450
851	753	654	556	458	360	262	262	360	458	556	654	753	851
485	455	415	368	352	300	256	222	247	271	294	317	341	366

Float height above liquid in mm	Stainless steel 1.4571 (with ribs)							Diagram	Titanium (with ribs)							Float height above liquid in mm	
	450	400	350	300	250	200	150		150	200	250	300	350	400	450		
0	--	--	--	--	--	--	--		--	--	--	--	--	--	0		
10	--	--	--	--	--	--	--		--	--	--	--	--	--	10		
20	--	--	--	--	--	--	--		--	--	--	--	--	--	20		
30	600	640	680	720	800	950	1170		980	760	640	560	510	460	440	30	
40	610	660	700	740	840	940	1010	1280		1080	810	670	580	530	480	450	40
50	630	680	720	780	880	1080	1420		1200	860	700	600	540	490	460	50	
60	650	700	750	810	930	1160	1600		1340	930	740	630	560	510	470	60	
70	660	720	780	850	980	1260	1820		1530	1000	790	660	580	520	480	70	
80	680	740	810	890	1050	1370	2110		1790	1090	830	690	610	540	500	80	
90	700	770	840	930	1110	1500	2520		--	1200	890	720	630	560	510	90	
100	720	790	870	960	1190	1670	--		--	1330	950	760	660	580	530	100	
110	740	820	910	1030	1280	1870	--		--	1500	1030	800	690	600	550	110	
120	770	850	950	1090	1390	2130	--		--	1710	1110	850	720	620	560	120	
130	790	890	1000	1160	1510	2480	--		--	1980	1210	900	750	650	580	130	
140	820	920	1050	1240	1660	2960	--		--	2370	1330	960	790	670	600	140	
150	850	960	1100	1320	1840	--	--		--	2930	1470	1030	830	700	620	150	

#### Technical data

Material:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

#### Stainless steel PN40

Stainless steel  
-70 °C ... +250 °C  
max. 40 bar  
max. 66 bar  
50 mm  
ZVS ...

#### Titanium PN40

Titanium  
-10 °C ... +200 °C  
max. 40 bar  
max. 97 bar  
50.8 mm  
ZTS ...

450	400	350	300	250	200	150	200	250	300	350	400	450	500
851	753	654	556	458	360	262	360	458	556	654	753	851	978
491	419	402	361	314	272	218	262	306	346	399	429	473	517

Float height above liquid in mm	Stainless steel 1.4571						Diagram	Titanium						Float height above liquid in mm		
	450	400	350	300	250	200		150	200	250	300	350	400		450	500
0	--	--	--	--	--	--		--	--	--	--	--	--	0		
10	--	--	--	--	--	--		--	--	--	--	--	--	10		
20	--	--	--	--	--	--		--	--	--	--	--	--	20		
30	610	630	660	700	760	860		960	800	710	650	610	590	570	550	30
40	630	650	690	730	800	910		1060	850	750	670	630	600	580	560	40
50	650	670	720	760	850	980		1160	900	790	700	650	620	590	570	50
60	660	690	730	790	890	1050		1320	980	830	740	680	640	610	590	60
70	670	710	750	830	930	1140		1500	1060	880	770	710	660	630	610	70
80	690	730	780	870	990	1240		1750	1160	930	810	730	680	650	620	80
90	710	760	810	910	1050	1360		2090	1270	1000	850	760	700	660	630	90
100	730	780	850	960	1130	1510		2590	1410	1070	890	790	730	680	650	100
110	750	810	880	1010	1220	1700		--	1580	1150	940	830	750	700	670	110
120	780	840	920	1070	1310	1930		--	1810	1240	1000	870	780	730	690	120
130	800	870	970	1140	1430	2250		--	2100	1350	1060	910	810	750	710	130
140	830	910	1020	1212	1570	2680		--	2510	1490	1130	950	840	770	730	140
150	860	940	1070	1300	1750	3325		--	3110	1650	1210	1000	880	800	750	150

### Stainless steel PN64 and PN100

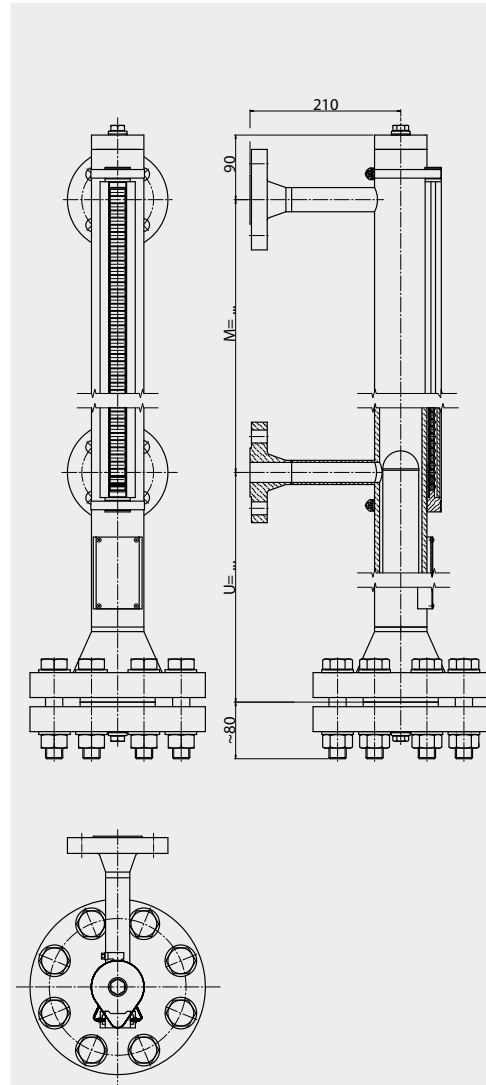
#### Technical data

<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	ø 60.3x2.6mm (PN64) ø 73.03x5.16mm (PN100)
<b>Chamber end top:</b>	- Flat top with venting - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- ..SK / ..SG / ..VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30 mm

#### Operating parameters

<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure:</b>	-1 ... 64 bar -1 ... 100 bar
<b>Specific gravity:</b>	Acc. to calculation
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - V .. - .. - Z.S ..  
BMG - .. / .. - .. - .. - .. K .. - M .. - V .. - .. - Z.S ..



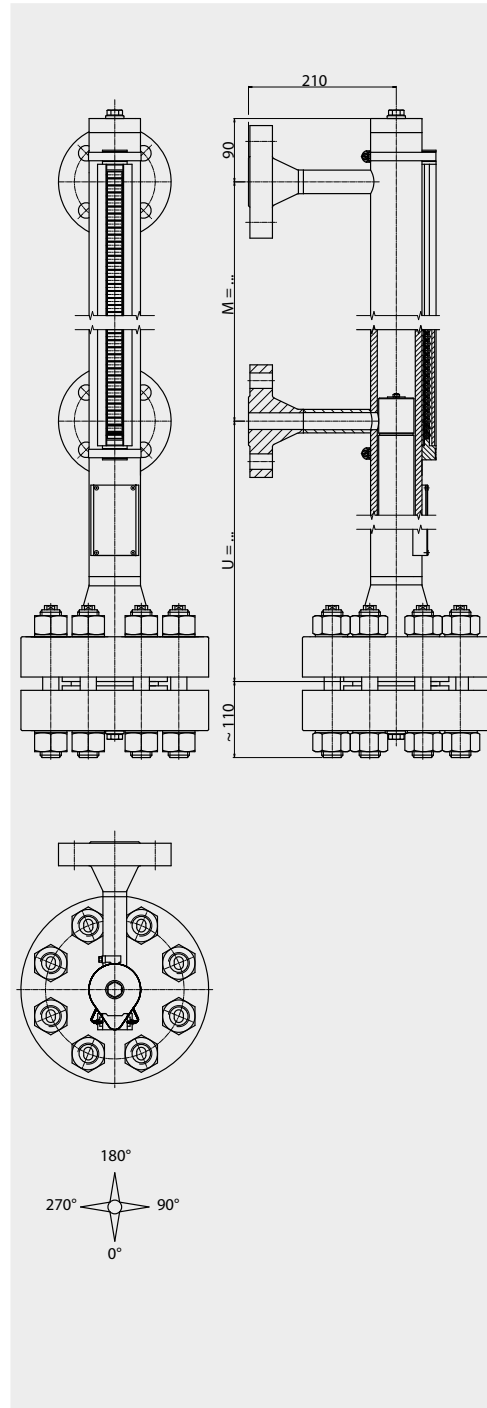
Type combination see type key Bypass - Level Indicators



## Stainless steel PN160, PN250, PN320 and PN400

Technical data	
<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	ø 73.03 x 7.01 (PN160-250) ø 73.03 x 9.53 (PN250-400)
<b>Chamber end top:</b>	- Flat top with venting - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 200 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- .. / SK / .. / SG / .. / VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 2006-207
<b>Float:</b>	- Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

BNA - .. / .. - M .. - V .. - .. - Z.S ..  
BMG - .. / .. - .. - .. - .. K .. - M .. - V .. - .. - Z.S ..



Operating parameters	
<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure:</b>	-1 ... 160 - 400 bar
<b>Specific gravity:</b>	Acc. to calculation
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

Type combination see type key Bypass - Level Indicators

### Cylindrical float PN160 and PN300

Technical data	
<b>Material:</b>	Titanium
<b>Operating temperature:</b>	-50 °C ... +300 °C
<b>Operating pressure:</b>	max. 175 bar
<b>Test pressure:</b>	max. 250 bar
<b>Diameter:</b>	52 mm
<b>Float type:</b>	ZTS - Tiba - 1 - ...
<b>Float data:</b>	
<b>Length L</b>	146 194 234 291 340 388 437 485 534 582 631 679
<b>Weight [g]</b>	225 250 275 300 325 350 375 400 425 450 475 500
<b>Amount of balls</b>	3 4 5 6 7 8 9 10 11 12 13 14

#### Titanium

Titanium  
-50 °C ... +300 °C  
max. 175 bar  
max. 250 bar  
52 mm  
ZTS - Tiba - 1 - ...

146	194	234	291	340	388	437	485	534	582	631	679
225	250	275	300	325	350	375	400	425	450	475	500
3	4	5	6	7	8	9	10	11	12	13	14

emerged height in mm	ZTS-Tiba-								emerged height in mm				
	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10		1-11	1-12	1-13	1-14
0	density of the medium ( kg/m³ )								density of the medium ( kg/m³ )				0
25	1340	1060	910	810	750	700	660	630	600	580	565	550	25
35	1470	1130	955	840	775	720	675	640	610	590	575	560	35
50	1670	1240	1020	890	810	750	700	660	630	610	590	570	50
60	2000	1365	1090	935	840	775	720	680	645	620	600	580	60
70	2340	1490	1160	980	870	800	740	700	660	635	610	590	70
80	2670	1615	1230	1025	900	825	760	720	675	645	620	600	80
90	3000	1740	1295	1070	935	850	760	735	690	660	630	610	90
100	3340	1860	1360	1120	970	870	800	750	700	670	640	620	100
110	--	--	--	--	--	--	--	750	715	680	650	630	110
120	--	--	--	--	--	--	--	765	730	690	660	640	120
130	--	--	--	--	--	--	--	780	745	700	670	650	130

Technical data	
<b>Material:</b>	Titanium
<b>Operating temperature:</b>	-50 °C ... +300 °C
<b>Operating pressure:</b>	max. 300 bar
<b>Test pressure:</b>	max. 420 bar
<b>Diameter:</b>	52 mm
<b>Float type:</b>	ZTS - Tiba - 2 - ...
<b>Float data:</b>	
<b>Length L</b>	146 194 243 291 340 388 437 485 534 582 631 679
<b>Weight [g]</b>	247 279 311 344 376 408 441 473 505 538 570 603
<b>Amount of balls</b>	3 4 5 6 7 8 9 10 11 12 13 14

#### Titanium PN300

Titanium  
-50 °C ... +300 °C  
max. 300 bar  
max. 420 bar  
52 mm  
ZTS - Tiba - 2 - ...

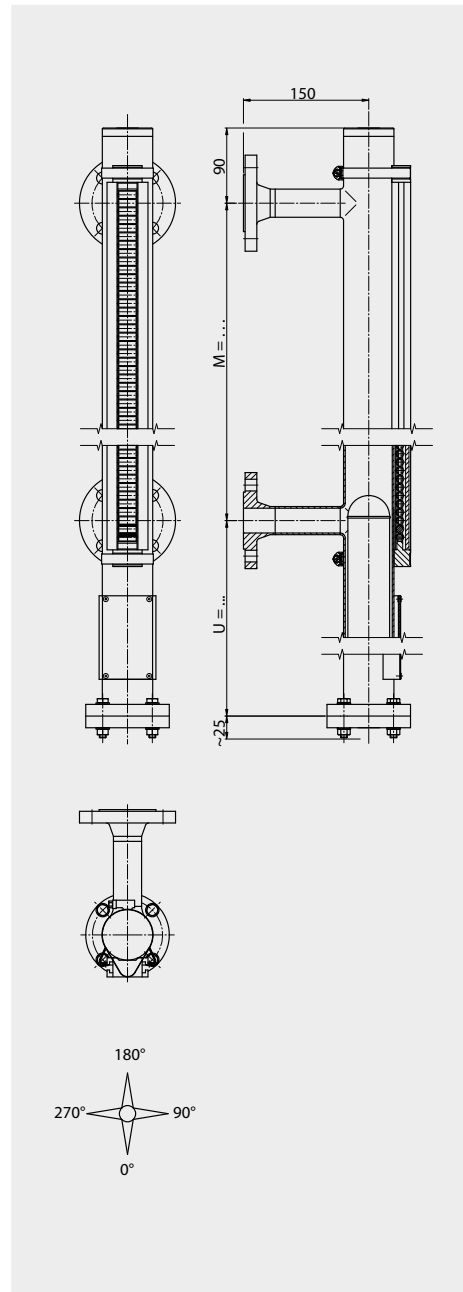
146	194	243	291	340	388	437	485	534	582	631	679
247	279	311	344	376	408	441	473	505	538	570	603
3	4	5	6	7	8	9	10	11	12	13	14

emerged height in mm	ZTS-Tiba-								emerged height in mm				
	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10		2-11	2-12	2-13	2-14
0	density of th mediums ( kg/m³ )								density of the mediums ( kg/m³ )				0
25	1470	1190	1030	930	860	810	770	740	720	700	680	670	25
35	1620	1265	1080	950	890	835	790	755	730	710	690	680	35
50	1840	1380	1160	1020	930	870	820	780	750	730	710	690	50
60	2200	1520	1235	1070	970	900	845	800	770	745	720	700	60
70	2570	1660	1310	1120	1010	930	870	820	790	760	730	710	70
80	2935	1800	1385	1170	1050	960	895	840	810	775	740	725	80
90	3300	1940	1460	1230	1090	990	920	860	825	790	750	735	90
100	3670	2080	1540	1280	1120	1010	940	880	840	800	760	750	100
110	--	--	--	--	--	--	--	900	855	810	770	760	110
120	--	--	--	--	--	--	--	920	870	820	780	770	120
130	--	--	--	--	--	--	--	940	885	830	790	780	130

### Titanium PN16 and PN40

Technical data	
Material:	Ni-Mo Material Alloy B, C
Chamber:	ø 60.33 x 2.77 mm
Chamber end top:	- Flat top - Options see page 238
Chamber end bottom:	- Flange connection - Options see page 238
Process connections:	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
Distance centre to centre:	M = 150 mm ... 25000 mm
Magnetic roller indicator:	- MRA / MRK - MNA / MNAV / MNKV - MNAN / MNKV / MNAP
Scale:	-. / SK.. / SG / .. / VSG
Magnetic switch:	- See pages 230-234
Level sensor:	- See pages 235-236
Insulation thickness:	- 30 mm - 60 mm
Approvals:	- Options see pages 206-207
Float:	- Acc. to protocol - Acc. to protocol
Interface:	U = float length L-30 mm

BNA-.. / ..-M .. -H...-ZH.S ..  
BMG-.. / .. - .. - .. - .. K .. - M .. - H .. - .. ZH.S ..



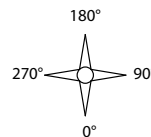
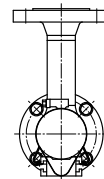
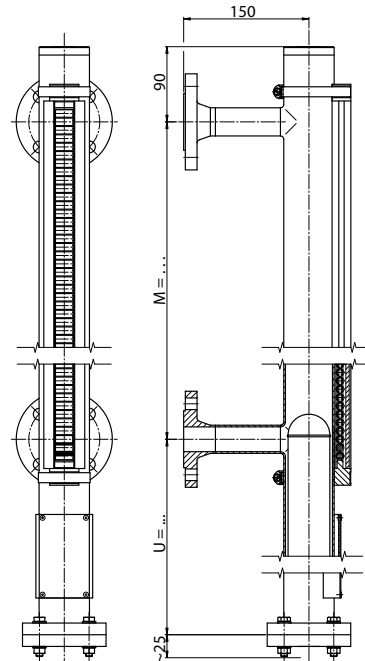
Operating parameters	
Temperature:	-196 °C .. 400 °C
Pressure:	-1 .. 40 bar
Specific gravity:	≥ 480 kg/m³
Accuracy:	5 mm
Repeatability:	+/- 2 mm

Type combination see type key Bypass - Level Indicators

### Alloy PN16 and PN40

Technical data	
Material:	Ni-Mo Material Alloy B, C
Chamber:	ø 60.33 x 2.77 mm
Chamber end top:	- Flat top - Options see page 238
Chamber end bottom:	- Flange connection - Options see page 238
Process connections:	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
Distance centre to centre:	M = 150 mm ... 25000 mm
Magnetic roller indicator:	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
Scale:	- ..SK / ..SG / ..VSG
Magnetic switch:	- See pages 230-234
Level sensor:	- See pages 235-236
Insulation thickness:	- 30 mm - 60 mm
Approvals:	- See pages 206-207
Float:	- Acc. to protocol
Interface:	- Acc. to protocol
Lower chamber extension:	U = float length L-30mm

BNA - .. / .. - M .. - H .. - .. - ZH.S ..  
BMG - .. / .. - .. - .. - .. K .. - M .. - H .. - .. - ZH.S ..



Operating parameters	
Operating temp. standard:	- 40 °C ... +250 °C
Operating temp. on request:	-160 °C ... +400 °C
Pressure:	-1 ... 16 bar -1 ... 40 bar
Specific gravity:	Acc. to calculation
Accuracy:	5 mm
Repeatability:	+/- 2 mm

Type combination see type key Bypass - Level Indicators

### Stainless steel E-CTFE coated to PN16

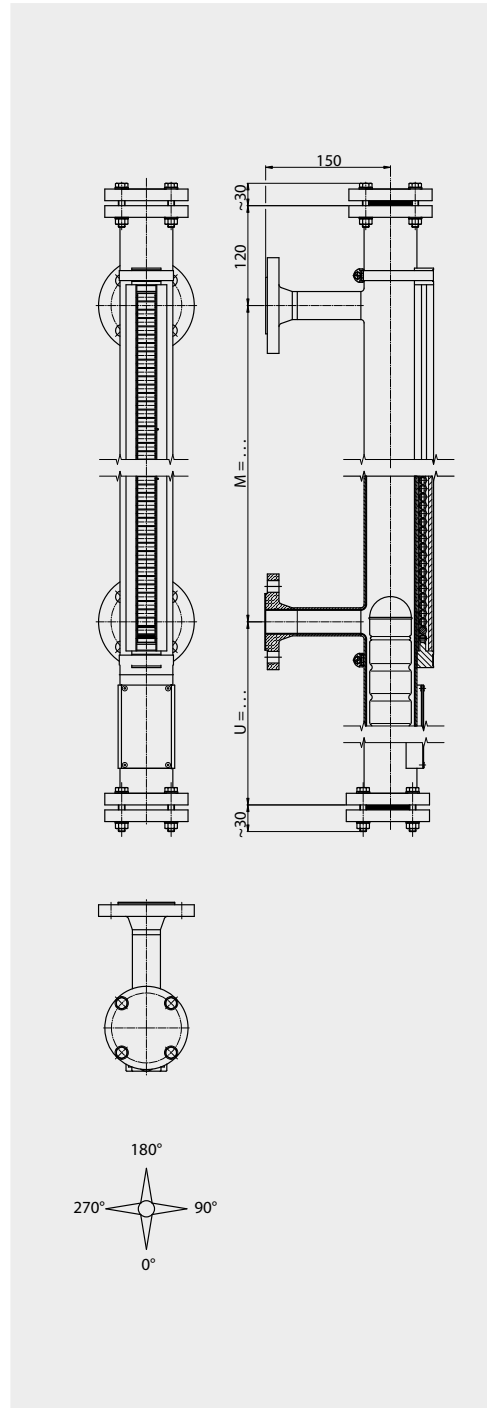
#### Technical data

<b>Material:</b>	1.4404 / 316 L E-CTFE coated 1.4435 / 316 L E-CTFE coated 1.4571 / 316 TI E-CTFE coated
<b>Chamber:</b>	ø 63.5 x 2 mm
<b>Chamber end top:</b>	- Flange connection - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 200-201
<b>Float:</b>	- Acc. to table (standard) page 216 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

#### Operating parameters

<b>Medium temperature:</b>	-40 °C ... +150 °C
<b>Pressure:</b>	-1 ... 16 bar
<b>Specific gravity:</b>	≥ 540 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - EEC .. - .. - Z.EECS ..  
BMG - .. / .. - .. - .. - .. K .. - M .. - EEC .. - .. - Z.EECS ..



Type combination see type key Bypass - Level Indicators

### Cylindrical float E-CTFE coated

#### Technical data

Material:  
Coating:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

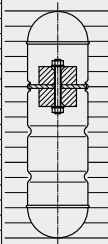
#### Stainless steel

Stainless steel  
E-CTFE  
depending on medium  
max. 20 bar  
max. 33 bar  
ca. 53 mm  
ZVEECSS ...

#### Titanium

Titanium  
E-CTFE  
depending on medium  
max. 16 bar  
max. 28 bar  
ca. 54 mm  
ZTEECSS ...

<b>450</b>	<b>400</b>	<b>350</b>	<b>300</b>	<b>250</b>	<b>200</b>	<b>150</b>	<b>150</b>	<b>200</b>	<b>250</b>	<b>300</b>	<b>350</b>	<b>400</b>	<b>450</b>
885	782	680	578	476	374	272	272	374	476	578	680	782	885
551	514	467	413	369	330	279	242	270	302	332	364	401	434

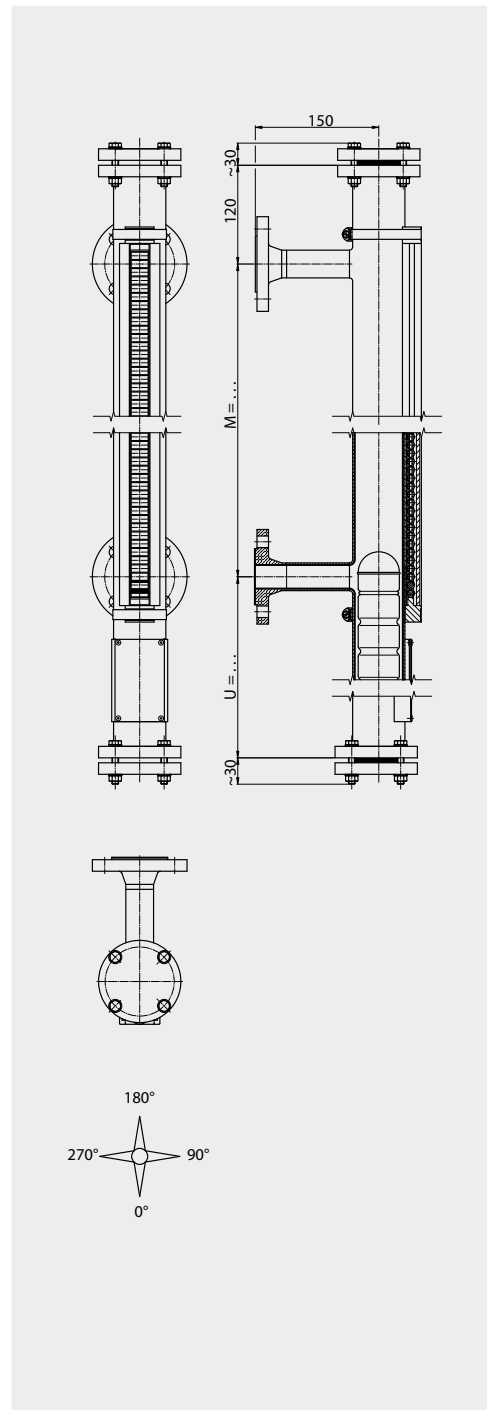
Float height above liquid in mm	Stainless steel 1.4571 (with ribs)								Titanium (with ribs)							Float height above liquid in mm
	450	400	350	300	250	200	150		150	200	250	300	350	400	450	
	Specific gravity of the liquid (kg/m <sup>3</sup> )								Specific gravity of the liquid (kg/m <sup>3</sup> )							
0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	
10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	
20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	
30	660	700	730	770	850	1000	1220	990	820	700	620	570	540	520	30	
40	670	720	760	800	900	1070	1350	1100	870	730	650	590	560	530	40	
50	<b>690</b>	<b>740</b>	<b>780</b>	<b>840</b>	<b>940</b>	<b>1140</b>	<b>1490</b>	<b>1200</b>	<b>930</b>	<b>770</b>	<b>670</b>	<b>610</b>	<b>570</b>	<b>540</b>	50	
60	710	760	810	870	1000	1230	1680	1370	1010	810	700	630	590	560	60	
70	730	780	840	910	1050	1330	1910	1550	1090	860	730	660	610	570	70	
80	750	810	870	960	1120	1450	2220	1790	1190	920	770	680	630	590	80	
90	770	830	910	1000	1190	1590	2650	--	1300	980	810	710	650	600	90	
100	<b>790</b>	<b>860</b>	<b>950</b>	<b>1060</b>	<b>1280</b>	<b>1770</b>	--	--	<b>1440</b>	<b>1040</b>	<b>850</b>	<b>740</b>	<b>670</b>	<b>620</b>	100	
110	810	890	990	1110	1370	1980	--	--	1620	1120	900	770	700	640	110	
120	840	930	1030	1180	1490	2260	--	--	1850	1220	950	800	720	660	120	
130	870	960	1080	1250	1620	2630	--	--	2150	1330	1010	840	750	680	130	
140	890	1000	1130	1330	1780	--	--	--	2570	1460	1070	880	780	700	140	
150	<b>930</b>	<b>1040</b>	<b>1190</b>	<b>1430</b>	<b>1970</b>	--	--	--	--	--	<b>1620</b>	<b>1150</b>	<b>930</b>	<b>810</b>	<b>730</b>	150

### Stainless steel PFA coated to PN16

#### Technical data

<b>Material:</b>	1.4404 / 316 L PFA coated 1.4435 / 316 L PFA coated 1.4571 / 316 Ti PFA coated
<b>Chamber:</b>	ø 63.5 x 2 mm (with glass float ø 46) ø 73.03 x 5.16 mm
<b>Chamber end top:</b>	- Flange connection - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNKV - MNAN / MNKV / MNAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

BNA - .. / .. - M .. - PFA .. - .. - Z.PFAS ..  
BMG - .. / .. - .. - .. - K .. - M .. - PFA .. - .. - Z.PFAS ..



#### Operating parameters

<b>Medium temperature:</b>	-40 °C ... +200 °C
<b>Pressure:</b>	-1 ... 16 bar
<b>Specific gravity:</b>	Acc. to calculation
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

Type combination see type key Bypass - Level Indicators

### Heating jacket design PN16 to PN40

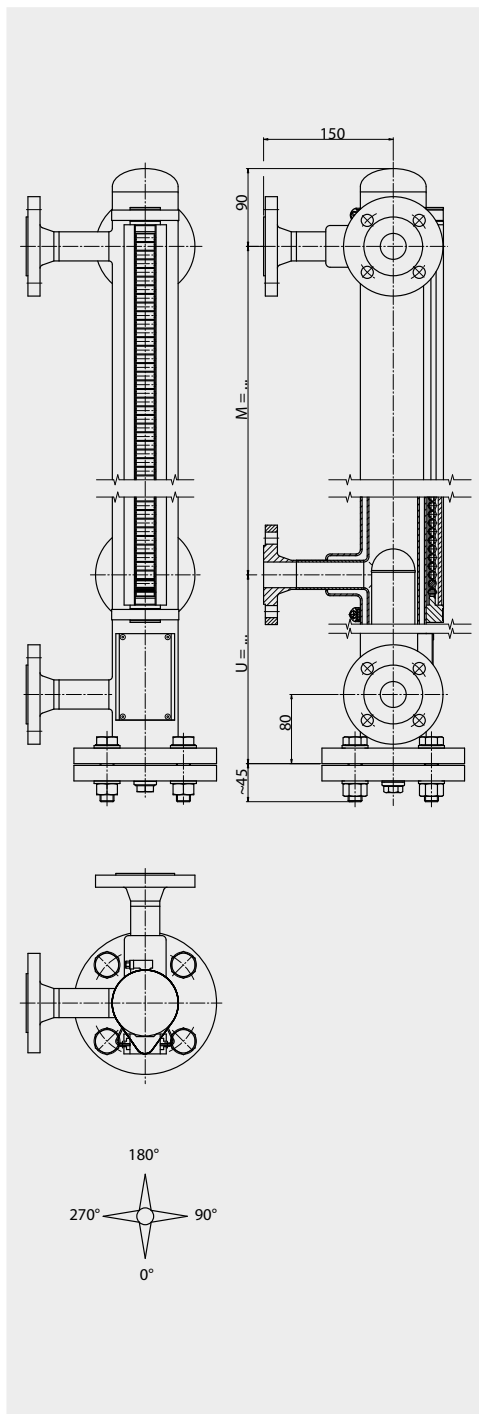
#### Technical data

<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	ø 60.3x2mm standard ø 76.1x2mm heating jacket
<b>Chamber end top:</b>	- Welding cap (standard) - Flat top - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 5500 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNAP
<b>Scale:</b>	- ..SK / ..SG / ..VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to table (standard) page 220 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

#### Operating parameters

<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure process connection:</b>	- 1 ... 25 bar
<b>Pressure heating jacket connec.:</b>	+1 ... 16 bar
<b>Specific gravity:</b>	≥580 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - V60/76 .. - .. - Z . S ..  
BMG - .. / .. - .. - .. - ..K.. - M .. - V60/76 .. - .. - Z . S ..



Type combination see type key Bypass - Level Indicators



### Liquid gas design PN16 to PN40

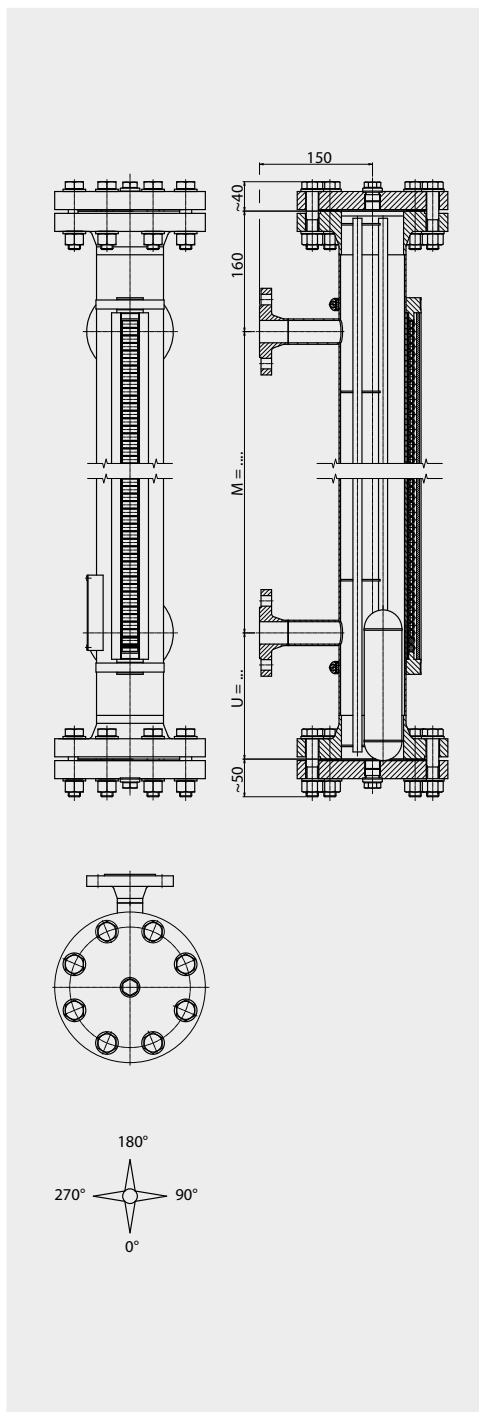
#### Technical data

<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	ø 88.9 x 2 mm ø 88.9 x 2.6 mm
<b>Float guidance device:</b>	Longitudinal tubes (3)
<b>Chamber end top:</b>	- Flange connection - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 5500 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to table (standard) page 220 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

#### Operating parameters

<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure:</b>	-1 ... 25 bar
<b>Specific gravity:</b>	≥ 580 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - V88- .. - Z . S ..  
BMG - .. / .. - .. - .. - ..K .. - M .. - V88- .. - Z . S ..



Type combination see type key Bypass - Level Indicators

### Cylindrical float for heating jacket and liquid gas design

#### Technical data

Material:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

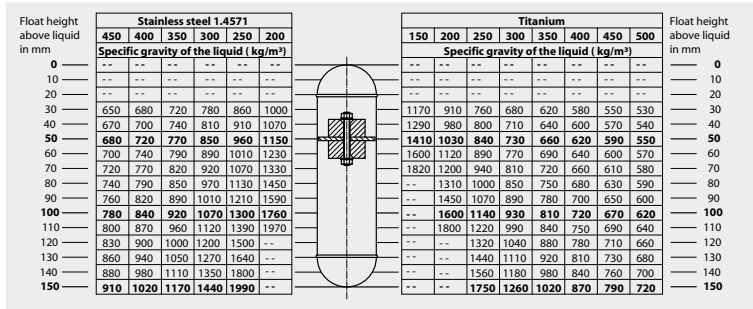
#### Stainless steel PN16

Stainless steel  
-70 °C ... +250 °C  
max. 16 bar  
max. 26 bar  
50 mm  
ZVS ... /16/250/K74

#### Titanium PN16

Titanium  
-10 °C ... +200 °C  
max. 16 bar  
max. 39 bar  
50.8 mm  
ZTS ... /16/200/K74

450	400	350	300	250	200	150	200	250	300	350	400	450	500
851	753	654	556	458	360	270	371	472	574	675	776	878	979
523	481	439	402	360	318	264	298	327	362	396	430	464	494



#### Technical data

Material:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

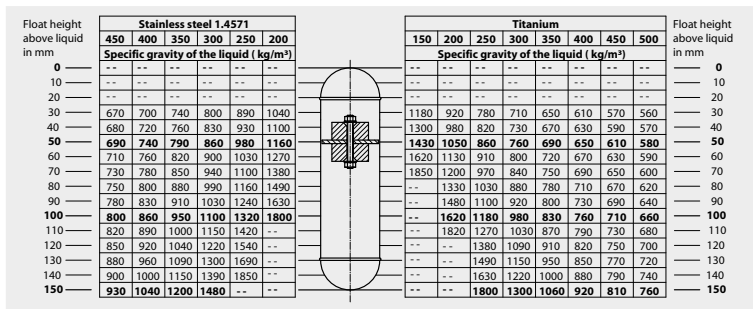
#### Stainless steel PN25

Stainless steel  
-70 °C ... +250 °C  
max. 25 bar  
max. 41 bar  
50 mm  
ZVS ... /25/250/K74

#### Titanium PN25

Titanium  
-10 °C ... +200 °C  
max. 25 bar  
max. 60 bar  
50.8 mm  
ZTS ... /25/200/K74

450	400	350	300	250	200	150	200	250	300	350	400	450	500
851	753	654	556	458	360	270	371	472	574	675	776	878	979
537	495	453	411	369	327	268	303	337	376	410	449	483	522

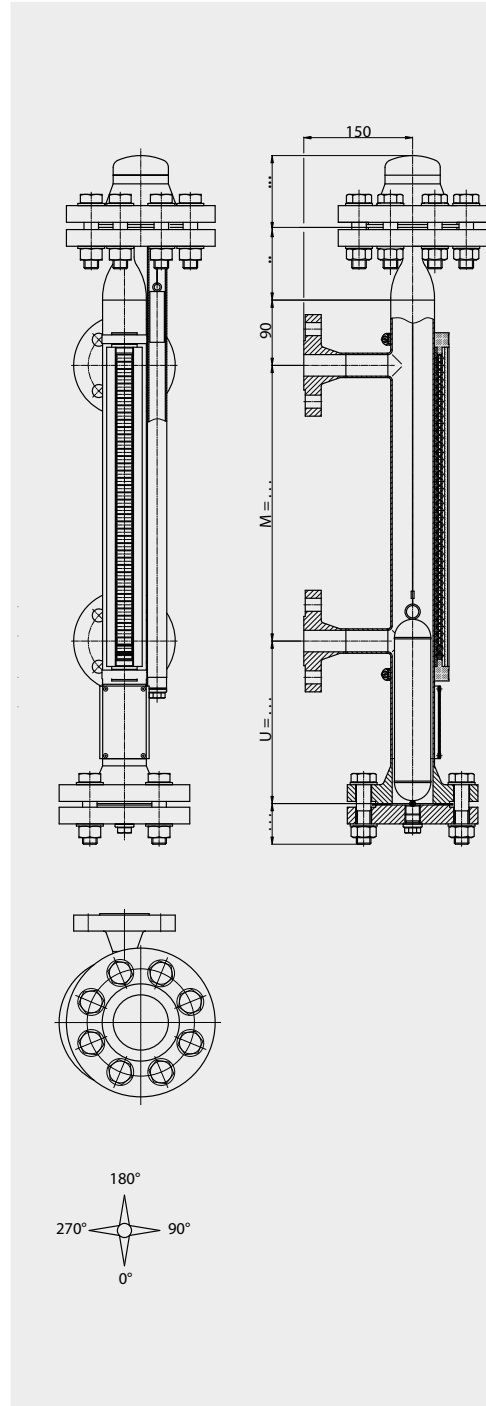


## Differential compensated $\geq 350\text{kg/m}^3$ PN16 to PN250

### Technical data

<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	$\varnothing$ 60.3 mm PN16/40/64 $\varnothing$ 73.0 mm PN 250/160
<b>Chamber end top:</b>	- Welding cap / Flat top - Options see page 238
<b>Chamber end bottom:</b>	- Flange connection with drain plug - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 150 mm ... 25000 mm
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- ..JSK / ..JSG / ..JVG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

BNA - .. / .. - M .. - V .. - .. - Z . S .. - DIF  
BMG - .. / .. - .. - .. - ..K .. - M .. - V .. - .. - Z . S .. - DIF



### Operating parameters

<b>Medium temperature:</b>	-40 °C ... +150 °C
<b>Pressure:</b>	-1 ... 250 bar
<b>Specific gravity:</b>	$\geq 350 \text{ kg/m}^3$
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

Type combination see type key Bypass - Level Indicators

## Stainless steel without lateral connections PN16 and PN40

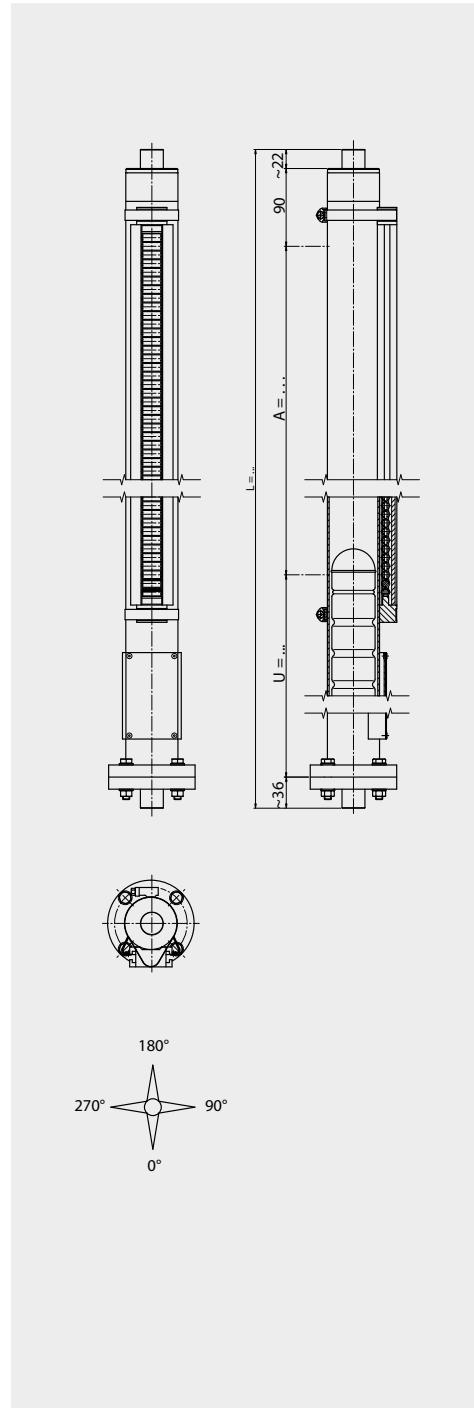
### Technical data

<b>Material:</b>	1.4404 / 316 L 1.4435 / 316 L 1.4571 / 316 Ti
<b>Chamber:</b>	ø 60 x 2 mm
<b>Chamber end top:</b>	- Flat top with welded socket and dampening spring
<b>Chamber end bottom:</b>	- Flat top with welded socket and dampening spring
<b>Process connections:</b>	- Without lateral connections
<b>Length of instrument:</b>	L = 300 mm ... 25000 mm
<b>Indicating range:</b>	A = L - ~ 148 -U
<b>Magnetic roller indicator:</b>	- MRA / MRK - MNA / MNAV / MNK - MNAN / MNKV / MNAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	- 30 mm - 60 mm
<b>Approvals:</b>	- See pages 206-207
<b>Float:</b>	- Acc. to table 16 bar page 209 - Acc. to table 40 bar page 209
<b>Lower chamber extension:</b>	U = float length L-30mm

### Operating parameters

<b>Operating temp. standard:</b>	- 40 °C ... +250 °C
<b>Operating temp. on request:</b>	-160 °C ... +400 °C
<b>Pressure:</b>	-1 ... 40 bar
<b>Specific gravity:</b>	≥ 460 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - OS - M .. - V .. - .. - Z . S ..  
BMG - OS .. - .. - .. - ..K .. - M .. - V .. - .. - Z . S ..



Type combination see type key Bypass - Level Indicators

### PVC / Polyvinylchloride

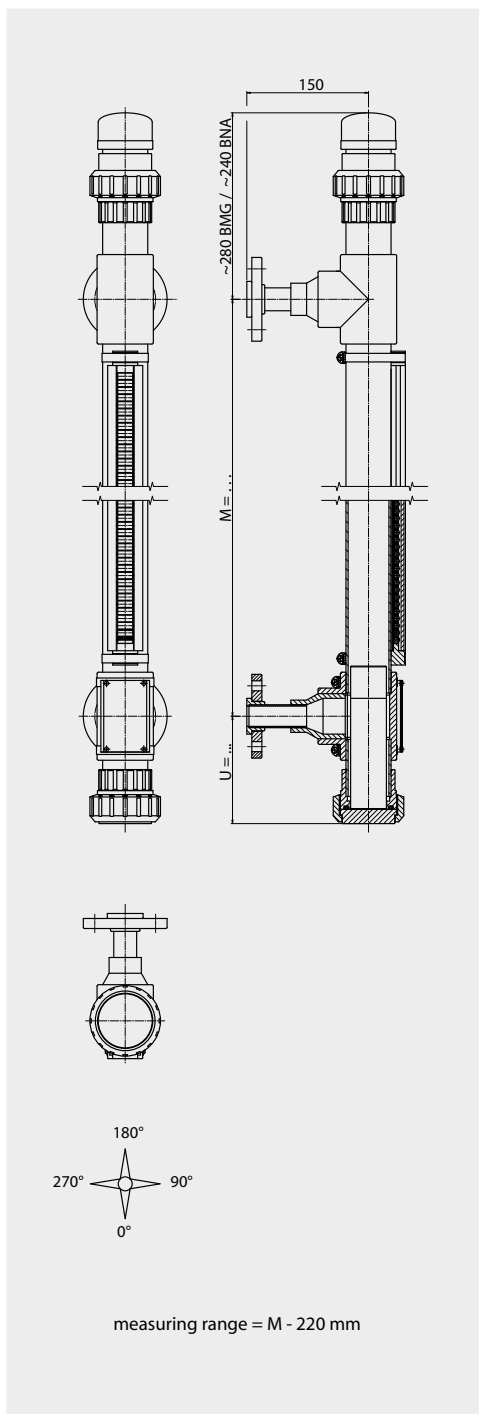
#### Technical data

<b>Material:</b>	PVC / Polyvinylchloride
<b>Chamber:</b>	ø 63.5 x 3 mm
<b>Chamber end top:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Chamber end bottom:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Tube ends - ...
<b>Distance centre to centre:</b>	M = 300 mm ... 4000 mm
<b>Magnetic roller indicator:</b>	- MRA - MNA / MNAV - MNAN / MNAP
<b>Scale:</b>	- ..SK / ..SG / ..VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	-
<b>Approvals:</b>	-
<b>Float:</b>	- Acc. to table (standard) page 226 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

#### Operating parameters

<b>Temperature:</b>	-10 °C ... +60 °C
<b>Pressure:</b>	-1 ... 4 bar
<b>Specific gravity:</b>	≥ 740 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - P63- .. - ZPS ..  
BMG - .. / .. - .. - .. - ..K .. - M .. - P63- .. - ZPS ..



Type combination see type key Bypass - Level Indicators

### PP / Polypropylene

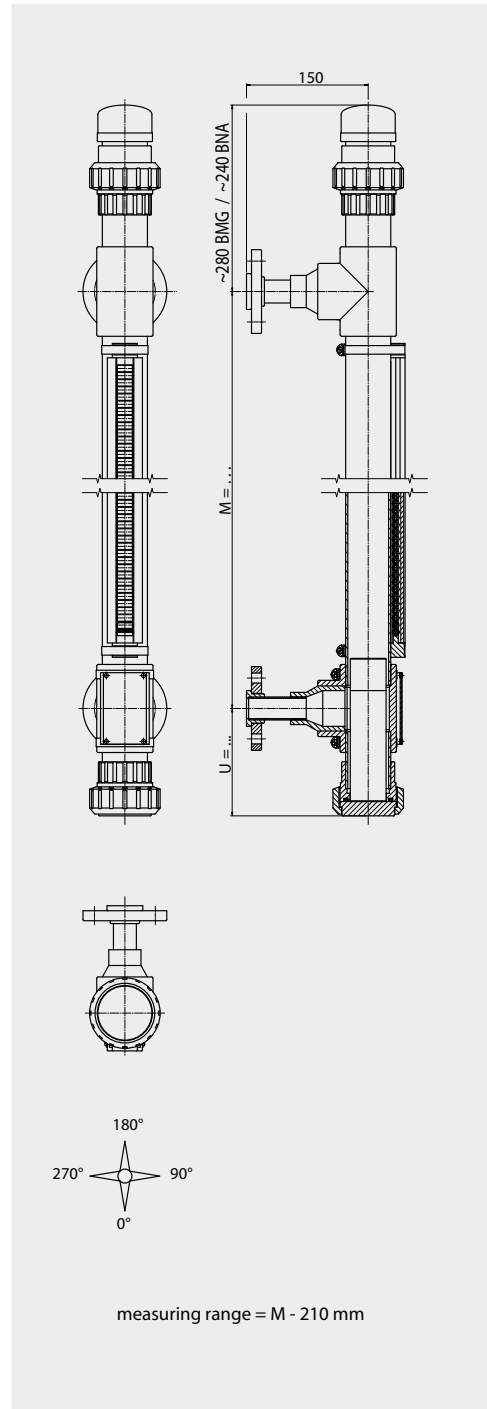
#### Technical data

<b>Material:</b>	PP / Polypropylene
<b>Chamber:</b>	ø 63.5 x 3.6 mm
<b>Chamber end top:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Chamber end bottom:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Welding ends - ...
<b>Distance centre to centre:</b>	M = 300 mm ... 4000 mm
<b>Magnetic roller indicator:</b>	- MRA - MNA / MNAV - MNAN / MNAP
<b>Scale:</b>	- .. /SK /.. /SG / .. /VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	-
<b>Approvals:</b>	-
<b>Float:</b>	- Acc. to table (standard) page 226 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

#### Operating parameters

<b>Temperature:</b>	-5 °C ... + 80 °C
<b>Pressure:</b>	-1 ... 4 bar
<b>Specific gravity:</b>	≥ 640 kg/m <sup>3</sup>
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - PP63- .. - ZPPS ..  
BMG - .. / .. - .. - .. - ..K .. - M .. - PP63- .. - ZPPS ..

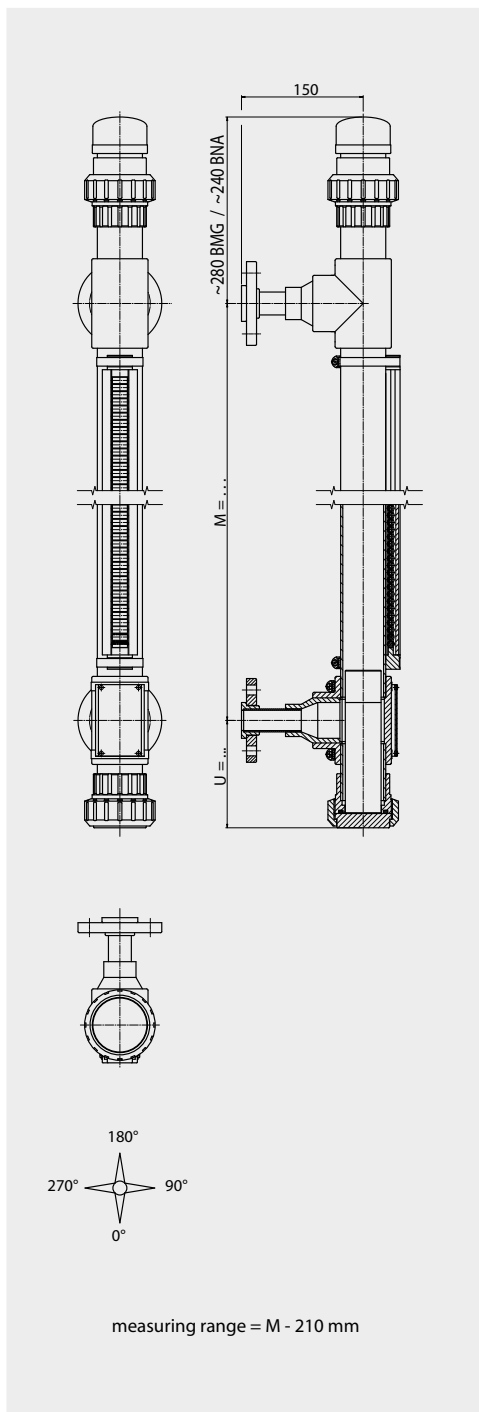


## PVDF / Polyvinylidenfluoride

### Technical data

<b>Material:</b>	PVDF Polyvinylidenfluoride
<b>Chamber:</b>	ø 63.5 x 3 mm
<b>Chamber end top:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Chamber end bottom:</b>	- Welding cap - Screwed connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Welding ends - ...
<b>Distance centre to centre:</b>	M = 300 mm ... 4000 mm
<b>Magnetic roller indicator:</b>	- MRA - MNA / MNAV - MNAN / MNAP
<b>Scale:</b>	- ../SK / ../SG / ../VSG
<b>Magnetic switch:</b>	- See pages 230-234
<b>Level sensor:</b>	- See pages 235-236
<b>Insulation thickness:</b>	-
<b>Approvals:</b>	-
<b>Float:</b>	- Acc. to table (standard) page 226 - Acc. to protocol
<b>Interface:</b>	- Acc. to protocol
<b>Lower chamber extension:</b>	U = float length L-30mm

BNA - .. / .. - M .. - PF63- .. - ZPFS ..  
BMG - .. / .. - .. - .. - ..K .. - M .. - PF63- .. - ZPFS ..



### Operating parameters

<b>Temperature:</b>	-5 °C ... +100 °C
<b>Pressure:</b>	-1 ... 4 bar
<b>Specific gravity:</b>	≥ 750 kg/m³
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

Type combination see type key Bypass - Level Indicators

### Cylindrical float in PVDF, PP or PVC

#### Technical data

Material:  
Operating temperature:  
Operating pressure:  
Test pressure:  
Diameter:  
Type of float:

Float data:  
Length L [mm]  
Volume [cm<sup>3</sup>]  
Weight [g]

#### PVDF

PVDF  
-5 °C ... +100 °C  
max. 6 bar  
max. 9 bar  
50 mm  
ZPFS ...

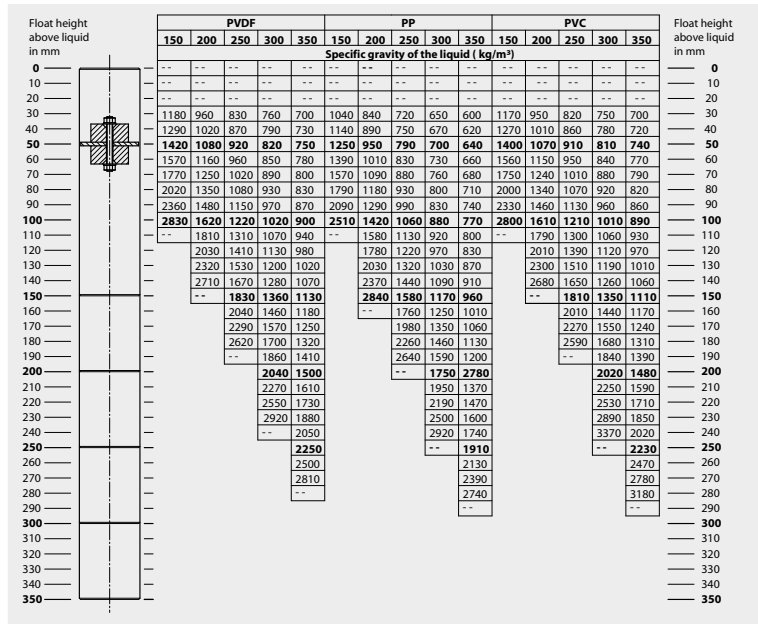
#### PP

PP  
-5 °C ... +80 °C  
max. 6 bar  
max. 9 bar  
50 mm  
ZPPS ...

#### PVC

PVC  
-10 °C ... +60 °C  
max. 6 bar  
max. 9 bar  
50 mm  
ZPS ...

PVDF					PP					PVC				
150	200	250	300	350	150	200	250	300	350	150	200	250	300	350
295	393	491	589	687	295	393	491	589	687	295	393	491	589	687
278	319	360	401	442	246	279	311	344	376	275	316	356	397	437

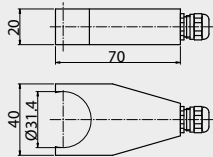




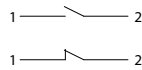
## PVC / Polyvinylchloride transparent

### Technical data

<b>Material:</b>	PVC / Polyvinylchloride transparent
<b>Chamber:</b>	∅ 32.0 x 1.8 mm
<b>Chamber end top:</b>	- Screwed connection - Options see page 238
<b>Chamber end bottom:</b>	- Screwed connection - Options see page 238
<b>Process connections:</b>	- Flange acc. to DIN - Flange acc. to Ansi - Thread female - Thread male - Tube ends - ...
<b>Distance centre to centre:</b>	M = 200 mm ... 4000 mm
<b>Approvals:</b>	-
<b>Float:</b>	- SP 24/80 red - SP 24/120 red
<b>Magnetic switch:</b>	

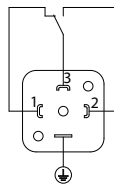


- FKSM-B32-S- ..PVC
- FKSM-B32-O- ..PVC
- FKSM-B32-U- ..PVC

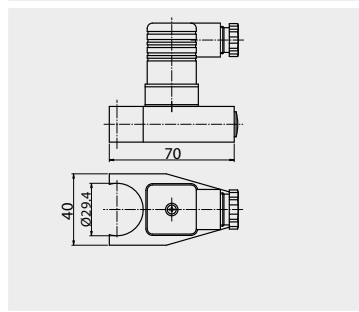


- Change over  
150 V, 0.5 A, 10 VA
- Norm.open / Norm.closed  
230 V, 1 A, 100 VA

- FKSM-B32-U-plug



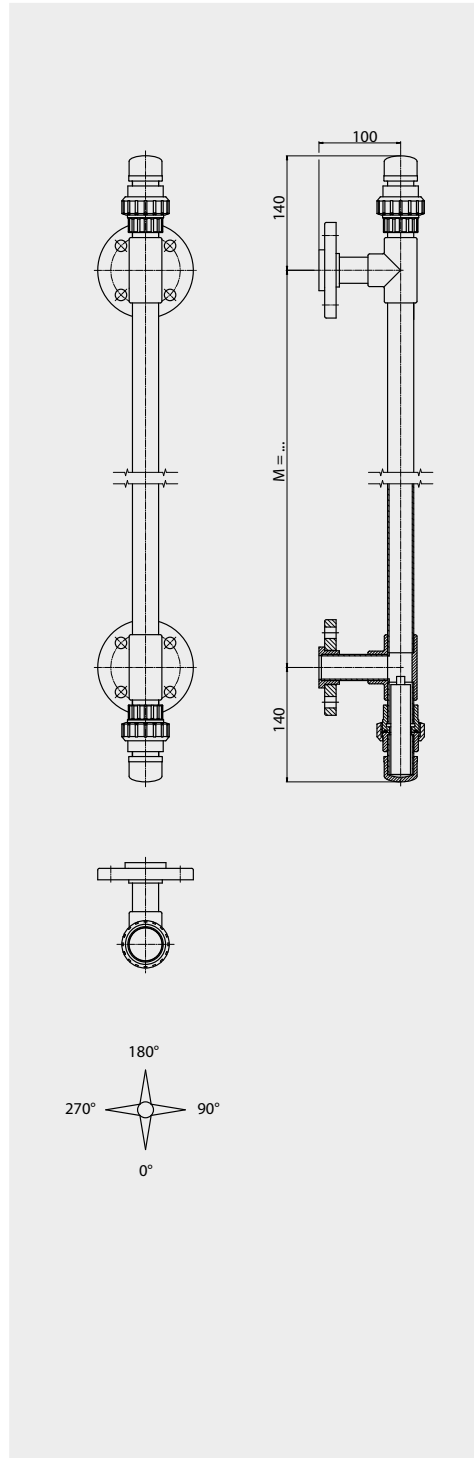
- Change over  
150 V, 1 A, 100 VA



### Operating parameters

<b>Temperature:</b>	-10 °C ... +60 °C
<b>Pressure:</b>	-1 ... 1 bar
<b>Specific gravity:</b>	≥ 900 kg/m <sup>3</sup> SP24/80 ≥ 600 kg/m <sup>3</sup> SP24/120
<b>Accuracy:</b>	5 mm
<b>Repeatability:</b>	+/- 2 mm

BNA - .. / .. - M .. - P32- .. - ZPS ..



Type combination see type key Bypass - Level Indicators

### Magnetic roller indicator

#### Magnetic roller indicator

MRA - M ..  
MRK - M ..

Housing:  
- aluminium anodized

Indicator rolls MRA:  
- material: pocan  
- colours: white / red

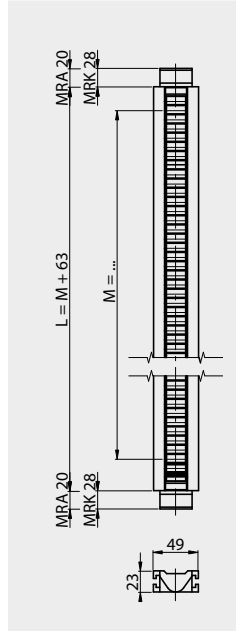
Indicator rolls MRK:  
- material: ceramics  
- colours: white / red

Cover:  
- macrolon (MRA)  
- glass (MRK)

Ambient temperature:  
- MRA -40 °C ... +200 °C  
- MRK 0 °C ... +400 °C

Protection rating:  
- IP 64 (optional IP 67)

Approval:  
- See pages 206-207



#### Magnetic roller indicator

MNA - M ..  
MNK - M ..

Housing:  
- aluminium anodized

Indicator rolls MNA :  
- material: pocan  
- colours: white / red

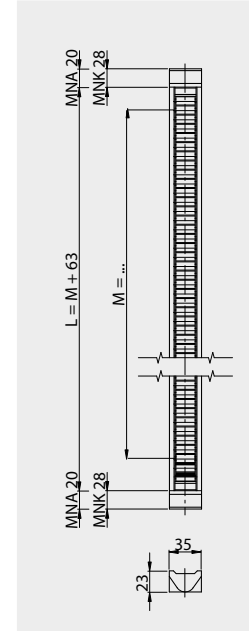
Indicator rolls MNK:  
- material: ceramics  
- colours: white / red

Cover:  
- macrolon (MNA)  
- glass (MNK)

Ambient temperature:  
- MNA -40 °C ... +200 °C  
- MNK 0 °C ... +400 °C

Protection rating:  
- IP 64 (optional IP 67)

Approval:  
- See pages 206-207



#### Magnetic roller indicator

MNAV - M ..  
MNKV - M ..

Housing:  
- aluminium with stainless steel covered

Indicator rolls MNAV:  
- material: pocan  
- colours: white / red

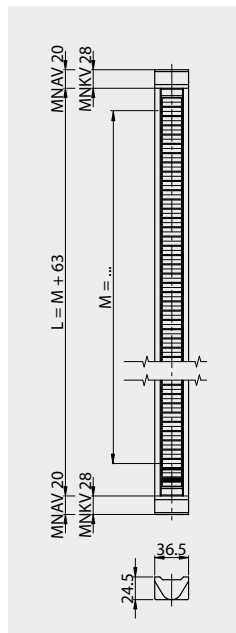
Indicator rolls MNKV:  
- material: ceramics  
- colours: white / red

Cover:  
- macrolon (MNAV)  
- glass (MNKV)

Ambient temperature:  
- MNAV -40 °C ... +200 °C  
- MNKV 0 °C ... +400 °C

Protection rating:  
- IP 64 (optional IP 67)

Approval:  
- See pages 206-207



#### Magnetic roller indicator

MNAN - M ..

Housing:  
- aluminium anodized

Indicator rolls MNAN:  
- material: pocan  
- colours: white / red

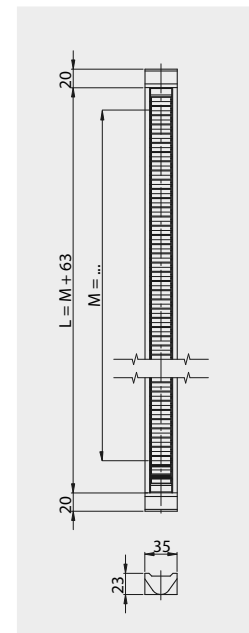
Shock proof design:  
- rollers turning max. 180°

Cover:  
- macrolon  
- glass

Ambient temperature:  
- MNAN -40 °C ... +200 °C

Protection rating:  
- IP 64 (optional IP 67)

Approval:  
- See pages 206-207



Type combination see type key Bypass-Level Indicators

### Scale

**Scale  
.. / SK**

Angle profile:  
- aluminium

Width:  
- 40 mm

Scale:  
- adhesive foil

Separation:  
- in cm

Ambient temperature:  
-40 °C ... +200 °C

**Scale  
.. / SG**

Angle profile:  
- aluminium

Width:  
- 40 mm

Scale:  
- engraved

Separation:  
- acc. to specification

Ambient temperature:  
-40 °C ... +200 °C

Approval:  
- pages 206-207

**Scale  
.. / VSG**

Angle profile:  
- stainless steel

Width:  
- 40 mm

Scale:  
- engraved

Separation:  
- acc. to specification

Ambient temperature:  
-40 °C ... +400 °C

Approval:  
- pages 206-207

**Indicator isolation with acrylic glass extender  
.. / P**

Material:  
- acrylic glass

Width:  
- 35 mm

Height:  
- 60 mm

Mounting:  
- onto magnetic roller indicator

Ambient temperature:  
-20 °C ... +100 °C

Type combination see type key Bypass-Level Indicators

### Magnetic switch

#### Technical data

**Housing:**

- aluminium anodized

**Contact function:**

- change over

**Switching action:**

- bistable

**Switching capacity:**

- 230 V AC / 60 VA / 1.0 A

- 230 V DC / 30 VA / 0.5 A

**Protection rating:**

- IP65

**Ambient temperature:**

- with PVC-cable max. +80 °C

- with Silicone-cable max. +180 °C

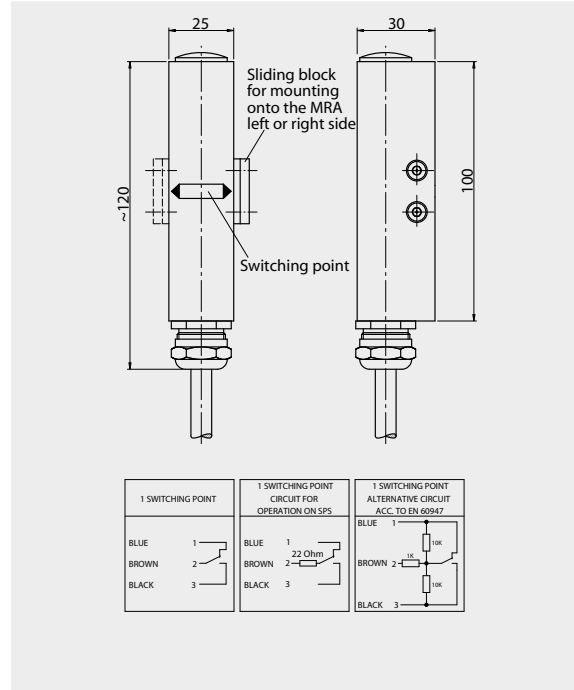
**Options:**

- with code addition .. / R

with 22 Ohm protection resistor

- with code addition .. / N acc. to Namur EN 60947

#### BGU - .. PVC / BGU - .. SIL



#### Technical data

**Housing:**

- aluminium anodized

**Contact function:**

- change over

**Switching action:**

- bistable

**Switching capacity:**

- 230 V AC/60 VA/1.0 A

- 230 V DC/30 VA/0.5 A

**Protection rating:**

- IP65

**Ambient temperature:**

- max. +130 °C

**Installation:**

right or left of the magnet roll display

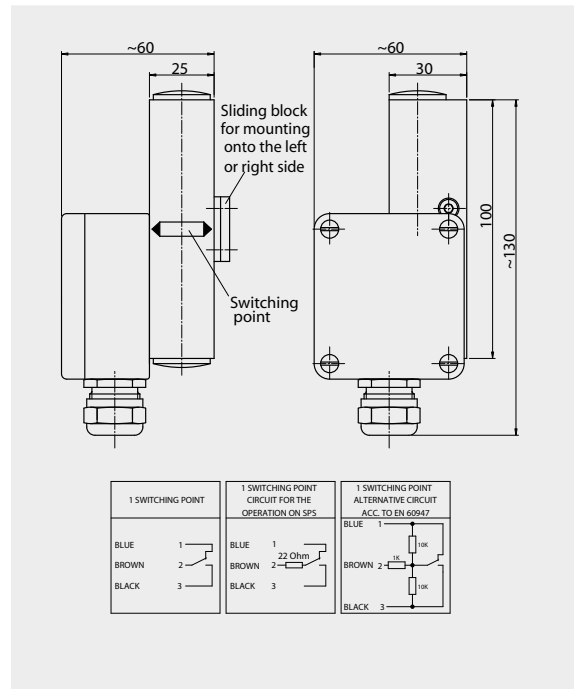
**Options:**

- with code addition .. / R

with 22 Ohm protection resistor

- with code addition .. / N acc. to Namur EN 60947

#### BGU - A (R) / BGU - A (L)



Type combination see type key Bypass-Level Indicators

### Magnetic switch

#### Technical data

Housing:  
- aluminium anodized

Contact function:  
- change over

Switching action:  
- bistable

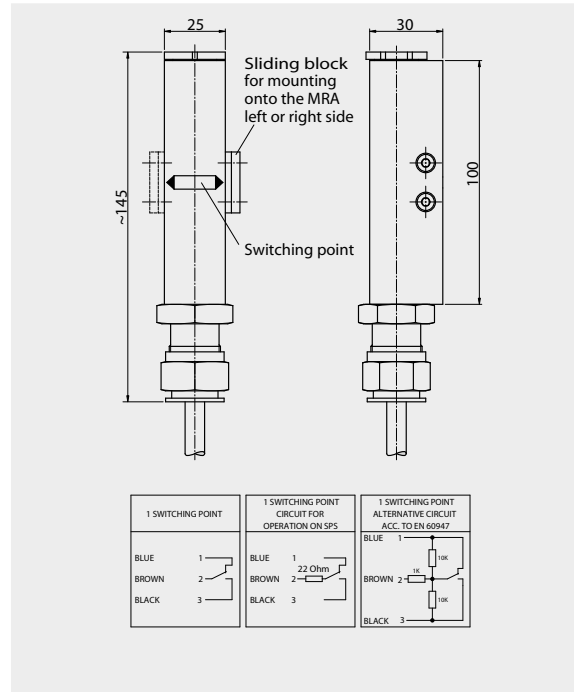
Switching capacity:  
- 230 V AC / 50 VA / 1.0 A  
- 230 V DC / 30 VA / 0.5 A

Protection rating:  
- IP65

Ambient temperature:  
- with PVC-cable max. +80 °C  
- with Silicone-cable max. +120 °C

Options:  
- with code addition .. / R  
with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### BGU - .. .. - EExd



#### Technical data

Housing:  
- aluminium anodized

Contact function:  
- change over

Switching action:  
- bistable

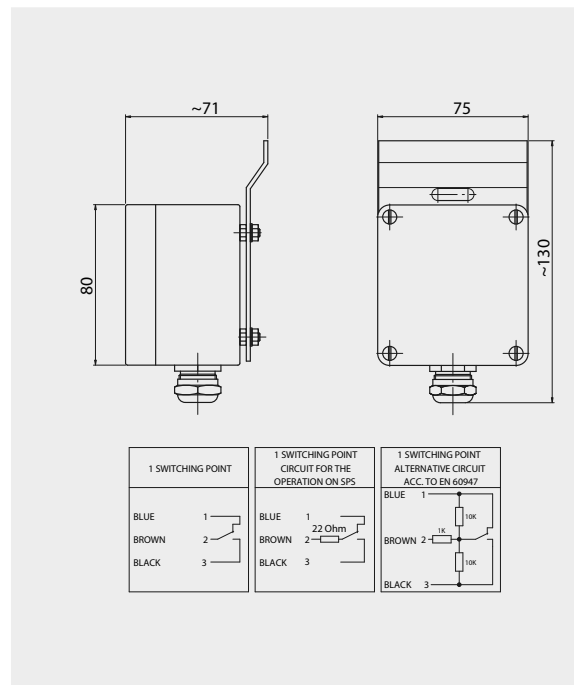
Switching capacity:  
- 230 V DC / 30 VA / 0.5 A  
230 V AC / 50 VA / 1.5 A

Protection rating:  
- IP65

Ambient temperature:  
- max. +300 °C  
Installation:  
right or left of the magnet roll display

Options:  
- with code addition .. / R  
with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### STMU (R) / STMU (L)



Type combination see type key Bypass-Level Indicators

### Magnetic switch

#### Technical data

**Housing:**

- aluminium anodized

**Contact function:**

- change over

**Switching action:**

- bistable

**Switching capacity:**

- 230 V AC / 60 VA / 1.0 A

- 230 V DC / 30 VA / 0.5 A

**Protection rating:**

- IP65

**Ambient temperature:**

- with PVC-cable max. +80 °C

- with Silicone-cable max. +180 °C

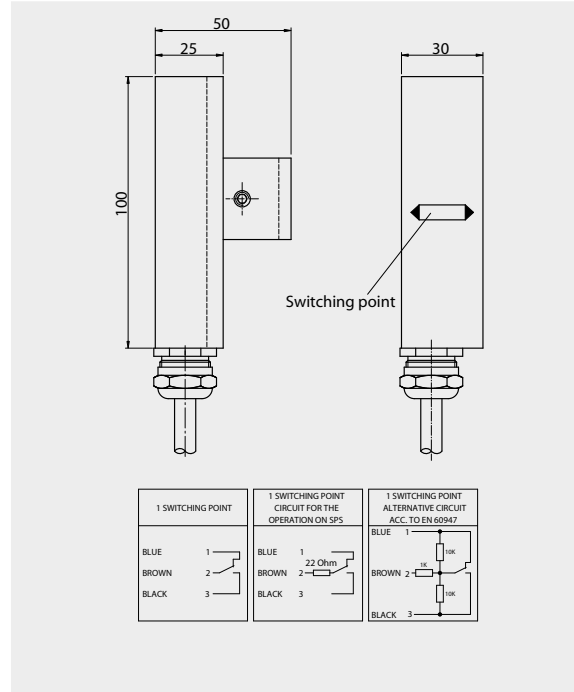
**Options:**

- with code addition .. / R

with 22 Ohm protection resistor

- with code addition .. / N acc. to Namur EN 60947

#### BMUM - .. PVC / BMUM - .. Sil



#### Technical data

**Housing:**

- stainless steel

**Contact function:**

- change over

**Switching action:**

- bistable

**Switching capacity:**

- 230 V AC / 60 VA / 1.0 A

- 230 V DC / 30 VA / 0.5 A

**Protection rating:**

- IP65

**Ambient temperature:**

- with PVC-cable max. +80 °C

- with Silicone-cable max. +180 °C

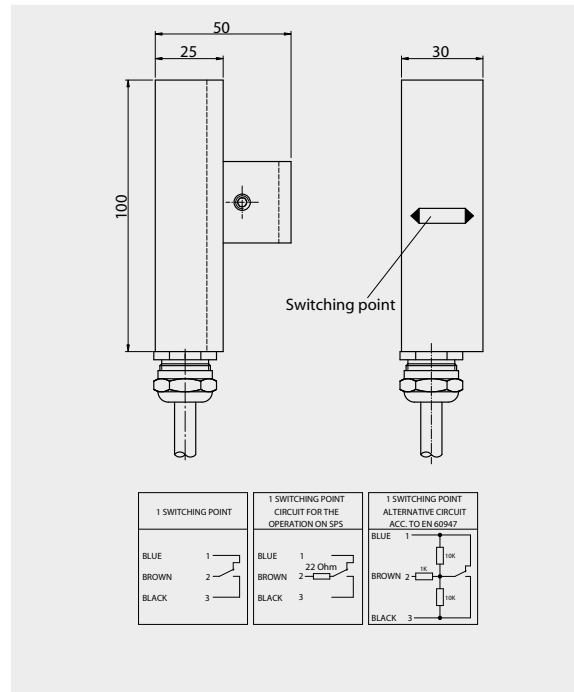
**Options:**

- with code addition .. / R

with 22 Ohm protection resistor

- with code addition .. / N acc. to Namur EN 60947

#### BMUMV - .. PVC / BMUMV - .. Sil



Type combination see type key Bypass-Level Indicators

### Magnetic switch

#### Technical data

Housing:  
- aluminium

Contact function:  
- change over

Switching action:  
- bistable

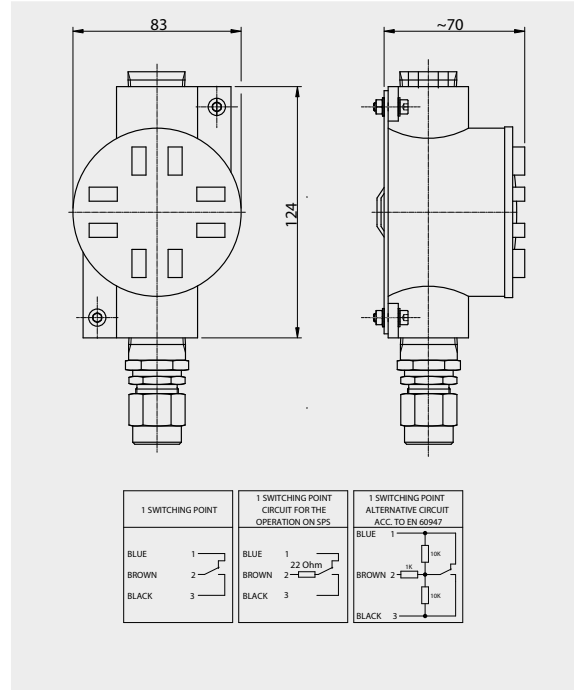
Switching capacity:  
- 230 V AC / 60 VA / 1.0 A  
- 230 V DC / 30 VA / 0.5 A

Protection rating:  
- IP65

Ambient temperature:  
- max. +85 °C

Options:  
- with code addition .. / R  
  with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### BMUM - ALDC - EExd



#### Technical data

Housing:  
- stainless steel

Contact function:  
- change over

Switching action:  
- bistable

Switching capacity:  
- 230 V AC / 60 VA / 1.0 A  
- 230 V DC / 30 VA / 0.5 A

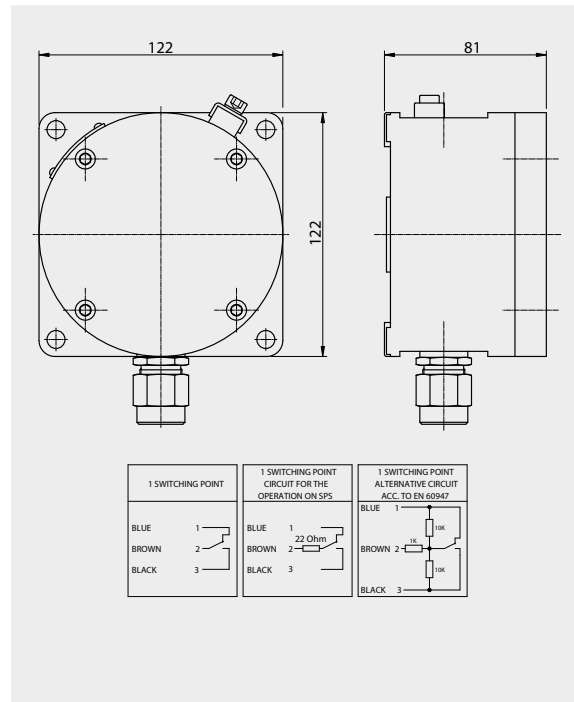
Protection rating:  
- IP65

Ambient temperature:  
- max. +55 °C

Cable entry:  
- M20 x 1.5 mm

Options:  
- with code addition .. / R  
  with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### BMUM - AVD - EExd



Type combination see type key Bypass-Level Indicators

### Magnetic switch

#### Technical data

Housing:  
- aluminium anodized

Contact function:  
- change over

Switching action:  
- bistable

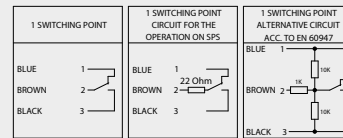
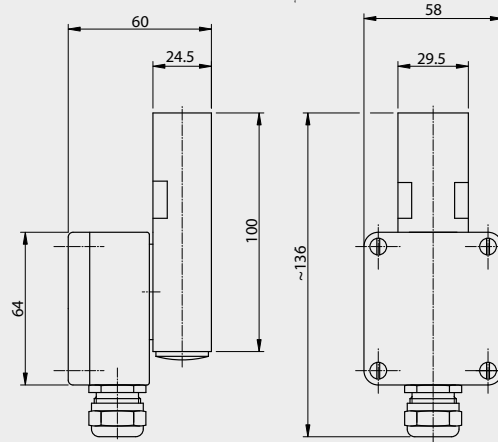
Switching capacity:  
- 230 V AC / 60 VA / 1.0 A  
- 230 V DC / 30 VA / 0.5 A

Protection rating:  
- IP65

Ambient temperature:  
- max. +130 °C

Options:  
- with code addition .. / R  
with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### AUM - 80



#### Technical data

Housing:  
- stainless steel  
- electrical connection box polyester

Contact function:  
- change over

Switching action:  
- bistable

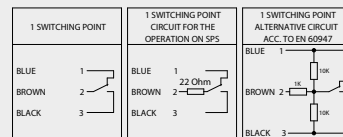
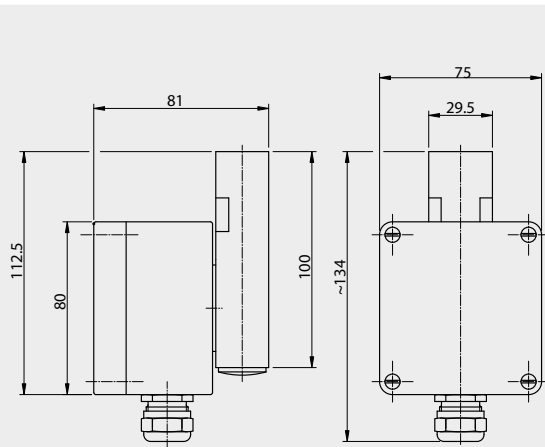
Switching capacity:  
- 230 V AC / 60 VA / 1.0 A  
- 230 V DC / 30 VA / 0.5 A

Protection rating:  
- IP65

Ambient temperature:  
- max. +100 °C

Options:  
- with code addition .. / R  
with 22 Ohm protection resistor  
- with code addition .. / N acc. to Namur EN 60947

#### APMUMV



Type combination see type key Bypass-Level Indicators

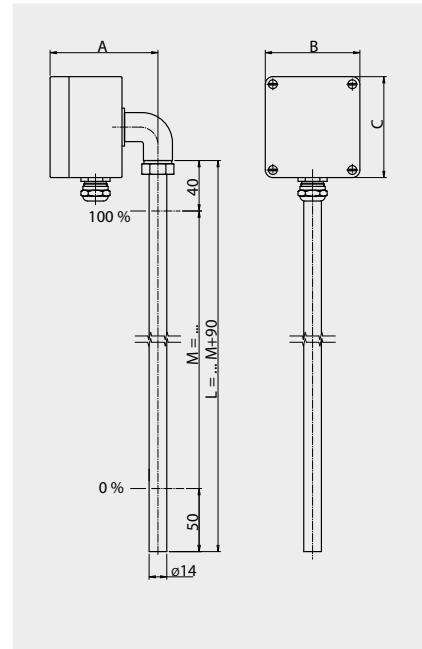


### Level sensor

#### Technical data

<b>Terminal box:</b>	Aluminium A 105: 80 x 75 x 57 A 101: 64 x 58 x 34	
<b>Dimensions:</b>	<b>A 105</b> A = 85.5 mm B = 75.0 mm C = 89.0 mm	<b>A 101</b> A = 62.5 mm B = 50.0 mm C = 68.0 mm
<b>Guide tube:</b>	ø 14 mm	
<b>Resolution:</b>	5.0 mm      -30 °C ... +130 °C 10.0 mm    -30 °C ... +130 °C 15.0 mm    -30 °C ... +130 °C 5.0 mm (HTF)    -30 °C ... +200 °C 10.0 mm (HTF)   -30 °C ... +200 °C 15.0 mm (HTF)   -30 °C ... +200 °C 5.0 mm (HT)    -100 °C ... +250 °C 10.0 mm (HT)    -100 °C ... +250 °C 15.0 mm (HT)    -100 °C ... +250 °C	
<b>Control unit:</b>	TP5343A/B TP5350A/B TD5335A/B XT-42-SI	

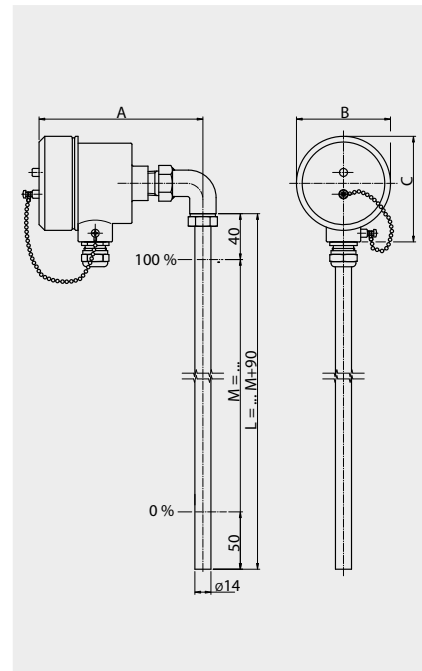
#### AL - ... - VK ... - M



#### Technical data

<b>Terminal box:</b>	Stainless steel 92 x 82 x 95 mm	
<b>Cable gland:</b>	Brass nickel-plated (standard)	
<b>Dimensions:</b>	A = ~145 mm B = ~ 82 mm C = ~ 92 mm	
<b>Guide tube:</b>	ø 14 mm	
<b>Resolution:</b>	5.0 mm      -30 °C ... +130 °C 10.0 mm    -30 °C ... +130 °C 15.0 mm    -30 °C ... +130 °C 5.0 mm (HTF)    -30 °C ... +200 °C 10.0 mm (HTF)   -30 °C ... +200 °C 15.0 mm (HTF)   -30 °C ... +200 °C 5.0 mm (HT)    -100 °C ... +250 °C 10.0 mm (HT)    -100 °C ... +250 °C 15.0 mm (HT)    -100 °C ... +250 °C	
<b>Control unit:</b>	TP5343A/B TP5350A/B TD5335A/B XT-42-SI	
<b>Option:</b>	Cable gland in stainless steel	

#### AV - ... - VK ... - M ..



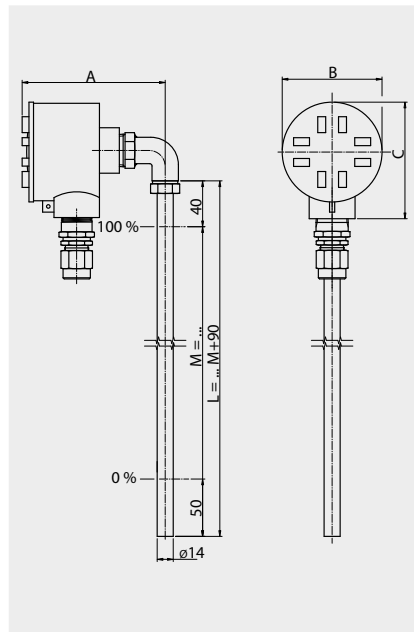
Type combination see type key Bypass-Level Indicators

### Level sensor

#### Technical data

<b>Terminal box:</b>	Aluminium 102 x 87 x 85 mm
<b>Dimensions:</b>	A = ~ 125 mm B = ~ 87 mm C = ~ 102 mm
<b>Guide tube:</b>	∅ 14 mm
<b>Resolution:</b>	5.0 mm -30 °C ... +120 °C 10.0 mm -30 °C ... +120 °C 15.0 mm -30 °C ... +120 °C
<b>Control unit:</b>	TP5343A/B TP5350A/B TD5335A/B XT-42-SI
<b>Ambient temperature EExd:</b>	+85 °C

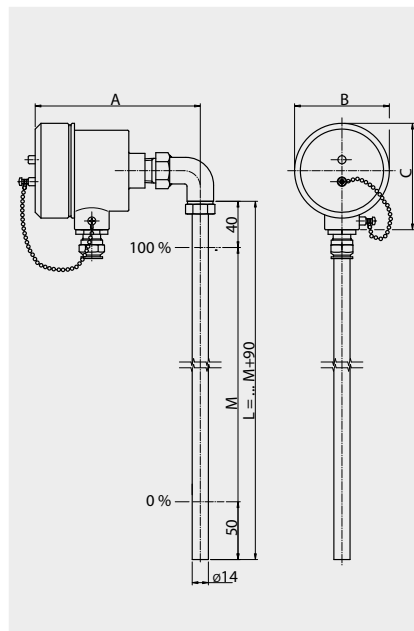
#### ALDC - .. - VK .. - M .. - EExd



#### Technical data

<b>Terminal box:</b>	Stainless steel (max. +40 °C) 92 x 82 x 95 mm
<b>Cable gland:</b>	Brass nickel-plated (standard)
<b>Dimensions:</b>	A = ~ 145 mm B = ~ 82 mm C = ~ 92 mm
<b>Guide tube:</b>	∅ 14 mm
<b>Resolution:</b>	5.0 mm -30 °C ... +120 °C 10.0 mm -30 °C ... +120 °C 15.0 mm -30 °C ... +120 °C
<b>Control unit:</b>	TP5343A/B TP5350A/B TD5335A/B XT-42-SI
<b>Option:</b>	Cable gland in stainless steel

#### AVD - .. - VK .. - M .. - EExd

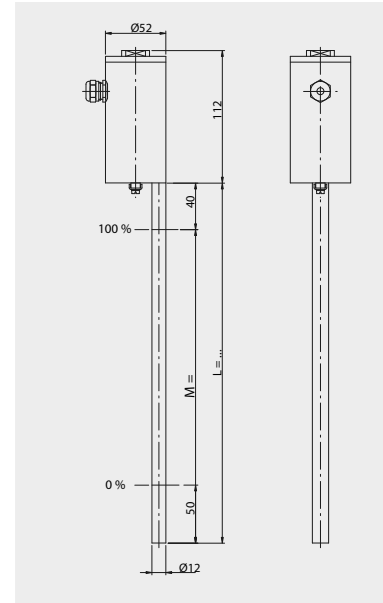


Type combination see type key Bypass-Level Indicators

## Level sensor magnetostrictive

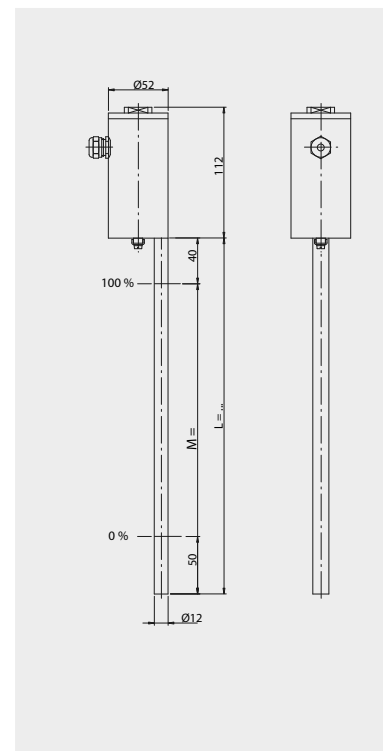
Technical data	
Terminal box:	Ø 52 x 112 mm
Dimensions:	A= 52 mm B= 52 mm C= 112 mm
Screwed cable gland:	M16 x 1.5 mm
Length of instrument:	200 ... 6000 mm
Resolution:	0.1 mm -40 °C ... +125 °C 0.1 mm -200 °C ... +250 °C
Electrical connections:	2-wire connection (Option HART®)
Electrical power supply:	10 ... 30 V DC / 4 ... 20 mA
Ambient temperature:	-40 °C ... +85 °C
Measuring range:	free adjustable
System of protection:	IP68
Material:	Stainless steel

AMU - M ...



Technical data	
Terminal box:	Ø 52 x 112 mm
Dimensions:	A= 52 mm B= 52 mm C= 112 mm
Screwed cable gland:	M16 x 1.5 mm
Length of instrument:	200 ... 6000 mm
Resolution:	Hazardous area 0 + 1 0.1 mm -20 °C ... +60 °C  Hazardous area 2 0.1 mm -20 °C ... +60 °C 0.1 mm (HT) -20 °C ... +250 °C
Electrical connections:	2-wire connection (Option HART®)
Electrical power supply:	10 ... 30 V DC / 4 ... 20 mA
Ambient temperature:	-20 °C ... +85 °C
Measuring range:	free adjustable
System of protection:	IP68
Material:	Stainless steel
Approvals:	TÜV Atex 1772 X, II ½ G EExia T2 - T6

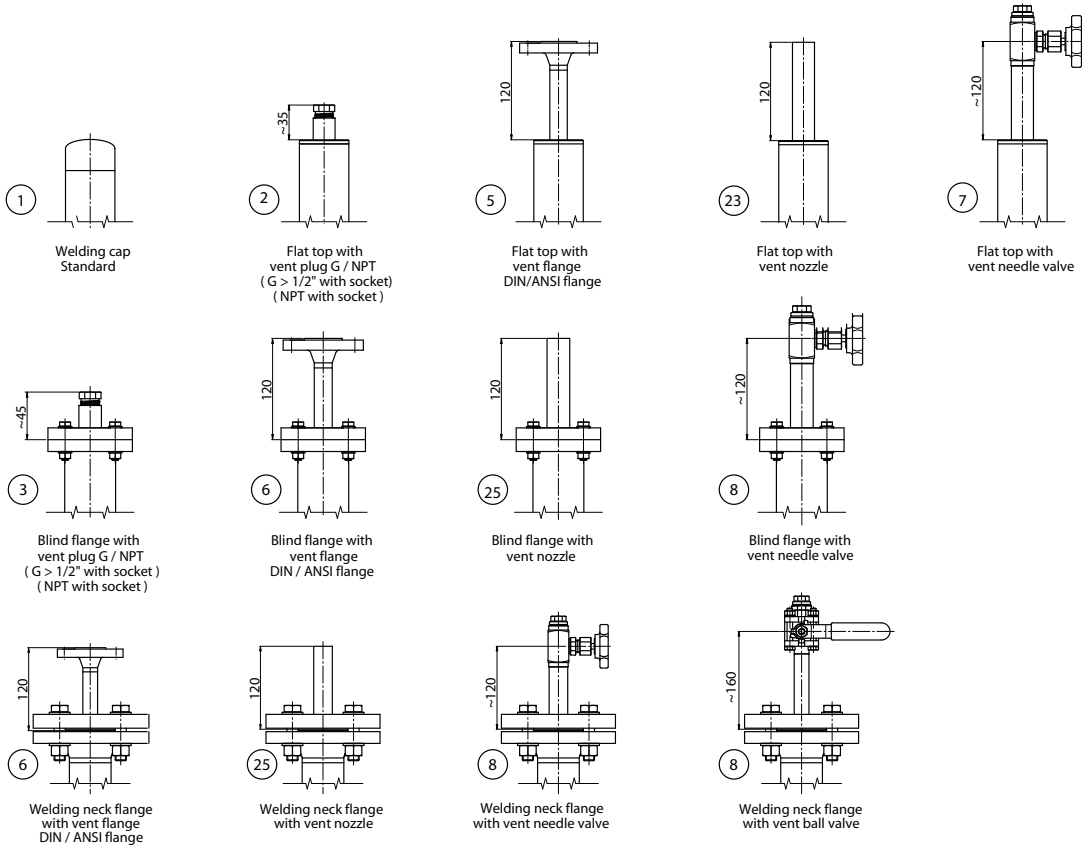
AMU - M ... - Ex



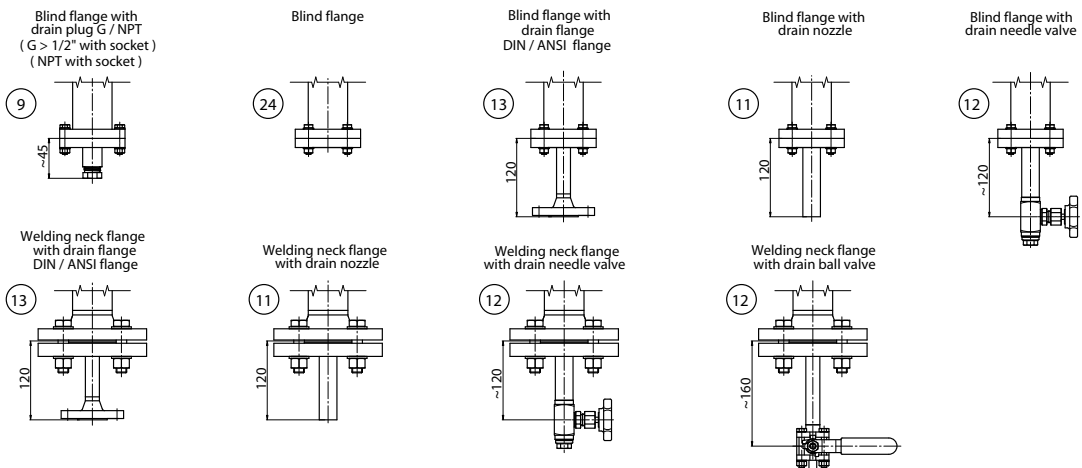
Type combination see type key Bypass-Level Indicators

## Options chamber ends

### Chamber end top

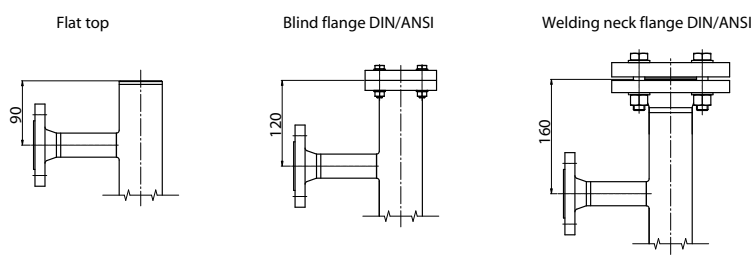
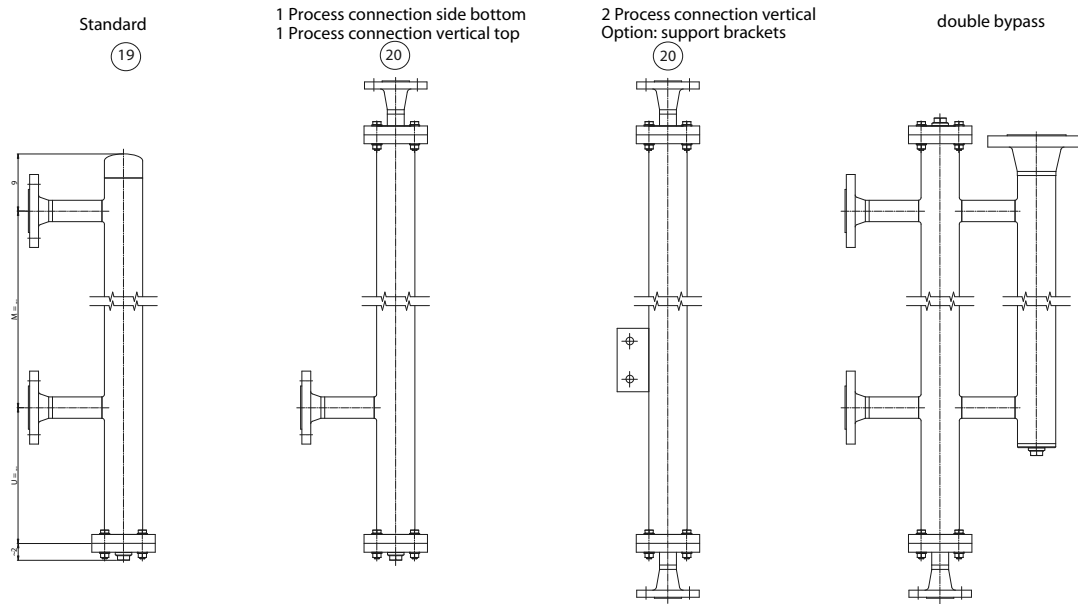
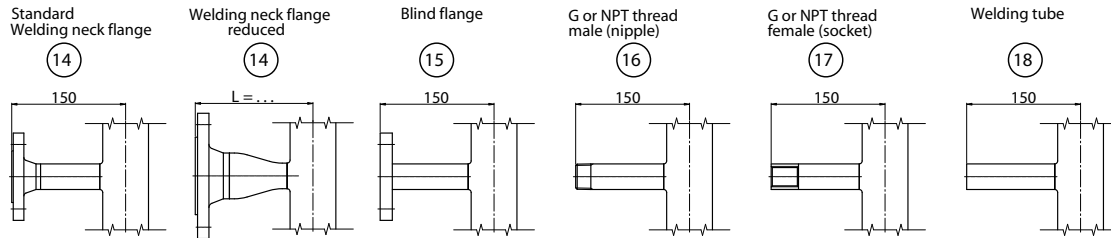


### Chamber end bottom



## Options process connections

**Options process connections**



### Type key

Code 1	Key 1		ATEX
	BNA -	Bypass - Level Indicators	Ⓔ
	BMG -	Bypass - Level Indicators with level sensor	Ⓔ
Code 2	Key 1	Design process connections	ATEX
	.. / .. / .. -	Flange norm    1. nom.width    2. nom.pressure    3. form	
		DIN                DN 6 .. 500        PN 6 .. 400        C, F, N, B ..	Ⓔ
		ANSI              1/2" .. 24"        150 lbs .. 2500    SF, RTJ, RF..	Ⓔ
		JIS B 2010        2" .. 20"        5K .. 63K        A .. T	Ⓔ
		BSI BS 4504      DN 10 .. 500      PN 2.5 .. 400	Ⓔ
		S                  Special flange with outside diameter mm	Ⓔ
	G .. -	GM thread female .."	Ⓔ
		GN thread male .."	Ⓔ
	NPT .. -	NPTM thread female .."	Ⓔ
		NPTN thread male .."	Ⓔ
	SE .. -	Welding ends .."	Ⓔ
	OS -	Without lateral connections	Ⓔ
Code 3	Key 1	Electrical connection for level sensor	ATEX
	AL -	Aluminium terminal box	Ⓔ
	AV -	Stainless steel terminal box	Ⓔ
	ALDC -	Aluminium terminal box EExd explosion proof	Ⓔ
	ALD -	Aluminium terminal box EExd explosion proof	Ⓔ
	AVD -	Stainless steel terminal box EExd explosion proof	Ⓔ
	AP -	Terminal box polyester	Ⓔ
	AB -	Terminal box ABS	
	E -	Connection cable	Ⓔ
	U .. -	Connection mountend on bottom (with appropriate electrical connection)	Ⓔ
	.. -	Various	

### Type combination

Code	1	2	3	4	5	6	7	8	9
Key	1	1/2/3	1/2/3	1	1	1/2	1	1	1
Example	BMG -	25/16/C -	AL-VK10 -	M700 -	V60 -	MRA/SG -	1/BGU-A -	ZVSS250 -	Ex

## Type key

Code 3	Key 2	2-wire control unit in terminal box	ATEX
	ZMU -	XT-42-SI	
	ZMUP -	956045	
	ZMUL -	2251	
	TP -	TP 5333B	
	TPA -	TP 5333A	
	TP43 -	TP 5343B	
	TP43A -	TP 5343A	
	TP50 -	TP 5350B	
	TP50A -	TP 5350A	
	TD -	TD 5335B	
	TDA -	TD 5335A	
	AMU -	AMU	
	...	Various	
	Key 3	Design resolution in stainless steel tube	ATEX
	VK5 -	Resolution 5.0 mm	
	VK5 (HTF) -	Resolution 5.0 mm high temperature	
	VK5 (HT) -	Resolution 5.0 mm high temperature	
	VK10 -	Resolution 10.0 mm	
	VK10 (HTF) -	Resolution 10.0 mm high temperature	
	VK10 (HT) -	Resolution 10.0 mm high temperature	
	VK15 -	Resolution 15.0 mm	
	VK15 (HTF) -	Resolution 15.0 mm high temperature	
	VK15 (HT) -	Resolution 15.0 mm high temperature	
Code 4	Key 1	Distance centre to centre / length in mm	ATEX
	- M .. -	Distance middle process connection to middle process connection	
	- L .. -	Length of instrument for bypasses without lateral connections	
Code 5	Key 1	Material of chamber	ATEX
	V .. -	Stainless steel	
	Ti .. -	Titanium	
	H .. -	Alloy	
	EEC .. -	Stainless steel E-CTFE coated	
	PFA .. -	Stainless steel PFA coated	
	P .. -	Polyvinylchloride PVC	
	PP .. -	Polypropylene PP	
	PF .. -	Polyvinylidenfluoride PVDF	
	... -	Various	

### Type combination

Code	1	2	3	4	5	6	7	8	9
Key	1	1/2/3	1/2/3	1	1	1/2	1	1	1

Example	BMG -	25/16/C -	AL-VK10 -	M700 -	V60 -	MRA/SG -	1/BGU-A -	ZVSS250 -	Ex
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## Type key

Code 5	Key 2	Diameter of chamber	ATEX
	60 -	60.0 mm	
	64 -	63.5 mm	
	73 -	73.0 mm	
	76 -	76.0 mm	
	88 -	88.0 mm	
	114 -	114.0 mm	

Code 6	Key 1	Magnetic roller indicator	ATEX
	MRA	Aluminium profile with plastic rollers and switch-rail profile	
	MNA	Aluminium profile with plastic rollers	
	MNAN	Aluminium profile with plastic rollers shock proof	
	MRK	Aluminium profile with ceramics rollers and switch-rail profile	
	MNK	Aluminium profile with ceramics rollers	
	MNAV	Stainless steel profile with plastic rollers	
	MNKV	Stainless steel profile with ceramics rollers	

	Key 2	Scale for mounting onto magnetic roller indicator	ATEX
	/ SK -	Aluminium scale with adhesive foil, separation in cm	
	/ SG -	Aluminium engraved, separation acc. to specification	
	/ VSG -	Stainless steel engraved, separation acc. to specification	
	/ P -	Acrylic glass extender for refrigeration applications	

Code 7	Key 1	Magnetic switches see pages 224-227

Code 8	Key 1	Float designs with length of float	ATEX
	ZVS .. -	Stainless steel	
	ZTS .. -	Titanium	
	ZHS .. -	Alloy	
	ZVEECS .. -	Stainless steel E-CTFE coated	
	ZTEECS .. -	Titanium E-CTFE coated	
	ZVPFAS .. -	Stainless steel PFA coated	
	ZTPFA .. -	Titanium PFA coated	
	ZPS .. -	Polyvinylchloride PVC	
	ZPPS .. -	Polypropylene PP	
	ZPFS .. -	Polyvinylidenfluoride PVDF	
	.. -	Various	

## Type combination









Code	1	2	3	4	5	6	7	8	9
Key	1	1/2/3	1/2/3	1	1	1/2	1	1	1

Example	BMG -	25/16/C -	AL-VK10 -	M700 -	V60 -	MRA/SG -	1/BGU-A -	ZVSS250 -	Ex
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## Type key

Code 9	Key 1	Approvals and options	ATEX
	Ex	Intrinsically safe design acc. to EExia	
	EExd	Explosion proof design acc. to EExd	
	Ex/D	Intrinsically safe design acc. to EExia with dust Ex	
	EExd/D	Explosion proof design acc. to EExd with dust Ex	
	GL	Germanischer Lloyd	
	BV	Bureau Veritas	
	RINA	Registro Italiano Navale	
	DNV	Det Norske Veritas	

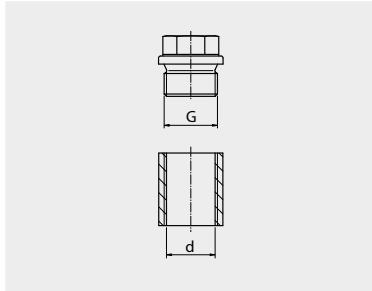
## Type combination

Code	1	2	3	4	5	6	7	8	9
Key	1	1/2/3	1/2/3	1	1	1/2	1	1	1

**Example** BMG - 25/16/C - AL-VK10 - M700 - V60 - MRA/SG - 1/BGU-A - ZVSS250 - Ex

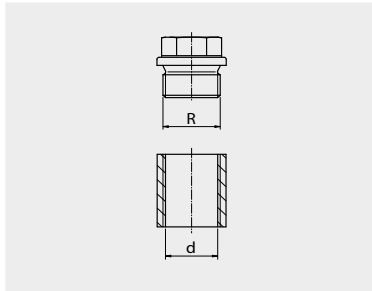
## Design process connections

### Thread G ..."



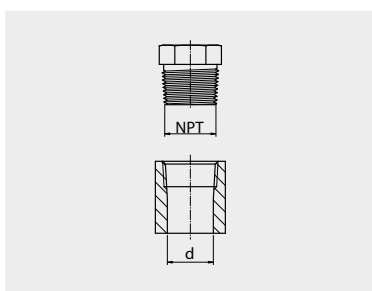
Size	Diameter G [mm]	Core ø d [mm]	Bore [mm]
1/8"	9.7	8.5	8.0
1/4"	13.2	11.4	11.0
3/8"	16.7	14.9	14.5
1/2"	21.0	18.9	18.0
3/4"	26.5	24.1	23.5
1"	33.3	30.2	29.5
1 1/2"	47.8	44.9	44.0
2"	59.7	56.6	56.0

### Thread R ..."



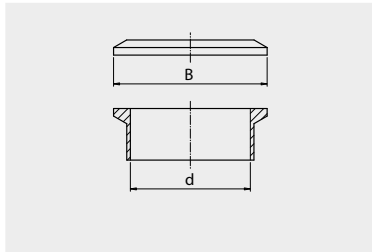
Size	Diameter R [mm]	Core ø d [mm]	Bore [mm]
1/8"	9.7	8.5	8.0
1/4"	13.2	11.4	11.0
3/8"	16.7	14.9	14.5
1/2"	21.0	18.6	18.0
3/4"	26.5	24.1	23.5
1"	33.3	30.2	29.5
1 1/2"	47.8	44.8	44.0
2"	59.7	56.6	56.0

### Thread NPT ..."



Size	Diameter NPT [mm]	Core ø d [mm]	Bore [mm]
1/8"	9.6	8.4	8.5
1/4"	12.8	11.2	11.0
3/8"	16.2	14.6	14.5
1/2"	19.9	18.2	18.0
3/4"	25.6	23.4	23.0
1"	31.8	29.8	29.0
1 1/2"	46.8	44.2	44.0
2"	58.6	56.4	56.0

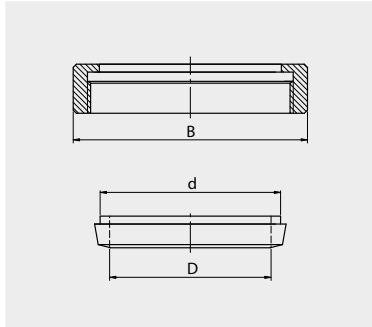
### Flange Tri - Clamp DIN 32676



Size	Diameter B [mm]	Inside ø d [mm]	Bore [mm]
DN15	34.0	16.0	15.0
DN20	34.0	20.0	19.0
DN25	50.5	26.0	25.0
DN50	64.0	50.0	48.0
DN65	91.0	66.0	64.0
DN80	106.0	81.0	79.0
DN100	119.0	100.0	98.0

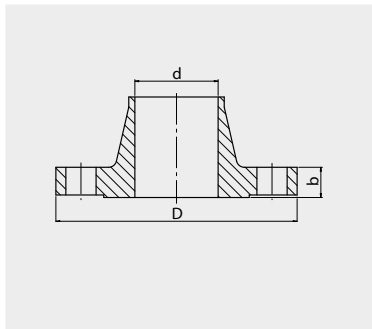
## Design process connections

### Tube connection DIN 11851



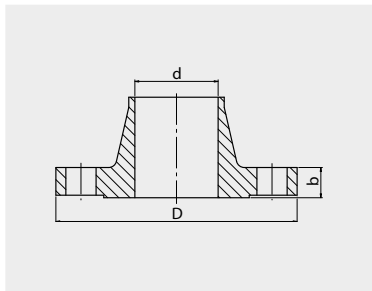
Size	Bore $\phi$ d [mm]	Inside $\phi$ D [mm]	Union nut B [mm]
DN10	18	10	38
DN15	24	16	44
DN20	30	20	54
DN25	35	26	63
DN40	48	38	78
DN50	61	50	92
DN65	79	66	112
DN80	93	81	127
DN100	114	100	148

### Flange DIN 16 bar DIN 2633



Size	Flange $\phi$ D [mm]	Inside $\phi$ d [mm]	Flange thickness b [mm]
DN10	90	13.6	14
DN15	95	17.3	14
DN20	105	22.3	16
DN25	115	28.5	16
DN40	150	43.1	16
DN50	165	54.5	18
DN65	185	70.3	18
DN80	200	82.5	20
DN100	220	107.1	20

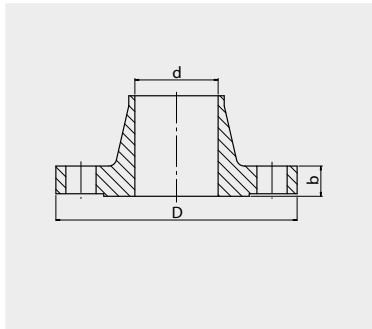
### Flange Ansi 150 lbs B 16.5



Size	Flange $\phi$ D [mm]	Inside $\phi$ d [mm]	Flange thickness b [mm]
½"	88.9	15.7	11.2
¾"	98.6	20.8	12.7
1"	108.0	26.7	14.2
1½"	127.0	40.9	17.5
2"	152.4	52.6	19.1
2½"	177.8	62.7	22.4
3"	190.5	78.0	23.9
4"	228.6	102.4	23.9

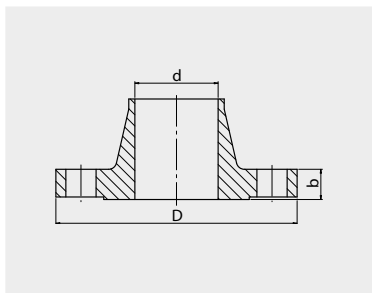
## Design process connections / Materials

### Flange DIN 40 bar DIN 2635



Size	Flange ø D [mm]	Inside ø d [mm]	Flange thickness b [mm]
DN10	90	13.6	16
DN15	95	17.3	16
DN20	105	22.3	18
DN25	115	28.5	18
DN40	150	43.1	18
DN50	165	54.5	20
DN65	185	70.3	22
DN80	200	82.5	24
DN100	235	107.1	24

### Flange Ansi 300 lbs B 16.5



Size	Flange ø D [mm]	Inside ø d [mm]	Flange thickness b [mm]
½"	95.2	15.7	14.2
¾"	117.3	20.8	15.7
1"	124.0	26.7	17.5
1½"	155.4	40.9	20.6
2"	165.1	52.6	22.4
2½"	190.5	62.7	25.4
3"	209.6	78.0	28.4
4"	254.0	102.4	31.8

## Materials

### Material temperatures

Material	Material	Temperature min.	Temperature max.
V	Stainless steel	- 196 °C	+ 400 °C
Ti	Titanium	- 10 °C	+ 300 °C
H	Alloy / Ni Mo	- 196 °C	+ 400 °C
EEC	Stainless steel E-CTFE coated	- 78 °C	+ 150 °C
PFA	Stainless steel PFA coated	- 100 °C	+ 250 °C
P	Polyvinylchloride PVC	- 15 °C	+ 60 °C
PP	Polypropylene PP	- 5 °C	+ 100 °C
PF	Polyvinylidenfluoride PVDF	- 5 °C	+ 150 °C
PA	Polyamide PA	- 40 °C	+ 110 °C
M	Brass	- 196 °C	+ 250 °C
AL	Auminium	- 196 °C	+ 150 °C