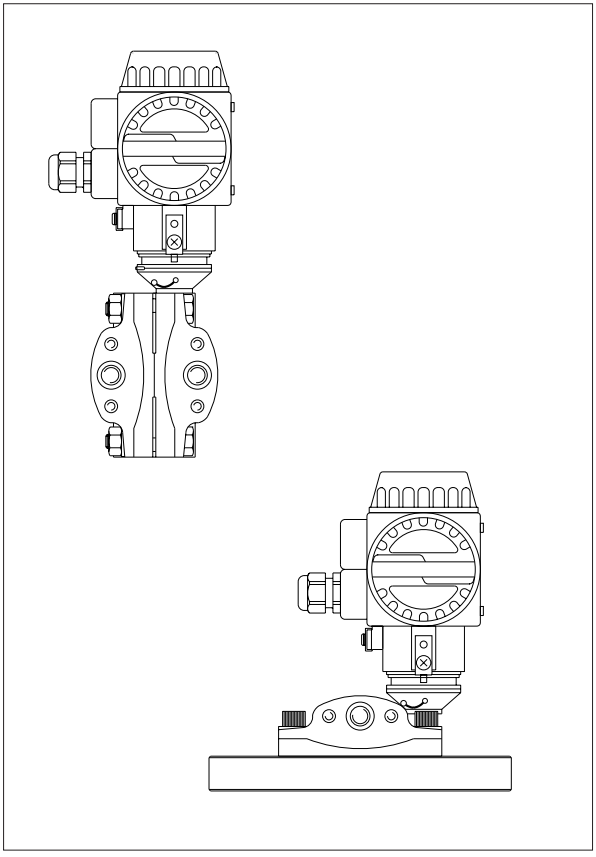
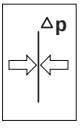
Operating Instructions

VEGADIF 34 ... 51





Contents

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Safety information

Please read this manual carefully, and also take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

For safety and warranty reasons, any internal work on the instruments, apart from that involved in normal installation and electrical connection, must be carried out only by qualified VEGA personnel.

Note Ex area

Please note the attached safety instructions containing important information on installation and operation in Ex areas.

These safety instructions are part of the operating instructions manual and come with the Ex approved instruments.

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1 Product description

1.1 Function and configuration

Function

VEGADIF 34 ... 51 differential pressure transmitters are an efficient, modular instrument series for differential pressure, level and flow measurement.

The sensor element of VEGADIF 34 and 44 is a single-chamber ceramic measuring cell. It consists of a disk-shaped ceramic body with ceramic diaphragms on both sides. Depending on the acting pressures, the diaphragms move in or out and the measuring capacitances change. The difference of the individual capacitances is reciprocally proportional to the difference of the pressures.

The sensor element of VEGADIF 35, 45 and 51 is a silicon plate with pressure sensitive resistors. The differential pressure to be measured is received via separating diaphragms and transmitted to the sensor element via incompressible oil (silicone oil or inert oil). The silicon plate moves according to the differential pressure. The values of the resistors change (piezoresistive principle).

The capacitance or resistance values are detected by the integrated electronics, processed in the microcomputer and converted into a 4 ... 20 mA output signal. This output signal is proportional to the difference of the pressures. Precise, digital processing of measured data with maximum resolution ensures excellent technical data and accuracy.

The electronics in the pressure transmitter requires a power supply of 11.5 ... 45 V DC.

The external power supply is provided via a separate supply instrument, e.g.:
- power supply unit (e.g. VEGASTAB 690)
- processing unit with integrated direct voltage source (e.g. active PLC input)
- VEGAMET series 500 or 600 signal conditioning instrument, VEGALOG 571 processing system or VEGADIS 371 indicating instrument

Configuration

Each VEGADIF consists of only two modular components:
- the electronics housing
- the measuring cell housing.

Sensor-specific data are permanently stored in an ASIC in the sensor. Hence the measuring cell modules can be exchanged, e.g. ceramic for silicon and vice versa. The electronics can be exchanged, e.g. from 4 ... 20 mA standard to 4 ... 20 mA with HART® communication protocol, without dismounting the transmitter.

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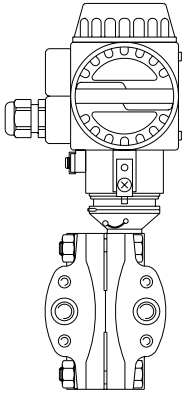
1.2 Types and versions

VEGADIF 34

Measuring cell:
ceramic-capacitive

Process fitting:
acc. to DIN 19 213

Standard application:
Differential pressure and flow measurement with gases, vapours and liquids



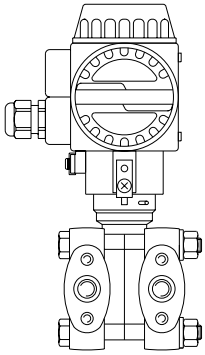
VEGADIF 34

VEGADIF 35

Measuring cell:
silicon-piezoresistive with metal separating diaphragms

Process fitting:
acc. to DIN 19 213

Standard application:
Differential pressure and flow measurement with gases, vapours and liquids, with differential pressures up to 40 bar and static pressures up to 420 bar



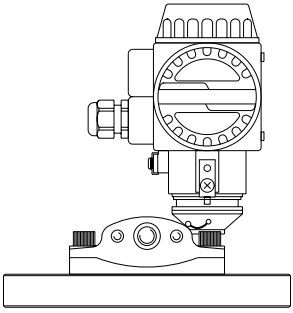
VEGADIF 35

VEGADIF 44

Measuring cell:
ceramic-capacitive

Process fitting:
Plus side flange,
minus side acc. to DIN 19 213

Standard application:
Level measurement in pressurized vessels, even with suspended solids, abrasive or high viscosity products



VEGADIF 44

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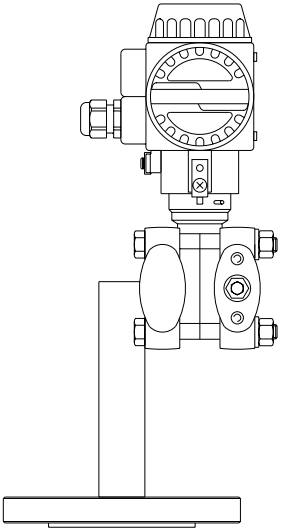
VEGADIF 45

Measuring cell:
silicon-piezoresistive with metal separating diaphragm

Process fitting:
Plus side flange,
minus side acc. to DIN 19 213

Standard application:
Level measurement in pressurized vessels, even with product temperatures up to 400°C



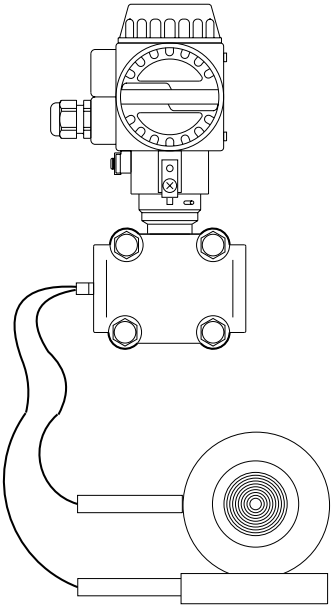
VEGADIF 45

VEGADIF 51

Measuring cell:
silicon-piezoresistive with metal separating diaphragms

Process fitting:
Isolating diaphragm in standard series, connected via capillary lines

Standard application:
Level, differential pressure and flow measurement especially with high-viscosity products, high temperatures and in food processing industries



VEGADIF 51

Certified instruments are available for application in hazardous areas as well as part of an overfill protection system acc. to WHG (Water Resources Act).

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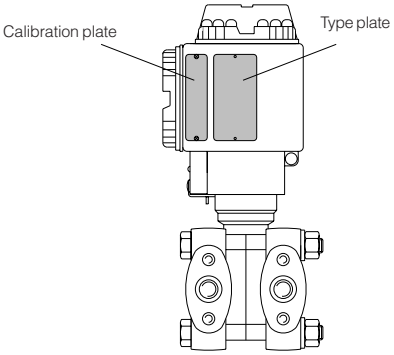
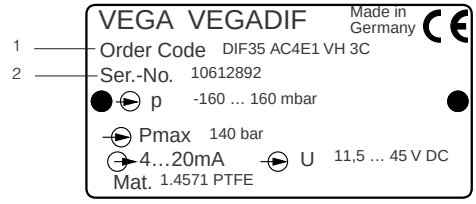
1.3 Type plate

Before installation and electrical connection, make sure that you are using a suitable differential pressure transmitter. Observe type and calibration plate which is located as follows:



Both plates include important data required for mounting and connection. The configuration and contents of the plates are explained in the following example.

Configuration of the type plate (example)



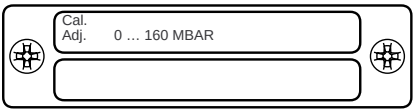
1 Basic data of the order no.
2 Serial number

Product coding example

type DIF35AC4E1VH3C

- Process fitting flange 1.4435
- Meas. cell seal PTFE
- 2 ventilation valves, 1 mounting loop
- Nominal value calibration in mbar/bar
- Nom. meas. range 160 mbar, static pressure max. 140 bar
- LC display on top
- Cable entry Pg 13.5

Configuration of the calibration plate (example)



Calibration range 0 … 160 mbar

1.4 Technical data

Mechanical data

Materials, wetted parts

VEGADIF 34	
- diaphragm	Aluminium oxide ceramic (Al_2O_3)
- process seal	FPM, Hastelloy C4 PTFE-plated, EPDM, FPM for oxygen application, Kalrez
- process fitting	carbon steel C22.8 chromized 1.0460, stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819, PVDF (PN 10)
- ventilation valves	stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819 (only with process fitting Hastelloy)
VEGADIF 35	
- separating diaphragms	stainless steel 1.4401
- process seal	FPM, NBR, PTFE, FPM for oxygen applications
- process fitting	carbon steel C22.8 chromized 1.0460 stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819
- ventilation valves	stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819 (only with process fitting Hastelloy)
VEGADIF 44	
- diaphragm	Aluminium oxide ceramic (Al_2O_3)
- process seal	FPM, Hastelloy C-4 PTFE-plated, EPDM, FPM for oxygen application, Kalrez
- process fitting (plus side)	carbon steel C22.8 chromized 1.0460, stainless steel 1.4571, stainless steel 1.4571 PTFE coated Hastelloy C276 2.4819
- process fitting (minus side)	carbon steel C22.8 chromized 1.0460, stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819
VEGADIF 45	
- isolating diaphragm	stainless steel 1.4435
- process flange (plus side)	stainless steel 1.4435
- process flange (minus side)	carbon steel C22.8 chromized 1.0460, stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819
VEGADIF 51	
- isolating diaphragm	stainless steel 1.4435
- process fitting	carbon steel C22.8 chromized 1.0460, stainless steel 1.4571 or 1.4404, Hastelloy C276 2.4819

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Materials, non-wetted parts

Common components	
- electronics housing and cover	Al-die casting (Cu-free), protective coating [1] Polyester-based, colour yellow RAL 1018, black RAL … (cover)
- type plates	stainless steel 1.4301
- O-rings for cover seal	NBR
- screws and nuts for measuring cell housing or process fitting	carbon steel C22.8
- mounting loop	corresponding on the process fitting carbon steel C22.8, stainless steel 1.4571
VEGADIF 34	
- fill fluid of the measuring cell	silicone oil, mineral oil, Voltalef 1 A [2]
VEGADIF 35	
- measuring cell housing	stainless steel 1.4571
- fill fluid of the measuring cell	silicone oil, Fluorolube [2]
VEGADIF 44	
- fill fluid of the measuring cell	silicone oil, mineral oil, Voltalef 1 A [2]
VEGADIF 45 and VEGADIF 51	
- measuring cell housing	stainless steel 1.4571
- fill fluid of the isolating diaphragm	silicone oil, vegetable oil, glycerine, high temperature oil, oil for oxygen applications
- capillary cable	stainless steel 1.4571
- fill fluid of the measuring cell	silicone oil, Fluorolube [2]

Weights

VEGADIF 34	approx. 5 kg
VEGADIF 35	4 … 6 kg, depending on the version
VEGADIF 44	8 … 10.5 kg, depending on the flange size
VEGADIF 45	6 … 12 kg, depending on the flange size and extension length
VEGADIF 51	4 kg plus capillaries and flange isolating diaphragm
Isolating diaphragm	see tables in "1.5 Dimensions - Isolating diaphragm"

[1] Sea water resistant (salt spray test acc. to DIN 50 021 passed for 504 h)
[2] for applications in pure gases

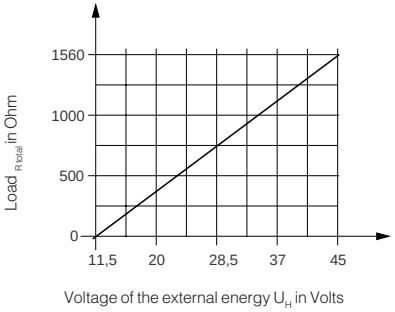
Electrical data

Connection

Cable entry	Pg 13.5 (for cable-ø 9 … 12 mm) [1]
Screw terminals	for wire cross section up to 2.5 mm²
Ground terminal	for wire cross section up to 4 mm²

Supply and signal circuit (4 … 20 mA signal)

Supply voltage	
- non-Ex instruments	11.5 … 45 V DC
- Ex instruments	11.5 … 30 V DC
Residual ripple	no influence at U_{SS} ≤ 4.5 V
Output signal	4 … 20 mA linear (differential pressure proportio nal) or square root (flow proportional changeable)
Resolution	better than 6 µA
Current limitation	approx. 23 mA
Measuring range overrun	2.8 mA (standard) or 4 mA
Measuring range overrun	20.5 mA acc. to NAMUR
Fault signal (adjustable)	3.6 mA, 21.5 mA, current value
Integration time [2]	0 … 16 s with keys on the instrument 0 … 40 s with HART® handheld
Adjustment period	0.5 … 2.0 s depending on the measuring range
Rise time	0.4 … 1.6 s depending on the measuring range
Heating time	2 s
Connection cable	2-wire
Max. permissible load	depending on the power supply



Supply and signal circuit (digital communication signal HART®)

Connection cable by unshielded cables)	2-wire (communication must not be influenced
Line resistance	≤ 25 Ω/km
Total resistance	more than 250 Ω (communication resistance of at least 250 Ω necessary)
Total capacitance	less than 180 nF
Max. length	1000 m

[1] with smaller cable diameter, a suitable seal must be provided by the customer
[2] Adjustment time of 10 % … 63 % of the measuring range final value

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Protective measures

Protection	IP 65 IP 68 (option for VEGADIF 35, 45 and 51)
Protection class	III

CE conformity CE

VEGADIF 34, VEGADIF 35, VEGADIF 44, VEGADIF 45 and VEGADIF 51 differential pressure transmitters meet the protective regulations of EMC (89/336/EWG) and NSR (73/23/EWG). Conformity has been judged acc. to the following standards:

EMC	Emission	EN 50 081 - 1
	Susceptibility	EN 50 082 - 2
NSR		EN 61 010

Furthermore VEGADIF 35 is subject to the pressure instrument directive (97/23/EG):
- instruments with max. permissible pressures > 200 bar need the CE mark
- instruments with max. permissible pressures ≤ 200 bar do not need the CE mark

NAMUR regulations

Full compliance with the NAMUR regulations NE21, May 1993.

Transmission reaction

Measuring ranges

VEGADIF 34 and VEGADIF 44

Features / Nom. meas. ranges	Limits		Span		System pressure		Pressure transmission liquid
	Initial value	Final value	minimum	maximum	Overload unilateral	Overload bilateral	in the sensor
25 mbar	-25 mbar	25 mbar	5 mbar	25 mbar	10 bar	10 bar	silicone oil [1]
100 mbar	-100 mbar	100 mbar	5 mbar	100 mbar	16 bar [2]	25 bar [2]	silicone oil [1]
500 mbar	-500 mbar	500 mbar	25 mbar	500 mbar	100 bar [2]	140 bar [2]	mineral oil [1]
3000 mbar	-3000 mbar	3000 mbar	150 mbar	3000 mbar	100 bar [2]	140 bar [2]	mineral oil [1]

VEGADIF 35, VEGADIF 45 and VEGADIF 51

Features / Nom. meas. ranges	Limits		Span		System pressure		Pressure transmission liquid
	Initial value	Final value	minimum	maximum	Overload unilateral	Overload bilateral	in the sensor
10 mbar[3]	-10 mbar	10 mbar	2 mbar	10 mbar	140 bar	140 bar	silicone oil [1]
40 mbar[3]	-40 mbar	40 mbar	5 mbar	40 mbar	140 bar	140 bar	silicone oil [1]
160 mbar	-160 mbar	160 mbar	10 mbar	160 mbar	140 bar	140 bar	silicone oil [1]
1000 mbar	-1000 mbar	1000 mbar	50 mbar	1000 mbar	420 bar [4]	420 bar [4]	silicone oil [1]
6000 mbar	-6000 mbar	6000 mbar	300 mbar	6000 mbar	420 bar [4]	420 bar [4]	silicone oil [1]
40000 mbar[3]	-40000 mbar	40000 mbar	2000 mbar	40000 mbar	100 bar	420 bar [4]	silicone oil [1]

[1] In applications with pure gas Voltalef 1 A
[2] 10 bar with process fitting PVDF for VEGADIF 34; 40 bar with process flange for VEGADIF 44
[3] only VEGADIF 35
[4] Note nominal pressure of the flanges

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Minimum pressure

VEGADIF 34, 35 and 44	1 mbar $_{abs}$
VEGADIF 45 and 51	10 mbar $_{abs}$

Output characteristics

Determination of characteristics	fixed point method acc. to VDI/VDE 2600, sheet 4 (corresponds to the limit point adjustment acc. to DIN 16 086)
Characteristics	linear (differential pressure proportional), changeable to square root (flow proportional)

Accuracy data [1]

Feature / Instrument	Accuracy [2]	Share hysteresis	Share repeatability
VEGADIF 34	better than 0.1 %	better than 0.05 %	better than 0.05 %
VEGADIF 35	better than 0.1 %	better than 0.1 %	better than 0.1 %
VEGADIF 44	better than 0.1 %	better than 0.05 %	better than 0.05 %
VEGADIF 45	better than 0.2 %	better than 0.1 %	better than 0.1 %
VEGADIF 51	better than 0.2 %	better than 0.1 %	better than 0.1 %

Log-term stability of the zero signal [3]	better than 0.1 %/12 months (VEGADIF 34 a. 44) better than 0.2 %/12 months (VEGADIF 35,45,51)

Influence of other actuating variables

Influence of the static pressure on zero and span	better than 0.2 %/PN (VEGADIF 34 and 44) better than 0.2 %/100 bar (VEGADIF 35, 45, 51)
Electromagnetic compatibility (EMC)	interference immunity acc. to NAMUR: 30 V/m
Influence of vibration [5] [6]	better than ±0.1 % acc. to DIN/IEC 68, part 2 - 6
Climatic class	GPC acc. to DIN 40 040
Calibration position	upright
Influence of the mounting position	max. 2 mbar

Temperature influence

Average temperature influence coefficient of the zero signal [3] [4] or the output span	better than 0.02 %/10 K (+10 … +60°C) better than 0.1 %/10 K (-40 … +10°C a. 60°C…85°C)

[1] Similar to DIN 16 086
[2] Relating to the nominal measuring range with recommended turn-down of 20 : 1
[3] Relating to the nominal measuring range, reference temperature 25°C, with recommended turn-down limit of 20 : 1
[4] with VEGADIF 45 and 51 without isolating diaphragm or capillaries, see Temperature influence
[5] Relating to the nominal measuring range
[6] with silicon measuring cell measured on the 6000 mbar sensor

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Additional temperature influence [1] with VEGADIF 45:
- by isolating diaphragm

Process fitting	effective diaphragm-ø	Temperature coefficient [mbar/10 K]
Flange DN 50 PN 40 acc. to DIN 2501, Seal surface acc. to DIN 2526 form D	46 mm	5.0
Flange DN 80 PN 40 acc. to DIN 2501, Seal surface acc. to DIN 2526 form D	70 mm	3.0
Flange DN 80 PN 40 with extension 50 mm	70 mm	3.0
Flange DN 80 PN 40 with extension 100 mm	70 mm	3.0
Flange DN 80 PN 40 with extension 150 mm	70 mm	3.0
Flange DN 80 PN 40 with extension 200 mm	70 mm	3.0

Additional temperature influence [1] with VEGADIF 51:
- by isolating diaphragm

Isolating diaphragm series	effective diaphragm-ø	Temperature coefficient [mbar/10 K]	
		unilateral	bilateral
Cell DN 50 PN 16/400	46 mm	3.0	0.5
Cell DN 80 PN 16/400	70 mm	0.7	0.1
Cell DN 100 PN 16/400	70 mm	0.7	0.1
Cell 3" class 150/2000	$2^3/_4$"	0.7	0.1
Cell 4" class 150/2000	$2^3/_4$"	0.7	0.1
DIN 11 851, nut DN 50 PN 25	46 mm	3.0	0.5
DIN 11 851, nut DN 65 PN 25	52 mm	1.0	0.2
DIN 11 851, nut DN 80 PN 25	71.5 mm	0.7	0.1
DIN 11 851, socket DN 50 PN 25	46 mm	3.0	0.5
DIN 11 851, socket DN 65 PN 25	52 mm	1.0	0.2
DIN 11 851, socket DN 80 PN 25	71.5 mm	0.7	0.1
Clamp 2" PN 25	45 mm	3.0	0.5
Clamp 3" PN 25	71.5 mm	0.7	0.1
DRD flange DN 25	46 mm	1.5	0.25

- by capillary line [2] per m — 0.5 mbar/10 K (unilateral)
0.12 mbar/10 K (bilateral)

Operating conditions

Medium characteristics

Aggregate Condition	gaseous, vapour, liquid to high viscosity also abrasive or corrosive (with suitable material for wetted parts acc. to order code)

[1] Standard values relating to isolating liquid silicone oil
[2] Both capillary lines are supplied with the same length

Temperatures

Ambient temperature	-40°C … +85°C (for indication: -20°C … +85°C)	
Medium temperature		
- VEGADIF 34 and VEGADIF 44		
FPM (Viton, Fluor-caoutchouc)	-20°C … +85°C	
PTFE (Hastelloy C4, from p_{abs} ≥ 900 mbar)		-40°C … +85°C
EPDM	-40°C … +85°C	
FPM (Viton for oxygen, oil and grease free)		-10°C … +85°C
Kalrez	-10°C … +85°C	
- VEGADIF 35 and minus side VEGADIF 45		
FDM (Viton, Fluor-caoutchouc)	-20°C … +85°C	
NBR	-20°C … +85°C	
PTFE, from p_{abs} ≥ 1 mbar	-40°C … +85°C	
FPM (Viton for oxygen, oil and grease free)		-10°C … +85°C
- plus side VEGADIF 45 and VEGADIF 51		
isolating liquid:	p_{abs} ≥ 1 bar	/ 0.05 bar ≤ p_{abs} [1] < 1 bar
- silicone oil	-40°C … +200°C	/ -40°C … +180°C
- vegetable oil	-10°C … +200°C	/ -10°C … +120°C
- glycerine	+15°C … +200°C	/ –––
- high temperature oil	-10°C … +350°C	/ -10°C … +200°C
- oil for oxygen application	-40°C … +175°C	/ -40°C … +80°C
Storage and transport temperature	-40°C … +100°C (VEGADIF 34 and 44)	
	-50°C … +100°C (VEGADIF 35, 45 and 51)	

Ex technical data CENELEC

General data

Classification mark	EEx ia IIC T4/T6

Intrinsically safe supply and signal circuit

Classification	EEx ia IIC
Only for connection to certified, intrinsically safe circuits with the max. values:	
- voltage	U_O = 30 V
- current	I_K = 300 mA
- efficiency	P = 1 W
Inner effective capacitance	C_{int} = 11.2 nF
Inner effective inductance	L_{int} = 0.2 mH

Ambient conditions

Ambient temperature around the oscillator	
- temperature class T6	-40°C … +40°C
- temperature class T5	-40°C … +55°C
- temperature class T4	-40°C … +85°C

[1] at p_{abs} < 1 bar (vacuum range) the isolating liquid boils already at lower temperatures

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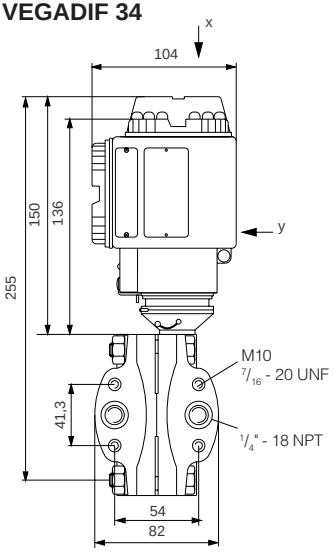
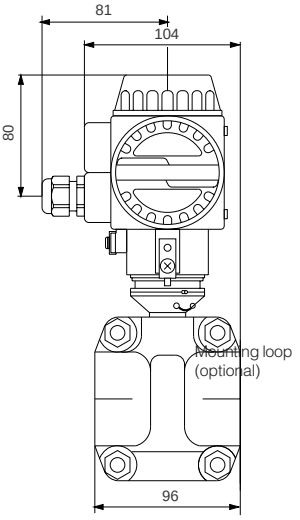
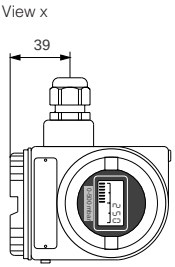
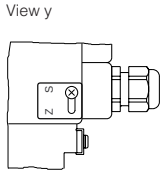
1.5 Dimensions

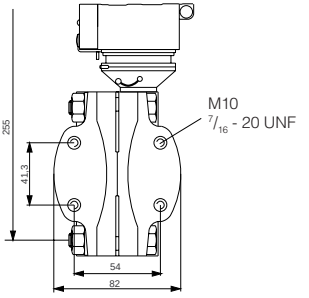
VEGADIF 34

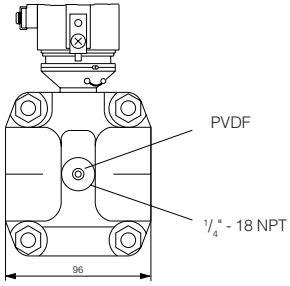






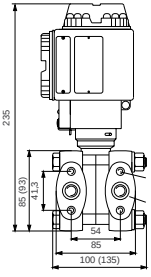


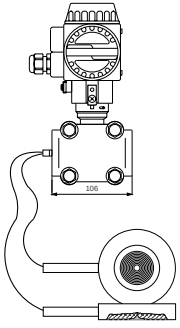




with PVDF flange

VEGADIF 35

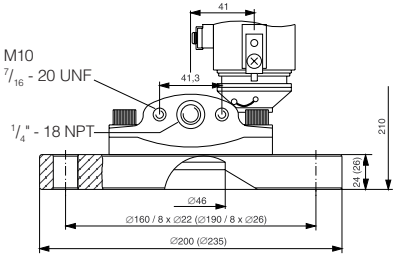




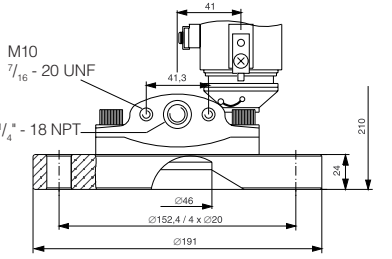
The values in brackets relate to PN 420

VEGADIF 44

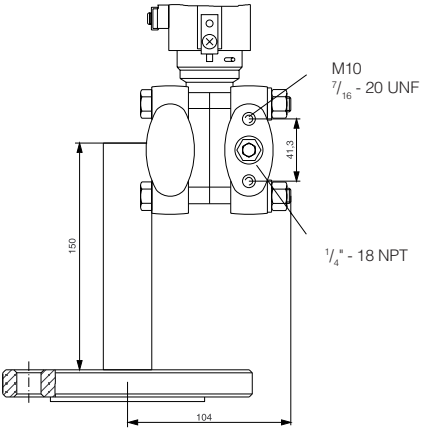
DIN flange DN 80/DN 100



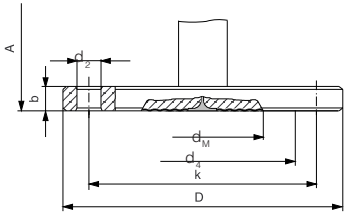
ANSI flange 3"

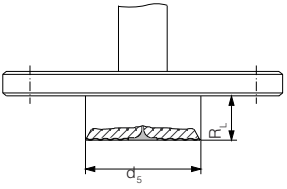


VEGADIF 45



A	=	Installation height
D	=	Outer flange diameter
b	=	Flange thickness
k	=	Diameter of hole circle
d_2	=	Diameter of hole
d_4	=	Seal ledge diameter
d_5	=	Extension diameter
R_L	=	Extension length
d_M	=	Diaphragm diameter





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Flange connection acc. to DIN 2501, seal ledge acc. to DIN 2526 form D

Order code	Flange Size / Nominal pressure	D	b	k	Holes No.	d_2	Seal ledge d_4	d_M	Dia. R_L	Extension d_5	d_M	Install. height A
B	DN 50 / PN 40	165	20	125	4	18	102	46	––	––	––	360
C	DN 80 / PN 40	200	24	160	8	22	138	70	––	––	––	360
D	DN 80 / PN 40	200	24	160	8	22	138	––	50	76.5	70	360
E	DN 80 / PN 40	200	24	160	8	22	138	––	100	76.5	70	360
F	DN 80 / PN 40	200	24	160	8	22	138	––	200	76.5	70	360
G	DN 100 / PN 40	235	26	190	8	26	162	70	––	76.5	70	360

Flange connection acc. to ANSI B 16,5

Order code	Flange Size in	/ Nominal pr. lb/sq in	D in/mm	b in/mm	k in/mm	Holes No.	d_2 in/mm	Seal ledge d_4 in/mm	d_M in/mm	Dia. R_L in/mm	Extension d_5 in/mm	d_M in/mm	Install. height A
P	2	/ 150	6/152	$^3/_4$ / 19.5	$4^3/_4$/ 120.7	4	$^3/_4$/ 20	$3^5/_8$/ 92	$1^3/_4$/ 46	––	––	––	14.2/ 360
R	3	/ 150	8.25/ 191	$^{15}/_{16}$ / 24	6/ 152.4	4	$^3/_4$/ 20	5 / 127	$2^3/_4$/ 70	––	––	––	14.2/ 360
S	3	/ 150	8.25/ 191	$^{15}/_{16}$ / 24	6/ 152.4	4	$^3/_4$/ 20	5/ 127	––	2/ 50.8	3/ 76.5	$2^3/_4$/ 70	14.2/ 360
T	3	/ 150	8.25/ 191	$^{15}/_{16}$ / 24	6/ 152.4	4	$^3/_4$/ 20	5/ 127	––	4/ 101.6	3/ 76.5	$2^3/_4$/ 70	14.2/ 360
U	3	/ 150	8.25/ 191	$^{15}/_{16}$ / 24	6/ 152.4	4	$^3/_4$/ 20	5/ 127	––	8/ 203.2	3/ 76.5	$2^3/_4$/ 70	14.2/ 360
W	4	/ 300	10/ 254	$1^1/_2$ / 32	$7^8/_9$/ 200.1	8	$^{14}/_{16}$/ 23	$6^2/_9$/ 158	$2^3/_4$/ 70	––	––	––	14.2/ 360

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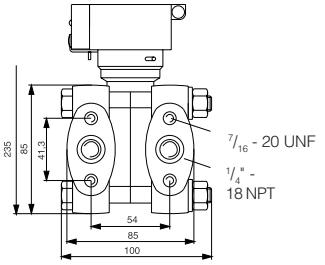
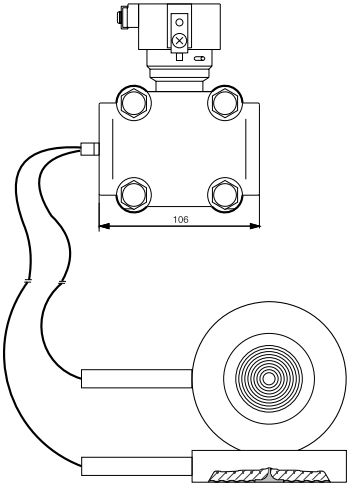
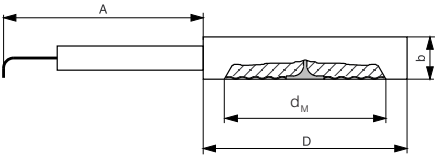
VEGADIF 51





Isolating diaphragm in cell version, AA … CR



acc. to DIN 2501

Order code	Socket Size/Nominal pressure	Cell D	b	d_M	Min. mounting distance A	Max. pressure	Weight approx.
AA	DN 50 PN 16	102	20	46	130	400 bar	2.6 kg
AK	DN 80 PN 16	138	20	70	130	400 bar	4.6 kg
AM	DN 80 PN 16 PTFE	138	20	70	130	400 bar	4.6 kg
AN	DN 80 PN 16 Hastelloy	138	20	70	130	400 bar	4.6 kg
AR	DN 100 PN 16	158	20	70	130	400 bar	6.2 kg

acc. to ANSI 16.5

Order code	Socket Size/Nom pr. in / lb sq in	Cell D in/mm	b in/mm	d_M in/mm	Min. mounting distance A in/mm	Max. pressure lb/sq in	Weight approx.
CK	3 / 150	$7^1/_2$ / 134	$^3/_4$ / 20	$2^3/_4$ / 70	5 / 130	––	4.5 kg
CR	4 / 150	$8^1/_4$ / 158	$^3/_4$ / 20	$2^3/_4$ / 70	5 / 130	2500	6.2 kg

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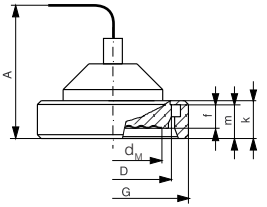
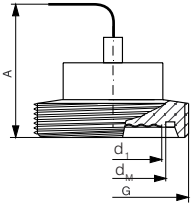
Isolating diaphragm as cone socket with compression nut, FA … FK



acc. to DIN 11 851

Order code	Socket Size/Nominal pr.	Cell D	f	d_M	Compression nut G	k	m	Min. mount. distance A	Weight approx.
FA	DN 50/PN 25	68	11	46	Rd78x1/6"	22	19	120	2.2 kg
FE	DN 65/PN 25	86	12	52	Rd95x1/6"	25	21	120	4.0 kg
FK	DN 80/PN 25	100	12	71.5	Rd110x1/4"	29	25	120	5.1 kg

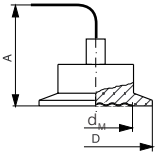
Isolating diaphragm as threaded socket, GA … GK



acc. to DIN 11 851

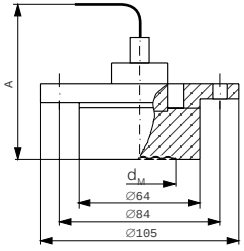
Order code	Socket Size/Nominal pr.	Threaded socket d_1	G	d_M	Min. mounting distance A	Weight approx.
GA	DN 50/PN 25	60	Rd78/1/6"	46	110	1.8 kg
GA	DN 65/PN 25	66	Rd95x1/6"	52	110	3.4 kg
GK	DN 80/PN 25	91	Rd110x1/6"	71.5	110	4.0 kg

Isolating diaphragm as Clamp, HA and HK



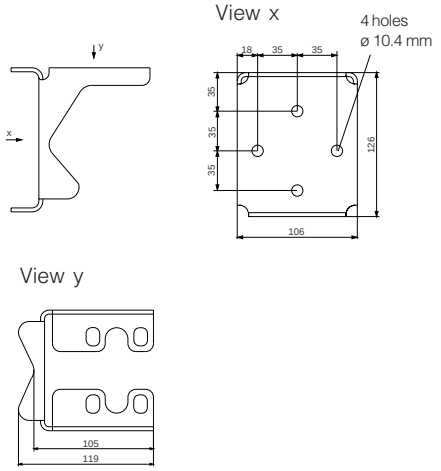
Order code	Socket Size/Nominal pr.	Terminal socket D	d_M	Min. mounting distance A	Weight approx.
HA	DN 2" PN 40	64	46	100	1.4 kg
HK	DN 3" PN 40	91	71.5	100	2.4 kg

Isolating diaphragm as DRD flange, KE

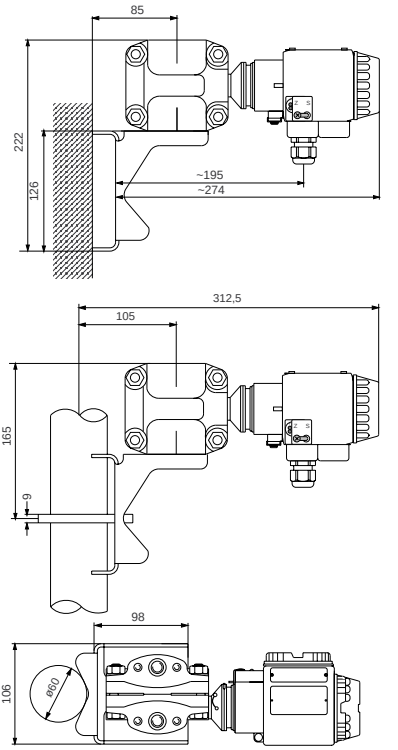


Order code	Socket Nominal pr.	Dimensions	d_M	Min. mounting distance A	Weight approx.
KE	PN 25	see drawing	46	100	1.5 kg

Mounting bracket



Installation instructions



1.6 Approvals

For these applications the appropriate official documents (test reports, test certificates and conformity certificates) have to be noted. These are supplied with the appropriate instrument.

Overview of approvals being prepared or applied for

Approval Type	CENELEC EEx ia IIC	CENELEC EEx d IIC	PTB-Zone 0 EEx ia IIC	FM Explosion proof and non incentive	FM Intrinsically safe	WHG
VEGADIF 34	•	•	•	•	•	•
VEGADIF 35	•	•	•	•	•	•
VEGADIF 44	•	•	•	•	•	•
VEGADIF 45	•	•	•	•	•	•
VEGADIF 51	•	•	•	•	•	•

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2 Mounting

2.1 Checking the operating conditions

VEGADIF is a rugged transmitter for precise differential pressure, level and flow measurement. The accuracy of the measurement mainly depends on the correct installation and connection of differential pressure lines.

Detailed information on differential pressure measurement in corrosive products as well as further information on wiring and coordination of valves, measuring lines and components is provided in the VDI/VDE regulations 3512 as well as DIN 19 201 and DIN 1952. Further information on level measurement is stated in the VDI/VDE regulations 3519.

The implemented differential pressure transmitter must meet the technical and safety requirements of the application. For this reason, double-check the type plate, calibration plate and order code regarding the following data:

Nominal pressure

The nominal pressure rating of VEGADIF must be above the operating pressure of the process.

Measuring range

The measuring range is calibrated (factory setting) according to the order data. The pressure values adjusted for zero and span are documented on the calibration plate. The values must cover the application. If an adaptation is necessary, this should be carried out acc. to section 4 Set-up.

Materials of wetted parts

The materials of wetted parts must be sufficiently resistant. Use the respective material tables to check this. A table is provided in the product information manual of VEGADIF, for more information we recommend the VEGA resistance lists.

Ambient temperature

The ambient temperature at the installation site must be in the range of -40°C … +85°C. The surface temperature of the electronics housing must not exceed +85°C. It is therefore important to make sure that the temperature of the electronics housing does not go above +85°C through radiated heat from neighbouring instruments or other system equipment. If there is the danger of this happening, VEGADIF should be protected against this heat radiation. If temperatures below -40°C are expected at the installation, the transmitter should be installed in a temperature insulated and heatable protective box. If there is the danger of medium or condensate freezing in the process connection or on the measuring cell, the transmitter must be installed in a warmer place or in a heatable protective box for the process connections and process seals. Similar measures should be taken to protect the pressure lines.

Product temperature

The permissible product temperature depends on the process seal, the measuring cell and the isolating liquid. When VEGADIF 45 or 51 are used, note that the product temperature can differ between plus and minus side.

Humidity

Mount horizontally installed instruments with the cable entry pointing downward, in order to avoid moisture ingress. To facilitate this, the sensor housing can be rotated by approx. 350°. With vertically installed instruments, loop the connection cables in a bow pointing downward towards the instrument housing, so that rain and condensation water can drain off. This applies particularly when mounting outdoors, in humid areas (e.g. by cleaning processes) or on cooled or heated vessels.

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2.2 Pre-installation

Selection of the installation location

Especially under extreme ambient conditions, selection of a suitable mounting site is decisive for the
- quality of the measurement
- lifespan of the transmitter
- level of maintenance expenses.

Please observe the following rules:

Installation level
- **Below** the min. level for level measurements (the diaphragm or the isolating diaphragm must be completely covered by the medium).
- **Above** the pressure tapping point for measurement of gases.
- **Below** the pressure tapping point for measurement of vapours and liquids.

Mounting location
- Mount the transmitter as near as possible to the pressure tapping point.
- Keep impulse lines as short as possible.
- Mounting and maintenance work should be carried out without obstructions.
- The transmitter, the tapping points, the impulse lines and the valves should be easily accessible.
- If available, the mounting site should provide a good view to the LC display.

Ambient influences
- Keep vibration and shock to a minimum.
- Avoid corrosive ambient atmosphere.
- Reduce condensation to a minimum.

Note:
Under unfavourable ambient conditions, a protective housing is recommended.

Adaptation of the transmitter

To optimally adapt your VEGADIF to the installation site, the following measures can be carried out:

Rotate the electronics housing
After loosening the locking screw below the electronics housing, the housing can be rotated by approx. 330°. A stop prevents further turning. By this means the terminal compartment can be set to an optimum position for cable entry or the LC display to an optimum reading position.

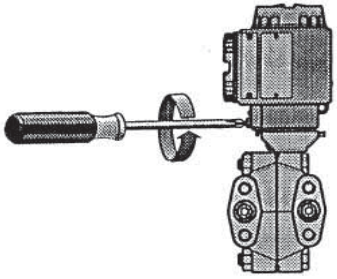


Fig. 2.1 Loosen the locking screw

When the best position is reached, tighten the locking screw again.

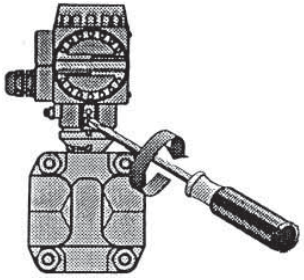


Fig. 2.2 Fastening the locking screw

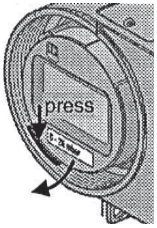
Rotating the display

If the integrated display is not correctly positioned it can be rotated in 90° steps after opening the housing cover.

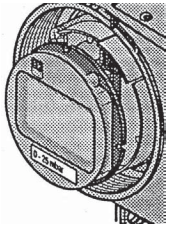
Avoid exposure of the electronics compartment and carry out these measures if possible in a workshop.

1 Unscrew the display cover

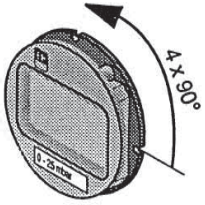
2 Push the protruding clamp with a screwdriver outwards



3 Tilt the display in this position and take it out



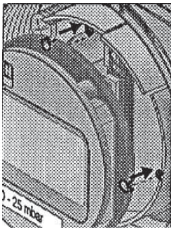
4 Rotate display as needed

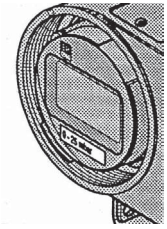


Note

Do not turn more than 2 x 90° to the left or right, otherwise the connection cable will be damaged.

5 Insert the display into the clamp until it snaps in





6 Screw the cover back on

Remove the protective cover

Transmitter or isolating diaphragm are provided with protective plastic covers. Remove them before installation.

2.3 Mounting

2.3.1 VEGADIF 34, 35 and 51

As a rule, the differential pressure transmitter must be firmly mounted. There are three mounting options for VEGADIF 34, 35 and 51:
- pipe mounting (2“ pipe)
- wall mounting
- mounting on a valve block [1)]

Simply hanging the transmitter on the pressure lines is not recommended and is not permitted with capillary lines.

For correct mounting, VEGA offers a universal mounting kit consisting of:
- a mounting bracket
- a pipe shackle for 2“ pipes (up to outer-ø 63 mm)
- two hexagon nuts M8 with plain washers
- four hexagon screws ($^{7}/_{16}$ UNF or M10 x 18[2)])

For easy removal of the transmitter, a three or five valve manifold (ball valve fitting) can be connected [1)].

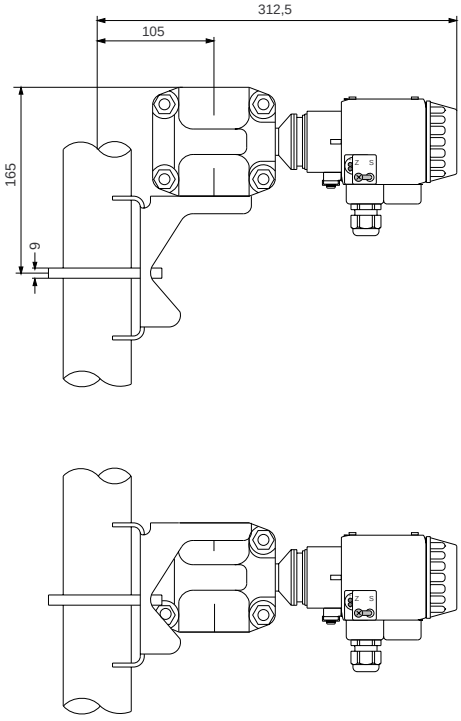
In this case, the valve block can be mounted with the mounting kit to a pipe or wall instead of the transmitter. This mounting option ensures easy mounting and dismounting of the transmitter without interrupting the process. The impulse lines can be sealed via the valves and the manifold with the connected impulse lines can be left in place after removal of the transmitter.

Pipe mounting

Use the complete mounting kit material and the take note of the following procedure:
1 Hold the mounting bracket in the required direction on the tube.
2 Insert the u-bolt around the pipe through the holes of the mounting bracket.
3 Screw the two hexagon nuts to the u-bolt and fasten the bracket to the pipe by tightening the nuts.
4 Fasten the transmitter to the bracket (the screws with plain washers pass through the holes of the bracket into the thread).

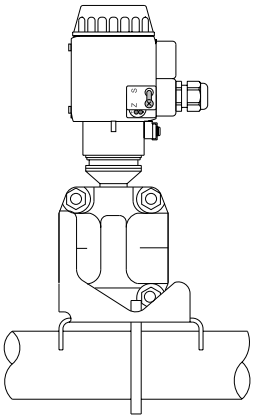
Mounting on vertical pipe

approx. dimensions in mm



[1)] not with VEGADIF 51
[2)] M12 x 18 with 420 bar version of VEGADIF 35

Mounting on horizontal pipe



Wall mounting

Use the following mounting kit material:
- mounting bracket
- four hexagon screws

Provide the following material:
- four screws with suitable plugs

Note the following procedure:
1 Screw the mounting bracket to the wall by using the screws with the suitable plugs.
2 Screw the transmitter to the bracket (the screws with plain washers pass via the holes of the bracket into the thread).

Mounting with valve block [1)]

The valve block is fastened by pipe or wall mounting as described above.

Procedure:
1 Fasten bracket to a pipe or wall.
2 Screw the valve block to the mounting bracket with two hexagon screws and plain washers.

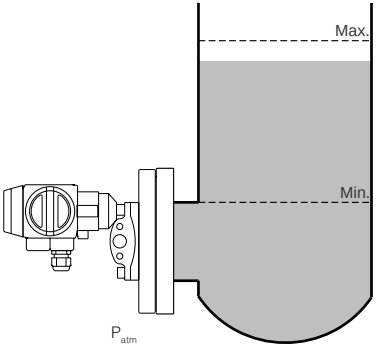
The transmitter is normally flanged to the valve block just before setting up the measurement loop.

2.3.2 VEGADIF 44 and 45

The following instructions are for VEGADIF 44, however, they are also applicable to VEGADIF 45.

Open vessel

The minus side of the transmitter is open to atmospheric pressure. Therefore the open process connection of the minus side should point downwards.

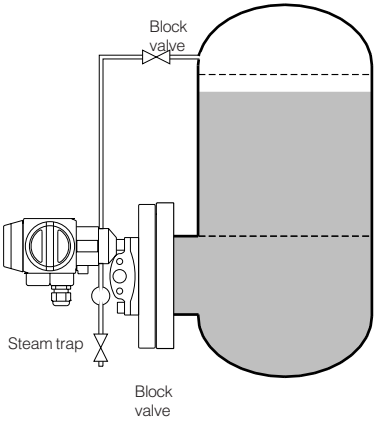


Atmospheric pressure on the minus side of the transmitter

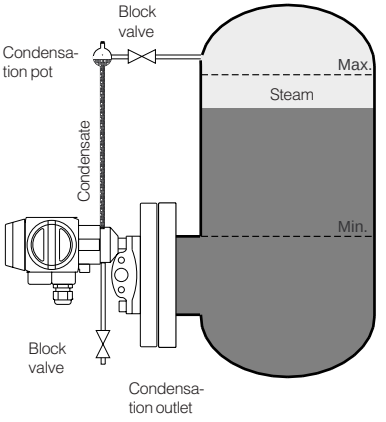
1) not with VEGADIF 51

Closed vessel

The minus side of the transmitter is connected via an impulse line with the vessel and receives the overlaid pressure. The pressure tapping point must be above the max. level. The impulse line should equipped with a block valve.



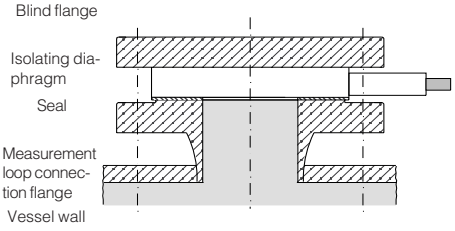
If the static pressure is caused by steam above the product, the minus side is connected via a condensate column. Before opening the block valve, the impulse line must be filled via the condensation pot.



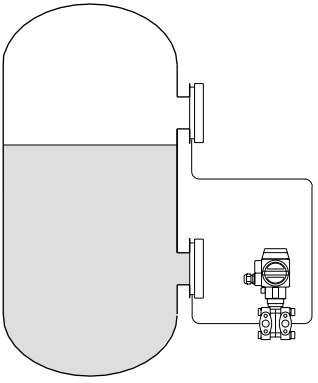
2.3.3 Isolating diaphragm mounting with VEGADIF 51

The two isolating diaphragms connect the pressure transmitter with the process. The dimensions of the cell isolating diaphragm are dependent on the respective standard flange. The fastening is made by means of a suitable blind flange. Depending on the flange, a seal acc. to DIN 2690 or ANSI B 16.5 must be used.

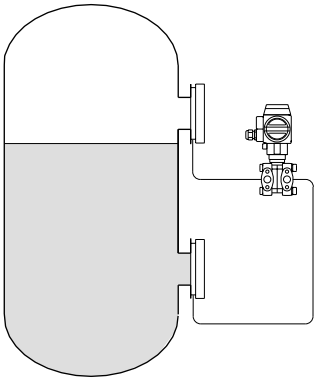
Mounting



Level measurement

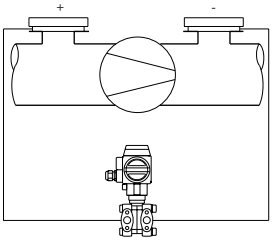


Recommended mounting

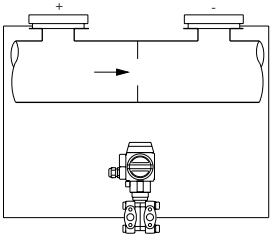


Only permitted if no vacuum can occur (not even short-term occurrence).

Differential pressure measurement



Flow measurement



Avoid buildup in the form of solids or adhesive products on the isolating diaphragm when mounting to horizontal pipelines. We recommend positioning the flange connections on top of the pipe.

3 Electrical connection

3.1 Connection instructions

The electronics of the pressure transmitters requires a supply voltage of 11.5 … 45 V DC. Supply voltage (DC voltage) and current signal are carried over the same two-wire connection cable to the terminals.

The supply voltage is provided via a separate power supply unit:
- power supply unit (e.g. VEGASTAB 690)
- processing unit with integrated DC voltage source (e.g. active PLC input)
- VEGAMET series 500 or 600 signal conditioning instrument, VEGALOG 571 processing system or VEGADIS 371 indicating instrument

Make sure that the external energy source is reliably separated from the mains circuits acc. to DIN VDE 0106, part 101. VEGA instruments meet this requirement and protection class III is therefore maintained.

For electrical connection note the following instructions:
- The connection must be made acc. to the specific national installation standards (e.g. in Germany acc. to the VDE regulations).
- The wiring between transmitter and power supply can be carried out with standard two-wire cable.
- If strong electromagnetic interference is expected, screened cable is recommended. The screening must be earthed at one sensor end.
- The connection cable for the external energy must never be connected to terminal 3 of the terminal block or to the test plug connection via terminal 1 of the terminal block (danger of damaging the electronics).
- After electrical connection, housing cover and cable entry must be tightened to avoid moisture ingress in the connection compartment

3.2 Load resistance

Various instruments can be connected to the signal output of the pressure transmitter, e.g.:
- remote transmission systems
- computers
- indicating instruments
- recorders
- controllers
- contactors etc.

The total resistance of the connected instruments and the connection cable must not exceed the value of the max. load resistance.

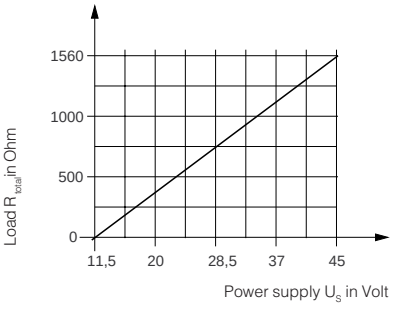
The load resistance consists of the line resistance R_L, adjustment resistance R_X, and the resistance of the processing system and/or indicating instrument.

This max. load resistance depends on the voltage of the external energy and can be calculated acc. to the following formula:

$$R_{Lmax} = \frac{U_S - U_K}{I_{max}}$$

R_{Lmax} = max. load resistance
U_S = power supply
U_{KI} = terminal voltage
I_{max} = max. current (approx. 23 mA)

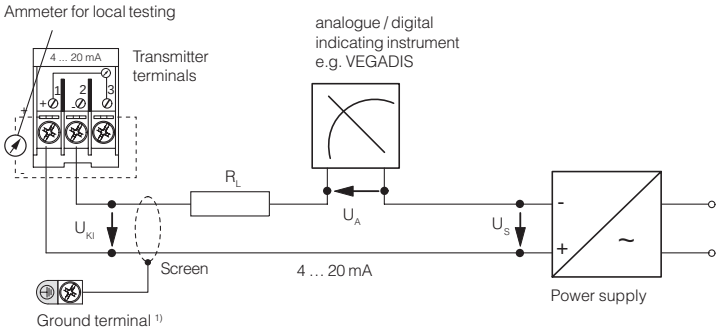
The following load diagram is used for simplified determination of this value:



3.3 Connection

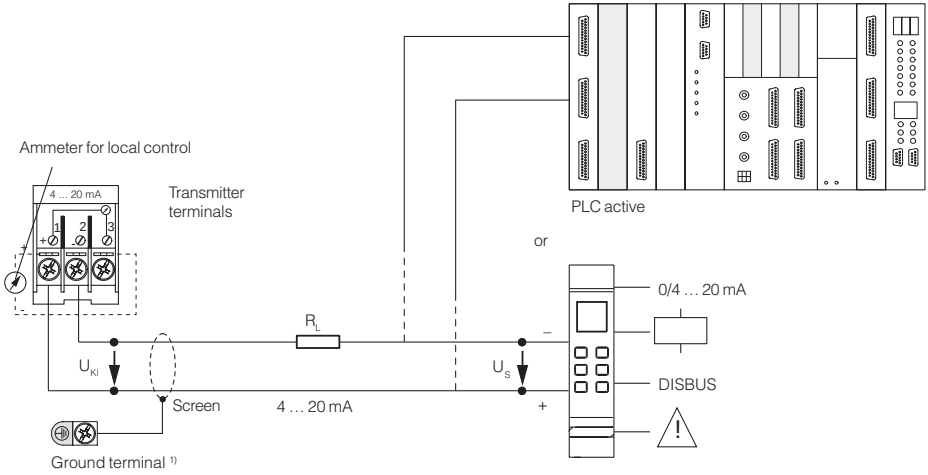
Electronics powered by a power supply unit

Processing via an indicating instrument.



Electronics powered by a VEGA signal conditioning instrument or a PLC with active input circuit

Processing is made via the PLC or the VEGAMET signal conditioning instrument.



U_S = Power supply
U_A = Voltage loss in the indicating instrument
U_{KL} = Terminal voltage (supply voltage)
R_L = Resistance processing systems and connection cable (load resistance)

1) Connect screen, here, ground terminals on the housing exterior acc. to regulations. The two terminals are galvanically connected.

Note:

An ammeter for local testing of the output current can be connected to terminals 1 and 3 as well as their tag. This measurement can be made during operation without interrupting the supply cable.

3.4 Ex applications

Applications in Ex areas require the use of approved instruments.

For these applications, the appropriate documents (test reports, test and conformity certificates) must be noted. These are supplied with the appropriate instrument.

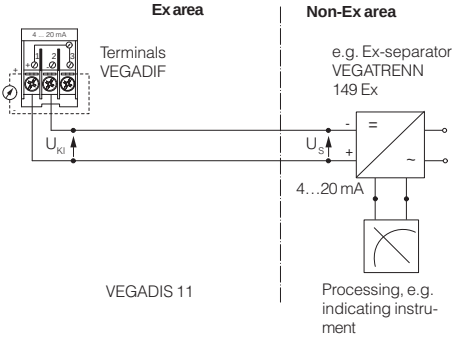
Please note the attached approval documents (yellow binder) and especially the attached safety data sheet.

In Ex applications, the power must be provided only via an intrinsically safe circuit.
There are the following options:
- VEGAMET signal conditioning instrument in Ex version
- non-certified VEGAMET signal conditioning instrument with VEGA safety barrier type 145
- Ex separator (e.g. VEGATRENN 149 Ex)
- VEGADIS 371 indicating and power supply unit in Ex version.

The legal documents of these instruments must also be noted.

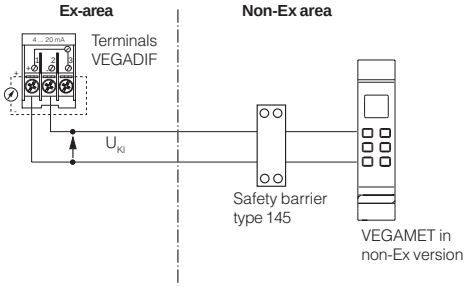
Application with power supply via Ex-separator, e.g. VEGATRENN 149 Ex

The processing is done by an indicating instrument in non-Ex area.



Ex application with power supply via VEGA non-Ex signal conditioning instrument with safety barrier type 145

The processing is done by the signal conditioning instrument in the non-Ex area.



Note
- Carry out the adjustment only with connected safety barrier (reason: the current consumption of approx. 300 µA is considered).
- When connecting a VEGADIS 11 Ex the regulations for wiring of intrinsically safe circuits should be noted.

Determination of the cable length in the ia IIC circuit
The sum of the inner capacitances and inductances of the components must not exceed the max. permissible values of the ia IIC circuit.

Example:

ia IIC circuit max. total L_{ext}/C_{ext}	Pressure transmitter L_{int}/C_{int}	1 pce. overv. arrester L_{int}/C_{int}	Cable [1] L_{int}/C_{int}
0.5 mH	0.2 mH	0.13 mH	0.17 mH
56 nF	11.2 nF	1 nF	44.8 nF

[1] Typical values for unscreened two-wire cables:
L‘ = 0.00065 mH/m; C‘ = 0.00012 nF/m

Calculation of L_{int}/C_{int} of the cable:

L_{int} (cable) = L_{ext} (ia IIC circuit) – L_{int} (pressure transmitter) – L_{int} (overvoltage protection)

= 0.5 mH – 0.2 mH - 0.13 mH

= 0.17 mH

C_{int} (cable) = C_{ext} (ia IIC circuit) – C_{int} (pressure transmitter) – C_{int} (overvoltage protection)

= 56 nF – 11.2 nF - 1 nF

= 44.8 nF

Calculation of the cable length:

$$l = \frac{0.17\ \text{mH}}{0.65\ \mu\text{H}} \bullet m = 262\ \text{m}$$

$$l = \frac{44.8\ \text{nF}}{120\ \text{pF}\ *} \bullet m = 373\ \text{m}$$

To be on the safe side, the cable length in this example should not exceed a value of 250 m.

4 Set-up

4.1 Adjustment structure

The differential pressure transmitters can be set up with
- the PC and the VEGA adjustment program VVO,
- the HART® handheld or
- the integrated 4-key adjustment elements.

Adjustment program VVO

The adjustment program VVO (VEGA Visual Operating) on the PC allows very convenient sensor adjustment. The PC communicates via the interface converter VEGACONNECT 2 with the sensor. During adjustment, a digital adjustment signal is superimposed on the signal and supply cable. The adjustment can be carried out a any point along the signal cable, and of course also directly on the sensor.

HART® handheld

Beside the PC and the 4-key adjustment elements, the sensors can be also adjusted with the HART® handheld.

4-key adjustment elements with LC-display

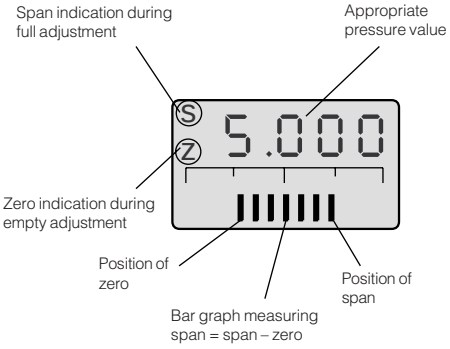
If you have neither a PC nor a HART® handheld, the sensors can be also set up directly with the integrated 4-key adjustment elements.

4.2 Adjustment with the 4-key adjustment element

LC display in operating mode

According to the ordered version, your VEGADIF is provided with an integrated LC-display. This display can be retrofitted or removed. The display is located below the upper housing cover behind a glass pane.

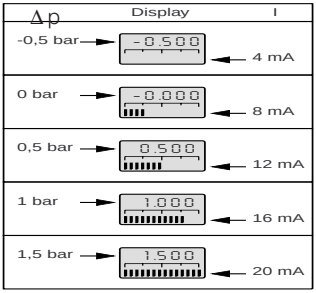
The LC display provides the following information in the adjustment mode:



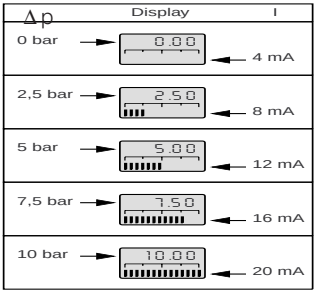
LC-display

The following examples show possible indication values.

Example 1: Meas. range -0.5 … 1.5 bar, LCD in operating mode



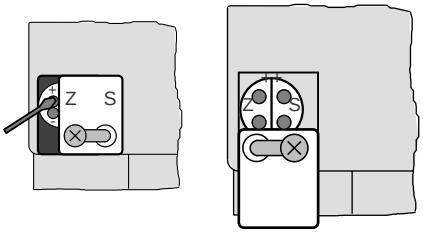
Example 2: Meas. range 0 … 10 bar



4-key adjustment elements

Your VEGADIF is provided with the following direct adjustment elements:
- four adjustment keys
- one step switch

The adjustment keys are located below a sliding cover laterally on the electronics housing. The slider cover is marked with z (zero) and s (span) and can be moved after loosening the recessed head screw. When the sliding cover is moved, two adjustment keys are exposed; when the sliding cover is rotated, all four adjustment keys are exposed.

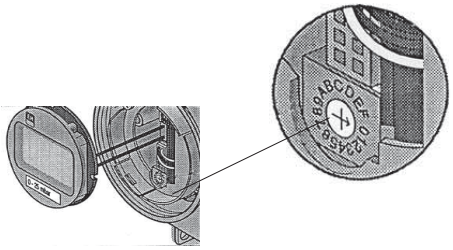


First of all the sliding cover exposes 2 keys and then all four keys

Via these four keys in conjunction with the LC-display, you can carry out the most important adjustments such as zero, span and bias pressure directly on the transmitter.

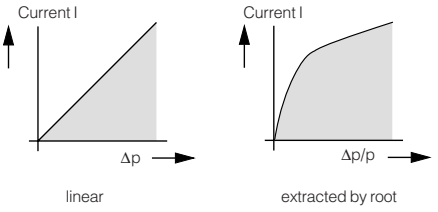
If you have a VEGADIF without LC-display, connect an ammeter with measuring range 0 … 20 mA (e.g. digital multimeter) to the terminal and tag 1. A precision ammeter is recommended for exact adjustment. Push the keys with a small screwdriver.

The second adjustment element, the step switch, is located below the LC-display; to use it, remove the display, as described under „2.2 Pre-installation“.



The step switch below the LC-display

The settings on the step switch mean:
- **0 Adjustment with PC or HART®, therefore damping adjustable from 0 … 40 s**
- 2 Damping 0.5 s linear
- 3 Damping 1.0 s linear
- 4 Damping 2.0 s linear
- 5 Damping 4.0 s linear
- 6 Damping 8.0 s linear
- 7 Damping 16.0 s linear
- **8 Adjustment with PC or HART®, therefore damping adjustable from 0 … 40 s**
- 9 Damping 0 s extracted by root
- A Damping 0.5 s extracted by root
- B Damping 1.0 s extracted by root
- C Damping 2.0 s extracted by root
- D Damping 4.0 s extracted by root
- E Damping 8.0 s extracted by root
- F Damping 16.0 s extracted by root



Display zero
1 Push +z or –z key
2 Monitor the displayed value and release the key again.

After approx. 2 s the indication resets automatically to operating mode.

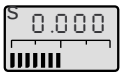
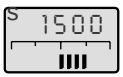
Example for display of zero:

Meas. range	Display
-3…0 bar	
0…1,5 bar	
2,5…-0,5 bar [1]	

Display span
1 Push +s or –s key
2 Monitor the displayed value for s and release the key again

The display resets automatically to operating mode after approx. 2 s.

Examples for display of span:

Meas. range	Display
-3…0 bar	
0…1,5 bar	
2,5…-0,5 bar [1]	

[1] This setting effects an inversion of the current output

Data of the default setting

Measuring range
Your VEGADIF is calibrated acc. to the order. The calibration data is stated on the calibration plate, e.g. 0 … 1000 mbar.

For this measuring range:
- The 4 mA signal is always assigned to the first pressure value (in the example 0 mbar).
- The 20 mA signal is always assigned to the second pressure value (in the example 1000 mbar).

Check if the calibrated measuring value corresponds to the application and, if necessary, adapt acc. to the following paragraph „Adjustment“.

Integration time
A factory set integration time of 0 s is supplied. Via the step switch this time can be changed from 0 … 16 s, with the PC to 0 … 40 s, to achieve an increased smoothing of the output signal.

Output characteristics
The factory setting is linear characteristics. A square root output can be selected with the step switch.

Electronics replacement
The calibration data is saved in the EERPOM memory of the electronics. Always check the data when replacing the electronics and modify, if necessary.

Adjustment

First note the adjustment range for zero and span. The values are stated under „1.4 Technical data - Transmission reaction“. Make sure that your requested values are within the possible adjustment ranges.

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Two adjustment methods are available
- adjustment without pressure (dry)
- adjustment with pressure (wet)

The dry adjustment can be carried out in the workshop before mounting or after mounting at the measuring site. During adjustment **before** mounting, make sure that the position of the transmitter corresponds to the intended installation position. This is particularly necessary for VEGADIF 45 and 51 with isolating system or capillaries. For sensors without display you should use a precision ammeter (class 0.03 or better) to adjust the current output.

Adjustment without pressure (dry)

Reduce zero
1 Push the z– key twice and hold it pushed.
2 Note the current change.
3 Release the z- key when the requested current value is reached.
4 The display resets automatically to operating mode after approx. 2 s and the adjusted value is saved.

Example:
given: 0 … 1000 mbar, (z = 0 mbar, s = 1000 mbar)
z to be changed to: z = -500 mbar

Increase zero
Push the z+ key twice and hold it pushed. The procedure is the same as for reduce zero.

Reduce span
1 Push the s– key twice and hold it pushed.
2 Note the current change.
3 Release the s- key when the requested value is reached.
4 The display resets automatically to operating mode after approx. 2 s and the adjusted value is saved.

Example:
given: 0 … 1000 mbar, (z = 0 mbar, s = 1000 mbar)
to be changed to: s = 500 mbar

Push the s- key and hold it pushed until 500 mbar are adjusted.

Adjustment range (editing limits) of zero and span:
-110 … +110 % of the nominal range

Adjustment with pressure (wet)

When adjusting with pressure, VEGADIF must be connected to a variable pressure source. These are the options:
- connect to a pressure calibrator
- connect directly to the process

Adjust zero with display
1) Set pressure for zero precisely (e.g. 0 bar) and check via the display.
2) Push the z+ and z– keys simultaneously.

The pressure (e.g. 0 bar) corresponds to the output current 4 mA.

Adjust span with display
1) Set pressure for span precisely (e.g. 1 bar) and check via the display.
2) Push the s+ and s– keys simultaneously.

The pressure (e.g. 1 bar) corresponds to the output current 20 mA.

Adjust zero without display
1) Set pressure for zero precisely (e.g. 0 bar) and check via an external pressure calibrator.
2) Push the z+ and z– keys simultaneously.

The pressure (e.g. 0 bar) corresponds to the output current 4 mA.

Adjust span without display

1) Set pressure for span precisely (e.g. 1 bar) and check via an external pressure calibrator.
2) Push the s+ and s– keys simultaneously.

The pressure (e.g. 1 bar) corresponds to the output current 20 mA.

Adjust zero/span without display, however with current ammeter

For adjustment, a control instrument with measuring range 0 … 20 mA is connected to terminal 1 and tag 1.

1) Set pressure for zero precisely (e.g. 0 bar) and check via an external pressure calibrator.
2) Adjust with the z+ and z– keys a current of 4 mA.

The pressure (e.g. 0 bar) corresponds to the output current 4 mA.

3) Set pressure for span precisely (e.g. 1 bar) and check via an external pressure calibrator.
4) Adjust with the s+ and s– keys a current of 20 mA.

The pressure (e.g. 1 bar) corresponds to the output current 20 mA.

Note:
If only intermediate values are available for the reference pressures, the current to be adjusted can be also calculated:

$$I = 4\ mA + 16\ mA \bullet \frac{p - p_z}{p_s - p_z}$$

p = Reference pressure
p_s = Pressure at span
p_z = Pressure at zero

Example:
Meas. range 0 … 1000 mbar
Reference pressures span p_s = 1000 mbar, zero p_z = 0 mbar, reference pressure p = 250 mA (750 mbar)

$$I_z = 4\ mA + 16\ mA \bullet \frac{250\ mbar - 0\ mbar}{1000\ mbar - 0\ mbar}$$

I_z = 8 mA

$$I_s = 4\ mA + 16\ mA \bullet \frac{750\ mbar - 0\ mbar}{1000\ mbar - 0\ mbar}$$

I_s = 16 mA

Position adjustment display (bias pressure)

In some cases the display does not show zero for zero pressure when setting zero. These can be the reasons:
- effective pressure lines have different fillings
- asymmetrical routing of the capillary cables
- position-dependent measuring cell (max. 2 mbar by 90° tilt).

The function „Save/accept bias pressure“ saves the available pressure as correction value and sets the display to zero. The pressure values for zero and span are now shifted by the bias pressure (see example below). This shift is only possible up to the editing limits. This shift does not affect the current output.

Example:
Save/accept before bias pressure
Zero 0.000 bar, span 0.500 bar
Display = -0.002 bar

Save/accept after bias pressure
Zero 0.002 bar, span 502 bar
Display = 0.000 mbar.

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Display bias pressure

1) Push the z+ and s+ keys once simultaneously.
2) The adjusted bias pressure is displayed.
3) The display resets automatically to operating mode after approx. 2 s.

Save/accept bias pressure

1) Push the z+ and s+ keys twice simultaneously. The available pressure value is accepted as bias value.
2) The display resets automatically to operating mode after approx. 2 s and displays 0.000 bar. The acting pressure (0 bar) was thus accepted as bias pressure (correction value).

Delete bias pressure

1) Push the z– and s– keys simultaneously twice.
2) The display resets automatically to operating mode after approx. 2 s and displays the value of the uncorrected bias pressure.

Lock/unlock keys

Lock

1) Push the z+ and s– keys simultaneously twice.
2) „Prot“ = protected appears.
3) The display resets automatically to operating mode after approx. 2 s.

Unlock

1) Push the z– and s+ keys simultaneously once.
2) „Free“ = unlocked appears.
3) The display resets automatically to operating mode after approx. 2 s.

Integration time and output characteristics

An integration time of 0, 1, 2, 4, 8, 16 s can be adjusted via the step switch on your VEGADIF to smooth the output signal. The output characteristics for pressure, level and flow can be selected as linear or extracted by root.

The integration time is the time required by the output to reach 63 % of the actual height after a signal jump of the differential pressure. After three times the adjusted integration time, the current output signal has reached 95 % of the step change.

Explanation:
- an integration time of 0 s means tracking of the current output without additional delay.
- an integration time of 16 s means that the output will reach its final value only after more than one minute.

Adjust the integration time and the output characteristics acc. to the chart. The figures indicate the switch positions:

Characteristics / Integration time	linear $I \sim \Delta p$	extracted by root $I \sim \sqrt{\Delta p/\Delta p}_{max.}$
0 s	1	9
0.5 s	2	A
1 s	3	B
2 s	4	C
4 s	5	D
8 s	6	E
16 s	7	F

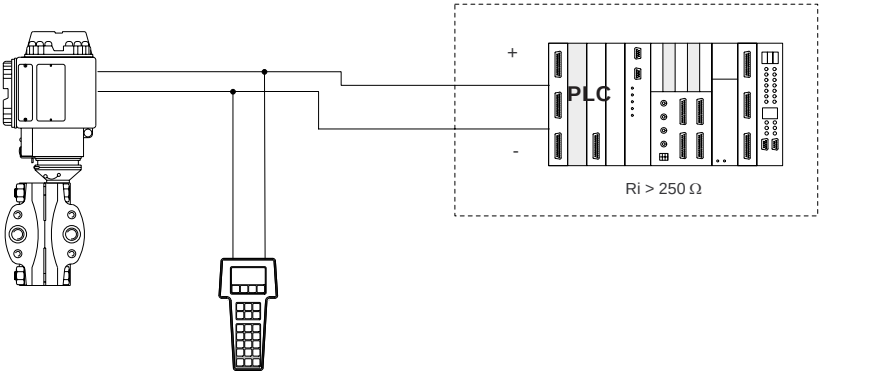
Positions 0 and 8 allow the adjustment with the PC (VVO) or the HART® handheld by which you can also adjust the integration time of 0 … 40 s.

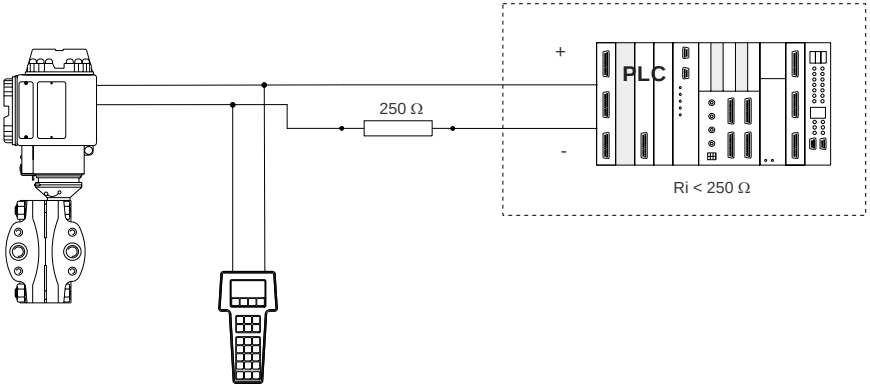
4.3 Adjustment with the HART® handheld

Apart from adjustment with the 4-key adjustment element in the sensor and adjustment with the PC and the adjustment software VVO, a VEGADIF can be also operated with a HART® handheld. If the inner resistance of the power supply is less than 250 Ω, a resistor of R_X = 250 Ω $^1/_4$ W must be connected to the signal /connection cable during adjustment.

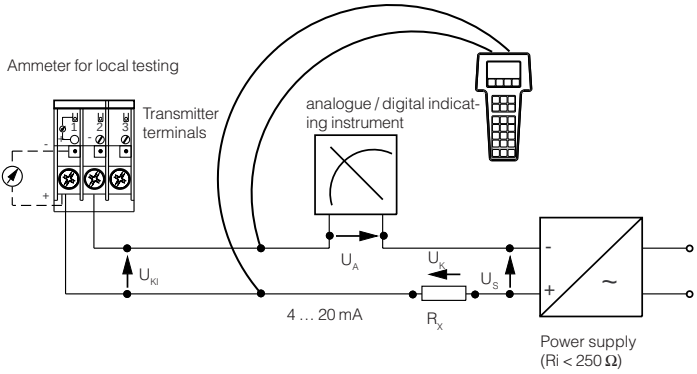
The digital adjustment and communication signals would otherwise be short-circuited because of insufficient resistances of the supply current source or the processing system - sensor communication would not be ensured.

Electronics powered by PLC with active input circuit



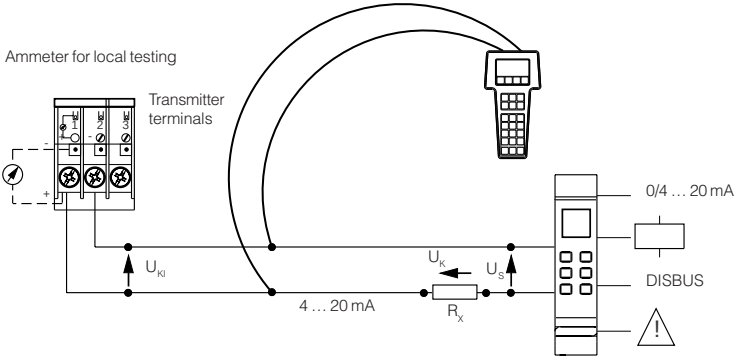


Electronics powered by a power supply unit



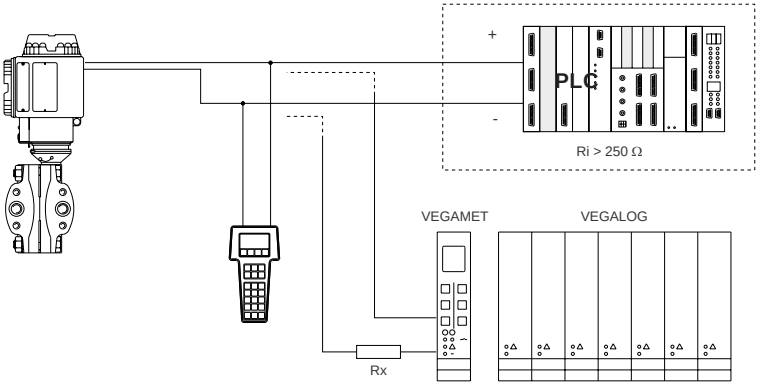
Note:
An ammeter for local testing of the output current can be connected between terminal 1 and its tag. This measurement can be carried out during operation without interrupting the supply cable.

Electronics powered by a VEGA signal conditioning instrument



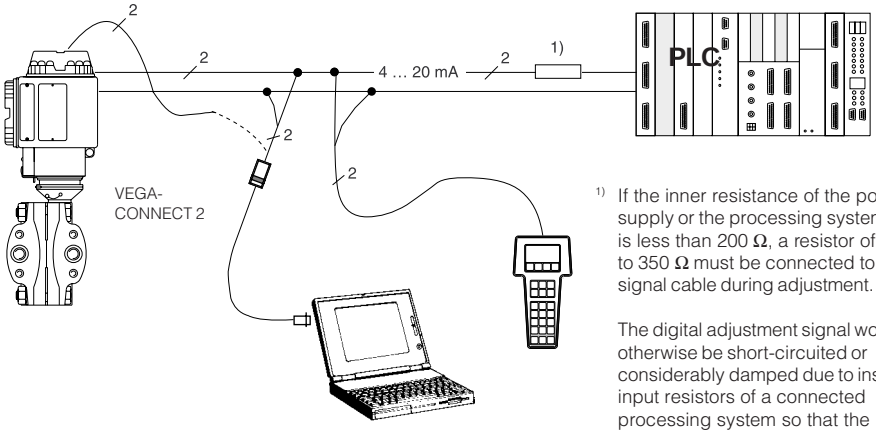
If the differential pressure transmitters are operated on a VEGA signal conditioning instrument, you have to connect the sensor via a resistor acc. to the following chart (see next page) to the signal conditioning instrument during the HART® adjustment. Together with the inner resistance of the signal conditioning instrument, the resistance value of 250 Ω required for the HART® instrument is reached.

If the resistance of the processing system or the power supply is more than 250 Ω, then no „adjustment resistor“ required.



VEGA signal conditioning instr.	R_x
VEGAMET 513, 514, 515, 602 VEGATRENN 544 VEGATOR 521…527	50 … 100 Ohm
VEGAMET 614 VEGADIS 371	no additional resistance required
VEGAMET 601	200 … 250 Ohm
VEGASEL 643	150 … 200 Ohm
VEGAMET 513 S4, 514 S4 515 S4, VEGALOG EA card	100 … 150 Ohm

4.4 Adjustment with the PC



[1] If the inner resistance of the power supply or the processing system (PLC) is less than 200 Ω, a resistor of 200 Ω to 350 Ω must be connected to the signal cable during adjustment.

The digital adjustment signal would otherwise be short-circuited or considerably damped due to insufficient input resistors of a connected processing system so that the communication with the sensor would not be ensured.

To connect the PC to the pressure transmitter, a VEGACONNECT 2 interface converter is required.

Connecting the PC
Plug VEGACONNECT into the standard connection of the PC and connect the two-wire cable of VEGACONNECT to the pressure transmitter or the signal/supply cable of the pressure transmitter.

5 Typical installation connections

5.1 Valves

For VEGADIF 34 and 35 the use of three or fivefold valve blocks which can be directly flanged to the transmitter is recommended. These offer the following advantages:

- Mounting and dismounting of the transmitter are possible without interrupting the process.
- With the fivefold valve block there are two valves for vent drain (for gasing liquids) or for condensate drain (for condensating gases).

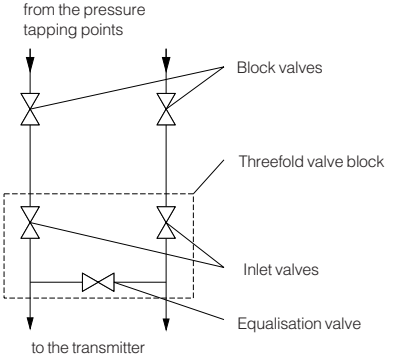
Typical valve connections with threefold valve block

(standard connection)

For impulse lines, a block valve should be provided on each pressure tapping point. The threefold valve block includes two inlet valves and one equalisation valve.

The two inlet valves are used to block the measuring cell from the impulse lines.

The equalisation valve is used for zero-point adjustment of the transmitter especially in flow and level measurement.



Typical valve connections for a fivefold valve block

(connection also in liquids with impurities)

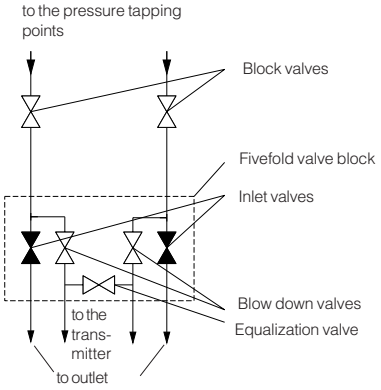
For each impulse line, a block valve should be provided at the pressure tapping point. The fivefold valve block includes two inlet valves and one equalisation valve as well as two additional blow down valves. This connection is also suitable for liquids with impurities. The two inlet valves are used for blocking the measuring cell from the impulse lines.

The equalisation valve is used for zero point adjustment of the transmitter especially in flow and level measurement.

Two additional blow down vales are used to drain off buildup in the impulse lines. The pipe between the T-branch and the blow down valve is used as catch pan.

Observe the following procedure for cleaning:
1 Close inlet valves
2 Open blow down valves

By doing this, the impulse lines are cleaned from the pressure tapping point to the blow down valves. A pipeline from the blow down valves to an appropriate outlet is recommended.



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5.2 Impulse lines

The impulse lines are used for pressure transmission from the pressure tapping points to the transmitter. The following regulations must be observed for running the impulse lines so that the measured pressure reaches the measuring cell unaltered:

- Lines with 12 x 1.5 mm or larger should be used (see e.g. DIN 19 210, impulse lines for flow measuring systems).
- The tube material must be corrosion resistant, suitable for the measured product.
- The impulse lines must be as short as possible and must be grounded; avoid bending.
- The impulse lines must have a gradient of at least 10 % (10 cm per meter); this prevents buildup in the impulse lines.
- Ensure that the whole measurement system (transmitter, high and low side impulse lines etc.) is installed in the same aggregate condition, corresponding to the process aggregate condition and should be independent of the ambient temperature.
- Both impulse lines should have the same temperature (the differential pressure measurement is density-dependent); hence the impulse lines must be routed close together; if necessary insulate or couple thermally.
- If necessary, the impulse lines should be fastened with pipe clamps.
- We recommend connecting the impulse lines via block or multiple valve blocks to the transmitter; this ensures simple mounting and dismounting of the transmitter without interrupting the process.

Connection of the impulse lines

The impulse lines must be cleaned before connecting to the transmitter:

- in applications with gases blow through with compressed air.
- in applications with liquids use a suitable cleaning liquid.

Contamination such as e.g. welding or pickling residues must not penetrate the process flanges (measurement errors!).

Before connecting to the transmitter, the impulse lines to the block valves or valve block must be tested for leaks.

The impulse line with the higher pressure must be connected to the plus side of the transmitter, the impulse line with the lower pressure to the minus side of the transmitter.

Connection of impulse lines directly to the transmitter

In this case the following connection options exist:

- with cutting ring threading (non-soldered bolting) to the $^1/_4$“ NPT, $^1/_2$“ NPT or R_C $^1/_4$“ NPT inner threads of the process fittings to the transmitter.
- with separate oval flange adapter to the $^1/_2$“ inner thread.

Connection of the impulse lines to the valve block

The impulse lines are connected with cutting ring threading (non-soldered bolting) to the $^1/_4$ - 18 NPT inner thread of the valve block.

Connection of the transmitter to the valve block

The connection of the transmitter is normally made just before commissioning. Generally seal rings made of PTFE as well as four screws are supplied with the valve block. Flat seals are used on both process connections of VEGADIF.

Procedure:

1 Push both seal rings into the grooves of the valve block (it is always recommended that two new PTFE seals be used every time the transmitter is connected to the valve block).
2 Screw the transmitter carefully onto the valve block (4 screws).
3 Tighten the screws crosswise (recommended torque 6 - 8 Nm).

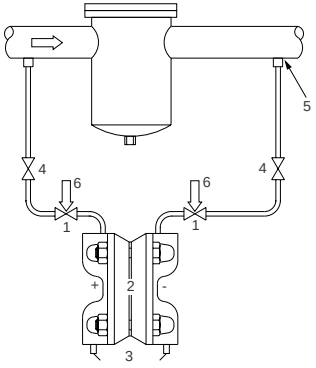
5.3 Differential pressure measurement

Installation connection for liquids

If the pressure of a flowing material is to be measured in a pipe, the pressure tapping points must be located where there is steady flow. The impulse lines must be installed with continuous gradient ≥ 1 : 10 (i.e. 10 cm per meter).

The recommended installation position of the transmitter is below the pressure tapping points.

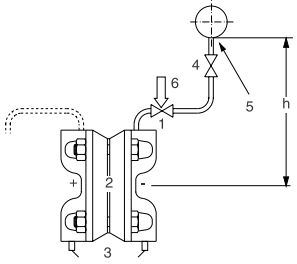
With products containing solid particles, the pressure tapping points must be positioned on top of the pipelines.



1 Inlet valves
2 Transmitter
3 Vent or drain valves
4 Block valves
5 Pressure tapping point
6 Ventilation screw

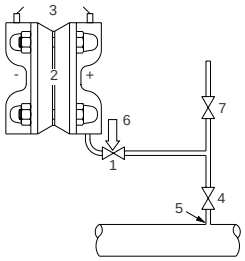
For differential pressure measurements referenced to the open atmosphere, the impulse line must be connected to the plus side of the transmitter. The minus side remains open to the atmosphere. In case of extremely dirty atmospheres, we recommend using a filter on the minus side or an open tube bent down. This protects the minus side against buildup.

For this connection, the height difference „h“ between tapping point and measuring cell center must be taken into account for adjustment of zero and span (the liquid column acts only on the plus side of the measuring cell).



1 Inlet valves
2 Transmitter
3 Vent or drain valves
4 Block valves
5 Pressure tapping point
6 Vent screw

If the transmitter is mounted above the pressure tapping point, the vent or drain valves on the process flange must be turned towards the top. The impulse lines are provided with an additional vent valve.

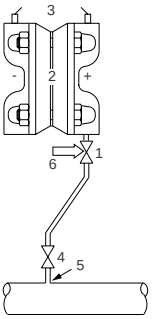


1 Inlet valves
2 Transmitter
3 Vent or drain valves
4 Block valves
5 Pressure tapping point
6 Vent screw
7 Vent vale (impulse line)

Installation connection for gases

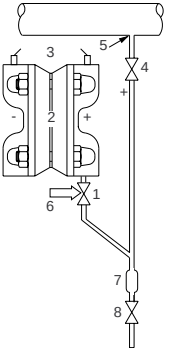
For the pressure measurement of gases, the transmitter should be preferably positioned above the pressure tapping point The impulse line must be connected to the plus side of the transmitter. The minus side remains open to the atmosphere. In a very dirty atmosphere the use of a filter on the minus side or an open tube bent down are recommended. This protects the minus side against buildup.

The impulse lines must be run with continuous gradient so that condensation can drain off automatically. If a gas contains impurities, special pressure tapping sockets must be used.



1 Inlet valves
2 Transmitter
3 Vent or drain valves
4 Block valves
5 Pressure tapping point
6 Vent screw

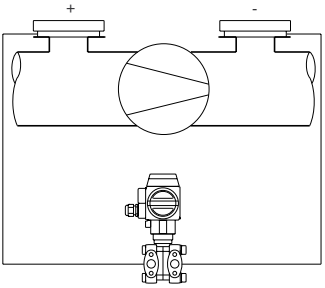
If due to constructional reasons the transmitter must be mounted below the pressure tapping point, a separator for impurities as well as a blow down valve must be installed in the lowest position of the impulse line.



1 Inlet valves
2 Transmitter
3 Vent or drain valves
4 Block valves
5 Pressure tapping point
6 Vent screw
7 Separator for impurities
8 Blow down valves

Note
The described connections are recommended measurement set-ups. For other measurement set-ups, various VDE/VDI regulations or DIN standards (e.g. VDE/VDI 3512) give additional installation instructions.

Special instructions for VEGADIF 51



For mounting to horizontal pipelines, buildup on the isolating diaphragm in the form of solids or materials sticking to the diaphragm should be avoided. We therefore recommend installing the flange connections on top of the pipeline.

5.4 Level measurement

Installation on open vessels

On an open vessel the level is measured via the hydrostatic pressure. „Open vessel“ means all vessels with an atmospheric pressure above the liquid.

VEGADIF takes the hydrostatic pressure on the plus side via a flange diaphragm, via an impulse line or an isolating diaphragm. The atmospheric pressure is taken via the minus side.

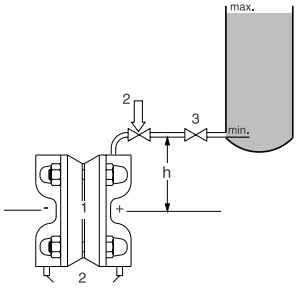
The hydrostatic pressure corresponds to the level measured from the center of the flange diaphragm or the center of the impulse line multiplied by the specific gravity of the product and the acceleration due to gravity. Because the atmospheric pressure acts on the plus side as well as on the minus side of VEGADIF, it is compensated in the differential pressure generation.

$$\Delta p = p_{hydr} = \rho \bullet g \bullet h$$

Δp, p_{hydr}: hydrostatic pressure [Pa]
ρ: Density [kg/m^3]
g: Acceleration due to gravity [m/sec^2]
h: Level [m]

VEGADIF 34, 35

The transmitter should be installed preferably at the height of the planned pressure tapping point. If a location below the pressure tapping point must be used, the height difference „h“ for adjustment of zero and span must be taken into account (the liquid column in the impulse line influences the meas. result).



1 Differential pressure transmitter
2 Vent or drain valves
3 Block valve

If in special cases a location above the pressure tapping point is necessary, only the liquid column above the centre of the measuring cell is measured.

With such an arrangement, gas pockets can lead to measurement errors. Impulse line and measuring cell must therefore be vented regularly.

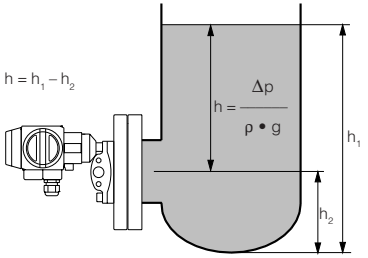
In both cases the minus side remains open to the atmosphere. If the ambient atmosphere is extremely dirty, we recommend for the minus side a filter or an open vent tube bent downwards. This prevents the minus side from being clogged.

VEGADIF 44, 45

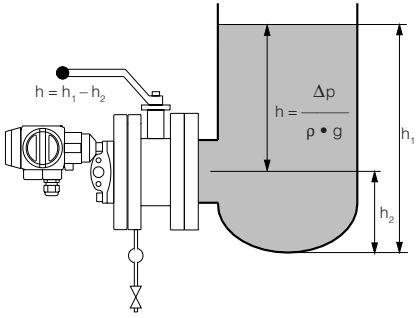
The transmitter must be mounted on the vessel in such a way that the isolating diaphragm is completely covered by the medium (even at min. level).

If the instrument is mounted below the min. level, the height difference must be taken into account for the adjustment of zero and span (the liquid column in the pressure line influences the meas. result). If the ambient atmosphere is extremely dirty, we recommend applying a filter on the minus side. This prevents the minus side from getting clogged.

Example VEGADIF 44:
Transmitter directly flanged



Example VEGADIF 45:
Transmitter flanged via maintenance unit



1 Transmitter
2 Block valve
3 Emptying valve

This installation has the advantage that zero and span can be checked/modified without emptying the vessel. Valve 3 enables the necessary venting/emptying of the tapping socket.

Installation on closed vessels

In a closed, pressurised vessel, the level of the medium is determined by measuring the hydrostatic pressure. The sum of the liquid hydrostatic pressure and the overlaid pressure is the total pressure acting on the bottom of the vessel. The hydrostatic pressure is therefore the difference between the total pressure and the overlaid pressure.

The hydrostatic pressure corresponds to the level of the product, measured from the centre of the flange isolating diaphragm, multiplied by the specific gravity of the product (because the overlaid pressure acts on the plus side as well as on the minus side of the transmitter, it is compensated in differential pressure generation).

$\Delta p = \rho \bullet g \bullet h$

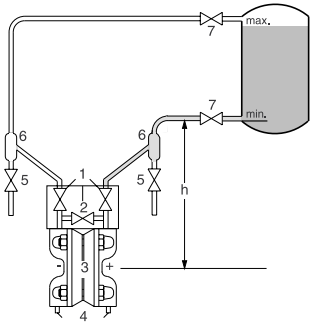
Δp: hydrostatic pressure [N/m²]
ρ: density of the fill fluid [kg/m³]
g: acceleration due to gravity [m/sec²]
h: level [m]

With this installation a blow down valve and a separator for impurities are recommended for the impulse line. This measure is not necessary if the medium is clean and the formation of buildup or sludge in the pipelines is not expected.

VEGADIF 34, 35

Standard installation connection

The transmitter should be installed preferably at the height of the planned pressure tapping point. If a location below the lower pressure tapping point is planned, the height difference „h“ (to the centre of the measuring cell) be taken into account in the adjustment of zero and span.



1 Inlet valves
2 Equalization valves
3 Transmitter
4 Vent or drain valves
5 Blow down valves
6 Separator for impurities
7 Block valves

Note:
- Unlike single pressure transmitters differential pressure transmitters are selected only according to the expected pressure difference. As long as the overlaid pressure does not exceed the permissible nominal pressure, it does not have to be taken into account. The selected measuring range can thus be perfectly adapted to the expected pressure difference.
- The described connections are recommended measurement set-ups. For other measurement set-ups, various VDE/VDI regulations or DIN standards (e.g. VDE/VDI 3512) provide further installation instructions.

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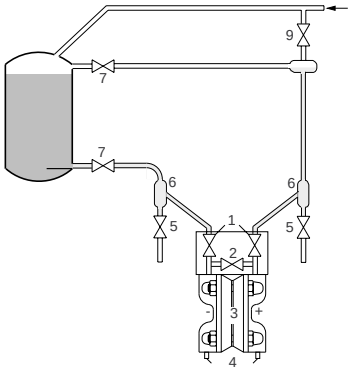
Installation on closed vessels with overlaid steam pressure

In a closed vessel with overlaid steam pressure, the sum of the steam pressure and the hydrostatic pressure acts on the bottom of the vessel as total pressure. This total pressure is fed to the plus side of the transmitter. In a separate vessel a fixed level is generated by condensate. This condensate column transmits the steam pressure to the minus side of the transmitter and protects the measuring cell from hot steam.

The following must be noted:
- The impulse line from the condensate pot to the vessel must be run with a slight gradient to the vessel so that excess condensate returns to the vessel and the level in the condensate pot remains constant.
- Block valve „7" between vessel and condensate pot must not impede the steam outlet to the condensate pot; the installation must prevent water pockets from forming in the valve.
- If there is insufficient condensate formation in the condensate pot, additional condensate must be added via dosing valve „9".
- If the medium has a density other than the condensate column (1.0 g/cm³), this must be taken into account for the span adjustment.

For this installation a blow down valve and a separator for impurities are recommended for each impulse line. This measure is not necessary if the medium is clean and the formation of buildup or sludge in the pipelines is not expected.



1 Inlet valves
2 Equalization valve
3 Transmitter
4 Vent or drain valves
5 Blow down valves
6 Separator for impurities
7 Block valves
8 Adjustment pot
9 Dosing valve

The differential pressure is determined by the transmitter as follows:

$$\Delta_P = p_F + p_D - (p_k + p_D)$$

$$\Delta_P = p_F - p_k$$

Δ_P: Differential pressure
p_F: Hydrostatic pressure of the liquid column
p_D: Static pressure of the steam
p_k: Hydrostatic pressure of the condensate column (constant)

Zero is determined as a negative differential pressure $p_F - p_k$.

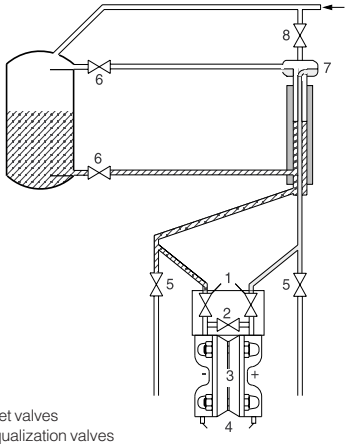
Installation on closed vessels with overlaid steam pressure and heated comparative column

This installation is a variant of the one described previously. In this case, the condensate column is covered by a tube (of larger nominal width diameter) which is filled with the measured product and acts as a communicating pipe. Through the resulting temperature equalisation, the density is the same in both columns. The outer pipe must therefore be insulated - not the adjustment vessel however (the condensate heat must be dissipated).

This arrangement is preferred for measuring substances with higher density because it delivers more accurate measurement results.

The previously described technical conditions also apply to this measurement set-up.

The VDE/VDI regulations 3512 of various DIN standards give more detailed information on:
- layout and configuration of throttles and impulse lines
- selection of components for corrosive mediums.



1 Inlet valves
2 Equalization valves
3 Transmitter
4 Vent or drain valves
5 Block valves
6 Blow down valves
7 Separator for impurities

VEGADIF 44, 45

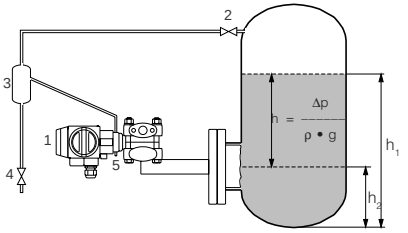
The transmitter must be mounted to the vessel in such a way that the isolating diaphragm is completely covered by the medium (even at min. level).

The pressure tapping point for the total pressure can be at the bottom of the vessel or at a defined height. The pressure tapping point for the overlaid pressure must be above the max. level. The lower pressure tapping point is connected to the plus side, the upper tapping point to the minus side of the transmitter.

The transmitter receives the total pressure on the plus side via the flange isolating diaphragm, the overlaid pressure on the minus side via the impulse line and the process connection.

Standard connection

Example VEGADIF 45:
Transmitter directly flanged



1 Transmitter
2 Block valve
3 Separator for impurities
4 Blow down valve
5 Vent or drain valve

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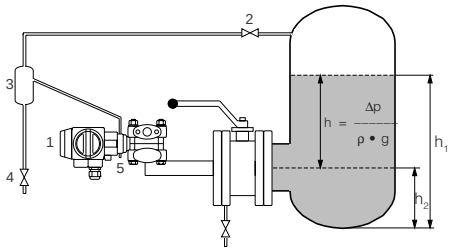
Example VEGADIF 45:
Transmitter flange via maintenance unit



1 Transmitter
2 Block valve
3 Separator for impurities
4 Blow down valve
5 Emptying valve

This arrangement has the advantage that zero and span can be checked (modified) without emptying the vessel. The valves 5 and 6 allow the necessary venting/emptying of the tapping socket.

Installation on closed vessels with overlaid steam pressure

In a closed vessel with steam pressure, the product level is determined via the measurement of the hydrostatic pressure. The sum of the steam pressure and hydrostatic pressure acts as total pressure on the bottom of the vessel. The hydrostatic pressure is therefore the difference between total pressure and overlaid steam pressure.

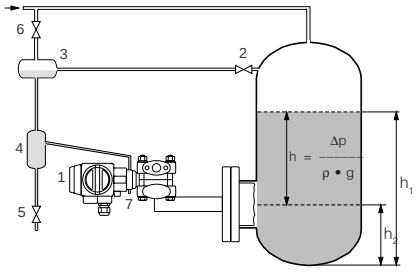
The transmitter receives the total pressure on the plus side via the isolating diaphragm, the overlaid pressure on the minus side via the impulse line and the process fitting. In a separate adjustment pot, a fixed level is generated by existing condensate. This condensate column transmits the steam pressure to the minus side of the transmitter and protects the measuring cell against hot steam.

The following must be noted:
- The impulse line from the adjustment pot to the vessel must be run with a slight gradient to the vessel; excess condensate returns to the vessel, the level in the adjustment pot remains constant.
- Block valve „2“ between vessel and adjustment pot must not impede the steam line to the adjustment pot; the installation must prevent water pockets from forming in the valve.
- If there is insufficient condensate formation in the adjustment pot, additional liquid must be added in small quantities via dosing valve „6“.
- If the reference liquid has a different density than the condensate column (1.0 g/cm³), this has to be taken into account for the span adjustment.

For this installation, a blow down valve and a separator for impurities are recommended. This measure is not necessary if the medium is clean and the formation of buildup or sludge in the pipelines is not expected.

Note:
For this installation connection, a measuring cell which allows a lowering of the zero point down to -100 % (of measuring range) must be implemented.

Example VEGADIF 45:
Transmitter directly flanged [1)]



1 Transmitter
2 Block valve
3 Adjustment pot
4 Separator for impurities
5 Blow down valve
6 Dosing valve
7 Vent or drain valve

The differential pressure is determined by the transmitter as follows:

$\Delta_P = p_F + p_D - (p_k + p_D)$

$\Delta_P = p_F - p_k$

Δ_P: Differential pressure
p_F: Hydrostatic pressure of the liquid column
p_D: Static pressure of the steam
p_k: Hydrostatic pressure of the condensate column (constant)

Zero is determined to a negative differential pressure $p_F - p_k$.

Installation on closed vessels with overlaid steam pressure and heated comparative column

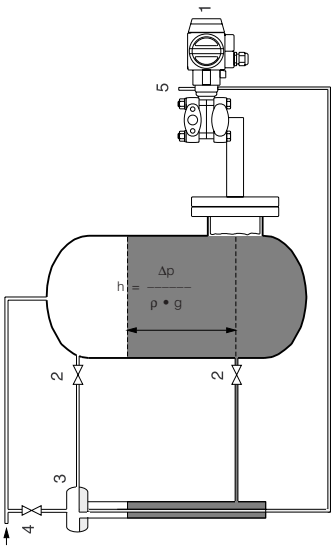
This installation is a variant of the one described previously. In this case, the condensate column is covered by a tube (of larger nominal diameter) which is filled with the measured product and acts a communicating pipe. Through the resulting temperature equalisation, the density is the same in both columns.

The outer pipe must therefore be insulated - not the adjustment vessel however (the condensate heat must be dissipated).

This arrangement is preferred for measuring substances with higher density because it delivers more accurate measurement results.

The previously described technical conditions also apply to this measurement set-up.

Example VEGADIF 45:
Transmitter directly flanged



1 Transmitter
2 Block valve
3 Adjustment pot
4 Dosing valve
5 Vent or drain valve

VEGADIF 51

Installation on closed vessels with overlaid pressure

In a closed, pressurised vessel, the level of a product is determined by measuring the hydrostatic pressure. The sum of the hydrostatic pressure and the overlaid pressure acts as total pressure on the bottom. The hydrostatic pressure is therefore the difference between total pressure and overlaid pressure.

The transmitter receives the total pressure on the plus side via the isolating diaphragm and the overlaid pressure on the minus side.

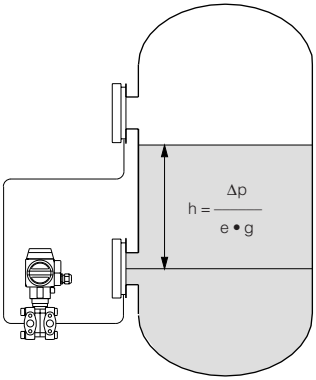
The isolating diaphragm must be mounted on the vessel in such a way that the isolating diaphragm is completely covered by the product even at min. level.

[1] Der Messumformer kann entsprechend den vorhergehenden Darstellungen auch über eine Wartungseinheit angeflanscht werden.

The hydrostatic pressure corresponds to the level of the product, measured from the centre of the flange isolating diaphragm, multiplied by the specific gravity of the product (because the overlaid pressure acts on the plus side as well as on the minus side of the transmitter, it is compensated in differential pressure generation).

$\Delta p = \rho \bullet g \bullet h$

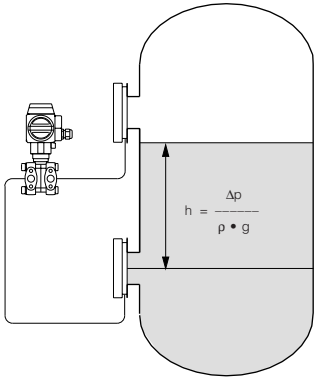
Δp: Hydrostatic pressure [N/m²]
ρ: Density of the fill fluid [kg/m³]
g: Acceleration due to gravity [m/sec²]
h: Level [m]



Note:

- If the transmitter is installed below the min. level, the resulting height difference for the adjustment of zero and span must be taken into account (the liquid column in the capillary line influences the measurement result).
- Unlike single pressure transmitters, differential pressure transmitters are selected only according to the expected pressure difference. As long as the overlaid pressure does not exceed the permissible nominal pressure, it does not have to be taken into account. The selected measuring range can thus be perfectly adapted to the expected pressure difference.

This mounting arrangement is recommended if a vacuum can occur. It prevents the pressure column in the capillary tube from being disrupted.



This mounting arrangement is only permissible if no vacuum can occur (even temporarily).

5.5 Flow measurement

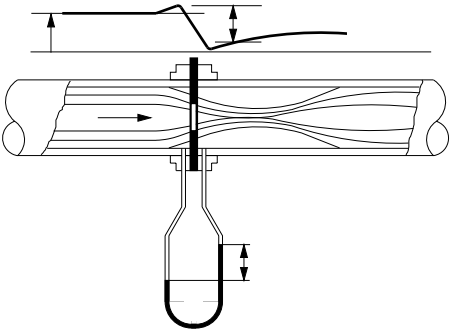
Principle of operation

The implemented effective pressure method is based on the fact that the flow and the energy content of a flowing medium are constant at all positions in a closed system. This total energy consists of a dynamic element (due to the flow rate) and a static element (due to the pressure). A restriction of the flow causes an increase of the flow speed and a reduction of the pressure. This pressure difference is called effective pressure and is a clear measure of flow. The following correlation applies here:

$$q = c \bullet \sqrt{\Delta_p}$$

q: Flow
c: Influence factor of the effective pressure transmitter (restriction)
Δ_p: Measured effective pressure (differential pressure)

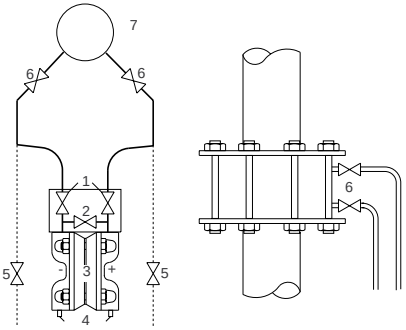
The flow is thus proportional to the square root of the differential pressure across the restriction.



Measurement set-up for liquids

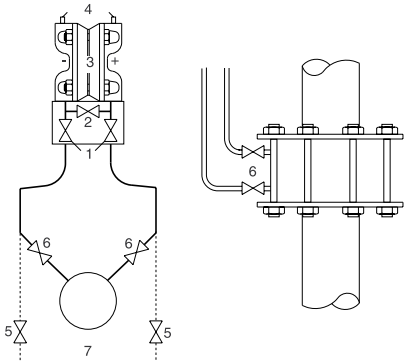
For measurement of liquids, the impulse lines must be completely filled with liquid. Gas pockets in the impulse line or in the measuring cell cause measurement errors. By mounting the transmitter below the pressure tapping points, the impulse lines can degas automatically.

Hence the recommended installation position of the transmitter is below the pressure tapping points.

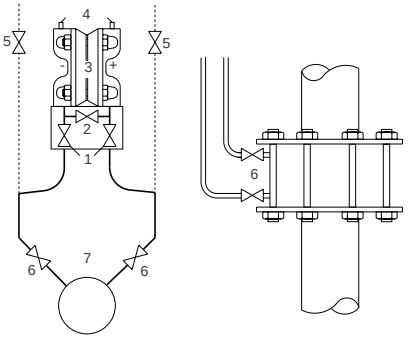


1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter

The transmitter can be also installed above the pressure tapping points. With this arrangement, however air or gas pockets can form in the highest part of the measuring system and influence the measurement. Therefore a vent is necessary. This arrangement should be used only when there is sufficient static pressure. It is very advantageous when buildup or sludge is expected: measuring cell and impulse lines clean themselves automatically.



1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter



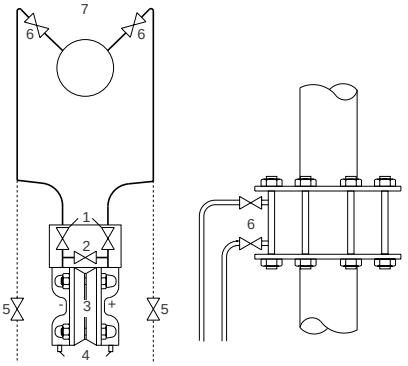
1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter

Measurement set-up for vapours

For the flow measurement of vapours, the impulse lines must be filled with condensate so that the measuring cell is protected against the high temperatures of the hot steam. The recommended installation position of the transmitter is therefore below the pressure tapping points.

This arrangement also ensures a continuous filling of the impulse lines with the condensate. The tapping sockets of the impulse lines must be mounted laterally at the same height. Adjustment pots at the pressure tapping points ensure the levelling of the hydrostatic pressure of the condensation columns.

If in an installation for flow measurement of vapours, the transmitter is installed above the pressure tapping points, the location of the bends in the impulse lines to the pressure tapping points must be noted. They must have exactly the same height, in order to avoid distorting the effective pressure through different condensate column heights.



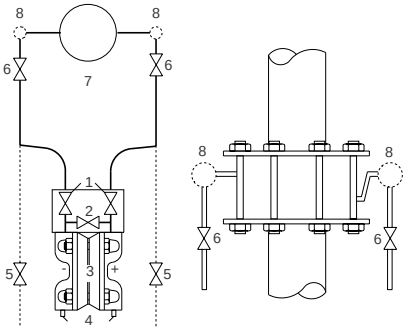
1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter

Instructions for both connections

- For steam flow measurements, blow down lines should be installed. The line to the blow down valve should be as straight as possible.
- The impulse lines must be able to dissipate condensation heat. Hence they should not be insulated.
- VDE/VDI regulation 3512 or different DIN standards give additional information.

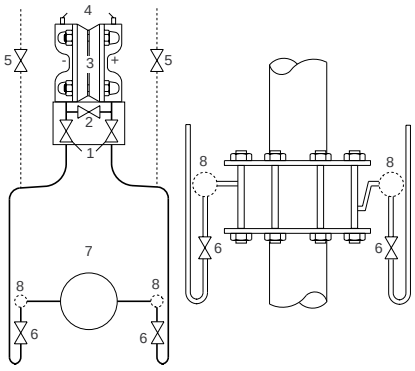
Measurement set-up for gases

Humid gases at ambient temperatures contain a certain quantity of condensating particles. The recommended installation position of the transmitter is hence above the pressure tapping points so that condensate can return to the process. The arrangement prevents unequal condensate buildup in front of the plus and minus side of the transmitter and the resulting measurement errors. The impulse lines must be run with sufficient gradient.



1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter
8 Adjustment pots

With dry gases, the transmitter can be installed above as well as below the pressure tapping points. Also in this case, the impulse lines must be run with sufficient gradient so that condensate can flow to the drainage valves.



1 Inlet valve
2 Equalization valve
3 Transmitter
4 Vent or drain valve
5 Blow down valve (if needed)
6 Block valve
7 Effective pressure transmitter
8 Adjustment pots

Instructions for corrosive gases

If the measuring cell needs to be protected against very corrosive gases, an arrangement with protective vessels acc. to VDE/VDI 3512 should be implemented. As an alternative, the method of protective gas flushing can be implemented - it is applicable for corrosive gases with impurities.

6 Diagnostics

Maintenance

VEGADIF 34 … 51 differential pressure transmitters are maintenance-free. Only the wetted parts are subject to a certain amount of wear. Therefore check regularly the condition of these parts, particularly the diaphragms and process seals. Note the service instructions VEGADIF 34 … 51 differential pressure transmitter.

Repair

If the measures for failure rectification are not successful, return the affected instrument for repair to VEGA. Please note the following:

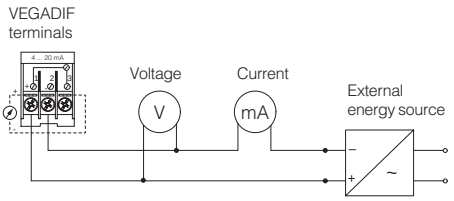
- Attach information: application, medium, failure description.
- Remove buildup, especially it is composed of substances hazardous to health.

Fault rectification

Through self-monitoring, VEGADIF differential pressure transmitters offer a high degree of reliability. Within the framework of self-monitoring, the signal circuit 4 … 20 mA is additionally used for transmission of failure information. If a failure is detected, the output current takes on a value of 21.5 mA. Before removing VEGADIF to look for faults, the following should be checked:

- atmospheric pressure compensation (for level measurements on open vessels)
- electrical components and connections

Checking the electrical components



Instructions for Ex applications

Deviating from the above arrangement, terminal 1 and tag 1 are used only for short-term connection to a certified, active floating (max. value: 470 mW) or to any passive floating measuring instrument. When connecting, the regulations for wiring intrinsically safe circuits (measuring instrument, supply and signal circuit) must be noted.

External overvoltage arresters

(if present)

- check on interruption and short-circuit.

Voltage

- the terminal voltage on the differential pressure transmitter must be at least 11.5 V DC.
- the supply voltage for the differential pressure transmitter, provided by e.g. a VEGAMET signal conditioning instrument, must be approx. 25 V DC.

Current

Current value	Condition
3.8 … 20.6 mA	standard range of the output current
21.5 mA	fault signal
0 mA	signal cable interrupted
< 3.6 mA	electronics or pressure sensor element defective
> 21.6 mA	short-circuit in the signal cable, electronics or pressure sensor element defective

6.1 Error codes

If faults occur, VEGADIF outputs error codes. The bar graph on the display module indicates the last valid measured value and keeps it flashing.

If several errors occur at the same time, the sequence of the indication depends on the priority of the errors.

Code	Type	Reason and rectification
E101	Failure	Electrical instrument failure - EEPROM check sum error
E102	Warning	Electronic instrument failure with pointer display - carry out a reset (Code 7864), carry out a fresh adjustment
E103	Failure	Initialisation is running - wait until the procedure is finished
E104	Warning	Sensor adjustment, calibration error, adjustment points too close together - fresh adjustment of the sensor
E106	Failure	Upload/Download active - wait until the procedure is finished
E110	Failure	Check sum error - carry out a reset (Code 5140), error remains - removal by service
E111	Failure	No connection to the sensor-EEPROM (when switching on)
E112	Failure	No connection to the sensor ADC (only ceramic sensors)
E113	Failure	Measurement error during pressure and temperature measurement
E114	Failure	Measurement error during temperature measurement, temperature sensor defective
E115	Failure	Sensor gauge pressure P+ - remains until gauge pressure disappears
E116	Failure	Download error - restart download
E120	Failure	Sensor low pressure - remains until low pressure disappears
E602	Warning	Not monotonously raising or falling vessel characteristics - check the plausibility of the manually entered characteristics. Volume increases with the level?
E604	Warning	Vessel characteristics consists of less than 2 index markers - check the manually entered characteristics
E605	Failure	Manual linearisation curve incomplete . Enter the linearisation curve in mode „Level linear“ and choose the mode „Characteristics“.
E610	Failure	Adjustment error, same pressure value for Low and High - check the adjustment
E620	Warning	Signal current/Measured value not within the permitted range < 3.8 mA or > 20.5 mA

7 Instrument modification

Mounting the LC display

VEGADIF 34 ... 51 differential pressure transmitters can be equipped with an LC display. Make sure that the stated measuring range on the display, e.g. 0 ... 1000 mbar corresponds to the sensor data.

- When installing the display, care should be taken to prevent moisture or corrosive substances from getting into the electronics compartment.
- The scope of delivery encompasses a special housing cover with inspection window. This enclosed the electronics compartment with integrated LC display.

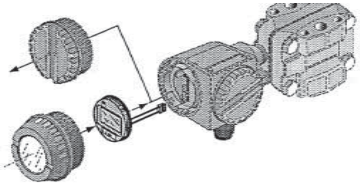


Fig. 6.1 Mounting the LC display

Mounting procedure

1 Unscrew the housing cover of the electronics compartment.
2 Remove blind coupling on the electronics board in the transmitter. Press the four-pole coupling of the LC display onto the socket of the electronics board until it snaps in.
Note:
The blind coupling must be kept in case the LC display is removed.
3 Insert the LC display in the requested 90° position into the holder until it snaps in.
4 Close the electronics compartment with the housing cover for the display module.

Supplement

CE declaration of conformity

CE

Konformitätserklärung

Declaration of conformity
Déclaration de conformité

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach

erklärt in alleiniger Verantwortung, daß das Produkt / declare under our sole responsibility that our product / déclare sous sa seule responsabilité que le produit

VEGADIF 34/35...
VEGADIF 44/45...
VEGADIF 51...

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt / to which this declaration relates is in conformity with the following standards / auquel se réfère cette déclaration est conforme aux normes

EN 50082-2 : 1995
EN 50081-1 : 1992
EN 61010-1 : 1993

gemäß den Bestimmungen der Richtlinien / following the provision of Directives / conformément aux dispositions des Directives

89/336 EWG
73/23 EWG

Schiltach, 20.11.1998

Hubert Nöll
Geschäftsführer

EC declaration of conformity

VEGA

EG- Konformitätserklärung
EC declaration of conformity
Déclaration CE de conformité

VEGA Grieshaber KG
Am Hohenstein 113
D-77761 Schiltach

erklärt in alleiniger Verantwortung, dass das Produkt
declares in sole responsibility, that the product
déclare sous sa seule responsibilité que le produit

VEGADIF 35, PN > 200bar

mit den Vorschriften folgender Europäischer Richtlinien übereinstimmt :
conforms with the regulations of the following European Directives
est conforme aux prescriptions et directives Européennes suivantes :

Druckgeräterichtlinie (PED) 97/23/EG

Konformitätsbewertungsverfahren nach PED :
Conformity assessment procedure followed module PED :
Module de procédures d'évaluation de conformité PED :

Modul A

Schiltach, 15.01.2003

i.V. Fruhauf
Leitung Zertifikatsabteilung

20094-EN-030731

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All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.