Vortex Flow Meter

Multi-Parameter

DVE

- Measuring range
  Liquids: 5.2 - 157 ... 284 - 85 371 m³/h
  Air: 89 - 1 463 ... 26 915 - 2 467 081 Nm³/h (20 °C, 0 bar rel)
  Saturated steam: 81 - 938 ... 22 435 - 1 324 739 kg/h (0 bar rel)
- Accuracy:
  ± 1.2 % of reading (liquids)
  ± 1.5 % of reading (gases and steam)
- p_{max}: 100 bar abs; t_{max}: 260 °C (400 °C)
- Connection (insertion version):
  flange or thread via compression fitting or packing glands for tubes DN 80 ... DN 600 (3" ... 24")
- Material: stainless steel
- Multi-Parameter version with 5 process factors flow, temperature, pressure, energy consumption, density
- Output:
  1(3) analogue output, 1(3) limit switches, totaliser pulse, HART® Protocol, Modbus
- ATEX, IECEx
- Energy consumption (monitoring)

S5

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Despriction

The KOBOLD Vortex Flow meter DVE utilises three primary sensing elements: **a vortex shedding velocity sensor**, **a RTD temperature sensor** and **a solid-state pressure transducer** to measure the mass flow rate of gases, liquids and steam.

Systems that use external process measurements may not provide adequate compensation for the fact that process conditions can change radically between the point of velocity measurement and the point where upstream or downstream pressure and temperature measurements are being made.

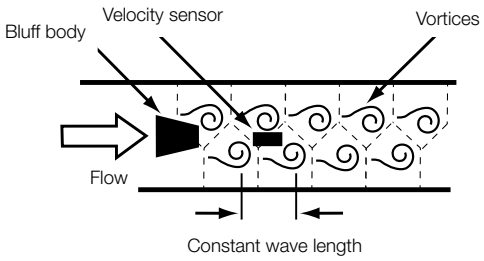
Because the DVE multivariable flow meter measures all of these parameters in **a single location**, it delivers a more accurate process measurement.

Integrating multivariable output capability with a single line penetration also simplifies system complexity and helps reduce initial equipment cost, installation cost and maintenance costs.

Advantages of the DVE Vortex Flow meter

- DVE-V provides cost effective volumetric flow monitoring solution for most low-viscosity liquids
- DVE-T incorporates temperature sensing to provide a compensated mass flow reading of saturated steam
- DVE-P multivariable meter delivers mass flow, temperature, pressure and density readings
- Connections: ANSI 3" up to ANSI 24", DN 80 up to DN 600
- Easy to install and commission
- Field- configurable ranges, outputs and displays
- HART® Protocol, Modbus
- IECEx / ATEX
- Energy consumption (monitoring)

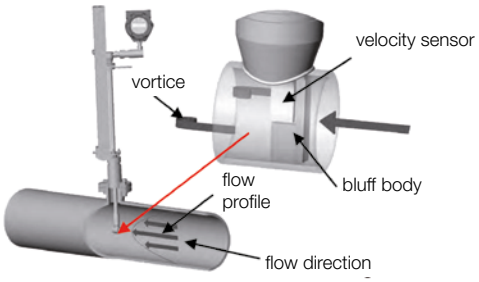
Measuring Principle



The measuring principle is based on the Karman vortice street. A specially shaped bluff body is located in direction of the flow. From a certain flow velocity on vortices are generated through the bluff body.

These small vortices generate small pressure differences which are sensed from a piezoelectric sensor behind.

The number of vortices is directly proportional to the flow velocity and will be converted into a frequency signal.



Model DVE-V

The Model DVE-V delivers a direct reading of volumetric flow rate - generally the most costeffective solution for liquid flow monitoring - in applications ranging from general water flows to hydrocarbon fuel flow measurement.

Model DVE-T

The Model DVE-T integrates a precision Pt1000 platinum RTD temperature sensor that can be used to calculate and output a compensated mass reading. This device is typically used to measure flow rates of saturated steam.

Model DVE-P

The Model DVE-P offers you flow computer functionality in a compact field device. This multivariable instrument incorporates temperature and pressure sensors to provide an instantaneous reading of compensated mass flow rate of gases, liquids and steam. In addition to outputs for totalised mass and alarm settings, the field-configurable electronics deliver up to three analog (4 - 20 mA) outputs of five process measurements, including volumetric flow rate, mass flow rate, pressure and density.

Model DVE-M/E

The Model DVE-M/E Energy Monitoring option permits real-time calculation of energy consumption for a facility or process. The meter can be programmed to measure steam, hot water or chilled water.

The flow meter DVE-E monitors one side of the process, either sent or return, and uses the input from a second separate temperature sensor on the opposite leg of the process to calculate the energy consumption over the temperature difference and flow. (Not approved for custody transfer applications).

Selectable energy units include:

Btu, joules, calories, Watthours, Megawatt-hours and horsepower-hours.

The local or remote electronics indicates: temperature, delta T, mass total and energy total.

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Technical Details

Mass flow rate accuracy: for gas and steam based on 50-100% of pressure range

Model DVE accuracy

Process variables	Liquids	Gas/Steam
Volumetric Flow Rate	± 1.2% of reading	± 1.5% of reading
Mass Flow Rate	± 1.5% of reading	± 2.0% of reading
Temperature	± 1 °C ; ± 2 °F	± 1 °C ; ± 2 °F
Pressure	± 0.3% of full scale	± 0.3% of full scale
Density	± 0.3% of reading	± 0.5% of reading

Repeatability

Mass flow rate: ± 0.2% of rate
Volumetric
Flow rate: ± 0.1% of rate
Temperature: ± 0.1 °C, (± 0.2 °F)
Pressure: ± 0.5% of full scale
Density: ± 0.1% of reading

Stability over 12 month

Mass flow rate: ± 0.2% of rate
Volumetric
Flow rate: ± negligible
Temperature: ± 0.5 °C, (± 0.9 °F)
Pressure: ± 0.1% of full scale
Density: ± 0.1% of reading
Response time: adjustable from 1 ... 100 s

Process and ambient temperature

Standard: -200 ... 260 °C, (-330 ... 500 °F)
High temperature: up to 400 °C, (750 °F)
Ambient temperature: -40 ... 60 °C, (-40 ... 185 °F)
Storage temperature: -40 ... 65 °C, (-40 ... 185 °F)

Pressure ratings

Pressure sensor			
Max. operating pressure		Max. overload pressure	
psia	bar abs	psia	bar abs
30	2	60	4
100	7	200	14
300	20	600	40
500	35	1000	70
1500	100	2500	175

Stem and vortex sensor head: PN100
Compression fitting: PN 100
Packing gland: PN 64 (600 lbs)
Pressure ratings of process connection acc. specification: see model code

Auxiliary energy

Model DVE-V: 12 - 36 V_{DC}, loop powered
Model DVE-P, DC option: 12 - 36 V_{DC}, 300 mA max
Model DVE-P, AC option: 85 - 240 V_{AC}, 50/60 Hz, 5 Watt
Display: alphanumeric 2-line (16 characters) digital LCD Display rotateable in 90° steps
Buttons: six buttons for full field configuration the pushbuttons can be operated with magnetic wand without removal of enclosure covers.

Output signals

Analogue: 4 - 20 mA loop powered for volumetric meters
Alarm: solid state relay 40 V_{DC}
Totaliser pulse: 50 ms 40 V_{DC}
Volumetric: 1x analogue, 1x totaliser pulse, HART®
Multivariable: up to 3 analog signals 3 alarms, 1 totaliser pulse, HART®
Option: Modbus process monitoring

Wetted materials

Material: stainless steel 1.4404 (316L)
Models with pressure transducer: Dupont Teflon® based thread sealant
Version standard temperature: Dupont Teflon® packing
High temperature: Graphit based packing

Piping conditions

Conditions	Pipe diameters D	
	Upstream	Downstream
one 90° elbow before meter	**10 D**	**5 D**
two 90° elbows before meter	**15 D**	**5 D**
two 90° elbows before meter (out of plane)	**25 D**	**5 D**
Reduction before meter	**10 D**	**5 D**
Expansion before meter	**20 D**	**5 D**
Partially open valve	**25 D**	**5 D**

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Velocity range

Liquids

Maximum velocity: 9 m/s (30 ft/s)

Minimum velocity: 0.3 m/s (1 ft/s)

Gas/stream

Maximum velocity: 90 m/s (300 ft/s)

Minimum velocity:

$$v_{min} = \frac{6.1}{\sqrt{\text{Density}\ (\frac{kg}{m^3})}}\ \frac{m}{s} \qquad v_{min} = \frac{5}{\sqrt{\text{Density}\ (\frac{Lb}{ft^3})}}\ \frac{ft}{s}$$

Water Minimum and Maximum flow rates

Approvals

ATEX: II 2 G Ex d IIB + H_2 T6
II 2 D Ex tD A21 IP 66 T85 °C
Ta = -40 °C ... +60 °C

IECEx: Ex d IIB + H2 T6
Ex tD A21 IP 66 T85 °C, Ta = -40 °C ... +60 °C

	Nominal pipe size [mm]					
DN [mm]	**80**	**150**	**200**	**300**	**400**	**600**
m³/hr min.	5.2	20.4	35.4	79.2	125	284
m³/hr max.	157	614	1062	2337	3753	8537
	Nominal pipe size [inch]					
DN [in]	**3**	**6**	**8**	**12**	**16**	**24**
GPM min.	20.6	81.3	142	317	501	1138
GPM max.	618	2437	4270	9501	15043	34144

Turndown:
(Turndown is application dependent, can exceed 100:1)

Typical saturated steam Minimum and Maximum flow rates Unit: [kg/h]							
		Nominal pipe size [mm]					
Pressure		**80**	**150**	**200**	**300**	**400**	**600**
0 bar rel	min.	81	316	548	1226	1936	4404
	max.	938	3667	6350	14209	22432	51039
5 bar rel	min.	187	729	1283	2826	4461	10151
	max.	4986	19486	33742	75495	119189	271187
10 bar rel	min.	249	972	1683	3767	5947	13530
	max.	8859	34620	33752	134132	211764	481821
15 bar rel	min.	298	1164	2016	4510	7120	16200
	max.	12700	49629	85939	192283	303570	690705
20 bar rel	min.	340	1329	2301	5148	8128	18493
	max.	16550	64676	111995	250581	395609	900119
30 bar rel	min.	412	1612	2791	6246	9860	22435
	max.	24357	95187	164827	368789	582234	1324739

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Turndown (continued)**:**
(Turndown is application dependent, can exceed 100:1)

Typical air Minimum and maximum flow rates (20 °C) Unit: [Nm³/h]							
		Nominal pipe size [mm]					
Pressure		**80**	**150**	**200**	**300**	**400**	**600**
0 bar rel	min.	89	347	601	1345	2124	4833
	max.	1463	5716	9897	22145	34962	79547
5 bar rel	min.	217	847	1467	3282	5181	11788
	max.	8702	34006	58885	131751	208004	473266
10 bar rel	min.	294	1148	1987	4446	7020	15972
	max.	15975	62430	108105	241878	381870	868857
15 bar rel	min.	355	1385	2399	5368	8474	19282
	max.	23280	90979	157542	352487	556497	1266182
20 bar rel	min.	407	1589	2751	6156	9718	22112
	max.	30615	119642	207175	463539	731823	1665095
30 bar rel	min.	495	1934	3349	7493	11829	26915
	max.	46361	177268	306961	686801	1084302	2467081

Typical air Minimum and Maximum flow rates (70 °F) Unit: (SCFM)							
		Nominal pipe size [inch]					
Pressure		**3**	**6**	**8**	**12**	**16**	**24**
0 psig	min.	56	220	381	852	1345	3059
	max.	924	3611	6253	13991	22089	50250
100 psig	min.	157	615	1065	2383	3763	8560
	max.	7236	28279	48969	109564	172977	393500
200 psig	min.	216	843	1460	3266	5156	117729
	max.	13588	53101	91950	205732	324804	738886
300 psig	min.	262	1022	1770	3960	6251	14221
	max.	19974	78059	135169	302430	477467	1086176
400 psig	min.	301	1175	2034	4551	7186	16346
	max.	26391	103136	178593	399588	630859	1435121
500 psig	min.	335	1310	2269	5077	8015	18233
	max.	32834	128314	222191	497136	784865	1785464

Typical saturated steam Minimum and Maximum flow rates Unit: [lb/h]							
		Nominal pipe size [in]					
Pressure		**3**	**6**	**8**	**12**	**16**	**24**
5 psig	min.	205	800	1382	3099	4893	11132
	max.	2721	10633	18412	41196	65039	177954
100 psig	min.	468	1831	3170	7092	11197	25472
	max.	14246	55674	96407	215703	340546	774698
200 psig	min.	632	2471	4278	9572	15111	34377
	max.	25948	10145	175595	392880	620268	1411029
300 psig	min.	762	2976	5153	11530	18203	41410
	max.	37652	147145	254799	570093	900047	2047489
400 psig	min.	873	3412	5908	13219	20870	47477
	max.	49494	193420	334930	749382	1183103	2691404
500 psig	min.	974	3805	6588	14741	23272	52942
	max.	61543	240507	416488	931816	1471125	3346615

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Order Details (Example: **DVE-V S L L 2 S 0 AH**)

Model	Version	Special length	Electronic mounting	Power supply	Output options
DVE-	**V** = measuring of volume for liquids, gas and steam **T** = flow velocity incl. temperature sensor **P** = flow velocity incl. temperature- and pressure sensor **E**[5] = option energy consumption **M** = option energy consumption incl. pressure sensor **X** = special	**S** = standard **C** = compact **E**[5] = long version **X** = special	**L** = compact IP66 incl. LCD display **R**[6] = separated IP 66 incl. LCD display (standard cable length 5 m) **X** = special	**L**[1] = 12 - 36 V_{DC}, 2-wire **D**[2] = 12 - 36 V_{DC}, 4-wire **A**[2] = 85 - 240 V_{AC}, 50/60 Hz, 12 W	**2** = 2-wire, 1 x 4-20 mA, Hart®, 1 x pulse **H** = 1 x 4-20 mA, Hart®, 1 x alarm, 1 x pulse **M** = 1 x 4-20 mA, 1 x alarm, 1 x pulse Modbus **3** = 3 x 4-20 mA, Hart®, 3 x alarm, 1 x pulse **4** = 3 x 4-20 mA, 3 x alarm, 1 x pulse Modbus **X** = special

Process temperature	Pressure sensor	Connection
S = standard -40 ... +260 °C (-40 ... +500 °F) **H** = high temperature up to +400 °C (+750 °F) **T** = low temperature down to -200 °C (-328 °F) **X** = special	**0**[3] = without **1**[4] = incl. sensor, max. 2 bar abs (30 psia) **2**[4] = incl. sensor, max. 7 bar abs (100 psia) **3**[4] = incl. sensor, max. 20 bar abs (300 psia) **4**[4] = incl. sensor, max. 34 bar abs (500 psia) **5**[4] = incl. sensor, max. 100 bar abs (1500 psia) **X**[4] = special	**AH** = 2" NPT male, compression fitting **BH** = 2" 150 lbs flange, compression fitting **CH** = DN 50 PN 16 flange, compression fitting **DH** = 2" 300 lbs flange, compression fitting **EH** = DN 50 PN 40 flange, compression fitting **FH** = 2" 600 lbs flange, compression fitting **GH** = DN 50 PN 64 flange, compression fitting **HH** = 2" NPT male, packing gland **IH** = 2" 150 lbs flange, packing gland **JH** = DN 50 PN 16 flange, packing gland **KH** = 2" 300 lbs flange, packing gland **LH** = DN 50 PN 40 flange, packing gland **MH** = 2" NPT male, packing gland, incl. retractor device **NH** = 2" 150 lbs flange, packing gland incl. retractor device **OH** = DN 50 PN 16 flange, packing gland incl. retractor device **PH** = 2" 300 lbs flange, packing gland incl. retractor device **QH** = DN 50 PN 40 flange, packing gland incl. retractor device **RH** = 2" 600 lbs flange, packing gland incl. retractor device **SH** = DN 50 PN 64 flange, packing gland incl. retractor device **TH** = 2" NPT male (only ext. length), packing gland incl. retractor device **UH** = DN 50 PN 16 (only ext. length) flange, packing gland incl. retractor device **VH** = DN 50 PN 40 (only ext. length) flange, packing gland incl. retractor device **WH** = DN 50 PN 64 (only ext. length) flange, packing gland incl. retractor device **YH** = 2" 150 lbs (only ext. length) flange, packing gland incl. retractor device **ZH** = 2" 300 lbs (only ext. length) flange, packing gland incl. retractor device **1H** = 2" 600 lbs (only ext. length) flange, packing gland incl. retractor device **XH** = special

[1] Only for output option '2' [2] Only for output option 'H', 'M', '3' or '4' [3] Only for versions DVE-V.., DVE-T.., DVE-E.. [4] Only for versions DVE-P.., DVE-M..
[5] Only with process connection T/U/V/W/Y/Z/1 [6] Max. possible cable length 15 m; please specify cable length in clear text

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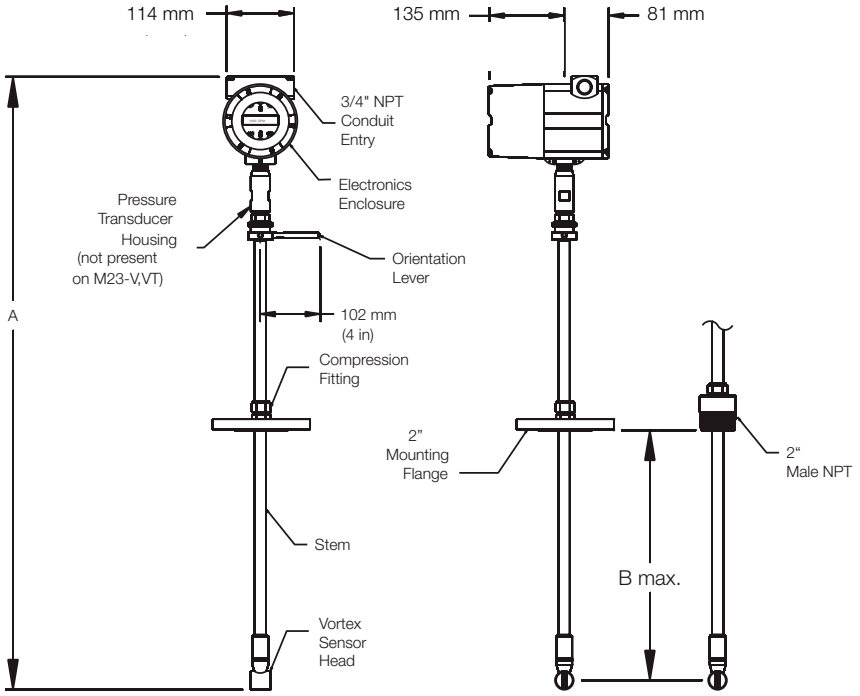
Dimensions Compression Fitting [mm]



Model DVE-V, -T	CL/ Compact length [mm]		SL/ Standard length [mm]		EL/ Extended length [mm]		Weight [kg]		
	A	B	A	B	A	B	CL	SL	EL
Compression fitting 2" NPT male	549	249	965	665	1270	970	5.7	6.2	6.7
Compression fitting 150 lb/PN 16 flange	549	277	965	693	1270	998	6.8	7.3	7.8
Compression fitting 300 lb/PN 40 flange	549	274	965	691	1270	996	7.8	8.3	8.8
Compression fitting 600 lb/PN 64 flange	549	264	965	681	1270	986	8.2	8.7	9.2

For remote electronics add 5 kg (11Lb)

Model DVE-P	CL/ Compact lenght [mm]		SL/ Standard length [mm]		EL/ Extended length [mm]		Weight [kg]		
	A	B	A	B	A	B	CL	SL	EL
Compression fitting 2" NPT male	625	249	1041	665	1346	970	5.7	6.2	6.7
Compression fitting 150 lb/PN 16 flange	625	277	1041	693	1346	998	6.8	7.3	7.8
Compression fitting 300 lb/PN 40 flange	625	274	1041	691	1346	996	7.8	8.3	8.8
Compression fitting 600 lb/PN 64 flange	625	264	1041	681	1346	986	8.2	8.7	9.2

For remote electronics add 5 kg (11Lb)

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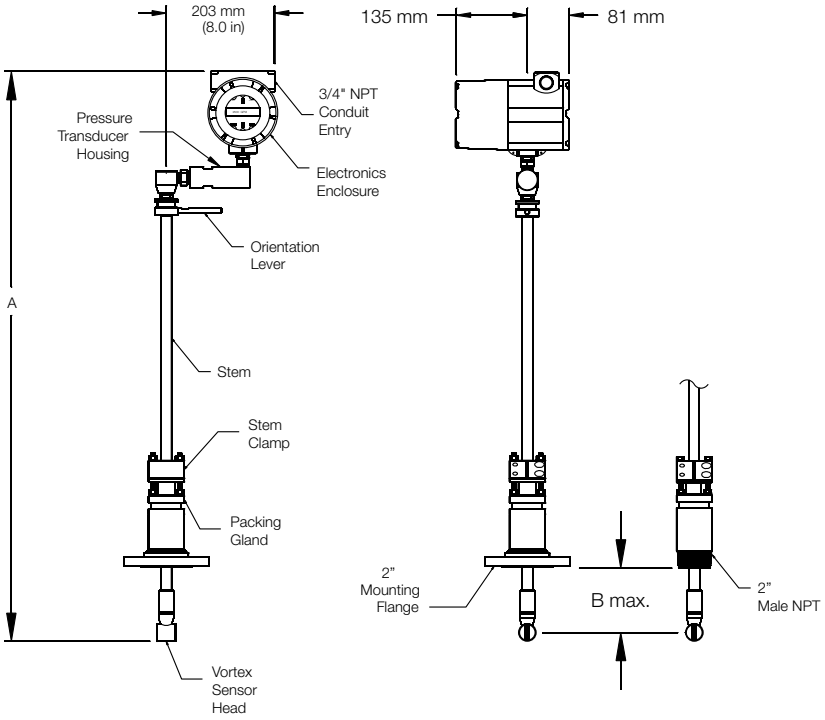
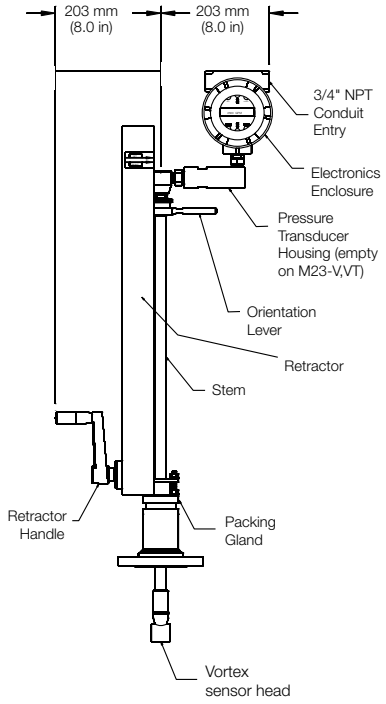
Dimensions [mm]

Packing gland



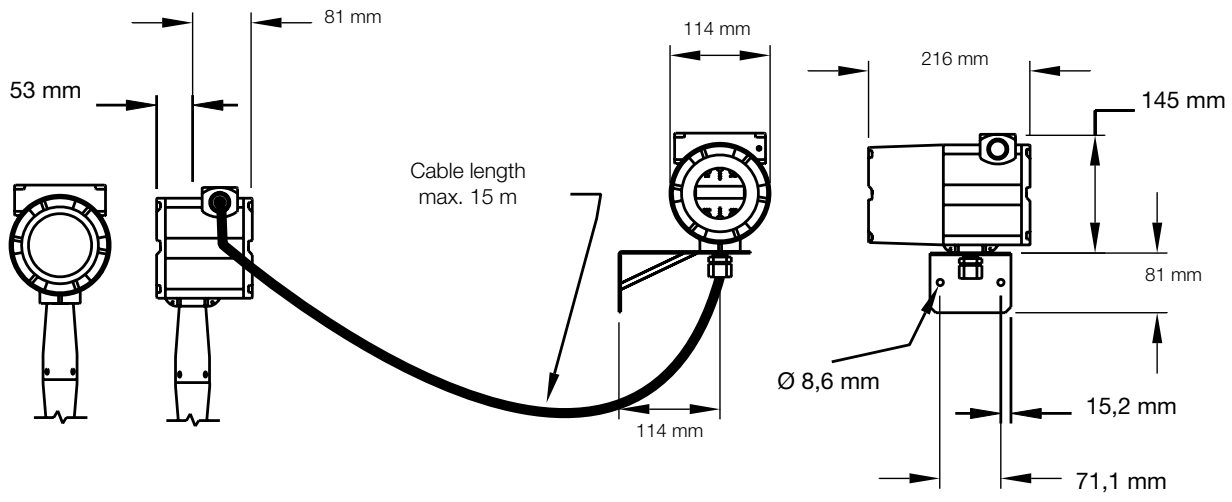
Retractor device



Model DVE with compression fitting/ retractor device	SL/ Standard length [mm]		EL/ Extended length [mm]		Weigth [kg]		Weigth [kg] incl. retractor device	
	A	B	A	B	SL	EL	SL	EL
Packing gland 2" NPT male	1029	546	1334	851	7.5	7.8	11.5	14.5
Packing gland 150 lb/PN16 flange	1029	536	1334	841	9.5	10	13.7	16.7
Packing gland 300 lb/PN40 flange	1029	536	1334	841	11.5	12	15.5	18.5
Packing gland 600 lb/PN64 flange	1029	536	1334	841	12.5	15	16	19

For remote electronics add 5 kg (11Lb)

Remote Electronic



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