Pro-V™ Multivariable Flowmeter

Model M23 Insertion Vortex

Vortek Instruments' Pro-V multivariable flowmeters utilise three primary sensing elements - a vortex shedding velocity sensor, an RTD temperature sensor and a solid-state pressure transducer - to measure the mass flow rate of gases, liquid and steam.

Systems that use external process measurements to calculate mass flow 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 down-stream pressure and temperature measurements are beign made. Because the Pro-V multivariable flowmeter 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.

The product line is available with a wide range of options and meter configurations to meet your specific application requirements.

Pro-V™ Advantage:

- Volumetric or mass monitoring of most liquids, gases and steam
- Multivariable meter delivers mass flow, pressure, and density readings from a single device and reduces initial cost, installation costcost-of ownership over the lifetime of the instrument
- Mass flow equations - real gas, ideal gas, AGA 8, API2540
- Compensated mass flow reading of liquids, gases, and steam
- Energy Monitoring - ability to computer and energy use
- Easy to install and commission - Hot tappable
- Reliable–no moving parts,no fluid to sensor
- High accuracy with rangeability up to 100:1
- Temperature up to 750°F / 400°C
- Pressureup to 1500psig
- Inline configuraton for pipes from 1/2"- 8" DN15to DN300
- Field configurable ranges, outputs and displays
- Remote electronics options available for in harsh environments or locations with limited access
- 4-20mA loop-powered Mass Meter design saves on energy costs
- HART protocol communicaitons - standard
- Modbus communications available
- FM, FMC, ATEX, IECEx Approved

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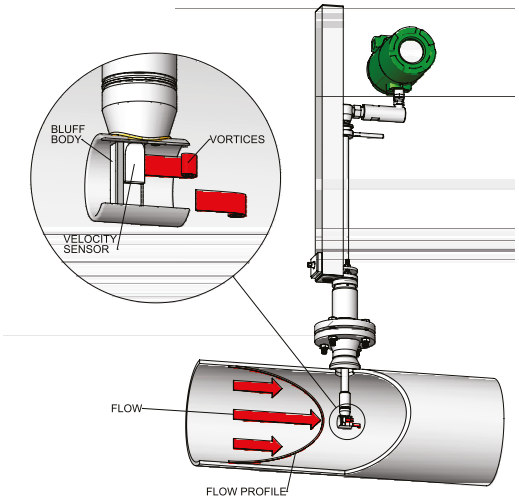
Pro-V™ Principle of Operation

Vortex flowmeters measure flows of liquid, gas and steam by detecting the frequency at which vortices are alternately shed from a bluff body. According to proven laws of physics, the frequency at which the vortices are alternately shed is directly proportional to the flow velocity.

Insertion vortex flowmeters measure flow by detecting the local velocity at a strategically located position within the pipe. The Pro-V™ M23 detects the frequency at which vortices are alternately shed from the bluff body located within the sensor head. The Pro-V™ M23 uses the local velocity, along with other parameters, such as fluid type, pipe size and Reynolds number to calculate the average pipe velocity, and consequently , the volumetric flow rate.



Pro-V™ Model M23-VTP

The Model M23-VTP offers you flow computer functionality in a compact field device. This multivariable instrument incorporates temperature and pressure sensors to provide an instantaneous reading of the 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, temperature and density.

Pro-V™ Model M23-VT

The Model M23-VT integrates a precision 1000 Ohm 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.

Pro-V™ Model M23-V

The Model M23-V delivers a direct reading of volumetric flow rate - generally the most cost-effective solution for liquid flow monitoring - in applications ranging from general water flows to hydrocarbon fuel flow measurement.

Pro-V™ Model M23-EM

The Model M23 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 Model M23-VTP flowmeter monitors oneside of the process, either sent or returned, and uses the input from a second separate temperature sensor on the opposite leg of the process to calculate the change in energy. Selectable energy units include Btu, joules, calories, Watt-hours, Megawatt-hours and Horsepower-hours. The local or remote electronics indicate two temperatures, delta T, mass total and energy total.

Pro-V™ Model M23-VTEP, VETEP

Similar to M23-VTP but with the option for an external input (T or P) via RTD or 4-20mA or one of each.

Performance Specifications

Accuracy

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

Model M22 Multiparameter Inline Vortex Meter		
Process Variables	Liquids	Gas & Steam
Volumetric Flow Rate	± 1.2% of Rate	± 1.5% of Rate
Mass Flow Rate	± 1.5% of Rate	± 2.0% of Rate
Temperature	± 2°F (± 1°C)	± 2°F (± 1°C)
Pressure	± .3% of Full Scale	± .3% of Full Scale
Density	± .3% of Reading	± .5% of Reading

Repeatability

Mass Flow Rate . . . . . ± .2% of rate
Volumetric Flow Rate . . . . . ± .1% of rate
Temperature . . . . . ± .2°F (± .1°C)
Pressure . . . . . ± .05% of full scale
Density . . . . . ± .1% of reading

Stability Over 12 Months

Mass Flow Rate . . . . . ± .2% of rate
Volumetric Flow Rate . . . . . ± negligible
Temperature . . . . . ± .9°F (± .5°C)
Pressure . . . . . ± .1% of full scale
Density . . . . . ± .1% of reading

Response Time

Adjustable from 1 to 100 seconds

Operating Specifications

Any gas, liquid or steam compatible with 316L stainless steel. Not recommended for multi-phase fluids.

Process and Ambient Temperature

Process Standard Temperature (code ST): -330 to 500°F (-200 to 260°C)
Process High Temperature (code HT): to 750°F (400°C)
Ambient Operating: -40 to 140°F (-40 to 60°C)
Ambient Storage: -40 to 185°F (-40 to 85°C)

Pressure Transducer Ratings			
Full Scale Operating Pressure		Max. Over-Range Pressure	
psia	bara	psia	bara
30	2	60	4
100	7	200	14
300	20	600	40
500	35	1000	70
1500	100	2500	175

Pressure Ratings			
Style Connection	Process	Rating Code	Ordering
Compression Fitting	2-inch Male NPT	ANSI 600 lb.	CNPT
	2-inch 150 lb. flange	ANSI 150 lb.	C150
	2-inch 300 lb. flange	ANSI 300 lb.	C300
	2-inch 600 lb flange	ANSI 600 lb.	C600
Packing Gland	2-inch Male NPT	50 Psig (3.5 BarG)	PNPT
	2-inch 150 lb. flange	50 Psig (3.5 BarG)	P150
	2-inch 300 lb. flange	50 Psig (3.5 BarG)	P300
Packing Gland & Removable Retractor	2-inch Male NPT	ANSI 300 lb.	PNPT & RR
	2-inch 150 lb. flange	ANSI 150 lb.	P150 & RR
	2-inch 300 lb. flange	ANSI 300 lb.	P300 & RR
Packing Gland & Permanent Retractor	2-inch Male NPT	ANSI 600 lb.	PNPTR
	2-inch 150 lb. flange	ANSI 150 lb.	P150R
	2-inch 300 lb. flange	ANSI 300 lb.	P300R
	2-inch 600 lb. flange	ANSI 600 lb.	P600R

Power Requirements

DCL option: 12-36 VDC, 25mA, 1W max, loop powered (single output)
DCH option: 12-36 VDC, 300mA, 9W max, (multiple outputs)
AC option: 100-240 VAC, 50/60Hz line power, 5W (multiple outputs)

Display

Alphanumeric 2 line x 16 character LCD digital display
Six pushbuttons for full field configuration
Pushbuttons can be operated with magnetic want without removal of the enclosure covers
Display can be mounted in 90° intervals for better viewing

Output Signals

Analog: 4-20 mA
Alarm: Solid state relay, 40 VDC
Totalizer Pulse: 50 millisecond pulse, 40 VDC
Volumetric or Loop Powered Mass: One analog, one totalizer pulse, HART
Multivariable option: Up to three analog signals, three alarms, one totalizer pulse, HART
Multivariable option: Modbus or BACnet process monitoring

Physical Specifications

Wetted Materials

316L stainless steel, plus:

- DuPont Teflon® based thread sealant on models with pressure transducer.
- DuPont Teflon® packing on standard temperature models with packing gland.
- Graphite based packing on high temperature models with packing gland.

Approvals

FM, FMC CLASS I, DIV. 1, GROUPS B,C,D
CLASS II/III, DIV. 1, GROUPS E,F,G
Type 4X and IP66, T6, Ta = -40 to 60°C

ATEX II 2 G Ex d IIB + H2 T6
II 2 D EX tD A21 IP66 T85°C, Ta = -40 to 60°C

IECEx Ex d IIB + H2 T6
Ex tD A21 IP66 T85°C, Ta = -40 to 60°C

Sizing Considerations

Piping Conditions		
Condition	Pipe Diameters, D	
	Upstream	Downstream
One 90° elbow before meter	10D	5D
Two 90° elbows before meter	15D	5D
Two 90° elbows before meter, out of plane	30D	10D
Reduction before meter	10D	5D
Expansion before meter	20D	5D
Partially open valve	30D	10D

Velocity Range

Maximum velocity, liquid: 30 feet/sec (9 meters/second)
Minimum velocity, liquid: 1 foot/sec (.3 meters/second)
Maximum velocity, gas or steam: 300 feet/sec (90 meters/second)
Minimum velocity, gas or steam feet/sec (meters/second):

$$\frac{5}{\sqrt{\text{density (Lb/ft}^3\text{)}}} \qquad \frac{6.1}{\sqrt{\text{density (kg/m}^3\text{)}}}$$

Consult the VorTek Instruments Sizing Program @vortekinst.com for easy calculation of flow range.

Water Minimum and Maximum Flow Rates						
Rate	Nominal Pipe Size (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
Nominal Pipe Size (mm)						
	80	150	200	300	400	600
M^3/hr min	5.2	20.4	35.4	79.2	125	284
M^3/hr Max	157	614	1062	2337	3753	8537

Typical Saturated Steam Minimum and Maximum Flow Rates (lb/hr)						
	Nominal Pipe Size (in)					
Pressure	3	6	8	12	16	24
5 psig	205	800	1385	3099	4893	11132
	2721	10633	18412	41196	65039	147954
100 psig	468	1831	3170	7092	11197	25472
	14246	55674	96407	215703	340546	774698
200 psig	632	2471	4278	9572	15111	34377
	25948	101405	175595	392880	620268	1411029
300 psig	762	2976	5153	11530	18203	41410
	37652	147145	254799	570093	900047	2047489
400 psig	873	3412	5908	13219	20870	47477
	49494	193420	334930	749382	1183103	2691404
500 psig	974	3805	6588	14741	23272	52942
	61543	240507	416468	931816	1471125	3346615

Typical Saturated Steam Minimum and Maximum Flow Rates (kg/hr)						
	Nominal Pipe Size (mm)					
Pressure	80	150	200	300	400	600
0 barg	81	316	548	1226	1936	4404
	938	3667	6350	14209	22432	51039
5 barg	187	729	1263	2826	4461	10151
	4986	19486	33742	75495	119189	271187
10 barg	249	972	1683	3767	5947	13530
	8859	34620	59949	134132	211764	481821
15 barg	298	1164	2016	4510	7120	16200
	12700	49629	85939	192283	303570	690705
20 barg	340	1329	2301	5148	8128	18493
	16550	64676	111995	250581	395609	900119
30 barg	413	1612	2791	6246	9860	22435
	24357	95187	164827	368789	582234	1324739

Typical Air Minimum and Maximum Flow Rates (SCFM) Air at 70°F						
	Nominal Pipe Size (in)					
Pressure	3	6	8	12	16	24
0 psig	56	220	381	852	1345	3059
	924	3611	6253	13991	22089	50250
100 psig	157	615	1065	2383	3763	8560
	7236	28279	48969	109564	172977	393500
200 psig	216	843	1460	3266	5156	11729
	13588	53101	91950	205732	324804	738886
300 psig	262	1022	1770	3960	6251	14221
	19974	78059	135169	302430	477467	1086176
400 psig	301	1175	2034	4551	7186	16346
	26391	103136	178593	399588	630859	1435121
500 psig	335	1310	2269	5077	8015	18233
	32834	128314	222191	497136	784865	1785464

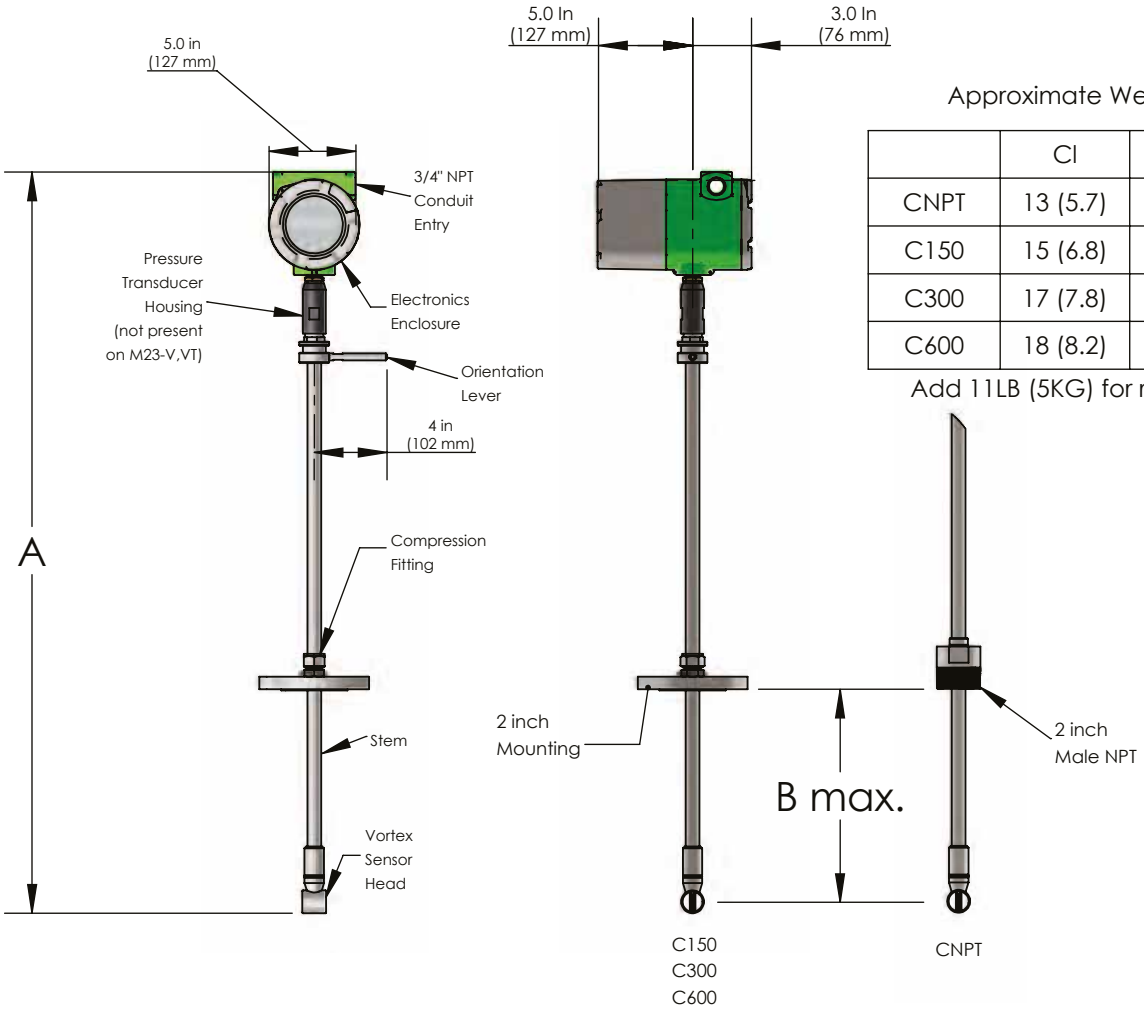
Typical Air Minimum and Maximum Flow Rates (nm3/hr) Air at 20°C						
	Nominal Pipe Size (mm)					
Pressure	80	150	200	300	400	600
0 barg	89	347	601	1345	2124	4833
	1463	5716	9897	22145	34962	79547
5 barg	217	847	1467	3282	5181	11788
	8702	34006	58885	131751	208004	473266
10 barg	294	1148	1987	4446	7020	15972
	15975	62430	108105	241878	381870	868857
15 barg	355	1385	2399	5368	8474	19282
	23280	90979	157542	352487	556497	1266182
20 barg	407	1589	2751	6156	9718	22112
	30615	119642	207175	463539	731823	1665095
30 barg	495	1934	3349	7493	11829	26915
	45361	177268	306961	686801	1084302	2467081

Turndown

Turndown is application dependent. Consult the VorTek Instruments Sizing Program @vortekinst.com for exact values.

Turndown can exceed 100:1

Dimensional Outline: Pro-V™ Compression Fitting Models



Approximate Weight, LB (KG)

	CI	SL	EL
CNPT	13 (5.7)	14 (6.2)	15 (6.7)
C150	15 (6.8)	16 (7.3)	17 (7.8)
C300	17 (7.8)	18 (8.3)	19 (8.8)
C600	18 (8.2)	19 (8.7)	20 (9.2)

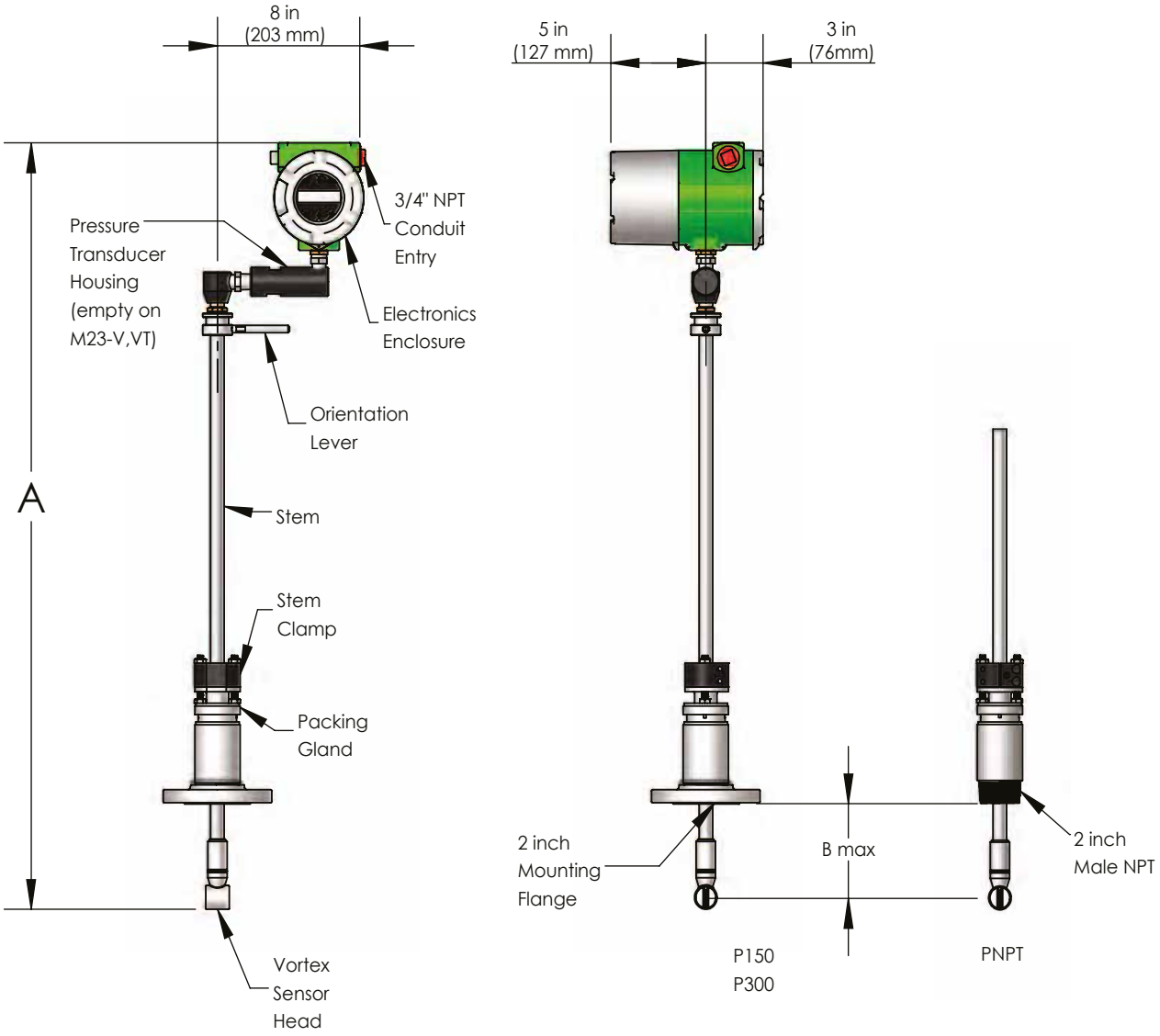
Add 11LB (5KG) for remote electronics

MODEL M23-V,VT, VTEP, VETEP in (mm)	CL/Compact Length		SL/Standard Length		EL/Extended Length	
	A	B	A	B	A	B
CNPT, Compression Fitting, Male NPT	21.6 (549)	9.8 (249)	38 (965)	26.2 (665)	50 (1270)	38.2 (970)
C150, Compression Fitting, 150 lb. Flange	21.6 (549)	10.9 (277)	38 (965)	27.3 (693)	50 (1270)	39.3 (998)
C300, Compression Fitting, 300 lb. Flange	21.6 (549)	10.8 (274)	38 (965)	27.2 (691)	50 (1270)	39.2 (996)
C600, Compression Fitting, 600 lb. Flange	21.6 (549)	10.4 (264)	38 (965)	26.8 (681)	50 (1270)	28.8 (986)

MODEL M23-VTP in (mm)	CL/Compact Length		SL/Standard Length		EL/Extended Length	
	A	B	A	B	A	B
CNPT, Compression Fitting, Male NPT	24.6 (625)	9.8 (249)	41 (1041)	26.2 (665)	53 (1346)	38.2 (970)
C150, Compression Fitting, 150 lb. Flange	24.6 (625)	10.9 (277)	41 (1041)	27.3 (693)	53 (1346)	39.3 (998)
C300, Compression Fitting, 300 lb. Flange	24.6 (625)	10.8 (274)	41 (1041)	27.2 (691)	53 (1346)	39.2 (996)
C600, Compression Fitting, 600 lb. Flange	24.6 (625)	10.4 (264)	41 (1041)	26.8 (681)	53 (1346)	28.8 (986)

Dimensional Outline: Pro-V™ Packing Gland Models

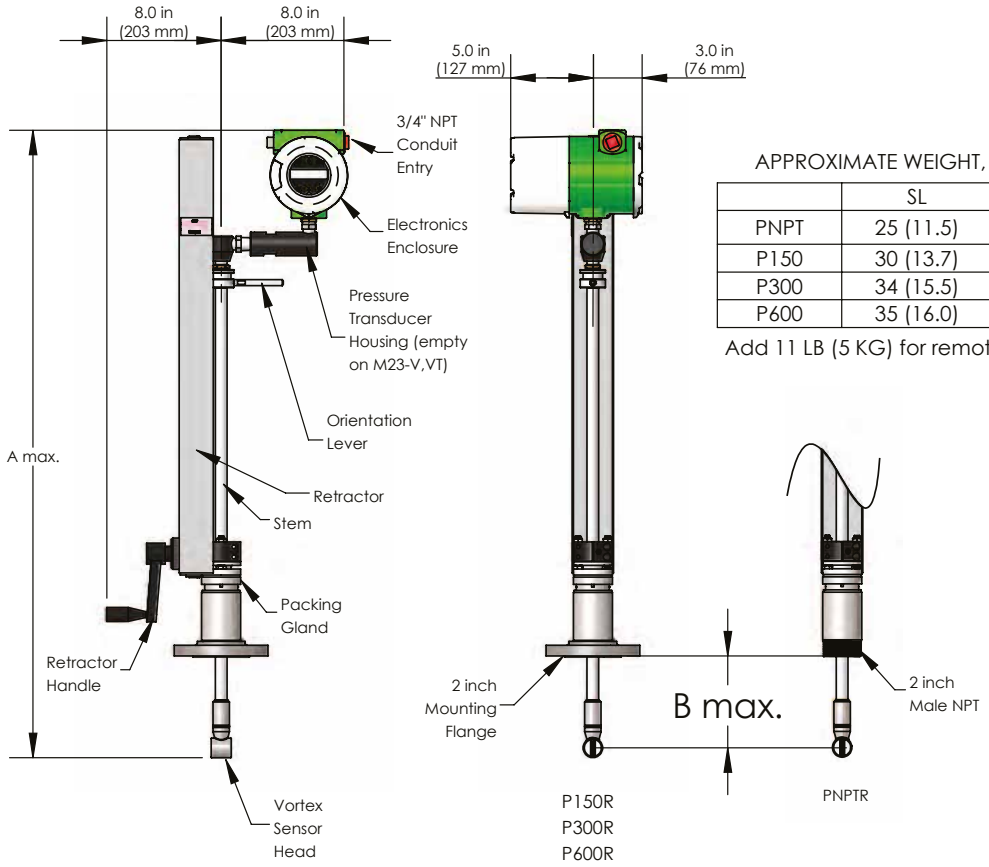
Removable retractor can be used with these models



MODEL M23 in (mm)	SL/Standard Length		EL/Extended Length	
	A	B	A	B
PNPT, Packing Gland, male NPT	40.5 (1029)	21.5 (546)	52.5 (1334)	33.5 (851)
P150, Packing Gland, 150 lb. Flange	40.5 (1029)	21.1 (536)	52.5 (1334)	33.1 (841)
P300, Packing Gland, 300 lb. Flange	40.5 (1029)	21.1 (536)	52.5 (1334)	33.1 (841)

Approximate Weight, LB (KG)	SL	EL
PNPT	41 (1041)	53 (1346)
P150	41 (1041)	53 (1346)
P300	41 (1041)	53 (1346)

Dimensional Outline: Pro-V™ Packing Gland Models with Permanent Retractor



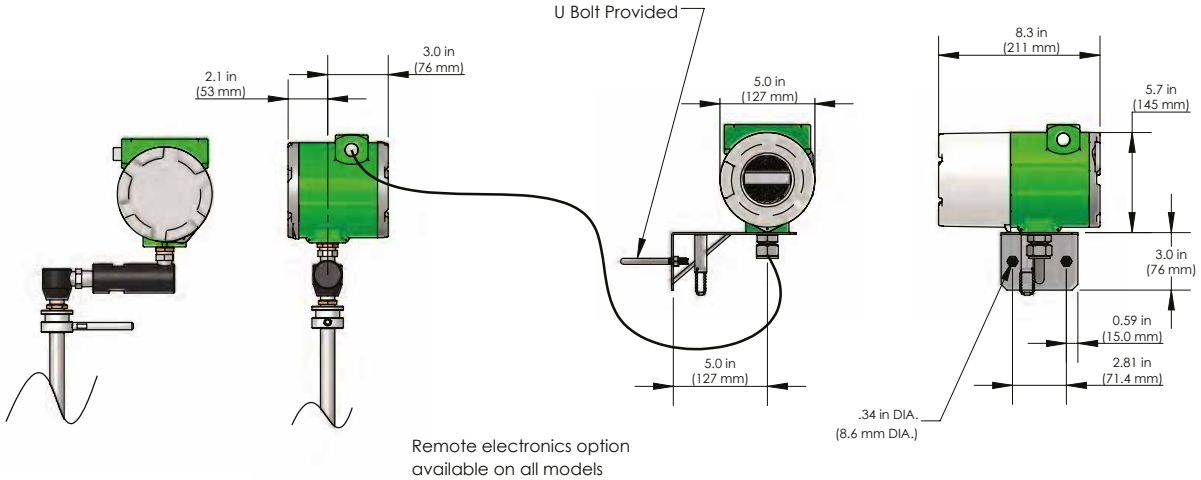
APPROXIMATE WEIGHT, LB (KG)

	SL	EL
PNPT	25 (11.5)	32 (14.5)
P150	30 (13.7)	37 (16.7)
P300	34 (15.5)	41 (18.5)
P600	35 (16.0)	42 (19.0)

Add 11 LB (5 KG) for remote electronics

MODEL M23 in (mm) with permanent retractor	SL/Standard Length		EL/Extended Length	
	A	B	A	B
PNPTR, Packing Gland, Male NPT	40.5 (1029)	21.5 (546)	52.5 (1334)	33.5 (851)
P150R, Packing Gland, 150 lb. Flange	40.5 (1029)	21.1 (536)	52.5 (1334)	33.1 (841)
P300R, Packing Gland, 300 lb. Flange	40.5 (1029)	21.1 (536)	52.5 (1334)	33.1 (841)
P600R, Packing Gland, 600 lb. Flange	40.5 (1029)	21.1 (536)	52.5 (1334)	33.1 (841)

Dimensional Outline: Remote Electronics Option



Remote electronics option
available on all models

Model Number Information - Pro-V™ Model M23 Insertion Mass Vortex Flowmeter

M23 [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Parent Number Code

M23	Insertion Multivariable Mass Vortex Flow Meter

Feature 1: Multivariable Options

V	Volumetric Flow Meter for liquid, gas and steam
VT	Velocity and Temperature Sensors
VTP	Velocity, Temperature and Pressure Sensors
VTEP	Velocity,Temperature and External 4-20mA Input (Tor P)
VETEP	Velocity, External RTD Temperature Input, External 4-20mA Input (T or P)
VT-EM	Energy output options
VTP-EM	Energy options with Pressure Sensor
VTEP-EM	Velocity,Temperature and External 4-20mA Input (Tor P)
VETEP-EM	Velocity, External RTD Temperature Input, External 4-20mAInput(TorP)

Feature 2: Probe Length

SL	Standard Length
CL	Compact Length
EL	Extended Length

Feature 3: Electronics Enclosure

L	NEMA 4X, IP66 Enclosure
R	Remote Electronics NEMA 4X, IP66, Specify cable length in parentheses

Feature 4: Display Options

DD	Digital Display and Programming Buttons
ND	No Display

Feature 5: Input Power

DCL	12-36 VDC, 25mA. 1W max, required on loop powered meters, 1AHL only
DCH	12-36 VDC, 300mA, 9W max. – use with 1AH, 1AM, 1AB, 3AH, 3AM, 3AB
AC	100-240 VAC, 50/60 Hz line power, 5W max – use with 1AH, 1AM,1AB, 3AH, 3AM, 3AB

Feature 6: Output

1AHL	Loop powered option - one analog output (4-20mA),one alarm, one pulse, HART, DCL input power only*
1AH	One analog output (4-20 mA), one alarm, one pulse, HART Communication Protocol, DCH or AC option only*
1AM	One analog output (4-20 mA), one alarm, one pulse, MODBUS Communication Protocol, DCH or AC option only*
1AB	One analog output (4-20 mA), one alarm, one pulse, BACnet Communication Protocol, DCH or AC option only*
3AH	Three analog outputs (4-20 mA), three alarms, one pulse, HART (VT,VTP only), DCH or AC option only*
3AM	Three analog outputs (4-20 mA), three alarms, one pulse, MODBUS (VT,VTP only), DCH or AC option only*
3AB	Three analog outputs (4-20 mA), three alarms, one pulse, BACnet (VT,VTP only), DCH or AC option only*

* Includes scaled frequency output.

Feature 7: Temperature Options

ST	Standard temperature Process temperature –330 to 500°F (-200 to 260°C)
HT	High temperature Process temperature to 750°F (400°C)

Feature 8: Pressure Options

P0	No pressure sensor
P1	Maximum 30 psia (2 bara), Proof 60 psia (4bara)
P2	Maximum 100 psia (7 bara), Proof 200 psia (14bara)
P3	Maximum 300 psia (20 bara), Proof 600 psia (41 bara)
P4	Maximum 500 psia (34 bara), Proof 1000 psia (64 bara)
P5	Maximum 1500 psia (100 bara), Proof 2500 psia (175 bara)

Feature 9: Process Connections

CNPT	Compression, 2 inch NPT
C150	Compression, 2 inch 150# Flange
C16	Compression, DN50 PN16 Flange
C300	Compression, 2 inch 300# Flange
C40	Compression, DN50 PN40 Flange
C600	Compression, 2 inch 600# Flange
C64	Compression, DN50 PN64 Flange
PNPT	Packing Gland, 2 inch NPT
P150	Packing Gland, 2 inch 150# Flange
P16	Packing Gland, DN50 PN16 Flange
P300	Packing Gland, 2 inch 300# Flange
P40	Packing Gland, DN50 PN40 Flange
PNPTR	Packing Gland, 2 inch NPT, Retractor
P150R	Packing Gland, 2 inch 150# Flange, Retractor
P16R	Packing Gland, DN50 PN16 Flange, Retractor
P300R	Packing Gland, 2 inch 300# Flange, Retractor
P40R	Packing Gland, DN50 PN40 Flange, Retractor
P600R	Packing Gland, 2 inch 600# Flange, Retractor
P64R	Packing Gland, DN50 PN64 Flange, Retractor

*JIS flanges available upon request

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