racine

Corrosion-Resistant for Harsh Liquid Applications

Badger Meter

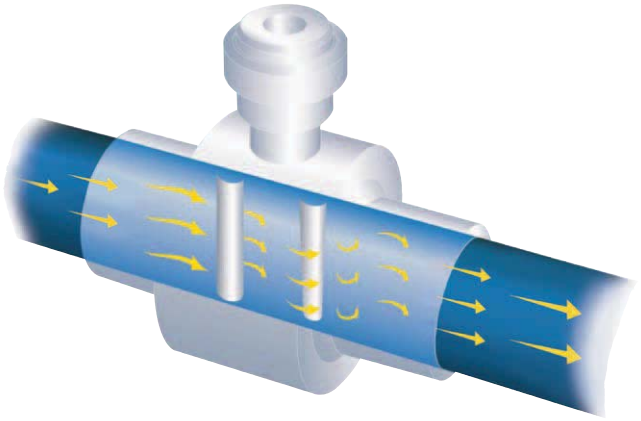
RVL Vortex Flow Meter

RVL Series Vortex Liquid Flow Meters

The RVL series meter utilizes vortex-shedding technology to provide a repeatable flow measurement accurate to ±1 percent of full scale. The meter has no moving parts, and any potential for fluid contamination is eliminated by the meter's corrosion-resistant all plastic construction. The meter includes a compact two-wire (4-20 milliamperes) or three-wire (0…5 Volt DC or pulse) transmitter, contained within a conveniently replaceable plug-in electronics module. All electronics are housed in a corrosion-resistant enclosure. Unlike meters containing metal or moving parts, the RVL is perfect for aggressive or easily contaminated fluids. Applications range from ultra-pure water to highly corrosive chemicals and slurries. Units may be re-calibrated and the meter output span reprogrammed in the field.

Operating Principle

Operation of the RVL vortex flow meter is based on the vortex shedding principle. As fluid moves around a body, vortices (eddies) are formed and move downstream. They form alternately, from one side to the other, causing pressure fluctuations. These are sensed by a piezoelectric crystal in the sensor tube, and are converted to a 4-20 milliamperes, 0…5 Volt DC or pulse signal. The frequency of the vortices is directly proportional to the flow rate. This results in extremely accurate and repeatable measurements using no moving parts.



Material Selection

When choosing the best flow meter for a process, it is necessary to review the fluid to be measured, its concentration, the minimum and maximum operating temperatures, operating pressure, fluid viscosity, suspended particles, density of the fluid and, most importantly, expected flow range.

One advantage of utilizing a RVL vortex flow meter is that there are no gaskets or elastomers in the meter. Therefore, one need only be concerned with the thermoplastic material used in body construction.

In a thermoplastic piping system, the material chosen for the flow meter should match that of the pipe wherever possible.

Chemical Compatibility

Chemical	PVC	PVDF	CPVC	Polypropylene
Aluminum Hydroxide	A	A	A	A
Chlorine Water	A	B	A	D
Fuel Oils	A	B	N/A	A
Hydraulic Oil	A	A	N/A	D
Hydrochloric Acid 37%	B	A	A	C
Hydrochloric Acid 20%	B	A	C	A
Isopropyl Alcohol	A	N/A	C	A
Nitric Acid (Concentrated)	B	A	D	D
Phosphoric Acid (>40%)	B	B	A	A
Potassium Hydroxide	A	A	A	A
Propylene Glycol	C	N/A	C	A
Sulfuric Acid (10…75%)	A	A	A	A

A= Excellent **B**= Good **C**= Fair **D**= Severe Effect

Line Fluids

Many factors may affect the capability of a meter to measure the flow of specific fluids accurately. Different solutions have varying effects on meters. For instance, heavy particle suspension will wear down internal parts on some meters or cause sensing inaccuracies for non-obtrusive metering systems. For vortex flow meters, high viscosities tend to dampen the formation of vortices and reduce the effective range. Particles and internal bubbles do not usually affect vortex meters. PVDF models typically work very well in slurry services, though slurries containing grit can wear down the bluff body over a period of time. Also, long fibers can catch and build up on the bluff, decreasing accuracy.

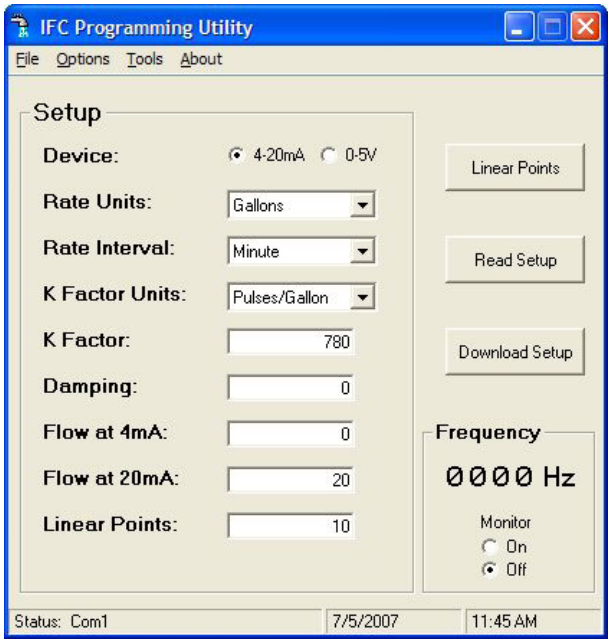
Standard factory calibration is for tap water at 32 Saybolt Seconds Universal (1 CentiStokes) viscosity and ambient temperature. Viscosity above 1 CentiStokes will raise the minimum readable flow rate, reducing rangeability. The effect is linear to viscosity. No adjustments are required for specific gravities up to 2.0. Liquids with high specific gravities will adversely affect the permissible amount and duration of overrange flow. The following chart indicates the reduction of range based on viscosity:

Viscosity and Rangeability

Viscosity	Minimum	Maximum	Flow Range
1 cSt	1	12	12:1
2 cSt	2	12	6:1
3 cSt	3	12	4:1
4 cSt	4	12	3:1
5 cSt	5	12	2.4:1
6 cSt	6	12	2:1

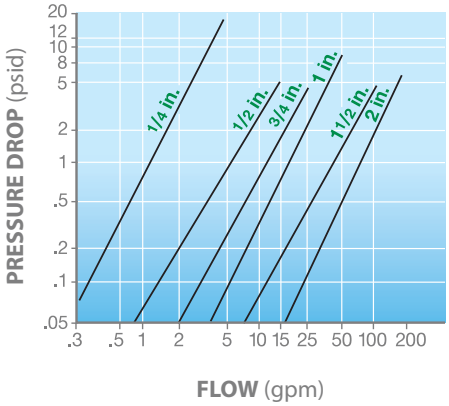
Software Utility (Optional)

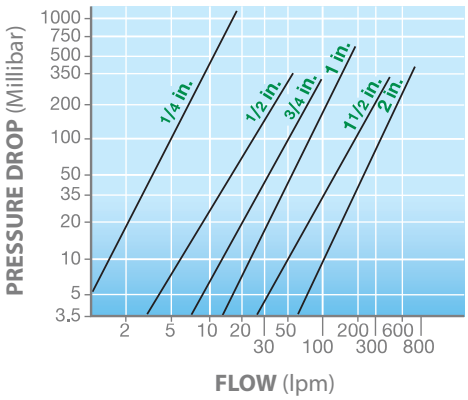
An optional software utility kit is available to configure the RVL 4-20 milliamperes or 0…5 Volt DC outputs. (The pulse output is not field configurable.) Part number RVS220-954 contains a RS232 nine-pin cable, software CD, TTL to RS232 converter and a board interface cable. The program enables easy configuration of span, damping and units of measurement.



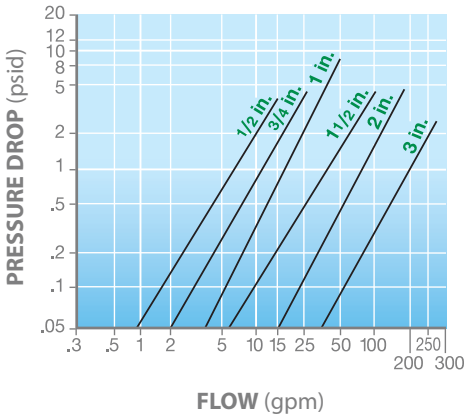
Pressure Drop vs Flow Rate

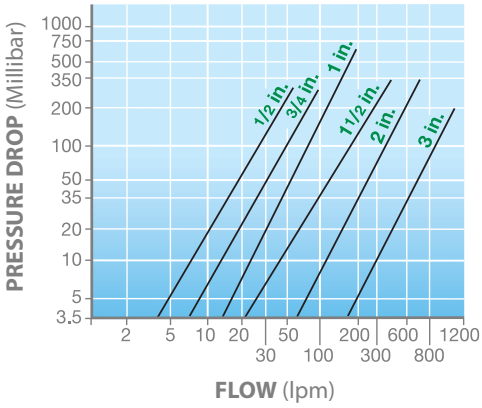
In-Line Style Flow Meters



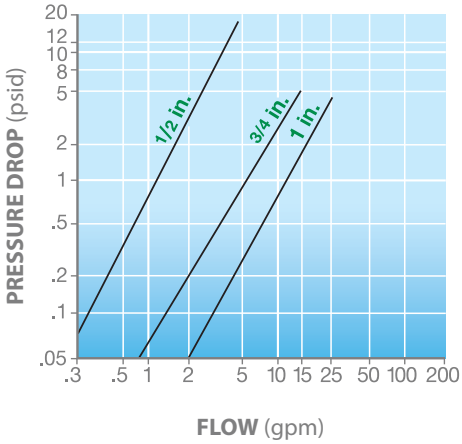


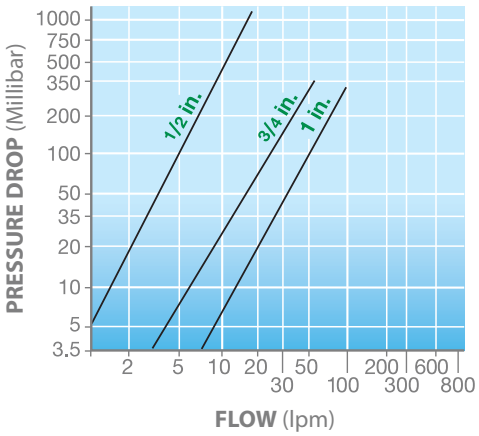
Wafer Style Flow Meters





In-Line Flare End Style Flow Meters





RVL Series In-Line Style Flow Meters

Specifications

Applications	Semiconductor equipment Low viscosity slurry Chemical processing DI water: semiconductor, institutional DI water skids Water/wastewater Pharmaceutical
Measured	Liquids
Connection	Butt or NPT thread
Turndown Ratio	12:1 (except 1/4 in. meter size; 8:1)
Accuracy	±1% of full scale, 4-20 mA and 0…5V DC; ±2% of full scale, frequency pulse
Repeatability	±0.25% actual flow
Output Signal	4-20 mA, 0…5V DC or frequency pulse (source – sink driver; 1A source/1.5A sink; typical output resistance 10 Ω)
Input Power	13…30V DC
Enclosure	NEMA 4X (IP 66)
Response Time	2 seconds minimum, step change in flow

Pressure and Temperature Rating

Maximum Fluid Temperature		Maximum Operating Pressure PSIG (bar)		
° F	° C	PVC	CPVC	PVDF
203	95	NR	24 (1.6)	40 (2.7)
150	66	NR	63 (4.3)	130 (8.9)
100	38	93 (6.4)	120 (8.3)	150 (10.3)
70	21	150 (10.3)	150 (10.3)	150 (10.3)

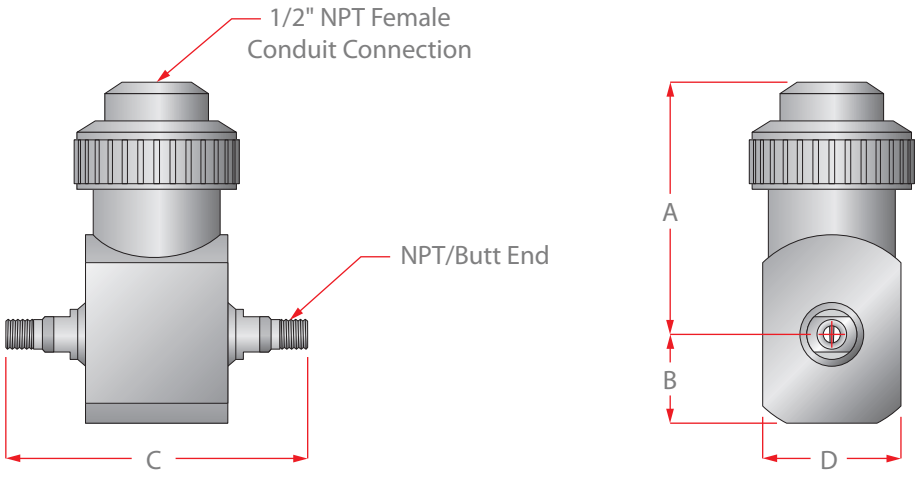
NR = Not Recommended

Minimum and Maximum Flow Rates

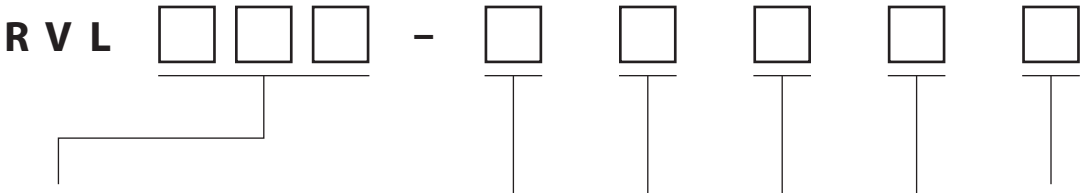
Meter	Minimum Flow		Maximum Flow	
Size	GPM	LPM	GPM	LPM
1/4 in.	0.6	2.3	5	19
1/2 in.	1.3	4.7	15	56.8
3/4 in.	2.1	7.9	25	94.6
1 in.	4.2	15.8	50	189
1-1/2 in.	8.3	31.5	100	379
2 in.	16.7	63.1	200	757

Dimensions: Inches (mm)

Meter	PVC/CPVC				PVDF (Butt)			
Size	A	B	C	D	A	B	C	D
1/4 in.	3.81 (97)	1.75 (45)	5.25 (133)	2.50 (64)	5.90 (150)	0.63 (16)	4.87 (124)	1.31 (33)
1/2 in.	3.81 (97)	1.75 (45)	7.13 (181)	2.50 (64)	5.75 (146)	0.78 (20)	4.87 (124)	1.31 (33)
3/4 in.	3.81 (97)	1.75 (45)	7.63 (194)	2.50 (64)	5.75 (146)	0.94 (24)	4.87 (124)	1.44 (37)
1 in.	3.92 (100)	1.75 (45)	8.03 (204)	2.50 (64)	5.88 (149)	1.19 (30)	5.09 (129)	2.00 (51)
1-1/2 in.	3.90 (99)	2.00 (51)	8.37 (213)	2.50 (64)	6.21 (158)	1.50 (38)	6.24 (158)	2.50 (64)
2 in.	4.31 (109)	2.00 (51)	8.37 (213)	2.50 (64)	6.60 (168)	1.88 (48)	6.77 (172)	3.00 (76)



Part Number Construction



Line Size ***Max. Flow (lpm)***

025) 1/4 in. 5 gpm (19)
050) 1/2 in. 15 gpm (56.8)
075) 3/4 in. 25 gpm (94.6)
100) 1 in. 50 gpm (189)
150) 1-1/2 in. 100 gpm (379)
200) 2 in. 200 gpm (757)

Body Style/End Connections

B) Butt End Connection (available with PVDF material only)
N) NPT (Male) Thread

Body Material

1) PVC
2) CPVC
4) PVDF

Output

X) 4-20 mA (standard)
P) Frequency Pulse[3]
V) 0…5V DC

Option[1]

N) None
C) Class 1000 Cleaning
H) High Temperature rated: 203° F (95° C)[2]
S) Stainless Steel Tag
3) 3-Pin Connector

Display

N) None
1) Top Mount LCD
2) Bottom Mount LCD
3) Right Mount LCD
4) Left Mount LCD

[1] Multiple options may be selected
[2] High Temperature option ONLY available with CPVC and PVDF body materials
[3] Not available with display

RVL Series Wafer Style Flow Meters

Specifications

Applications	Semiconductor equipment Low viscosity slurry Chemical processing DI water: semiconductor, institutional DI water skids Water/wastewater Pharmaceutical
Measured	Liquids
Connection	Wafer (mounted between flanges)
Turndown Ratio	12:1
Accuracy	±1% of full scale, 4-20 mA and 0…5V DC; ±2% of full scale, frequency pulse
Repeatability	±0.25% actual flow
Output Signal	4-20 mA, 0…5V DC or frequency pulse (source – sink driver; 1A source/1.5A sink; typical output resistance 10 Ω)
Input Power	13…30V DC
Enclosure	NEMA 4X (IP 66)
Response Time	2 seconds minimum, step change in flow

Pressure and Temperature Rating

Maximum Fluid Temperature		Maximum Operating Pressure PSIG (bar)			
° F	° C	PVC	PP	CPVC	PVDF
203	95	NR	NR	24 (1.6)	40 (2.7)
150	66	NR	90 (6.2)	100 (6.9)	130 (8.9)
100	38	130 (8.9)	130 (8.9)	130 (8.9)	150 (10.3)
70	21	150 (10.3)	150 (10.3)	150 (10.3)	150 (10.3)

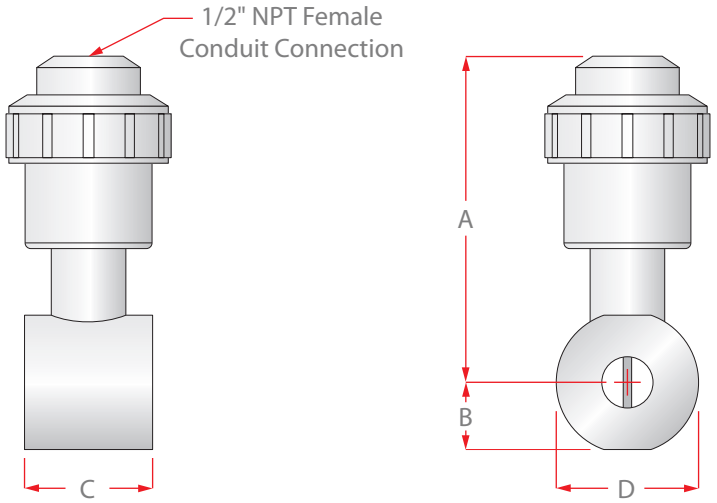
NR = Not Recommended

Minimum and Maximum Flow Rates

Meter Size	Minimum Flow GPM	Minimum Flow LPM	Maximum Flow GPM	Maximum Flow LPM
1/2 in.	1.3	4.7	15	56.8
3/4 in.	2.1	7.9	25	94.6
1 in.	4.2	15.8	50	189
1-1/2 in.	8.3	31.5	100	379
2 in.	16.7	63.1	200	757
3 in.	25.0	94.6	300	1136

Dimensions: Inches (mm)

Meter Size	PVDF A	PVDF B	PVDF C	PVDF D
1/2 in.	5.85 (149)	0.78 (20)	2.03 (52)	1.75 (44)
3/4 in.	5.90 (150)	0.94 (24)	2.03 (52)	2.13 (54)
1 in.	5.69 (145)	1.19 (30)	2.25 (57)	2.47 (63)
1-1/2 in.	6.00 (152)	1.50 (38)	2.63 (67)	3.25 (83)
2 in.	6.37 (162)	1.88 (48)	3.22 (82)	4.00 (102)
3 in.	6.88 (175)	2.50 (64)	4.25 (108)	5.24 (133)



Part Number Construction

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Line Size ***Max. Flow (lpm)***

050) 1/2 in. 15 gpm (56.8)
075) 3/4 in. 25 gpm (94.6)
100) 1 in. 50 gpm (189)
150) 1-1/2 in. 100 gpm (379)
200) 2 in. 200 gpm (757)
300) 3 in. 300 gpm (1136)

Body Style

W) Wafer
(mounts between flanges)

Body Material

1) PVC
2) CPVC
3) Polypropylene
4) PVDF

Output

X) 4-20 mA (standard)
P) Frequency Pulse[3]
V) 0…5V DC

Option[1]

N) None
C) Class 1000 Cleaning
H) High Temperature rated: 203° F (95° C)[2]
S) Stainless Steel Tag
3) 3-Pin Connector

Display

N) None
1) Top Mount LCD
2) Bottom Mount LCD
3) Right Mount LCD
4) Left Mount LCD

[1] Multiple options may be selected

[2] High Temperature option ONLY available with CPVC and PVDF body materials

[3] Not available with display

RVL Series In-Line Flare End Style Flow Meters

Specifications

Applications	Semiconductor equipment Low viscosity slurry Chemical processing DI water: semiconductor, institutional DI water skids Water/wastewater Pharmaceutical
Measured	Liquids
Connection	Tube (flare ends)*
Turndown Ratio	1/2 in. size = 8:1 3/4 in. size = 12:1 1 in. size = 12:1
Accuracy	±1% of full scale, 4-20 mA and 0…5V DC; ±2% of full scale, frequency pulse
Repeatability	±0.25% actual flow
Output Signal	4-20 mA, 0…5V DC or frequency pulse (source – sink driver; 1A source/1.5A sink; typical output resistance 10 Ω)
Input Power	13…30V DC
Enclosure	NEMA 4X (IP 66)
Response Time	2 seconds minimum, step change in flow

** Required two flare tubing nuts (not included)*

Pressure and Temperature Rating

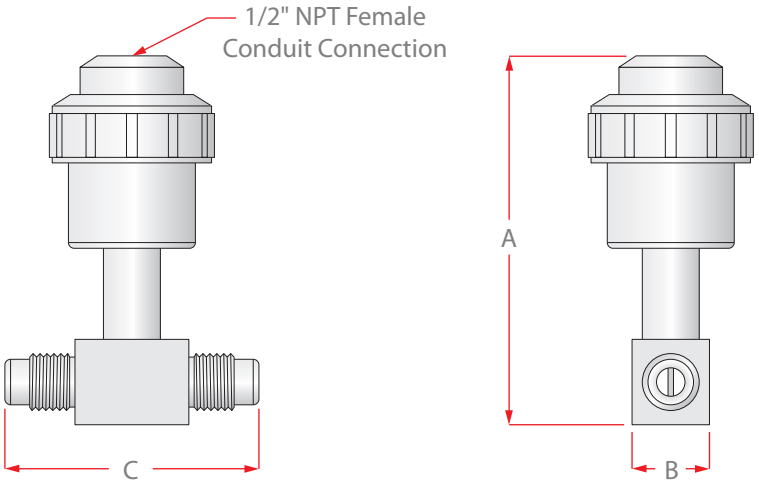
Maximum Fluid Temperature		Maximum Operating Pressure PSIG (bar)
° F	° C	PVDF
203	95	20 (1.4)
140	60	37 (2.6)
100	38	67 (4.6)
70	21	150 (10.3)

Minimum and Maximum Flow Rates

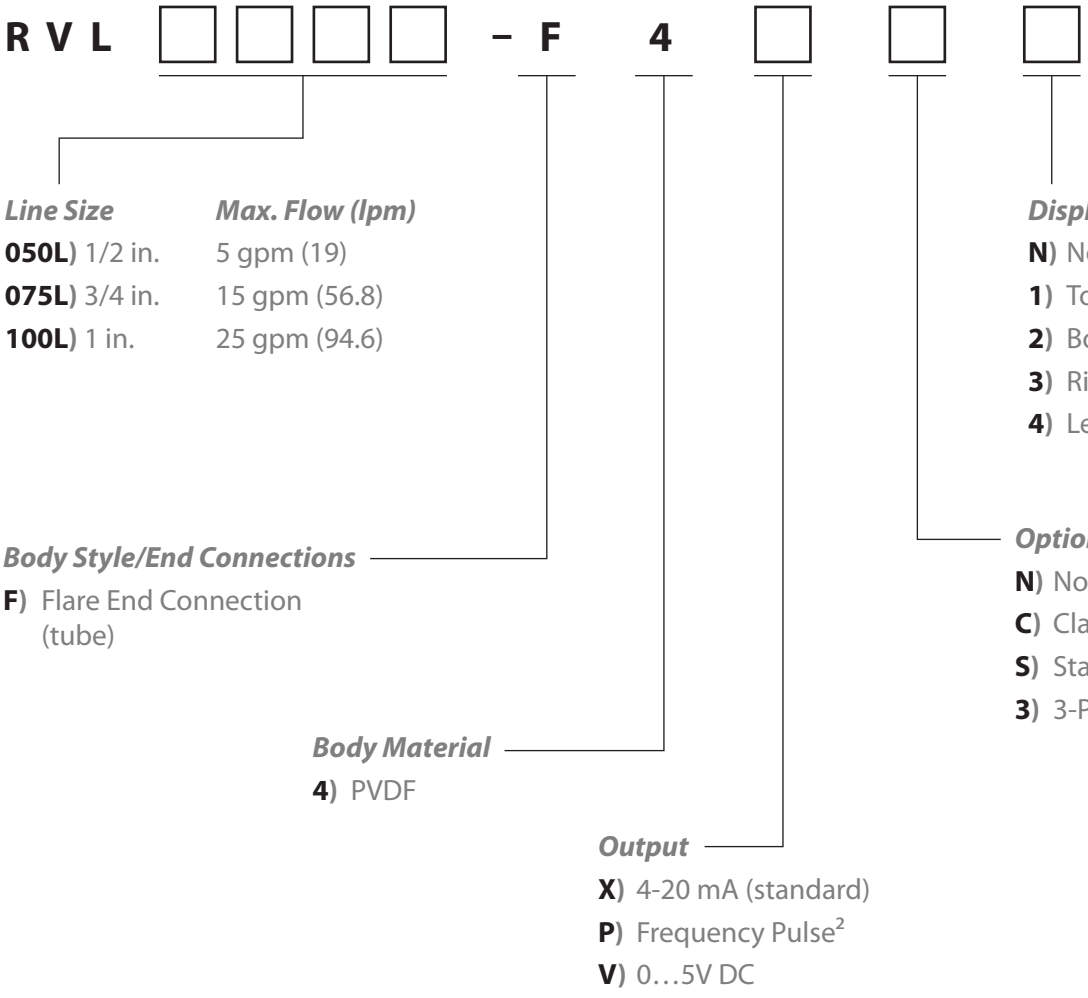
Tube Size	Minimum Flow GPM	Minimum Flow LPM	Maximum Flow GPM	Maximum Flow LPM
1/2 in.	0.6	2.3	5	19
3/4 in.	1.3	4.7	15	56.8
1 in.	2.1	7.9	25	94.6

Dimensions: Inches (mm)

Meter Size	PVDF A	PVDF B	PVDF C
1/2 in.	6.25 (159)	1.31 (33)	4.87 (124)
3/4 in.	6.25 (159)	1.31 (33)	4.66 (118)
1 in.	6.59 (167)	1.44 (37)	5.42 (138)



Part Number Construction



[1] Multiple options may be selected

[2] Not available with display

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