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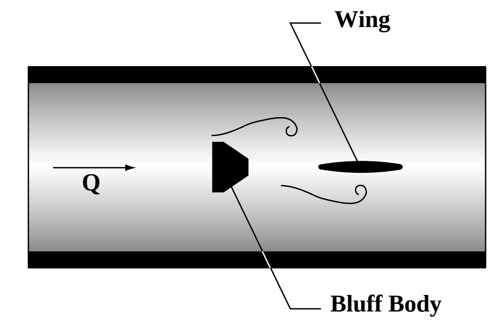
PRINCIPLE OF OPERATION



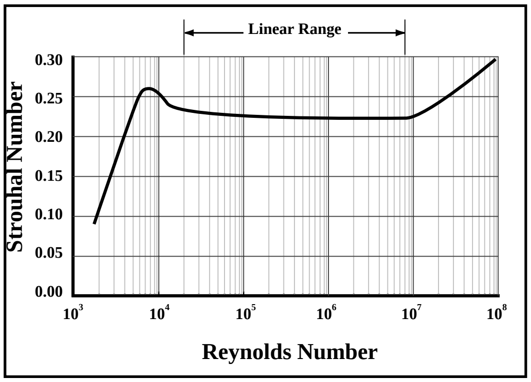
Cross Sectional View of Body

The Vortex PhD™ measures volumetric flowr ate by detecting the frequency at which alternating vortices are shed from a bluff body inserted into the flow stream. These vortices are known as Von Karman vortices. The Vortex PhD™ calculates the flow velocity using the following equation:

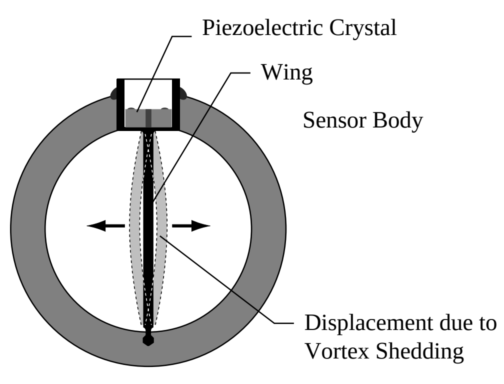
$$Q = \frac{f}{K}$$

Where

Q = flow rate
f = vortex shedding frequency
K = calibration constant



The linear range of the flowmeter (where Strouhal number is constant) is for Reynolds numbers between 20,000 and 7,000,000. (The Strouhal and Reynolds numbers are dimensionless and characterize the flow conditions.)



Passage of a vortex causes a slight bow of a wing placed downstream of the bluff body. The bend is measured by a piezoelectric crystal sensor in contact with the top of the wing.

Microprocessor based electronics amplify, filter, and convert the sensor input into either a 4-20 mA or frequency output. Locally displayed flowrate and totals in user-selectable, engineering units are available.

FEATURES

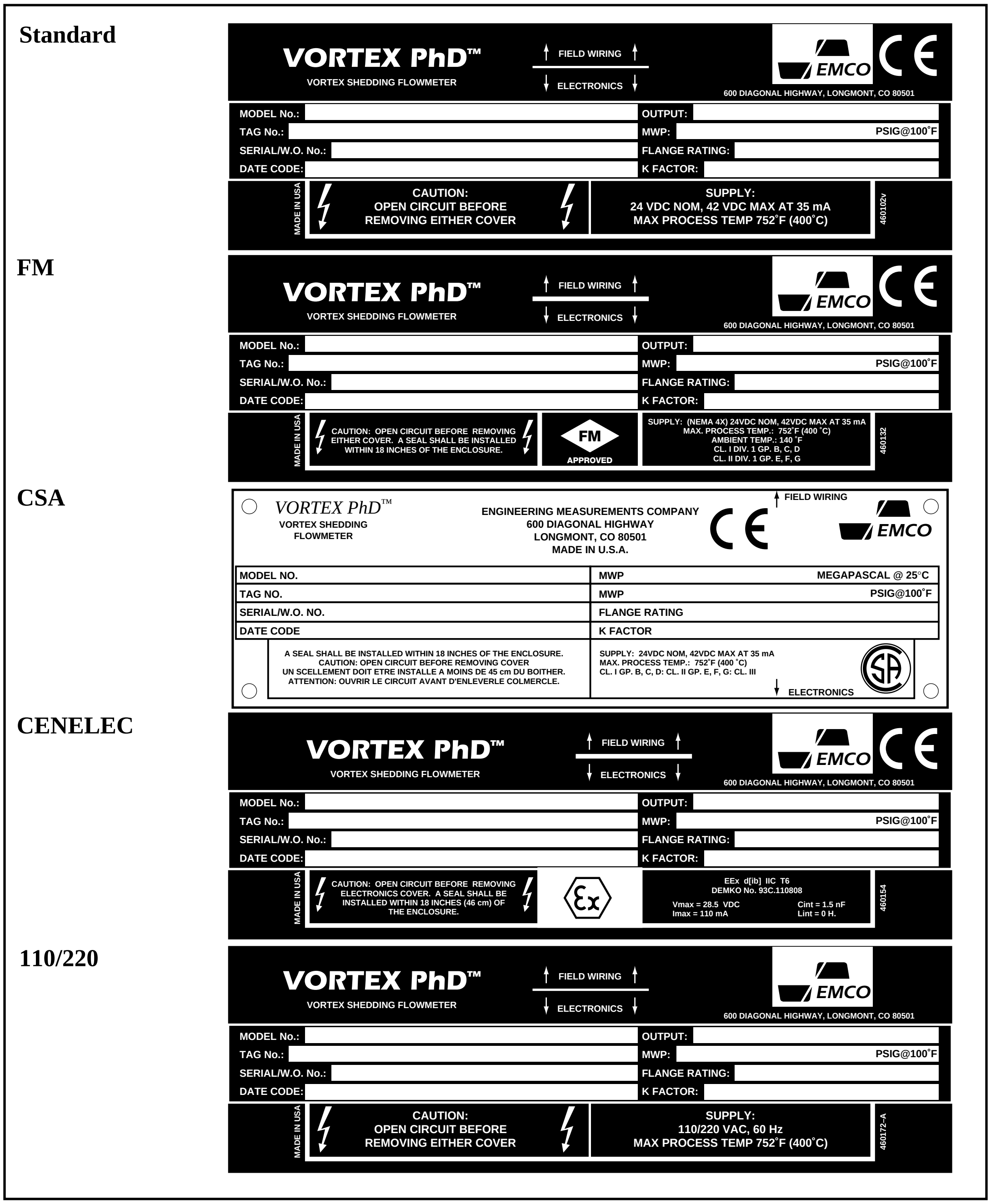
- EZ Logic user interface
- Smart transmitter/HART protocol
- Fully welded design
- Simultaneous 4-20 mA and frequency outputs
- Removable sensor under flow conditions
- Line sizes: 1 to 12"
- FM APPROVED approved – Class I, Division 2, Groups A, B, C, and D; and Dust-ignition Proof for Class II, Division 2, Groups F, and G hazardous (classified) locations.
- CSA approved – Class I, Division 1, Groups B, C, and D; Dust-ignition Proof for Class II, Division 1, Groups E, F, and G; and Class III hazardous locations.
- CENELEC – EEx d[ib] IIC T6.
- CE – EU EMC Directive 89/336/EEC; EN 55011 Class B; EN 50082-1

EQUIPMENT

Upon receiving your EMCO flowmeter, verify that all items on the packing list are present. In addition, check for possible shipping damage. Notify the freight carrier or your EMCO representative if any has occurred.

I.D. PLATES

A permanent identification plate is attached to your Vortex PhD™. This I.D. plate contains information on model, serial/W.O., date, pressure, temperature, K–factor, and line location (if supplied by customer). Verify that this information is consistent with your order.



CALIBRATION SHEET

Make sure to save the calibration data sheet when unpacking your new meter. The calibration sheet is important in setting up and monitoring the performance of your meter.

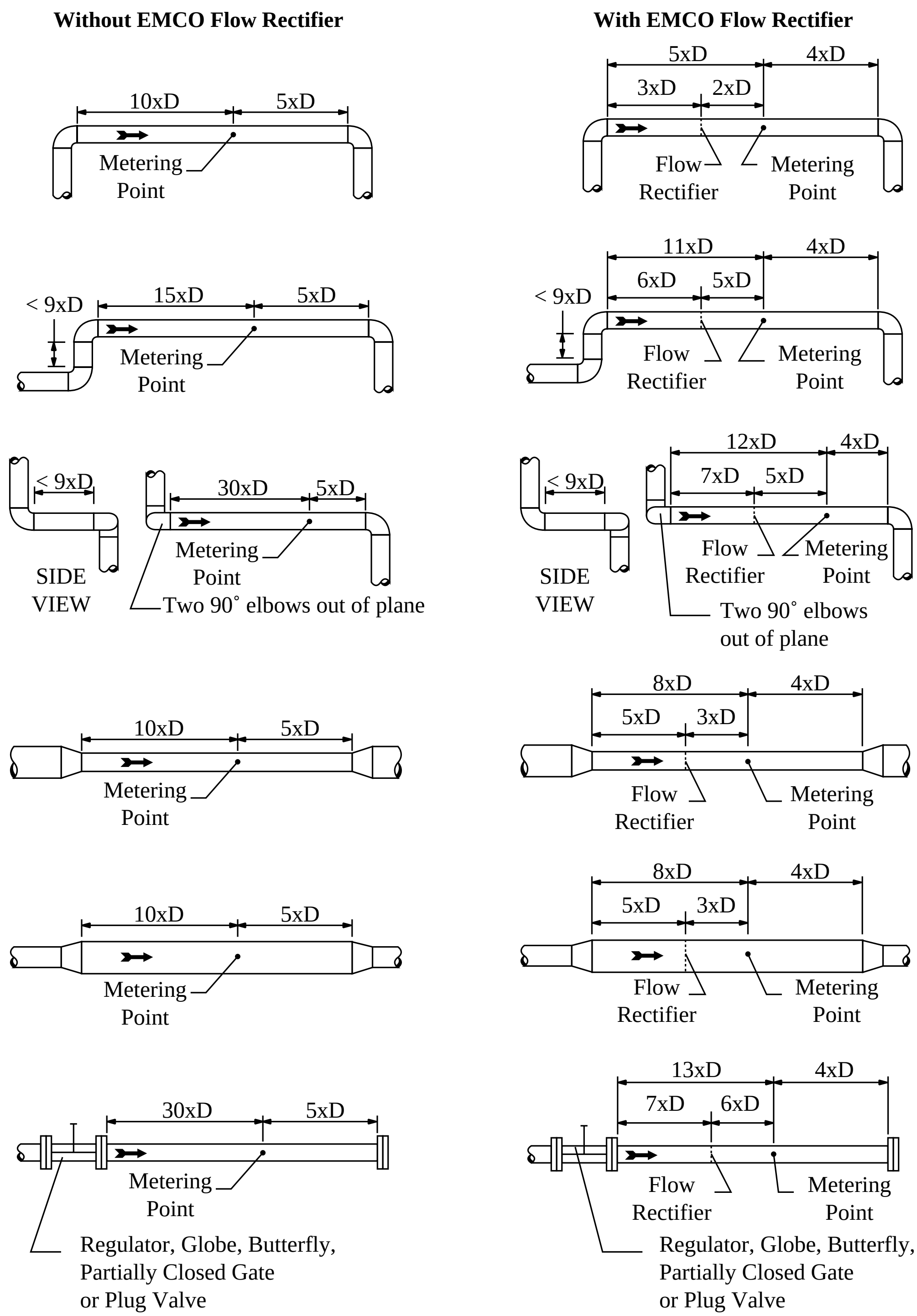
EZ LOGIC INTERFACE MAP

This map shows how the meter has been programmed at the factory. If your application changes, contact your EMCO representative for an updated map.

PIPING

Straight Run Requirements

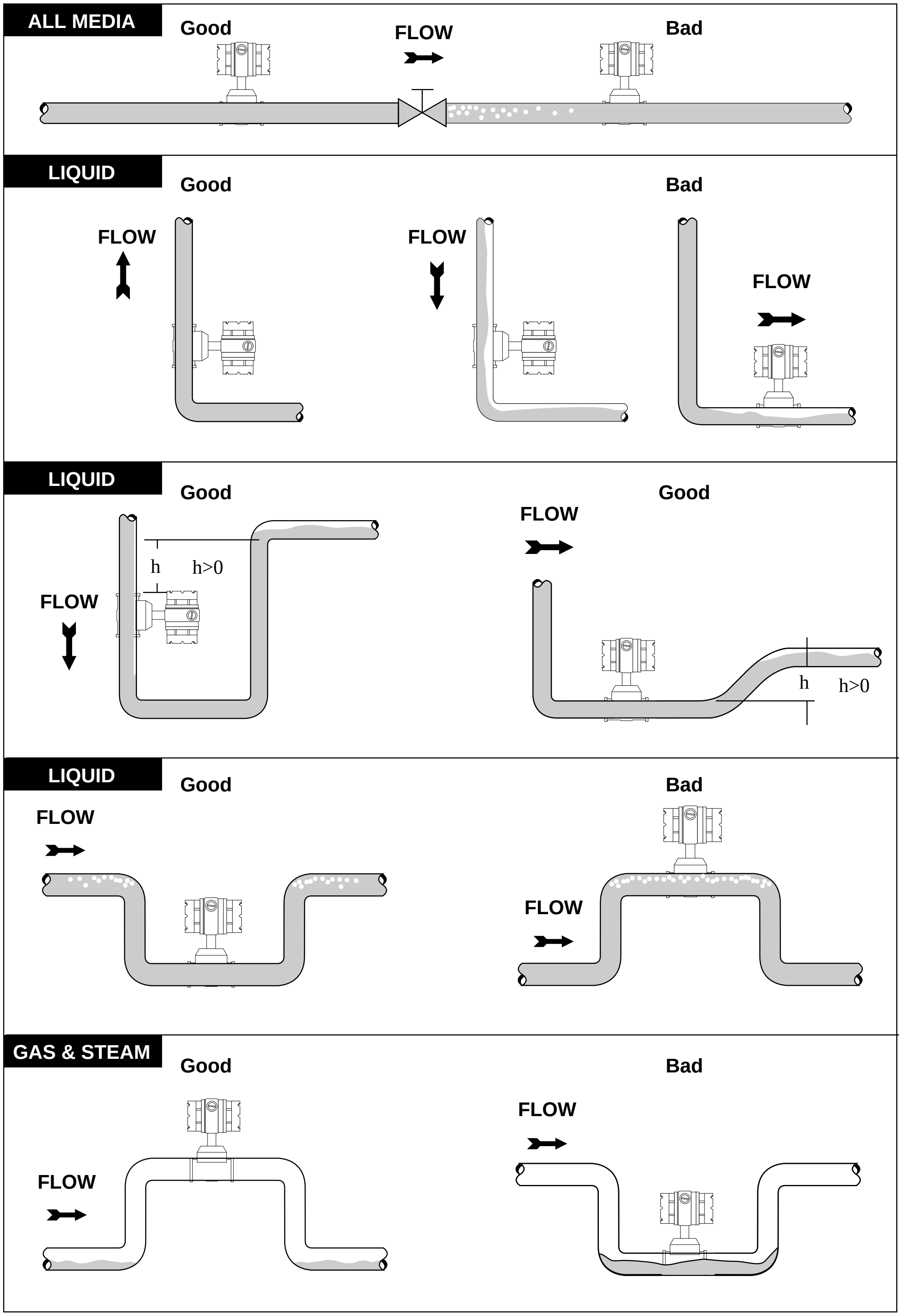
Note: The straight run of piping must have the same nominal diameter as the meter.



NOTE: D = flowmeter nominal diameter

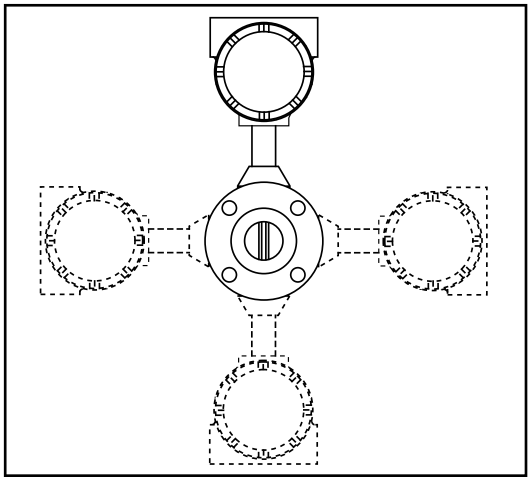
PIPING
(continued)

Meter Location
Recommended meter locations are shown.



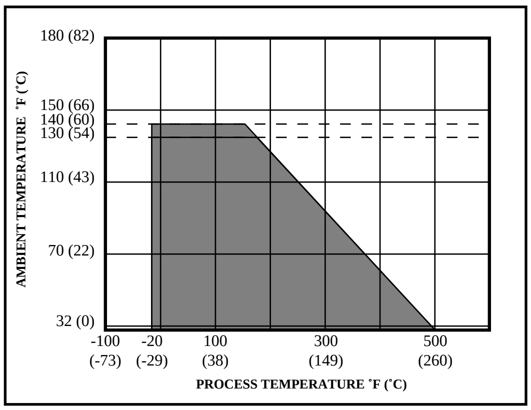
MOUNTING

General



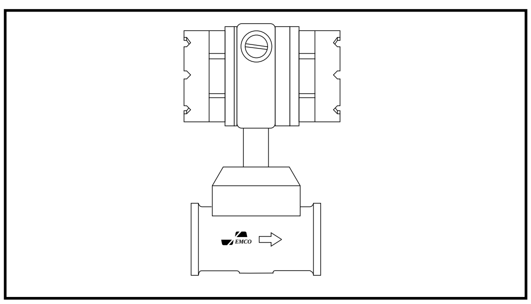
Meter can be installed at any angle.

Integral/ Remote Mounting



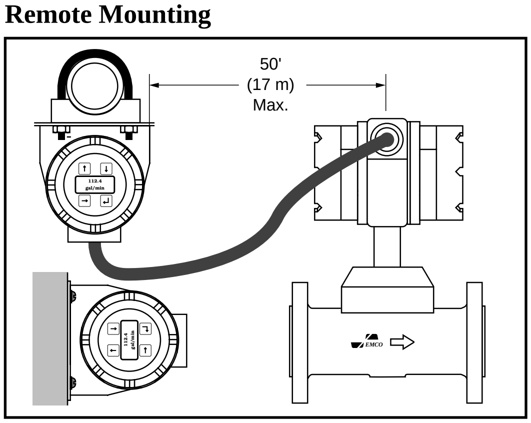
Sensor and electronics can be mounted either integral or remote. For integral mounting, the temperature of the medium and/or the ambient temperature must be within the shaded area of the graph shown . It is possible to shield the electronics from the high temperature of the piping system with thermal insulation blankets.

Integral Mounting



Sensor and electronics are mounted as one unit.

Remote Mounting



If the temperature of the medium and/or the ambient temperature exceeds the parameters of the shaded area of the graph shown, remote mounting is necessary. There are two options for remote mounting, pipe or wall. The distance between sensor and the electronics must not exceed 50'. If remote mounting is ordered, mounting clamps and plate, and 33' of cable is supplied (50' of cable can be ordered as an option.)

MECHANICAL

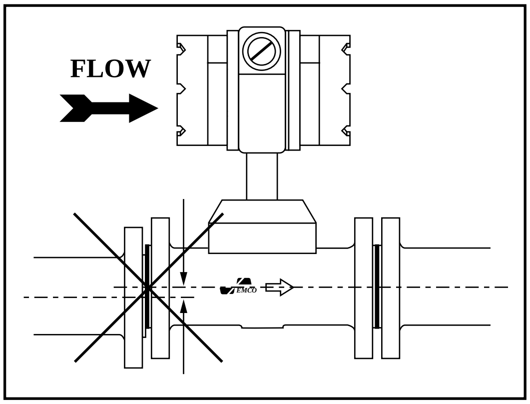
General

The Vortex PhD ™ can be used in systems using pipe I.D.'s ≥ schedule 80 pipe. The schedule of the mating pipe must be ≥ the internal diameter of the flowmeter. Weldneck flanges and self-centering gaskets are recommended for optimum performance, and gaskets should *not* be allowed to protrude into the flow stream.

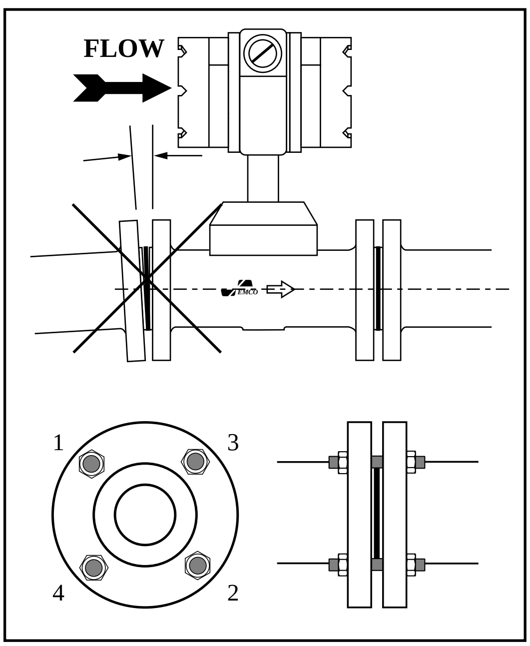
Pipe supports are recommended if mechanical vibration is present. Pipe supports should follow industry standard piping practices.

Install the meter with the flow arrow on the meter body in the direction of flow.

Flange Style



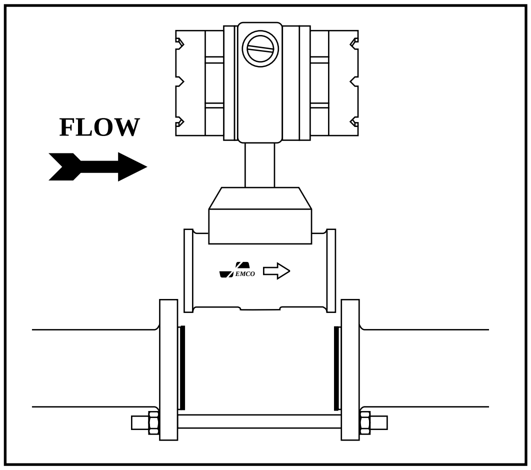
Align the bolt holes of each set of mating flanges. The bolt holes should be directly opposite each other in order to minimize any stress on the flowmeter body.



Snug all bolts prior to final tightening. Tighten bolts in a staggered fashion to avoid tilt.

MECHANICAL
(continued)

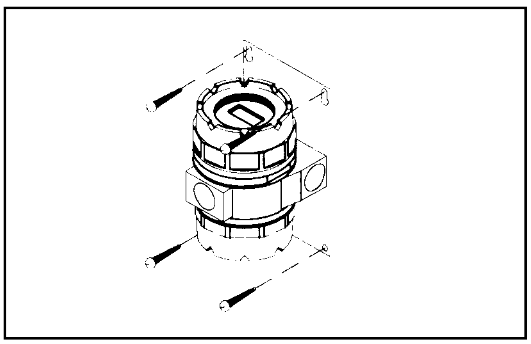
Wafer Style



Place the meter body between flanges; take care that the gaskets do not protrude into the bore. Install bolts. Tighten the bolts until snug; the bolts should be snug enough to hold the meter, yet loose enough to allow movement. Align the upstream end of the flowmeter by measuring from the outside edge of the flowmeter body to the outside diameter of the flange at several points. Adjust the position of the meter body until these measurements are within 1/16" of each other for meter sizes 2" and less, and 1/8" for larger sizes. Repeat for the downstream end of the meter. The alignment of the inlet to the meter is more critical than the outlet; i.e., if the piping system is warped such that both ends cannot be aligned, sacrifice the downstream alignment. Tighten all bolts.

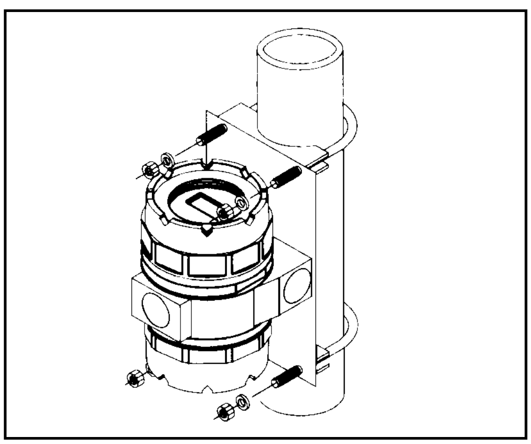
Remote Mount

Remote mount can be either pipe or wall mount. Secure the electronics condulet mounting bracket to either a 2" pipe or support structure. Position the condulet caps and the 3/4" NPT connections, so they can be easily accessed.



Wall Mount

For wall mounting, use 1/4" bolts (not supplied).

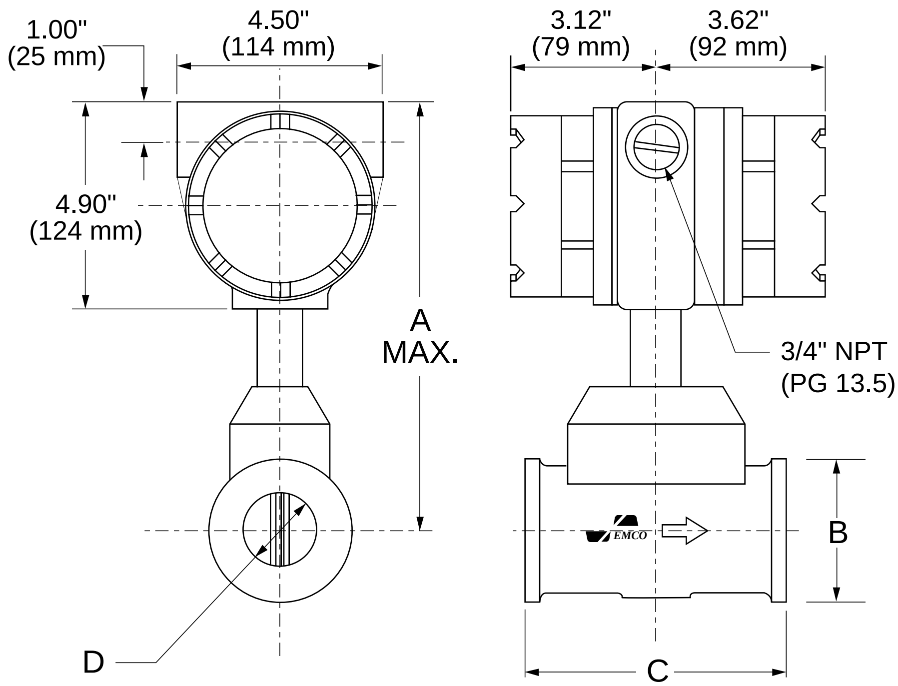


Pipe Mount

For pipe mounting, use the U-Bolts included with the remote mount kit. Note: For horizontal installation, mount transmitter below piping.

MECHANICAL
(continued)

Dimensions and Weights Integral
Wafer Style (available in stainless steel (sizes 1–4" only) and Hastelloy (sizes 1–3" only))



WAFER CONNECTION

Wafer connection is available in stainless steel (sizes 1 – 4" only) and Hastelloy (sizes 1–3" only). The schedule of the mating pipe's internal diameter ≥ dimension "D".

SIZE [in]	A [in]	B [in]	C [in]	D [in]	Approx Wt [lb]
1	10.8	2.2	4.1	0.957	13
1.5	10.5	3.1	4.1	1.500	14
2	10.8	3.6	5.0	1.939	17
3	11.5	5.0	7.0	2.900	32
4	12.2	6.2	9.5	3.826	51

English Weights & Dimensions: Wafer

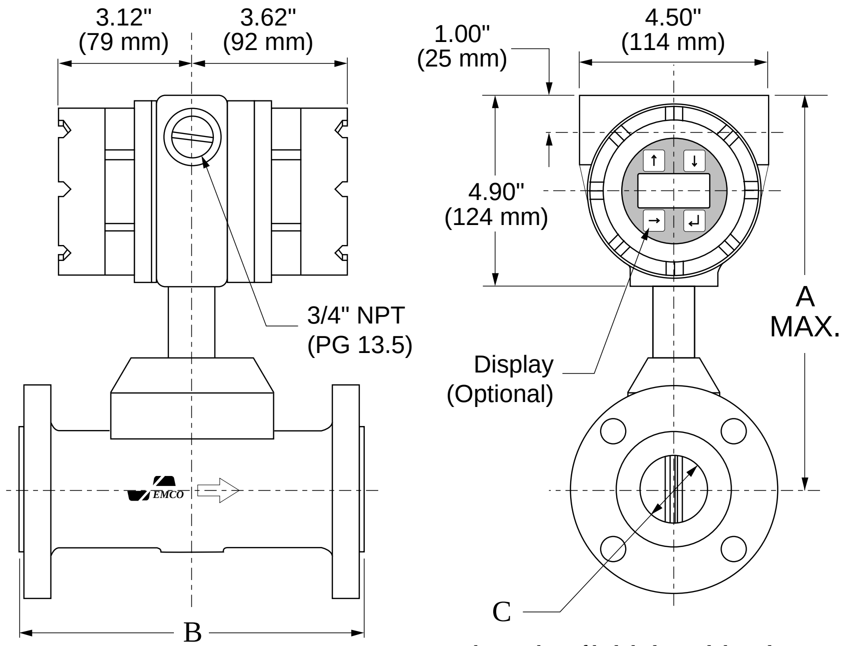
SIZE [mm]	A [mm]	B [mm]	C [mm]	D [mm]	Approx Wt [kg]
25	274	55.9	104.6	24.3	5.9
40	267	78.5	104.6	38.1	6.4
50	274	91.9	127.0	49.3	7.7
80	292	127.0	177.8	73.7	14.5
100	310	157.2	241.3	97.2	23.2

Metric Weights & Dimensions: Wafer

MECHANICAL
(continued)

Dimensions and Weights Integral

Flanged Style



The number of bolt holes and their diameter depend upon ANSI or DIN standard.

Notes:

1. The schedule of the mating pipe's internal diameter ≥ dimension"C".
2. N/A = Not Available, C/F = Consult Factory

SIZE [in]	**A** [in]	**B** [in]	**C** [in] **Stainless Steel**		**C** [in] **Carbon Steel**		**C** [in] **Hastelloy**	**Approx. Wt** [lb]		
			150# 300# Flanges	600# Flange	150# 300# Flanges	600# Flange	150# 300# 600# Flanges	150# Flange	300# Flange	600# Flange
1	10.7	7.6	0.957	0.957	N/A	N/A	0.957	18	20	20
1.5	10.7	8.1	1.500	1.500	N/A	N/A	1.500	22	28	28
2	13.2	8.5	1.939	1.939	N/A	N/A	1.939	31	36	36
3	13.8	9.0	2.900	2.900	N/A	N/A	2.900	51	60	60
4	14.3	9.5	3.826	3.826	N/A	N/A	3.826	55	72	99
6	15.3	13.6	5.761	5.761	5.761	5.761	C/F	92	116	140
8	16.3	18.5	7.625	7.625	7.625	7.625	C/F	144	182	220
10	17.4	18.5	10.020	9.750	10.020	9.750	C/F	180	260	440
12	18.4	18.5	12.000	11.750	11.938	11.374	C/F	265	365	535

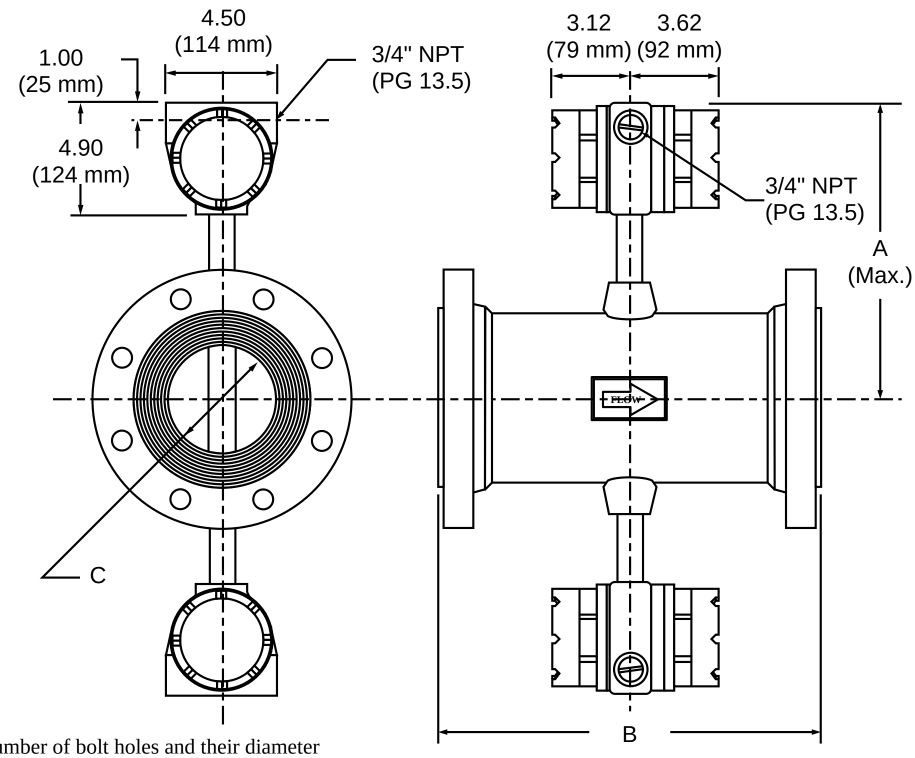
English Weights & Dimensions: Flange

SIZE [mm]	**A** [mm]	**B** [mm]	**C** [mm] **Stainless Steel**		**C** [mm] **Carbon Steel**		**C** [mm] **Hastelloy**	**Approx. Wt** [kg]		
			PN 16 PN 40 Flanges	PN 64 Flange	PN 16 PN 40 Flanges	PN 64 Flange	PN 16 PN 40 PN 64 Flanges	PN 16 Flange	PN 40 Flange	PN 64 Flange
25	272	192.0	24.3	N/A	N/A	N/A	24.3	8.2	9.1	N/A
40	272	206.2	38.1	N/A	N/A	N/A	38.1	10.0	12.7	N/A
50	335	215.9	49.3	49.3	N/A	N/A	49.3	14.1	16.3	16.3
80	350	228.6	73.7	73.7	N/A	N/A	73.7	23.1	27.2	27.2
100	363	241.3	97.2	97.2	N/A	N/A	97.2	25.0	32.7	44.9
150	389	346.2	146.3	146.3	146.3	146.3	C/F	41.7	52.6	63.5
200	414	469.9	193.7	193.7	193.7	193.7	C/F	65.3	82.6	99.8
250	442	469.9	254.4	247.7	254.5	247.7	C/F	81.6	117.9	199.6
300	467	469.9	304.8	298.5	303.2	288.9	C/F	120.2	165.6	242.7

Metric Weights & Dimensions: Flange

MECHANICAL
(continued)

Dimensions and Weights
Dual Style



The number of bolt holes and their diameter depend upon ANSI or DIN standard.

Notes:

1. The schedule of the mating pipe's internal diameter ≥ dimension"C".
2. N/A = Not Available, C/F = Consult Factory

SIZE [in]	**A** [in]	**B** [in]			**C** [in] **Stainless Steel**		**C** [in] **Carbon Steel**		**C** [in] **Hastelloy**	**Approx. Wt** [lb]		
		150# Flange	300# Flange	600# Flange	150# 300# Flanges	600# Flange	150# 300# Flanges	600# Flange	150# 300# 600# Flanges	150# Flange	300# Flange	600# Flange
1	13.8	8.4	8.9	9.4	0.957	0.957	N/A	N/A	0.957	28	30	30
1.5	14.0	8.9	9.4	10.0	1.500	1.500	N/A	N/A	1.500	32	38	38
2	14.2	9.0	9.5	10.3	1.939	1.939	N/A	N/A	1.939	35	46	46
3	13.8	9.0	9.0	9.0	2.900	2.900	N/A	N/A	2.900	61	70	70
4	14.3	9.5	9.5	9.5	3.826	3.826	N/A	N/A	3.826	76	93	109
6	15.3	13.6	13.6	13.6	5.761	5.761	5.761	5.761	C/F	102	126	150
8	16.3	18.5	18.5	18.5	7.625	7.625	7.625	7.625	C/F	154	192	230
10	17.4	18.5	18.5	18.5	10.020	9.750	10.020	9.750	C/F	190	270	450
12	18.4	18.5	18.5	18.5	12.000	11.750	11.938	11.374	C/F	275	375	545

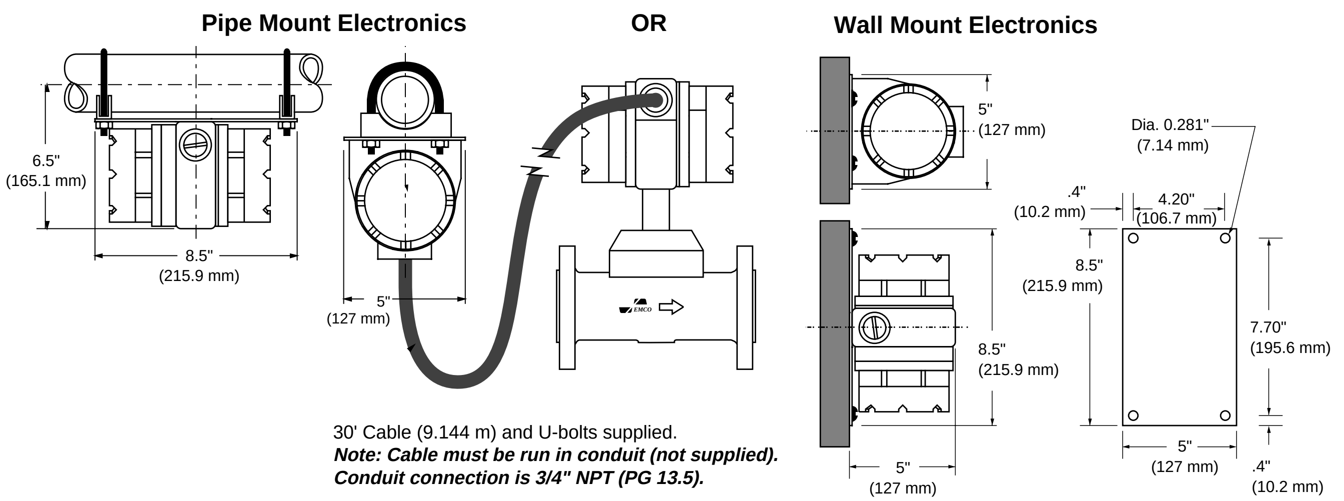
English Weights & Dimensions: Dual

SIZE [mm]	**A** [mm]	**B** [mm]			**C** [mm] **Stainless Steel**		**C** [mm] **Carbon Steel**		**C** [mm] **Hastelloy**	**Approx. Wt** [kg]		
		PN 16 Flange	PN 40 Flange	PN 64 Flange	PN 16 PN 40 Flanges	PN 64 Flange	PN 16 PN 40 Flanges	PN 64 Flange	PN 16 PN 40 PN 64 Flanges	PN 16 Flange	PN 40 Flange	PN 64 Flange
25	351	212.9	225.6	238.3	24.3	24.3	N/A	N/A	24.3	8.2	9.1	9.1
40	356	225.6	238.3	254.0	38.1	38.1	N/A	N/A	38.1	10.0	12.7	12.7
50	361	228.6	241.3	260.4	49.3	49.3	N/A	N/A	49.3	15.9	16.3	16.3
80	350	228.6	228.6	228.6	73.7	73.7	N/A	N/A	73.7	23.1	27.2	27.2
100	369	241.3	241.3	241.3	97.2	97.2	N/A	N/A	97.2	29.9	37.6	44.9
150	388	346.2	346.2	346.2	146.3	146.3	146.3	146.3	C/F	41.7	52.6	63.5
200	413	469.9	469.9	469.9	193.7	193.7	193.7	193.7	C/F	65.3	82.6	99.8
250	445	469.9	469.9	469.9	254.4	247.7	254.5	247.7	C/F	81.6	117.9	199.6
300	470	469.9	469.9	469.9	304.8	298.5	303.2	288.9	C/F	120.2	165.6	242.7

Metric Weights & Dimensions: Dual

MECHANICAL (continued)

Dimensions and Weights
Remote



NOTE: CENELEC: Hard conduit not approved for CENELEC. Approved glandnuts are provided with CENELEC flowmeters.

	Approximate Weight (lb)						
Size	150# Flange		300# Flange		600# Flange		Wafer
(in)	Std	Dual	Std	Dual	Std	Dual	Std
1	24	40	26	42	26	42	19
1.5	28	44	34	50	34	50	20
2	37	53	42	58	42	58	23
3	57	73	66	82	66	82	38
4	72	88	89	105	105	121	57
6	98	114	122	138	146	162	N/A
8	150	166	188	204	226	242	N/A
10	186	202	266	282	556	462	N/A
12	271	287	371	387	541	557	N/A

	Approximate Weight (kg)						
Size	PN 16 Flange		PN 40 Flange		PN 64 Flange		Wafer
(mm)	Std	Dual	Std	Dual	Std	Dual	Std
25	10.9	18.1	11.8	19.1	11.8	19.1	8.6
40	12.7	20.0	15.5	22.7	15.5	22.7	9.1
50	16.8	24.0	19.1	26.3	19.1	26.3	10.4
80	25.9	33.1	30.0	37.2	30.0	37.2	17.2
100	32.7	39.9	40.5	47.6	47.7	54.9	25.9
150	44.5	51.7	55.5	62.6	66.4	73.5	N/A
200	68.5	75.3	85.5	92.5	102.7	109.8	N/A
250	91.6	91.6	127.9	127.9	209.6	209.6	N/A
300	130.2	130.2	175.5	175.5	252.7	252.7	N/A

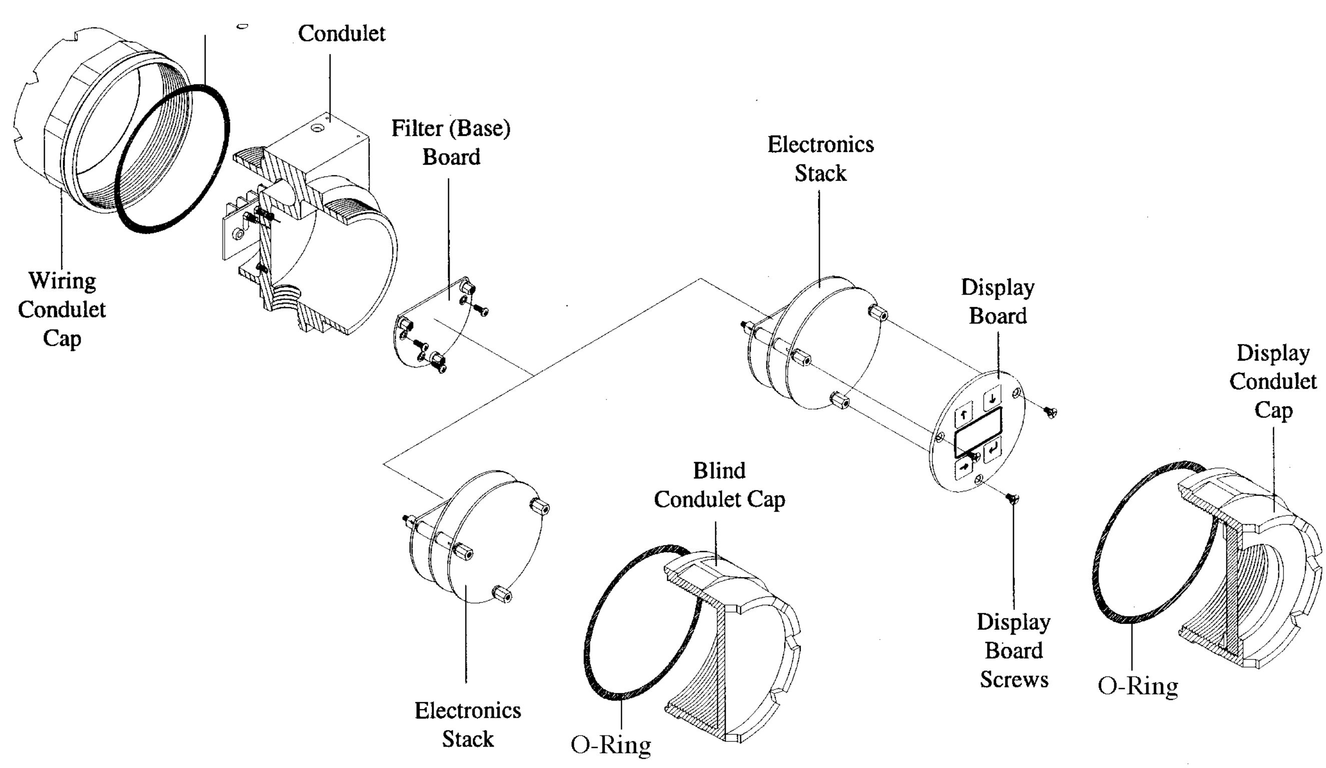
ELECTRICAL

General

To avoid personal injury, property damage from electrical shock, contact with live electrical systems or from combustible material, or contact with explosive gases which can be ignited by electrical arcing: wiring and conduit must be installed in accordance with national, local laws, standards, codes, and industry practices. Furthermore, for explosion proof applications, install a suitable conduit seal no more than 18 inches from the conduit connection.

Jumper Settings

The flowmeter jumpers are factory configured for each specific application. Additional configuration should not be required except for application changes. Jumper settings can be accomplished by exposing the filter (base) board located in the electronics condulet; *before* any disassembly is done, the user should be properly grounded using proper electrostatic discharge (ESD) precautions. To expose the filter board, remove condulet cap and unscrew the display board screws. Gently remove the display board from the electronics stack. Disregard previous if your flowmeter does not have a display. Unscrew the hex standoff bolts, and remove the electronics stack from the base board.

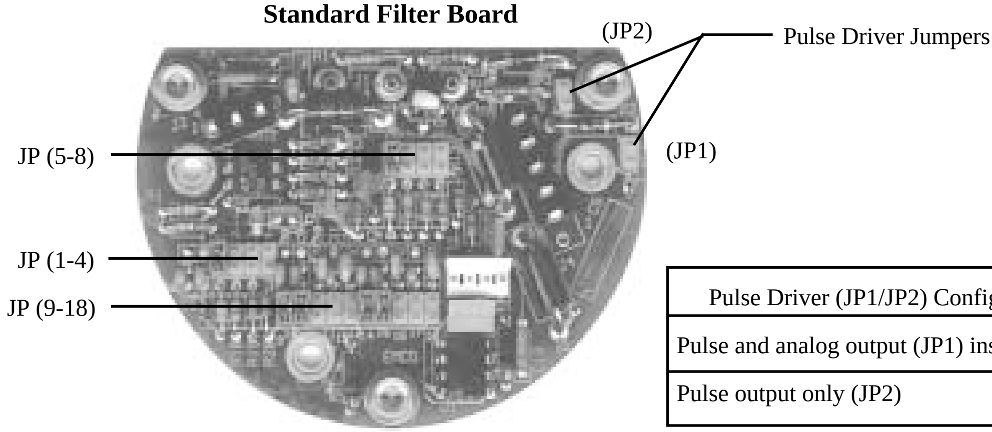


ELECTRICAL
(continued)

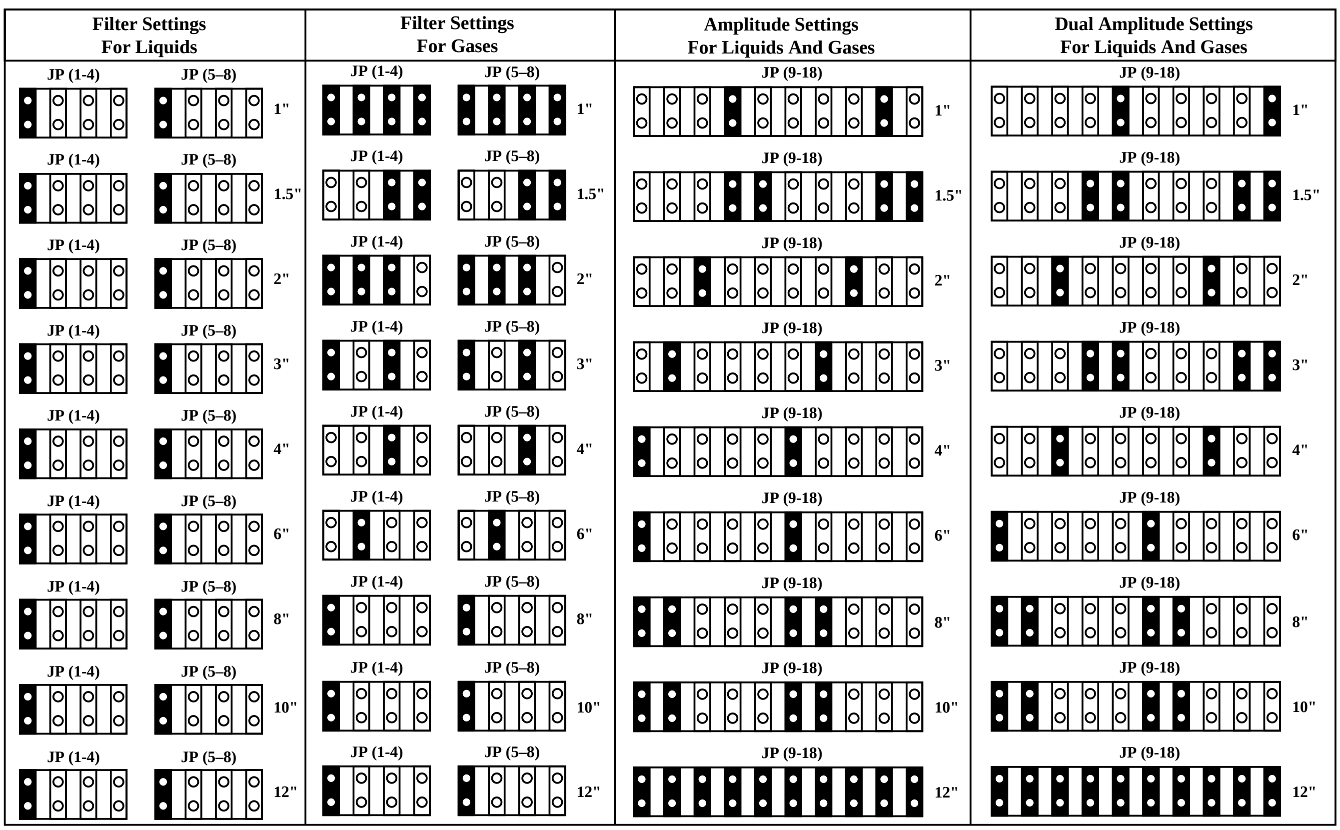
Standard Jumper Settings

Jumper positions JP(1-4), (5-8), and (9-18) indicate input signal parameters for each size and fluid type. Jumper positions JP1 and JP2 are pulse output driver jumpers. JP1 is installed at the factory .

Standard Filter Board



Pulse Driver (JP1/JP2) Configuration Table
Pulse and analog output (JP1) installed at factory
Pulse output only (JP2)

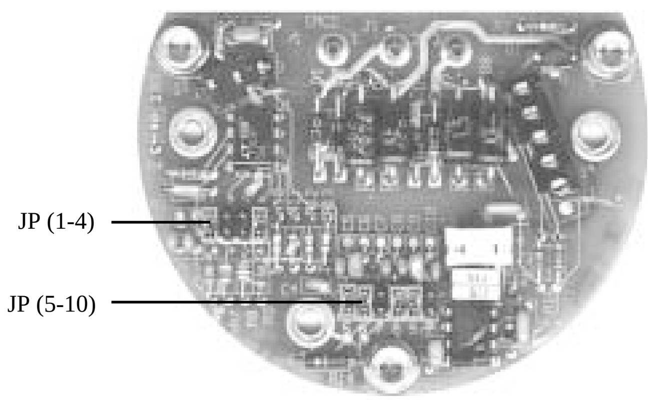


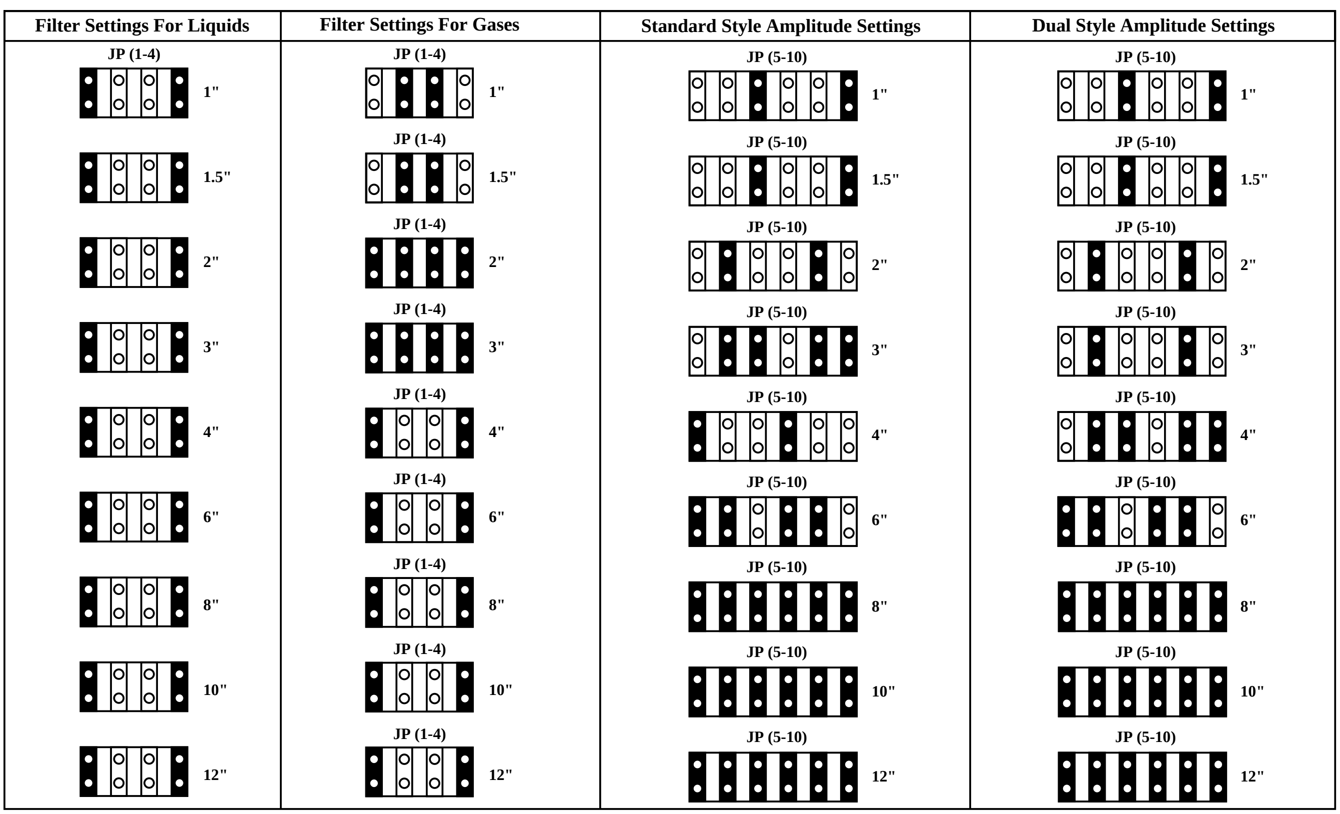
ELECTRICAL
(continued)

CENELEC Jumper Settings

Jumper positions JP(1-4) and (5-10) indicate input signal parameters for each size and fluid type. Pulse output driver jumpers JP1 and JP2 are not included on the CENELEC approved filter board. Pulse output must be accomplished by using an external pull-up resistor (See CENELEC wiring diagram on page 22).

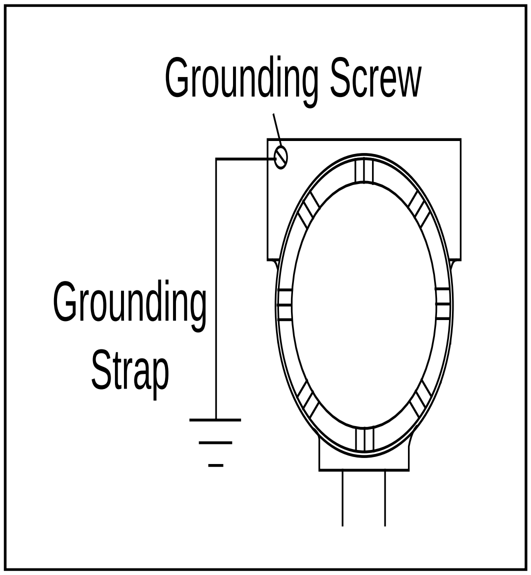
CENELEC Filter Board





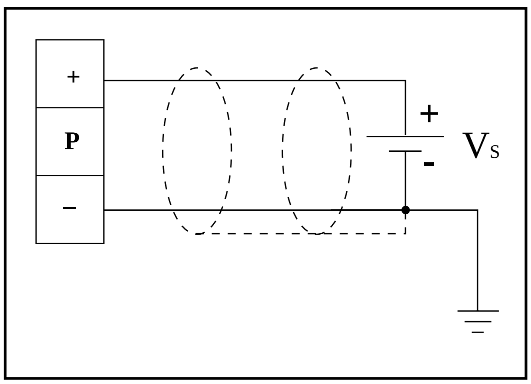
ELECTRICAL
(continued)

Grounding



Meter

To ensure proper electrical noise rejection, connect a ground strap (size 8 AWG or larger wire) from the ground screw –attached to the outside of the electronics enclosure–to a known earth ground (not the pipe).

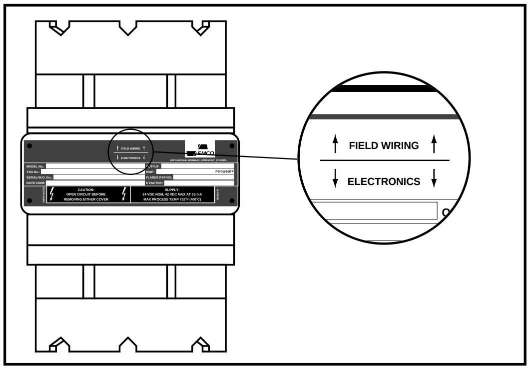


Power Supply

Shielded cable should be at least 18 AWG or larger. Connect wire from shielded cable to earth ground at the power supply. Insulate the other end of the wire (from electrical condulet) at the meter.

ELECTRICAL
(continued)

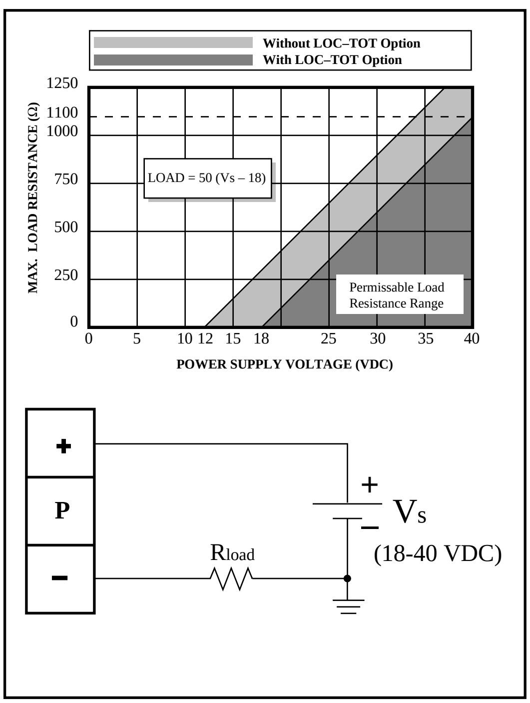
Accessing Field Wiring Terminals



The field wiring terminal for power and signal wiring may be accessed by removing the field wiring condulet.

D.C. Power and Signal Wiring

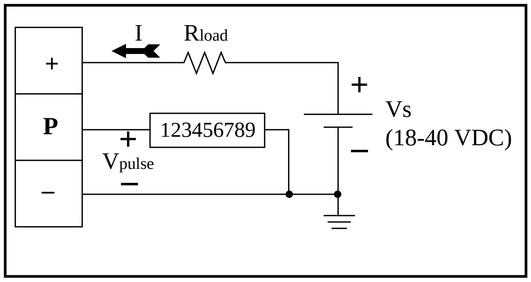
The Vortex PhD™ may be operated using a 24 VDC power supply. It is unique in its ability to supply both the 4-20 mA and pulse output, simultaneously. The installation of jumpers JP1 and JP2 on the base board determines the pulse output. JP1 is installed at the factory; the other configurations represent typical field wiring diagrams.



Analog Output (JP1 installed or no jumpers)
Scalable 4-20 mA output, 2 wire principle. A load resistor may be installed on the supply or return line. Permissible load resistance values are shown in the graph.

ELECTRICAL
(continued)

D.C. Power and Signal Wiring (continued)

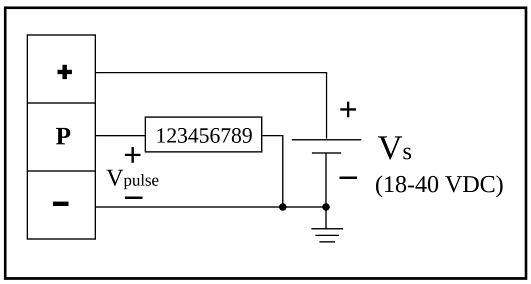


Simultaneous Pulse and Analog Output (JP1 installed)
Simultaneous 4-20 mA and pulse output for a high impedance electronic counter. Load resistor in the supply line. Pulse output will vary from:

$$0\text{-}1 \text{ V to } V_{pulse} = V_s - (I \bullet R_{load})$$

Note: Load resistor may also be placed in the return line. Pulse output will vary from $V_{pulse} = (I \bullet R_{load}) + 1$ to V_s.

where:
- V_{pulse} = pulse output amplitude
- V_s = power supply voltage
- I = current (4-20 mA)
- R_{load} = load resistance (see graph)

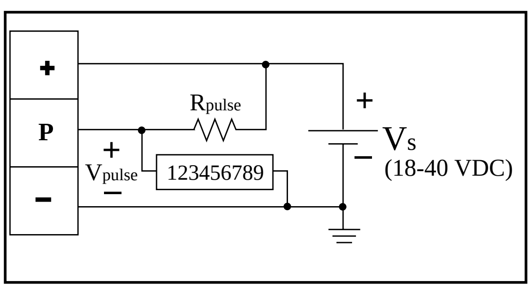


Pulse Output Only (JP2 installed)
This option is for pulse output only using a low impedance electromechanical counter. V_{pulse} will vary from:

$$0-1\text{V to } V_{pulse} = V_S\left(\frac{R_C}{R_C+6800}\right)$$

Note: Note: $R_C \geq 6800\left(\frac{V_C}{V_S - V_C}\right)$

Where:
- V_{pulse} = pulse output amplitude
- R_C = counter impedance
- V_S = power supply voltage
- V_C = minimum required voltage to trip counter



Pulse Output Only (No Jumpers)
This is an open collector pulse output using a high impedance electronic counter. V_{pulse} will vary from:

$$0-1\text{V to } V_{pulse} = V_S\left(\frac{R_C}{R_C+R_{pulse}}\right)$$

Note: Note: $R_{pulse} \geq \left(\frac{V_S}{0.16}\right)$

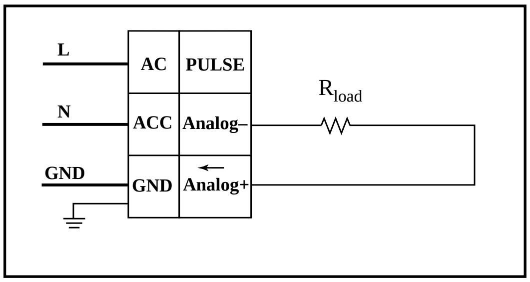
Where:
- V_{pulse} = pulse output amplitude
- R_C = counter impedance
- V_S = power supply voltage
- V_C = minimum required voltage to trip counter

NOTE: Low impedence electromechanical counter may not be compatible with CE wiring.

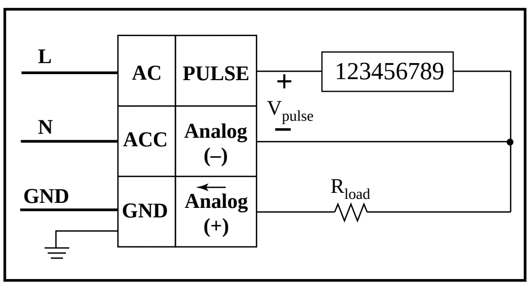
ELECTRICAL
(continued)

110/220 VAC Power and Signal Wiring

The Vortex PhD™ may be operated using a 110 or 220 VAC power supply. The power supply board converts the 110/220 VAC to 24 VDC. It is unique in its ability to supply both the 4-20 mA output and the pulse output simultaneously. The installation of jumpers JP1 and JP2 on the bottom of the 110/220 VAC power supply controls the output selection. JP1 is installed at the factory.



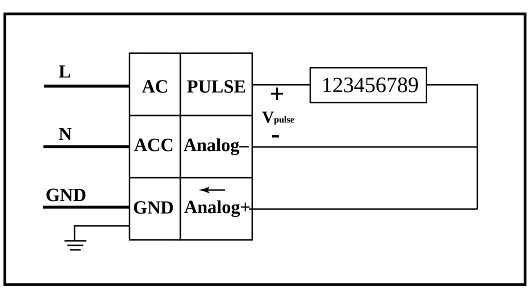
Analog Output (JP1 installed or no jumpers)
Scalable 4-20 mA output, 2 wire principle. Load resistor may be installed on supply or return line. R_{load} must be 250 Ω.



Simultaneous Pulse and Analog Output (JP1 installed)
Simultaneous 4-20 mA and pulse output for a high impedance electronic counter. Load resistor in the supply line. Pulse output will vary from:

$$0\text{-}1\ V \text{ to } V_{pulse} = 24 - (I \cdot R_{load})$$

where:
- V_{pulse} = pulse output amplitude
- I = current (4-20 mA)
- R_{load} = load resistance (250 Ω)



Pulse Output Only (JP2 installed and analog jumper installed)
This option is for pulse output only. V_{pulse} will vary from:

$$0 - 1V \text{ to } V_{pulse} = 24\left(\frac{R_C}{R_C + 6800}\right)$$

Note:

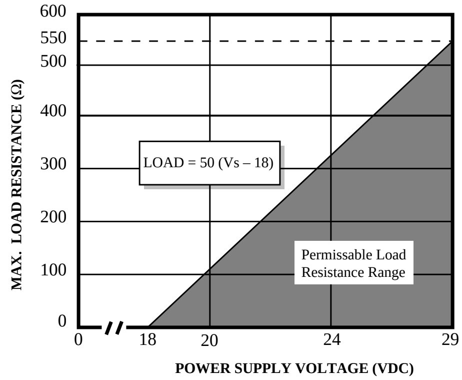
$$\text{Note: } R_C \geq 6800\left(\frac{V_C}{24 - V_C}\right)$$

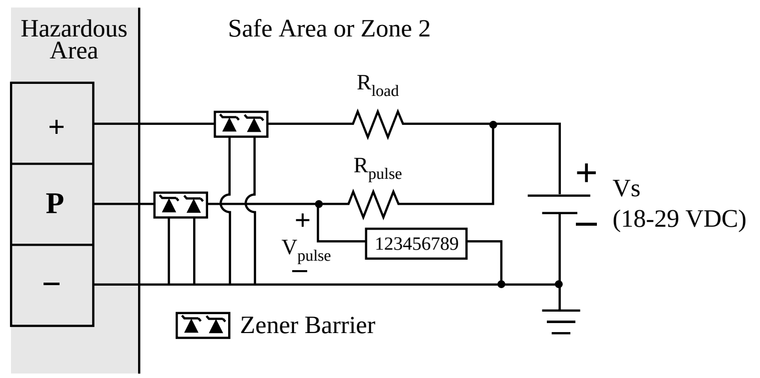
Where:
- V_{pulse} = pulse output amplitude
- R_C = counter impedance
- V_C = minimum required voltage to trip counter

NOTE: Low impedence electromechanical counter may not be compatible with CE wiring.

ELECTRICAL
(continued)

Cenelec Approved–Power & Signal Wiring





The Vortex PhD™ flowmeter may be operated using a 24 VDC power supply. The 4-20 mA output is scalable (2 wire principle). Permissible load resistance values are shown in graph. The pulse output should be connected to a high impedance, electronic counter.

V_{pulse} varies from: $$0 - 1\text{VDC to } V_{pulse} = V_S\left(\frac{R_C}{R_C + R_{pulse}}\right)$$

Note: $$\text{Note: } R_{pulse} \geq \left(\frac{V_S}{0.16}\right)$$

where:

V_{pulse} = pulse output amplitude
V_S = power supply voltage (18 to 29 VDC)
R_{load} = load resistance
R_C = counter impedance
R_{pulse} = pull–up resistance

The wiring schematic shown is for the areas defined by the Cenelec approval. I. S. zener barriers must have the following specifications:

V_{max} = 29 VDC = Maximum voltage which may be connected to barrier terminals

I_{max} = 110 mA = Maximum current which may be connected to barrier terminals

C_{int} = 1.5 nF = Maximum equivalent internal capacitance across barrier terminals

L_{int} = 0 H = Maximum equivalent internal inductance across barrier terminals

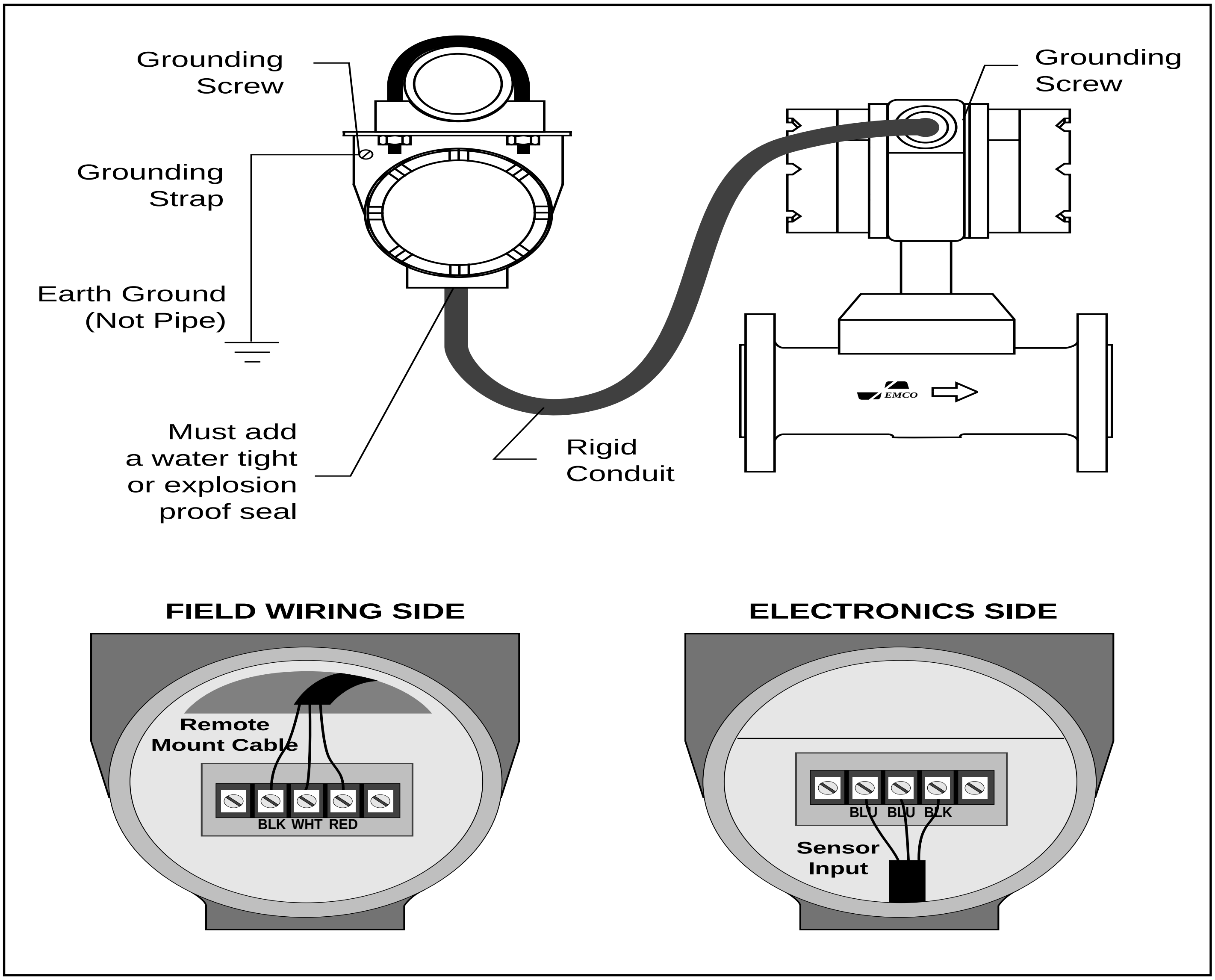
ELECTRICAL
(continued)

Remote Wiring

Output wiring from the remote electronics is identical to the integral electronics. However, the wiring from the remote electronics condulet to the electrical junction box is not, and must be performed in the field.

Connect the remote cable to the terminal block in the junction box as shown. If nonconductive conduit is used, attach a ground strap from the ground screw on the remote electronics condulet to the ground screw on the sensor condulet. Run rigid conduit from the conduit entry on the remote condulet to the condulet mounted on the meter body.

Note: If the remote cable is cut to a shorter length, insulate shield with tape at electrical junction box.



NOTE: CENELEC: Hard conduit not approved for CENELEC. Approved glandnuts are provided with CENELEC flowmeters.

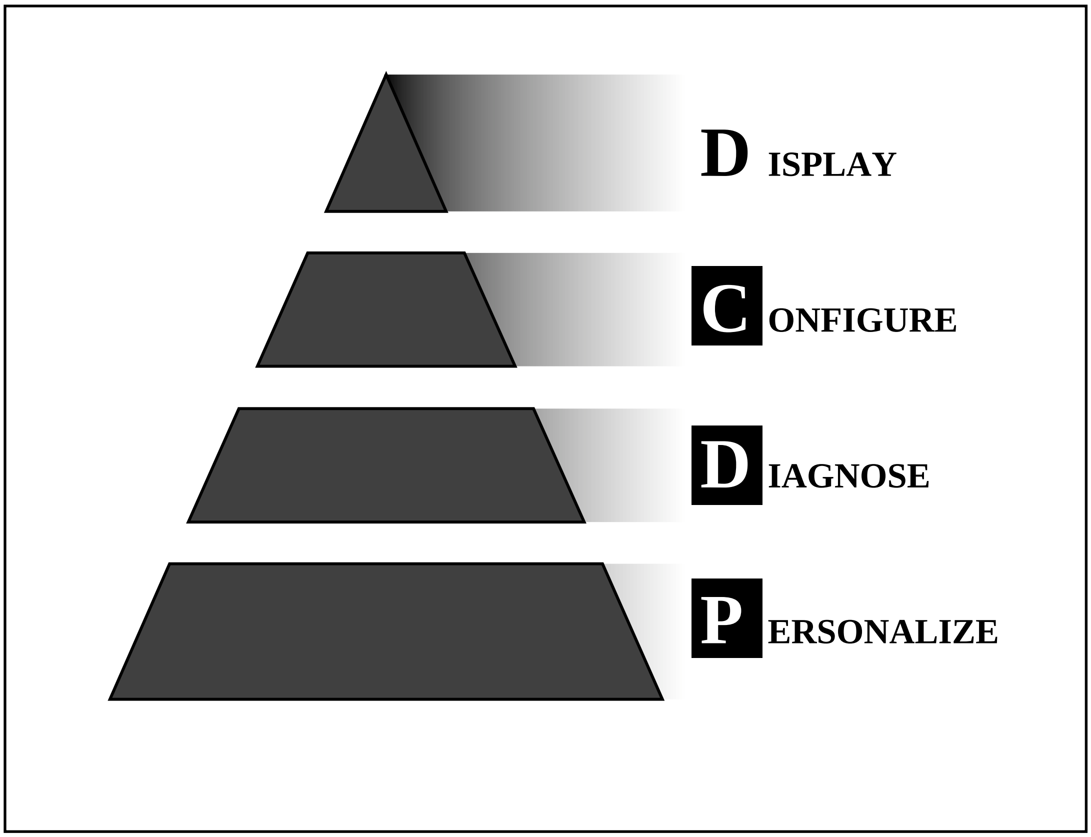
EZ LOGIC USER INTERFACE

General

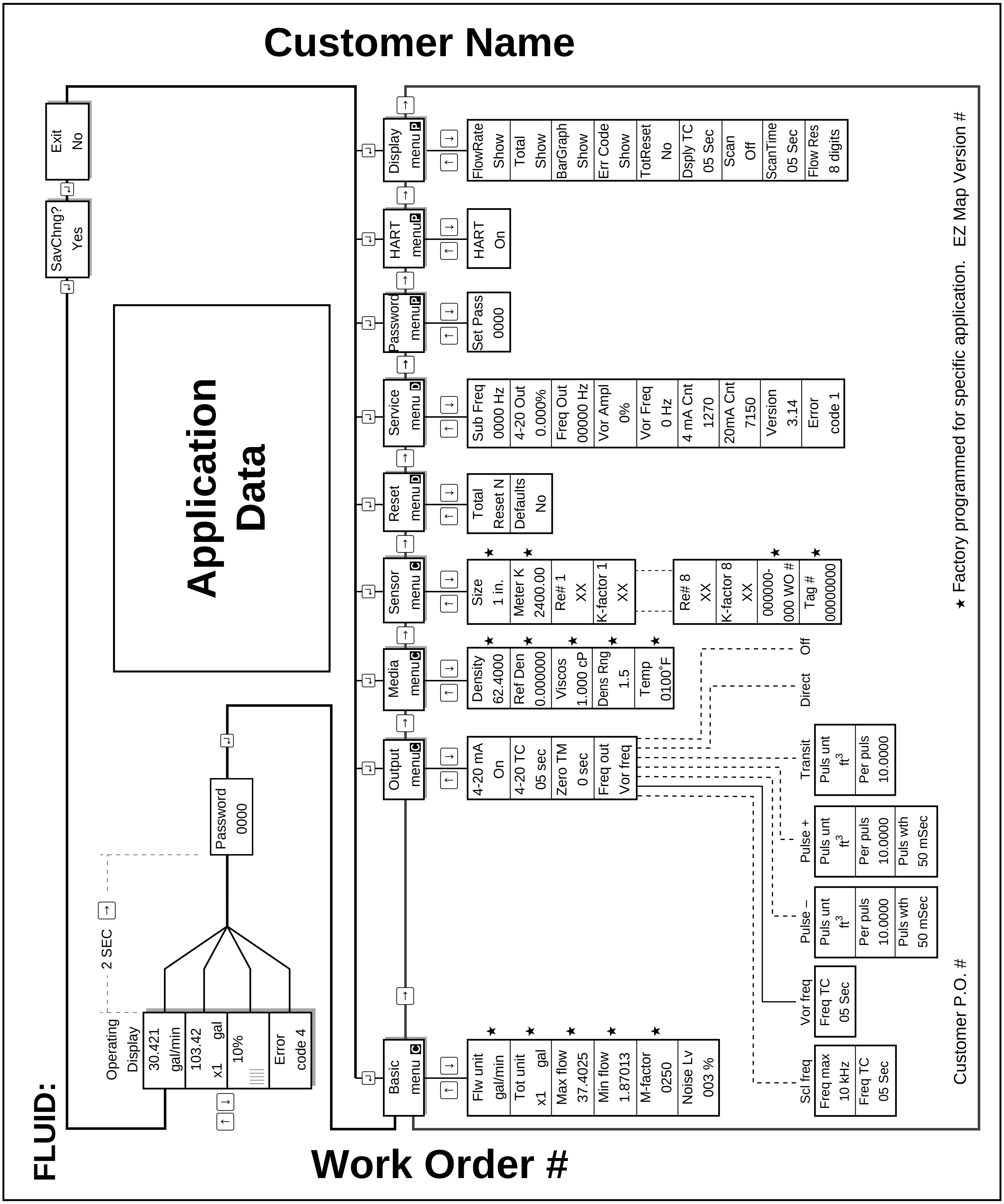
The EZ Logic User Interface is a menu driven interface, consisting of the top display menu, and nine programming submenus. The submenus are called: Basic, Output, Fluid, Sensor, Reset, Service, Password, HART, and Display. These submenus are grouped by functionality.

The first group is called Configure; the second, Diagnose; and the third, Personalize. The Configure group is comprised of the Basic, Output, Fluid, and Sensor submenus. These submenus configure the flowmeter for operation in a specific application. The Diagnose group consists of the Reset and Service submenus each containing information relating to flowmeter maintenance. Finally, the Personalize group contains the Password, HART and Display submenus. This group allows the user to customize the flowmeter by choosing display parameters or changing the password.

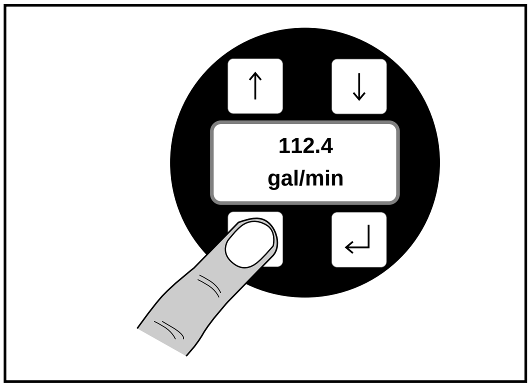
Each group has its own icon: Configure "**C**", Diagnose "**D**", and Personalize "**P**". These icons appear in the upper (or lower), right hand corner of the display to help the user identify their location within the interface map.



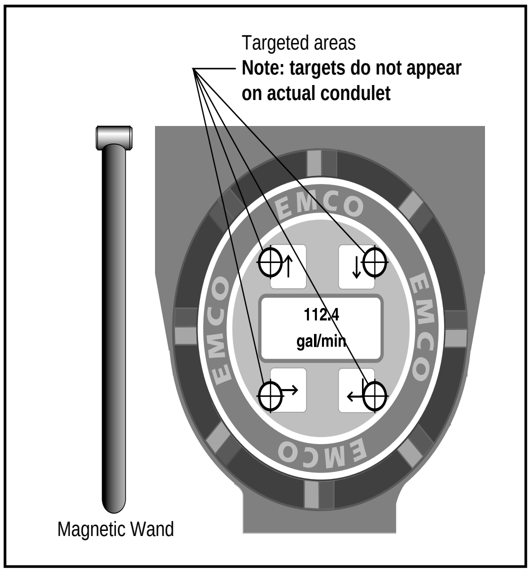
INTERFACE MAP



KEYPAD ACTIVATION



There are two ways to access the interface map from the keypad. The first is to remove the condulet cap, and depress the membrane keys using your fingers.

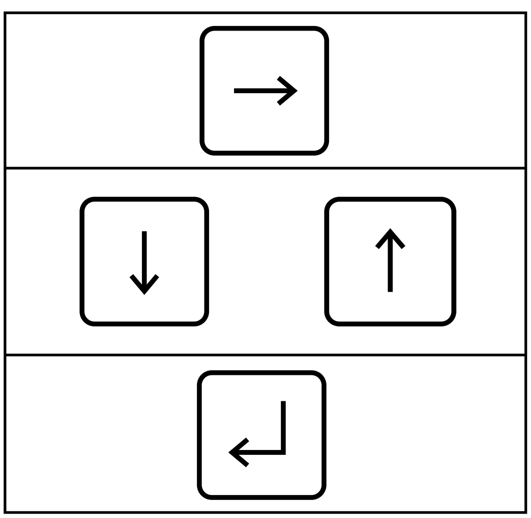


The second method is to use the magnet wand. This allows the keys to be activated through the condulet cap, and is required to maintain the explosion proof rating.

To activate keys, place the magnetic wand on the targeted area and remove. Note: magnetic wand is only supplied, as a standard tool, with the explosion proof meters.

Caution: Do *not* place magnet wand near magnetically sensitive items, such as: credit cards, card keys, etc...

MOVEMENT THROUGH INTERFACE



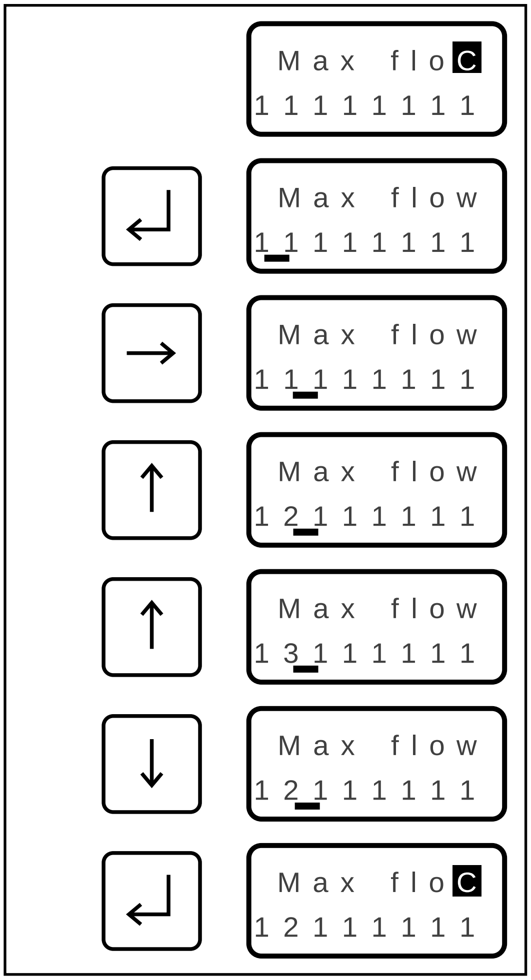
The interface was designed to be simple. For example, if you would like to go right, across the column headings, press the right arrow key.

To move up or down through each column, use the up or down arrow key. Note: each column is set up as a loop; once you reach the bottom (using the down arrow key), pressing the down arrow key again will move you to the top–to the column heading.

The enter key is used to exit the programming submenus.

ALTERING REAL NUMBER DATA

Keys are also used to alter data within a selected block within a submenu. Note: below is an example of only one of many parameters that can be altered in a block; refer to submenu descriptions for more information.



In order to alter data, press the enter key. A cursor will appear under the first digit. Note: blinking icon will disappear.

Press the right arrow key to move the cursor to the desired digit.

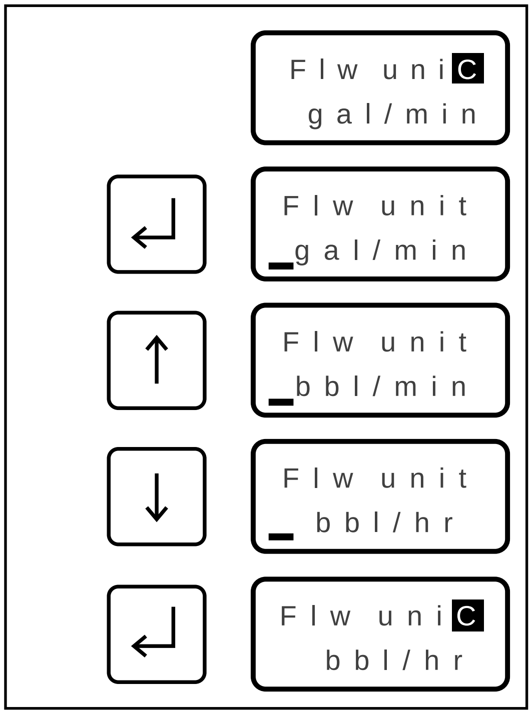
Pressing the up-arrow key will change the value of the digit. Possible choices for each digit are: 0-9, blank space, or a decimal point.

The values may also be changed by pressing the down-arrow key.

After the desired changes are made, press the enter key to store the new value; the blinking icon will reappear.

ALTERING PRESET DATA

Some blocks in the programming submenus are for choosing user-selectable, engineering units. The example below illustrates how to select, and change (in the submenu block called "Flw unit") units for flow rate. (For a complete list of specific submenu options, refer to the submenu descriptions.)



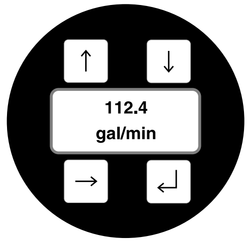
Press the enter key; the blinking *cursor* will appear (the blinking *icon* will disappear).

Press the up-arrow key to change the volume unit (in the numerator).

To change the time unit (in the denominator), press the down-arrow key.

After the desired changes are made, press the enter key to store the new value; the blinking *icon* will reappear.

DISPLAY MENU

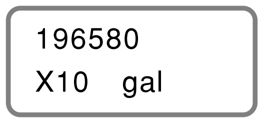


The display menu will appear as soon as the meter is powered up. The display menu has four options.

Flow rate

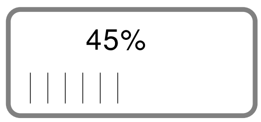
Continuously displays the actual flow rate, in the units selected in the "Flw unit" submenu.

Totalized Flow



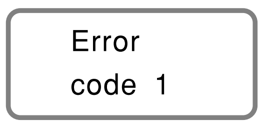
Continuously displays the totalized flow, in the units selected in the "Tot unit" submenu.

Bar Graph



Displays the percentage of full scale flow, and a corresponding bar graph.

Error Code

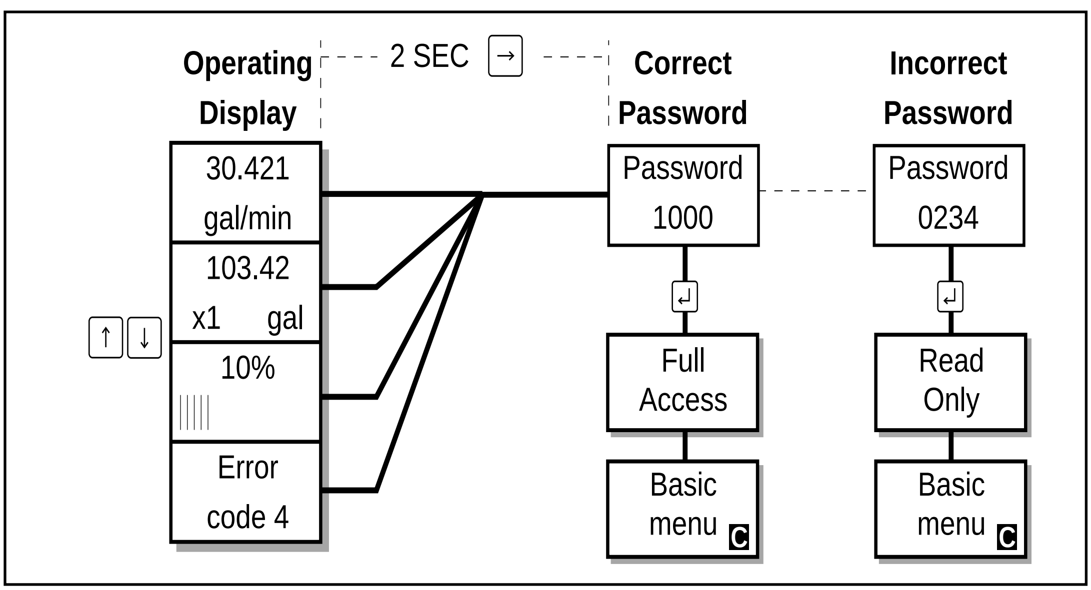


The electronics monitor and record errors that may occur during operation. Push the right-arrow key to scroll through error codes; see the troubleshooting section for error code messages.

ACCESSING PROGRAMMING SUBMENUS

In order to enter the programming submenus, the user must hold down the right-arrow key for 2 seconds; then enter the correct password to access the submenus. If the correct password is entered, the display will read "Full Access." If an incorrect password is entered, the display will read "Read Only," and the user will not be able to alter any programming.

The flowmeter comes from the factory without a password, therefore, holding down the right-arrow key will allow "Full Access." Refer to the Personalize group to add, or change, the password. Note: When in the programming submenus, the meter will be "off line." The last values of the totalizer and the flowrate (before going "off line") will be stored until the user returns to the display menu.



CONFIGURE GROUP

Basic
↓ menu C

Flow Unit

Flw unit
gal/min

The units chosen for flow rate in this block will show in the display menu. Also, the engineering units chosen here will be the same for the max flow and min flow used to scale the 4-20 mA and frequency output.

Arrow up to scroll through the volume units, down to scroll through the time units. Possible flow units : gallons, bbl, cm^3, liters, m^3, lb, tons, grams, kilograms, metric tons, standard ft^3, normal m^3, ft^3, and in^3. Possible time units: seconds, minutes, hours, and days.

Totalizer Unit

Tot unit
1X gal

The totalizer units chosen will show in the display menu. The counting of the totalizer can be changed by increasing, or decreasing, the multiplier.
Up-arrow key to scroll through multipliers, down-arrow key to scroll through units. Possible multipliers: x1, x10, x100, $x10^3$. Possible units: gallons, bbl, cm^3, liters, m^3, lb, tons, grams, kilograms, metric tons, standard ft^3, normal m^3, ft^3, and in^3.

Maximum Flow

Max flow
37.4025

Maximum flow value sets the 20 mA point, and the scaled frequency output. Note: The units for flow rate are selected in the "Flw unit" block.

Minimum Flow

Min flow
1.87013

Minimum flow sets the cutoff value where the output drops to 4 mA, and/or the scaled frequency output drops to 0 Hz. This value *cannot* be programmed below the published minimum flow rate of the meter.

M-Factor

M-factor
0150

M–factor sets the signal input filter. The M–factor is factory determined, and programmed, during calibration. However, for best performance, the M–factor should be reset during actual flow conditions.

Note: Before the M-factor can be reset, the flowmeter must be operating at least 1/10 of the meter's maximum flow rate (3.2 ft/sec for liquids, 26 ft/sec or more for gases).

To reset the M-factor, change the value to 0000; press the enter key. Wait approximately 5 seconds; the meter will automatically reset the M-factor. If the sensor input signal is too weak (due to the flow rate not being at least 1/10 of the meter's maximum flow rate) the electronics will *not* auto set the M-factor. The display will read "Too Low NOT SET" (for 1 second), and the previous M–Factor will be displayed.

Meter size	M–Factor
0.5"	320
1"	255
1.5"	160
2"	125
3"	85
4"	45
6"	30
8"	30
10"	30
12"	30

These are **nominal** M-factor settings for different size meters. These numbers are only to be used as a reference guide. Each meter will have an M–factor that will vary slightly from these nominal values.

CONFIGURE GROUP
(continued)

Basic
↓ menu C

(continued)

Noise Level

Noise Lv
010 %

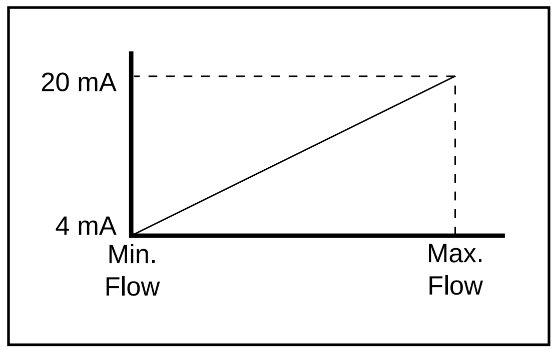
This value sets the no flow, cutoff level. If the input signal drops below this value, the meter will not output or display a flow rate. The Noise level can be set from 1-100%. 0% represents no flow, 100 % represents 100% of the meter's maximum flow (this is not the maximum flow for the specific application programmed in the Basic Menu). If the value is programmed as 000, the meter will perform an automatic Noise level setting. After 5 seconds, the meter will return with the new calculated value. For best results, auto set the noise level with the pump on, and down stream valve closed to ensure no flow conditions. **The programming assumes there is NO flow in the pipe when the auto setting is made, otherwise, the meter will not display any output.**

Output
↓ Menu C

Analog Output

4-20 mA
On

Linear analog output set by min. and max. flow.
Toggle on/off with the up and down-arrow keys.



4-20 TC
05 sec

Analog Output Time Constant
Dampens the analog output. Analog time constant can be set from 0-99 sec.

Output Zero Time

Zero TM
0 sec

Number of seconds, before output drops to zero, after the actual flow drops below the programmed minimum flow.

Frequency/Pulse Output Setup

Freq out
Scl freq

Type of Frequency/Pulse output can be selected here. The possible output options are: scaled frequency, vortex frequency, direct frequency, pulse –, pulse +, and transition. The frequency/pulse output can be disabled by choosing "off" as the output selection. The display changes depending on output option selected; refer to EZ Logic Map.

Note: When connecting the Vortex PhD™ flowmeter to an EMCO flow processor, select vortex frequency (Vor freq) as the OUTPUT SETUP.

CONFIGURE GROUP
(continued)

Output
↓ Menu C

(continued)

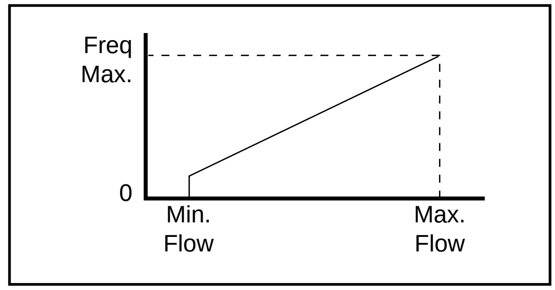
Scaled Frequency* Output

Freq out
Scl freq

Linear output frequency scaled between minimum and maximum flow, and maximum output frequency (see graph below).

Freq max
10 kHz

Maximum Output Frequency
Sets the maximum output frequency. Available settings: 500 Hz, 1 kHz, 3 kHz, 5 kHz, or 10 kHz.



Freq TC
05 sec

Frequency Output Time Constant
Dampens the frequency output. Frequency output time constant can be set from 0-99 sec.

Vortex Frequency* Output

Freq out
Vor freq

Output frequency will be the true shedding frequency with a 50% duty cycle, where:

$$FLOW = \frac{Freq}{K - Factor}\left(\frac{ft^3}{s}\right)$$

Freq TC
05 sec

Frequency Output Time Constant
Frequency output time constant can be set from 0-99 sec; default is 5 seconds.

Direct* Frequency Output

Freq out
Direct

Output frequency will be the true shedding frequency. This is an instantaneous representation of the flow, where:

$$FLOW = \frac{Freq}{K - Factor}\left(\frac{ft^3}{s}\right)$$

***When connecting any EMCO flow processor to the Vortex PhD™ meter, select vortex frequency (Vor freq) as the OUTPUT SETUP.**

CONFIGURE GROUP

(continued)

Output
↓ Menu C

(continued)

Pulse -

Freq out
Pulse -

With this output selection, one negative pulse is generated each time the totalizer increments. The increment is set by the Per pulse and pulse unit.

Per puls
10,000

Per pulse
This number represents the amount of fluid that passes through the meter, per pulse.

Puls unt
ft^3

Pulse Unit
Possible units: gal, bbl, cm^3, lit, m^3, lb, tons, grams, kilograms, metric tons, standard ft^3, normal m^3, ft^3, and in^3.

Puls wth
50 mSec

Pulse Width
Possible pulse width settings: 5 msec, 50 msec, 500 msec, 1 sec, and 5 sec. Note: Programmed pulse width must be less than the actual output signal pulse width, at maximum flowrate.

Pulse +

Freq out
Pulse +

With this output selection, one positive pulse is generated each time the totalizer increments. The increment is set by the Per pulse and pulse unit.

Per puls
10,000

Per pulse
This programmed number represents the amount of fluid that passes through the meter, per pulse.

Puls unt
ft^3

Pulse Unit
Possible units: gal, bbl, cm^3, lit, m^3, lb, tons, grams, kilograms, metric tons, standard ft^3, normal m^3, ft^3, and in^3.

Puls wth
50 mSec

Pulse Width
Possible pulse width settings: 5 msec, 50 msec, 500 msec, 1 sec, and 5 sec. Note: Programmed pulse width must be less than the actual output signal pulse width, at maximum flowrate.

Transition

Freq out
Transit

With this output selection, the totalizer increments with each transition from low state to high state . The increment is set by Per pulse and Pulse unit.

Per puls
10,000

Per pulse
This programmed number represents the amount of fluid that passes the meter per pulse.

Puls unt
ft^3

Pulse Unit
Possible units: gal, bbl, cm^3, lit, m^3, lb, tons, grams, kilograms, metric tons, standard ft^3, normal m^3, ft^3, and in^3.

CONFIGURE GROUP
(continued)

Menu	Parameter	Display	Description
Fluid ↓ Menu C	**Fluid Density**	Density 62.4000	Actual fluid density of your application, in lbm/ft^3.
	Reference Density	Ref Den 0.000000	The reference density is programmed in lbm/ft^3. It is the density of the application fluid at standard conditions, and is used for displaying and scaling standard or normal flow rates. If the reference density is set to zero, it will default to the fluid density value.
	Density Range	Dens Rng 1.5	The default setting is 1.5 or the user may input the maximum density of the application fluid, divided by the minimum density.
	Fluid Viscosity	Viscos 1 cP	The fluid viscosity used to calculate the Reynolds number.
	Fluid Temperature	Temp 0100° F	The nominal fluid temperature. It is used to compensate for changes in the internal diameter of the pipe, by shifting the K-Factor.
Sensor ↓ Menu C	**Size**	Size 1 in.	Toggle through 1" to 12" size meters.
	Calibration Factor	Meter K 2400.00	Calibrated meter K-factor in pulses/ft^3. (The K-factor value is also located on the meter serial tag I.D.)
	Reynolds Number	Re #1 0.000	Reynolds #1 – 8 utilized for linearization purposes. When set to zero – Meter K is used.
	K-Factor	Ke #1 0.000	K-Factor #1 – 8 utilized for linearization purposes. When set to zero – Meter K is used.
	Serial	000000 – 000 WO#	Meter body serial/work order number (view only). (Also located on the meter serial tag I.D.)
	Tag Number	Tag # 00000000	Meter tag number (view only).

DIAGNOSE GROUP

Menu	Parameter	Display	Description
Reset ↓ Menu D	**Totalizer Reset**	Total Reset N	User can reset the totalizer by selecting yes (Y).

DIAGNOSE GROUP

(continued)

Reset
↓ Menu D

Set Defaults	Defaults No

User can reset the meter to the original programmed defaults, shown below. **Note: choosing "yes" will erase any changes made to the meter programming.**

(continued)

Programmed Defaults

Basic menu C	Output menu C	Fluid menu C	Sensor menu C	Reset menu D	Service menu D	Password menu P	HART menu P	Display menu P
Flw unit gal/min	4-20 mA On	Density 62.4000	Size 1 in.	Total Reset N	Sub Freq 0000 Hz	Set Pass 0000	HART On	FlowRate Show
Tot unit x1 gal	4-20 TC 05 sec	Ref Den 0.000000	Meter K 2400.00	Defaults No	4-20 Out 0%			Total Show
Max flow -	Zero TM 0 sec	Dens Rng 1.5	000000 – 000 WO#		Freq Out 00000 Hz			BarGraph Show
Min flow -	Freq out Vor Freq	Temp 70˚F	Tag # 00000000		4 mA Cnt 1270			Err Code Show
M-factor 0300					20mA Cnt 6900			TotReset Yes
Noise Lv 003 %					Version 2.30			Dsply TC 05 Sec
								Scan Off
	Vor freq: Freq TC 05 Sec							Flow Res 3 digits

Service
↓ Menu D

Substitute Frequency	Sub freq 0000 Hz
Simulated Analog Output	4-20 Out 0.000%
Simulated Frequency Output	Freq out Scl freq

This frequency will simulate a vortex shedding frequency for the display and the output. Note: this value must be set to zero before the meter will return to the actual frequency input.

Simulation of the analog output: 0 % flow and 100% flow (4 - 20 mA). Can be set at any value between 0 and 100%. (Operates only while in this display.)

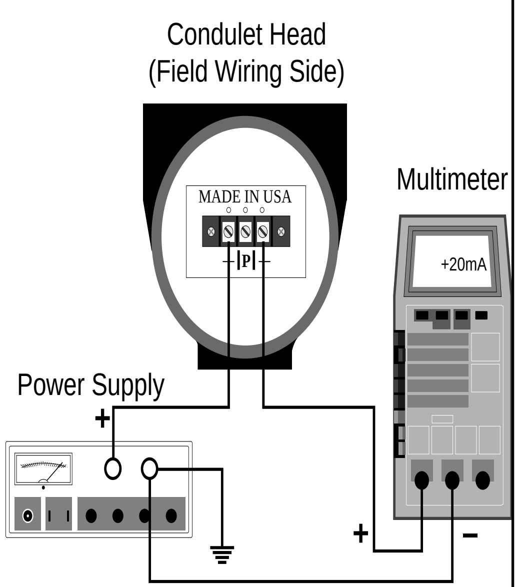
Simulation of the frequency output: 0 - 10,000 Hz. Only visible if the pulse output is selected to be either scaled frequency "Scl freq" or vortex frequency "Vor freq." (Operates only while in this display.)

DIAGNOSE GROUP
(continued)

Service
↓ Menu D

(continued)

Parameter	Display	Description
Input Signal Amplitude	Vor Ampl 0%	Input signal level: 0 -100% of meter's maximum. (*Not* based on maximum flow, it is specific to the application, and programmed in the Basic Menu). (View only).
Vortex Frequency	Vor Freq 0 Hz	The raw input frequency from the sensor (view only.)
4 mA Calibration Value	4 mA Cnt 1270	Sets the # of units, the microprocessor must send to the current output circuit, to generate 4 mA.
20mA Calibration Value	20mA Cnt 7150	Sets the # of units, the microprocessor must send to the current output circuit, to generate 20 mA.



Wiring diagram to calibrate the 4-20 mA output . To calibrate the 4 mA count, go to "4 mA cnt"; press enter. Read current value from multimeter. The value, on the multimeter, should be 4 ± 0.012 mA. If value deviates by more than ± 0.012 mA, adjust the microprocessor count until the multimeter value equals 4 mA; press enter.

For the 20 mA count, go to "20mA cnt," and repeat the steps above.

Parameter	Display	Description
Software Revision	Version 2.10	Revision number of the software used is displayed (view only.)
Self Diagnostics	Error code 1	Displays current error codes. Once the error condition no longer exists, the error code is cleared. Push the right-arrow key to scroll through the errors (if there is more than one.) See trouble shooting section for error code descriptions (view only).

PERSONALIZE GROUP

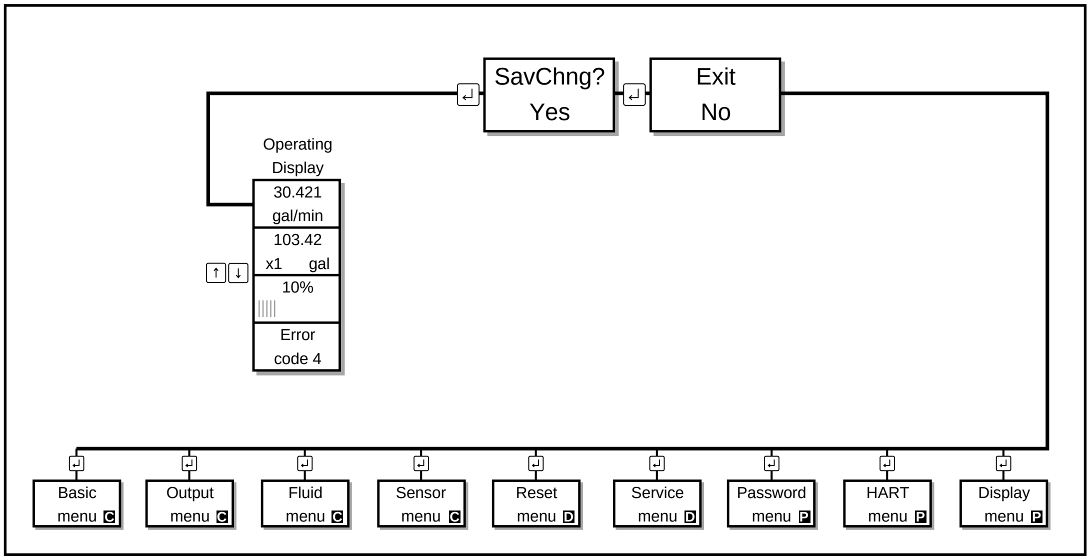
Menu	Parameter	Display	Description
Password ↓ Menu P	**Set New Password**	Set Pass 1000	A password can be added or changed in this block. If` 0000 is selected, there will be no password, and there is unlimited access.

Menu	Parameter	Display	Description
HART ↓ Menu P	**HART Enable/Disable**	HART On	User may turn the meter's HART communication capabilities on or off.

Menu	Parameter	Display	Description
Display ↓ Menu P	**Flowrate**	FlowRate Show	Show or Hide the flowrate from the display menu.
	Totalizer	Total Hide	Show or Hide totalizer from the display menu.
	Bar Graph	BarGraph Show	Show or Hide the bar graph from the display menu.
	Error Code	Err Code Show	Show or Hide error codes from the display menu.
	Totalizer Reset	TotReset Yes	If set to yes and the enter key pressed, then the totalizer will be reset in the display mode.
	Display Time Constant	Dsply TC 05 Sec	Sets the dampening of the flowrate in the display mode.
	Scan	Scan On	Turns the automatic scrolling of the display menu on or off.
	Scan Time	ScanTime 05 Sec	The amount of time that each display is shown in the display mode. ("Scan" must be "on".)
	Flow Resolution	Flow Res 8 digits	Selects how many significant digits of the flow rate to display .

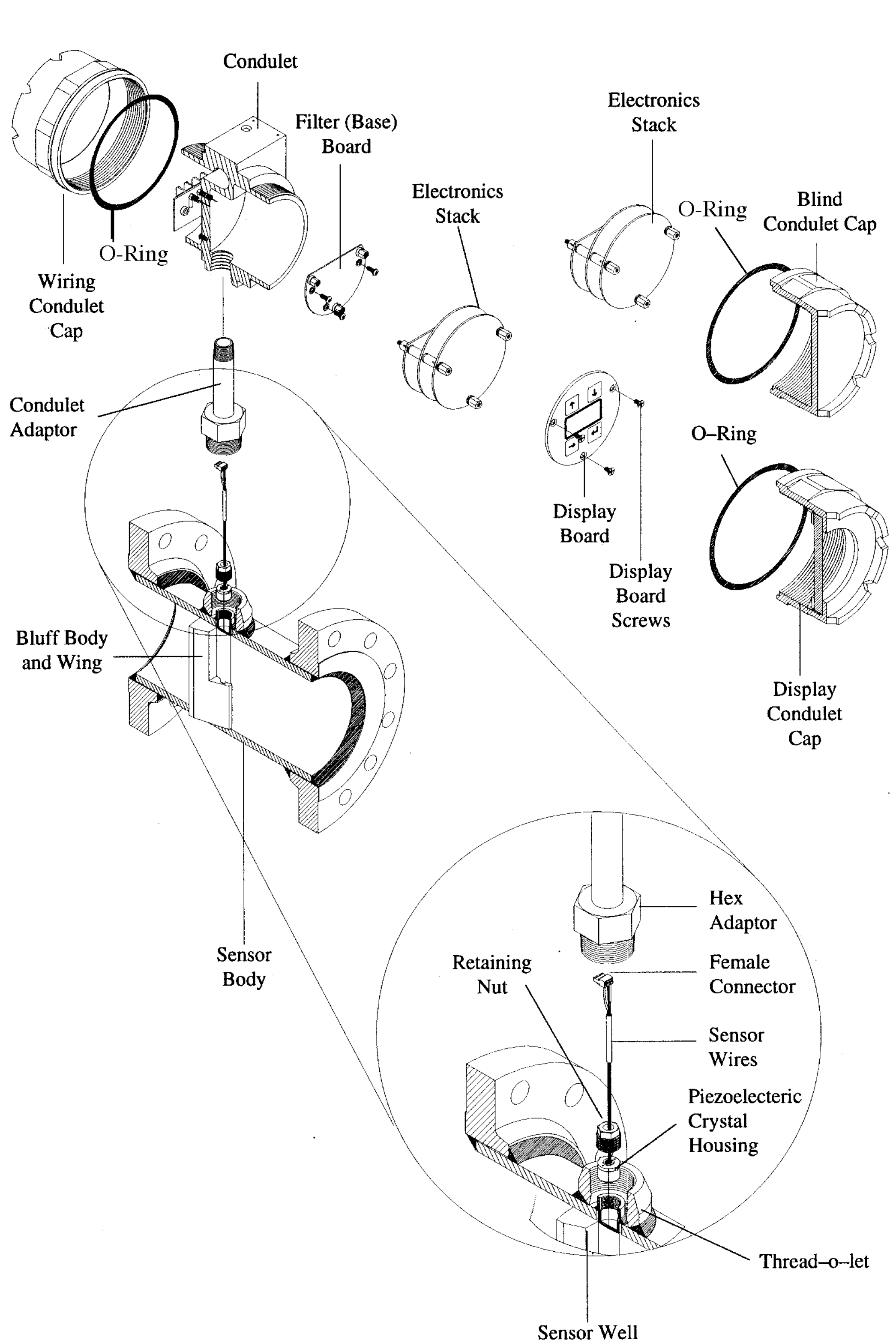
EXITING PROGRAMMING SUBMENUS

The programming submenus can only be exited at the top of each submenu heading. To exit, press the enter key. The display will read "Exit." Toggle to "yes" with the up or down-arrow key; press enter. If you have made any changes and want to save them, press enter when prompted by "Save Changes."

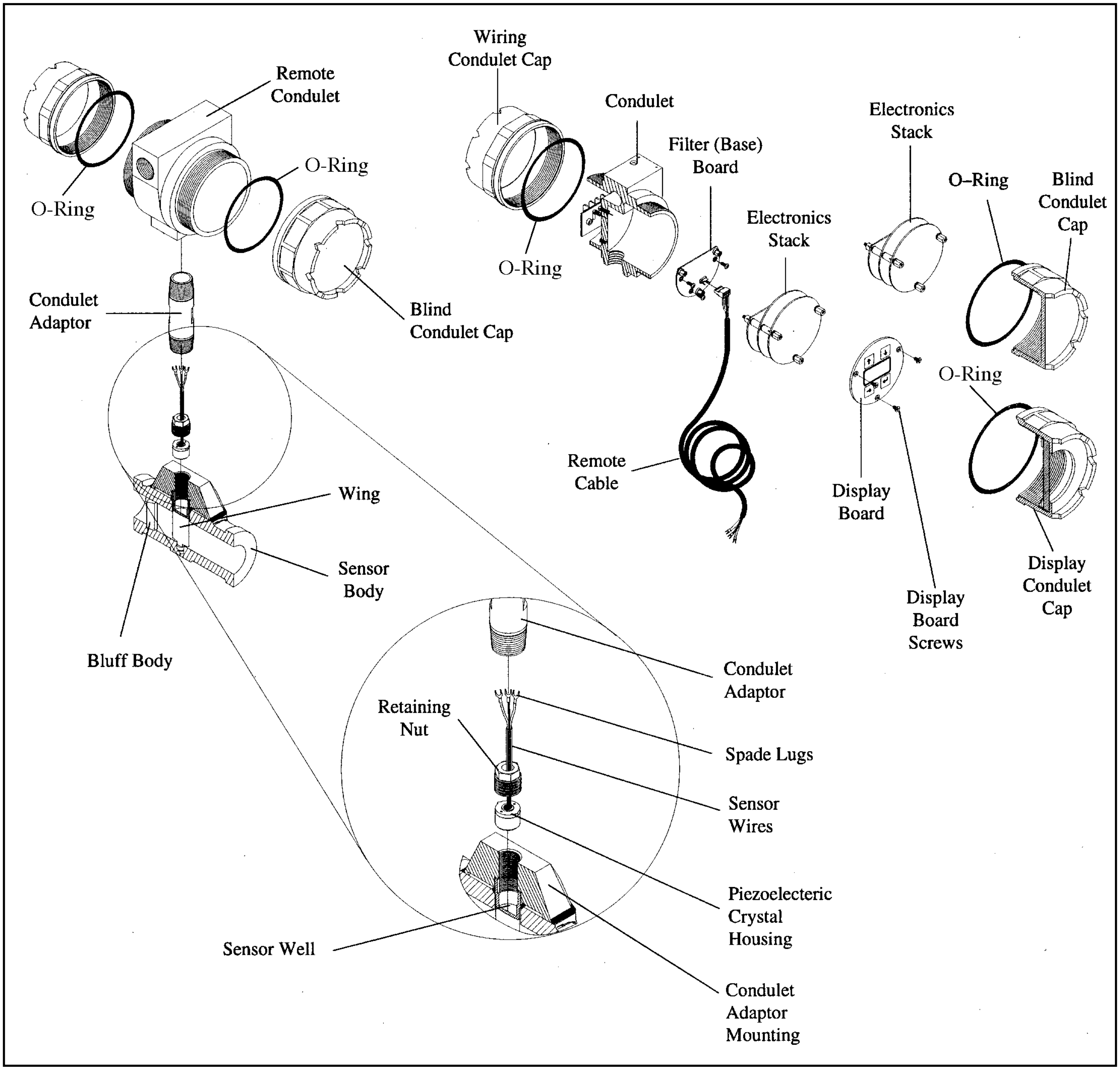


INTEGRAL ASSEMBLY Style shown: 2" through 12" flanged meter bodies

Note: Dual model has an additional sensor, and condulet assembly located on the opposite side of meter body.



REMOTE ASSEMBLY Style shown: All wafer meter bodies, and 1" and 1.5" flanged meter bodies.

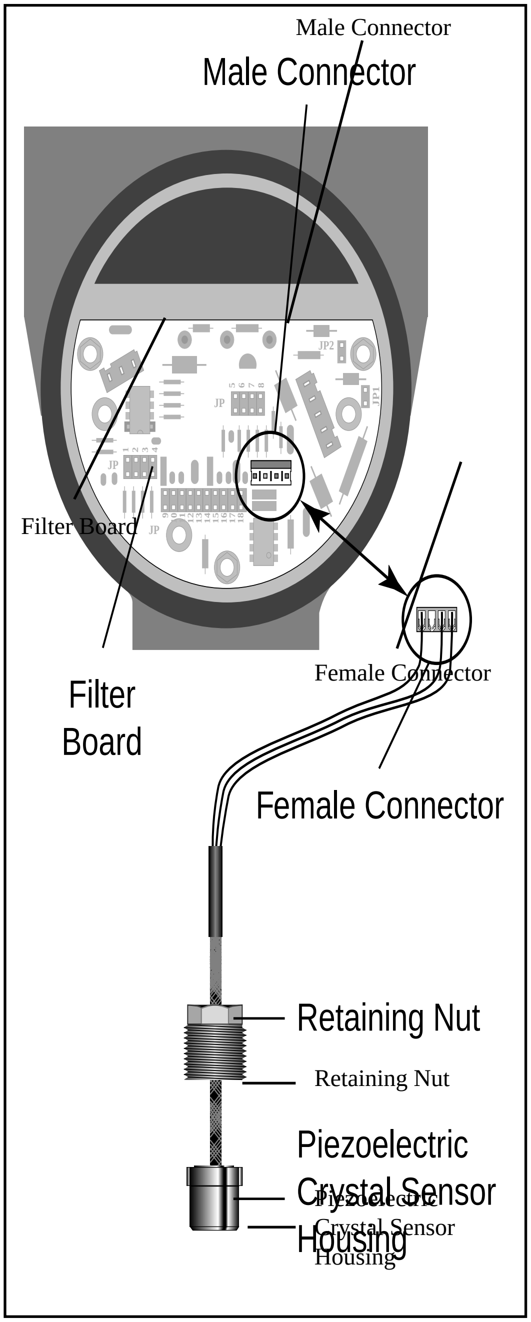


SENSOR REMOVAL

General

The process pressure must be less than 750 psig before the sensor can be removed. Employ electrostatic discharge (ESD) precautions when handling the electronics.

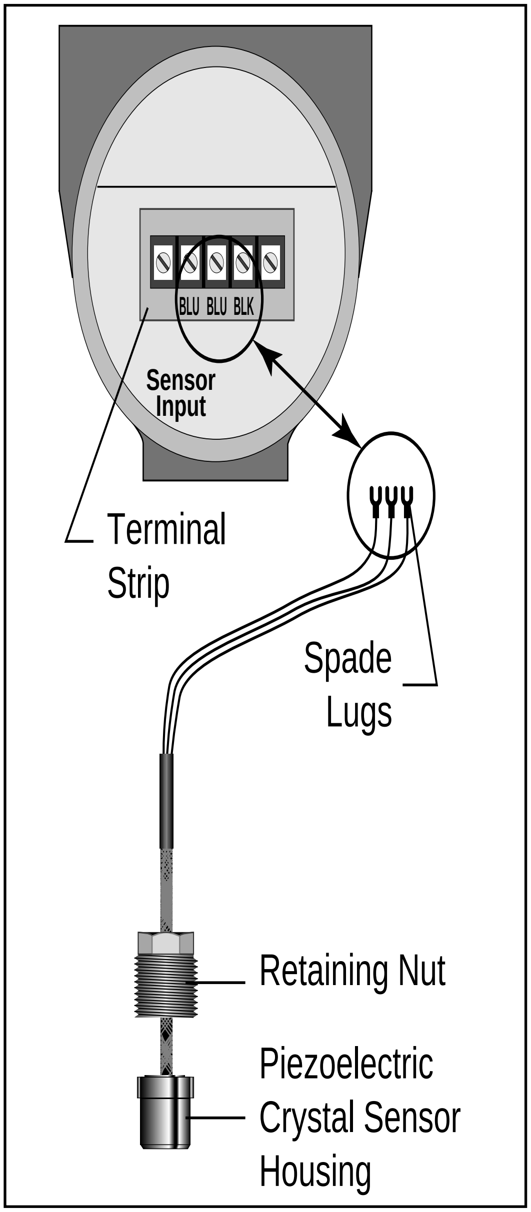
Integral



Disconnect power; remove condulet cap from electronics side of condulet. Remove the three display board screws. Carefully, disconnect display board from underlying board. **Note: Disregard previous if you don't have a local display.** Loosen the three, hex, standoff bolts, (bolts are retained, and only require about three revolutions to disconnect.) Remove the electronics stack from the condulet. Disconnect the sensor female connector from the base board. Using a crescent wrench, unscrew the condulet adaptor from the sensor body. **Note: There are two different condulet adaptor styles, depending on meter size.** Remove adaptor from sensor body; use care to allow the sensor wires to pass freely through it. Using a 5/8" deep well socket (with the wires passing through the wrench opening) and a crescent wrench, unscrew the retaining nut holding the piezoelectric crystal sensor housing in place. Remove sensor.

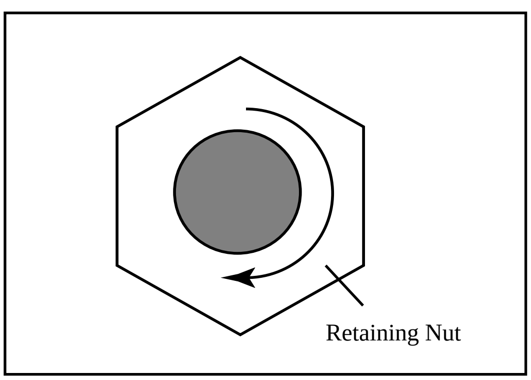
SENSOR REMOVAL
(continued)

Remote



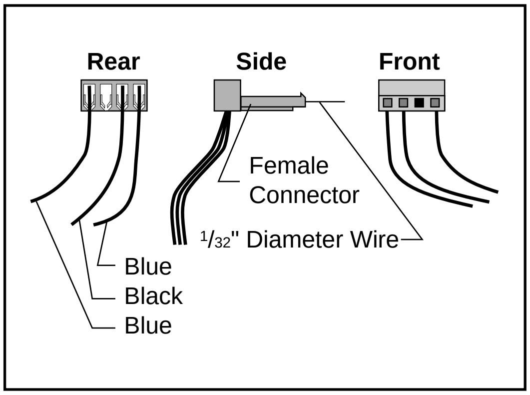
Sensor removal for a remote installation is the same as the integral installation with the following exceptions: 1) the sensor is disconnected from the remote mount condulet on the sensor body instead of at the remote electronics, and 2) the sensor is connected to a terminal strip in the remote mount condulet with spade lugs instead of a female connector.

SENSOR REPLACEMENT



Apply high temperature (-95 to +2600˚F), Nickel–Based, anti–seize, lubricant compound, or equivalent, to the threaded portion of the sensor retaining nut. Install the sensor by guiding it into the sensor well until contact can be felt with the bottom. There are two tabs to control the orientation of the sensor. Thread the sensor retaining nut, into the sensor well, until it is hand tight. Tighten the sensor retaining nut with a 5/8" deep well socket (with the wires passing through the wrench opening) to a torque of 20 ft-lbs for a 1" meter, and 40 ft-lbs for all other sizes. If a torque wrench is not available, a rule of thumb for sensor tightening is: 1/8 turn beyond hand tight = 25 ft-lbs of torque; and 1/4 turn beyond hand tight = 40 ft-lbs of torque. Reconnect the sensor, and replace the condulet, reversing the instructions above.

SENSOR FUNCTIONALITY TEST



Functionality testing should be performed at the electronics condulet, regardless of type of the meter (integral or remote). Use proper ESD precautions at all times.

Disconnect the power. Remove the electronics stack from the condulet, and place it into an anti-static bag. Verify proper connection of the sensor to the filter (base) board. Disconnect the sensor from the filter (base) board. Check the resistance between the black wire and the blue wires. Insert solid wire (approx. 1/32" diameter) into the sensor female connector, to serve as leads. The resistance should be at least 20 MΩ. Check the resistance between all three wires and earth ground (the condulet or meter body). The resistance should also be at least 20 MΩ.

Check the sensor output voltage using an oscilloscope with a x10 probe (power should still be disconnected for this test, and the flowrate should be greater than 1/3 of the flowmeter's maximum flowrate.) Connect the ground lead of the scope to the black sensor wire. Connect the scope probe to one blue sensor wire. The output should be a sine wave, approximately 10 mV to 5 V in amplitude. As the flow rate increases, the amplitude and the frequency should increase. Disconnect the positive lead, and attach it to the other blue sensor wire. The output should be approximately the same voltage and frequency.

TROUBLE SHOOTING CHART

Symptom	Output signals	Error Code	Possible reason	Solution
Blank display	0-4 mA or 0 Hz		Supply voltage	Check supply voltage on the terminal board of the meter
				Check resistance of the current loop. Refer to analog output section for permissible values
			Defective Electronics	Replace electronics stack in the meter
Displays flow without output signal	<4 mA		Current output not selected	Turn 4-20 mA to "On" in output menu
	0 Hz		Frequency output not selected	Select frequency/pulse output option in output menu
No flow display or output at flow	4 mA or 0 Hz	1	Minimum flow setting too high	Reduce minimum flow in basic menu
			M–factor set too low	Auto set M–factor in Basic menu (flow>1/10 Q_{max})
		2	No signal from piezoelectric crystal	Check resistance across sensor wires: should be more than 20 Mohms
Shows flow without flow in pipe	Undefined		Pipe vibration or media pulsations disturbing the flow signal	Auto set M–factor in Basic menu (flow>1/10 Q_{max})
				Increase minimum flow setting in Basic menu until output goes to 4 mA or 0 Hz
				Auto set noise level in Basic menu
				Support pipe to reduce vibration
Unstable flow signal	Unstable		Pipe vibration and/or flow pulsations disturb flow measurement	Auto set M-factor in Basic menu (flow>1/10 Q_{max})
			Air bubbles in the media	Follow piping guidelines
			Pulsating flow	Increase the time constant for outputs and display
Measuring error	>20 mA	3	Flow exceeds 110% of Maximum flow	Make sure the sensor is correctly sized and check maximum flow setting in Basic menu
	>10 kHz max	4	Flow exceeds 110% of Maximum flow	Make sure the sensor is correctly sized and check maximum flow setting in Basic menu
	0 Hz	5	Volume/pulse too low or pulse width too long	Check volume/pulse and pulse width in Output menu for the flow measured
			Wrong calibration constant	Check that the K-factor in the Sensor menu corresponds to the value on the nameplate of the meter
	4 mA offset at no flow		4 mA calibration value incorrect	Calibrate 4 mA point in Service menu (pg. 25)
	20 mA offset at max. flow		20 mA calibration value incorrect	Calibrate 20 mA point in Service menu (pg. 25)

MODEL AND SUFFIX CODES

***PhD* Vortex Shedding Flowmeter**

Category	Description	Suffix Codes						
Wetted parts	Stainless Steel (sizes 1–12")	PhD-90	...	...	...	...	...	...
	Hastelloy (sizes 1–8")	PhD-91	...	...	...	...	...	...
	Carbon Steel (Stainless steel wing) (sizes 6–12")	PhD-92	...	...	...	...	...	...
Fluid Type	Steam or gas	...	S	...	...	...	...	...
	Liquid	...	L	...	...	...	...	...
Line Size	1"	...	...	10	...	...	...	...
	1.5"	...	...	15	...	...	...	...
	2" (*see note 1 for wafer option*)[1]	...	...	20	...	...	...	...
	3"	...	...	30	...	...	...	...
	4"	...	...	40	...	...	...	...
	6"	...	...	60	...	...	...	...
	8"	...	...	80	...	...	...	...
	10"	...	...	100	...	...	...	...
	12"	...	...	120	...	...	...	...
	25 mm	...	...	DN25	...	...	...	...
	40 mm	...	...	DN40	...	...	...	...
	50 mm	...	...	DN50	...	...	...	...
	80 mm	...	...	DN80	...	...	...	...
	100 mm	...	...	DN100	...	...	...	...
	150 mm	...	...	DN150	...	...	...	...
	200 mm	...	...	DN200	...	...	...	...
	250 mm	...	...	DN250	...	...	...	...
	300 mm	...	...	DN300	...	...	...	...
Connection Type	Wafer[6]	...	...	...	W	...	...	...
	Flange	...	...	...	F	...	...	...
Connection Rating	ANSI Class 150	...	...	...	...	150	...	...
	ANSI Class 300	...	...	...	...	300	...	...
	ANSI Class 600	...	...	...	...	600	...	...
	DIN, PN 16	...	...	...	...	PN 16	...	...
	DIN, PN 40	...	...	...	...	PN 40	...	...
	DIN, PN 64	...	...	...	...	PN 64	...	...
Options	No indicator/totalizer option[2]	...	...	...	...	...	STD	...
	FM approved[3]	...	...	...	...	...	FM	...
	CSA approved	...	...	...	...	...	CSA	...
	CENELEC approved[3]	...	...	...	...	...	CEN	...
	Local Indicator and Totalizer[4]	...	...	...	...	...	LOC-TOT	...
	Remote Mount Electronics[5]	...	...	...	...	...	RMT	...
	Integral 110 Vac input[8]	...	...	...	...	...	110	...
	Integral 220 Vac input [8]	...	...	...	...	...	220	...
	Dual sensor and transmitter[7]	...	...	...	...	...	DUAL	...
Sensor Wires (Internal)	Teflon, -40˚ to 400˚F (-40˚ to 204˚C)	...	...	...	...	...	...	T
	Fiberglass, 150˚ to 750˚F (65˚ to 400˚C)	...	...	...	...	...	...	F

Example: **PhD–90S–60–F–300–LOC–TOT–RMT–T**

Notes:
1. The 2" wafer model is not available when used with 300# and 600# flanges.
2. Has 4-20 mA and/or 50% duty cycle frequency output. A 50% duty cycle frequency can be scaled.
3. FM and CENELEC approved meters come with a magnet wand. For all other meters the wand can be ordered as an option.
4. At least one local indicator display is recommended at each site. If one display is to be used on many meters, it should be purchased separately.
5. Remote mount electronics are required for high process temperatures (refer to the general specification). The standard remote mount option comes with 30' of cable.
6. Wafer style meters available in stainless steel (sizes 1–4" only) and Hastelloy (sizes 1–3" only). (*Not* available with dual option)
7. Dual meter is *not* available with wafer connections or CSA approval.
8. Not available with CE Mark.

Compatibility Chart