

## TFE-LINED VAREA-METER®

## PVC-TUBE VAREA-METER®

STRAIGHT THROUGH ROTAMETERS FOR VERY AGGRESSIVE CHEMICALS



*USFilter's Wallace & Tiernan Products offers a choice of two straight-through rotameters for metering difficult fluids and gases. The TFE-lined Varea-Meter® is designed to give long, dependable service metering aggressive chemicals at high temperatures and/or pressures. For lower temperatures and pressures where PVC is acceptable, the PVC-tube Varea-Meter also gives excellent results metering aggressive chemicals.*

### FEATURES

#### EXACT CAPACITIES

The float is custom weight loaded at the factory to give the desired full scale flow capacity - exactly.

#### TRUE STRAIGHT-THROUGH DESIGN

Both meters feature straight-through construction. There are no guides, springs, or other obstructions. Only the float is in the path.

### EASY TO CHANGE READOUTS

The standard readout is in a magnetically coupled indicator unit. An optional Factory Mutual-approved, explosion-proof 4-20 mA transmitter is also available.

#### NO EXTENSIONS, NO SPOOL PIECES

There are no float extensions. In and out piping is vertical. No spool pieces are required at installation.

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### STRAIGHT THROUGH ROTAMETERS FOR VERY AGGRESSIVE CHEMICALS

#### TFE-LINED VAREA-METER FEATURES

##### DURABLE AND RELIABLE WITH AGGRESSIVE FLUIDS

The well-known thermal- and chemical-resistant properties of TFE are added to the pressure-containing properties of flanged, stainless steel meter bodies. The combination offers excellent durability and reliability metering aggressive process chemicals.

##### SPECIAL DESIGN

The TFE-lined Varea-Meter is not an adaptation of a standard stainless steel tube rotameter. It was developed from the beginning as a lined meter. Therefore it readily adapts to conventional metal, plastic, or lined pipe systems.

##### MAXIMUM CORROSION RESISTANCE

All wetted parts are corrosion-resistant material. The TFE flange gaskets supplied are envelope types. The tube liner, tube insert, and float are TFE. The float metering disc can be tantalum, Hastelloy C, or Kynar.

#### PVC-TUBE VAREA-METER FEATURES

##### LONG LIFE WITH AGGRESSIVE FLUIDS

The type I, Grade I PVC metering tube gives long life with aggressive chemicals such as hydrochloric acid and hypochlorite solutions.

##### Low Cost

For low temperature and pressure service where PVC is acceptable this meter will give excellent service at low initial cost.

#### TECHNICAL DATA

Accuracy - 2% of full scale with standard calibration. Special calibration to 1% of full scale.

Range - 10 to 1.

##### Temperature-Pressure Rating

*TFE-Lined Meter:*

Maximum pressure: 275 PSI

Maximum temperature: 300° F.

*PVC-Tube Meter:*

Maximum pressure: 200 PSI

Maximum temperature 150° F.

##### Mounting

Vertical, in-line.

##### Connection

TFE meter: 150 lb flanges. Flange gaskets are TFE jacketed steel and nobestos.

PVC meter: 150 ANSI flat-faced flanges.

##### Calibration Units

Percent of maximum flow is standard. GPM for water, SCFM for air, and other graduations are optional. Scale length is 6 inches.

##### Materials of Construction

TFE meter: Flanges are 316 stainless; metering tube is 304 stainless with 1/16-inch TFE liner; the tapered insert is TFE; the float is all TFE with Hastelloy C, tantalum, or Kynar metering disk; the flange gaskets are TFE jacketed steel and nobestos.

PVC meter: the metering tube and float body are Type I, Grade I PVC. Metering disk is Hastelloy C, tantalum, or Kynar.

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## STRAIGHT THROUGH ROTAMETERS FOR VERY AGGRESSIVE CHEMICALS

### SELECTION PROCEDURE

#### HOW TO SIZE PVC AND TFE METERS FOR GAS SERVICE

If the gas is other than air or is air other than STP (14.7 psi and 70°F), its flow rate must be converted to equivalent scfm air.

1. Convert flow units to scfm:

a. for flow rate given in cfm:

$$\text{cfm} \times \frac{(14.7 + \text{psig}) \times 530}{14.7 \times (460 + F)} = \text{scfm}$$

b. for flow rate given in pounds per minute:

$$\text{ppm} \times \frac{13.31}{\text{gas sp. gravity}} = \text{scfm}$$

2. Convert scfm flow to equivalent flow:

Multiply scfm by selected correction factors for operating pressure from table 1, operating temperature from table 2, and specific gravity from table 3.

TABLE 2

OPERATING TEMPERATURE CORRECTION FACTOR			
$X_T = \sqrt{\frac{460 + F}{530}}$			
OPER. TEMP. °F	FACTOR X <sub>T</sub>	OPER. TEMP. °F	FACTOR X <sub>T</sub>
0	.932	120	1.046
10	.942	130	1.055
20	.952	140	1.064
30	.962	150	1.073
40	.972	160	1.080
50	.981	170	1.090
60	.991	180	1.098
70	1.000	190	1.107
80	1.009	200	1.116
90	1.019	210	1.124
100	1.028	220	1.132
110	1.037	230	1.141

TABLE 1

OPERATING PRESSURE CORRECTION FACTOR					
$X_p^* = \sqrt{\frac{14.7}{14.7 + \text{psig}}}$					
OPER. PRESS. "Hg. Vac.	FACTOR X <sub>p</sub>	OPER. PRESS. PSIG	FACTOR X <sub>p</sub>	OPER. PRESS. PSIG	FACTOR X <sub>p</sub>
1"	1.017	0	1.000	30	.574
2"	1.035	1/2	.983	35	.545
3"	1.054	1	.968	40	.518
4"	1.074	2	.938	45	.496
5"	1.096	3	.911	50	.476
6"	1.118	4	.887	55	.459
7"	1.142	5	.864	60	.443
8"	1.168	6	.843	65	.429
9"	1.196	7	.823	70	.416
10"	1.226	8	.806	75	.404
OPER. PRESS. PSIG	FACTOR X <sub>p</sub>	9	.787	80	.394
		10	.772	85	.384
		15	.704	90	.374
		20	.651	95	.366
		25	.608	100	.358

TABLE 3

GAS SPECIFIC GRAVITY CORRECTION			
$X_{sp. gr.} = \sqrt{\text{Sp. Gr.}}$			
Gas Sp. Gr. (Both air and gas at 70 °F & 14.7 psig)	FACTOR X <sub>sp. gr.</sub>	Gas Sp. Gr. (Both air and gas at 70 °F & 14.7 psig)	FACTOR X <sub>sp. gr.</sub>
2.500	1.581	1.100	1.049
2.400	1.549	1.000 (Air)	1.000
2.300	1.517	.965 (Nitrogen)	.982
2.250	1.500	.964 (Carbon Monoxide)	.982
2.200	1.483	.900	.949
2.100	1.449	.800	.894
2.000	1.414	.700	.837
1.900	1.378	.600	.775
1.800	1.341	.587 (Ammonia)	.766
1.750	1.322	.500	.707
1.700	1.304	.400	.632
1.600	1.265	.300	.548
1.520 (Carbon Dioxide)	1.232	.200	.447
1.500	1.225	.138 (Helium)	.372
1.400	1.183	.100	.316
1.377 (Argon)	1.170	.090	.300
1.300	1.140	.080	.283
1.250	1.118	.070	.265
1.200	1.095	.0696 (Hydrogen)	.264
1.103 (Oxygen)	1.049		

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## STRAIGHT THROUGH ROTAMETERS FOR VERY AGGRESSIVE CHEMICALS

### SELECTION PROCEDURE

#### HOW TO SIZE PVC AND TFE METERS FOR LIQUID SERVICE

1. Convert flow units to gpm (table 4).
2. From table 5 or 6, select the column with the specific gravity value nearest to that of the liquid in question. Find the gpm range that includes the flow rate desired. The correct meter size will be found in the far left column. (The capacity table indicates an upper and a lower maximum range of flow capacities available. For example, a PVC meter with 1/2-10 tube used for a liquid specific gravity of 1.0 has a minimum full scale capacity of 0.66 gpm and a maximum full scale capacity of 1.11 gpm. Any full scale flow between 0.66 and 1.11 gpm can be provided.)

TABLE 4

FLOW CONVERSION FACTORS FOR LIQUIDS	
cc per minute x 2.642x10 <sup>-4</sup>	} = gpm
liters per minute x 0.2642	
cubic feet per minute x 7.1481	
pounds per minute x $\frac{0.1201}{\text{sp. gr.}}$	

TABLE 5

FLANGE SIZE	METER SIZE TUBE NO.	PVC METER CAPACITIES & TUBE AND FLOAT CODES												
		LIQUIDS					MAX. PRESS. DROP (IN. H <sub>2</sub> O)	VIS-COSITY CEILING (CSS ACTUAL)	TUBE CODE	FLOAT CODE	GASES			
		ACTUAL MAXIMUM CAPACITY* IN GPM									SCFM AIR (AT STP)	MAX. PRESS. DROP (IN. H <sub>2</sub> O)	TUBE CODE	FLOAT CODE
sp. gr. 0.6	sp. gr. 0.8	sp. gr. 1.0	sp. gr. 1.4	sp. gr. 1.8										
1" # 150 FF	1/2-10	1.02 1.53	.81 1.28	.66 1.11	.48 .86	.42 .69	22.0	4	08	B10V	1/2-inch meter not available for gas service			
	1/2-14	1.46 2.21	1.17 1.85	.94 1.60	.68 1.24	.60 .99	22.0	10	08	B14V				
	1/2-20	2.24 3.39	1.78 2.84	1.44 2.45	1.02 1.89	.90 1.51	22.0	3	08	B20V				
	3/4-24	4.01 6.73	3.10 5.61	2.40 4.83	1.55 3.72	1.37 2.94	17.0	3	12	C24V	15.2 22.1	21.0	12	C24V
	3/4-40	8.04 13.5	6.22 11.2	4.82 9.69	3.11 7.48	2.74 5.90	17.0	4	12	C40V	30.6 44.6	22.7	12	C40V
	1-38	12.1 21.2	9.59 17.9	7.70 15.6	5.45 12.3	4.79 10.1	20.0	3	16	D38V	44.3 68.7	22.1	16	D38V
1 1/2" # 150 FF	1 1/2-40	20.4 39.9	16.0 33.7	12.6 29.4	8.47 23.5	7.47 19.4	22.0	4	24	E40V	79.2 133.3	27.4	24	E40V
2" # 150 FF	2-40 VI	48.7 107.7	37.2 91.1	28.2 79.6	17.0 63.9	15.0 53.2	22.0	3	32	F40V	192.5 352.8	28.4	32	F40V
	2-40 NVI	66.5 149.9	50.0 126.7	36.8 110.4	19.7 88.2	17.3 73.0	38.0	1.0	32	F40N	259.2 477.7	28.4	32	F40N
3" # 150 FF	3-40 VI	115.7 201.3	91.2 169.3	72.8 146.8	50.7 115.7	44.8 94.2	23.0	3	48	G40V	426.4 649.1	35.0	48	G40V
	3-40 NVI	157.2 281.3	122.3 236.5	95.5 204.9	63.7 161.4	56.2 130.7	30.0	1.0	48	G40N	577.7 907.9	35.0	48	G40N

TABLE 6

FLANGE SIZE	METER SIZE TUBE NO.	TFE METER CAPACITIES & TUBE AND FLOAT CODES												
		LIQUIDS					MAX. PRESS. DROP (IN. H <sub>2</sub> O)	VIS-COSITY CEILING (CSS ACTUAL)	TUBE CODE	FLOAT CODE	GASES			
		ACTUAL MAXIMUM CAPACITY* IN GPM									SCFM AIR (AT STP)	MAX. PRESS. DROP (IN. H <sub>2</sub> O)	TUBE CODE	FLOAT CODE
sp. gr. 0.6	sp. gr. 0.8	sp. gr. 1.0	sp. gr. 1.4	sp. gr. 1.8										
1" # 150 FF	1/2-10	1.26 1.67	1.04 1.41	.88 1.22	.65 .96	.47 .79	27.0	4	08	B10V	1/2-inch meter not available for gas service			
	1/2-14	1.82 2.41	1.49 2.03	1.26 1.76	.92 1.39	.66 1.13	27.0	10	08	B14V				
	1/2-20	2.78 3.70	2.28 3.11	1.92 2.70	1.40 2.13	1.0 1.73	27.0	3	08	B20V				
	3/4-24	5.26 7.65	4.29 6.44	3.57 5.59	2.52 4.42	1.67 3.61	23.0	3	12	C24V	18.3 24.6	21.0	12	C24V
	3/4-40	10.6 15.3	8.59 12.9	7.16 11.2	5.06 8.87	3.36 7.25	23.0	4	12	C40V	36.8 49.7	22.7	12	C40V
	1-38	13.3 21.0	10.8 17.7	8.81 15.3	5.93 12.1	4.79 9.99	19.0	3	16	D38V	47.3 68.0	22.1	16	D38V
1 1/2" # 150 FF	1 1/2-40	23.4 36.2	18.8 30.4	15.4 26.3	10.2 20.7	7.47 16.8	18.0	4	24	E40V	86.8 122.4	27.4	24	E40V
2" # 150 FF	2-40 VI	52.6 107.7	41.0 91.1	32.1 79.6	17.1 63.9	15.0 53.2	22.0	3	32	F40V	201.9 352.8	28.4	32	F40V
	2-40 NVI	72.1 149.9	55.5 126.7	42.6 110.4	19.7 88.2	17.3 73.0	38.0	1.0	32	F40N	272.0 477.7	28.4	32	F40N
3" # 150 FF	3-36 VI	98.4 171.2	77.5 143.9	61.7 124.8	42.8 98.4	37.7 80.1	24.0	3	48	G36V	361.6 551.9	35.0	48	G36V
	3-36 NVI	141.7 254.1	110.0 213.6	85.6 185.1	56.4 145.6	49.5 117.6	34.0	1.0	48	G36N	517.9 820.2	35.0	48	G36N

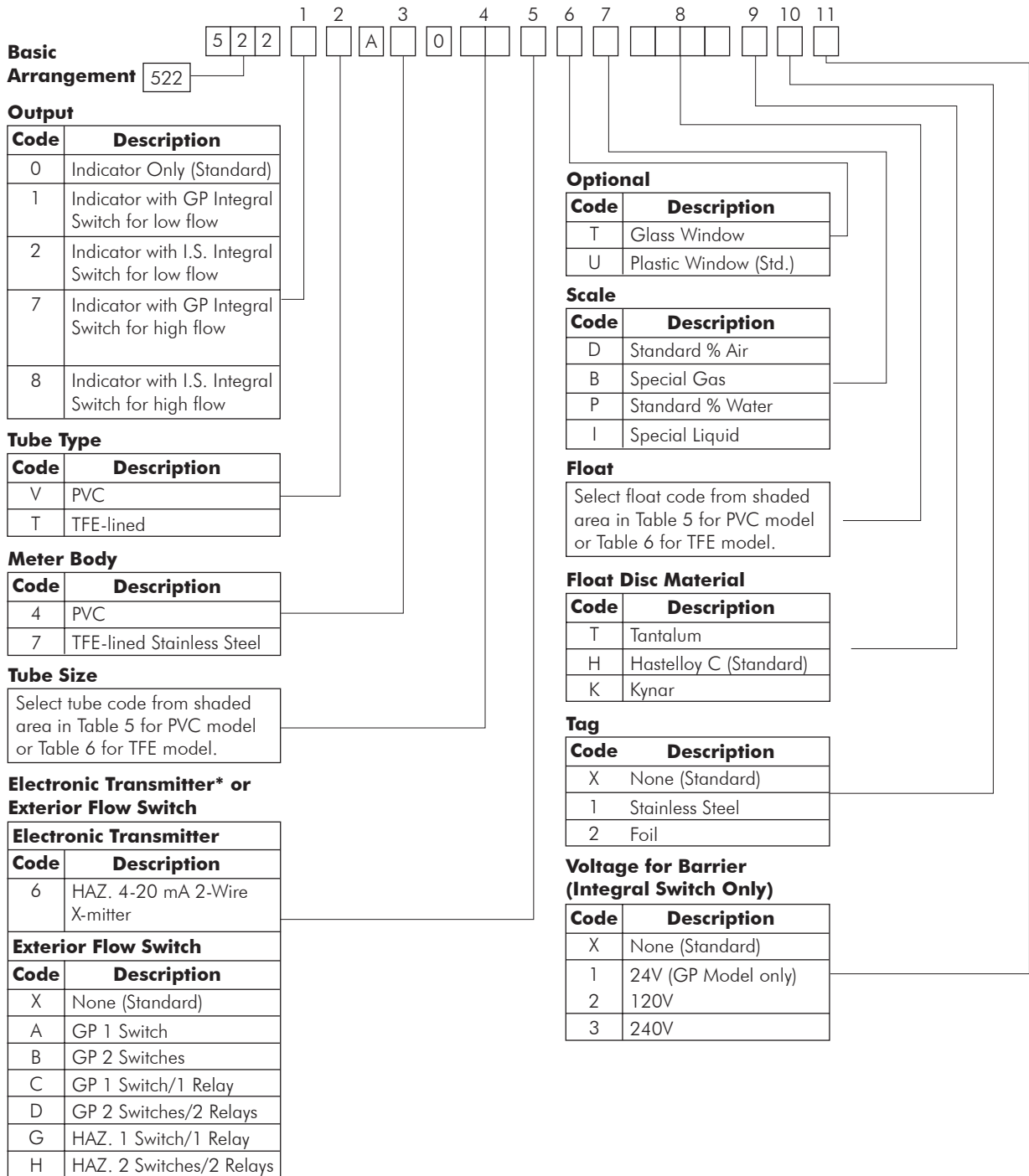
\*Actual capacity has an upper and lower limit to determine full scale based on the loaded float weight determined by maximum desired flow rate between the lower and upper limit.

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TABLE 7 - ORDERING PROCEDURES FOR TUBES AND FLOATS



\* Select either Exterior Flow Switch or Electronic Transmitter.

# TFE-LINED VAREA-METER® PVC-TUBE VAREA-METER®

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## ELECTRONIC TRANSMITTER

USFilter's Wallace & Tiernan Products' (USF/W&T) Varea-Com™ explosion-proof Electronic Transmitter provides accurate magnet angle detection and computation of the angle to a 4-20 mA industry standard output signal. This compact, microprocessor-driven device is capable of filling flow-correction needs at the meter, providing accurate flow information remotely to external support systems. The patented magnetic sensor with automatic gain control enables a high dynamic capture range without sacrificing accuracy.



## FEATURES

### SEPARATE FLOW INDICATION

The scale and pointer readout is independent of the transmitting mechanism. The pointer indicates flow rate even if the transmitting element is removed or if power fails.

### EASY ADDITION IN FIELD

Any model can be ordered mounted on a new meter or can be easily added to an already-installed meter. Field installation requires calibration to the meter.

### DESIGN AND FEATURES

- NEMA 4, FM-Approved Hazardous Area enclosure
- Smart, microprocessor-based field transmitter; 2-wire, low power
- Patented sensor with micro-processor-controlled gain
- 4-20 mA Analog Output for magnetic angle signaling. Voltage range: 8.28 VDC

- 11-calibration-point transmitter linearization and storage in nonvolatile memory
- External Zero Button Wire
- Adjustable low-cutoff
- Adjustable low-pass filter
- PC-interface (no external power required)
- Accuracy better than 0.5% (over the range from 0.0 to 360.0 degrees, pick-up accuracy ~0.1 degree)
- Electronics designed to meet international certifications and CE requirements.

## TECHNICAL DATA

**Accuracy** - Combined meter and transmitter accuracy is 2% of full scale (1% with custom calibration).

**Sensitivity** - 0.2% of full scale.

**Repeatability** - 0.3% of full scale.

**Speed of Response** - Complete response to a flow-rate change in 0.5 seconds.

**Output Signals** - 4-20 mA DC flow proportional.

## Electrical Requirements

- Input: 24 VDC
- Current Consumption: 5 mA signal current.

**Temperature Range** - Maximum fluid temperature is 300°F; ambient range is -13 to 140°F.

## Electrical Classification

As an explosion-proof arrangement, the transmitter is FM-approved as explosion-proof for Class I, Division 1, Group A, B, C, and D hazardous locations; and FM-approved as dust-ignition-proof for Class II, Division 1, Group E, F and G hazardous locations; suitable for Class III, Division 1.

**Connections** - Enclosed 1/2" conduit connection. Transmitter to receiver, unshielded wires.

**Dimensions** - For complete dimensions, please refer to CN 521.282 UA and CN 521.310 UA.

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### EXTERNAL FLOW SWITCH

USFilter's Wallace & Tiernan Products' (USF/W&T) External Flow Switch is a compact option that gives reliable high and/or low flow switching. The External Flow Switch contains a powerful rotating magnet that responds linearly to float position. Its switches are long life, hermetically sealed reed types. Almost frictionless rotation of the switch magnet and its powerful bond with the float magnet give a dependable magnetic coupling. Even under sudden flow surges, switching remains reliable. The switch is available in a UL-listed, hazardous location\* arrangement (Series 5500) and a general purpose arrangement (Series 5600) in a NEMA 4 enclosure.

The External Flow Switch is easily added in the field with the meter in the line. No extension rod, on interference with vertical piping. Switches can be set to open or close on increasing or decreasing flow. In the general purpose model, this is done without removing the cover. A screwdriver adjustment sets each switch independently over 0 to 100% of the flow range.

\*As defined in Article 500, NEC.



### TECHNICAL DATA

**Repeatability** - 0.6% of full scale.

#### Electrical Ratings

Series 5600 General Purpose: one or two switches rated 250 mA at 48 VDC or 120 VAC resistive or 50 mA at 48 VDC or 120 VAC inductive; one or two single-pole, double-throw relays rated 10 amperes at 28 VDC or 120 VAC; coil supply 120 VAC, 50/60 Hz.

Series 5500 Hazardous Location: one or two single-pole, double-throw relays rated 10 amperes at 120 VAC; coil supply 120 VAC, 50/60 Hz. UL-listed for Class I, Division 1 & 2 Groups C and D or Class II, Division 1 & 2 Groups C and D or Class II, Division 1 & 2 Group E, F, and G.

**Temperature Limits** - Ambient, -20° to 120° F.

**Actuating Time** - Reed switches open in one millisecond.

**Enclosures** - Heavy cast aluminum (NEMA 4) with corrosion resistant finish.

**Dimensions** - For complete dimensions, please refer to CN 521.284 UA, CN 521.286 UA, CN 521.312 UA, and CN 521.314 UA.

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### INTEGRAL FLOW SWITCH

USFilter's Wallace & Tiernan Products' (USF/W&T) Integral Flow Switch is a low-cost switch that mounts inside the meter's indicator and enables remote monitoring of either high or low set points. The switch is housed in the indicator, which is in a NEMA 4 enclosure with a plastic window; a glass window is available as an option. There is also an FM-approved, intrinsically safe arrangement with a power supply and an integral (to the power supply) relay available for Class I, II & III, Division 1 & 2 hazardous areas.



### FEATURES

#### ALARM OPERATION

The user can easily set the switching point by removing the indicator cover and moving the switch pointer tip (located in the slot) to the desired set point. Any value along the slot can be used as the desired set position. The placement of the pointer tip provides a local and visual indication of the set point. The disc mounted on the indicator needle actuates the limit switch within the housing. This compact, inexpensive switch gives a reliable high- or low-flow signal even under sudden flow surges. The alarm can be set to open or close on increasing or decreasing process flow.

USFilter Corporation reserves the right to change the specifications referred to in this literature at any time, without prior notice.

Varea-Meter and Varea-Com are trademarks of USFilter Corporation and its subsidiaries.

TI 520.215 UA 7/05

### TECHNICAL DATA

#### Specifications

- Electrical Classification: NEMA 4 for General Purpose; Intrinsically Safe for Hazardous Areas  
Class I, Div. 1 Haz Group A, B, C, D  
Class II, Div. 1 Haz Group E, F, G  
Class III, Div. 1
- Supply Voltage:  
NEMA 4 - 30 VDC or less  
Intrinsically Safe - 24 VDC, 120 VAC or 240 VAC (based on barrier selected)

#### Repeatability

Intrinsically Safe Alarm:  $\leq .0004$  in. of the set point

General Purpose Alarm:  $\leq .0002$  in. of the set point

#### Ambient Operating Temperature

NEMA 4 -13 to 131° F

Intrinsically Safe -13 to 140° F

**Dimensions** - For complete dimensions, please refer to CN 521.280 UA and CN 521.298 UA.

### Shipping Weights (lbs.)

Tube Size	1/2"	3/4"	1"	1 1/2"	2"	3"
TFE Meter w/ Magnetic Indicator	15*	15*	15*	21*	34*	53*
PVC Meter w/ Magnetic Indicator	10*	11*	13*	15*	21*	30*

\* Add 3 lbs. for GP Flow Switch, 4 lbs. for HAZ. Flow Switch, and 3 lbs. for HAZ. Area Transmitter.

To find out more about how to put USFilter to work for you, contact us at

**USFilter**

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