



**Principles of Operation**

Vortices are created when a fluid passes around a bluff body as shown below. Vortices are alternately shed on each side of the body, 180 degrees out of phase to each other, resulting in an oscillating pressure gradient. As flow increases the frequency of vortices increases in proportion to the increased flow thereby creating a linear relationship. Aalborg's unique dual signal processing technology independently measures each vortex on either side of the bluff body and filters out non-flow noise. This results in less noise and higher accuracy throughout the flow range.

Dual signal processing technology independently measures each vortex providing increased accuracy and turndown.



Vortex In-line Flow Meter Shown with Wafer Mounting

**TABLE 29 - BENEFITS**

<b>RELIABLE</b>	No moving parts to wear or fail. Electronics can be remote mounted up to 30.5 m (100 ft). No fluid to sensor contact. No holes to clog.
<b>WIDE RANGEABILITY</b>	High flow turndown ratio up to 80:1. Dual signal processing technology improves accuracy at low flows.
<b>HIGH ACCURACY</b>	±0.5% of rate. Increased noise cancellation as a result of dual signal processing technology.

**TABLE 30 - FUNCTIONAL SPECIFICATIONS**

<b>FLUID TYPES</b>	Steam, Gas, Liquid.
<b>MAXIMUM PRESSURE</b>	103 bar (1500 psig) with wafer mount See Table 40 for flange mount.
<b>FLUID TEMPERATURE</b>	-73° to 232 °C std./to 316 °C opt. (-100° to 450 °F std./to 600 °F opt).
<b>LOW FLOW CUT-OFF</b>	Adjustable: Set @min. per Tables 34 to 38.
<b>HIGH FLOW CUT-OFF</b>	Adjustable: Set @max. per Tables 34 to 38.
<b>VOLTAGE</b>	115 /230 VAC selectable or 24 VDC.
<b>FREQUENCY</b>	50 /60 Hz.
<b>OUTPUTS</b>	Analog: 4-20 mA DC into 600 ohm or less.
<b>LINEAR RANGE</b>	Reynolds number of >10,000.

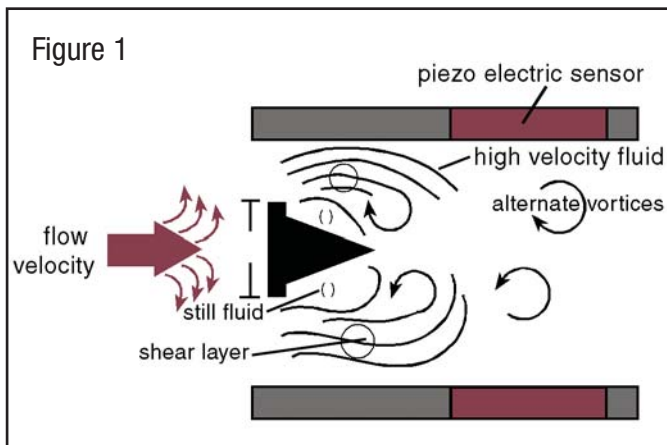




TABLE 31 - PERFORMANCE SPECIFICATIONS	
ACCURACY	± 0.5% of rate.
REPEATABILITY	± 0.25% of rate.
FLOW TURNDOWN RATIO	See Tables 34 to 38.
RESPONSE TIME	1000 ms.
DAMPING	Adjustable: 1 to 10 sec.
VELOCITY RANGE	Liq.: 1.32 or $\frac{10000\mu}{\bar{n}d \cdot 124}$ to 30 ft/sec Steam & Gas: $(144/\bar{n})^{1/3}$ to 250 ft/sec $\bar{n}$ = density (lb/ft <sup>3</sup> ) $d$ = pipe diameter (in) $\mu$ = viscosity (cp)
AGENCY APPROVALS*	FM and CSA Class 1 Div 2 Groups B,C,D.

\* Designed to meet.  
 Contact Aalborg for status of the agency approval.

\*\*The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.



Vortex In-line Flow Meter Shown with Flange Mounting

TABLE 32 - PHYSICAL SPECIFICATION	
<b>** MATERIALS OF CONSTRUCTION</b>	
SHEDDER BAR	304 SS or 316 SS.
ELECTRODES	304 SS or 316 SS encapsulated ceramic.
METERING TUBE	304 SS or 316 SS.
FLANGES	304L SS or 316L SS.
ELECTRONICS HOUSING	Epoxy coated aluminum.
<b>CONNECTIONS AND MOUNTINGS</b>	
MOUNTING POSITION	Vertical, horizontal, angle.
TYPICAL STRAIGHT PIPE REQUIREMENTS	Upstream: 20 x D. Downstream: 5 x D.
TEMPERATURE TAP (BY CUSTOMER)	Downstream: 3.5 x D.
PRESSURE TAP (BY CUSTOMER)	Upstream: 3.5 x D.
PROCESS CONNECTIONS	ANSI Class 150 RF, 300 RF, 600 RF, Wafer.
ELECTRICAL CONNECT	3/4" FNPT.

TABLE 33 - ELECTRONIC SPECIFICATIONS	
AMBIENT TEMPERATURE	-12° to 65 °C (-15° to 149 °F).
TRANSMITTER	Microprocessor-based.
DISPLAY	Two lines, simultaneous rate and total, 16 alphanumeric characters each.
FUNCTIONS	Zero, span, hi cutoff, low cutoff, response time, sample time, engineering units, totalizer, data logger, RS-232 interface.
OUTPUT SIGNAL	4-20mA output into 600 Ohm or less, 5V TTL Pulse Output. Use 18 or 20 gauge twisted pair shielded cable.
ENCLOSURE PROTECTION	NEMA 4X.
ENCLOSURE APPROVALS	UL, CSA, FM Class I Groups B, C, D Class II Groups E, F, G KEMA/CENELEC EEx d IIB
POWER SUPPLY	15-30 VDC or 115 / 230 VAC (optional).



**Flow Ranges**

Minimum and maximum flow rates to achieve accuracy in Gal/min, L/min. Pipe ID based on schedule 80 steel.

**TABLE 34 - WATER FLOW RATES AT 60 °F**

SIZE (INCH)	3/4"		1"		1.5"		2"		3"		4"	
	min	max	min	max	min	max	min	max	min	max	min	max
Gal/min	2.6	40.4	3.4	67.2	7.3	164.9	12.1	276.0	27.2	617.6	47.3	1075.3
L/MIN	9.9	152.9	12.8	254.3	27.5	624.4	46.0	1044.9	102.9	2337.9	179.1	4070.4

Minimum and maximum flow rates to achieve accuracy lb/hr. Pipe ID based on schedule 80 steel.

**TABLE 35 - SATURATED STEAM FLOW RATES AT SELECTED PROCESS PRESSURES (English)**

SIZE (INCH)	3/4"		1"		1.5"		2"		3"		4"	
PRESSURE (psig)	min	max	min	max	min	max	min	max	min	max	min	max
10	8.7	83.6	14.5	203.5	35.7	668.1	59.7	1118.1	133.5	2501.7	232.5	4355.6
25	11.7	129.9	19.5	316.0	48.0	1041.9	80.3	1743.5	179.6	3901.2	312.6	6792.1
50	16.0	204.9	26.5	498.6	65.1	1649.3	109.0	2760.1	243.9	6175.9	424.7	10752.4
75	19.6	278.5	32.6	677.7	80.0	2245.8	133.9	3758.3	299.6	8409.3	521.7	14640.7
100	22.9	351.3	38.1	854.8	93.4	2833.4	156.4	4741.7	349.9	10609.7	609.1	18471.6
125	25.9	423.5	43.1	1030	105.9	3417.8	177.2	5719.5	396.5	12797.7	690.2	22280.9
150	28.8	492.7	47.9	1199	117.6	4001.0	196.8	6695.5	440.4	14981.6	766.7	26083.1
200	34.1	639.2	56.8	1555	139.4	5160.8	233.2	8636.4	521.8	19324.6	908.5	33644.2
250	39.1	782.7	65.0	1904	159.6	6323.9	267.0	10582.9	597.5	23679.9	1040.3	41226.9
300	43.7	883.6	72.8	2150	178.6	7489.3	298.9	12533.1	668.8	28043.5	1164.5	48824.0
350	48.2	1057	80.2	2573	196.8	8663.4	329.4	14498.0	737.0	32440.2	1283.2	56478.6
400	52.5	1174	87.3	2857	214.3	9844.2	358.7	16474.0	802.6	36861.6	1397.3	64176.3
450	56.6	1316	94.2	3202	231.3	11036.0	387.1	18468.5	866.1	41324.3	1507.9	71945.9
500	60.7	1460	101.0	3552	247.8	12240.0	414.7	20483.2	928.0	45832.4	1615.7	79794.5
550	64.7	1605	107.5	3905	264.0	13456.0	441.8	22518.2	988.5	50385.9	1721.0	87722.2
600	68.5	1752	114.0	4262	279.8	14684.2	468.3	24573.6	1047.8	54984.8	1824.2	95729.0



Minimum and maximum flow rates to achieve accuracy in (kg/hr) Pipe ID based on schedule 80 steel.

**TABLE 36 - SATURATED STEAM FLOW RATES AT SELECTED PROCESS PRESSURES (Metric)**

Size (mm)	20		25		40		50		80		100	
Pressure (bara)	min	max	min	max	min	max	min	max	min	max	min	max
1	2.5	22.8	4.1	54.9	10.2	184.6	17.0	307.7	38.1	689.9	66.3	1201.7
2	3.9	43.5	7.7	105	15.7	353.2	26.2	588.6	58.7	1319.8	102.2	2298.8
4	5.9	84.0	11.9	206	24.2	676.6	40.4	1127.6	90.5	2528.2	157.6	4403.6
6	7.7	123	15.3	300	31.2	991.3	52.1	1652.2	116.7	3704.3	203.3	6452.1
10	10.6	200	21.2	489	43.2	1609.6	71.9	2682.6	161.3	6014.7	280.9	10476.3
14	13.1	276	26.3	673	53.5	2222.3	89.2	3703.9	200.0	8304.4	348.3	14464.5
18	15.5	353	30.9	862	62.9	2834.7	104.9	4724.5	235.2	10592.8	409.6	18450.4
22	17.6	426	35.2	1037	71.7	3449.7	119.6	5749.5	268.1	12891.1	466.9	22453.5
26	19.7	505	39.3	1229	80.1	4069.0	133.5	6781.6	299.3	15205.0	521.2	26483.9
28	20.7	531	41.3	1294	84.1	4380.6	140.2	7300.9	314.4	16369.4	547.5	28512.0
30	21.6	569	43.3	1369	88.1	4693.7	146.8	7822.9	329.2	17539.8	573.3	30550.5
32	22.6	607	45.2	1461	92.0	5008.5	153.3	8347.5	343.7	18715.9	598.7	32599.0
34	23.5	637	47.1	1530	95.8	5325.0	159.7	8874.9	358.0	19898.5	623.6	34658.9
36	24.5	675	48.9	1622	99.6	5643.3	166.0	9405.5	372.2	21088.1	648.3	36731.0
38	25.4	713	50.8	1714	103.3	5963.7	172.2	9939.5	386.1	22285.4	672.6	38816.3
40	26.3	751	52.6	1806	107.0	6286.0	178.4	10476.7	399.9	23490.0	696.6	40914.5

Minimum and maximum flow rates to achieve accuracy in CFPM (14.7 psia 70 °F) CFM at actual process temperature = min. or max values below \*520/ (Actual Temp. (°F) + 460) Pipe ID based on schedule 80 steel. Flow Temp. 60 °F.

**TABLE 37 - AIR FLOW RATES AT SELECTED PROCESS PRESSURES (English)**

Size (inch)		3/4"		1"		1.5"		2"		3"		4"	
Density (lb/ft3)	Pressure (psig)	min	max	min	max	min	max	min	max	min	max	min	max
0.076	0	2.2	22.2	3.7	54.2	9.1	183.8	15.2	307.5	34.0	688.1	59.2	1197.9
0.103	5	2.7	29.8	4.5	72.7	11.0	246.3	18.5	412.1	41.3	922.1	71.9	1605.3
0.128	10	3.1	37.4	5.2	91.9	12.8	308.8	21.5	516.7	48.1	1156.1	83.7	2012.8
0.180	20	3.9	52.6	6.6	128	16.1	433.8	26.9	725.9	60.3	1624.2	104.9	2827.7
0.232	30	4.7	67.7	7.8	164	19.1	558.8	31.9	935.1	71.4	2092.2	124.2	3642.6
0.284	40	5.3	82.9	8.9	201	21.8	683.8	36.5	1144.2	81.7	2560.3	142.2	4457.5
0.336	50	6.0	98.1	9.9	238	24.4	808.8	40.8	1353.4	91.3	3028.4	159.0	5272.4
0.388	60	6.6	113.2	10.9	275	26.8	933.8	44.9	1562.6	100.5	3496.4	175.0	6087.3
0.440	70	7.1	128.4	11.9	312	29.2	1058.8	48.8	1771.8	109.3	3964.5	190.2	6902.2
0.493	80	7.7	143.6	12.8	349	31.4	1183.8	52.6	1981.0	117.7	4432.5	204.9	7717.1
0.545	90	8.2	158.7	13.7	386	33.6	1308.8	56.2	2190.2	125.8	4900.6	219.0	8532.0
0.596	100	8.7	173.9	14.6	423	35.7	1433.8	59.8	2399.3	133.8	5368.7	232.9	9346.9
0.649	110	9.2	189.1	15.4	460	37.7	1558.8	63.2	2608.5	141.3	5836.7	246.1	10161.8
0.700	120	9.7	204.2	16.2	497	39.8	1683.8	66.5	2817.7	148.9	6304.8	259.2	10976.7
0.752	130	10.2	219.4	17.0	534	41.7	1808.8	69.8	3026.9	156.2	6772.8	271.9	11791.6
0.804	140	10.7	234.6	17.8	570	43.6	1933.8	73.0	3236.1	163.3	7240.9	284.2	12606.5
0.856	150	11.1	249.7	18.5	607	45.5	2058.8	76.1	3445.3	170.2	7709.0	296.4	13421.4
1.116	200	13.3	325.6	22.1	792	54.2	2683.8	90.8	4491.2	203.1	10049.3	353.6	17495.9
1.636	300	17.1	477.2	28.5	1161	70.0	3933.8	117.1	6583.0	262.1	14729.9	456.3	25644.8