

spirax/sarco®

S-PhD Inline Vortex

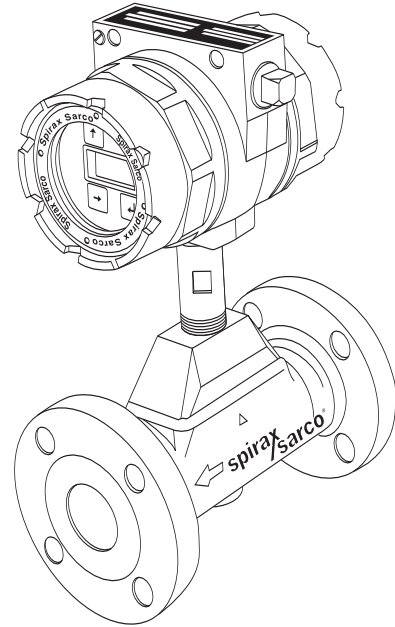
Description

The Spirax Sarco Vortex S-PhD vortex shedding flowmeter measures process fluid flow by detecting the frequency at which vortices are shed from an obstruction in the process fluid line (the bluff body). A piezo-electric sensor mounted outside the flow line acts as the transducer, converting vortex pulses into electrical signals.

The 'Smart' electronics provide excellent noise immunity while the wide range of wetted materials provide outstanding compatibility with most process fluids. The transmitter provides a frequency output, scaled frequency output, totalizer pulse or a 4-20 mA DC signal proportional to the flow rate.

Features

- Reliable—no moving parts, no fluid to sensor contact
- In-process removable sensor, below 750 psig (52 barg) pressure
- Simple, rugged, all welded construction, no internal gaskets, no leak paths
- High accuracy with wide rangeability
- Line sizes from 1" to 12"
- High temperature operation up to 750°F
- EZ Logic™ menu-driven user interface
- 'Smart' electronics provide excellent noise immunity
- Compatible with HART Protocol



Performance Specifications

Accuracy

Liquid	± 0.7% of flow rate
Gas and Steam	± 1.0% of flow rate
Analog Output Version	Add ± 0.1% of full scale

Repeatability

± 0.15% of flow rate

Response Time

Adjustable from 1 – 100 seconds (analog output version)

K-factor – Temperature Correction

The K-factor of the flowmeter decreases by 0.29% for each 100°F increase in temperature above 70°F. The converse is true below 70°F. By programming the operating fluid temperature in the electronics, the change in the K-Factor is automatically corrected for.

Operating Specifications

Fluid Types

Liquid, gas or steam

Line Sizes

1" – 12"

Process Temperature Limit

–40 to 750°F

Process Pressure

Flange

ANSI Class 150, 300 or 600

Wafer

All wafer bodies are rated based on appropriate flange rating to a maximum of ANSI Class 600

Enclosure Specifications

Approved for NEMA 4X watertight and dust tight requirements.

Ambient Temperature Limit

Normal

– 20 to 140°F

Display Option

32 – 140°F

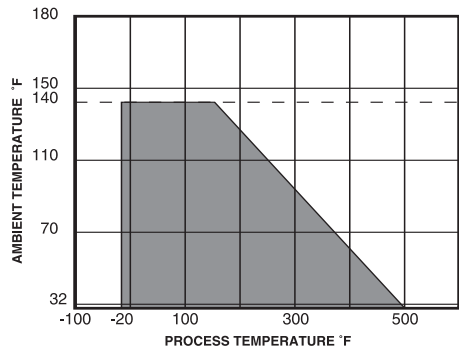


Figure 1. Ambient Temperature Range for Locally Mounted Electronics.

Ambient Humidity Limit

5 – 100% RH non-condensing

Power Requirements

18 – 40 VDC; max power consumed: 1 watt

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Operating Specifications continued

Output

Analog

4 – 20 mA, loop powered 2 wire system, digitally adjusted span

Frequency

Voltage pulses, 3 wire system, 1 to 10 kHz square wave, open collector FET output with selectable pull-up resistors. The pulse output can be scaled so that 1 pulse represents a specific quantity of fluid passing through the flowmeter. For typical applications, the amplitude of the squarewave can be determined by:

$$V_{\text{pulse}} = V_s - (I \cdot R_{\text{load}})$$

For other options refer to the Vortex S-PhD manual

Span Setting

For analog outputs the span setting can be adjusted without the use of electronic test equipment by programming the full scale rate using the EZ Logic™ keypad.

HART Protocol

In addition to using the keypad for field configuration, the Vortex S-PhD is also compatible with a laptop PC using a Hart Modem and EZ Comm communications software. This can be used to calibrate the 4-20 mA settings, set the 20 mA point, assign a tag or descriptor, display flowrate, output level, total, velocity and shedding frequency.

Cable Conduit Connection

ANSI 3/4" female NPT.
DIN PG 13.5.

Signal Cable

18, 20 or 22 gauge, shielded instrumentation cable. Belden #9939 double shielded cable or equivalent required for European CE rating.

Measurable Flow Velocities

Liquid

1.5 to 32 ft/sec

$$\text{Gas/Steam} \sqrt{\frac{50}{\rho}} \text{ to } 260 \text{ ft/sec}$$

Where: $\rho = \text{density in } \frac{\text{lb}}{\text{ft}^3}$

Process Viscosity

For minimum linear flow velocities at varying viscosities. (See Figure 2)

Linear Range

Reynolds Numbers of 20,000 to 7,000,000

Flowmeter Sizing

Selecting the appropriate size flowmeter can be critical. If the flowmeter is over-sized, the signal strength could be weak – limiting rangeability. If the flowmeter is undersized, excessive pressure drop or cavitation may occur – affecting accuracy. Use the minimum linear flow velocity curves and Tables 1 through 5 (minimum and maximum flow rates for various types of applications) for general sizing. For more detailed information, contact your Spirax Sarco representative or go to www.spiraxsarco.com/us for sizing program.

Pressure Loss

If a differential pressure transducer were connected between pressure taps up and downstream of a vortex flowmeter, the measured differential pressure would be the pressure loss for the device. This value can be calculated using the following equations:

$$\begin{aligned} \Delta P &= 2.67 \times 10^{-4} \cdot \rho \cdot V^2 \\ \text{or } \Delta P &= 2.50 \times 10^{-3} \cdot \rho \cdot (Q_1)^2 / D^4 \\ \text{or } \Delta P &= 4.47 \times 10^{-5} \cdot \rho \cdot (Q_2)^2 / D^4 \end{aligned}$$

Where:

- ΔP = Pressure loss psi
- ρ = Density at operating conditions lb/ft³
- V = Flow velocity in ft/s
- Q_1 = Volumetric flow rate in ACFM
- Q_2 = Volumetric flow rate in U.S. GPM
- D = Flowmeter internal diameter in inches

Minimum Back Pressure (Liquid Service Only)

The line pressure must be sufficiently high so that no cavitation occurs. The minimum required line pressure can be obtained from the equation:
 $PG \geq (1 \cdot 3 \cdot P_o) + (2.7 \cdot \Delta P) - P_{\text{ATM}}$

Where:

- P_o = Line pressure required psig
- ΔP = Maximum pressure loss psig
- P_o = Saturation liquid vapor pressure at operating temperature psia
- P_{ATM} = Atmospheric pressure psia (bara)

Example:

Water flow rate: 0 to 200 US GPM
Operating temperature: 100°F
Operating pressure: 10 psig
Atmospheric pressure: 14.7 psia
Flowmeter size: 1.939" I.D.
Specific weight: 61.96 lb/ft³

Solution:

$$\begin{aligned} \Delta P &= 4.47 \times 10^{-5} \cdot 61.96 \cdot (200)^2 / (1.939)^4 = 7.84 \\ P_o &= [(1.3) \cdot (0.951)] + [(2.7) \cdot (7.84)] - 14.7 \\ P_o &= 7.70 \text{ psig} \end{aligned}$$

Since the operating pressure of 10 psig is higher than 7.70 psig, no cavitation occurs.

For meter sizing, download
"emcosize" program at
www.spiraxsarco.com/us

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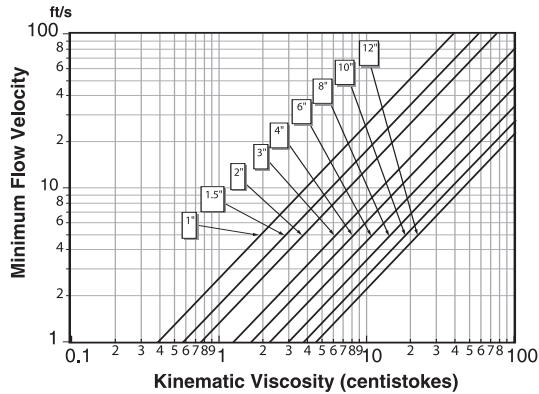


Figure 2. Minimum Linear Flow Velocity vs. Kinematic Viscosity.

Nominal Size	Nominal pulse rate	Nominal Meter Factor	
		pulses/gal	pulses/ft ³
inch	Hz/ft/s		
1	12.0	321.2	2,403
1.5	7.5	81.7	611
2	6.0	39.1	293
3	4.0	11.7	87.2
4	3.0	11.7	87.2
6	2.0	1.5	11.0
8	1.3	0.6	4.2
10	1.2	0.3	2.2
12	1.0	0.2	1.3

Table 1. Nominal Pulse Rate and Flowmeter Factor.

Notes:

- 1 Water values are determined at standard conditions of 60°F.
- 2 The minimum flow rate for the 1", and 1.5" flowmeters are below the linear range (the Reynolds number < 20,000).
- 3 The velocities used to calculate the minimum and maximum flow rates were 1.5 ft/sec and 32 ft/sec respectively.

Nominal Size	Flow Range in GPM		Flow Range in L/s	
	min	max	min	max
inch				
1	3.4	72	0.2	4.5
1.5	8.3	176	0.5	11.1
2	13.8	295	0.9	18.6
3	30.9	659	1.9	41.6
4	53.8	1,147	3.4	72.3
6	121.9	2,600	7.7	163.9
8	213.5	4,555	13.5	287.2
10	358.7	7,653	22.6	482.5
12	508.3	10,843	32.0	683.7

Table 2. Water Flow Rates.

Physical Specifications

Materials

Wetted Parts

Wing and Shedder Bar

- Stainless steel and Carbon steel Models 316L or the cast equivalent, CF3M

Body

- Stainless steel Model (all sizes) 316L or the cast equivalent, CF3M
- Carbon Steel Model (flanged), 6" and larger ASTM A105, A06 Grade C, and A108 Grade 1018

Electronics Enclosure

383 Aluminum

All Other Parts

Stainless Steel

Flowmeter Classification

Standard

Designed to meet NEMA 4X watertight and dust tight specifications

Explosion Proof version

FM and CSA approved

Explosion Proof and Intrinsically-Safe version

CENELEC approved

European CE Mark

Approved

Remote Mount Electronics (RMT)

Signal cable is provided to mount the electronics enclosure up to 30 ft (optional 50 ft) from the flowmeter body, and must be installed within proper electrical conduit.

Local Indicator and Totalizer (LOC-TOT)

The indicator displays flowrate and total in user-selectable, engineering units. It is a two line, 8 character per line, LCD display. The totalizer enables a pulse output providing a 5 – 999 msec pulse each time the totalizer increments.

Note: This option changes the lower, ambient temperature limit to 32°F. Below 32°F, the display intensity begins to fade but does not affect the transmitter output.

Material of Construction

All models are available in stainless steel; some models can be ordered in carbon steel.

FM Approval (Explosion Proof)

Class I, Div. I, Groups B, C, D
 Class II, Div. I, Groups E, F, G
 Class I, Div. II, Groups A, B, C, D
 Class II, III, Div. 2, Groups F, G

CSA Approval (Explosion Proof)

Class I, Div. I, Groups B, C, D
 Dust-ignition Proof for Class II, Div. 1 Groups E, F, G
 Class III Hazardous locations

CENELEC Approval

(Explosion Proof and Intrinsically Safe)
 EEX d [ib] IIC T6 and/or EEX d IIC T6.

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Accessories

Flow Processor

A microprocessor-based flow processor can be used to significantly increase the accuracy and functionality of any flowmetering application. See the S-FP-93 TIS for complete details.

Straight Run Piping Requirements

Typical 10 diameters upstream, 5 diameters downstream. In certain applications where multiple bends or butterfly valves are present, more straight run may be required.

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

Other Installation Considerations

Installation

Flowmeter can be installed vertically, horizontally, or at any angle. For liquid service, the flow line must be full during flowmeter operation – flow up in vertical lines is recommended.

Site Selection

The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps and other piping components may add disturbances to the flow.

Servicability

The sensor element can be removed, and replaced, without removing the flowmeter body from the process line, and without process shut down for process pressures below 750 psig. The flowmeter K-factor is not affected by sensor or electronics servicing.

Pressure and Temperature Taps

Pressure tap should be mounted 3.5 to 7 pipe diameters downstream from the flowmeter. The temperature tap should be mounted an additional 3.5 to 7 pipe diameters downstream of the pressure tap. See Figure 3.

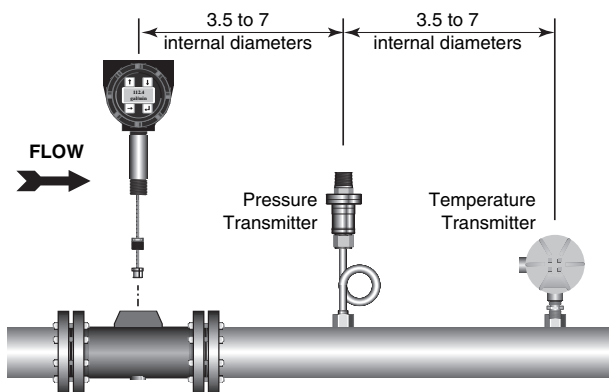


Figure 3. Pressure and Temperature Tap Dimensions.

Pres PSIG	1"		1.5"		2"		3"		4"		6"		8"		10"		12"	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
10	31	283	77	697	129	1164	288	2604	501	4534	1135	10277	1988	18000	3341	30258	4733	42860
15	34	337	84	828	140	1383	313	3094	546	5387	1237	12213	2167	21390	3642	35955	5160	50930
20	37	390	90	958	151	1600	337	3580	587	6233	1331	14129	2331	24746	3918	41597	5550	58923
30	41	494	102	1214	170	2029	380	4539	661	7903	1498	17915	2624	31377	4412	52742	6249	74710
40	45	597	112	1468	187	2453	417	5486	727	9552	1647	21655	2885	37927	4850	63753	6870	90307
50	49	699	121	1719	202	2872	452	6424	786	11186	1783	25357	3122	44412	5249	74654	7435	105748
60	53	801	129	1968	216	3289	483	7356	841	12807	1908	29033	3341	50849	5616	85474	7955	121075
70	56	901	137	2215	229	3702	513	8281	893	14419	2024	32686	3545	57248	5959	96231	8441	136312
80	59	1002	145	2462	242	4114	541	9202	941	16022	2134	36321	3737	63614	6282	106932	8898	151470
90	62	1102	152	2707	253	4524	567	10120	987	17619	2237	39942	3919	69956	6587	117593	9331	166572
100	64	1201	158	2952	265	4933	592	11034	1031	19211	2336	43550	4092	76275	6878	128214	9743	181617
120	70	1399	171	3439	286	5747	639	12855	1112	22382	2522	50740	4417	88868	7424	149382	10517	195065
140	74	1597	183	3925	305	6559	683	14670	1188	25543	2694	57904	4718	101416	7931	166214	11235	197804
160	79	1794	194	4409	323	7369	723	16482	1260	28697	2855	65054	5001	113938	8407	168295	11908	200281
180	83	1991	204	4893	341	8177	762	18291	1327	31846	3008	72193	5268	126441	8856	170158	12545	202498
200	87	2188	214	5377	357	8986	799	20099	1391	34994	3153	79330	5523	132583	9283	171911	13150	204584
220	91	2385	223	5861	373	9795	834	21908	1452	38143	3292	86469	5766	133935	9692	173664	13729	206670
250	96	2680	237	6588	395	11009	884	24624	1540	42873	3490	97191	6113	135625	10275	175855	14555	209278
300	105	3175	257	7803	430	13040	962	29166	1676	50781	3798	104535	6653	138329	11183	179362	15841	213450
350	113	3672	277	9025	463	15082	1035	33734	1802	58735	4085	106259	7155	140610	12027	182320	17036	216971
400	120	4173	295	10256	493	17140	1103	38337	1921	66748	4355	107855	7627	142723	12821	185059	18161	220231
450	127	4679	313	11498	522	19215	1168	42978	2034	72657	4611	109388	8076	144751	13575	187689	19229	223360
500	134	5189	329	12751	550	21310	1230	47665	2142	73548	4856	110729	8505	146525	14296	189990	20251	226098
600	147	6225	361	15299	602	25568	1348	57016	2346	75244	5523	117628	9316	149906	15659	194372	22182	231314

Table 3. Saturated Steam Flow Rates at Selected Process Pressures ^{1,2} (Minimum and Maximum Operating Flow Rates in lb/hr)

Notes: 1. Maximum flow velocity is 260 ft/sec or Reynolds number limit or 7,000,000 whichever is less.

2. Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{\text{lb}}{\text{ft}^3}$ or Reynolds number limit of 20,000 whichever is greater.

TI-8-601-US 10.05

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Pres PSIG	1"		1.5"		2"		3"		4"		6"		8		10"		12"	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
0	711	4675	1130	11486	1888	19194	4224	42934	7352	74730	16669	169433	29201	296813	49087	498888	69532	706680
10	711	7858	1465	19306	2448	32260	5476	72160	9531	125601	21611	284772	37857	498864	63722	838268	90263	1187415
20	711	11043	1737	27129	2902	45332	6491	101403	11299	176499	25618	400174	44877	701024	75490	1177647	106933	1668149
30	802	14229	1971	34957	3294	58412	7369	130661	12826	227425	29080	515637	50942	903292	85473	1517027	121073	2148884
40	888	17417	2181	42789	3645	71499	8152	159934	14190	278378	32173	631161	56360	1105667	94572	1856406	133962	2629619
50	966	20606	2372	50624	3964	84593	8868	189223	15435	329357	34995	746746	61304	1308148	102870	2195786	145716	3065336
60	1038	23798	2550	58464	4260	97693	9529	218527	16587	380363	37607	862390	65880	1510734	110546	2535166	156590	3066018
70	1105	26990	2715	66308	4537	110800	10149	247845	17665	431394	40050	978094	70160	1713422	117723	2576801	166756	3066539
80	1169	30185	2871	74156	4798	123914	10732	277179	18681	482452	42354	1093855	74196	1916212	124487	2577147	176337	3066950
90	1229	33381	3020	82008	5046	137034	11286	306527	19645	533534	44540	1209674	78025	1981748	130782	2572706	185254	3061665
100	1287	36578	3161	89863	5282	150160	11814	335889	20564	584642	46625	1325549	81677	1981748	136902	2573347	193923	3062428
120	1395	42978	3426	105586	5725	176433	12806	394656	22291	686931	50539	1497292	88534	1981748	148387	2574344	210192	3063615
140	1495	49384	3673	121323	6137	202729	13728	453478	23894	789315	54175	1497292	94903	1981748	158946	2571893	225149	3060698
160	1589	55795	3904	137075	6523	229050	14592	512354	25398	891794	57584	1497292	100876	1981748	168847	2570006	239173	3058452
180	1678	62213	4122	152840	6888	255394	15408	571282	26819	994362	60805	1497292	106519	1981748	177936	2568955	252048	3064681
200	1762	68635	4330	168619	7235	281760	16184	630260	28169	994383	63867	1497292	111882	1981748	187249	2571876	265241	3060678
220	1843	75063	4528	184411	7566	308148	16925	689287	29459	994383	66791	1497292	117004	1981748	195325	2560024	276680	3046573
250	1958	84715	4810	208123	8038	347770	17980	753714	31295	994383	70955	1497292	124299	1981748	207975	2573422	294599	3062517
300	2136	100825	5248	247701	8769	413905	19615	753714	34141	994383	77408	1497292	135604	1981748	226127	2558874	320311	3045204
350	2301	116963	5652	287347	9445	480154	21127	753714	36772	994383	83373	1497292	146053	1981748	243566	2561760	345014	3048639
400	2454	133125	6030	327054	10076	503949	22539	753714	39231	994383	88947	1497292	155818	1981748	259241	2552194	367217	3037255
450	2599	149310	6386	366814	10671	503949	23870	753714	41547	994383	94199	1497292	165018	1981748	274584	2555165	388951	3040791
500	2737	165512	6724	389852	11235	503949	25132	753714	43743	994383	99179	1497292	173741	1981748	288580	2548126	408777	3032414
600	2993	197961	7353	389852	12287	503949	27485	753714	47840	994383	108466	1497292	190010	1981748	315201	2545390	446486	3029158

Table 4. Air Flow at Selected Process Pressures at 60°F^{1,2,3}
(Minimum and Maximum Operating Flow Rates in SCFH)

[Download "emcosize" at www.spiraxsarco.com/us](http://www.spiraxsarco.com/us)

Notes:

- At standard conditions of 60°F and 14.7 psia, SCFH: standard cubic feet per hour.
- Maximum flow velocity is 260 ft/sec (79 m/s) or Reynolds number limit or 7,000,000 whichever is less.
- Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{lb}{ft^3}$ or Reynolds number limit of 20,000 whichever is greater.

Pres PSIG	1"		1.5"		2"		3"		4"		6"		8		10"		12"	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
0	772	4665	1444	11460	2413	19149	5397	42834	9395	74557	21300	169041	37314	296126	64968	511367	93181	733432
10	772	7851	1873	19289	3130	32231	7002	72096	12188	125490	27634	284520	48410	498422	84286	860683	120888	123441
20	905	11048	2222	27142	3713	45354	8307	101452	14458	176585	32781	400368	57426	701364	99983	1211101	143401	1737031
30	1028	14255	2524	35021	4218	58520	9436	130901	16423	227844	37236	516588	65230	904957	113570	1562626	162889	2241207
40	1138	17472	2795	42925	4670	71728	10446	160445	18182	279268	41225	633180	72217	1109202	125733	1915261	180334	2746978
50	1238	20700	3042	50855	5083	84978	11370	190084	19791	330857	44871	750146	78605	1314104	136853	2269014	196283	2746978
60	1332	23938	3271	58810	5466	98271	12227	219818	21282	382611	48253	867489	84530	1519664	147166	2623888	211075	3254350
70	1419	27187	3486	66791	5825	111606	13030	249648	22680	434533	51423	985209	90083	1725887	156833	2890521	224938	3461702
80	1502	30446	3689	74797	6165	124985	13789	279575	24001	486622	54418	1103309	95329	1932775	165965	2890521	238036	3461702
90	1580	33715	3882	82829	6487	138407	14511	309597	25257	538879	57265	1221791	100317	2140331	174647	2890521	250488	3461702
100	1655	36995	4067	90887	6795	151872	15200	339717	26457	591305	59986	1340656	105084	2152958	182943	2890521	262387	3461702
120	1797	43587	4414	107082	7376	178933	16499	400250	28718	696667	65112	1579542	114062	2152958	198569	2890521	284500	3461702
140	1929	50222	4738	123382	7917	206171	17710	461176	30826	802714	69892	1626648	122436	2152958	213142	2890521	305701	3461702
160	2053	56900	5043	139789	8427	233585	18851	522500	32812	909452	74394	1626648	130323	2152958	226866	2890521	325384	3461702
180	2171	63622	5333	156302	8911	261179	19933	584223	34696	1016887	78665	1626648	137805	2152958	239886	2890521	344058	3461702
200	2283	70388	5609	172924	9373	288953	20967	646350	36494	1080291	82742	1626648	144947	2152958	252312	2890521	361881	3461702
220	2391	77198	5874	189654	9816	316909	21957	708885	38219	1080291	86652	1626648	151797	2152958	264230	2890521	378973	3461702
250	2546	87496	6254	214956	10450	359188	23376	803456	40688	1080291	92252	1626648	161606	2152958	281293	2890521	403446	3461702
300	2787	104888	6847	257682	11442	430583	25594	818830	44549	1080291	101005	1626648	176940	2152958	307963	2890521	441698	3461702
350	3013	122567	7402	301115	12369	503159	27667	818830	48157	1080291	109186	1626648	191271	2152958	332885	2890521	477442	3461702
400	3226	140539	7926	345267	13245	547487	29626	818830	51567	1080291	116917	1626648	204815	2152958	356431	2890521	511214	3461702
450	3430	158808	8426	390150	14079	547487	31493	818830	54816	1080291	124284	1626648	217720	2152958	378865	2890521	543389	3461702
500	3625	177379	8905	423533	14880	547487	33284	818830	57933	1080291	131350	1626648	230098	2152958	400376	2890521	574242	3461702
600	3995	215439	9814	423533	16398	547487	36681	818830	63846	1080291	144757	1626648	253585	2152958	441178	2890521	632763	3461702

Table 5. Natural Gas Flow Rates at Selected Process Pressures at 60°F^{1,2,3,4}
(Minimum and Maximum Operating Flow Rates in SCFH)

[Download "emcosize" at www.spiraxsarco.com/us](http://www.spiraxsarco.com/us)

Notes:

- At standard conditions of 60°F and 14.7 psia, SCFH: standard cubic feet per hour
- Maximum flow velocity is 260 ft/sec (79 m/s) or Reynolds number limit or 7,000,000 whichever is less.
- Specific Gravity of natural gas = 0.61 and 0.8% N₂.
- Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{lb}{ft^3}$ or Reynolds number limit of 20,000 whichever is greater.

S-PhD Inline Vortex

Dimensions and Weights

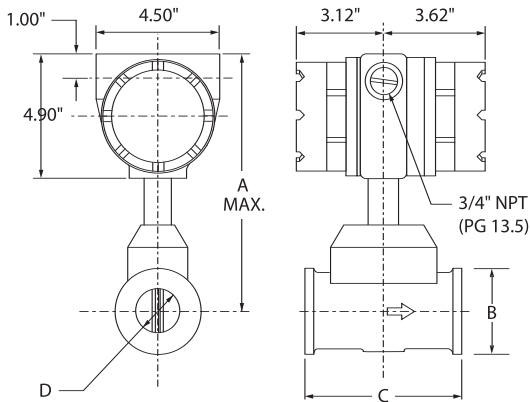


Figure 4. Dimensions: Wafer Connection Type, Integral Mounting.

Wafer Connection

Wafer connection is available in stainless steel sizes 1 – 4” only. The schedule of the mating pipe’s internal diameter \geq 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

Table 6. Weights & Dimensions: Wafer

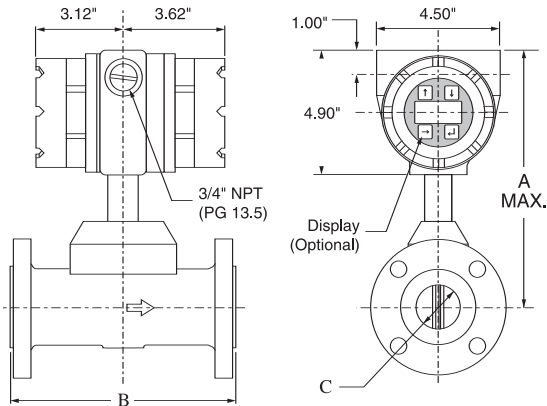


Figure 6. Dimensions: Flange Connection, Integral Mounting.

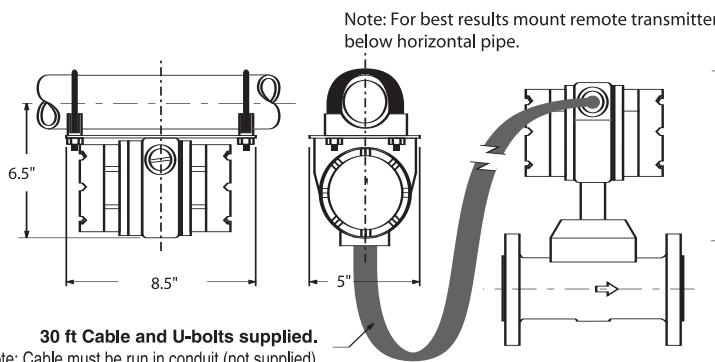
all in inches size	A	B	C				Approx. Wt.(lb)		
			Stainless Steel		Carbon Steel		150#	300#	600#
			150#	300#	150#	300#			
1	10.7	7.6	0.957	0.957	N/A	N/A	18	20	20
1.5	10.7	8.1	1.500	1.500	N/A	N/A	22	28	28
2	13.2	8.5	1.939	1.939	N/A	N/A	31	36	36
3	13.8	9.0	2.900	2.900	N/A	N/A	51	60	60
4	14.3	9.5	3.826	3.826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

Table 7. Weights & Dimensions: Flange.

Notes:
 1. The schedule of the mating pipe’s internal diameter \geq dimension ‘C’.
 2. N/A = Not Available.

REMOTE MOUNTING

Pipe Mount Electronics



30 ft Cable and U-bolts supplied.
 Note: Cable must be run in conduit (not supplied).
 Conduit connection is 3/4” NPT (PG 13.5).

Wall Mount Electronics

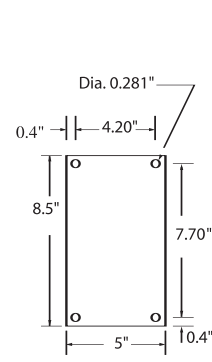


Figure 5. Dimensions weights: Remote Mounting

size (in)	Approximate Weight (lb)			Wafer
	150# Flange	300# Flange	600# Flange	
1	24	26	26	19
1.5	28	34	34	20
2	37	42	42	23
3	57	66	66	38
4	72	89	105	57
6	98	122	146	N/A
8	150	188	226	N/A
10	186	266	556	N/A
12	271	371	541	N/A

S-PhD Inline Vortex

Wiring

Figures 7- 9 represent typical field wiring applications for the Vortex Ph.D.

Analog Output

The Vortex S-PhD may be operated using a 24 VDC power supply. The 4-20 mA output is scalable (2 wire principle.) The load resistor may be installed on supply or return line. Permissible load resistance values are shown in Figure 7.

Pulse Output

This is an open collector pulse output using a high impedance electronic counter. V_{pulse} will vary from:

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

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

Where:

- V_{pulse} = pulse output amplitude
- R_c = counter impedance
- V_s = power supply voltage
- V_c = minimum required voltage to trip counter
- R_{pulse} = pull-up resistance

Cenelec Approved—Power & Signal Wiring

The Vortex S-PhD flowmeter may be operated using a 24 VDC power supply. The wiring schematic shown (Figure 9) is for the areas defined by the Cenelec approval (see approval description in options section). I. S. zener barriers must have the following specifications:

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

The 4-20 mA output is scalable (2 wire principle.) The 4-20 mA loop resistor should be 250 Ω ; and the pulse output is to be connected to a high impedance, electronic counter.

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

$$\text{Note: } R_{pulse} \geq \frac{V_s}{0.16}$$

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

110/220 VAC—Power & Signal Wiring

The Vortex S-PhD flowmeter may be operated using a 110/220 VAC power supply. The power supply board converts the 110/220 VAC to 24 VDC.

The 4-20 mA output is scalable (2 wire principle.) The 4-20 mA loop resistor should be 250 Ω ; and the pulse output is to be connected to a high impedance, electronic counter. (Figure 10)

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

Where:

- V_{pulse} = Pulse output amplitude
- R_{load} = Load resistance (250 Ω)
- I = Current (4-20 mA)

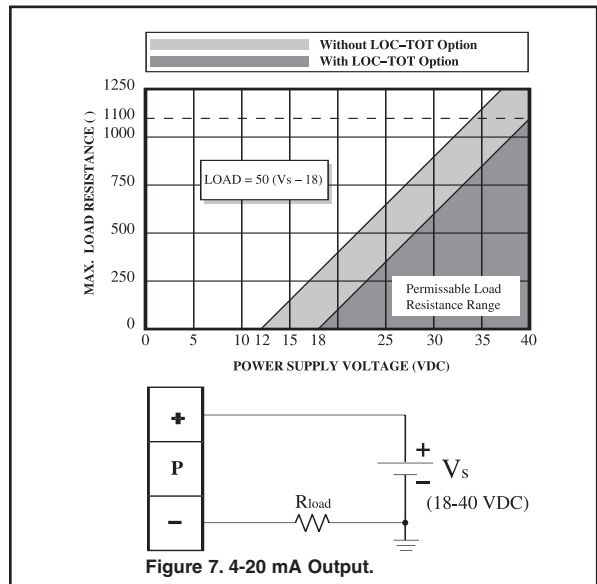


Figure 7. 4-20 mA Output.

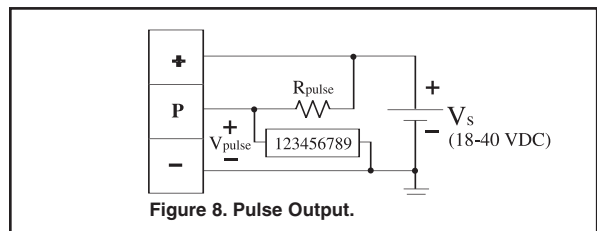


Figure 8. Pulse Output.

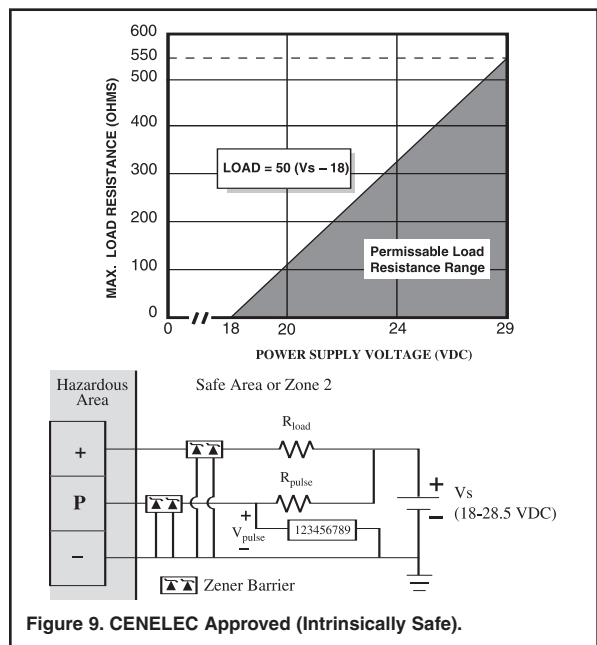


Figure 9. CENELEC Approved (Intrinsically Safe).

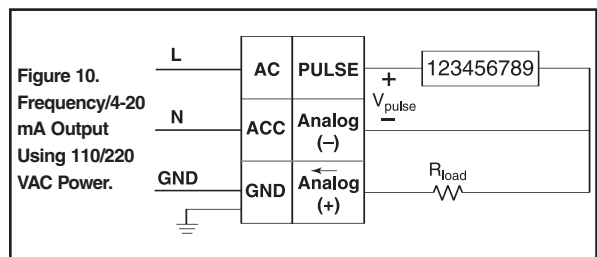


Figure 10. Frequency/4-20 mA Output Using 110/220 VAC Power.

S-PhD Inline Vortex

Model and Suffix Codes

Category	Description	Suffix Codes						
Model	Stainless Steel (sizes 1 – 12") Carbon Steel (Stainless steel wing) (sizes 6 – 12")	S-PhD-90...	...	...	...	...	...	...
Fluid Type	Steam or gas Liquid	...	S L	...	...	...	...	...
Line Size	1" 1.5" 2" 3" 4" 6" 8" 10" 12"	...	...	10 15 20 30 40 60 80 100 120	...	...	...	...
Connection Type	Wafer ⁶ Flange	...	...	...	W F	...	...	...
Connection Rating	ANSI Class 150 ANSI Class 300 ANSI Class 600	...	...	...	...	150 300 600	...	...
Options	No indicator/totalizer option ¹ FM approved ² CSA approved CENELEC approved ² Local Indicator and Totalizer ³ Remote Mount Electronics ⁴ Integral 110 VAC input ⁵ Integral 220 VAC input ⁵	...	...	...	...	...	STD FM CSA CEN LOC-TOT RMT 110 220	...
Sensor Wires (Internal)	Teflon, -40° to 400°F Fiberglass, 150° to 750°F	...	...	...	...	...	F	T

Example

→ S-PhD-90-S-60-F-300-LOC-TOT-RMT-T

Table 8. S-PhD Vortex Shedding Flowmeter.

Notes:

- Has 4-20 mA and/or 50% duty cycle frequency output. A 50% duty cycle frequency can be scaled.
- FM, and CENELEC approved option meters come with a magnet wand. For all other meters the wand can be ordered as an option.
- At least one local indicator is recommended at each site. If one display will be used on many meters, it should be purchased separately.
- Remote mount electronics are required for high process temperatures (refer to the general specification). The standard remote mount option comes with 30' of cable.
- Not available with European CE Mark or FM, CSA and CENELEC approvals.
- Wafer style meters available in stainless steel sizes 1 – 4" only.

Compatibility Chart

- Compatible
- Incompatible

	STD	FM	CSA	CENELEC	LOC-TOT	RMT	110/220	CARBON STEEL	STAINLESS STEEL	EUROPEAN CE MARK
STD	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FM	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CSA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CENELEC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
LOC-TOT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
RMT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
110/220	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CARBON STEEL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
STAINLESS STEEL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
EUROPEAN CE MARK	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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