spirax sarco®

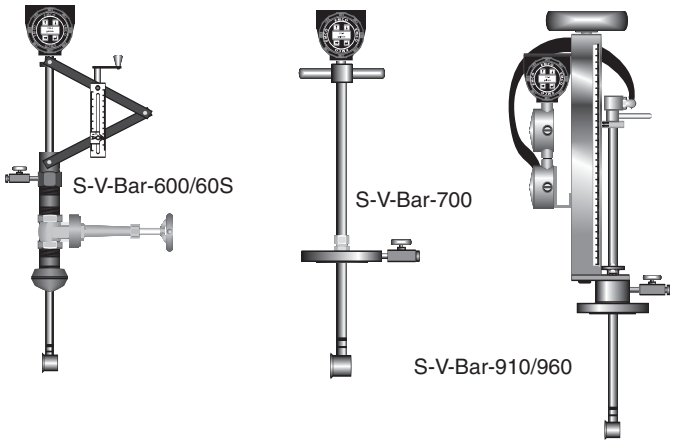
S-V-Bar Insertion Vortex

Models S-V-Bar-600/60S • S-V-Bar-700 • S-V-Bar-910/960

Description

Spirax Sarco S-V-Bar insertion flow meters have three main components: the retractor, the sensor, and the electronics. The retractor serves to position the sensor within the pipe. The sensor detects the pattern of vortices as a frequency signal. The "Smart," microprocessor-based EZ-Logic electronics conditions the signal and provides a frequency output, a scaled pulse output, or a 4 to 20 mA DC signal proportional to the average pipe flow rate.

Most S-V-Bar flow meters can be installed on an isolation valve, which permits installation and removal without process shutdown. Integral pressure and/or temperature measurement may be combined with the S-V-Bar to provide mass flow measurement from a single pipe tap. In addition, a flow processor may be used to increase the accuracy and functionality of the metering system.



Features

- Fluid types: liquid, gas, or steam
- Pipe sizes: 3 to 80"
- Rugged construction
- Reliability: no moving parts
- Process pressure up to 2000 psig (138 barg)
- Process temperatures up to 500°F
- Industry standard frequency and/or 4 to 20 mA output signals
- Optional integral pressure and/or temperature measurement
- Negligible head loss
- Compatible with HART® protocol
- EZ-Logic™ menu-driven user interface (microprocessor-based)
- Local programming via EZ-Logic keypad or magnet wand through explosion-proof enclosure

Performance Specifications

Accuracy (Linear Ranges)	
Liquid	±1.0% of flow rate Test conditions: Water at 60°F, 50 psig (3.4 barg) with a flow rectifier and 10 pipe diameters upstream.
Gas and Steam	±1.5% of flow rate Test conditions: Air at 68°F, 26 psia with a flow rectifier and 10 pipe diameters upstream.
Analog Output	Add ±0.1% of full scale
Repeatability	±0.15% of flow rate
Response Time	Adjustable from 1 to 100 seconds

Application Guide

Model	Liquid	Gas	Steam	Hot Tap	Temperature Range	Maximum Pressure[1]	Seal Type	Line Sizes inches
600	yes	yes	no	yes	-40 to 400°F	125 psig	Viton®	3 to 80
60S	no	no	yes	yes	-40 to 400°F	125 psig	E/P[2]®	3 to 80
700	yes	yes	yes	no	-40 to 500°F	2000[3] psig	Swagelok™	3 to 80
910	yes	yes	yes	yes	-40 to 400°F	flange rating	Teflon®	3 to 80
960	yes	yes	yes	yes	-40 to 500°F	flange rating	Grafoil®	3 to 80

1 Maximum pressure at maximum temperature with appropriate connection.
2 Ethylene-Propylene elastomer.
3 Rating listed is for NPT connection. For flange connections, use ANSI flange rating.
4 Procedure 980318 has PSIG-2160

Operating Specifications

Linear Range

Reynolds number from 20,000 to 7,000,000

Measurable Flow Velocities

Liquid Flow

V_{min}	1.5 ft/sec
V_{max}	32 ft/sec

Gas and Steam Flow

V_{min}	$\sqrt{\frac{50}{P}}$ ft/3
V_{max}	300 ft/sec

Where: p = density (lb/ft^3)

Operating Range

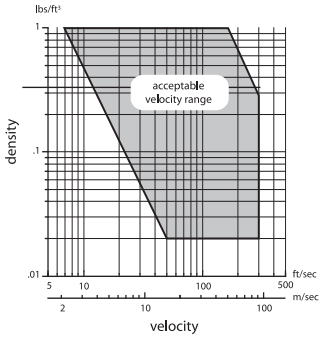
Average Fluid Velocities

Liquid	0.4085	$\frac{Q_1}{D^2}$
Gas	3.056	$\frac{Q_2}{D^2}$
Steam	0.051	$\frac{M}{\rho \cdot D^2}$

Where:

V =	average fluid velocity	ft/sec
D =	pipe inside diameter	inches
Q_1 =	liquid volumetric flow	gal/min
Q_2 =	gas actual volumetric flow	ft^3/min
M =	mass flow rate	lb/h
p =	fluid density	lb/ft^3

Gas Flow Operating Range:



Local regulations may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

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Process Viscosity

Reynolds number must be > 20,000. Figure 1 translates the minimum Reynolds number, 20,000, to the minimum measurable pipe velocity.

Kinematic Viscosity

$$\upsilon = \frac{\mu(cP)}{S.G.}$$

$$Re = \frac{124pVD}{\mu}$$

where p = Fluid density
V = Average velocity (lb/ft^3)
D = Pipe inside diameter (inches)
μ = Fluid viscosity (cP)
S.G. = Specific gravity

Ambient Temperature Limit
32° to 140°F

Ambient Humidity Limit
5 to 100% relative humidity non-condensing

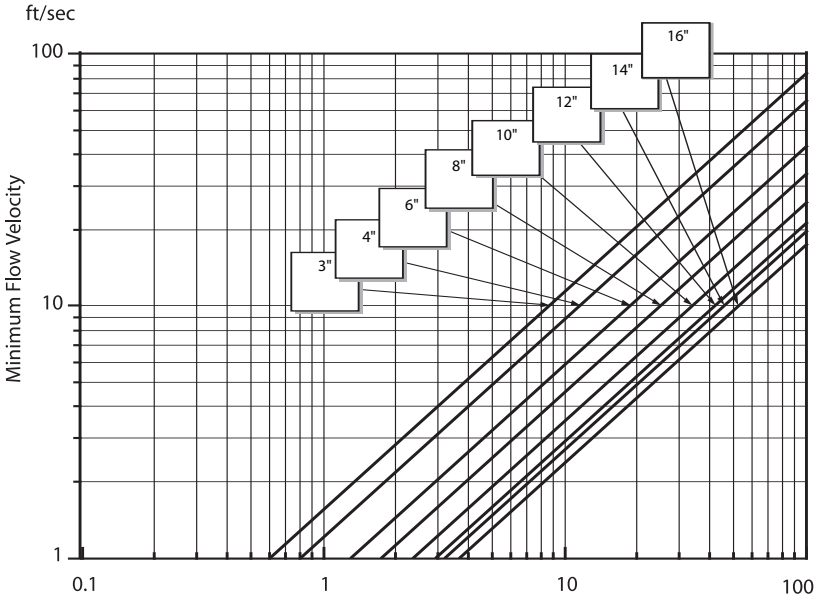

Figure 1. Kinematic Viscosity, centistokes

Power Requirements

Standard	Isolated 18 to 40 VDC, 35 mA maximum Maximum voltage with pressure transmitter option is 30 V.	
Optional	110/220 VAC All power wiring must be enclosed in rigid conduit, and a watertight and/or explosion-proof seal must be applied at the condulet entry.	
Output Signals		
Analog	4 to 20 mA, 2-wire system, digitally adjusted span	
Frequency	Voltage pulses, 3-wire system, 0 to 3000 Hz square wave, 50% duty cycle.	Low Level: 0 to 1 V High Level: power supply voltage-load
Pulse	3-wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe.	
Hart®	Communications protocol	
Display (LOC-TOT)	2-line by 8-character LCD digital display alternately show flow rate and totalized flow in user-selectable engineering units. Four buttons (up, down, right, enter), operatable either directly on the display panel or with a hand-held magnetic wand through the explosion-proof enclosure, enable programming. Local programming follows the EZ-Logic menu-driven user interface.	
Zero & Span Setting (Analog Output Only)	Zero and span calibration can be performed without a frequency source by programming the flow rate using the EZ-Logic interface.	

Physical Specifications

Materials	
Wetted Parts	316L stainless steel or the cast equivalent, CF3M (bronze & carbon steel on S-V-Bar-600/60S)
External Parts	Aluminum, 316 stainless steel, carbon steel (bronze & carbon steel on S-V-Bar-600/60S)
Electrical Enclosure	383 aluminum. Approved for NEMA 4X watertight and dust-tight requirements.
Retractor Type	
S-V-Bar-600/60S	Screw thread, rising stem
S-V-Bar-700	Not retractable
S-V-Bar-910/960	Acme thread, non-rising
Process Connection	
S-V-Bar-600/60S	2" NPT
S-V-Bar-700	2" NPT 2" 150#, 300#, 600# or 900# ANSI raised face flange
S-V-Bar-910/960	2" 150#, 300#, 600# or 900# ANSI raised face flange

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Isolation Valve (S-V-Bar-600/60S only)
2" full-port, bronze gate valve, 125 psig (8.62 bar) maximum.
For S-V-Bar-910/960, see Accessories.

Pressure Tap and Bleed Valve
Standard 0.25" NPT pipe nipple with 0.25" stainless steel bleed valve (bleed valve is bronze for S-V-Bar-600/60S only). Provides connections for mounting optional pressure transmitter (Model S-PT).

Model S-PT Pressure Transmitter (Optional)
A pressure transmitter can be mounted using the 0.25" NPT connection on the bleed valve supplied with the meter, eliminating the need for a separate pressure tap. A 4 to 20 mA output, scaled to the desired pressure range, is provided. All pressure transmitters include a siphon tube, bleed valve, plug, nipple, and tee. A pressure transmitter is not available with 110/220 VAC power. See the S-PT TIS General Specifications for complete details.

Temperature Sensor (RTD Option)
A 1000, 2-wire, platinum RTD can be mounted inside the stem of the flow meter probe, eliminating the need for a separate temperature tap.

Temperature Transmitter (TXX option)
Includes the RTD option with an additional 4 to 20 mA output, scaled to the desired temperature range. A temperature transmitter is not available with 110/220 VAC power.

Remote Mount Electronics (RMT Option)
30' (9.144 m) signal cable and U-bolts are provided with remote-mount electronics. Cable must be run in conduit (conduit not supplied). Conduit connection is 0.75" NPT Female (PG 13.5).

Approvals
FM Approval (FM Option)
Certified by FM for Class I, Division 2, Groups A, B, C and D; Class II, III, Division 2, Groups F and G.

FM option is not available when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. Use the RTD option only for temperature selection, if FM is required.

CSA Approval (CSA Option)
Certified by CSA for Hazardous Locations Class I, Division 2, Groups A, B, C and D; Class II, Division 2, Groups F and G; Class III.

CSA option is not available when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. Use the RTD option only for temperature selection, if CSA is required.

FM or CSA are not available when using a pressure transmitter scaled 0 to 1000 psig or with a special scaling.

Accessories

Gate Valve (Model 2GV) (For use with S-V-Bar-910/960 only)
Installation with a 2", double-flanged, raised-face, full-port gate valve enables the flow sensor to be inserted and removed from the pipe under full flow conditions. Both the valve and pipe tap must have a minimum 1.875" internal diameter clearance.

Flow Rectifier
A flow rectifier is recommended when there is insufficient straight pipe run or flow disturbance. When using a flow rectifier, the straight pipe run can be a combination of 5 pipe diameters upstream and 2 pipe diameters downstream, instead of the standard 10 and 5.

Flow Processors (S-FP-93)
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.

Measurable Flow Rates

The following tables are for reference only. Measurable flow rates for your specific application are available using EMCOSIZE (downloadable at www.spiraxsarco.com/us).

Water Minimum and Maximum Flow Rates[1]

	3"	4"	6"	8"	12"	16"	24"
gpm	35	60	135	234	523	826	1,879
	737	1,270	2,882	4,990	11,164	17,625	40,096

Air Minimum and Maximum Flow Rates (SCFM)[1]

pressure — psig (density lb/ft³)	3"	4"	6"	8"	12"	16"	24"
0	79	136	308	533	1,193	1,883	4,284
(0.0764)	924	1,591	3,611	6,253	13,991	22,089	50,250
50	165	285	646	1,119	2,504	3,954	8,995
(0.3368)	4,073	7,015	15,916	27,561	61,665	97,355	221,469
100	220	380	861	1,491	3,337	5,268	11,984
(0.5979)	7,229	12,452	28,253	48,923	109,461	172,814	393,129
150	264	455	1,033	1,789	4,002	6,318	14,373
(0.8600)	9,449	16,272	36,927	63,943	143,067	225,869	513,823
200	302	520	1,180	2,043	4,571	7,216	16,415
(1.1219)	10,792	18,589	42,175	73,030	163,400	257,971	586,851
300	366	630	1,430	2,476	5,540	8.746	19,896
(1.6480)	13,080	22,530	51,117	88,514	198,044	312,667	711,276
400	420	724	1,643	2,845	6,365	10,050	22,862
(2.1760)	15,030	25,889	58,736	101,709	227,567	359,276	817,305
500	469	807	1,832	3,172	7,098	11,206	25,491
(2.7054)	16,759	28,866	65,493	113,408	253,742	400,602	911,316

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.

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Saturated Steam Minimum and Maximum Flow Rates (lb/h)[1]

pressure — psig (density lb/ft³)	3"	4"	6"	8"	12"	16"	24"
0	252	435	987	1,709	3,823	6,034	13,729
(0.0373)	2,069	3,563	8,087	14,004	31,333	49,468	112,534
50	506	871	1,976	3,421	7,654	12,085	27,491
(0.1496)	8,297	14,287	32,425	56,148	125,627	198,336	451,189
100	663	1,141	2,589	4,483	10,031	15,837	36,027
(0.2570)	14,250	24,538	55,688	96,431	215,758	340,632	774,893
150	787	1,356	3,078	5,327	11,919	18,817	42,805
(0.3630)	20,116	34,640	78,613	136,129	304,577	480,858	1,093,889
200	894	1,540	3,494	6,051	13,539	21,3774	48,624
(0.4682)	25,957	44,698	101,439	175,654	393,013	620,477	1,411,504
300	1,077	1,855	4,209	7,289	16,309	25,748	58,574
(0.6794)	37,667	64,862	147,200	254,895	507,308	900.386	2,048,260
400	1,235	2,127	4,826	8,357	18,698	29,520	67,154
(0.8930)	44,149	76,024	172,024	298,759	668,452	1,055,332	2,400,742
500	1,377	2,371	5,381	9,318	20,849	32,916	74,879
(1.1102)	49,228	84,770	192,380	333,129	745,351	1,176,739	2,676,927

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.

Natural Gas Minimum and Maximum Flow Rates (SCFM)[1]

pressure — psig (density lb/ft³)	3"	4"	6"	8"	12"	16"	24"
0	102	175	398	690	1,543	2,437	5,543
(0.0457)	924	1,588	3,611	6,253	13,991	22,089	50,250
50	217	368	848	1,468	3,284	5,185	11,795
(0.2067)	4,184	7,044	16,352	28,315	63,352	100,019	227,529
100	290	492	1,133	1,962	4,390	6,931	15,768
(0.3695)	7,478	12,588	29,223	50,603	113,221	178,750	406,634
150	341	588	1,334	2,309	5,166	8,157	18,555
(0.5350)	10,590	18,236	41,384	71,662	160,338	253,137	575,854
200	400	679	1,563	2,707	6,056	9,561	21,749
(0.7030)	14,227	23,945	55,600	96,279	215,417	340,094	773,669
300	488	829	1,908	3,304	7,392	11,671	26,550
(1.475)	17,455	29,623	68,212	118,117	264,278	417,235	949,156
400	565	959	2,209	3,824	8,557	13,510	30,732
(1.4036)	2,204	34,286	78,958	136,725	305,912	482,965	1,098,683
500	635	1,077	2,481	4,297	9,613	15,177	34,526
(1.7715)	22,698	38,513	88,705	153,603	343,676	542,586	1,234,312

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.
Note: Approximate specific gravity of natural gas = 0.61 and 0.8% N_2.

Straight Run Piping Requirements

	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

D is equal to the internal diameter of the pipe.

If there is not sufficient straight run of pipe, a flow rectifier can be used to reduce the above lengths. Consult your local representative or the factory for your application.

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Other Installation Considerations

Tap Size
1.875" minimum diameter.

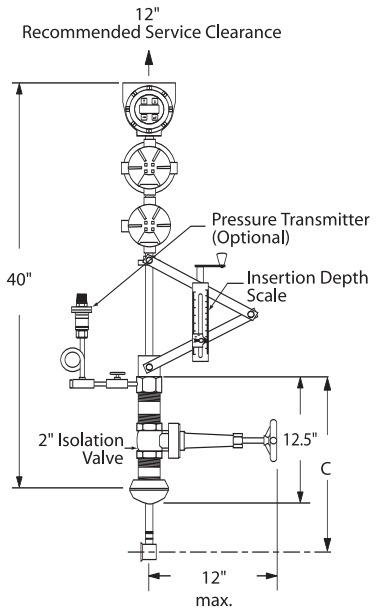
Mounting Position
S-V-Bar probes may be installed in vertical, horizontal, or angled pipe sections. The meter is attached perpendicular to the axis of the pipe and should not be mounted "upside-down" (with its top section hanging below the pipe mount). For liquid service, the fluid must completely fill the pipe.

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.

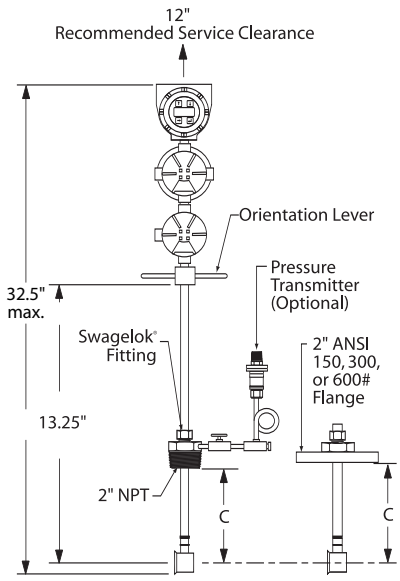
Hot Tap Compatibility
The S-V-Bar-600/60S is hot tap compatible, which means that the sensor can be installed and removed under full flow conditions. The S-V-Bar-910/960 is hot tap compatible when installed with a 2", double-flanged, full-port ball or gate valve that adheres to the dimensions of the gate valve on page 6.

Dimensions and Weights

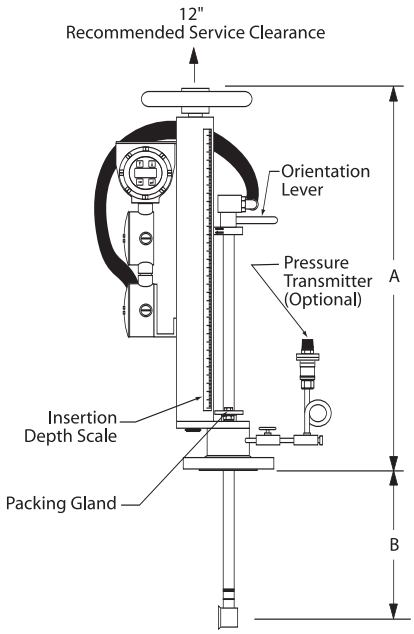
S-V-Bar-600/60S



S-V-Bar-700



S-V-Bar-910/960



Dimensions	A	B	C
Model 600/60S			
2" NPT Connection	---	---	4.5" min 18" max
Model 700			
2" NPT Connection	---	---	3" min 10" max
2" 150# Connection	---	---	3" min 11.5" max
2" 300# Connection	---	---	3" min 11.25" max
2" 600# Connection	---	---	3" min 11" max
2" 900# Connection	---	---	3" min 10.75" max
Model 910/960			
Standard Stem Length	30"	1.5" min 20" max	---

Weight	
Model 600/60S	
2" NPT Connection	28 lb max
Model 700	
2" NPT Connection	9 lb
2" 150# Connection	12 lb
2" 300# Connection	14 lb
2" 600# Connection	16 lb
2" 900# Connection	20 lb
Model 910/960	
2" 150#	30 lb
2" 300#	35 lb
2" 600#	40 lb
2" 900#	47 lb

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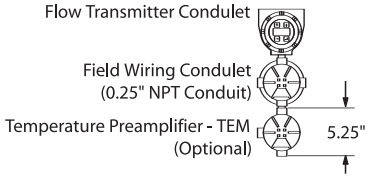
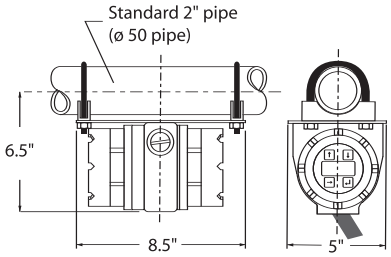
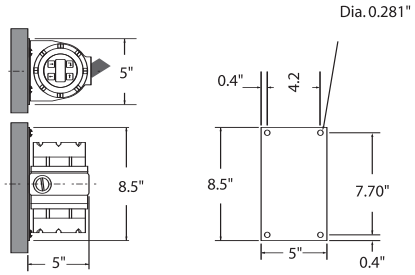
Integral Electronics



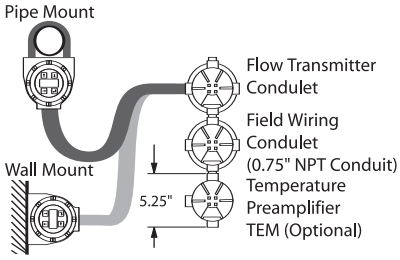
Pipe Mount Remote Electronics



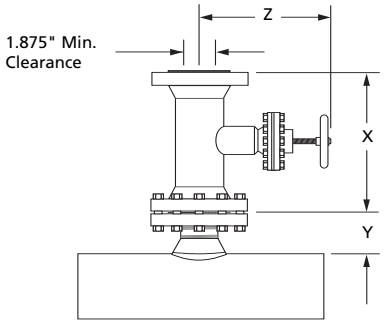
Pipe Mount Remote Electronics



Remote Electronics Configuration



Gate Valve



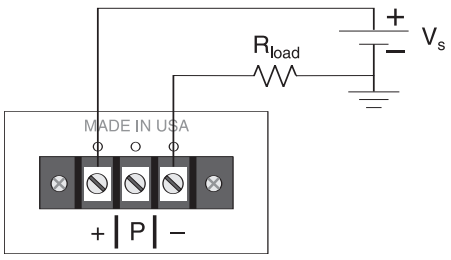
Gate valve is intended for use with the S-V-Bar-910/960 only.

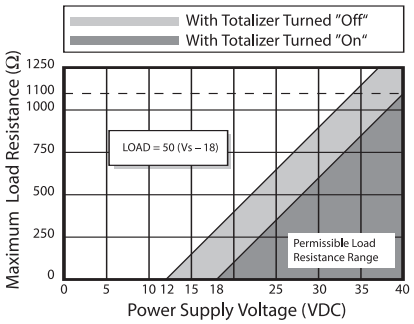
Gate Valve Dimensions	X	Y	Z
2" 150#	7"	3.5"	15.325"
2" 300#	8.5"	3.75"	16.325"
2" 600#	11.5"	3.75"	17.875"

For flange kit, add 14 lb (6.4 kg) to weight.

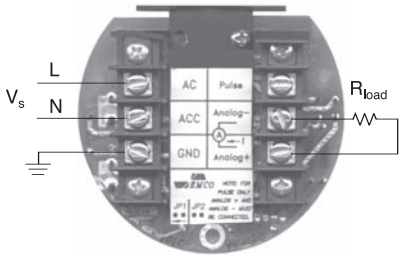
Wiring Diagrams

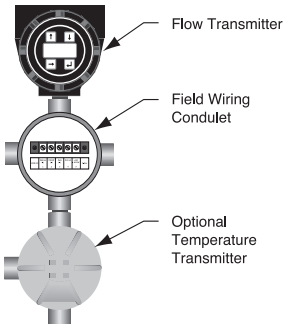
VDC Power: Analog Output
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line. Vs = 18 to 40 VDC. See graph below for permissible R_{load} values.





VAC Power: Analog Output
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line.
V_S = 110/220 VAC. R_{load} must be less than 300 Ω.

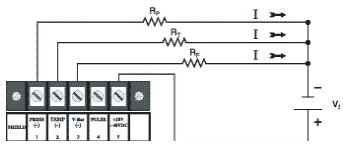




VDC Power: Pressure and Temperature Transmitter Wiring
Remove the field wiring condulet cap to access the field wiring terminal block for power and signal wiring. Flow, pressure, and temperature output wiring connects to the terminal block. Refer to the previous section on 24 VDC power and signal wiring for appropriate load resistance and power supply values. Pressure and temperature transmitters are scaled to the appropriate ranges at the factory.

Maximum voltage with optional pressure transmitter is 30 VDC, and 110/220 VAC power supply is not available with pressure and/or temperature transmitters.

Wiring with Analog Output:



where:
V_s = 18 to 30 VDC
R_P = Pressure measuring resistance
R_T = Temperature measuring resistance
R_F = Flow rate measuring resistance

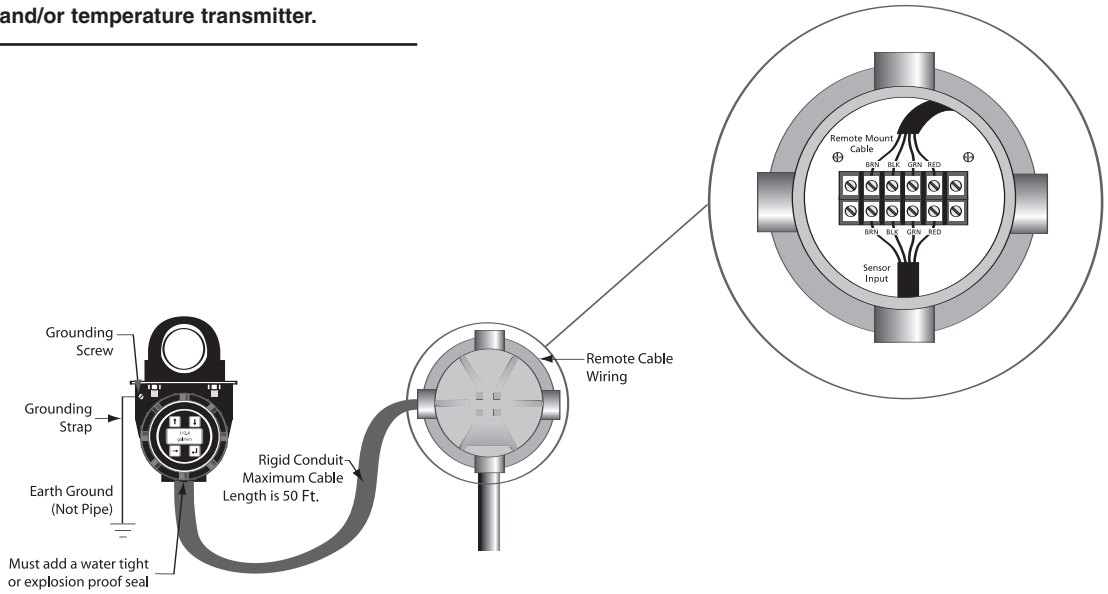
Spirax Sarco, Inc., 1150 Northpoint Blvd., Blythewood, SC 29016 Telephone: (303) 682-7060 FAX (303) 682-7069

S-V-Bar Insertion Vortex
Models S-V-Bar-600/60S • S-V-Bar-700 • S-V-Bar-910/960

Remote-Mount Wiring Diagram

Output wiring from remote electronics is identical to output wiring from integral electronics. Wiring from the remote electronics condulet to the electrical junction box must be performed in the field. Connect the remote cable to the terminal block in the junction box as shown. If non-conductive conduit is used, attach a ground strap from the ground screw on the remote electronics condulet. If the remote cable is cut to a shorter length, insulate shield with tape at electrical junction box.

If remote mounting is required with a pressure and/or temperature transmitter, two power supplies are required for operation: one for the remote flow transmitter and one for the pressure and/or temperature transmitter.



1 Special transmitter scaling is available. Please note scaling range below model code when ordering. If no special scaling is indicated, transmitter will be scaled per model code.

2 Unidirectional only. Unit has 4 to 20 mA and frequency output.

3 The standard remote option comes with 30' of cable.

4 Not available for use with pressure and temperature transmitters.

5 Certified by FM for Class I, Div. 2, Groups A, B, C, & D; Class II, III, Div. 2, Groups F & G; NEMA 4X. Not approved by FM when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If FM is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.

6 Certified by CSA for Class I, Div. 2, Groups A, B, C, & D; Class II, Div. 2, Groups F & G; Class III; Type 4X. Not approved by CSA when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If CSA is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.

Please specify the following information with your order:

- Fluid type or composition
- Maximum, minimum, and normal operating flow rate
- Maximum, minimum, and normal operating temperatures
- Maximum, minimum, and normal operating pressures
- Specific weight and viscosity at normal operating conditions

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S-V-Bar Insertion Vortex
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Models and Suffix Codes

Category	Suffix Codes				
Model					
Liquid or gas service, 400°F (204°C)	S-V-Bar-600				
Steam service, 400°F (204°C)	S-V-Bar-60S				
Liquid, gas, or steam service, 500°F (260°C)	S-V-Bar-700				
Liquid, gas, or steam service, 400°F (204°C)	S-V-Bar-910				
Liquid, gas, or steam service, 500°F (260°C)	S-V-Bar-960				
Connection					
2", male NPT (model 700)		2NPT			
2", 150# flange (model 700, 910, 960)		2F150			
2", 300# flange (model 700, 910, 960)		2F300			
2", 600# flange (model 700, 910, 960)		2F600			
2", 900# flange (model 700, 910, 960)		2F900			
Thread-o-let, xx = 03 to 80 inches (models 600, 60S) includes 2" isolation valve		VXX			
Pressure Transmitter					
No pressure transmitter			XX		
PT for pressure range 0 to 50 psig (0 to 3.44 barg)			50		
0 to 100 psig (0 to 6.89 barg) (model 600, 60S, 700, 910, 960)			100		
0 to 150 psig (0 to 10.34 barg) (model 600, 60S, 700, 910, 960)			150		
0 to 200 psig (0 to 13.79 barg) (model 600, 60S, 700, 910, 960)			200		
0 to 250 psig (0 to 17.24 barg) (model 700, 910, 960)			250		
0 to 500 psig (0 to 34.47 barg) (model 700, 910, 960)			500		
0 to 1000 psig (0 to 68.95 barg) (model 700, 910, 960)			1000		
Special scaling requests[1]			PXX		
Temperature Sensor or Transmitter					
No temperature transmitter				XXX	
Temperature sensor without preamplifier (RTD only)					
Teflon RTD internal wires - 40 to 400°F (- 40 to 204°C)				RTD-T	
Temperature sensor without preamplifier (RTD only)					
Fiberglass RTD internal wires 150 to 500°F (65 to 260°C) (models 700 and 960 only)				RTD-F	
Temperature sensor with preamplifier scaled from 32 to 68°F (0 to 20°C) (liquid/gas)				T09	
0 to 250°F (-18 to 121°C) (liquid/gas)				T10	
-40 to 150°F (-40 to 66°C) (liquid/gas)				T11	
212 to 400°F (100 to 204°C) (liquid/gas)				T12	
212 to 500°F (100 to 260°C) (steam) (model 700, 910, 960 only)				T14	
0 to 250°F (-17.7 to 121.1°C) (liquid/gas)				T20	
-40 to 149°C (-40 to 65°C) (liquid/gas)				T21	
212 to 400°F (100 to 204°C) (steam)				T22	
212 to 500°F (100 to 260°C) (liquid/gas) (model 700, 910, 960 only)				T24	
Special scaling requests[1,]				TXX	
Electronics					
EZ-Logic with local rate and total[2]					LOC-TOT
Remote mount electronics[3]					RMT
FM Approval[5]					FM
CSA Approval[6]					CSA
Integral 110 VAC input[4,]					110
Integral 220 VAC input[4,]					220
	S-V-Bar-600-	**2NPT-**	**XX-**	**XXX-**	**LOC-TOT**

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