TI 597SI

TECHNICAL INSTRUCTIONS
Iron Body Series 597 SI

UTILITY IRON BODY SERIES

DESCRIPTION

The rugged Powers Type SI (single seat iron body) balanced valve is primarily used for steam and water modulating applications with moderate pressure drops. The equal percent plug provides excellent control characteristics and is more tolerant of oversizing than linear or quick-opening plugs. The SI's control and close off characteristics are particularly well-suited to commercial water heaters, boilers, and industrial utility applications. The SI balanced valve is available with the Powers 46 in.^{2} and 100 in.^{2} actuators. Actuator selection depends on valve size and flowing system pressure drop across the valve.

SPECIFICATIONS

VALVE	
Body Sizes:	2½" – 6"
Body Material:	Cast Iron (per ASTM A126-93 Class B)
End Connections:	125 # Flanged (per ANSI B16.1–1993)
Trim:	Bronze Composition Disc
Packing:	Spring loaded TFE/EPDM packing
Seat Leakage:	ANSI Class IV < 0.01% leakage
Close-off Pressure:	125psi
Cv Range:	56-370
Rangeability:	100:1
Characteristics:	Equal Percent
Maximum Pressure:	200 psi @ Temp. <150°F
Max. Differential Press.:	50 psi for Bronze
Temperature Range:	40° – 281° F
ACTUATOR	
Housing Construction:	Die cast aluminum
Diaphragm Construction:	Replaceable molded neoprene
Diaphragm Area:	2½" – 5", 46 in.^{2}, 6" – 100 in.^{2}
Maximum Pressure and Temp.:	35 psi and 200°F
Ambient Shipping Limits:	- 40 to 220° F
Ambient Operating Limits:	- 20 to 220° F
Air Connection:	46 in.^{2}, ¼" NPT 100 in.^{2} ⅛" NPT
Position Indication:	⅛" increments
Mounting:	In any upright position with actuator head above 45° of the center line of the valve body. Actuator head may be swiveled to any convenient position.

Normally-closed 597 SI with 46 in.^{2} actuator shown

Sizes	Actuators Available
2½"	46 in.^{2} Diaphragm
3"	46 in.^{2} Diaphragm
4"	46 in.^{2} Diaphragm
5"	46 in.^{2} Diaphragm
6"	100 in.^{2} Diaphragm

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CALIFORNIA PROPOSITION 65 WARNING

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
(California law requires this warning to be given to customers in the State of California.)
For more information: www.watts.com/prop65

APPLICATION INFORMATION

Flowrite II Single Seated SI balanced valves are generally recommended for steam, hot water and chilled water applications. They are particularly suited for installations requiring tight shutoff and quick response.

THEORY OF OPERATION

On normally closed valve assemblies, the valve stem will start to open whenever the control air pressure applied against the actuator diaphragm area and the lower housing exceeds the holding force of the springs. A further increase in control air pressure will initiate a continued upward travel of the valve steam until the valve has fully opened.

On normally open valve assemblies, the stem will start to close whenever the control air pressure applied against the actuator diaphragm area and upper housing exceeds the holding force of the springs. A further increase in control air pressure will initiate a continued downward travel of the valve stem until the valve has fully closed.

The air pressure change to initiate full stem travel is known as the spring range or span. This spring span is factory set and will vary slightly as the pressure drop across the valve changes.

When the valve is at its' "full open" position there is maximum flow potential through the valve. At this position, valves are compared based on flow that is directly related to the valve flow coefficient (see Cv equations in table 1). The 597 SI valves are designed so that equal changes in valve stem position provide equal percentage changes in existing flow through the valve. This is otherwise know as an equal percent valve which has a typical flow curve (figure 2) that can be used to determine flow based on stem position, pressure drop, and Cv. As you can see from the graph, these valves are less sensitive at the low end, which gives both high rangeability and high flows. These types of valves are used extensively to compensate for fluctuating system requirements (pressure, flow, load, etc.).

Valve actuators equipped with positioners provide feedback for enhanced control strategies and, as an example, are required for valve staging. Valves with positioners can utilize full control air pressure at any point in stem travel to initiate stem movement or to maintain stem position. However, the actuator springs still provide the necessary force to move the stem in the opposite direction. Use of a positioner will tend to provide faster response and ensure repeatability of stem position regardless of the load on the actuator. However, in a system where available pressure and flow requirements are relatively consistent, control valves can usually perform adequately without a positioner.

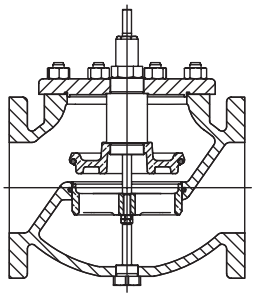


Figure 1 A- Push to Open

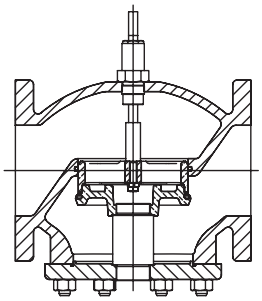


Figure 1 B- Push to Close

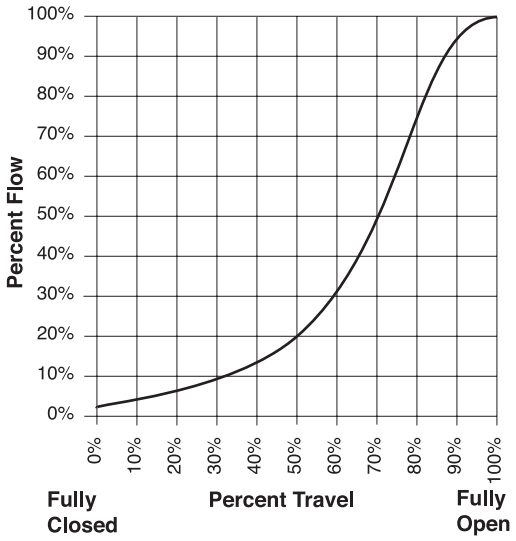


Figure 2

VALVE SIZING AND SELECTION (WATER)

The sizing of a valve is very important if it is to render good service. If it is "undersized", it will not have sufficient capacity. If it is "oversized", the controlled variable may cycle, the trim can be exposed to excessive wear or wire drawing, and you could expect reduced valve life. To help select the right valve, it is important to understand your application and its variables (controlled fluid, temperatures, pressures, min/max load, etc.). When your system variables are known and you have calculated actual demand, it is possible to select the right Powers valve for your application. The following technical data should help you in selecting a valve for your water control applications. For fluid applications other than water, contact Powers' application engineering.

$$Q = Cv\sqrt{\Delta P}$$

Where:

Q = Water flow (gpm)

Cv = Valve flow coefficient (gpm with $P\Delta$ = 1 psi)

ΔP = Pressure differential, P1- P2 (psi)

P1 = Inlet pressure (psi)

P2 = Outlet pressure (psi)

On/Off Control:

These types of applications are normally line sized to reduce pressure drop and pump size. In these applications it is important to verify valve seat leakage will not result in system overheat or damage. If this is a concern, it is necessary to take precautions to alleviate this potential problem.

Proportional Control:

In applications where the close-off pressure at the valve is below 20psig, use a pressure drop of 5psi.

In applications where the close-off pressure at the valve is above 20psig, it is generally recommended to take 25-50% of the system pressure drop at the control valve to maintain good valve/system performance. Certain applications can successfully utilize lower pressure drops across the valve (5-25%) if system fluctuations are kept to a minimum. If not, the valve is considered oversized it will not effectively throttle until it is nearly closed thereby resulting in poor control.

Refer to the following table for flow….

Table - 1 Water Capacity in Gallons Per Minute

Valve Size	Cv Rating	Differential Pressure (ΔP in psi)											
		5	10	20	30	40	50	60	70	80	90	100	125
2.5	**56**	125	177	250	307	354	396	434	469	501	531	560	626
3	**85**	190	269	380	466	538	601	658	711	760	806	850	950
4	**145**	324	459	648	794	917	1025	1123	1213	1297	1376	1450	1621
5	**240**	537	759	1073	1315	1518	1697	1859	2008	2147	2277	2400	2683
6	**370**	827	1170	1655	2027	2340	2616	2866	3096	3309	3510	3700	4137

CAVITATION LIMITATIONS ON VALVE PRESSURE DROP

A concern in high temperature water systems is the potential for cavitation/flashing, which is caused by the downstream pressure being lower than that of the vapor pressure of the fluid. This basically causes the water to "boil" and can result in reduced flow/capacity, excessive noise, vibration, wear and should be avoided if possible. Use the following equation to estimate the maximum allowable pressure drop across the valve:

Pmax = 0.5 (P1 – Pv)

Where:

Pmax = Maximum allowable pressure drop

P1 = Absolute inlet pressure (psia)

Pv = Absolute vapor pressure (refer to psia - Table 2)

Absolute pressure = gauge pressure + 14.7

Table-2 Vapor Pressure of Water Table

Water Temp. (°F)	Vapor Pressure (psia)	Water Temp. (°F)	Vapor Pressure (psia)
40	0.12	140	2.89
50	0.18	150	3.72
60	0.26	160	4.74
70	0.36	170	5.99
80	0.51	180	7.51
90	0.70	190	9.34
100	0.95	200	11.53
110	1.28	210	14.12
120	1.69	220	17.19
130	2.22	230	20.78

VALVE SIZING AND SELECTION (STEAM)

Steam:
One can use the same reasoning for selecting a valve in steam applications as would be used for water applications. Once again, pressure drop selection is a major determining factor for good control and system performance. In general, for steam applications, the largest possible pressure drop should be taken without exceeding the critical pressure ratio.

On/Off Control:
These types of applications are normally line sized to reduce pressure drop. In these applications it is important to verify valve seat leakage will not result in system overheat or damage. If this is a concern, it is necessary to take precautions to alleviate this potential problem.

Proportional Control:
For pressures less than 15psig, use an 80% of the gauge inlet pressure as a differential. For pressures above 15psig, use 42% of the absolute inlet pressure. In those cases where the required Cv falls between two valves, select the larger size.

One may be concerned about steam entering a heating coil at 0psig when these large pressure drops are taken at the valve. However, flow will continue as the pressure in the coil will drop to vacuum pressures due to the steam condensation. It is essential to use proper condensate piping and steam trapping in these applications.

Table - 3 Steam Capacity in Pounds Per Hour

Steam Inlet Pressure (psig)		2			5					10				
Pressure Drop Across Valve (psi)		0.5	1	2	1	2	3	4	5	2	4	6	8	10
Valve Size	Cv Rating													
2.5	56	477	669	932	729	1017	1229	1399	1542	1145	1585	1898	2140	2334
3	85	724	1016	1415	1106	1544	1865	2124	2341	1738	2405	2880	3249	3543
4	145	1235	1733	2413	1887	2634	3182	3623	3993	2965	4103	4914	5542	6044
5	240	2044	2869	3994	3123	4359	5267	5997	6610	4907	6792	8133	9172	10004
6	370	3151	4423	6157	4815	6720	8120	9246	10190	7565	10471	12538	14141	15423

Steam Inlet Pressure (psig)		15					25				50			
Pressure Drop Across Valve (psi)		3	6	9	12	(max) 15	5	10	15	(max) 20	10	20	30	(max) 32.5
Valve Size	Cv Rating													
2.5	56	1530	2105	2505	2805	3035	2268	3098	3655	4053	4064	5501	6422	6599
3	85	2322	3195	3802	4257	4607	3443	4702	5548	6152	6168	8350	9747	10017
4	145	3961	5450	6485	7262	7858	5873	8022	9464	10495	10522	14243	16628	17088
5	240	6556	9021	10734	12020	13007	9721	13277	15665	17372	17415	23575	27522	28284
6	370	10107	13908	16548	18531	20052	14986	20469	24150	26781	26489	36345	42430	43604

Steam Inlet Pressure (psig)		75					100					125				
Pressure Drop Across Valve (psi)		10	20	30	40	(max) 45	10	20	30	40	50	10	20	30	40	50
Valve Size	Cv Rating															
2.5	56	4840	6640	7873	8781	9146	5508	7610	9096	10236	11138	6104	8470	10172	11508	12595
3	85	7347	10079	11950	13329	13882	8361	11552	13806	15537	16906	9265	12857	15440	11467	19117
4	145	12533	17193	20386	22738	23681	14263	19706	23551	26504	28839	15805	21932	26339	29797	32611
5	240	20744	28457	33742	37635	39196	23607	32616	38981	43868	47734	26159	36302	43595	49320	53977
6	370	31980	43871	52018	58021	60426	36395	50283	60096	67630	73590	40329	55966	67209	76035	83215

$$W = \frac{2.1Cv\sqrt{\Delta P\,(P1+P2)}}{K}$$

Where:

W = Steam flow (lbs/hr)

Cv = Valve Flow Coefficient (US gpm with ΔP = psi)

K = 1+ (0.0007* °F superheat)

ΔP = Pressure differential, P1 - P2 (psi)

P1 = Inlet Pressure (psia)

P2 = Outlet pressure (psia)

Absolute Pressure = Gauge pressure + .7 (psia)

TEMPERATURE/PRESSURE RATINGS

In all cases, do not exceed the temperature/pressure ratings of the valve (see figure 3). Acceptable region is shown by the shaded area.

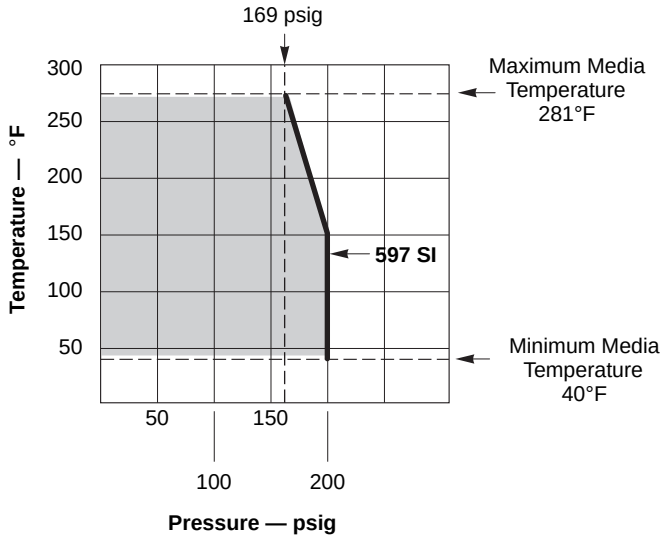


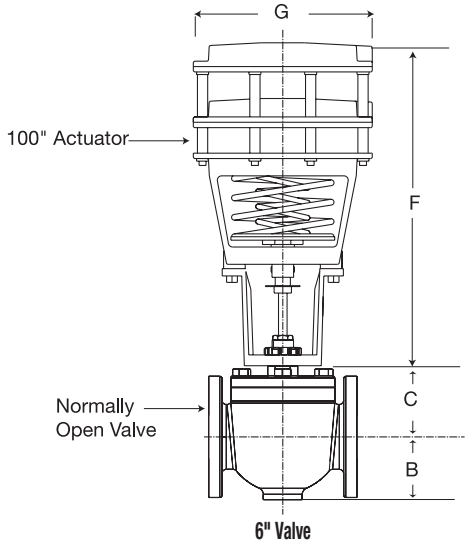
Figure 3 - Temperature and Pressure Ratings

DIMENSIONAL DATA

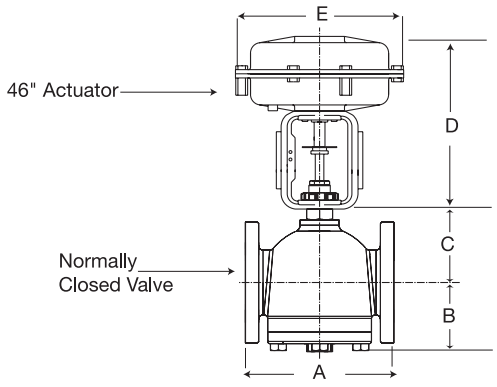
Table-4 Dimensions for 597 SI Series Valves

Nominal Pipe Size	2-1/2"	3"	4"	5"	6" Normally Closed	6" Normally Open
A	8.562	9.500	11.500	13.000	14.000	
STROKE	1.000	1.000	1.000	1.000	1.750	1.750
B	4.000	4.232	4.923	5.934	6.226	7.461
C	4.302	4.927	5.754	6.763	7.479	6.339
D	10.375	10.375	10.375	10.375	N/A	N/A
E	10.000	10.000	10.000	10.000	N/A	N/A
F	N/A	N/A	N/A	N/A	19.000	19.000
G	N/A	N/A	N/A	N/A	10.313	10.313
Valve Weight (lbs)	46	58	95	141	146	146
Weight w/46"	65.00	78.00	103.00	152.00	N/A	N/A
Weight w/100"	N/A	N/A	N/A	N/A	178.00	178.00

Figure 4 - 2-1/2" to 6" Valve Bodies



6" Valve

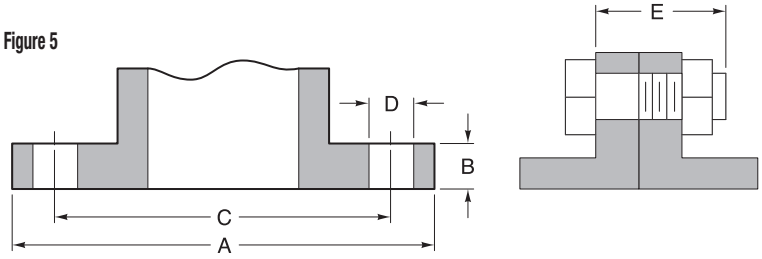


2-1/2" - 5" Valve

Table - 5 Flange Detail for American Standard 125 lb. Cast Iron Pipe Flanges

Valve Size	Flanges		Drilling		Bolting		Length of Machine Bolts
	Flange Diameter A	Flange Thickness B	Diameter of Bolt Circle C	Diameter of Bolt Holes D	Number of Bolts	Diameter of Bolts	E
2-1/2"	7"	11/16"	5-1/2"	3/4"	4	5/8"	2-1/2"
3"	7-1/2"	3/4"	6"	3/4"	4	5/8"	2-1/2"
4"	9"	15/16"	7-1/2"	3/4"	8	5/8"	3"
5"	10"	15/16"	8-1/2"	7/8"	8	3/4"	3"
6"	11"	1"	9-1/2"	7/8"	8	3/4"	3-1/4"

Figure 5



INSTALLATION

Inspection

Inspect the package for damage. If damaged, notify the appropriate carrier immediately.

If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

Requirements

- Pipe wrenches
- Flange gaskets, bolts/nuts
- Installer must be a qualified, experienced technician

CAUTION!

- Install the valve with the flow in the direction of the flow arrow. ("A" port is the inlet and "AB" is the outlet.)
- Do not exceed the ratings of the device.
- Avoid locations where excessive moisture, corrosive fumes, or vibration are present.

Mounting/Orientation

1. The valve should be mounted in a location that is within the ambient limits of the actuator. When selecting a location, allow sufficient room for valve linkage, actuator, and other accessories and for service of the product.
2. The preferred mounting position for the valve is with the valve stem vertical above the valve body. Avoid mounting the valve so that the valve stem is below horizontal.
3. On steam applications where the ambient temperature approaches the limit of the actuator, the valve stem should bemounted 45° from vertical.

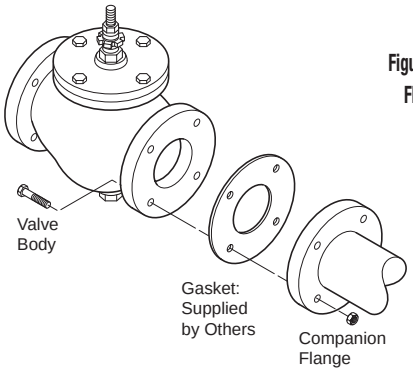


Figure 6 - Installation of Flanged End Valves

Flanged Connection

The 597SI series flanged valve bodies conform to American Standard 125 Lb. Cast Iron Pipe Flanges. The companion flanges (not provided) should be the same specification as the valve. The 125 lb. flanges have plain flat faces and should not be bolted to a raised faced flange.

1. All parts should be clean to assure the best results.
2. The pipe with the companion flanges installed should be properly supported and aligned. Be sure the companion flange is flush with the face of the valve body flange and lined up squarely.
3. Use a gasket material (not provided) that is recommended for the medium being handled.

   CAUTION! Do not apply pipe dope to the valve flange, gasket, or companion flange.
4. See Figure-5 for flange and flange bolt details.

   Figure-6 shows the proper way a flanged valve should be mounted.

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained performance. See Table-6 for maintenance kit part numbers.

Table - 6 Maintenance Kits for 597SI Valves

Valve Description	Replacement Packing Assembly	Replacement Gaskets	Valve Repair Kit*
2.5 Normally Closed	597 Pack	597250G	597 SIGOBCTK
3 Normally Closed		597300G	597 SIHOBCTK
4 Normally Closed		597400G	597 SIJOBCTK
5 Normally Closed		597500G	597 SIKOBCTK
6 Normally Closed		597600G	597 SILOBCTK
2.5 Normally Open		597250G	597 SIGOBXTK
3 Normally Open		597300G	597 SIHOBXTK
4 Normally Open		597400G	597 SIJOBXTK
5 Normally Open		597500G	597 SIKOBXTK
6 Normally Open		597600G	597 SILOBXTK

** Kit includes replacement packing and stem & plug assembly.*

Water System Maintenance

All systems are susceptible to valve and system problems caused by improper water treatment and system storage procedures. These guidelines are provided to help avoid valve and water system problems resulting from improperly treated water or storage procedures and to obtain maximum life from the valves.

Durability of valve stems and packings is dependent on maintaining non-damaging water conditions. Inadequate water treatment or filtration can result in corrosion, scale, and abrasive particle formation. Scale and particulates can result in stem and packing scratches and can adversely affect packing life and other parts of the hydronic system.

To maintain non-damaging conditions, follow these guidelines:

- Clean the system prior to start up.
- Use filtration equipment where needed.
- Properly store off-line systems and monitor water treatment results.
- Follow the advice of a water treatment professional.

ORDERING INFORMATION

597– S I □ □ □ □ □ □ □ □ □ □ □

Size **Order Code**
2 1/2″ **250**
3″ **300**
4″ **400**
5″ **500**
6″ **600**

End Connections
125# Flange ..... **F**

Valve Trim
Bronze ..... **B**

Action
Fail Open (Air-to-Close) ..... **X**
Fail Closed (Air-to-Open) ..... **C**

Packing
Spring loaded TFE/EPDM ..... **T**

ACCESSORIES SELECT CODE (see below)

ACTUATOR SELECT CODE (see below)

ACTUATOR SELECT CODE

CODE	PNEUMATIC DIAPHRAGM ACTUATORS
4C	46 Sq. In., 1″ Max Valve Stroke Extreme Cycle Springs, adjustable start w/6-12 lb. fixed span.
1U (for 6" valve only)	100 Sq. In; 8-13 psi Spring Range, (Normally Closed Valves)
1L (for 6" valve only)	100 Sq. In; 3-8 psi Spring Range, (Normally Open Valves)

ACCESSORIES SELECT CODE

CODE	DESCRIPTION
	Bellofram 1000 I/P'S
IS	3–15 psi
TS	1–17 psi
US	3–27 psi
	CONTROL/AIR TYPE 900X I/P
ES	0–30 psi
	UTILITY POSITIONER AND I/P
BS	4–20 mA
	UTILITY POSITIONER
PS	3-15 psi
RS	3-9 psi
SS	9-15 ps
	NO ACCESSORIES
OS	No Accessories

I/P TRANSDUCERS

The "standard" 3-15 psi signal was originally designed as a transmission signal, not a valve actuation signal. The Fluid Controls Institute (in Standard 87-2) has recommended that a 1–17 psi air signal range be used when directly actuating a control valve without a positioner. Powers concurs with this recommendation, and therefore, offers a 1–17 psi I/P transducer and a 0–30 psi I/P transducer and the Accritem pneumatic controller for maximum close-off. 3-15 psi I/P transducers should be used in conjunction with positioners.

POSITIONERS

Positioners are used for one or more of the following reasons:

1) To split range valves.
2) To eliminate unwanted valve movement caused by line pressure variations
3) To minimize the effects of "stick-slip"
4) To speed response time
5) To increase close-off rating when I/Ps are used.

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