Robertshaw
INDUSTRIAL PRODUCTS

PRODUCT SPECIFICATION

Valve Selection And Capacity Tables

Valve Sizing for self-actuated temperature regulators is critical to control and life. Use Robertshaw's "FLO-RULE" valve sizing slide rule and valve C_V chart for accurate sizing, or contact our representative or the factory. The application requirement can frequently be satisfied by one or two sizes smaller valve than the supply pipeline size.

The following tables give an approximation of the proper valve size for use with the cataloged self-actuated temperature regulators, in both two-way and three-way types on steam or water as indicated. For other fluids or other valve types, consult the "FLO-RULE" or our representative or factory.

STEAM FLOW — HEATING SERVICE

Table I lists the maximum steam flow at various supply pressures for the valves listed at their full-open position.

TO USE TABLE I: Follow the left-hand column down to the steam supply pressure. Read horizontally to the quantity (lbs. per hour of steam, or gallons per hour of water heated 100° F.) equal to or slightly higher than that required on the application. Read the proper valve size and type at the head of the column.

TABLE I

[Maximum Steam Flow With Critical Pressure Drop Across Two-way, Direct-acting Valves (Fully Open)]. See Note 1.

Valve Style		A	A	A	MA	MA	MA	MA	MA	FA‡	FA‡	FA‡	Maximum Downstream Pressure for Critical Flow (See Note 1)
Valve Size, In.		1/4 Port	3/8 Port	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	
Steam Pressure* (PSI Gauge)		Steam Flow, Lbs. per Hr. (or Gallons of Water per Hour Raised in Temperature by 100° F.)											
Dry, Saturated Steam	0	23	41	56	250	330	475	665	1220	2200	3400	6500	14" Hg Vac.
	4	29	52	72	320	420	610	850	1550	2800	4500	8500	10" Hg Vac.
	10	39	69	95	420	550	800	1120	2040	3700	5700	11000	3" Hg Vac.
	15	47	83	115	505	660	960	1340	2460	4500	7000	13000	1.0 PSIG
	20	54	97	135	590	775	1120	1570	2870	5000	8000	15500	4 PSIG
	25	62	110	150	675	885	1290	1800	3280	6000	9200	18000	6 PSIG
	30	70	125	170	760	1000	1450	2020	3700	6500	10000	20000	10 PSIG
	40	86	150	210	935	1220	1770	2480	4520	8000	13000	24000	14 PSIG
	50	100	180	250	1100	1440	2090	2930	5450	9500	15000	29500	20 PSIG
	60	120	210	290	1270	1660	2420	3380	6170	11000	17500	33000	25 PSIG
	70	135	235	325	1440	1890	2740	3830	7000	12500	20000	39000	30 PSIG
	80	150	265	365	1620	2110	3070	4280	7830	14000	22000	42500	36 PSIG
	90	165	290	400	1790	2330	3390	4740	8650	16000	24000	47000	40 PSIG
	100	180	320	440	1960	2550	3710	5190	9480	18000	26000	50000	46 PSIG
	125	220	390	535	2380	3110	4520	6320	12000				59 PSIG
	150				2800	3670	5330	7450					73 PSIG
	175				3340	4290	6270	8590					86 PSIG
	200				3660	4780	6950	9710					99 PSIG
	225				4100	5420	7920	10800					112 PSIG
	250				4510	5900	8560	12000					125 PSIG

* Steam flows are tabulated up to the maximum designed pressure drop of the valve. The maximum supply pressure should not exceed the published body rating. Certain self-actuated temperature regulators, when used with some of the valves listed, will not permit the maximum designed pressure drop. Check Table III for these limitations.

‡ Maximum designed pressure drop on the "FA" valve with bronze trim is 50 psi; with stainless steel trim is 100 psi.

NOTE 1 — Maximum steam flow through the valve is obtained when the downstream pressure is 53% of the absolute upstream supply pressure. This "critical pressure drop" situation is encountered on most steam heating applications, and is true wherever the downstream ("back") pressure is equal to or less than the figure in the last column of Table I. If downstream pressure is higher than that given on Table I, make correction as given in Table II.

HOW TO DETERMINE VALVE SIZE FROM GALLONS OF WATER HEATED/HR. WITH TEMPERATURE RISES OTHER THAN 100° F.

Table I gives capacity in terms of Gal./Hr. water heated through 100° F. temperature rise. For other temperature rise figures, the following formula will give equivalent steam flow to use.

$$\frac{\text{Water Heated (GPH)} \times 8.33 \text{ (wt. of water per gal.)} \times \text{Actual Temp. Rise (degrees)}}{900} = \text{Steam Quantity Required (lbs./hr.)}$$

Example:

To heat 3000 GPH (equals 50 GPM) through a 120° F. rise (for example, 60° to 180° F.) where the steam supply pressure is 40 PSIG:

$$\frac{3000 \times 8.33 \times 120}{900} = 3{,}332 \text{ lbs./hr. steam required}$$

Referring to Table I, read down column 1 to 40 psig. Read horizontally to 4,520 lbs./hr. Head of column shows that 2" MA is the proper selection.

TABLE II

SUB-CRITICAL FLOW CORRECTION FACTORS

To be applied only when downstream pressure is greater than the maximum value given in Table I.

PRESSURE RATIO Downstream Pres., PSIA* / Upstream Press., PSIA	CORRECTION FACTOR
.53 (or lower)	1.000
.55	1.014
.60	1.058
.65	1.114
.70	1.186
.75	1.279
.80	1.412
.85	1.608
.90	1.942
.95	2.717
.99	6.006

*PSIA — Absolute pressure: equals gage pressure plus 14.7 or sea level.

If the downstream ("back") pressure at the valve exceeds the figure in the last column of Table I, it is necessary to apply the correction factor in Table II. Multiply the required steam flow in lbs./hr. by this factor. Using the corrected flow figure obtained, refer to Table I and determine valve size required.

TABLE III

MAXIMUM RECOMMENDED PRESSURE DROP ACROSS VALVE

For Self-actuated Temperature Regulators (With upperworks power a consideration)

Regulator No.			1001	1003	1004	1006	1007	1008	1009	1010*	1011
Valve Type		Size (Port)	Maximum Recommended Pressure Drop, PSI								
2-Way Valves	A	1/4	125	125	125	125	125	125	125	---	125
	A	3/8	115	125	125	125	125	125	125	---	125
	A	1/2	65	125	125	90	110	125	125	---	125
	FA	3/4	160	125	125	125	125	125	125	---	125
	FA	1	110	125	125	125	125	125	125	---	125
	FA	1-1/4	110	125	125	125	125	125	125	---	125
	FA	1-1/2	85	125	125	125	125	125	125	---	125
	FA	2	30	85	125	45	55	85	85	---	85
	FA	2-1/2	25	65	110	---	45	65	65	---	65
	FA	3	20	55	90	---	35	55	55	---	55
	FA	4	15	40	70	---	25	40	40	---	40
	MA	3/4	250	250	250	250	250	250	250	---	250
	MA	1	250	250	250	250	250	250	250	---	250
	MA	1-1/4	250	250	250	---	250	250	250	---	250
	MA	1-1/2	250	250	250	---	250	250	250	---	250
	MA	2	125	125	125	---	125	125	125	---	125
3-Way Valves	WA	1/2	65	170	250	90	110	170	170	---	170
	WA	3/4	30	75	125	20	50	75	75	---	---
	WA	1	15	40	75	20	30	40	40	---	40
	WA	1-1/4	10	25	45	---	20	25	25	---	25
	WA	1-1/2	7	20	30	---	10	20	20	---	20
	WD	2	40	40	40	40	40	40	40	40	40
	WD	2-1/2	40	40	40	---	40	40	40	40	40
	WD	3	---	40	40	---	---	40	40	40	40
	WD	4	---	---	25	---	---	---	---	25	---

NOTE: FA type valves, all sizes, with bronze trim carry a maximum 50 psi recommended pressure drop.

*Regulator No. 1010 is available only with type WD valves.

The quantity of water flow through a valve is principally dependent on the pressure drop across the valve.

Table IV gives water capacities, in GPM, at various pressure drops for standard two-way valves for cooling or hot water service.

Tables V and VI, on pages 4 and 5, show water capacities for three-way valves at various pressure drops for cooling bypass, blending or diverting service.

For other two-way or three-way valves, see the Robertshaw "FLO-RULE" or contact our representative or the factory.

TO USE TABLES IV, V and VI: Follows pressure drop column down to known or estimated pressure drop through valve (supply pressure minus any downstream back pressure). Read horizontally to a value equal to or slightly greater than the required flow. Read the proper valve size and type at the head of the column.

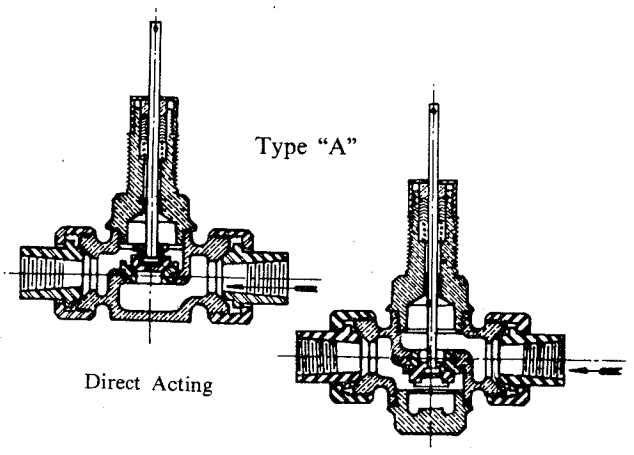
TABLE IV

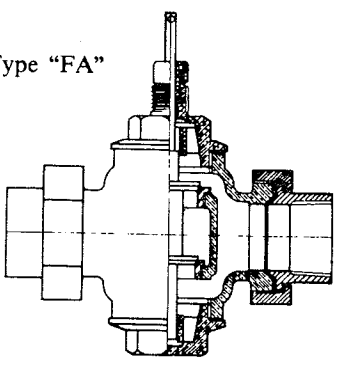
MAXIMUM WATER FLOW (GPM) THROUGH REVERSE-ACTING, TWO—WAY VALVES (FULL OPENING) WITH STAINLESS STEEL OR MONEL TRIM

Cataloged Valve Style	A	A	A	FA	FA	FA	FA	FA	FA	FA	FA
Valve Size, In.	1/4 (Port)	3/8 (Port)	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
Pressure Drop* across Valve (PSI)	Maximum Flow, GPM with Water at 60° F.										
1(a)	0.8	2.44	3.2	9.3	17.6	22.5	30.4	59.3	82.5	130	226
2	1.1	3.2	4.6	13	25	32	43	84	118	188	320
4	1.6	4.9	6.5	19	36	45	60	128	165	210	460
8	2.3	7.0	9.0	26	50	65	91	175	240	385	650
10	2.6	7.7	10.0	30	55	70	98	185	260	420	720
15	3.5	9.5	12.5	36	67	90	120	230	320	510	875
20	4.6	11.0	14	42	80	100	135	260	376	580	1000
25	4.0	12.0	16	47	89	110	150	300	410	650	1120
30	4.2	13.4	17.5	52	96	120	170	325	450	720	1250
40	5.0	15.5	20	60	110	140	185	375	520	830	1410
50	5.6	17.3	22	66	125	158	215	420	580	910	1600
60	6.2	19.9	24	73	135	175	240	460	650	1000	1720
70	6.8	20	26	80	147	188	260	490	700	1100	1900
80	7.2	22	28	85	158	210	280	525	750	1150	2000
90	7.8	23	30	90	168	215	290	555	780	1250	2175
100	8.0	24	32	95	175	220	300	595	820	1300	2220
125	9.0	26	36	108	195	250	325	660	925	1450	2500

* Water flows are tabulated for pressure drops up to the maximum designed pressure drop of the valve. The maximum supply pressure should not exceed the published body rating. Certain self-actuated temperature regulators will not permit the full body rating pressure drop. Check Table III for limitations.

(a) The water flow through the valve at 1 PSI pressure drop is the "Flow Coefficient" (frequently abbreviated as C_V) of the valve.





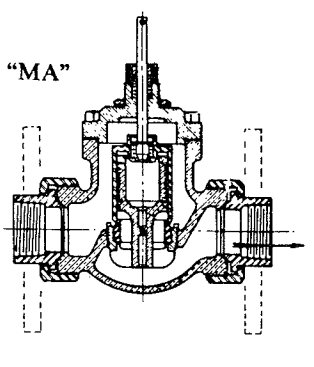


TABLE V

MAXIMUM WATER FLOW (GPM)

Three-Way Valves, Style "WA"

Valve Size, In.	1/2"		3/4"		1"		1-1/4"		1-1/2"	
Direction Flow	A to B	A to C	A to B	A to C	A to B	A to C	A to B	A to C	A to B	A to C
Pressure Drop across Valve PSI*	Maximum Flow Through Ports Indicated with Water at 60° F.									
1(a)	4.3	3.2	7.8	5.6	11.1	8.9	23.5	18.1	31.7	25
2	6.1	4.5	11.0	7.8	16	13	33	26	44	35
4	8.6	6.4	15.5	11.0	22	18	36	38	63	50
6	10	7.8	19.0	13.5	27	22	57	44	78	61
8	12	9.0	22.0	15.5	32	25	65	51	90	71
10	14	10	24.5	17.5	36	28	74	57	100	79
15	17	12	30.0	21.5	43	34	90	70	120	97
20	19	14	35.0	25.0	50	40	100	80	140	110
25	22	16	38.0	28.0	56	44	110	90	160	125
30	24	17	42.5	30.0	61	49	122	100	175	135
40	27	20	50.0	35.0	70	56	140	112	200	160
50	30	23	55	38	78	63	160	130	220	180
60	33	25	61	43	85	69				
70	36	27	65	46.5	93	75				
80	38	29	70	50	--	--				
100	42	31	77	55	--	--				

* Water flows are tabulated for pressure drops up to the maximum designed pressure drop of the valve. The maximum supply pressure should not exceed the published body rating. Careful consideration must be given to the type of service and pressure differential between the ports in selecting self-actuated temperature regulators with 3-way valves. Check Table III for limitations.

(a) The water flow through the valve at 1 PSI pressure drop is also the "Flow Coefficient" (frequently abbreviated as C_V) of the valve.

OTHER LIQUIDS

The flow of liquids other than water is affected by specific gravity and viscosity. With specific gravity from 0.95 to 1.05, and/or viscosity below 50 SSU, it is practical to use the water flow tables. For other conditions, use the Robertshaw "FLO-RULE" of contact our representative or the factory.

Type "WA"

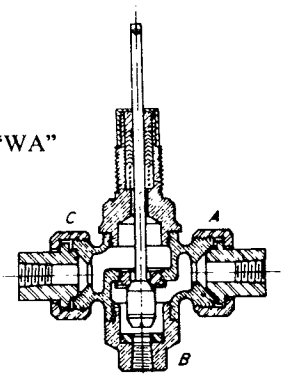


TABLE VI

MAXIMUM WATER FLOW (GPM)

Three-Way Valves, Style "WD"

Valve Size, In.	2"		2-1/2"		3"		4"		5"		6"	
Direction of Flow	E to B	E to C	E to B	E to C	E to B	E to C	E to B	E to C	E to B	E to C	E to B	E to C
Pressure Drop across Valve PSI*	Maximum Flow Through Ports Indicated with Water at 60° F.											
1 (a)	64	64	77	77	115	105	240	250	For maximum capacity Size 5" and 6" valves, consult factory.			
2	90	90	120	120	165	150	340	360				
4	138	138	165	165	235	210	480	500				
6	160	160	190	190	280	260	600	600				
8	180	180	235	235	350	320	725	750				
10	200	200	240	240	365	340	756	800				
15	250	250	300	300	445	400	930	975				
20	280	280	340	340	525	475	1090	1100				
25	320	320	385	385	575	530	1200	1250				
30	360	360	420	420	640	580	---	---				
40	400	400	490	490	730	675	---	---				

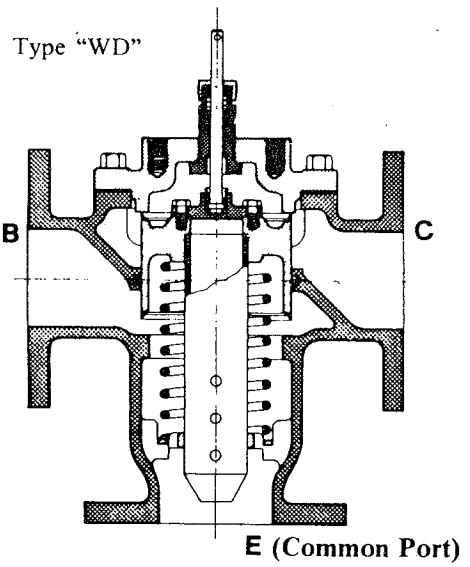
* Water flows are tabulated for pressure drops up to the maximum designed pressure drop of the valve. The maximum supply pressure should not exceed the published body rating. Careful consideration must be given to the type of service and pressure differential between the ports in selecting self-actuated temperature regulators. Check Table III and the specification sheets for limitations.

(a) The water flow through the valve at 1 PSI pressure drop is also the "Flow Coefficient," frequently abbreviated as C_V) of the valve.

OTHER LIQUIDS

The flow of liquids other than water is affected by specific gravity and viscosity. With specific gravity from 0.95 to 1.05, and/or viscosity below 50 SSU, it is practical to use the water flow tables. For other conditions, use the Robertshaw "FLO-RULE" or contact our representative or the factory.

Type "WD"



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Q-3313 (4/97) **Printed in U.S.A.**