Pressure and/or Temperature Pilot Operated Steam Regulators

Series 2000

The Hoffman Specialty Series 2000 consists of main valves, pilot valves, wells and hardware kits. They are designed to meet a wide range of temperature, pressure and capacity requirements and provide accurate, dependable, low maintenance operation. The Series 2000 Regulators meet MIL Spec MIL-V-16733D (Type IV) and MIL-V-18433B (Type I, Style A, Class 2).

Main Valves

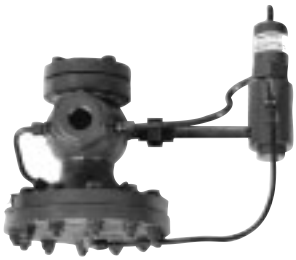
- Sizes available: 1/2" (15mm) - 6" (150mm)
- Cast iron body with 30,000 tensile
- Maximum rating 250 psig (17.3 bar) at 450°F (232°C)
- Full, normal and reduced ports available

Pilots

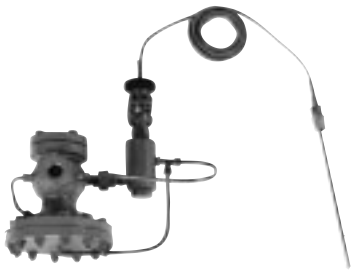
- Spring
- Temperature
- Air
- Solenoid
- Electro-Pneumatic Transducer

Part of the ESP PLUS EQUIPMENT SELECTION PROGRAM

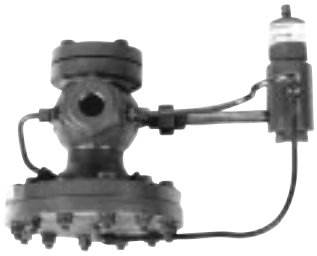
For computer aided selection of steam specialties contact your local Hoffman Specialty Representative (see back cover for listing).



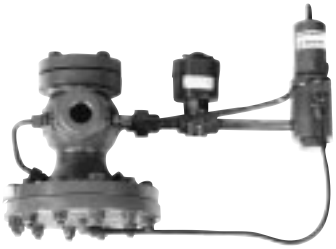
Main Valve with Pressure Control Spring Pilot



Main Valve with Temperature Control Pilot



Main Valve with Pressure Control Air Pilot



Main Valve with Electric on/off Solenoid Pilot and Pressure Control Spring Pilots

Basic Selection Data

Select main valve based on required sizing information.

Select type of pilots required.

Select hardware package based on main valve size and type of pilots used.

Example

For a 1½" (40mm) Full Port Valve using a combination of temperature pilot for 50-200°F (10-93°C) range and a spring pilot with 2-50 psig (.14-3.5 bar) range and a NC solenoid pilot…

Specify on purchase order

402412 main valve full port
400866 STPA-200 temperature pilot
400533 SSP-50 spring pilot
402255 normally closed solenoid pilot
400641 hardware kit

*** Contact your local Hoffman Specialty representative for information on Noise Silencers for Steam Regulators.**

Pressure and/or Temperature Pilot Operated Steam Regulators (continued)

How To Size Series 2000 Main Valves

1. Determine the available steam inlet pressure.
2. Determine the reduced steam outlet pressure.
3. Determine the available steam temperature based on the boiler's steam output.
4. Determine the capacity required by referring to the manufacturer's specifications for your equipment.
5. Apply the specifications (as determined in steps 1-4) to the Full Port Steam Capacity Table to determine the main valve size. If steam inlet pressure is below 30 psig (2.1 bar) use the Low Pressure Steam Capacity Table.

Select a main valve that will operate between 50-100% of the capacity rating.

If necessary, use the Normal or Reduced Port Steam Capacity Tables.

A normal or reduced port main valve is recommended for systems that will be expanded in the future.

To prevent excessive relief valve popping, the relief valve setting must be at least 5 psi (.35 bar) higher than the no load pressure setting on systems up to 35 psig (2.4 bar).

For systems greater than 35 psig (2.4 bar), the relief valve must be set 10 psi (0.7 bar) higher than the no load pressure setting.

Note: To prevent excessive noise and extend valve life, do not exceed pressure drops greater than 150 psig (10.4 bar) and avoid those greater than 100 psig (6.9 bar).

To prevent seat damage and to maintain control and accuracy, do not oversize. Select regulators that will operate between 50-100% of their capacity rating.

6. Use the Main Valve Body Style Chart to select a model number (based on size and pressure).

7. Use the Ordering Information Chart todetermine the part number (based on the model number).

8. Size inlet and outlet piping for velocity:
   For heating or indoor applications –
   4,000-6,000 ft./min. (1,219-1,828 m/min.)
   For industrial or outdoor applications –
   8,000-12,000 ft./min. (2,438-3,657 m/min.)

   Note: Main valve noise data available through ESP-Plus, or upon request.

9. Install drip traps ahead of regulators to drain condensate from steam lines.

Series 2000
Sizing Examples

Example 1.

Conditions:
In this example, the steam supply to the process equipment in the installation (system) will be regulated by one Series 2000 pressure regulator. Assume all equipment will be operating at the same time at a constant load.

Problem:
Calculate the steam load requirements for all of the equipment in the process system by referring to the equipment name plate. Then select a Series 2000 pressure regulator from the Steam Capacity Tables to determine the specific model pressure regulator and valve size needed.

Known Data
Inlet pressure 75 psi (5.3 bar)

Equipment Identification	Operating Pressure psi (bar)	Maximum Pressure psi (bar)	Equipment Steam Loads Requirements lbs./hr. (kg/hr.)	Pipe Size in. (mm)
A	20 (1.4)	40 (2.8)	300 (136)	½ (15)
B	20 (1.4)	30 (2.1)	600 (272)	¾ (20)
C	20 (1.4)	25 (1.75)	400 (181)	¾ (20)
D	20 (1.4)	25 (1.75)	800 (363)	1 (25)
E	20 (1.4)	25 (1.75)	500 (227)	½ (15)
F	20 (1.4)	50 (2.5)	600 (272)	¾ (20)
Total Capacity 3200 lbs./hr. (1453 kg/hr.)				

Procedure:
The steps to size a Series 2000 pressure regulator are listed on page 39. For this problem assume :

1. An inlet pressure of 75 psi (5.2 bar).
2. An outlet pressure of 20 psi (1.4 bar).
3. The steam load adds up to 3200 lbs./hr. (1453 kg/hr.) as shown to the left.
4. Be sure to review the recommendations for good practice in selecting pressure regulators.
5. Refer to the Full Port Capacity Table first for your selection. The normal and reduced trim capacity tables should be used if there is a possibility the system will be expanded in the future.
6. Select the smallest regulator possible that will handle the steam load requirements. Typically it can be found in the Full Port Capacity Table.
7. When the outlet steam pressure is 50% or less of the inlet pressure, use the lowest outlet pressure shown in the capacity table.

Answer:

1. Referring to the Full Port Capacity Table, with the conditions given above under procedure, the correct valve to select would be a Model 2100 1½" (40mm) Main Valve-Full Port.
2. Since in our example there is no supply of compressed air in the plant nor a need to also control temperature, a spring pilot would be selected to handle the outlet pressure requirements. This would be a Model SSP-50 with an adjustable range of 2 to 50 psi (.14 to 3.5 bar). You would adjust the pilot to 20 psi (1.4 bar).

Example 2.

Conditions:
In this example, a pressure/temperature regulator has to be selected to regulate the steam going into a steam to water heat exchanger. Due to a planned plant addition in the next 5 years, the steam system will be enlarged.

Problem:
The exchanger heats water from 50°F to 150°F (10-65°C) and has an assumed water flow of 50 gpm (189 lpm). The heat exchanger is limited to a 20 psi (1.4 bar) steam pressure. Assume the steam supply pressure is 100 psi (6.9 bar).

Known Data:
Temperature Rise — 150°F - 50°F = 100°F (66 - 10 = 56°C)
Water Flow — 50 gpm (189 lpm) = 3000 gph (11,356 lph)
Steam Inlet — 100 psi (6.9 bar)
Steam Outlet — 20 psi (1.4 bar) (heat exchanger limit)

Procedure:

1. Refer to the following two pages to obtain the steam required to satisfy the above conditions. This would be 2500 lbs./hr. (1134 kg/hr.) according to the tables. Hint: 50 gpm x 60 min. = 3000 gph
2. Next, refer to the steam capacity tables for a normal port to obtain the regulator size since it is planned to enlarge this system at a later date.

Pressure and/or Temperature Pilot Operated Steam Regulators (continued)

Series 2000
Sizing Examples

Example 2. (continued)

3. When the outlet steam pressure is 50% or less of the inlet pressure, use the lowest outlet pressure shown in the capacity table.

Answer:

1. Using the above data and referring to the normal port capacity table, a 1¼" (32mm) NPT main valve with a normal port that passes 2880 lbs./hr. (1306 kg/hr.) of steam would be the answer.
   The order would be for:

   One, Model 2100, 1¼" (32mm) Main Valve-Normal Port.

2. Since temperature must be controlled, a combination of spring and temperature pilots should be selected. This would be:

   One Model SSP-50 with adjustable range of 2 to 50 psi. (.14 to 3.5 bar). The pilot would be adjusted to the required 20 psi (1.4 bar).

   One Model STPA-200 with a temperature range of 50-200°F (10-93°C) would be selected and adjusted to 150°F (65°C) to maintain the desired temperature of water leaving the heat exchanger.

NOTE: An alternate option is to use a pneumatic temperature pilot with an air pressure pilot and an air regulator. This would be:

One Model 315 PNT with a temperature range of 50-300°F (10-149°C) adjusted to 150°F (65°C) to maintain the desired temperature of water leaving the heat exchanger.

One Model AP-1A Air Pressure pilot to receive the control signal from the pneumatic temperature pilot.

One Air PRV Regulator, adjusted to maintain a maximum 20 psi (1.4 bar) outlet pressure.

Typical Guidelines for Selection of Temperature Regulators

The degree of temperature variation depends on load change. The chart below is based on 0% through 100% load change.

Type of Heater	Application	Type of Regulator
Instantaneous Heater	Domestic Hot Water	Series 2000 with pneumatic pilot for ± 4 deg. F. (must be used with anti-scald protection)
	Process fluids	Series 2000 with pneumatic pilot for ± 4 deg. F. Series 2000 with STPA pilot for ±10 deg. F. (System recirculation is recommended)
	Wash down stations	Same as process fluids (Pneumatic recommended if available)
	Steam to water converters	Series 2000 with either direct or pneumatic operated pilots. ± 10 deg. F. accuracy.
Semi-instantaneous Heater or Storage Heater	Domestic hot water	Series 2000 with pneumatic temperature pilot ± 4 deg. F. accuracy (must be used with anti-scald protection)
	Process fluids	Series 2000 with pneumatic temperature pilot ± 4 deg. F. accuracy. Direct-operated pilots ± 10 deg. F. accuracy.
	Wash down stations	Same as process fluids

Series 2000

Formulas for Sizing

Heating water with steam	lbs. steam/hr. = $\frac{\text{GPM}}{2}$ x temp. rise °F
Heating fuel oil with steam	lbs. steam/hr. = $\frac{\text{GPM}}{4}$ x temp. rise °F
Heating air with steam	lbs. steam/hr. = $\frac{\text{CFM}}{900}$ x temp. rise °F
Radiation conversion	lbs. steam/hr. = $\frac{\text{sq. ft. EDR}}{4}$
To convert lbs. steam/hr. to kg. steam/hr.	Multiply lbs./hr. x .454 = kg/hr.
For steam P_1 = Inlet psia P_2 = Outlet psia	When P_2 is 1/2 P_1 or less $Cv = \frac{\text{lbs./hr.}}{1.5 \times P_1}$ When P_2 is more than 1/2 P_1 $Cv = \frac{\text{lbs./hr.}}{2.1\sqrt{\Delta P \times (P_1 + P_2)}}$
Corrections	For superheat = 1 + .00065 (°F superheat) Flow at superheat = $\frac{\text{Flow at saturation}}{\text{superheat correction}}$

Pressure and/or Temperature Pilot Operated Steam Regulators (continued)

Series 2000 (continued)

Table 1 – Weights and Specific Heats of Liquids at 60°F

Liquid	Weight lbs./Gal.	Specific Heat BTU per lb. per °F
Fuel Oil (No. 6)	7.909 to 8.448	0.4 to 0.5
Heat Transfer Oil (Light)	8.17	0.82
Mineral Oil	7.67	0.65
Olive Oil	7.67	0.47
Petroleum Oil	6.84	0.50
Water	8.337	1.00

Table 2 – Lbs. of Steam Per Hr. to Heat Water

Temp.	Water - Gallons Per Hour																
Rise(°F)	100	150	200	300	400	500	750	1000	1500	2000	3000	4000	5000	7500	10000	15000	20000
10	9	13	17	25	33	42	63	83	125	170	250	330	420	630	830	1250	1700
20	17	25	34	50	68	83	125	166	250	340	500	700	830	1250	1700	2500	3400
30	25	37	50	70	100	120	190	250	370	500	750	1000	1200	1900	2500	3700	5000
40	34	50	68	100	135	165	250	335	500	700	1000	1350	1650	2500	3350	5000	7000
50	42	63	84	125	170	210	310	420	630	840	1250	1680	2100	3100	4200	6300	8400
60	50	75	100	150	200	250	375	500	750	1000	1500	2000	2500	3750	5000	7500	10000
80	67	100	135	200	270	330	500	670	1000	1400	2000	2700	3300	5000	6700	10000	14000
100	83	125	166	250	330	420	630	830	1300	1700	2500	3300	4200	6300	8300	13000	17000
120	100	150	200	300	400	500	750	1000	1500	2000	3000	4000	5000	7500	10000	15000	20000
140	116	175	235	350	470	580	880	1160	1800	2400	3500	4700	5800	8800	11600	18000	24000
160	135	200	270	400	540	660	1000	1350	2000	2800	4000	5400	6600	10000	13500	20000	28000

Table 2A – Kg of Steam Per Hr. to Heat Water

Temp.	Water - Liters Per Hour																
Rise(°C)	378	568	757	1135	1515	1890	2840	3785	5680	7570	11355	15140	18925	28390	37855	56780	75710
5.5	4	6	8	11	15	19	28	38	57	77	113	150	190	285	375	570	770
10	8	11	15	23	31	38	56	75	113	155	227	320	375	570	770	1135	1540
15.5	11	17	23	32	45	54	86	113	168	227	340	450	545	860	1135	1590	2270
20	15	23	32	45	61	75	113	152	227	320	450	610	750	1135	1520	2270	3175
25.5	19	29	38	57	77	95	140	190	285	380	570	760	950	1405	1900	2860	3810
31	23	34	45	68	91	113	170	227	340	455	680	910	1135	1700	2270	3400	4535
44	30	45	61	91	122	150	227	300	455	635	910	1225	1500	2270	3040	4535	6350
55.5	38	57	75	113	150	190	285	375	590	770	1135	1500	1900	2860	3765	5900	7710
66.5	45	68	91	136	181	227	340	455	680	910	1360	1815	2270	3400	4535	6800	9070
78	53	79	106	159	213	263	400	525	820	1090	1590	2130	2630	3990	5260	8165	10886
89	61	91	122	181	245	299	455	612	910	1270	1815	2550	3000	4535	6125	9070	12700

Series 2000 (continued)

Properties of Saturated Steam (Metric Chart on following page)

Pressure psig	Temp. °F	Heat in Btu/lb.			Specific Volume Cu. ft. per lb.	Pressure (psig)	Temp. (°F)	Heat in Btu/lb.			Specific Volume Cu. ft. per lb.
		Sensible	Latent	Total				Sensible	Latent	Total	
1	215	183	968	1151	25.2	80	324	294	891	1185	4.67
2	219	187	966	1153	23.5	85	328	298	889	1187	4.44
3	222	190	964	1154	22.3	90	331	302	886	1188	4.24
4	224	192	962	1154	21.4	95	335	305	883	1188	4.05
5	227	195	960	1155	20.1	100	338	309	880	1189	3.89
6	230	198	959	1157	19.4	105	341	312	878	1190	3.74
7	232	200	957	1157	18.7	110	344	316	875	1191	3.59
8	233	201	956	1157	18.4	115	347	319	873	1192	3.46
9	237	205	954	1159	17.1	120	350	322	871	1193	3.34
10	239	207	953	1160	16.5	125	353	325	868	1193	3.23
12	244	212	949	1161	15.3	130	356	328	866	1194	3.12
14	248	216	947	1163	14.3	140	361	333	861	1194	2.92
16	252	220	944	1164	13.4	145	363	336	859	1195	2.84
18	256	224	941	1165	12.6	150	366	339	857	1196	2.74
20	259	227	939	1166	11.9	155	368	341	855	1196	2.68
22	262	230	937	1167	11.3	160	371	344	853	1197	2.60
24	265	233	934	1167	10.8	165	373	346	851	1197	2.54
26	268	236	933	1169	10.3	170	375	348	849	1197	2.47
28	271	239	930	1169	9.85	175	377	351	847	1198	2.41
30	274	243	929	1172	9.46	180	380	353	845	1198	2.34
32	277	246	927	1173	9.10	185	382	355	843	1198	2.29
34	279	248	925	1173	8.75	190	384	358	841	1199	2.24
36	282	251	923	1174	8.42	195	386	360	839	1199	2.19
38	284	253	922	1175	8.08	200	388	362	837	1199	2.14
40	286	256	920	1176	7.82	205	390	364	836	1200	2.09
42	289	258	918	1176	7.57	210	392	366	834	1200	2.05
44	291	260	917	1177	7.31	215	394	368	832	1200	2.00
46	293	262	915	1177	7.14	220	396	370	830	1200	1.96
48	295	264	914	1178	6.94	225	397	372	828	1200	1.92
50	298	267	912	1179	6.68	230	399	374	827	1201	1.89
55	300	271	909	1180	6.27	235	401	376	825	1201	1.85
60	307	277	906	1183	5.84	240	403	378	823	1201	1.81
65	312	282	901	1183	5.49	245	404	380	822	1202	1.78
70	316	286	898	1184	5.18	250	406	382	820	1202	1.75
75	320	290	895	1185	4.91						

Pressure and/or Temperature Pilot Operated Steam Regulators (continued)

Series 2000 (continued)

Properties of Saturated Steam (Metric)

Absolute Pressure (kPa)	Temp °C	Heat In kJ/kg			Specific Volume Cu. ft. per lb.	Pressure (kPa)	Temp °C	Heat In kJ/kg			Specific Volume Cu. ft. per lb.
		Sensible	Latent	Total				Sensible	Latent	Total	
111.3	102.66	430.2	2250.2	2680.4	1.533	801.3	170.50	721.4	2047.7	2769.1	0.240
121.3	105.10	440.8	2243.4	2684.2	1.414	851.3	173.02	732.5	2039.2	2771.7	0.227
131.3	107.39	450.4	2237.2	2687.6	1.312	901.3	175.43	743.1	2030.9	2774.0	0.215
141.3	109.55	459.7	2231.3	2691.0	1.225	951.3	177.75	753.3	2022.9	2776.2	0.204
151.3	111.61	468.3	2225.6	2693.9	1.149	1001.3	179.97	763.0	2015.1	2778.1	0.194
161.3	113.56	476.4	2220.4	2696.8	1.083	1051.3	182.10	772.5	2007.5	2780.0	0.185
171.3	115.40	484.1	2215.4	2699.5	1.024	1101.3	184.13	781.6	2000.1	2781.7	0.177
181.3	117.14	491.6	2210.5	2702.1	0.971	1141.3	185.68	788.6	1994.4	2783.0	0.172
191.3	118.80	498.9	2205.6	2704.5	0.923	1181.3	187.25	795.5	1988.8	2784.3	0.166
201.3	120.42	505.6	2201.1	2706.7	0.881	1221.3	188.78	802.3	1983.2	2785.5	0.161
211.3	121.96	512.2	2197.0	2709.2	0.841	1261.3	190.24	808.8	1977.8	2786.6	0.156
221.3	123.46	518.7	2192.8	2711.5	0.806	1301.3	191.68	815.1	1972.5	2787.6	0.151
231.3	124.90	524.6	2188.7	2713.3	0.773	1401.3	195.10	830.4	1959.6	2790.0	0.141
241.3	126.28	530.5	2184.8	2715.3	0.743	1501.3	198.35	845.1	1947.1	2792.2	0.132
251.3	127.62	536.1	2181.0	2717.1	0.714	1601.3	201.45	859.0	1935.0	2794.0	0.124
261.3	128.89	541.6	2177.3	2718.9	0.689	1701.3	204.38	872.3	1923.4	2795.7	0.117
271.3	130.13	547.1	2173.7	2720.8	0.665	1801.3	207.17	885.0	1912.1	2797.1	0.110
281.3	131.37	552.3	2170.1	2722.4	0.643	1901.3	209.90	897.2	1901.3	2798.5	0.105
291.3	132.54	557.3	2166.7	2724.0	0.622	2001.3	212.47	909.0	1890.5	2799.5	0.100
301.3	133.69	562.2	2163.3	2725.5	0.603	2101.3	214.96	920.3	1880.2	2800.5	0.0949
321.3	135.88	571.7	2156.9	2728.6	0.568	2201.3	217.35	931.3	1870.1	2801.4	0.0906
341.3	138.01	580.7	2150.7	2731.4	0.536	2301.3	219.65	941.9	1860.1	2802.0	0.0868
361.3	140.00	589.2	2144.7	2733.9	0.509	2401.3	221.85	952.2	1850.4	2802.6	0.0832
381.3	141.92	597.4	2139.0	2736.4	0.483	2501.3	224.02	962.2	1840.9	2803.1	0.0797
401.3	143.75	605.3	2133.4	2738.7	0.461	2601.3	226.12	972.1	1831.4	2803.5	0.0768
421.3	145.46	612.9	2128.1	2741.0	0.440	2901.3	232.05	999.7	1804.4	2804.1	0.0689
441.3	147.20	620.0	2122.9	2742.9	0.422						
461.3	148.84	627.1	2117.8	2744.9	0.405						
481.3	150.44	634.0	2112.9	2746.9	0.389						
501.3	151.96	640.7	2108.1	2748.8	0.374						
521.3	153.40	647.1	2103.5	2759.6	0.361						
541.3	154.84	653.3	2098.9	2752.2	0.348						
561.3	156.24	659.3	2094.5	2753.8	0.336						
581.3	157.62	665.2	2090.2	2755.4	0.325						
601.3	158.92	670.9	2086.0	2756.9	0.315						
651.3	162.08	684.6	2075.7	2760.3	0.292						
701.3	165.04	697.5	2066.0	2763.5	0.272						
751.3	167.83	709.7	2056.8	2766.5	0.255						