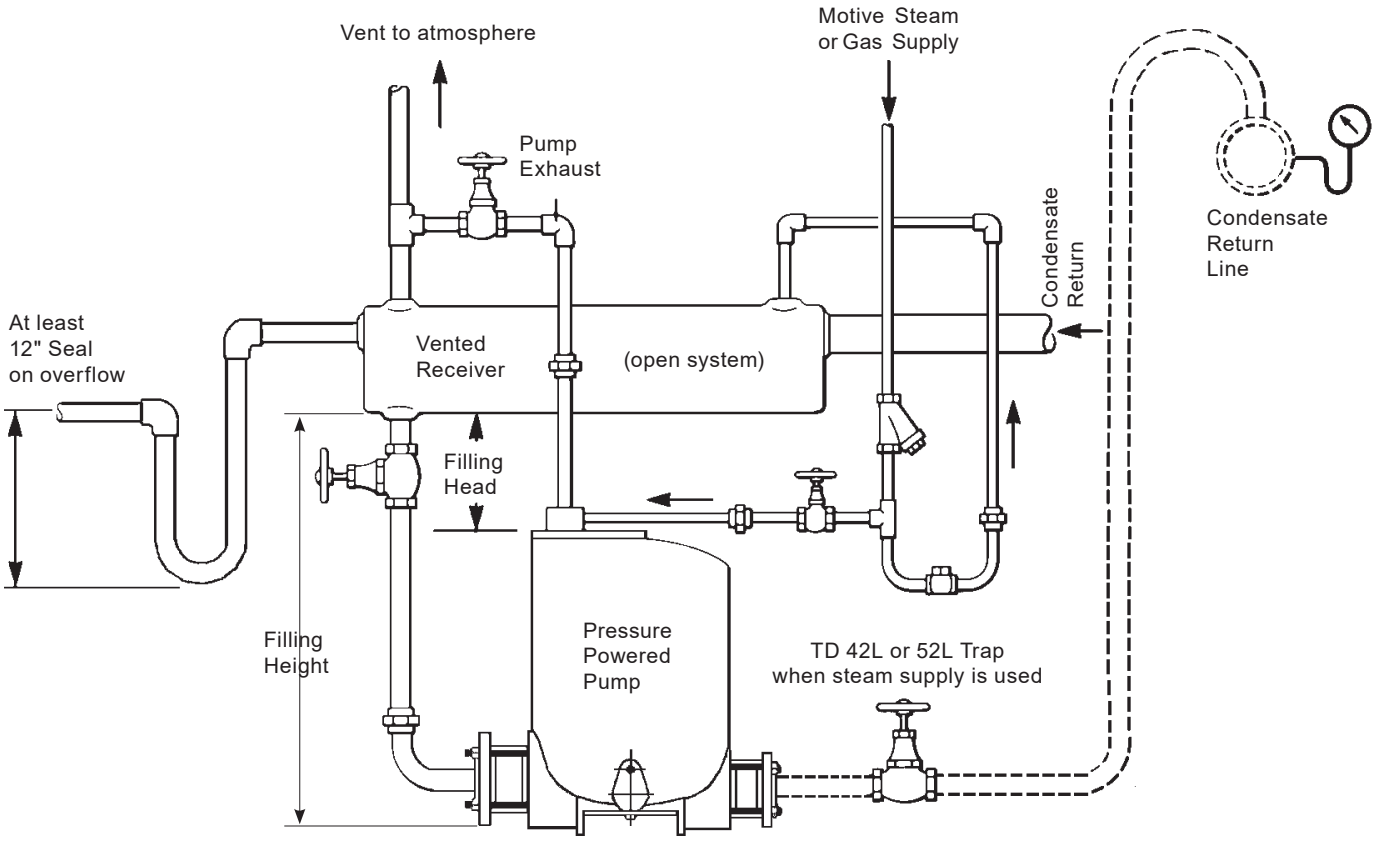
The Pivotrol® Pump Patented Selection and Sizing

How to Select and Size

From the inlet pressure, back pressure and filling head conditions given below, select the pump size and check valve package which meets the capacity requirement of the application.
Specify pump body, type PTC or PTF. Select optional extras as required.
For GPM, multiply the capacities below by 0.002.
For kg/h, multiply the capacities below by 0.454.
For liquid specific gravities from 0.9 to 0.65, consult Spirax Sarco.
* Back pressure is the lift height (H) in feet x 0.433 plus psi g in return line, plus downstream piping friction pressure drop in psi g calculated based on the maximum instantaneous discharge rate of the respective pump selected. (See TIS Sheets)

Note: To achieve rated capacity, pump must be installed with check valves supplied by Spirax Sarco. Use of a substitute check valve may effect the performance of the pump.



Recommended installation
The pump is fitted with vented receiver or an inlet reservoir.
Details of the application will determine whether a vented receiver or an inlet reservoir will be needed to accomplish this.

For capacities, condensate load and solution, see next page

Capacity lb/h

When installed with recommended filling head above top of pump.

Condensate load	7000 lb/h	(3175 kg/h)
Steam pressure available for operating pump	80 psi g	(5.51 bar g)
Vertical lift from pump to the return piping	30 feet	(914 cm)
Pressure in the return piping (piping friction negligible)	25 psi g	(1.72 bar g)
Filling head on the pump available	12"	(304 mm)

Solution:

1. Calculate "H", the total lift or back pressure, against which the condensate must be pumped = (30 x 0.433) + 25=38 psi g
2. From capacity table, with 80 psi g (5.51 bar g) inlet pressure and 40 psi g (2.75 bar g) back pressure, choose a 2" x 2" (50 mm x 50 mm) pump with stainless steel check valves, which ha a capacity of 6,935 lb/h.

Note from capacity multiplying factor charts:
A. Pump capacity if filling head is 24": 1.16 x 6,935 = 8045 lb/h
B. Pump capacity using compressed air: 1.12 x 6,935 = 7767 lb/h (% back pressure is 38—75=50%)

Vented receiver (Open system)

To drain condensate from a single or multiple source an "open" system, a vented receiver should be installed in a horizontal plane above and ahead of the pump. Sufficient receiver volume is needed above the filling head level to accept the condensate reachng the receiver during the pump discharge stroke.
More important, the receiver must be sized to allow sufficient area for complete flash steam separation from the condensate. The chart below shows proper vented receiver sizing (per criteria set forth in the A.S.H.R.A.E. Handbook) based on the amount of flash steam present. If the receiver is sized as shown below, there will be sufficient volume for condensate storage and sufficient area for flash steam separation. The receiver can be a length of large diameter pipe or a tank.

	Flash Steam up to —	Pipe Size Diameter	Length	Vent Line Diameter
Pump size - up to 3"x 2"	75 lb/h	4" (102 mm)	36" (914 mm)	1½" (38.1 mm)
	150 lb/h	6" (152 mm)	36" (914 mm)	2" (50.8 mm)
	300 lb/h	8" (203 mm)	36" (914 mm)	3" (76.2 mm)
	600 lb/h	10" (254 mm)	36" (914 mm)	4" (102 mm)
	900 lb/h	12" (305 mm)	36" (914 mm)	6" (152 mm)
	1200 lb/h	16" (406 mm)	36" (914 mm)	6" (152 mm)
	2000 lb/h	20" (508 mm)	36" (914 mm)	8" (203 mm)
Pump Size - PTF4	**Flash Steam up to —**	**Pipe Size Diameter**	**Length**	**Vent Line Diameter**
	1000 lb/h	16" (406 mm)	60" (1524 mm)	6" (152 mm)
	2000 lb/h	20" (508 mm)	60" (1524 mm)	8" (203 mm)
	3000 lb/h	24" (610 mm)	60" (1524 mm)	8" (203 mm)
	4000 lb/h	26'' (660 mm)	60" (1524 mm)	10" (254 mm)
	5000 lb/h	28" (711 mm)	60" (1524 mm)	10" (254 mm)
	6000 lb/h	30" (762 mm)	72" (1829 mm)	12" (305 mm)
	7000 lb/h	32" (813 mm)	72" (1829 mm)	12" (305 mm)
	8000 lb/h	36" (914 mm)	72" (1829 mm)	14" (356 mm)

Inlet Reservoir Piping (Closed System)

To drain condensate from a single piece of equipment in a "closed" system, a reservoir should be installed in a horizontal plane above and ahead of the pump. Sufficient reservoir volume is needed above the filling head level to accept the condensate reaching the reservoir during the pump discharge stroke. The chart below shows minimum reservoir sizing, based on condensate load, needed to prevent equipment flooding during the pump dischare stroke. The reservoir can be a length of large diameter pipe or a tank.

Pump size - up to 3"x 2"

Liquid lb/h	Reservoir Pipe Size				
	3"	4"	6"	8"	10"
500 or Less	2' (0.61 m)				
1000	2' (0.61 m)				
1500	3' (0.91 m)	2' (0.61 m)			
2000	3.5' (1.1 m)	2' (0.61 m)	1' (0.30 m)		
3000		3' (0.91 m)	2' (0.61 m)		
4000		4' (1.2 m)	2' (0.61 m)	1' (0.30 m)	
5000		6' (1.8 m)	3' (0.91 m)	2' (0.61 m)	
6000			3' (0.91 m)	2' (0.61 m)	
7000			3' (0.91 m)	2' (0.61 m)	
8000			4' (1.2 m)	2' (0.61 m)	
9000			4.5' (1.4 m)	3' (0.91 m)	2' (0.61 m)
10,000			5' (1.5 m)	3' (0.91 m)	2' (0.61 m)
11,000			5' (1.5 m)	3' (0.91 m)	2' (0.61 m)

Pump Size – PTF4

Liquid Load lb/h	Reservoir Pipe Size*			
	12"	16"	20"	24"
10,000	5' (1.5 m)	3' (0.91 m)	2' (0.61 m)	
20,000	10' (3.0 m)	7' (2.1 m)	4' (1.2 m)	
30,000		9' (2.7 m)	6' (1.8 m)	4' (1.2 m)
40,000		12' (3.7 m)	7.5' (2.3 m)	6' (1.8 m)
50,000			9' (2.7 m)	6' (1.8 m)
60,000			9' (2.7 m)	6' (1.8 m)

* When BP/MP is less than 50%, these reservoir lengths can be reduced by 1/2.

Capacity Multiplying Factors for other Filling Heads

Filling Head		Check valve and piping size, pump type			
Inches	**mm**	**2" x 2" PTC/PTF**	**3" x 2" PTC/PTF**	**PTF-HP**	**PTF4**
-3.0	-76	0.47	NA	NA	0.23
-1.0	-25	0.66	0.40	NA	0.41
0.0	0	0.76	0.43	0.6	0.70
6.0	152	0.90	0.69	0.9	0.89
12.0	305	1.00	1.00	1.0	0.95
18.0	457	1.08	1.02	1.1	0.98
24.0	610	1.16	1.04	1.2	1.00
36.0	914	1.38	1.17	1.3	1.00
48.0	1219	1.48	1.25	1.4	1.08
60.0	1524	N/A	N/A	1.5	1.20

Capacity Multiplying Factors for Motive Gas Supply

(other than steam) **2" and 3" x 2" PTC/PTF**									
10%	20%	30%	40%	50%	60%	70%	80%	90%	% Back Pressure VS. Motive Pressure (bp/MP)
1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.23	1.28	Capacity Multiplying Factors
PTF-HP									Capacity Multiplying Factors
1.19	1.43	1.43	1.53	1.85	2.04	2.14	2.20	2.44	
PTF4									Capacity Multiplying Factors
1.19	1.43	1.43	1.53	1.85	2.04	2.14	2.20	2.44	

Motive Pressure psi g	Back Pressure psi g	2" x 2" PTC/PTF 12" Filling Head lb/hr	3" x 2" PTC/PTF 3" x 3" PPF Top 12" Filling Head lb/hr	3" x 2" PTF-HTF 12" Filling Head lb/hr
200	180	-	-	-
200	160	-	5250	3518
200	140	6375	7375	4941
200	120	7375	9440	6325
200	100	8250	11145	7467
200	80	9000	12565	8419
200	60	9685	14260	9554
200	50	10000	14875	9966
200	40	10310	15690	10512
200	30	10635	16310	10928
200	20	10950	17000	11390
200	10	11195	17640	11819
180	160	-	3750	2513
180	140	5425	6335	4244
180	120	6685	8555	5732
180	100	7760	10375	6951
180	80	8600	11980	8027
180	60	9450	13625	9129
180	50	9830	14375	9631
180	40	10230	15150	10151
180	30	10560	15875	10636
180	20	10895	16665	11166
180	10	11195	17505	11728
160	140	4250	4860	3256
160	120	5750	7500	5025
160	100	7040	9375	6281
160	80	8065	11135	7460
160	60	9105	12940	8670
160	50	9565	13750	9213
160	40	9990	14565	9759
160	30	10440	15400	10318
160	20	10870	16270	10901
160	10	11195	17315	11601
140	120	4625	6085	4077
140	100	6120	8145	5457
140	80	7420	10065	6744
140	60	8625	12120	8120
140	50	9190	13000	8710
140	40	9690	13940	9340

Motive Pressure psi g	Back Pressure psi g	3" x 2" PTF-HP 12" Filling Head lb/hr
300	200	12550
300	185	13875
300	160	14565
300	140	15750
300	120	17125
300	100	19125
300	80	20315
300	60	22065
300	40	24375
300	20	27500
300	10	28750
280	200	11125
280	180	12435
280	160	13250
280	140	14435
280	120	16875
280	100	17875
280	80	19125
280	60	20850
280	40	23125
280	20	26125
280	10	27565
250	200	9190
250	180	10185
250	160	11000
250	140	12190
250	120	13935
250	100	15935
250	80	17065
250	60	19000
250	40	21200
250	20	24125
250	10	25700
200	180	6065
200	160	7190
200	140	8315
200	120	11935
200	100	12500
200	80	14065

Table continued on next page

Motive Pressure psi g	Back Pressure psi g	2" x 2" PTC/PTF 12" Filling Head lb/hr	3" x 2" PTC/PTF 3" x 3" PPF Top 12" Filling Head lb/hr	3" x 2" PTF-HTF 12" Filling Head lb/hr
140	30	10245	14875	9966
140	20	10760	15840	10613
140	10	11195	17045	11420
120	100	4700	6300	4221
120	80	6475	8625	5779
120	60	7845	10970	7350
120	50	8530	12100	8107
120	40	9240	13160	8817
120	30	9865	14250	9548
120	20	10535	15280	10238
120	10	11065	16655	11159
100	80	4995	6260	4194
100	60	6620	9255	6201
100	50	7500	10680	7156
100	40	8370	12040	8067
100	30	9145	13310	8918
100	20	9900	14460	9688
100	10	10630	16100	10787
80	60	5010	6485	4345
80	50	6000	8435	5651
80	40	6935	10185	6824
80	30	7970	11750	7873
80	20	8870	13250	8878
80	10	10000	15190	10177
60	50	4250	5000	3350
60	40	5315	7485	5015
60	30	6360	9625	6449
60	20	7460	11580	7759
60	10	9190	13750	9213
50	40	4440	5500	3685
50	30	5625	8125	5444
50	20	6730	10315	6911
50	10	8690	12755	8546
40	30	4630	5750	3853
40	20	5850	8700	5829
40	10	7930	11470	7685
30	20	4810	5810	3893
30	15	5475	8000	5360
30	10	6820	9690	6492
20	15	4375	5375	3601
20	10	5210	7450	4925
15	10	4375	6000	4020

Motive Pressure psi g	Back Pressure psi g	3" x 2" PTF-HP 12" Filling Head lb/hr
200	60	15825
200	40	18125
200	20	20815
200	10	22315
150	120	7875
150	100	8875
150	80	10750
150	60	12625
150	40	14935
150	20	17375
150	10	19000
125	100	7065
125	80	9065
125	60	10875
125	40	13250
125	20	15500
125	10	16685
100	80	7245
100	60	9125
100	40	11435
100	20	13810
100	10	15375
75	60	7035
75	40	9435
75	20	12125
75	10	13565
50	40	5085
50	20	10185
50	10	11625
25	20	2750
25	10	9685

PTF4

Motive Pressure psi g	Back Pressure psi g	36” Fill Head (70” Fill Height) lb/hr
200	150	22120
200	140	22970
200	120	24870
200	100	27110
200	80	29860
200	60	33400
200	50	35640
200	40	38390
200	30	41930
200	20	46920
200	15	50460
180	120	23700
180	100	26020
180	60	32500
180	50	34810
180	40	37640
180	30	41300
180	20	46440
180	15	50090
160	120	22530
160	100	24920
160	80	27830
160	60	31590
160	50	33980
160	40	36890
160	30	40660
160	20	45960
160	15	49720
140	100	23410
140	80	26220
140	60	29850
140	50	32150
140	40	34960
140	30	38590
140	20	43710
140	15	47340
120	80	24610
120	60	28110

Motive Pressure psi g	Back Pressure psi g	36” Fill Head (70” Fill Height) lb/hr
120	50	30320
120	40	33030
120	30	36530
120	20	41460
120	15	44950
100	60	24730
100	50	27100
100	40	30010
100	30	33750
100	20	39030
100	15	42780
80	60	21350
80	50	23880
80	40	26980
80	30	30970
80	20	36610
80	15	40600
70	50	21850
70	40	24830
70	30	28680
70	25	31120
70	20	34110
70	15	37960
60	40	22940
60	30	26840
60	25	29310
60	20	32330
60	15	36230
50	30	25310
50	25	27970
50	20	30910
50	15	34160
40	30	19480
40	25	22230
40	20	25600
40	15	29940
30	20	20440
30	15	25650

To size the PTF4 in a closed system:

Establish available motive pressure.
Establish static back pressure on Pump/Trap combination.
Place established pressures in formula below:

- Pump Motive Pressure (psi g) – min. VAV delta P (psi g) > Back Pressure (psi g)
- Capacity charts to be read as normal, i.e. at pump motive and back pressure.
- If, Pump Motive Pressure (psi g) – min. VAV delta P (psi g) < Back Pressure (psi g), then isolate or remove VAV and multiply capacity by 0.77 to find reduced capacity without VAV.

Sizing Example: 1

A closed system has the following conditions:
Motive steam available = 150 psi g. Static Back Pressure = 45 psi g.

Open System.

PTF4

Capacity charts show capacity at 150 psi g motive with 45 psi g back pressure.

Closed System.

The Vent Assist Valve on the PTF4 requires at least 75 psi g differential
pressure to operate in a closed system.

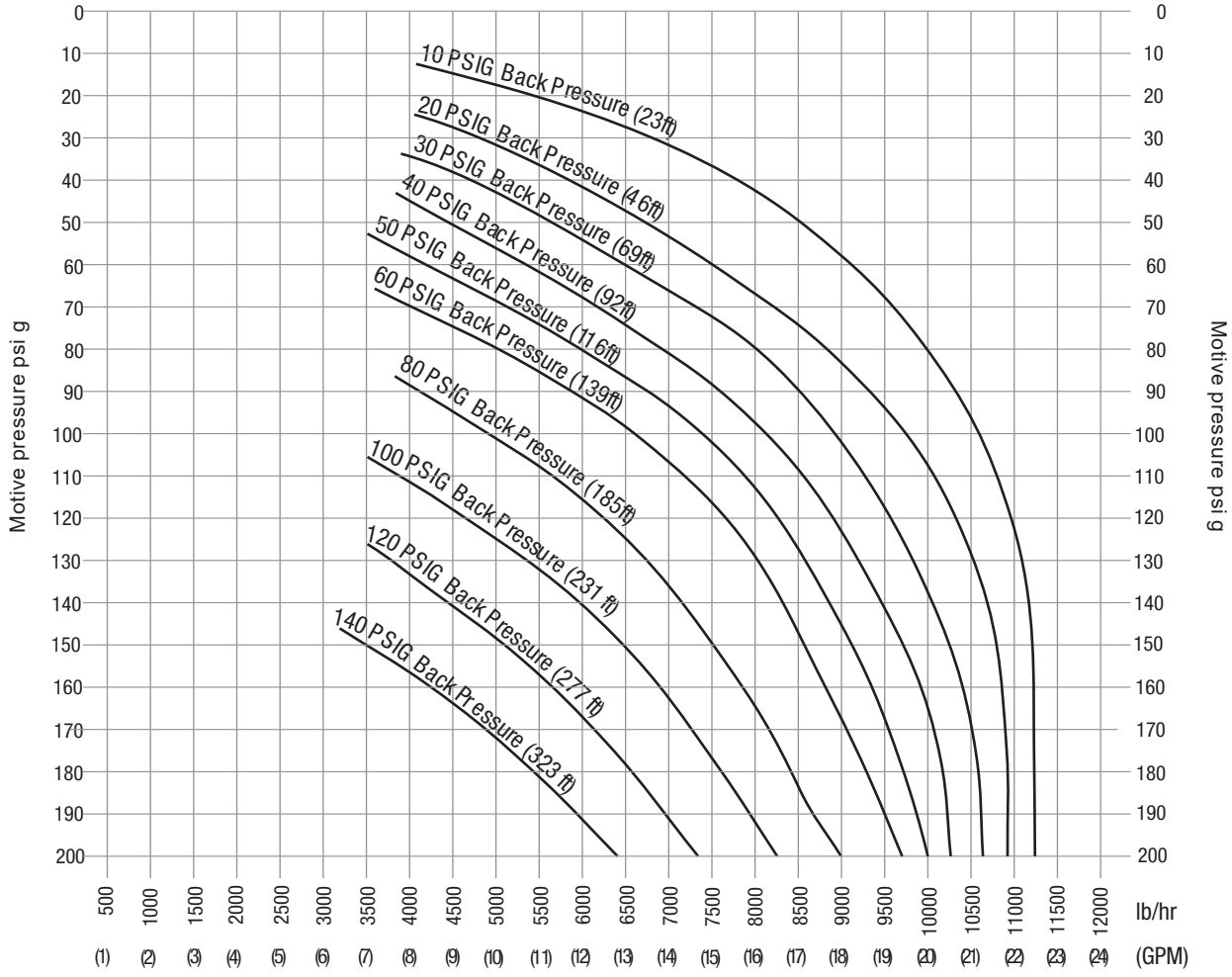
To size the PTF4 pump:

- Pump Motive Pressure – min. VAV delta P > Back Pressure.
- 150 psi g – 75 psi g > 45 psi g

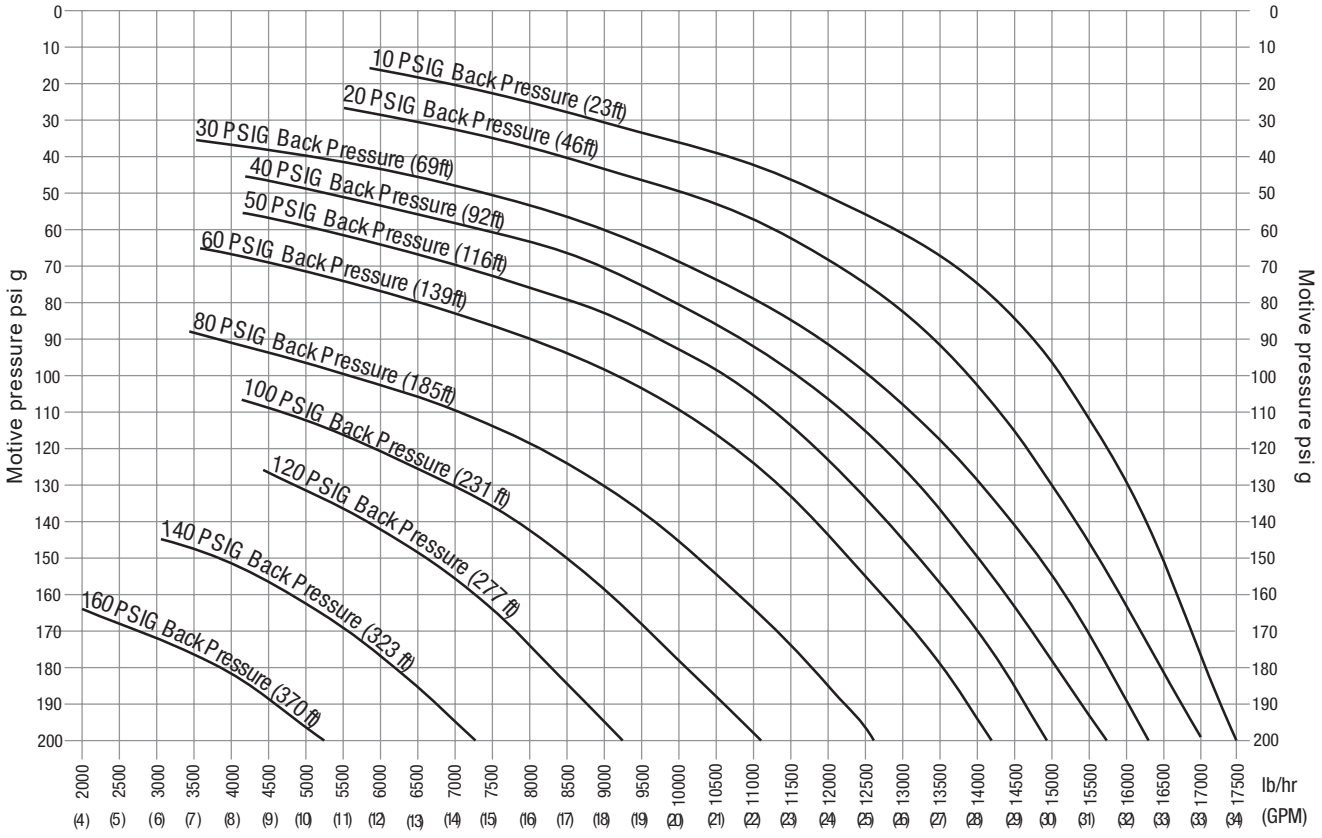
As the motive pressure is 150 psi g and the VAV requires a minimum 120 psi g to operate (75 + 45 = 120), this combination is sized correctly.

Capacity Charts

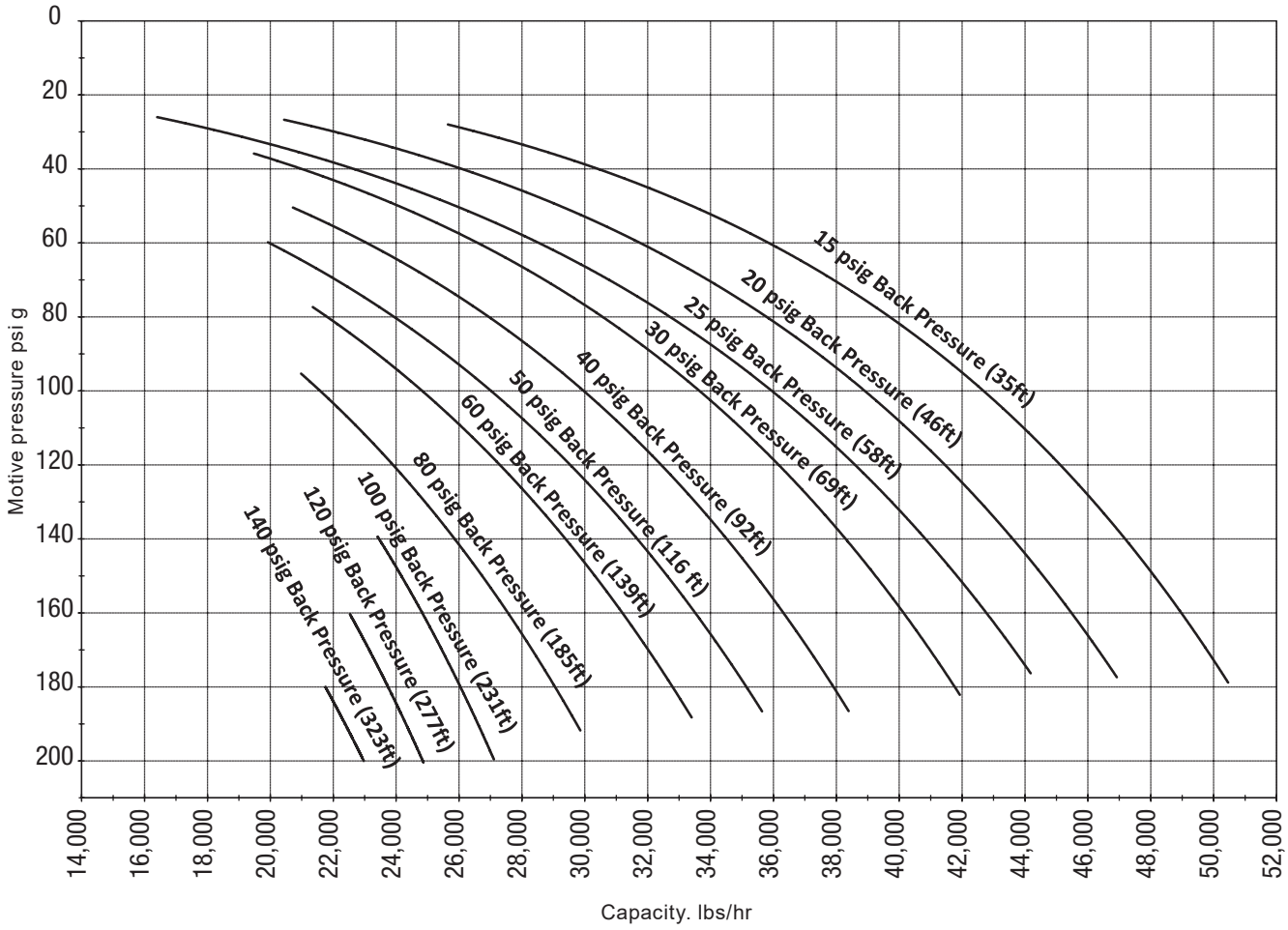
2" x 2" Pivotrol® Pump



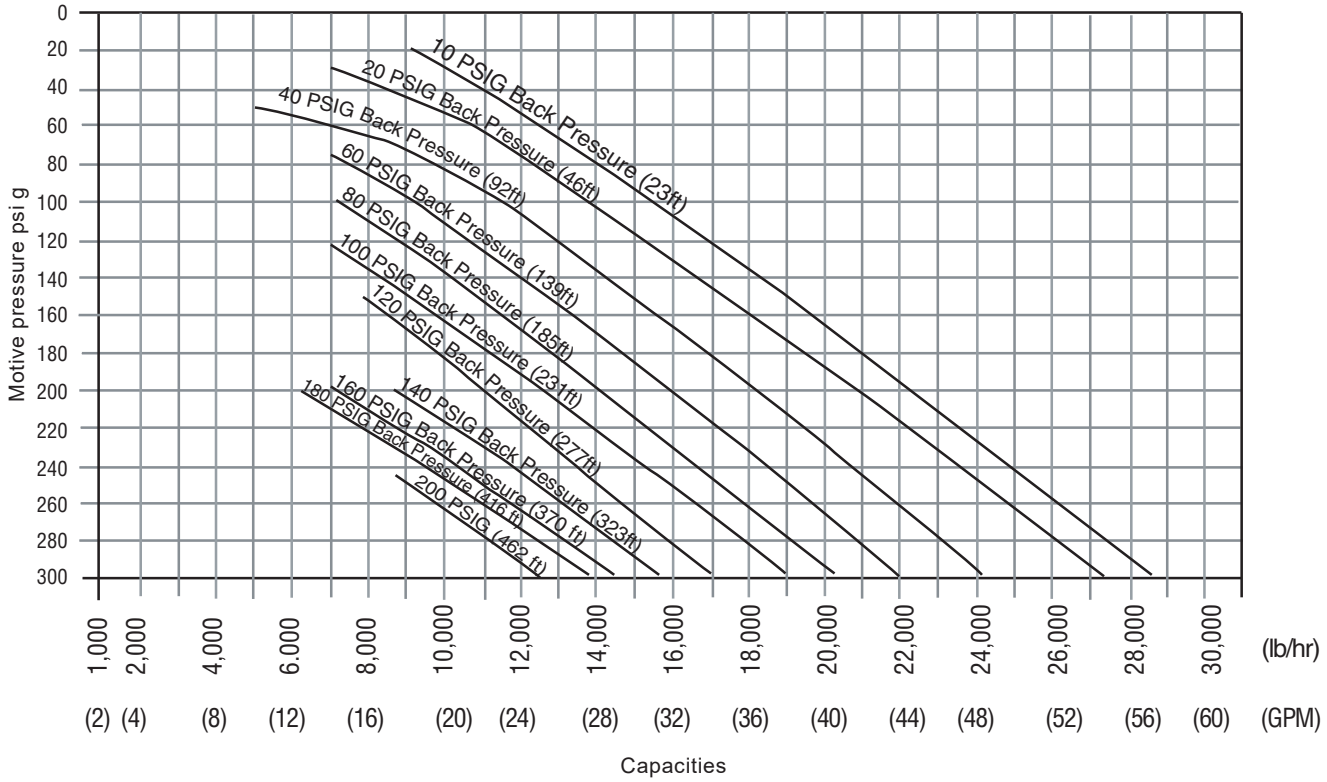
3" x 2" Pivotrol® Pump



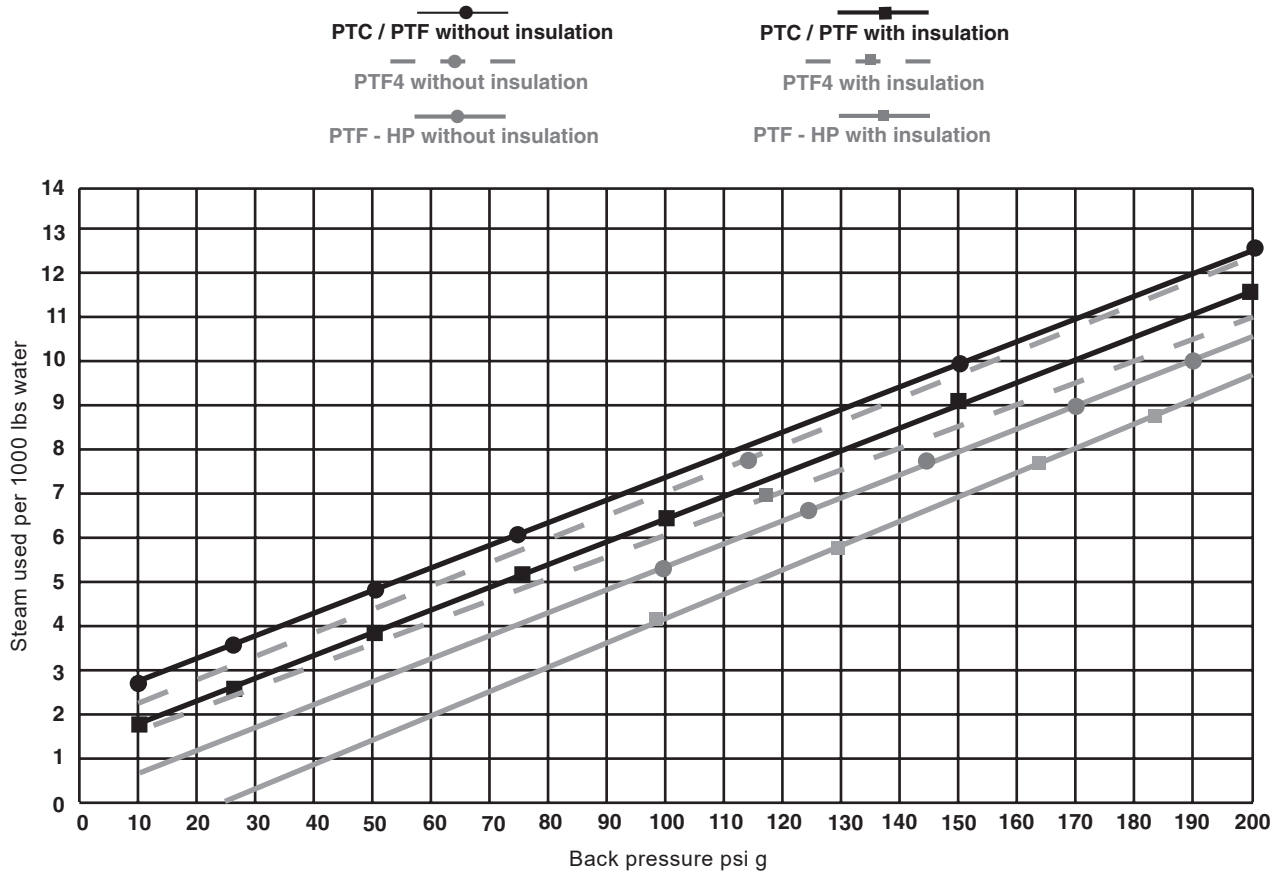
PTF4 Capacity Chart



3" x 2" PTF-HP Pivotrol® Pump



Pivotrol® Steam Consumption Chart



Pivotrol® air consumption chart