

Determining the Size of Fisher® Pump Governors

Calculation

The sizes of Fisher valves required for particular applications can be easily determined by using Emerson Process Management™ valve sizing techniques. However, before using these techniques for sizing pump governors that are to control the discharge pressure from steam driven direct acting pumps, the average steam cylinder pressure (valve outlet pressure) and the steam required should be calculated. These values can be found by the use of the following equations:

$$P_d = (P_1 - P_2) \frac{df^2}{ds^2} + F + P_e \quad \text{Equation 1}$$

$$S = \frac{(P_1 - P_2) QC}{1714} \quad \text{Equation 2}$$

Where:

- Pd = Average steam cylinder pressure, psig
- P₁ = Pump discharge, psig
- P₂ = Pump suction, psig
- Pe = Exhaust steam pressure, psig (If not given assume it to be Zero gauge)
- df = Diameter fluid cylinder, inches
- ds = Diameter steam cylinder, inches
- F = Correction factor for mechanical efficiency. (from table below)
- Q = Quantity of liquid, gpm
- C = Approximate steam consumption in lbs./hr. per delivered horse power hour. (from table below)
- S = Actual steam required, lbs./hr.

Stroke, Inches	Mech. Eff., %	Corr. Factor "F"	Approximate Steam Consumption, Pounds Dry Steam per Delivered Horsepower Hour For Direct Acting Duplex, Packed Piston, Non-condensing, Non-jacketed Pumps																		
			Steam Pressure at Pump, Psig																		
			50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	220	240	250
3	50	50	241	227	217	210	204	200	196	194	191	189	187	185	184	183	182	180	178	177	177
4	55	41	208	197	188	182	177	173	170	167	165	163	162	160	159	158	157	156	154	153	152
5	60	33	186	175	168	162	158	154	151	149	147	145	144	143	142	141	140	139	137	136	136
6	65	28	168	158	151	146	142	139	137	134	132	131	130	129	128	127	126	125	124	123	123
8	70	21	146	138	132	127	124	121	119	117	116	114	113	112	111	110	110	109	108	107	107
10	75	17	129	121	116	112	109	107	105	103	102	101	100	99	98	97	97	97	95	95	94
12	77.5	15	118	111	106	103	100	98	96	95	93	92	92	91	90	89	89	88	87	87	86
18	82.5	10	100	95	90	87	85	83	82	81	80	79	78	77	77	76	76	75	74	74	73
24	85	9	93	88	84	81	79	77	76	75	74	73	72	72	71	70	70	70	69	68	68



Example:

Required to size a pump governor which is to control the discharge pressure from an 8 x 5 x 10 inch (steam cylinder diameter x fluid cylinder diameter x stroke) duplex pump at 180 psig total head pressure pumping 100 gpm of fuel oil. Steam pressure is 120 psig with 15 psig exhaust steam pressure.

Steam Cylinder Pressure (Valve Outlet Pressure):

$$P_d = 180 \times \frac{(5)^2}{(8)^2} + 17 + 15 = 102 \text{ psig}$$

Steam Required:

$$S = \frac{180 \times 100 \times 107}{1714} = 1124 \text{ lb/hr}$$

Service Conditions:

Inlet = 120 psig

Pressure Drop = 18 psi

Steam Required = 1124 lb/hr

With the service conditions known, the size of the valve can be determined with Emerson Process Management valve sizing techniques.

Care must be taken not to use an extreme maximum value for the pump discharge pressure. If this is done, the steam cylinder pressure will be found, by equation 1, to exceed the steam supply pressure which may make the pump stall. If you still have difficulty obtaining a rational result, your Emerson Process Management sales office can assist you in the selection of the proper size pump governor for your particular application.

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