Pressure loss in fittings and valves

Pressure loss in fittings

Where the system is complex and intensively used and changes of directions, it is also possible to approximate the effect on head loss to the fittings. The following table can be used as a guid to the equivalent pipe length (in meters) for the commonly used pipe fittings:

Nominal size	½(15)	¾(25)	1(25)	1¼(32)	1½(40)	2(50)	3(80)	4(100)
Tee (Run)	0.30	0.43	0.52	0.70	0.82	1.22	1.86	2.41
Tee (Side Outlet)	1.16	1.49	1.83	2.23	2.54	3.66	5.00	6.70
90° Elbow	0.46	0.61	0.76	1.16	1.22	1.74	2.41	3.48
45° Elbow	0.24	0.34	0.43	0.55	0.64	0.79	1.22	1.55
Nominal size	6(150)	8(200)	10(250)	12(300)	14(350)	16(400)	20(500)	24(600)
Tee (Run)	3.75	4.27	5.33	6.10	7.62	8.23	10.67	12.80
Tee (Side Outlet)	9.97	14.94	17.38	20.43	23.78	26.83	35.98	41.77
90° Elbow	5.09	6.40	7.93	9.76	11.28	13.11	17.68	20.43
45° Elbow	2.44	3.23	4.12	4.73	5.49	6.10	7.62	9.15

Pressure loss in fittings and valves

Pressure loss in valves

All thermoplastic valves have a flow factor that is normally described as a Kv value. Kv value are an established means of defining the flow rate in m^3 per hour of water at 20° through a fully open value, with a pressure drop of 1 kg/cm^2.

The Cv vlaue is a commonly referenced flow coefficient for a valves manufactured in the U.S.A. it is defined as the flow of water though a value at 60°F (15.54°C) in US gallons per minute, with a pressure drop of 1 psi.

The connection between Flow Factor Kv and Flow Coefficient Cv can be expressed as:

Kv = 0.86 Cv
Cv = 1.16 Kv

The Kv value is also the sizing factor to calculate the drop (ΔP) in bar of a liquid flow across the value:

$$\Delta P = \delta \cdot \frac{Q^2}{Kv^2}$$

where
ΔP = Pressure drop (bar)
δ = Density of the liquid (kg/dm^3
Q = Flow rate (m^3/hr)

For example, calculate the pressure drop in a 50mm DN ball that is 50% closed handling 90% sulphuric acid (density 1.81kg/dm^3) at a flow rate of 12m^3/hr:

$$\Delta P = 1.81 \cdot \frac{12^2}{51^2}$$

(the Kv value is taken from the pressure drop characteristics table below and is calculated as 204 x 25%)

$$\Delta P = 1.81 \cdot 0.0554$$

$$\Delta P = 0.1002 \text{ bar}$$

If the flow, the maximum pressure drop and the density of the liquid are know, it is possible to calculate the minimum Kv value as follows:

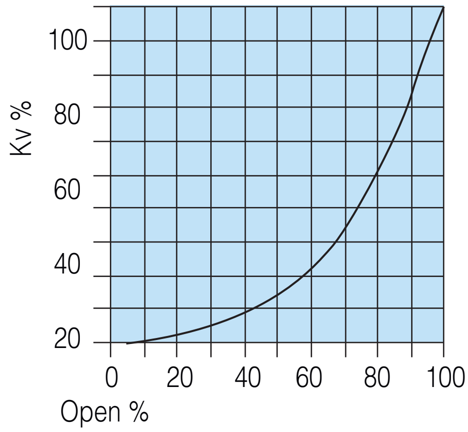
$$\text{Minimum Kv value in } m^3/hr = Q \sqrt{\frac{\delta}{\Delta P}}$$

The Kv value for all valves can be read from the appropriate flow chart for each valve type. Kv flow charts give the flow characteristics of each type of value, from the fully closed to the fully open position.

Typical valve pressure drop characteristics

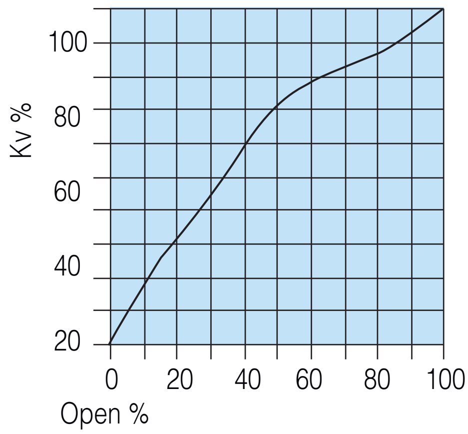
Ball Valve (2-way)

Dn (mm)	DN (inch)	Kv value (m³/hr)
15	fi	12
20	fl	23
25	1	46
32	1/	66
40	1fi	105
50	2	204
65	2fi	315
80	3	425
100	4	570



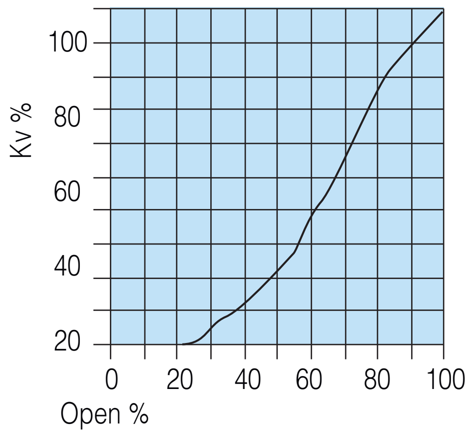
Diaphrarm Valve

Dn (mm)	DN (inch)	Kv value (m³/hr)
15	fi	5
20	fl	8
25	1	10
32	1/	18
40	1fi	25
50	2	46
65	2fi	78
80	3	120
100	4	162



Butterfly Valve

Dn (mm)	DN (inch)	Kv value (m³/hr)
65	2fi	102
80	3	213
100	4	354
125	45	591
150	6	1122
200	8	1830
250	10	3800
300	12	5400



Check Valve

Dn (mm)	DN (inch)	Kv value (m³/hr)
15	fi	7
20	fl	12
25	1	23
32	1/	34
40	1fi	50
50	2	78
65	2fi	117
80	3	156
100	4	210

Line Strainer

Dn (mm)	DN (inch)	Kv value (m³/hr)
15	fi	2
20	fl	4
25	1	6
32	1/	11
40	1fi	15
50	2	25
65	2fi	39
80	3	63
100	4	102