TERAL

Calculation of friction loss of piping

■ Formula for calculating friction loss of piping

This notification shall establish standards for calculating the friction loss of piping as stipulated in Article 12, Item 7, (g), Article 14, paragraph 1, Item 11,(e) and Article 16, paragraph 3, Item 3, (f) of the Fire Service Law Enforcement Regulation (Article 6 of the Ordinance of the Ministry of Home Affairs, 1961).

● Calculation of friction loss of piping shall be based on the following formula.

$$H = \sum_{n=1}^{N} Hn + 5 \qquad \left(H = \sum_{n=1}^{N} Hn \text{ for those not using the flow water detector} \right)$$

H is the friction loss head of piping (unit: m)

n is the number of Hn required to calculate the friction loss of the piping

Hn is the friction loss head (unit: m) for each nominal size of piping determined by the following formula.

$$Hn = 1.2 \frac{Q_k^{1.85}}{D_k^{4.87}} \left(\frac{1'_k + 1''_k}{100} \right)$$

Qk is the absolute value of the flow rate (unit: ℓ per minute) of water or bubble aqueous solution flowing in a pipe with a nominal size of K.

Dk is the absolute value of the reference bore diameter (unit: cm) of the pipe for which the nominal size is K.

1'k is the sum of the lengths of straight pipes with a nominal size of K (unit: m)

1''k is the sum of the values converted into straight pipe equivalent length by the values specified in Tables 1 to 3 for each type of pipe to be used in accordance with the nominal size of the pipe joints and valves for which the nominal size is K. (unit: m)

It should be noted that the value of $12 \frac{Q_k^{1.85}}{D_k^{4.87}}$ can be obtained by a numerical value for each flow rate in Figs 1 to 2, which is calculated according to the designation of the type and size of the pipe.

■ Straight pipe equivalent length

● When Carbon steel pipes for ordinary piping (JIS G3452)SGP is used

Table 1

Type		Nominal size		25	32	40	50	65	80	90	100	125	150	200	250	300	350
Pipe joint	Screwed type	45˚ Elbow		0.4	0.5	0.6	0.7	1.0	1.1	1.3	1.5	1.8	2.2	2.9	3.6	4.3	4.8
		90˚ Elbow		0.8	1.1	1.3	1.6	2.0	2.4	2.8	3.2	3.9	4.7	6.2	7.6	9.2	10.2
		Return bend (180˚)		2.0	2.6	3.0	3.9	5.0	5.9	6.8	7.7	9.6	11.3	15.0	18.6	22.3	24.8
		Tees or cloth (shunt 90˚)		1.7	2.2	2.5	3.2	4.1	4.9	5.6	6.3	7.9	9.3	12.3	15.3	18.3	20.4
	Welding type	45˚ elbow	Long	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.2	1.5	1.8	2.0
		90˚ Elbow	Short	0.5	0.6	0.7	0.9	1.1	1.3	1.5	1.7	2.1	2.5	3.3	4.1	4.9	5.4
			Long	0.3	0.4	0.5	0.6	0.8	1.0	1.1	1.3	1.6	1.9	2.5	3.1	3.7	4.1
		Tees or cloth (shunt 90°)		1.3	1.6	1.9	2.4	3.1	3.6	4.2	4.7	5.9	7.0	9.2	11.4	13.7	15.3
Valves		Gate valve		0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	1.6	2.0	2.2
		Ball valve		9.2	11.9	13.9	17.6	22.6	26.9	31.0	35.1	43.6	51.7	68.2	84.7	101.5	113.2
		Angle valve		4.6	6.0	7.0	8.9	11.3	13.5	15.6	17.6	21.9	26.0	34.2	42.5	50.9	56.8
		Check valve (Swing)		2.3	3.0	3.5	4.4	5.6	6.7	7.7	8.7	10.9	12.9	17.0	21.1	25.3	28.2

● Carbon steel pipes for pressure service (JIS G3454)STPG Schedule 40)

Table 2

Type		Nominal size		25	32	40	50	65	80	90	100	125	150	200	250	300	350
Pipe joint	Screwed type	45˚ Elbow		0.4	0.5	0.6	0.7	0.9	1.1	1.2	1.4	1.8	2.1	2.8	3.5	4.2	4.7
		90˚ Elbow		0.8	1.1	1.2	1.6	2.0	2.4	2.6	3.1	3.8	4.5	6.0	7.5	9.0	10
		Return bend (180˚)		2.0	2.6	3.0	3.9	4.8	5.7	6.6	7.5	9.3	1.0	14.6	18.2	21.8	24.3
		Tees or cloth (shunt 90˚)		1.6	2.1	2.5	3.2	4.0	4.7	5.2	6.1	7.6	9.1	12	15	18	20
	Welding type	45˚ elbow	Long	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.8	0.9	1.2	1.5	1.8	2.0
		90˚ Elbow	Short	0.4	0.6	0.7	0.9	1.1	1.3	1.4	1.6	2.0	2.4	3.2	4.0	4.8	5.3
			Long	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.5	1.8	2.4	3.0	3.6	4.0
		Tees or cloth (shunt 90°)		1.2	1.6	1.9	2.4	3.0	3.5	3.9	4.6	5.7	6.8	9.0	11.2	13.4	15
Valves		Gate valve		0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	1.6	2.0	2.2
		Ball valve		9.0	11.8	13.7	17.6	22	26	29.1	34	42	50.3	56.6	82.9	99.2	111
		Angle valve		4.6	5.9	6.9	8.8	11	13.1	14.6	17.1	21.2	25.2	33.4	41.6	48.8	55.7
		Check valve (Swing)		2.3	3.0	3.4	4.4	5.5	6.5	7.3	8.5	10.5	12.5	16.6	20.7	24.7	27.7

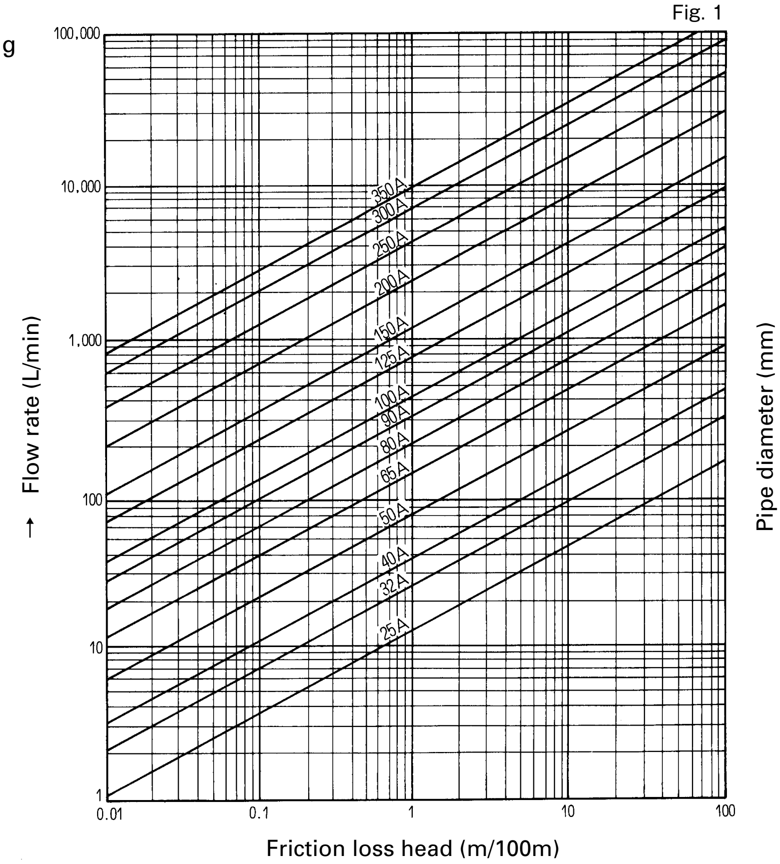
■ Friction loss head per 100m pipe length

● When using Carbon steel pipes for ordinary piping (JIS G3452)SGP

Numerical value when calculating friction loss head for pipe length 100m in m

Equation: $1.2\,\dfrac{Q_k^{1.85}}{D_k^{4.87}}$

Fig. 1

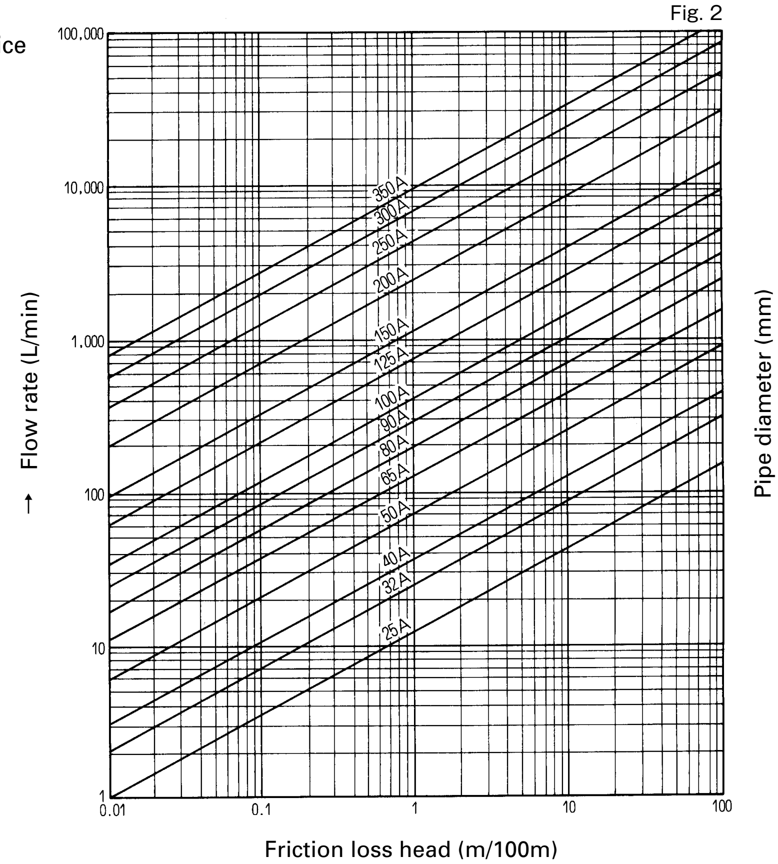


● When using Carbon steel pipes for pressure service (JIS G3454)STPG Schedule 40

Numerical value when calculating friction loss head for pipe length 100m in m

Equation: $1.2\,\dfrac{Q_k^{1.85}}{D_k^{4.87}}$

Fig. 2



● Friction loss head of fire hose

Table 3

Fire fighting equipment	Flow rate L/min	Friction loss head (m)			
		Length	Nominal hose diameter (A)		
			40	50	65
Indoor No.1	150	Per 1m	0.12	0.03	–
		Per 30 m	3.6	0.9	–
Outdoors	400	Per 1m	–	–	0.06
		Per 40 m	–	–	2.4

The hose friction loss heads for indoor No.2 and easy operation No.1 should be based on the manufacturer's catalog values.