GAS PIPE SIZING

1. Design Considerations

To determine the appropriate size of pipe used in a gas installation, the following factors must be considered:

- Allowable pressure loss from the outlet of gas meter installation to gas appliances. The Code of practice for gas installation [SS 608 : 2015] specifies that the pipework shall be designed to operate with a pressure drop of not exceeding **1 mbar** between the gas meter and the connection point of gas appliance(s).

- Gas demand. Sizing of piping must take into consideration of the required maximum gas flow and allowance for any future extension to existing gas installation.
- Diversity factor may be applied when demand of all the gas draw-off points (multi-usage) occurs at different time, over the demand period.

2. Pole's Formula

Pole's formula can be used as the basis for the relationship between flow rate, pipe size, pressure loss and pipe length. It is effective for calculating pipe sizes in low pressure gas installation.

$$Q = 0.0071\sqrt{\frac{h \times d^5}{s \times l}}$$

Where Q = flow rate (m^3/hr)
h = pressure loss (mbar)
d = pipe diameter (mm)
s = specific gravity of gas (0.59 for town gas)
l = length of pipe conveying gas (m)

3. Factors Affecting Pressure Drop

The factors that affect pressure drop are:

- gas flow rate (Q) – the amount of pressure loss is proportional to the square of the volume of gas flow$(m^3)^2$. In simple terms, double the flow rate and the pressure loss increases four fold.
- diameter of gas pipe (d) – the pressure loss is inversely proportional to the fifth power of the pipe diameter (d^5). In simple terms, if the diameter of a pipe is reduced by halve, its pressure will increase 32 times
- specific gravity of gas (s) – double the weight of the gas and the pressure loss will be doubled. Conversely, halve its weight and the pressure loss will be halved.

- length of pipe (l) & fittings – With double the length of pipe, the pressure loss is doubled. Conversely, if its length is halved, the pressure loss will be halved.
- friction factor – a smooth pipe wall will generate less friction than coarse surface.

(Source: R.D. Treloar, 2010, Gas Installation Technology 2nd edition)

4. Typical Pipe Size Calculation

Example:

Shown below is an illustration of a gas supply to four gas equipment at point C, E, G and H. Looking at the illustration you can see that there are 4 possible sections: (SA-B) + (SB-D) + (SD-F) + (SF-G) or (SF-H).

When designing the gas installation, it is essential that consideration is given to the permissible pressure loss in each section of the installation (e.g. Section A-H is made up of four sections. Then each section must have a reasonable or equal pressure loss of less than 0.25 mbar (1 mbar ÷ 4 sections).

The total pressure loss is the sum of the pressure loss in each section and should not exceed 1 mbar. If the total pressure loss exceeds, then it is necessary to re-evaluate the design of the installation.

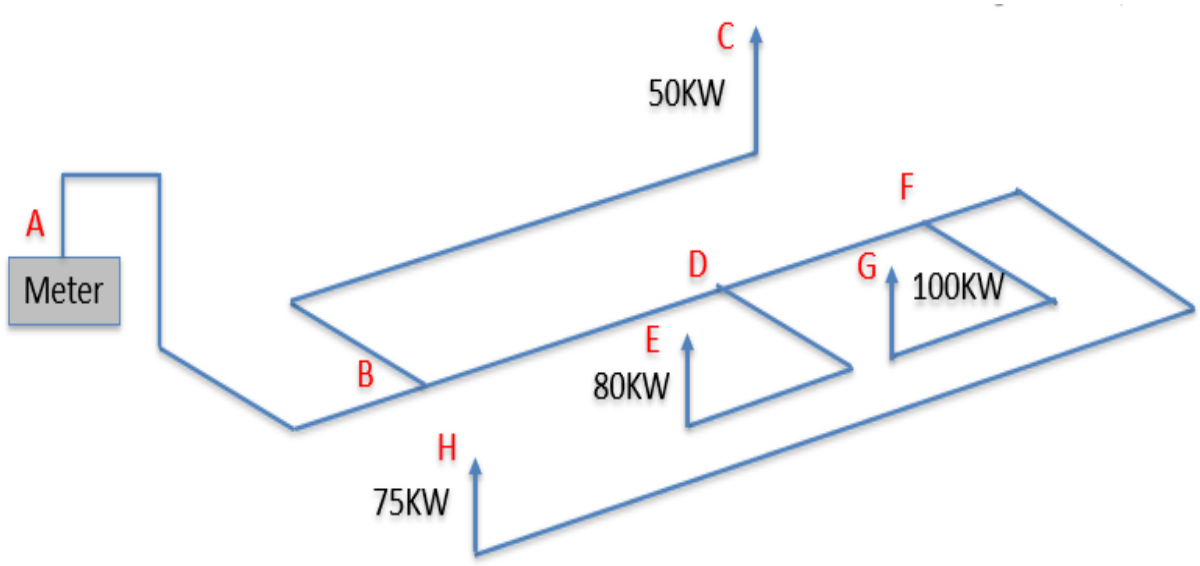

Table A1

	Pipe Section	Gas consumption (Q)		Pipe Length (L)	Equivalent length fitting (Le)			Total Length, $L_t = (L + Le)$	Selected Pipe Dia (d)	Pole's Formula $h = (Q^2 * s * L_t) / [d^5 * (0.0071)^2]$
		kW	m3/hr	m	No of fittings	Fitting Pressure Loss (m)	Equivalent length (m)	m	mm	mbar
S1	S_{A-B}	305.00	58.865	4.0	5	1.5	7.5	11.5	80	0.142
S2	S_{B-C}	50.00	9.650	6.0	2	1.5	3	9	40	0.096
S3	S_{B-D}	255.00	49.215	3.0	1	2	2	5	50	0.454
S4	S_{D-E}	80.00	15.440	3.5	2	1.5	3	6.5	40	0.177
S5	S_{D-F}	175.00	33.775	3.0	1	2.5	2.5	5.5	50	0.235
S6	S_{F-G}	100.00	19.300	3.0	2	2	4	7	50	0.098
S7	S_{F-H}	75.00	14.475	6.0	3	1.5	4.5	10.5	40	0.251

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Table A2

To equipment @ Point	Section	Total Pressure loss per application < 1 mbar
C	$S_{A-B} + S_{B-C}$	0.24
E	$S_{A-B} + S_{B-D} + S_{D-E}$	0.77
G	$S_{A-B} + S_{B-D} + S_{D-F} + S_{F-G}$	0.93
H	$S_{A-B} + S_{B-D} + S_{D-F} + S_{F-H}$	1.08

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Results from Table A1 & A2

Point 1 – Total pressure loss across for section A-H (meter to Equipment H) exceeded 1 mbar.

Point 2 – Pressure loss across section B-D is peculiar. Since each section must have a reasonable or equal pressure loss of less than 0.25 mbar (1 mbar ÷ 4 sections).

Action : review the proposed pipe size for Section B-D and re-assess the results.

Table A3 (Re-Evaluation)

	Pipe Section	Gas consumption (Q)		Pipe Length (L)	Equivalent length fitting (Le)			Total Length, $L_t = (L + Le)$	Selected Pipe Dia (d)	Pole's Formula $h = (Q^2 * s * L_t) / [d^5 * (0.0071)^2]$
		kW	m3/hr	m	No of fittings	Fitting Pressure Loss (m)	Equivalent length (m)	m	mm	mbar
S1	S_{A-B}	305.00	58.865	4.0	5	1.5	7.5	11.5	80	0.142
S2	S_{B-C}	50.00	9.650	6.0	2	1.5	3	9	40	0.096
S3	S_{B-D}	255.00	49.215	3.0	1	2	2	5	80	0.043
S4	S_{D-E}	80.00	15.440	3.5	2	1.5	3	6.5	40	0.177
S5	S_{D-F}	175.00	33.775	3.0	1	2.5	2.5	5.5	50	0.235
S6	S_{F-G}	100.00	19.300	3.0	2	2	4	7	50	0.098
S7	S_{F-H}	75.00	14.475	6.0	3	1.5	4.5	10.5	40	0.251

Pipe size for Section B-D revised to Ø80mm

Table A4

To equipment @ Point	Section	Total Pressure loss per application < 1 mbar
C	$S_{A-B} + S_{B-C}$	0.24
E	$S_{A-B} + S_{B-D} + S_{D-E}$	0.36
G	$S_{A-B} + S_{B-D} + S_{D-F} + S_{F-G}$	0.52
H	$S_{A-B} + S_{B-D} + S_{D-F} + S_{F-H}$	0.67

Results from Table A3 & A4

With the revision of the pipe size in Section B-D, the total pressure loss across for section A-H (meter to Equipment H) has gravitated below 1 mbar.

5. Allowance for Pipe Fittings

Suggested pressure loss due to pipe fittings.

Approx. Size	Metallic	≤25mm	40mm	50mm	65mm	80mm	150mm
	PE	≤25mm	55mm	75mm	100mm	140mm	200mm
90° Elbows & Tees		0.5m	1.0m	1.5m	2.0m	2.5m	3.0m
Pulled Bends		0.3m	0.45m	0.65m	1.0m	1.2m	2.2m

(Source: R.D. Treloar, 2010, Gas Installation Technology 2nd edition)

6. Estimated Monthly Gas Consumption Information

a) Residential Development

Gas Supply	Monthly Consumption (units/household)
Condominium (cooking)	50
Condominium (cooking + heating)	130
Public Housing (cooking)	110
Landed House (cooking)	150
Dormitory (cooking)	450

b) Commercial Development

Gas Supply	Monthly Consumption (units)
School Canteen Stall	350
School Lab	150
Foodcourt/Eating House stall	3,000
Food Kiosk	500
Food Centre stall	3,000
F&B (large/chinese)	20,000 - 50,000
F&B (small)	5,000 – 10,000
Laundromat	3,000

Note: Monthly gas consumption figures are based on historical data. The information serves as a reference for PE/LGSW when designing the gas installation. PE/LGSW is advised to obtain accurate figures for each project as the gas consumption figures may vary depending on provision of projects.

DISCLAMIER

This document serves as a reference for basic understanding of the various factors affecting pipe sizing in a low-pressure gas piping system. It is not intended to serve the purpose as a substitution of the specialized M&E design with the needs of detailed evaluation of complex applications.

For more detailed information and in-depth understanding of pipe sizing design, please seek professional advice or alternatively, please refer to the relevant textbooks that are available.