DOMESTIC GAS PIPEWORK

PART 1 - PIPE SIZING

Copper's strength, neat unobtrusive appearance, fire and corrosion resistance make it an ideal material for gas installation pipes.

Determining tube sizes

BS 6891 is the industry standard for mains gas piping installations. It states that in a domestic natural gas installation the pressure drop along the pipeline at periods of maximum demand should be no more than 1mbar. The reason for this is that, if under-sized pipes are installed, the pressure at the burner could become so low that incomplete combustion occurs, which is dangerous as carbon monoxide will be produced! So, when planning a gas installation it is important to ensure that the tube diameters chosen are able to supply the volume of gas required by the appliances without excessive pressure loss.

Manufacturer's installation instructions will only give guidance on the appropriate diameter of tube to be used to supply their own gas appliance. Where more than one appliance is to be installed, it is necessary to determine suitable tube diameters for the installation that can satisfy the maximum demand without excessive pressure loss.

Figure 1 shows a typical domestic natural gas piping installation; it supplies a gas fire with a heat input of 7kW and a cooker with a heat input of 16kW. The main existing piping run (1-2) is installed with 22mm tube. A boiler (with piping shown dashed) with a heat input of 35kW is to be added to the installation.

Assessing the existing meter capacity

Before extending an existing installation to add another appliance it is necessary to consider the existing meter capacity. In the UK the standard domestic gas meter has a maximum volume flow-rate of 6m^3 of gas per hour (Q max on the meter data plate), which equates to a maximum of 64.1kW of appliance heat input. This figure should not be exceeded, otherwise the meter will be overloaded and the pressure drop will be too great.

So, to check for spare capacity on an installation, first examine the data plates of the existing appliances to find their heat input in kW. Then total these and subtract the total from 64 to determine any spare capacity for the extra appliance. In Figure 1 the existing heat inputs are 7 + 16 = 23kW, and 64 – 23 = 41kW of spare capacity, which is more than is required for the new boiler with a heat input of 35kW.

Note: if there is insufficient capacity for the extra appliance, the gas supplier should be contacted before commencing work to extend the installation.

Table 1 gives details of maximum lengths of copper tube for various flow-rates for natural gas. We can use it to select suitable tube diameters for the installation.

Note: Flow rates are for low-pressure supplies with 1mbar differential pressure between ends of pipe for gas of relative density 0.6

Determining the gas flow rate for an appliance

To determine the gas-rate for an appliance divide the appliance heat input in kW by the 'calorific value' (CV) of the gas being burnt. In the case of natural gas this is 38.5MJ/m^3. For example, for a 10kW appliance the flow rate will be:
10 ÷ 38.5 = 0.26litres/second.
This figure can then be multiplied by 3.6 to convert the flow rate from l/s to m^3/hour = 0.26 x 3.6 = 0.936m^3/hour.

Table 2 - illustrates how the tube sizes needed to supply the appliances shown in Figure 1 can be found. First, each numbered pipe run is identified on the drawing and then listed in column 1 of the table. Next, the total gas flow in kW through each pipe run is found. This is determined by totalling the number of kW each pipe run supplies; this is then noted in column 2. For example, pipe run 1-2 has to serve all appliances and so will need to pass 7 + 16 + 35 = 58kW. Pipe run 2-4 serves the cooker and boiler, so it will need to pass 16 + 35 = 51kW. These figures can then be converted

Table 1 Approximate flow of gas (m^3/hour) in straight horizontal copper tube

Tube size (mm)	Length of pipe run (m)							
	3	6	9	12	15	20	25	30
10 x 0.6	0.84	0.56	0.51	0.36	0.31	0.22	0.17	0.14
12 x 0.6	1.52	1.01	0.84	0.82	0.67	0.51	0.39	0.33
15 x 0.7	2.9	1.9	1.5	1.3	1.1	0.95	0.92	0.88
22 x 0.9	8.7	5.8	4.6	3.9	3.6	2.8	2.6	2.3
28 x 0.9	18	12	9.4	8	7.2	6	5.4	4.8

Flow rates are for low-pressure supplies with 1mbar differential pressure between ends of pipe for gas of relative density 0.6.

Add 0.3m for each 90° bend and 0.5m for each elbow or tee fitted to the actual length of the tube to obtain the total effective length.

into m^3/hour by dividing each in turn by 38.5 and then multiplying by 3.6 and these results are noted in column 3. The measured length of each pipe run is then listed in column 5. Next an allowance has to be made for the pipe fittings. Allow 0.3m for each 90° bend and 0.5m for each elbow or tee that creates a change of direction and note the total fitting length for each pipe run in column 6. The figures in each row of column 5 and 6 can then be added to give an effective length for each pipe run, which is then noted in column 7.

By referring to the sizing table (*Table 1*) we can now select a provisional tube size (or check an existing tube size) and note this in column 4.

To use the table, first look down the column of the table that shows a length of pipe equal to or above the effective length of the pipe run in question until the flow rate required is reached; look to the right to see if longer lengths of pipe will give the required flow rate. If they do then use the longest possible length in column 8, then read off the tube diameter from the left-most column.

In the case of the 22mm existing pipe run 1-2 with an effective length of 5.5m we look down the 6m column until we reach the figure 5.8m^3/hour. Column 8 is then used to note the maximum length of tube that can supply the flow rate required; in this case 6m. Column 9 is used to record the actual pressure drop along the pipe run; the actual pressure drop is found by dividing the figure in column 7 by the figure in column 8. Then the progressive pressure drop can be found; this is done by totalling the pressure drops for each pipe run supplying an appliance.

In this example we are concerned to check whether the existing pipe runs 1-2 and 2-4 are adequate to serve the new boiler: from the table we can see that the progressive pressure drop along pipe runs 1-2 and 2-4 when supplying the new boiler will be 0.92 + 0.67 = 1.58mbar. This is well over the maximum allowed so a larger tube size (say 28mm) will have to be selected and noted in column 4 and the figures reworked to determine whether this is satisfactory. If the boiler is supplied by 28mm tube for pipe runs 1-2, 2-4 and 22mm tube for pipe run 4-6, the reworked progressive pressure drops are 0.18 + 0.13 + 0.17 = 0.48mbar, which shows that these tube sizes will be adequate to supply the new boiler.

Brian Curry: March 2008

Table 2 Tabulation form - gas pipe sizing

Pipe length	Power (kW)	Flow rate {col 2 x 3.6} cv (m^3/hour)	Assumed diameter {from Table 1} (mm)	Measured length (m)	Extra for fittings (m)	Effective length {5 + 6} (m)	Maximum length {from Table 1} (m)	Actual pressure drop {7÷8} (mbar)	Progressive pressure drop (mbar)
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
1 - 2	58.00	5.42	22.00	4.00	1.50	5.50	6.00	0.92	0.92
2 - 4	51.00	4.77	22.00	4.00	0.00	4.00	6.00	0.67	1.58
4 - 6	35.00	3.27	22.00	2.00	0.50	2.50	15.00	0.17	1.75
Re-work pipe runs 1 - 2 and 2 - 4 with 28mm tube size due to pressure drop being greater than permitted									
1 - 2	58.00	5.42	28.00	4.00	1.50	5.50	25.00	0.22	0.22
2 - 3	7.00	0.65	12.00	3.00	1.00	4.00	15.00	0.27	0.49
2 - 4	51.00	4.77	28.00	4.00	0.00	4.00	25.00	0.16	0.38
4 - 5	16.00	1.50	15.00	2.50	1.00	3.50	9.00	0.39	0.77
4 - 6	35.00	3.27	22.00	2.00	0.50	2.50	15.00	0.17	0.55

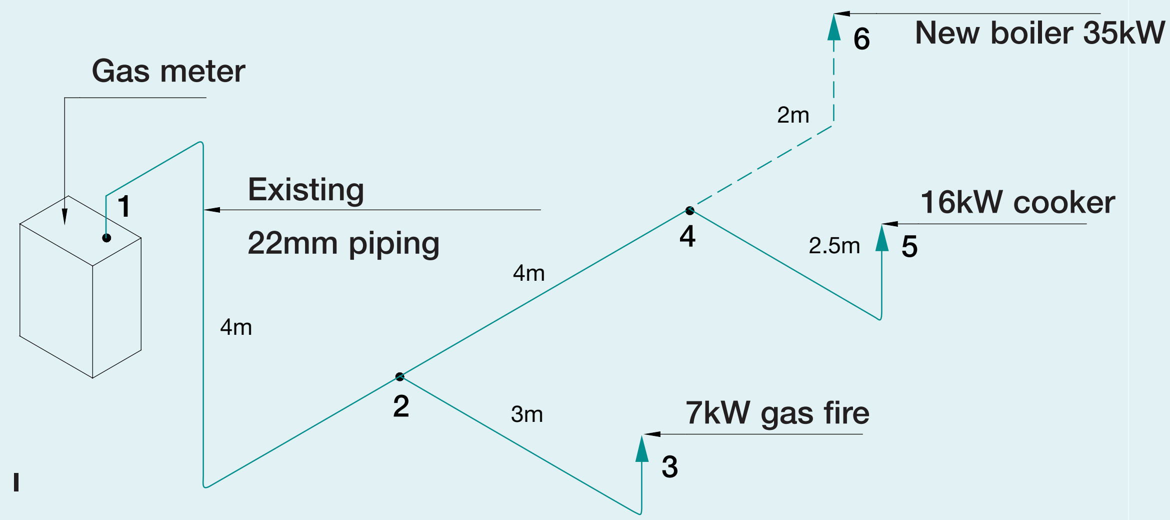

Figure 1