Chapter 10

Domestic and Residential Fire Sprinklers

Chapter 10 discusses four aspects of domestic and residential fire sprinklers:

1. Selecting the correct sprinkler head
2. Pressure requirements
3. Sizing the pipes
4. Pumps

It is a prerequisite that the reader has completed Chapters 4 and 5 before attempting the exercises in Chapter 10. Information contained in this chapter is based on an assumption that the fundamental principles of pipe sizing, as outlined in this text, are understood.

The methods and procedures for sizing domestic fire sprinklers are the same as for residential fire sprinklers. However, different rules and regulations apply for the design, documentation and building approvals for each type. 'Domestic' refers to single dwelling houses and 'residential' refers to multi-dwelling residential buildings of up to four levels. This text does not cover actual standards that apply in particular regions, as they will change over time. The designer must be conversant with, and able to interpret, local rules and regulations.

Manufacturers of sprinkler heads nominate the flow in litres per minute (L/m) and the pressure in kPa or bar.

$$\textbf{1 L/m} = \textbf{0.0166 L/s} \quad \left(\frac{1}{60}\right)$$

1 bar = 100 kPa

Selecting the Right Sprinkler Head

It is important to appreciate that domestic and residential buildings must not be fitted with commercial fire sprinklers. The residential type sprinkler head is a quick action head, specifically designed for the purpose. A commercial sprinkler has a much longer response time than the residential sprinkler where the response time is only 40 to 50 seconds. The Viking sprinkler technical data provides all the necessary information for design purposes.

From a pipe sizing perspective, important considerations when selecting sprinkler heads, include:

a) The number of sprinkler heads required to discharge at one time in order to maintain the coverage.
b) The flow requirement from each sprinkler (in L/m).
c) The required pressure at the outlet (in kPa).
d) The style of head to suit the situation.

Determining the Number of Heads to Discharge

To determine the total number of sprinkler heads that are to discharge at one time for the required coverage to be maintained, refer to the local codes, rules and regulations governing 'Domestic and Residential Fire Sprinklers'.

In some cases, one sprinkler head discharging in a single compartment may meet the requirement. In other cases, two or more sprinkler heads in a single compartment are required to discharge at the same time.

Selecting a Sprinkler Head

After the design is completed, a suitable sprinkler head is selected from the manufacturer's product data catalogue. The sprinkler head must be capable of providing the necessary coverage within a given compartment.

Sprinkler heads allow water to be discharged in predetermined patterns to ensure that total coverage for the particular situation is achieved. Owing to the number of obstacles in a house that must be accommodated in the design, various types of sprinkler heads are available in the marketplace:

a) Pendent and recess pendent.
b) Horizontal sidewall.
c) Recess horizontal sidewall.
d) Concealed pendent.

Flow Requirements

Each sprinkler head has a 'K' value which is important in the design of the sprinkler head, but not for the sizing of the pipe that connects to the sprinkler. The performance for the discharge in L/m takes the 'K' value into account and allows for the stated discharge to be maintained at the nominated pressure.

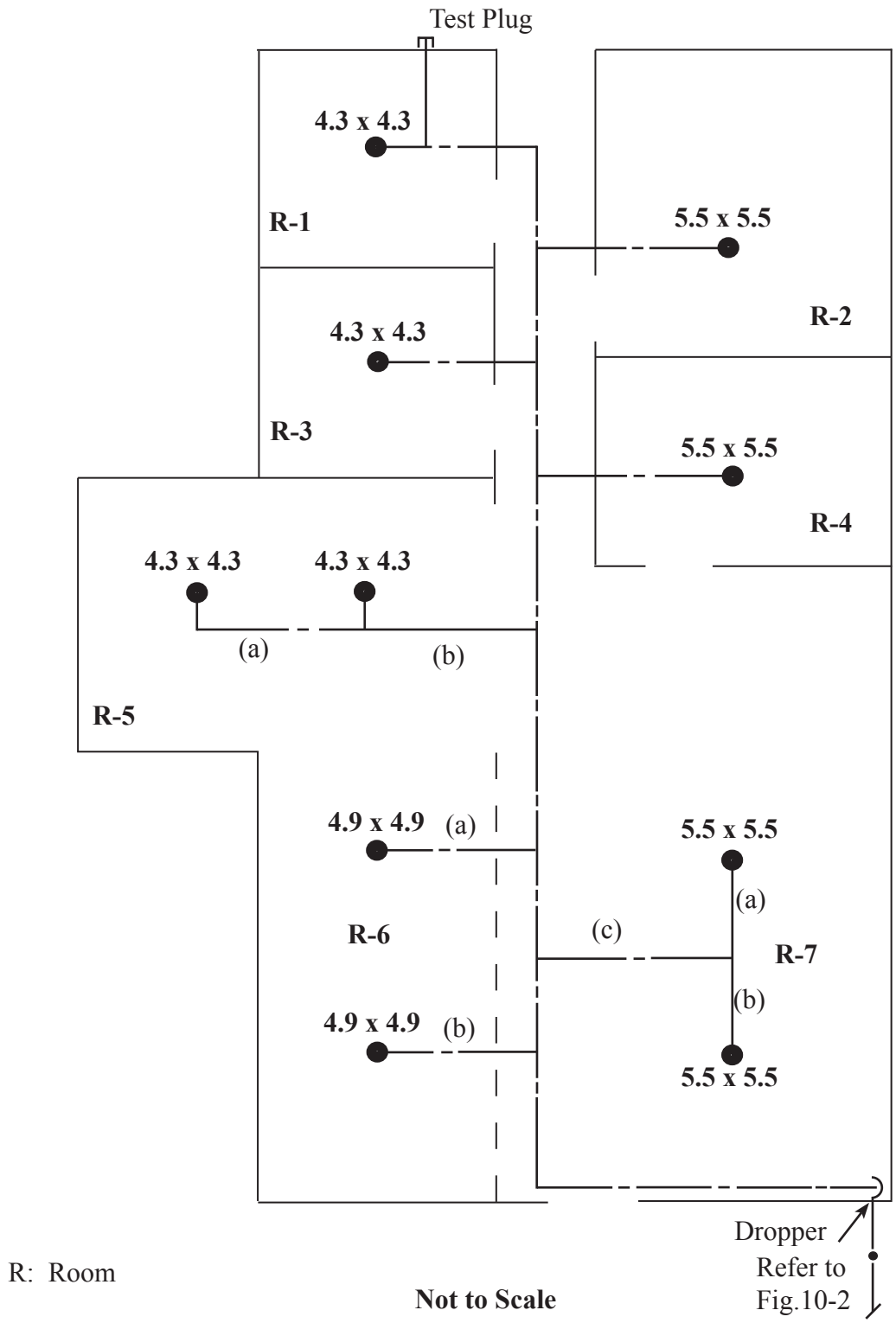

Figure 10-1 Residential Sprinkler Layout and Coverage for Individual Heads

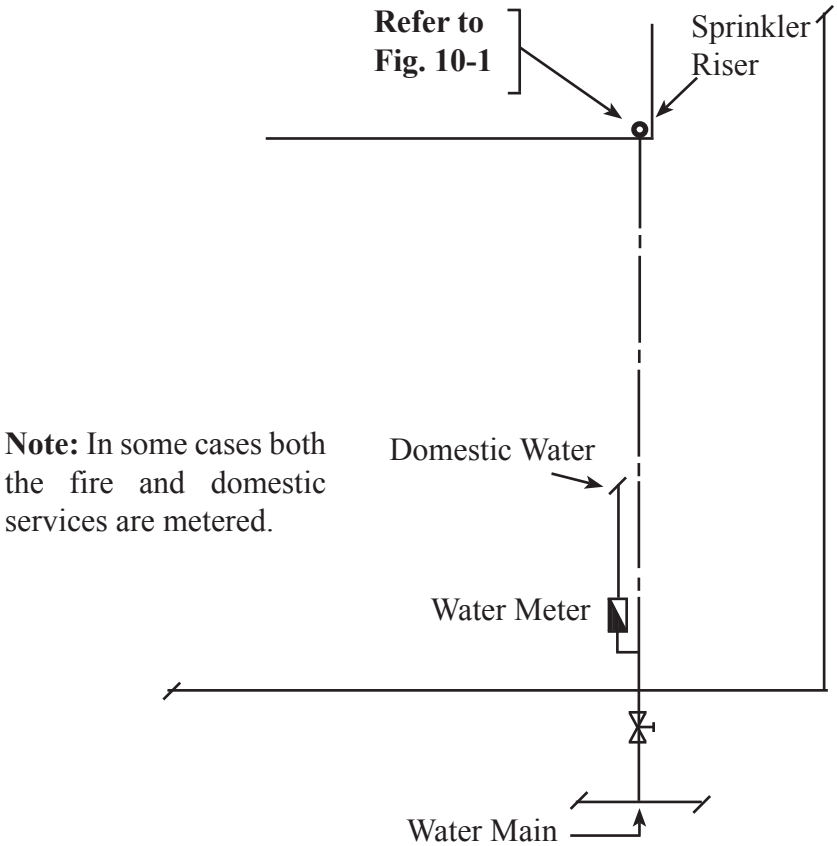

Figure 10-2 Typical Combined Potable Water and Fire Sprinkler Connection

Pressure Requirements

The available pressure from the local authority's water main used in fire sprinkler calculations, must be a 'flow pressure' as opposed to a 'static pressure'; that is, the pressure on the gauge is recorded while the water is discharging at the required flow.

In cases where it is not possible to achieve a flow and pressure test, a static pressure may be used with a reduced percentage applied in the calculations. The percentage is obtained from the local fire sprinkler regulations. It is usually 67%.

Where the water connection to the local authority's main is a combined potable and fire sprinkler system, the required flow for the potable service must be taken into consideration. However, it is unlikely the domestic service will be in use during a fire emergency.

Figure 10-2 illustrates a typical combined potable water and fire sprinkler connection. Although some local authorities will require the fire service be metered.

Sizing the pipes

The same principles governing the sizing of pipes, covered in Chapters 4 and 5, apply to residential and domestic fire sprinklers, with the exception that 'possible' and 'probable' flows are not applicable to fire services and the velocity may be higher.

Exercise 10-1

Using the layout in Figures 10-1 and 10-2, size the fire sprinkler pipe system. Two sprinkler heads must be capable of discharging in the event of a fire. The flow pressure is 47.0 m/h. (Answers are shown on Figures 10-3 and 10-4, on pages 134 and 135).

Sprinkler head performance (Concealed Pendent Sprinkler Head).

a) 4.3 x 4.3m coverage: 49.2 L/m (0.82 L/s) at 48.5 kPa (4.94 m/h)

b) 4.9 x 4.9m coverage: 53.0 L/m (0.88 L/s) at 56.3 kPa (5.74 m/h)

c) 5.5 x 5.5m coverage: 64.4 L/m (1.07 L/s) at 83.0 kPa (8.46 m/h)

Step 1

Using the above information, commence the pipe sizing from 'R-2', as it is the most disadvantaged location requiring the highest performance. Use Table 4-1 for sizing the pipes and a target velocity of 2.8 m/s.

Step 2

Repeat the process for 'R-1'.

Step 3

The pipe diameter will remain the same on the main line from 'R-2 to R-7', unless the head loss is too high due to the friction in the pipes and fittings.

Also, in this exercise 'R-7' will need to be calculated separately, as there are two sprinkler heads in one compartment that require a larger coverage than 'R-1 and R-2' combined.

The following calculations are read in conjunction with Figures 10-1 and 10-2.

Room 2	64.4 L/m	1.07 L/s	25mm diameter	2.2 m/s velocity
Room 1	49.2 L/m	0.82 L/s	25mm diameter	1.9 m/s velocity

R 2 to R 7	113.60 L/m	1.89 L/s	32mm diameter	3.0 m/s velocity
Room 3	49.20 L/m	0.82 L/s	25mm diameter	1.9 m/s velocity
Room 4	64.40 L/m	1.07 L/s	25mm diameter	2.2 m/s velocity
Room 5 (a)	49.20 L/m	0.82 L/s	25mm diameter	1.9 m/s velocity
Room 5 (b)	98.40 L/m	1.64 L/s	32mm diameter	2.6 m/s velocity
R 6 (a) & (b)	53.00 L/m	0.88 L/s	25mm diameter	1.9 m/s velocity
R 7 (a) & (b)	64.40 L/m	1.07 L/s	25mm diameter	2.2 m/s velocity
Room 7 (c)	128.8 L/m	2.14 L/s	32mm diameter	3.1 m/s velocity
Pipe to main	128.8 L/m	2.14 L/s	40mm diameter	1.9 m/s velocity
		or	32mm diameter	3.1 m/s velocity

Exercise 10-2

What is the total head loss in the sprinkler pipe system? The flow and pressure in the local authority main is 1,800 L/m at 47 m/h.

Location	Size mm DN	Length m	Flow L/s	Velocity m/s	EPL m	Loss m/h - 100m	Total m/h
Room 1	25	3.3	0.82	1.9		20.0	0.66
Room 2	25	3.0	1.07	2.2		25.0	0.75
Pipe R2 to R7	32	9.5	1.89	3.0		27.0	2.57
Tees x 5	32		1.89	3.0	9.00	27.0	2.43
R7 - Water Main	40	22.0	2.14	1.9		11.0	2.42
Tees x 3	40		2.14	1.9	5.94	11.0	0.65
Bends x 5	40		2.14	1.9	4.85	11.0	0.53
Valve	40		2.14	1.9	0.30	11.0	0.03
						Total	**10.04**

Exercise 10-3

What is the residual pressure after taking into account the required pressure at the most disadvantaged sprinkler head and all friction losses, as calculated in Exercise 10-2? The available flow pressure is 47 m/h.

Item	Metres Head
a) The working pressure at Room 2	8.46 (83.0 kPa)
b) Static head	3.0 (floor to ceiling)
c) Total friction loss	10.04
d) Total required pressure	**21.50**
e) Available flow pressure	47.0 m/h
f) Residual pressure	25.50 m/h

When the project is completed and a pressure reading is taken at the most disadvantaged sprinkler or the test plug, 33.96 m/h, 333.15 kPa or 3.33 bar, will be achieved while the flow is maintained at 64.0 L/m or 1.07 L/s.

Pumps for Residential Fire Sprinklers

The method of establishing if a pump is required on a residential or domestic fire system, is exactly the same as determining if pumps are required on commercial buildings, as described in Chapter 9. Where the water pressure at the most disadvantaged sprinkler head is lower than required while maintaining the desired flow rate, a pump will need to be installed to make up the shortfall of water pressure.

Had the result in Exercise 10-3 been a negative number, it would revert to a positive and become the duty for the pump. For example, had the shortfall been, -15 m/h, the pump duty in this case would be stated as; 128.8 L/m against a head of 15.0 metres.

The pump must be petrol or diesel powered. In the event of a fire, there is a high degree of probability that the electricity will be disabled.

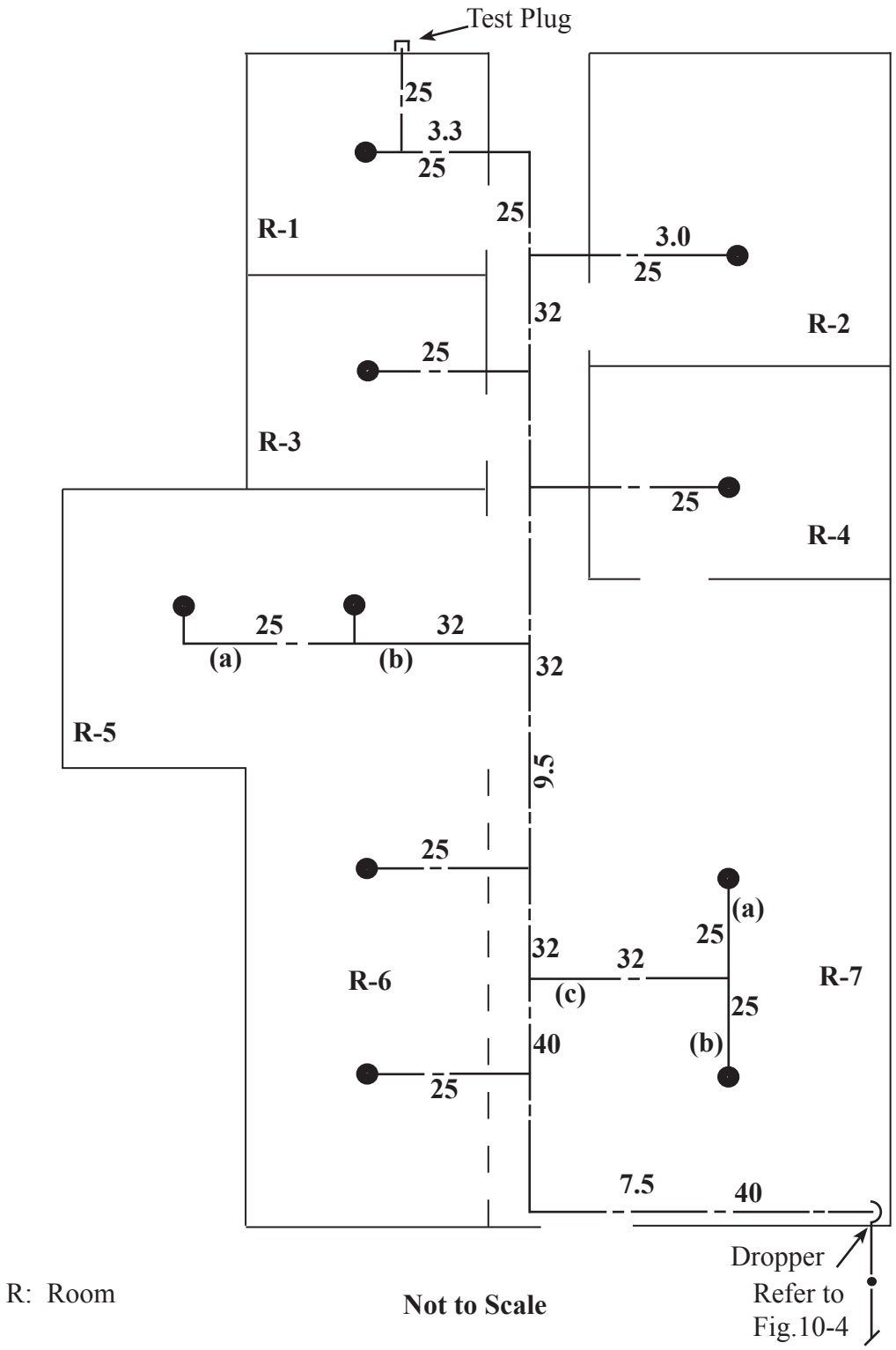

Figure 10-3 Residential Sprinkler Layout with Pipe Sizes

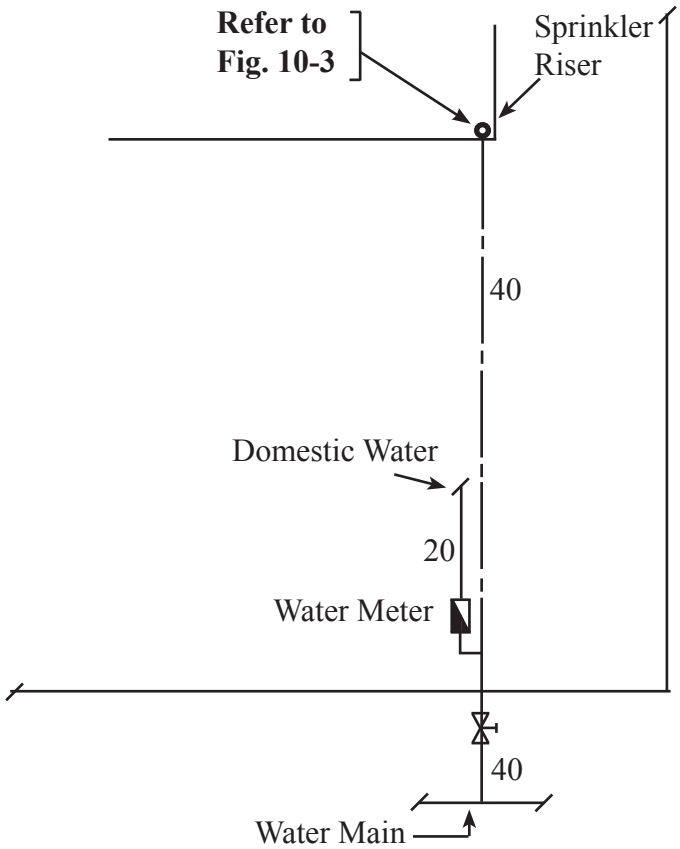

Figure 10-4 Water Connection to and Pipe Sizes

Note: The water connection in Figure 10-4 may be a 32mm. The pipe would then be increased to 40mm after it has entered the property.

In this exercise a 40mm pipe has been used to reduce the velocity and friction loss.