Designers need to be cognizant of the conditions when hydraulic shock can occur and incorporate abatement measures into their designs. Abatement measures may include:

- Safety relief system of valves.
- Expansion tanks that control hydraulic shock.
- Flexible pump mounts.
- Flexible pump connections.
- Slow closing tapware.

The designer shall select system materials and products that will be suitable for use in high water pressure installations, maintaining safe working pressure is in accordance with the standards and manufacturers requirements.

Velocity of Water Flow

The design of the water piping system is greatly influenced by the selected flow velocities. The recommended maximum velocities for copper tube are based on established permissible sound levels of moving water and entrapped air, and on the effects of corrosion (Table 17.1). Erosion in water piping systems is the impingement on the inside surface of the tube of rapidly moving water containing air bubbles or suspended solids. In some cases this may mean complete deterioration of the tube or pipe walls, particularly in areas of high turbulence such as at bends and elbows or the internal top surfaces of the pipe where there are entrained gases.

Since erosion is a function of time, water velocity and suspended matter in the water can affect the service life of the materials fixtures and fittings. The choice of design water velocities is a matter of judgement.

The velocities recommended for water flows in piping systems depend on the following six conditions:

- The service of which the pipe is used.
- The effects of erosion.
- The effects of hydraulic shock and noise.
- The type of piping material.
- The internal diameter of the piping material.
- The restrictions of pipe and fittings.

Recommended Water Velocities				
Service	Velocity Range m/s.			
	Recommended Design Velocity m/s	Institute of Plumbing Australia Selection and Sizing of Copper Tubes for Water Piping Systems	Australian Standards AS 3500.4 2003 +Amend 1&2	British Standard BS 6700:2006 +A1:2009
Cold Water - Mains pressure water services pipelines	Up to 2.4 Up to 1.6 within Dwelling / Apartment	1.0 to 2.1	Max. 3.0	Max. 3.0
Cold Water - Gravity flow pipelines from upper level storage tanks – Top two floors only	0.1 to 0.4	0.1 to 0.4	Max. 3.0	Max. 3.0
Cold Water - Gravity flow pipelines from upper level storage tanks – below top two floors	1.0 to 2.1	1.0 to 2.1	Max. 3.0	Max. 3.0
Cold Water - Pump suction pipelines	1.2 to 2.1	1.2 to 2.1	Max. 3.0	Max. 3.0
Cold Water - Pump delivery pipelines	1.5 to 2.1	1.5 to 2.1	Max. 3.0	Max. 3.0
Heated water - Flow and return – circulating system	1.0	Not Specified	Not Specified	Max. 3.0
Heated water - Non-circulatory systems	2.0	1.0 to 2.1	Max. 3.0	Max. 3.0

Table 17.1
Recommended Water Velocities for Cold and Heated Water Supplies

International Copper Association Australia

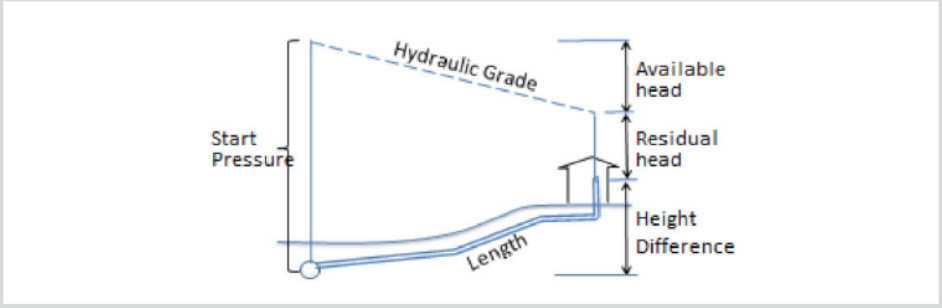


Figure 17.2
Available Head Pressure

International Copper Association Australia

Pipes

For the purposes of plumbing, pipes are given a 'nominal' size (DN). This may be different to the actual size. But it is the size that we refer to for purchasing. The pipe sizing apps program calculates the actual inside diameter required. Refer to AS 1432 Copper Tubes Specifications.

Maximum Allowable Velocity

The worlds major plumbing codes limit the velocity in pipework to a recommended 2.4 m/s or mandated 3 m/s, and sometimes even less for heated water services pipework.

There are three reasons for setting the maximum allowable velocity;

- To reduce piping noise.
- To reduce wear and tear on fittings.
- To reduce water hammer.

The **WaterBiz Free-version** of the pipe sizing programs uses the velocity below that permitted in the respective Plumbing Standard AS/NZS 3500.

The **WaterBiz Pro-version** allow the user to enter any value. However increasing the velocity above 3m/s should really only be done on straight runs with no bends or fittings, especially valves. But this will be outside the plumbing codes. It may be justified in irrigation, fire flows, etc, or even in an area of high pressure when the dwelling is a long way from the source.

Lowering the velocity on the other hand, would be advantageous. Lowering the allowable velocity increases the pipe size, increasing the allowable velocity reduces the selected pipe size.

So what is the effect of this in practice?

The velocity limitation applies when the available water pressure can easily push the required flow of water very fast through a small pipe, and still satisfy all the pressure loss requirements.

So to slow the velocity down, the water pipe must be increased in size (a bigger pipe can carry the same flow at a slower rate). Of course what this also means, is that the head loss is reduced, as the head loss is very dependent of the velocity. The greater the velocity, the greater the head loss. So the end result is, we end up with more pressure in the system.

The difficult and laborious way to size pipelines is to progressively calculate the head loss in every individual pipe. The object is to adjust all the friction/head loss in each pipe section so that the total head loss is as close as possible to the 'available head loss'.

This is necessary in systems where the end pressure must fall within certain limits, as in fire systems, and is recommended in certain Plumbing Codes. Usually this method involves a lot of trial and error. But is it necessary to recalculate the start pressure for every level of a high- rise building? And will this change the pipe sizes on each level, even if the Architecture is identical?

Note:
Although Australia and New Zealand have the same plumbing installation code; the Copper Pipes in NZ are manufactured to different standards. The Australian WaterBiz Free-version and Pro-version app is not suitable for use in New Zealand.

Pipe Sizes.
The internal diameters used in the programs are shown in Chapter 4 of this guide.

Minimum Velocity
The Free-version of the program uses 2.4 m/s for best design practice.
The Pro-version allows the user to enter any value.

Note:
The Australian Plumbing Code at present allows this to go to 3 m/s, however this is not recommended for cold and heated water supplies.

Minimum Residual Head
This is the pressure that would like to achieve at the last fixture (the worst case).

The Free-version of the program uses 15 m head (approx. 150kPa) as the residual head.

Note:
The Australian Plumbing Code is 5 m head, but this is too low to work modern devices.

The Pro-version allows the user to enter any head values.

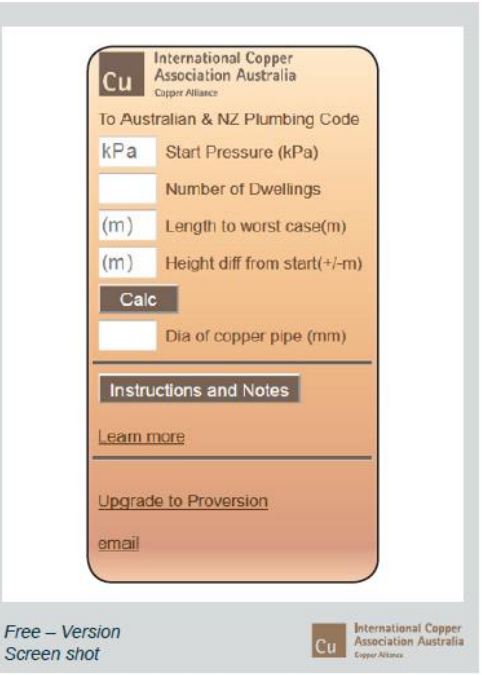
The Pro-version also has a table that displays the capability of every pipe size, for the calculated Hydraulic Grade.

That is:-

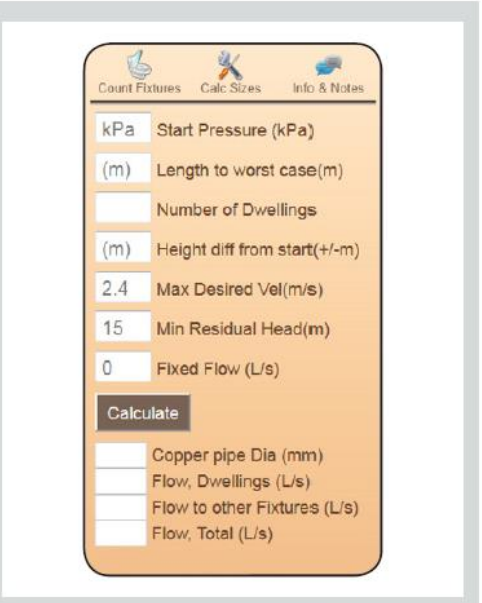
- How many dwellings each size can service.
- What flow (L/s) each diameter can supply.
- The velocity in each pipe diameter.
- The number of Loading Units each diameter can service.

Pro-version allows the user to change the maximum allowable velocity, and change the minimum residual head.

Pro-version also calculates the **Pump Duty**.



Free – Version
Screen shot



Pro – Version
Screen shot