

WHITE PAPER

Pipe Sizing Part 1: Friction Loss Basics

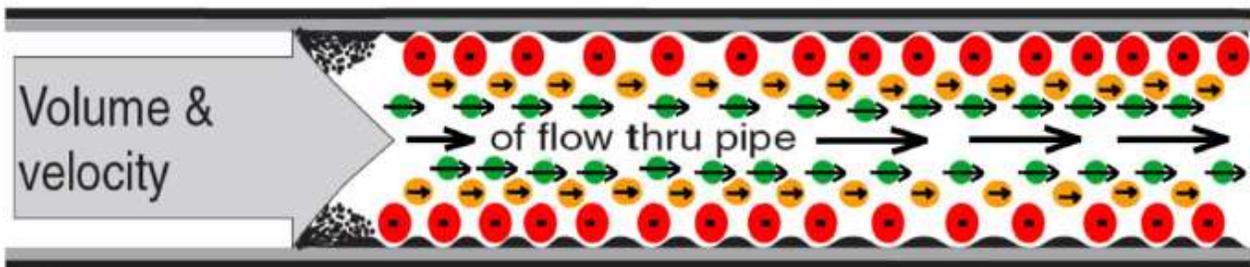
Introduction

When water moves through a pipe the molecules of water “rub” against the inside of the pipe and each other. This “rubbing” causes friction. Friction causes the moving water to lose pressure.

Defining the Problem

As water moves through pipe, water molecules that touch the pipe are held in place while the next layer of molecules moves over the first. This process repeats until water is considered “in the middle” of the pipe. That movement of molecules rubbing against the pipe and each other is causing friction inside the pipe.

The faster the water molecules move against one another, the more friction there is – just like when you rub your hands together to make them warm: The faster you move them, the warmer your hands get. Again, this is friction.



There are three types of energy in a pipe with moving water:

- 1) Velocity Energy -- If we measure the flow (velocity) of the water at several places inside the pipe, it would be the same. The conclusion is that the velocity energy (or speed) can be counted as energy by using the velocity head formula $V^2/2G$. This must remain the same throughout the pipe.
- 2) Friction Energy – If we had a section of pipe and put 40 gallons in one end, then 40 gallons would have to come out the other end. Likewise, the speed of the water coming out must be the same as the speed of the water going in.
Since we have one thing (water) moving against another thing (the pipe) then there is friction.
- 3) Pressure Energy – In order for water to move, there has to be higher pressure at one point than there is at another. Without this pressure difference, the water won't move.

The laws of physics state that the total energy within a “system” must remain the same. The energy can change from one form to another, but the *total energy* must remain constant within the system. In the case here, the water and

the pipe make up our “system.” Given what we know so far, we can reach some conclusions.

Conclusions

The volume of water inside the pipe cannot change. What goes into the pipe must come out.

Velocity Energy stays the same in the system. This is so because the flow rate of the water is the same at all points in the pipe.

There is Friction Energy inside the pipe because we have something moving against another.

Since the Volume and Velocity remain constant in the system, and Friction Energy is happening in the system, the only place that energy can come from is the Pressure Energy.

Therefore, as the amount of friction energy in the piping system increases, the amount of pressure energy must decrease.

The amount of pressure lost due to friction in the piping system depends upon a few factors. Please see our other White Papers for a more in-depth look at Friction Loss.