



Domestic Hot Water and Flow Meters

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June-2009

Objective:

Commercial systems often use 1-1/2", 2" or 3" pipe sizes in Domestic Hot Water (DHW) plumbing. Does that necessarily require an equivalently sized flow meter body which is used to measure hot water usage?

Background:

Measuring DHW usage is done by inserting a flow meter into the cold water supply of a DHW system. The motivation for inserting the flow meter in the cold water supply is multifold. For one, hot water is corrosive, and can over time dissolve heavy metals from a metal-based flow meter body. Secondly, hot water can also over time damage the moving flow meter parts.

Cold water pressure, as delivered at the curbside, is typically in the 60 to 80 PSI range, and in order to prevent a significant pressure loss, pipe dimensions have to be adequately sized. This is done by calculating dynamic pressure loss, commonly referred to as head loss. For copper based water applications, head loss is controlled by two parameters; 1) flow rate and 2) pipe size.

Estimating Head Loss:

Calculating water pipe Head Loss can be done using the Hazen-Williams equation, or by consulting a table such as this:

Pipe Size (inches)	GPM	Head Loss (PSI)
0.50	3.64	10.12
0.75	7.54	6.59
1.00	15.43	7.10
1.25	23.50	5.30
1.50	38.81	6.03
2.00	67.52	4.17
2.50	119.00	4.35
3.00	170.00	3.54
4.00	299.00	2.43

Table 1.0: Head Loss per 100 feet – Type ‘L’ Copper Tubing

For example; assume a 1.50 in pipe diameter 200ft long, that system will experience a 12.06 PSI head loss at a flow rate of 38.8GPM.

The ratio between flow rate and head loss is not linear. That is, reducing the flow rate by half does not reduce the head loss by half.

A Head Loss Example:

Consider a plumbing system with a 150ft long 1.5” feed from the street side to the mechanical room, and an additional 200ft long feed from the mechanical room to the point of use. Assume the application is feeding 25 shower heads which has a 1.5 GPM discharge rate, for a total of 38 GPM. At that rate, the head loss would be 6.03PSI/100ft * 350ft = 21PSI. Assuming a utility pressure of 65PSI, the point-of-use pressure would be 44PSI.

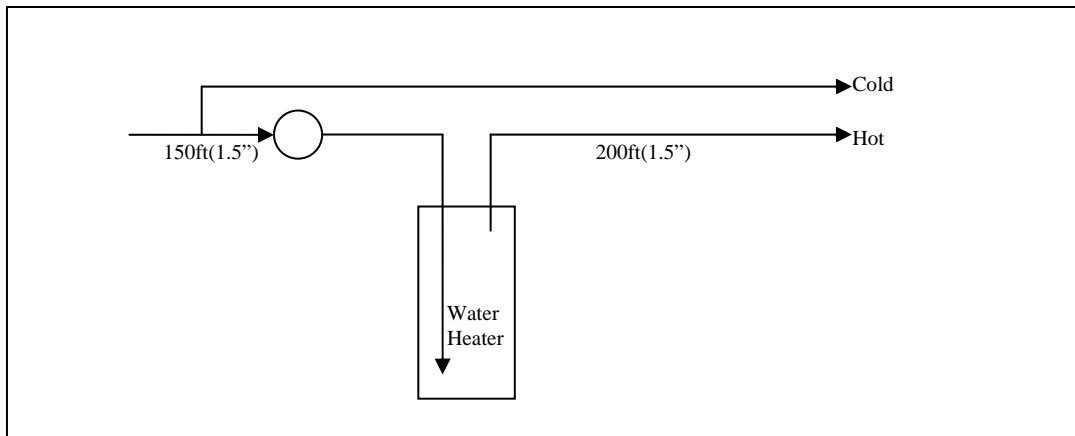


Diagram 1: Pressure & Head Loss

Head Loss Caused by Flow Meter

Inserting even a simple pipe coupling will result in some head loss, and it is no different with a flow meter. Flow meter bodies come in different sizes, and rapidly increase in cost for larger sizes. It is not uncommon to use a smaller flow meter than the plumbing pipe size. One can do so, because the added pressure loss from the flow meter is insignificant with that of the plumbing system.

Consider the plumbing example above. If one were to insert a [1" Badger flow meter](#) in the cold water supply to the Water Heater, it would result in an additional head loss of 7 PSI assuming a flow rate of 38 GPM. Another factor to consider when sizing a flow meter is the sustained/continuous flow rate.

Conclusion:

Flow meters must be inserted in DHW cold water feeds. When sizing flow meters, it is important to consider the worst case flow rate, and acceptable water pressure at the point of use. Using networked flow meter, such as part of the Lauritzen Thor Solar Control System, can provide important empirical feedback for existing systems, and help gauge future designs.

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References:

[The Copper Tube Handbook](#)

<http://www.ukcopperboard.co.uk/literature/pdfs/Installation-Tips/Pipe-sizing-basic-principles.pdf>

[Badger Water Meters](#)