HIXSON
ARCHITECTURE ENGINEERING INTERIORS

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From Experience

Linear Speed of Liquids

Most food and beverage plants operate pressurized liquid systems designed to move water, or liquids with viscosities similar to water. Whereas liquids with high viscosities must consider pressure drop as a primary design consideration, systems designed for lower viscosities are mostly concerned with the velocity of the fluid moving through the pipe. Linear speed requirements will vary based on the function of the systems and piping material used. However, the final determination of linear speed is based on a combination of installation cost, noise, and wear on the system.

The primary influence of the installed cost of a system is pipe size: Smaller diameter pipes are generally less expensive. However, as pipe size is reduced, linear speed at a given flow rate increases exponentially. High linear speeds create larger pressure drops, or reduced downstream pressures and flows, which may result in larger pump requirements needed to support higher inlet pressures. At some point, costs to control pressure drops exceed savings in pipe cost. Although the specific cost breakpoint must be assessed on a case-by-case basis, designers frequently defer to velocity rules-of-thumb (See Experience in Brief) to determine line sizes.

Noise is another concern. As pipe size decreases and linear speeds increase, there is a point at which noise, generated by water hammer, cavitation and other factors, will also become more noticeable, unless corrective actions are taken. In the case of plants where noise is generally constant and ear plugs required, noise may be less of an issue as compared to an office setting. Many remedial measures to eliminate water hammer are now proactively built into valve design and control systems. (For more information on water hammer, see "Dropping the Hammer: Controlling Water Hammer" from our May 2018 issue.)

Finally, the ability of the system to withstand wear and tear must be considered. In general,

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EXPERIENCE IN BRIEF

Common rules of thumb to remember when determining the linear speed of fluids in a pipe:

- Food product/ingredient systems: 5-7 ft/sec.
- Hydronic water systems: 5-8 ft/sec (will vary with temperature).
- Domestic water systems: 4-5 ft/sec where low noise is desired. At 5-8 ft/sec, there will be some noise abatement needs/concerns.
- In water systems where noise control and energy costs are not an issue (e.g., sprinkler systems), 8+ ft/sec may be acceptable.
- Speeds over 10 ft/sec will quickly destroy elbows, "T"s and other piping connections.

speeds at or above 10 feet per second are not acceptable and will result in damage to the system. For certain fluids, a high pressure drop may result in flashing well before this point. Certain rapidly moving fluids may abrade some piping materials, reducing system life expectancy and increasing maintenance costs.

When designing any piping system, it is important to consider how the system will function. Consider, for instance, a sprinkler system. Such systems are used infrequently, if at all. If in use, noise will be the least of the concerns and wear and tear will be minimal because the system will not be employed often. These factors make higher linear speeds generally acceptable in sprinkler systems.

Typical Speeds in Steel Pipe												
	Pipe Diameter (inches)											
	Sch 40 Pipe						*Sanitary Tubing*					
Velocity (Ft/Sec)	1	1.5	2	3	4	6	1	1.5	2	3	4	6
10 GPM	3.7	1.6					5.4	2.2				
25 GPM	9.3	3.9	2.4				13.5	5.4	2.9			
50 GPM	18.6	7.9	4.8	2.2			27.0	10.9	5.8	2.5		
100 GPM		15.8	9.6	4.3	2.5			21.8	11.7	5.0	2.8	
200 GPM			19.1	8.7	5.0	2.2			23.4	9.9	5.6	2.4
300 GPM				13.0	7.6	3.3				14.9	8.3	3.6
500 GPM					12.6	5.6					13.9	6.0

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