WATER HAMMER PREVENTION

Question:
Is a properly designed/sized air-chamber an acceptable alternative to a mechanical shock arrestor in Phoenix?

Answer:
No. An air-chamber will not perform in a manner equivalent to a listed mechanical shock arrestor, and is not considered an acceptable alternative.

The 2006 UPC requires installation of Water Hammer (shock) arrestors wherever "quick-acting" valves are being installed. A quick-acting valve is one that can be closed in 25/1000 of a second or faster. Many spring-loaded valves [water-saver valves] or single-handle ball-type valves can be closed that quickly. All solenoid valves and many mechanically actuated valves close instantaneously, or nearly so, and would certainly qualify as quick-acting valves.

When a valve is closed "quickly" it results in hydraulic shock that calculates to be roughly 60 times the flow velocity at the point of closure, plus the original line pressure. For example, a branch that is flowing at a design velocity of 8 fps [the greatest velocity allowed for any potable water piping material other than galvanized steel] will create a shock pressure (impact) wave of 480 psi [plus the original line pressure (not to exceed 80 psi)] at the location of the solenoid or quick-acting valve. This instantaneous cessation of flow will result in an instantaneous total shock pressure at that valve of 560 psi, which will then reverberate back through the piping system at speeds up to 4500 fps until the momentum is fully dissipated. The initial impact and the resulting reverberations place high stress on the joints, valves, hoses, supply tubes, and any other components of the piping system in the vicinity of the impact. It can also result in piping that is poorly secured responding to this impact by jumping around in the walls or ceilings. In a large system the shock will normally be experienced principally in the vicinity of the quick-closing valve. For this reason shock arrestors must also be located in close proximity to the quick-closing valve(s). Manufacturers provide guidance regarding the proper location and sizing of these devices. NOTE: Shock arrestors are typically sized using the water system's design operating pressure as one of the factors. When the design pressure exceeds 65 psi the manufacturer may recommend installing a larger size shock arrestor than would have been needed to serve a lesser system pressure. Water hammer arrestors are also designed and listed based upon PDI Standards that were developed using a presumption of 10 fps maximum flow velocity.

Section 609.10 of the UPC requires use of mechanical water hammer arrestors. Air chambers are not an allowable option. A properly designed air chamber requires a shut-off valve ahead of the chamber, a bleed valve at the bottom of the chamber, and an air-intake valve at the top of the chamber to facilitate frequent re-charging. Because the air in these chambers is relatively quickly absorbed back into the water they will soon become water-logged and useless. Without an effective maintenance program these appurtenances oftentimes fail and remain useless for most of the lifespan of the building, unknown other than by the tell-tale sound of pipe banging around in the walls when a valve slams shut. When an air-chamber becomes water-logged it represents little more than a short branch pipe to nowhere. A history of poor air-chamber design, and even worse maintenance, has resulted in air-chambers being deemed unacceptable as a Code approved alternative to mechanical water-hammer arrestors.

Poor placement or improper sizing of a water hammer arrestor can make it nearly as useless as a failed air-chamber. Some manufacturers recommend the use of *two* shock arrestors on branch lines that exceed 20'-0" in length. This would suggest that the benefit gained by installing a water hammer (shock) arrestor diminishes as the distance from the water hammer arrestor grows longer, and the manufacturer is advising that beyond 20'-0" there could be insufficient shock absorption to achieve the intended piping system protection. However, this limitation may be avoided if the shock-arrestor is oversized, based upon the manufacturer's guidance as regards total fixture unit loading on the branch served by that shock arrestor. For example, a branch 50'-0" long might be served by a 1" shock arrestor if there were no more than 60 *fixture units* connected to that branch according to some manufacturers. Branch length and fixture unit loading are separate factors, but a correlation between the two may be available as shown in alternative design Tables provided by some manufacturers of water hammer arrestors.

In summary, mechanical water hammer arrestors are now required on all water piping systems (branches) that are equipped with "quick-acting valves". When protection is required, an air-chamber is not an acceptable alternative. Shock-arrestors are mechanical devices that are not designed to survive the anticipated 75 year lifespan of a commercial building. As is true with all mechanical devices, it is necessary to provide a means to gain access to water hammer arrestors for eventual replacement.

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