TECHNICAL NOTES

KJWW ENGINEERING CONSULTANTS

15430-G.1.1

15430 - WATER HAMMER ARRESTERS

Water hammer occurs any time flowing water is stopped by closing a valve. The quicker acting the valve, the more severe the water hammer. A quick closing valve is defined as a valve that can close in one quarter of a turn or less. Single handle faucets, metering faucets, flush valves and solenoid valves are the most common quick closing valves used in plumbing systems that require water hammer control. Water hammer can be reduced by using slow closing valves, lowering water velocities, and using water hammer control devices.

The bellows style and the piston style are the two most common types of mechanical Water Hammer Arresters (WHA) used in engineered plumbing systems. The bellows design typically consists of a stainless steel bellows encased in a jacket with a charge of nitrogen between the bellows and the jacket. The piston type are cylindrical in shape and typically have a charge of air above a free floating plastic piston. KJWW design standard is to use the bellows style of WHA. The piston style WHA can be used as a cost saving measure.

Water hammer can also be dampened in a piping system by a standpipe type air chamber. Air chambers consist of a capped piece of pipe, at least the same diameter as the pipe it protects, and extends 12 to 24 inches vertically from the piping it protects. Air chambers must be sized correctly to provide effective dampening of water hammer, and even then they become water logged after time and their effectiveness diminishes substantially.

The gas in a mechanical WHA is compressible and provides a relief point for pressure surges that can be in excess of 500 PSIG. WHA's are designed to maintain the peak pressure in any segment of a piping system at or below 150 PSIG. WHA's benefits over air chambers are smaller size and resistance to water logging. However, air chambers are constructed on site and have a low first cost.

The Plumbing Drainage Institute (PDI) is a manufacturer organization that tests and rates WHA's and other plumbing fixtures. PDI Standard WH 201 provides standards for testing the capacity and installation of WHA's. PDI WH 201 groups WHA's by capacity into six standard sizes and labels the sizes ranging from A through F, (Refer to Table 1 and 2). Most major manufacturers have adopted these standard sizes and are members of PDI.

Table 1
WATER HAMMER ARRESTERS FOR MULTIPLE FIXTURES
WATER PRESSURES UP TO 65 P.S.I.G. Note 1
(PDI -WH201)

P.D.I. Units	A	B	C	D	E	F
Fixture Units	1-11	12-32	33-60	61-113	114-154	155-330

Notes:
1. For pressures above 65 P.S.I.G. and below 85 P.S.I.G. determine the PDI WHA required for the fixture units served and select the next larger PDI size WHA .

The water hammer arresters ratings in Table 1 are based on a flow pressure of 55 PSIG and a maximum velocity of 10 FPS. These assumptions allow the determination of the maximum amount of energy in the water column that must be dissipated by the water hammer arrester.

In piping systems, the pressure surges back and forth between the quick closing valve and the point of relief. The point of relief is the water supply pipe that is twice the size of the branch piping. To maintain pressures below 150 PSIG in branch piping with multiple fixtures operating simultaneously, individual WHA's are effective for branch lengths up to 20 feet.

The procedure for selecting water hammer arresters and installation guidelines are as follows:

Branch piping with multiple fixtures up to 20' in length:

1. Count the fixture units on the branch.
2. Select a WHA from Table 1 with adequate capacity for the branch.
3. If the water pressure is 65 PSIG or greater, select the next larger PDI size WHA.
4. Install the WHA between the last two fixtures.

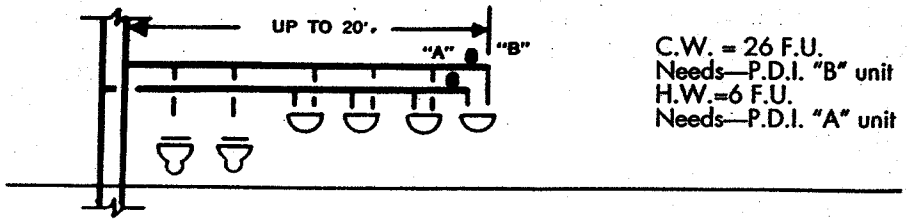


Figure 1. Example of WHA placement on branch lines up to 20' in length with a water supply pressure of less than 65 PSIG. (*Source*: PDI-WH 201)

Branch piping with multiple fixtures from 20' to 40' in length:

1. Count the fixture units on the branch.
2. Select two WHA's from Table 1 that, when added together, have adequate capacity for the total branch.
3. If the water pressure is 65 PSIG or greater, select the next larger PDI size WHA's.
4. Install one WHA between the last two fixtures.
5. Install the second WHA at the midpoint of the fixtures it serves.

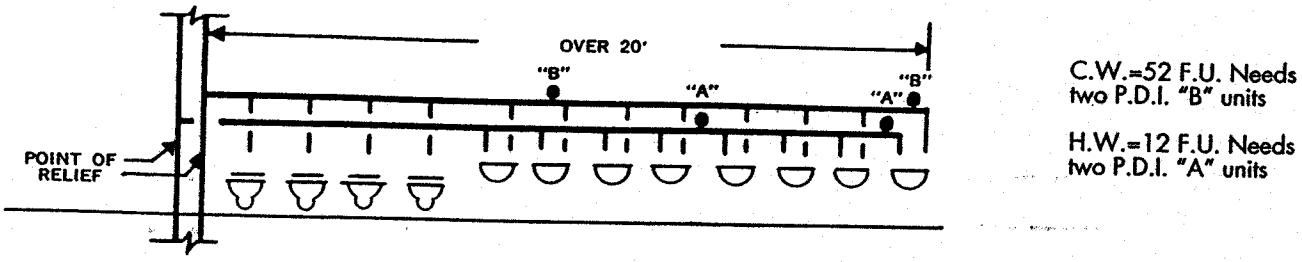


Figure 2. Example of WHA placement on branch lines between 20' and 40' in length with a water supply pressure of less than 65 PSIG. (*Source*: PDI-WH 201)

In situations where branch piping is between 40 feet and 60 feet long, the branch should be fed from the middle to limit the effective length of the branch to less than 40 feet.

Long branch piping with a single fixture (industrial/laundry application):
For long runs of piping serving a single fixture, the pipe size, length and supply pressure determine the amount of energy that will have to be dissipated. Table 2 indicates the sizes of water hammer arresters required for various sizes and lengths of pipes. The Water Hammer Arrester should be located as close as possible to the quick closing valve.

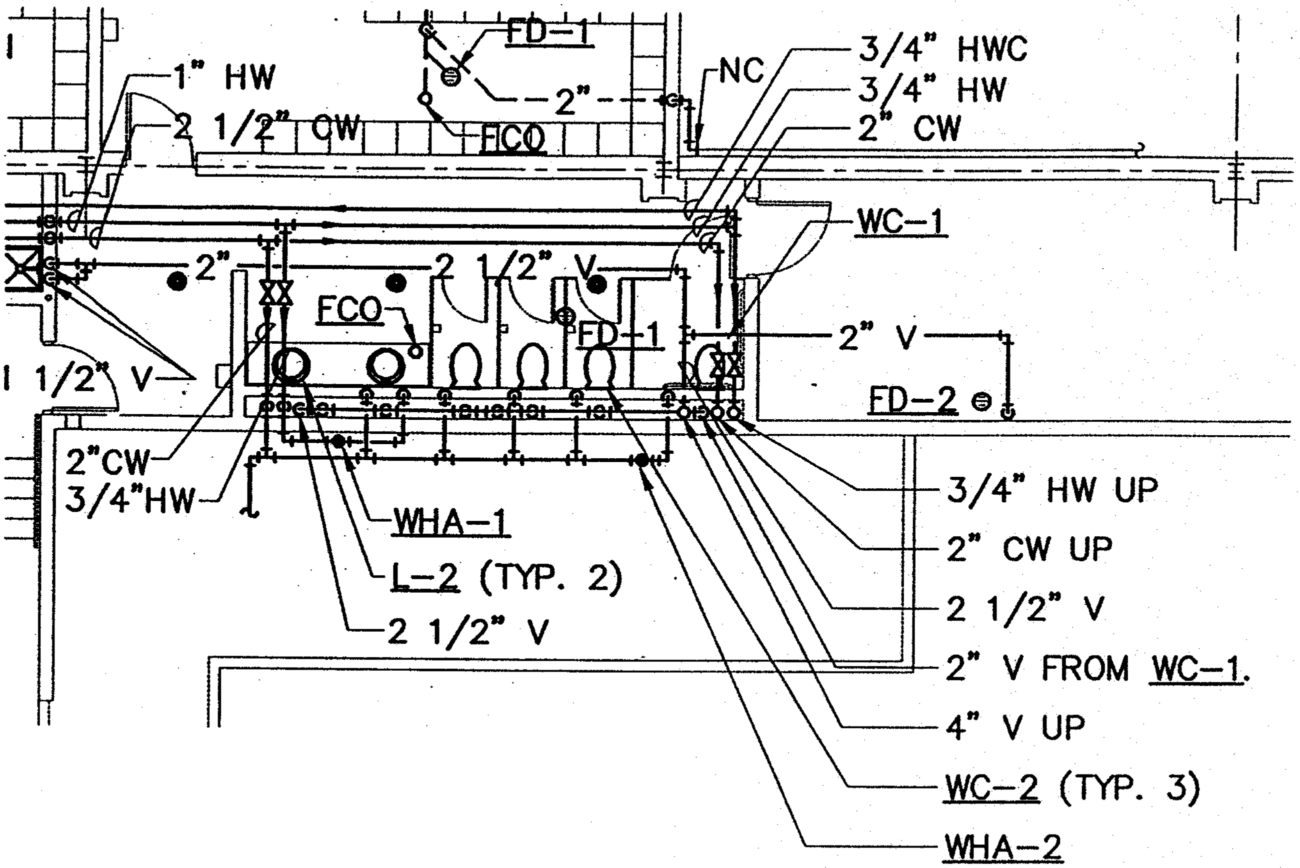
Table 2 WATER HAMMER ARRESTERS FOR AN INDIVIDUAL FIXTURE WATER PRESSURES UP TO 65 PSIG WATER PRESSURES ABOVE 65 PSIG AND BELOW 85 PSIG (shaded)												
	Nominal pipe diameter											
Pipe length	1/2"		3/4"		1"		1-1/4"		1-1/2"		2"	
to 25'	A	B	A	B	B	C	C	D	D	E	E	F
to 50'	A	B	B	C	C	D	D	E	E	F	F	C&F
to 75'	B	C	C	D	D	E	A&E	F	F	C&F	E & F	F&F
to 100'	C	D	D	E	E	F	F	C&F	C & F	E&F	F & F	E,F& F
to 125'	C	D	D	E	F	C&F	A & F	D&F	E & F	F&F	E, F &F	B,F,F &F
to 150'	D	E	E	F	F	C&F	D & F	F&F	F & F	D,F& F	F,F,F & F	F,F,F &F

As a design standard, KJWW recognizes the use of both air chambers and mechanical water hammer arresters. The chart below outlines when each type of water hammer dampening device should be used. These guidelines are KJWW standards and should be followed unless superceded by more stringent state or municipal codes in the area where the system under design will be installed. The guidelines listed below apply to both cold and hot water supply lines.

Table 3 WATER HAMMER ARRESTER USAGE GUIDE		
Design Condition	Type of water hammer control required	
	Mechanical [1,2]	Air Chamber [3]
Bathroom group with flush valves	X	
Bathroom group without flush valves	X	
Single flush valve installation	X	
Single flush tank water closet		X
Single sink or lavatory		X
Two or more sinks or lavatories supplied by one branch	X	
Solenoid valve, Dishwasher, Washing machine	X	

Notes:
1. Mechanical water hammer arresters must be accessible.
2. See Figures 1 and 2 for installation locations.
3. Accessibility is not required for air chambers.

Water hammer arresters should be shown on plumbing plans when possible. Air chambers, however, should be covered in the specification and are not shown on the plumbing drawings. Figure 3 is an example of KJWW standards for showing WHA's on a plumbing drawing.



Notes:

1. Symbol —●— shall replace previous symbol .
2. Riser diagram symbol shall continue to be be used when shown on riser diagrams.
3. The new symbol shall always be labeled with a WHA-# and included in the Plumbing Material List.
4. Symbol does not need to be included in the symbol list since it is labeled and part of the Plumbing Material List.

Figure 3. Example plumbing plan showing water hammer arrester placement and symbol.

When it is not practical to show the exact location of WHA on the drawings a key note should be used to indicate the approximate location on the drawing with the following information:

Branch piping with multiple fixtures up to 20' in length: (Refer to example 1)

Install WHA-# in the #" CW between the last two fixtures supplied by this pipe. Provide and install access doors as required to access the WHA.

Install WHA-# in the #" HW between the last two fixtures supplied by this pipe. Provide and install access doors as required to access the WHA.

Branch piping with multiple fixtures from 20' to 40' in length:(Refer to example 2)

Install WHA -# in the #" CW pipe at the midpoint of the fixtures it serves, and, WHA-# in the #" CW pipe between the last two fixtures supplied by this pipe. Provide and install access doors as required to access the WHA.

Install WHA -# in the #" HW pipe at the midpoint of the fixtures it serves, and WHA-# in the #" HW pipe between the last two fixtures supplied by this pipe. Provide and install access doors as required to access the WHA.

Long branch piping with a single fixture:

Install WHA -# in the #" CW pipe as close as possible to the fixture it serves. Provide and install access doors as required to access the WHA.

Install WHA -# in the #" HW pipe as close as possible to the fixture it serves. Provide and install access doors as required to access the WHA.