

IPA DEBATE CLUB QUESTION 7 (IPADCQ -7)

Compiled by:

BSA Narayan, Convener, IPA Technical Committee



Question 1. What are the criteria for selection and installation of water hammer arrestor in and hydraulically designed water supply distribution system for large facilities?

RESPONSES

Response 1:

These are the following criteria for selecting a Water Hammer Arrestor (WHA)

- 1) Have to identify whether it's a Commercial toilet or a Residential toilet?
- 2) Number of Fixtures in a Toilet (these details can be derived from the chart in the UPCI/ PDI)
- 3) The above factors will help to select the size of the WHA, as the size of WHA does not go by the size of the pipe where it is to be installed instead number of fixtures.
- 4) The chart is attached below.

FIXTURE UNIT SIZE

FIXTURE	Type Of Supply Control	Weight in Fixture - Units					
		Public			Private		
		Total	C.W. (Cold Water)	H.W. (Hot Water)	Total	C.W. (Cold Water)	H.W. (Hot Water)
Water Closet 1.66 PF	Flush Valve	8	8	-	5	5	-
Water Closet 1.66 PF	Flush Tank	5	5	-	2.5	2.5	-
Pedestal Urinal 1.06 PF	Flush Valve	4	4	-	-	-	-
Stall or Wall Urinal	Flush Valve 1.06 PF	4	4	-	-	-	-
Stall or Wall Urinal	Flush Tank 1.06 PF	2	2	-	-	-	-
Lavatory	Faucet	2	1 ½	1 ½	1	1	1
Bathtub	Faucet	4	2	3	2	1 ½	1 ½
Shower Head	Mixing Valve	4	2	3	2	1	2
Bathroom Group	Flush Valve Closet	-	-	-	8	8	3
Bathroom Group	Flush Valve Closet	-	-	-	6	6	3
Separate Shower	Mixing Valve	-	-	-	2	1	2
Service Sink	Faucet	3	3	3	-	-	-
Laundry Tubs (1-3)	Faucet	-	-	-	3	3	3
Combination Fixture	Faucet	-	-	-	3	3	3

Criteria for Installation

- 1) Where ever Quick closing valves are used WHA should be used.
- 2) In the Branch Line, before the last fixture the WHA should be installed

Abbas S Lehry

Managing Director

Lehry Instrumentation & Valves Pvt Ltd

Response 2:

The water hammer arrestors are selected based on the fixture-units. These can be fixed either immediately after the isolation valve or at the end of the line.

Binod Jose

Assistant General Manager – Services,

Colliers International, Bengaluru-IPA Life Member

Response3:

- Type of water supply fixture
- Inlet and operating pressure
- Pipe material
- Hydraulic network of water supply pipeline
- Mainline branch line and no of fixtures to be served
- Time or no. For valve opening and closing
- Shock wave value

- Source of shock wave
- Location of various valves
- Space requirements for operation and Maintenance
- P.D.I standards and group/cumulative fixture unit for size

Harshal Parikh

Vice Chairman

IPA Ahmedabad Chapter

Response 4:

Have you heard the banging noises in the pipelines? This happens when the water, which is flowing through the pipes has built up momentum, is rapidly stopped. There is a sudden surge of pressure which can loosen and damage the pipes and joints.

Hammering in pipes is a common condition found in large facilities where are a row fixtures fed by the single branch line. Hence, use of water hammer arrestor is one of the solutions to prevent water hammering in the pipeline.

The main criteria to be considered while selection and installation of the water hammer arrestor are as follows–

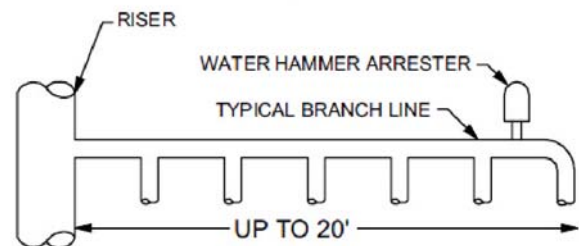
a) Size of arrestor – Most of us employ the fixture unit method for sizing the water supply lines. Hence, the same fixture units of a branch line could be considered to determine the size of arrestor as below.

TYPE	A	B	C	D	E
FIXTURE -UNIT	1-11	12-31	32-60	61-113	114-154

b) Where the arrestors should be placed – Among a row of valves, the arrestor needs to be fixed near last valve of the line and has to be as close to the valve as possible.

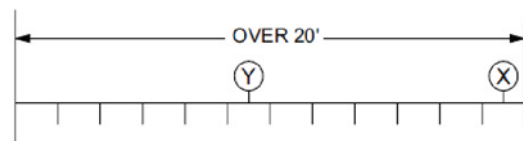
Rule 01 – For branch lines up to 6m

Water hammer arrestor shall be placed at the end of the branch line, close to the remotest fixture



Rule 02 – For branch lines more than 6m

The placing of arrestor shall be placed at intervals of 6m and also at the remotest fixture



c) Installation – It is always recommended that the arrestor has to be vertically installed in any pipeline in view of the efficiency of the instrument.

Manaswini

Design Engineer,

Adithi Plumbing and Fire Fighting Consultants, Bengaluru

IPA Professional Member

Response 5:

Water hammer arrestors are required to absorb the shocks in the supply network when water flowing in a piping system suddenly stops due to all quick closing valves, i.e. shutoff valves, dishwashers, clothes washers, etc.

Water hammer arrestors can be installed vertically, horizontally, or at any angle as per the site feasibility and design requirements.

Usually the water hammer arrestor shall be installed between the shutoff valve and the incoming water supply line, close to the valve.

Ideally water hammer arrestor shall be installed on both hot and cold water piping networks.

The latest P.D.I standards establish seven sizes for water hammer arrestors (AA, A, B, C, D, E, F). Each category sets down specific size and capacity requirements necessary to control shock in piping systems. "AA" represents the smallest-sized unit; "F" indicates the largest size.

Refer below table for selection of appropriate water hammer arrestor:

P.D.I Units	AA	A	B	C	D	E	F
Fixture Units	1 - 3	1 - 11	12 – 32	33 – 60	61 – 113	114 – 154	155 - 330

The fixture units for water supply shall be calculated as per UIPC-I or NBC 2016.

The above table on sizing and selection, takes into consideration all design factors including simultaneous usage, pipe size, length, flow pressure and velocity, thus providing an easy, accurate method of determining the proper sized water hammer arrestor for each multiple fixture branch line, and automatically provides for all factors which has to be considered or otherwise calculated for proper sizing.

Ideally the flow pressure in branch lines serving fixtures should never exceed 4 kg/cm². Pressure reducing valves shall be installed to maintain proper pressure. However, when the flow pressure exceeds 4.5 kg/cm² the next larger size water hammer arrestor shall be selected.

When the Fixture-unit total has a ½ fraction, it is to be rounded up to the next larger, or whole number. Thus, if the total is 11½ fixture-units, 12 fixture-units shall be considered for sizing.

It has been established that the preferred location for the water hammer arrestor is at the end of the branch line between the last two fixtures served.

The location of the water hammer arrestors applies to branch lines that do not exceed 20' (6.0 m) in length, from the start of the horizontal branch line to the last fixture supply on this branch line. When the branch line exceeds the 20' (6.0 m) length, an additional water hammer arrestor shall be installed. Refer below two images defined by two rules to cover the placement of water hammer arresters –

Rule 1 - multiple fixture branch lines which do not exceed 6.0 m in length



Rule 2 - multiple fixture branch lines which exceeds 6.0 m in length.



Thus by using a properly sized water hammer arrestor, we can reduce the destructive forces, pounding noises and vibrations in a plumbing system, thus increasing the overall efficiency and health of the water supply network on a longer run.

Minesh Shah

Chapter Chairman

IPA Ahmedabad Chapter- Life Member

Response 6:

- Rate of closure of quick closing valve.
- Dia of pipe on which it has to be installed.
- Number of fixture units it will cater to.
- Change In flow velocity of water
- Weight of the piston in water hammer arrestor.

to gain maximum benefit and have minimum damage or disturbance, WHAs should be installed as close to the quick closing valves.

Purab Morwal

Senior Executive-Projects

Kalpataru Synergy, Mumbai

IPA Life Member

Response 7:

Water Hammer arrestors are to be installed at the nearest source point of hammering and has to be selected and sized based on the following criteria:

- 1) WHA can generally withstand up to 5 times the Line Pressure (backpressure caused due to hammering) and based on the line pressure you can select the model of WHA to be used Copper-piston type or SS-Diaphragm type.
- 2) Identify whether if it must be installed in public or private space and the number of fixture units used in each branch line based on which the sizes WHA can be selected.
- 3) Fixture unit values changes in the chart of the manufacturer; Fixture unit chart can be taken from the respective manufacture and selection of the sizes and can be selected accordingly.
- 4) If the pipe is longer then the water hammer needs to be placed every 6 meters.

Mathew Varghese

Territory Sales Manager

Lehry Instrumentation & Valves Pvt Ltd

CONCLUSION - Question 1

- The responses received are on the question No. 1, selection and installation of water hammer arrestor for hydraulically designed water supply system.
- The response are generally covers the selection and installation of the water hammer arrestor and are very explanatory and they have answered clearly about the selection and installation criteria.
- While considering the design aspect, water hammer arrestors to be designed on the fixture units loading as indicated in 2016 NBC/UIPC-I/PDI (Plumbing and Drainage Institute's standard – PDI WH 201). Sizes available are 15 mm and 20 mm with designed to operate at system operating pressure of 10.6 Bar. It is preferable to install them on the tap-of from main risers of cold as well as hot water piping.
- On the typical branch line if the branch length is within (20 feet) or 6 m at the end of the line between last two fixtures served based on manufacturer recommendation.
- Two locations on the branch line if the branch length is more than (20 feet) or 6 m based on the sum of fixture units shall be equal or greater than the demand of the branches as per manufacturer recommendation.
- Sizes more than 20 mm to be installed on the Main Water supply distribution ring or terminal type network at appropriate locations preferably as close as possible to the point of quick closure based on the fixture load.

Question 2: Design criteria to be adopted for connecting syphonic drainage piping outlet to rainy filters prior to connecting terrace rainwater to the collection sump @ Ground / basement level.

RESPONSES

Response 1:

Under normal rainy conditions the discharge will be through primary pipes. Under conditions of excessive rains or blockage of primary lines, secondary pipes will act as emergency line for discharge of roof drain. So it makes sense only to connect the primary lines to collection sump in basement or ground. As syphonic system will be financially feasible only for large scale projects with limited shafts for down-take pipes, it will

be better to bypass the roof rainwater to external storm water lines for the first rains using solenoid valves managed by BMS rather than installing rain filters that will need to be subjected to huge rain water volumes throughout the rainy season.

Binod Jose

Assistant General Manager – Services,

Colliers International, Bengaluru

IPA Life Member

Response 2:

Connection to rainy filter

1. Hourly rainfall
2. Discharge of outlet pipe of syphonic drainage system
3. Nos of outlet and location along with diameter.
4. Collection sump capacity

5. Roof gutter size and its capacity
6. Static head, Driving head and velocity of outlet pipe
7. Rainy filter level (e.g. on floor or below ground on ground etc)

Harshal Parikh
Vice Chairman
IPA Ahmedabad Chapter

Response 3:

Rainwater is the purest form of water which could be used for domestic purposes. However, the rainwater that flows over the open terraces and collected in the tank needs some amount of treatment before consumption. This is mainly due to the dirty surface of terrace which would contaminate the rainwater. Hence, first flush arrangement shall be made to flush out the water from the syphonic drainage system, during the onset of monsoon.

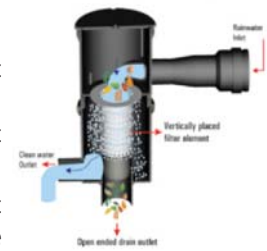
First flush is not a green practice as it requires the entire water from the terrace to flushed out on the first day of monsoon to ensure major dirt and contaminants do not accumulate in the storage tank. As an alternate to this practice, rainy filters have been introduced that can be fitted in the pipeline before entering into the storage tank. This filter mainly removes the major chunks of dirt from entering into the collection tank.

However, there are a set of criteria to be followed while designing this system.

- To ensure that maximum amount of water is obtained.
- Avoid oversizing of the instrument. The rainy filters are well designed for a particular catchment and hence need not be over designed which in turn adds up to the capital cost.
- Rainy filters must be connected at a location that is easily accessible for maintenance.
- Choosing the right size of filter for the terrace catchment is of utmost importance to ensure greater efficiency.
- It is always advisable to provide a bypass line for the rainy filter in case of an emergency failure condition.

Manaswini

Design Engineer,
Adithi Plumbing and Fire Fighting Consultants, Bengaluru
IPA Professional Member



Response 4:

- It should be ensured that water pressure at syphonic drainage pipe outlet is within the limits of maximum operating pressure defined by manufacturer of rainy filter.
- Rainy filter should be able to handle the rate of water discharge that shall be flowing through. The

quantum of water can be worked out depending upon the roof area and rainfall intensity of that area and number of drain outlets connecting to the rainy filter.

- Material used for filter and body of rainy filter.

Purab Morwal
Senior Executive-Projects
Kalpataru Synergy, Mumbai- IPA Life Member

CONCLUSION - Question 2

- The second question is not replied by some and others who replied are not are not directly answers the question. No doubt that the producers are explained about the first flush and storage, there is nothing said about the syphonic drainage and how to collect the discharge pipe to the rainy filter.
- As you might be aware that the syphonic roof drain system will work higher water velocity with no slope and smaller pipes size as compared to the conventional roof drain system. To get the piping connected to the rainy filter which is located at ground level or basement level prior to connecting the same to the terrace rain water storage, it is preferable to reduce the water velocity to around 1 to 1.5 m/sec by using properly designed syphonic breaker in the horizontal portion of the piping network. This syphonic breaker will ensure reasonably low velocity for proper functioning of the rain filter.

B. S. A. NARAYAN

Convener, Technical Committee (TC)