

# Flushometer Installation, Troubleshooting & Applications

# Summary

- Codes associated with flushometers
- Codes associated with fixtures
- History of the flushometer
- How a flushometer works
- Different types of flushometers and their applications
- Operating requirements
- Troubleshooting flushometers
- Diaphragm vs. Piston
- Type of fixtures
- What's new in the world of fixtures?
- Lavatories
- Special options and features

# What is a flushometer?

- A self-metering valve attached to a pressurized water supply pipe, designed so that when actuated, it opens the line for direct flow into the fixture at a rate and <u>predetermined</u> volume to properly operate the fixture and then gently close in order to avoid water hammer.
- A precision metering device Adjusts for proper volume over a pressure range of 10 100 psi.
- It is NOT a Flush Valve!
  - A 'flush valve' is a component in the bottom of a tank toilet.

#### • WIKIPEDIA DEFINITION:

The **Royal Flushometer** is a product of the Sloan Valve Company that uses an inline handle to flush urinals. It was invented by <u>William Elvis Sloan</u>.

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# History of the flushometer

- William Elvis Sloan invented and introduces the first diaphragm valve in fall of 1906
- Piston valve invented in 1926 by William Elvis Sloan
- Almost the exact same design from 1906 is still used today (only with a few extra bells and whistles added).





#### EARLY 1900'S FLUSHOMETERS

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# Components



#### Parts breakdown



Regulations for Low Consumption Batures prohibit the use of higher flugh volumes.

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#### Piston

A piston flushometer features a molded cup with the upper and lower chambers separated by a rubber lip seal. This seal is extended inside a hollow piston, and the bypass hole can be found on the piston side wall. The relief valve seals the upper chamber from the lower chamber.

Pressing the handle causes the plunger to push against the relief valve, making it tilt and release water from the upper chamber. This causes a reduction in the water pressure above the relief valve.

When the pressure above the relief valve is reduced, the high pressure under the molded cup lifts the piston, allowing the piston to rise up from the main seat. Water continues to flow from the inlet pipe, under the piston, to the fixture. Once the piston lifts, the relief valve re-seats and a smaller stream of water flows through the bypass hole, restoring the pressure within the piston, above the relief valve.

This creates enough force to push the piston assembly back down, and shut off the water supply.

#### **Piston Operation**



## Features of a well designed flushometer

The flowing features will allow for continual service with little maintenance.

- High quality synthetic rubber diaphragm, handle seals and vacuum breaker gasket.
- Red brass construction vs. yellow brass (Yellow brass contains more zinc which can break off and cause failures)
- Chrome plated covers for screwdriver stop (protects unit from vandalism and unwarranted adjustments)
- High quality vandal resistant handles on manual flushometers meant to withstand blunt force activation (kicking)

# Piston Flushometer

- The piston flushometer was created 20 years after the creation of the diaphragm flushometer in 1926.
- This type of flushometer is intended to be used in a building with low water pressure and/or when lots of sediment is present in the water
   supply. (Note: original pistons were made of red brass, todays are made of plastic)
- Low pressure
- High sediment or debris content in water



## Diaphragm or Piston: Depends on the Application

- Both perform the same basic function
  - Modern plumbing systems function better with diaphragm technology
  - Diaphragm creates a better bowl evacuation by starting the siphon quickly and then tappers off to complete evacuation and rinse bowl
  - Control the rate and amount of water delivered to the fixture
  - Reset quickly to prepare for the next flush
  - Diaphragm specified in most of modern plumbing systems in the US
  - Diaphragm uses rubber or synthetic rubber
  - Piston uses a molded plastic cup with lip seal
- The right choice depends on the application
  - High restroom traffic use diaphragm
  - Poor water quality use piston (debris in line)
  - Low water pressure use piston (20 psi or below/developing countries)

## **Electronic options**



#### **RETROFIT FLUSHOMETER**

- Automatically operates by means of an 
   infrared sensor with multiple-focused,
   lobular sensing fields for high and low 
   target detection
- User-friendly, three-second flush delay 

   and Courtesy Flush<sup>®</sup> override button
- Eliminates walk by activation
- Available with solar powered with battery back up

#### **CONCEALED FLUSHOMETER**

- Fixed volume piston with filtered O-ring bypass
- Vandal resistant wall plate
- Often available in designer finishes •
- Available with mechanical override
- Eliminates walk by activation

#### SIDE MOUNT RETROFIT

- Battery powered
- 30% water savings with reduced flush
- True Mechanical Override for manual flush (power loss)
- Eliminates walk by activation

# Recessed closet flushometers



- Manual or sensor
- Battery or hardwire
- 5 finish options
- All GPF available
- 70% smaller wall plate than the industry standard
- Easy servicing from the front
- True mechanical override
- Vandal resistant wall plate



## Recessed closet flushometers installation

- Integrated control stop
- Adjustable flush connection
- Allows installer to bring plumbing to the valve
- Completely serviceable from the front (no chase is required
- Wall box and mounting bracket aligns flushometer for exact placement

# Recessed urinal flushometers



- Manual or sensor
- Battery or hardwire
- 5 finish options
- All GPF available
- 70% smaller wall plate than the industry standard
- True mechanical override
- Front access wall plate requires no rear access plumbing chase
- ADA compliant push button
- Vandal resistant wall plate

# Troubleshooting guide (Manual)

#### **1.** Flushometer does not function (no flush).

- Control stop or main supply valve is closed. Open control stop or main supply valve.
- Handle assembly is damaged. Replace handle with handle repair kit.
- Relief valve is damaged. Replace diaphragm kit sized for proper GPF of fixture.

#### 2. Handle leaks.

• Handle seal or handle assembly is damaged. Replace handle with handle repair kit.

#### 3. Water splashes from fixture.

- Control stop is open wider than necessary. Adjust control stop for desired delivery of water volume.
- Water saver/conventional diaphragm assembly is installed on low consumption fixture or closet diaphragm assembly is installed on urinal fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.

#### 4. Volume of water is insufficient to adequately siphon fixture.

- Control stop is not open wide enough. Adjust control stop for desired delivery of water volume.
- Diaphragm assembly is damaged. Replace diaphragm assembly.
- Low consumption diaphragm assembly is installed on a high flow fixture replace with proper GPF diaphragm. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.
- Inadequate water volume or pressure is available from supply. Increase flow rate or pressure to the valve. If gauges are not available to measure supply pressure/volume, remove relief valve from diaphragm assembly and open the control stop. If the fixture siphons: Additional water volume is required. Install higher flushing volume relief valve or diaphragm assembly or cut flow ring from guide.

# Troubleshooting guide (Manual)

#### 5. Flushometer valve closes immediately (short flush).

- Worn or damaged diaphragm assembly. Replace diaphragm assembly.
- Handle assembly is damaged. Replace handle with handle repair kit.
- Low consumption diaphragm assembly is installed on water saver/ conventional fixture or urinal diaphragm assembly is installed on closet fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace relief valve or diaphragm assembly for appropriate flush volume of fixture.

#### 6. Length of flush is too long (long flush) or fails to shut off.

- Bypass hole (upper filter ring) of diaphragm assembly is dirty. Remove the diaphragm assembly. Disassemble the filter rings from the diaphragm, wash under running water, and reassemble. Replace as necessary.
- Relief valve or diaphragm assembly is damaged. Replace relief valve or diaphragm assembly.
- Water saver/conventional diaphragm assembly is installed on low consumption fixture or closet diaphragm assembly is installed on urinal fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.
- Inside cover is damaged. Install new part.
- Line water pressure dropped and is insufficient to close valve. Close the control stop until pressure is restored.
- Relief valve is not seated properly. Disassemble diaphragm components (relief valve, filter rings, and diaphragm unit), wash under running water, and reassemble. Replace as necessary.

#### 7. Chattering noise is heard during flush.

- Inside cover is damaged. Install new part.
- Relief valve or diaphragm assembly is damaged. Replace relief valve or diaphragm assembly.

#### 8. Low pressure

- Typical fixtures require 25 psi to flush. Check pressure.
- Line water pressure dropped and is insufficient to close valve. Close the control stop until pressure is restored.

## **Operating Requirements: Water Pressure**



- 10 to 100 psi for valve operation
  - (actual minimum & maximum pressure range is dependent upon fixture requirements & Plumbing Code)
- Typical Fixture requirements:
  - 25 to 80 psi
  - High efficiency toilets (HETs) may require 35 psi minimum
- Safe plumbing codes usually require PUBLIC operation to be 85 psi Maximum
- Flushometers typically require ~ 5 to 10 psi for Shut Off
- All pressures are Flowing not Static

# Flushometers and water hammer arrestors

Because of the quick closing nature of flushometers, water hammer arrestors are required to be installed at flushometer locations.

Even at low gallon flushes, the flow rate is high, and the diaphragm closes quickly creating water hammer.

- UPC and IPC codes require water hammer arrestors at locations where flushometers and quick closing fixtures are installed.
- A. ASSE 1010
- B. Uniform Plumbing Code UPC 609.10
- C. International Plumbing Code IPC 604.9
- D. International Mechanical Code IMC 1206.7

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#### Installation of water hammer arrestors

 If fixture installation is 20 foot or less, 1 arrestor 6 feet or less to the end of the last fixture



# Installation of water hammer arrestors cont.

For fixtures installations longer than 20 feet

 -A: install one arrestor at the last fixture
 -B: install additional arrestors every 20 feet

Arrestor sizes for flushometers is based on "fixture units"

Toilet with flushometers are 8 fixture unites Urinals with flushometers are 4 fixture unites



#### TABLE 1

FIXTURE	TYPE OF SUPPLY CONTROL	FIXTURE UNITS					
		PUBLIC			PRIVATE		
		TOTAL	C.W.	H.W.	TOTAL	C.W.	H.W.
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	4	4	-	-	-	-
Stall or Wall Urinal	Flush Tank	2	2	-	-	-	-
Lavatory	Faucet	2	1-1/2	1-1/2	1	1	1
Bathtub	Faucet	4	2	3	2	1-1/2	1-1/2
Shower Head	Mixing Valve	4	2	3	2	1	2
Bathroom Group	Flush Valve Closet	-	-	-	8	8	3
Bathroom Group	Flush Tank 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
Clothes Washer	Solenoid Valves	-	-	-	4	3	3
Dishwasher	Solenoid Valve	-	-	-	1.5	-	1.5
Ice Maker	Solenoid Valve	-	-	-	1	1	-

#### TABLE 2

ARRESTER SIZE	AA	А	В	С	D	E	F
FIXTURE UNITS	1-4	5-11	12-32	33-60	61-113	114-154	155-330

## Operating Requirements: Pipe Size & Flow Rate

- Water Closets
  - 25 to 35 Gallons Per Minute (gpm)
  - Flushometers produce a flow rate of 35 GPM which is required by the fixture
- Urinals
  - Wash Down 6 gpm
  - Siphon Jet 12 to 16 gpm
- To ensure adequate flow rate, pipes must be sized properly:
  - Water Closet: 1" pipe (DN 25 mm).
     Also for urinals with 1 ¼" spud
  - Urinals: ¾" pipe (DN 20 mm)



### How vitreous china fixtures are manufactured

- 1) 3D file or plaster model is created
- 2) Prototype mold ("block mold") is made from plaster-like material ~12% larger
- 3) Liquefied clay called slip is poured
- 4) The mold draws out water from slip creating a firm clay on the inside walls of the mold
- 5) The remaining slip is drained from the interior
- 6) The mold is removed leaving a 'greenware' sample
- 7) Greenware is cleaned up and after drying glaze is applied
- 8) The sample is put into kiln at 2,000F for about 24 hours



# Various fixture mounts, connections and heights - Closets



### Pressure assist toilets

Great performance, reduced cost



- Lower cost option for commercial fixtures ADA and regular height closets
- Lower installation cost
- Only requires a <sup>1</sup>/<sub>2</sub>" supply line not a 1" minimum required by flushometers
- 50% improved drain carry and better performance, lower GPF
- ASME code requires a 40' drain carry

(Sloan models carry to 90' and exceed 40' required by ASME)

#### <u>Applications</u>

- -Restaurants
- -Schools
- -Strip mall + retail
- -Hotels
- -Gas stations
- -Residential/multifamily
- -Office/Church

# Importance of Proper Match

### When improper match occurs...

- Fixture performance and carry can be compromised
- Critical for low flow applications match the fixture and flushometer for best results
- 1.28 GPF complies with both UPC and IPC codes
- Example:
  - IF... 3.5 gallons per flush flushometer on a new 1.28 gpf bowl
  - THEN...
    - Long flush wasting water
    - Surfing
    - Water spilling out vent holes of vacuum breaker

\*Problems from incorrectly matched flushometer and fixture

# Typical commercial fixture heights and connections - Urinals



## New high design urinals now available



- Small size and clean lines fits a large variety of applications and restroom looks
- Thorough washdown flushing action
- Meets ADA guidelines and ANSI A117.1 requirements when installed accordingly

## Hybrid urinals



- Jetrinse Solution Technology automatically cleans the housing and drain every 72 hours
- Virtually eliminates odor and drainline sediment formation that creates clogs
- Earns maximum LEED credits and minimal water and sewage costs

## Water-free urinal



- Uses no water for maximum LEED credits and minimal water and sewage costs
- Conserves up to 40;000 gallons of water each year
- cUPC certified to meet or exceed ASME 112.19.19 standards
- Requires scheduled maintenance to flush drain lines

## Fixture Line Up - Lavatories



# Special options and features

Some companies such as Sloan, American Standard and TOTO offer a special hyper clean glaze that defends against hard water and staining.

- Ultra clean
- Better bowl evacuation
- Inhibits growth of germs
- Helps with staining and hard water



#### Troubleshooting electronic flushometers





# Thank you for your attention!

• Please feel free to ask questions