



SOUTHWEST
ENVIRONMENTAL
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US Territories Water Operator Training Series

Session 19: Distribution 2: Valves, Hydrants, Meters, and Service Connections

4/2/2026

Your trainer for today

Matt Ziegler
Program Director



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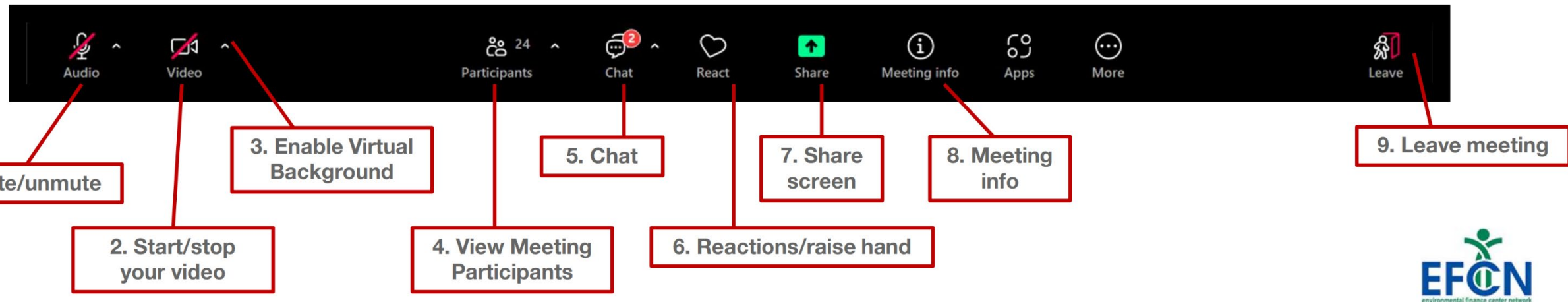
SCHOOL OF
ENGINEERING



This training series is funded by the US EPA

Attendee Meeting Controls

- Locate your control bar
- All attendees will see a black horizontal bar on their screen
- If your control bar is not visible, it may be hidden
 - Move your cursor to the screen's bottom (or top) to reveal this control bar.



Schedule for 2026:

Date	Topic
1/22/26	Alternative Treatment Processes (e.g. fluoridation, ion exchange, RO...)
2/5/26	Drinking Water Treatment Math & Concept Review
2/19/26	Safety Program Basics (including personal safety, equipment safety, facility safety)
3/5/26	Lead & Copper Rule, Corrosion Control
3/19/26	Distribution Systems 1: Hydraulics, Pipe Types, Selection, Installation, and Water Quality
4/2/26	Distribution Systems 2: Valves, Hydrants, Meters, and Service Connections
4/16/26	Distribution Systems 3: Storage and Booster Pumping
4/30/26	O&M: Pumps, Main, and Appurtenance Maintenance (including pressure monitoring, valve exercising, and flushing)
5/14/26	O&M: Cross Connection Control
5/28/26	O&M: Distribution System Math and Concept Review
6/11/26	Sampling & Lab Procedures/Analysis/Interpretation
6/25/26	Management Overview (including organization, communication, PR & record keeping)
7/9/26	Drinking Water Practice Exam and Review

Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

Pacific Island Territories Operator Certification Trainings

This page is a repository of Wastewater and Drinking Water Operator Certification (Op Cert) Training Webinars offered by the SW EFC for systems in the Pacific Territories. Below you will find the **training webinar schedules (wastewater, then drinking water)** followed by a **training webinar recordings library**.

[Jump to Wastewater Trainings](#) [↓](#)[Jump to Drinking Water Trainings](#) [↓](#)

Wastewater Training Schedule

Please note all times are local to CNMI and Guam. The times in American Samoa are one day earlier at 11 am.

Session	Date	Training Topic & Link to Recording (click to view)	Supporting Materials (click to download)
1	6/25/2025	Program Overview, Test Format, Study & Test Tips	PPT slides
2	7/9/2025	Treatment Overview	PPT slides
3	7/23/2025	WW Math Part 1 (Areas & Volumes)	PPT slides
4	8/6/2025	WW Math Part 2 (Flow Rates & Detention Times)	PPT slides
5	8/20/2025	Collection Systems – Gravity systems	PPT Slides

Sign in for every session to ensure you get credit for attending



**US Territories Water & Wastewater Operator Certification
Virtual Training Series Group Attendance Sheet**

Session Title: _____

Session Date: _____

Training Location: _____

Attendee Name	Attendee Signature	Arrival Time	Departure Time

I hereby certify that the individuals listed above attended the referenced training session.

Name: _____
Signature: _____
Title: _____
Date: _____

Please scan this sheet after each training session and email it to swefc@unm.edu with the subject line: "US Territories Op Cert Attendance Sheet"

Valves

Drinking Water Distribution Systems

Valves

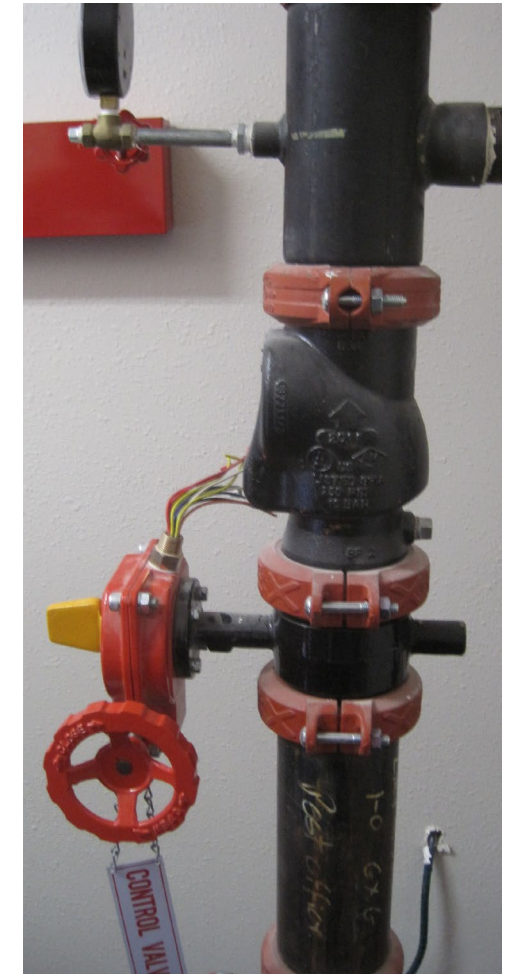
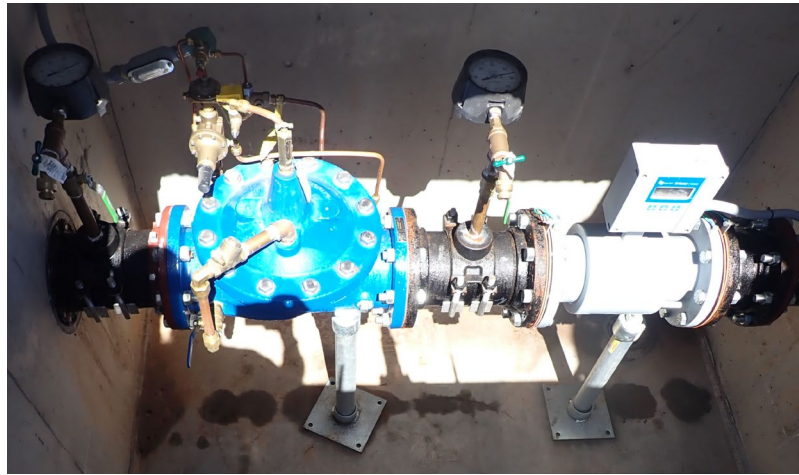
- Uses
- Types
- Operation
- Maintenance
- Affect on Water Quality



"20' gate valve - Calf Hey dam 1856 -
geograph.org.uk - 363562" by [liz
dawson](#) is licensed under [CC BY-SA 2.0](#).

Valves – Uses

- Flow Control
- Isolation
- Pressure Control
- Air Relief
- Vacuum Relief
- Backflow Prevention



Valves – Uses in Drinking Water



Sources



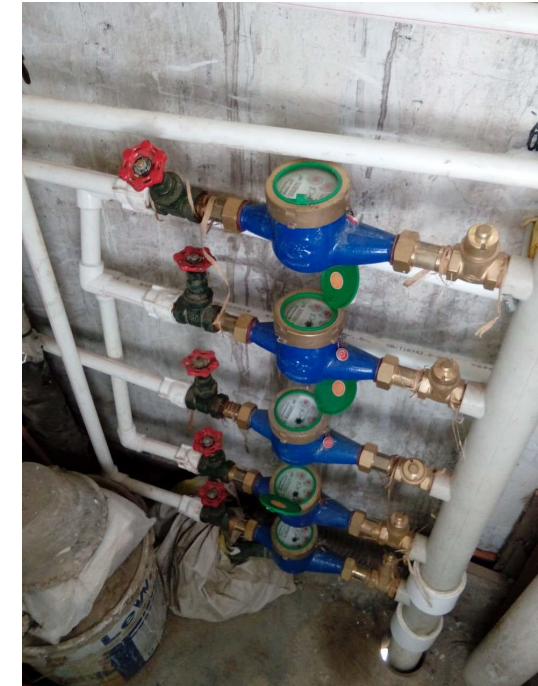
Treatment



Distribution



Storage



Service Connects

Valves – Types

- **Rotary Valves**

- Quarter turn valves
- Plug valves, ball valves, butterfly valves

- **Linear Stroke Valves**

- Valve stem must be rotated several times to open and close – more rotations for bigger valves
- Gate valves, globe valves

- **Air/Vacuum Relief**

- Allow air into or out of system

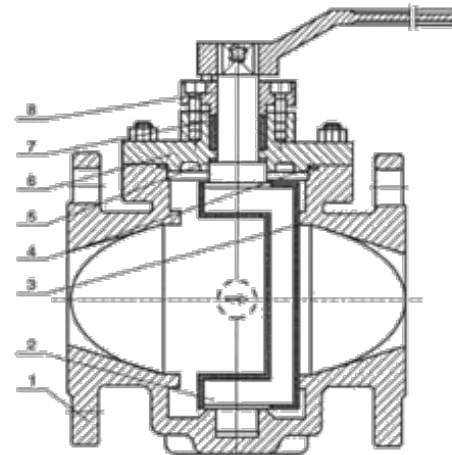
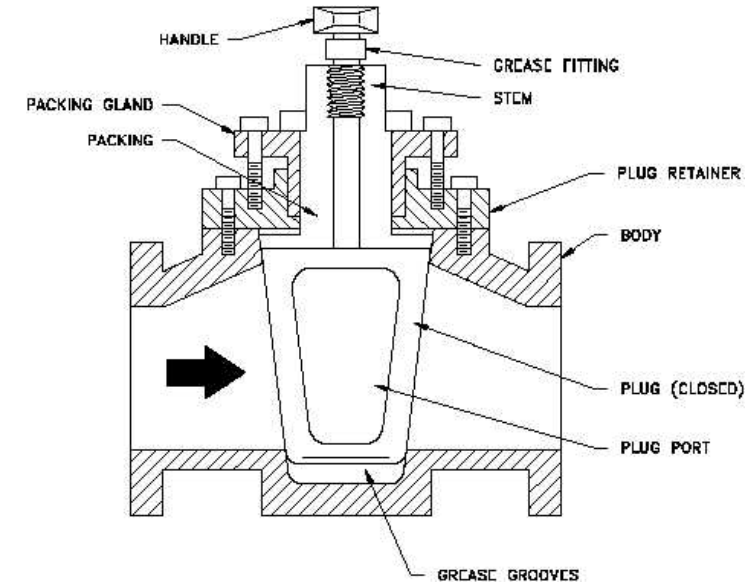
- **Check Valves**

- Keeps flow in only one direction

Valves – Rotary

- **Plug Valves**

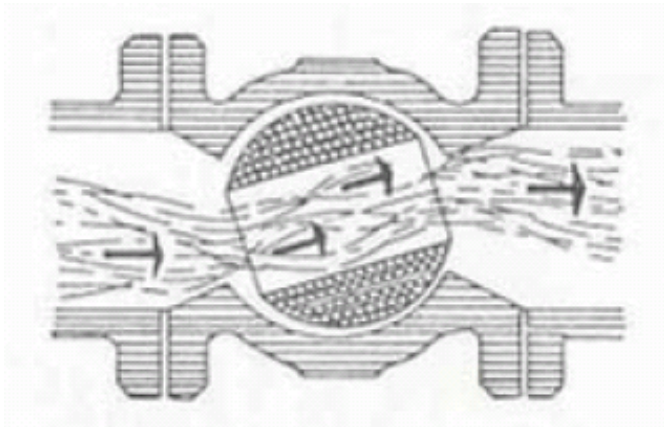
- Used in curb and corporation stops
- 1/4-turn to open, restrict, or stop flow
- Usually 3/4"-2"
- Standard plug valve with opening in center
- Eccentric/solid plug valve with plug off-center



Valves – Rotary

- **Ball Valves**

- Similar to plug valve
- ¼-turn to open
- Small diameter pipe ≤ 2 "
- Operate fully open or closed

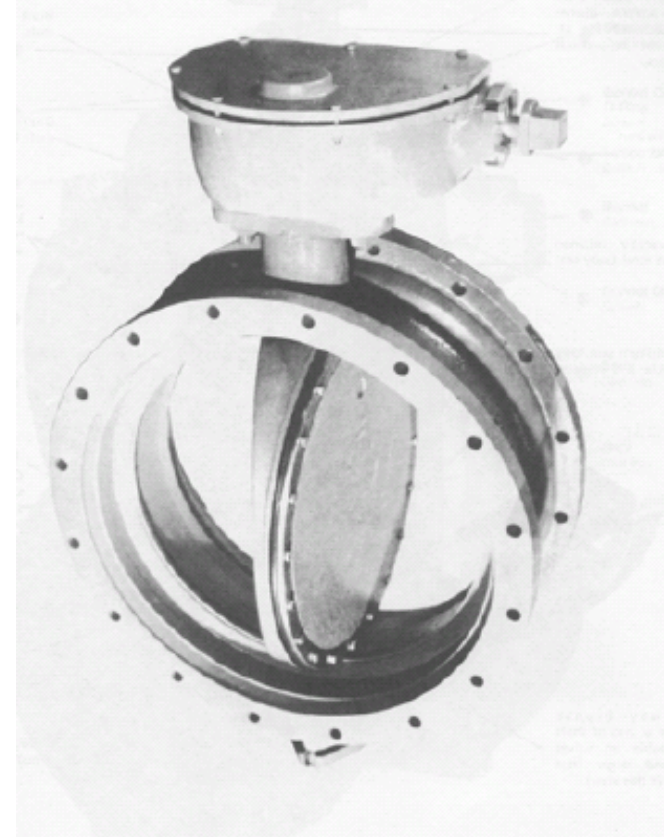


"[Ball Valve](#)" by [Bitjungle](#) is
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Valves – Rotary

- **Butterfly**

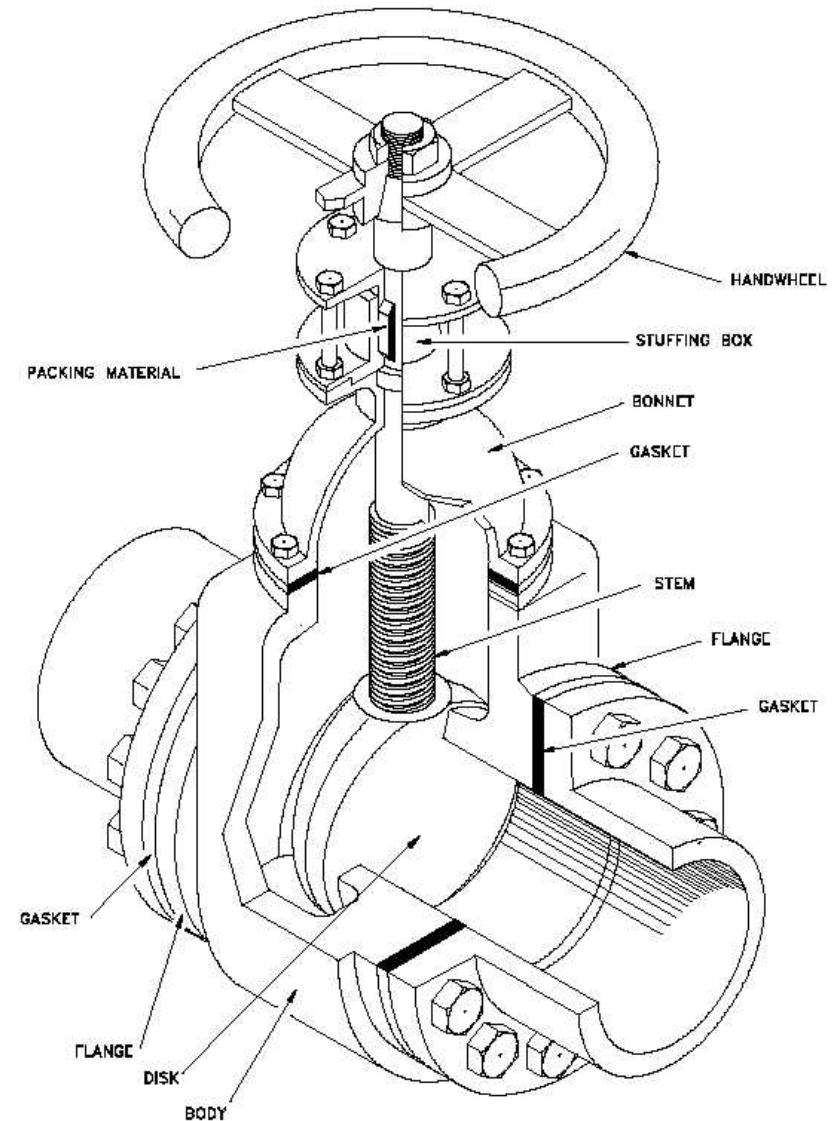
- ¼- turn to open
- Best for throttling flow under low flow/pressure conditions
- 4"-120"
- Easier to open
- Open automatically with actuators
- Used in treatment systems to automatically change between filter, backwash, and filter to waste



Valves – Linear Stroke

- **Gate**

- Best for isolation in distribution
- Operate 100% open or 100% closed (don't throttle flow)
- ½"-24" in diameter
- Least friction loss when open
- Rising or non rising stems
- Must overcome force against valve face

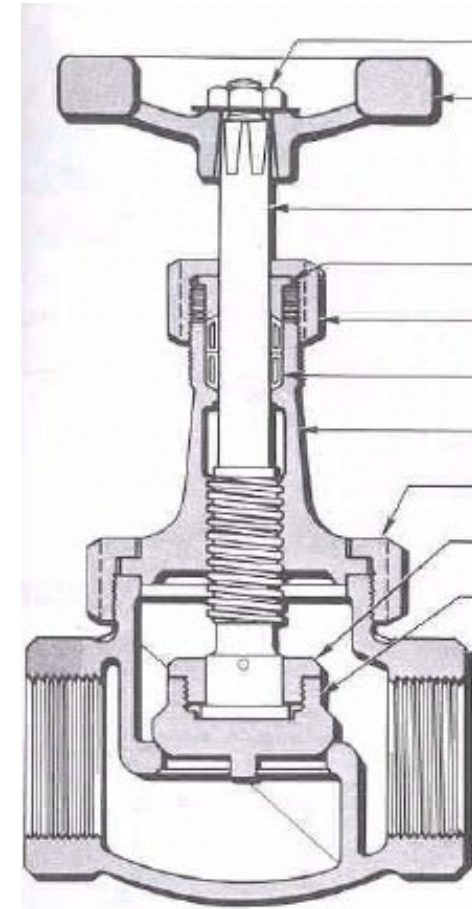


Number of turns to open/close = 3 x diameter (inches) + 1 to 3 turns

Valves – Linear Stroke

- **Control Valves**

- All globe valves
- Automatically react to changes in the system by opening or closing
- Used for flow control, pressure regulation
- Include altitude valves, pressure reducing valves, pressure sustaining valves, pump control valves, and check valves



Valves – Control

- **Pressure Reducing Valve**
 - Differences in elevation create high pressure at lower elevations
 - Installed at locations where static pressure is too high

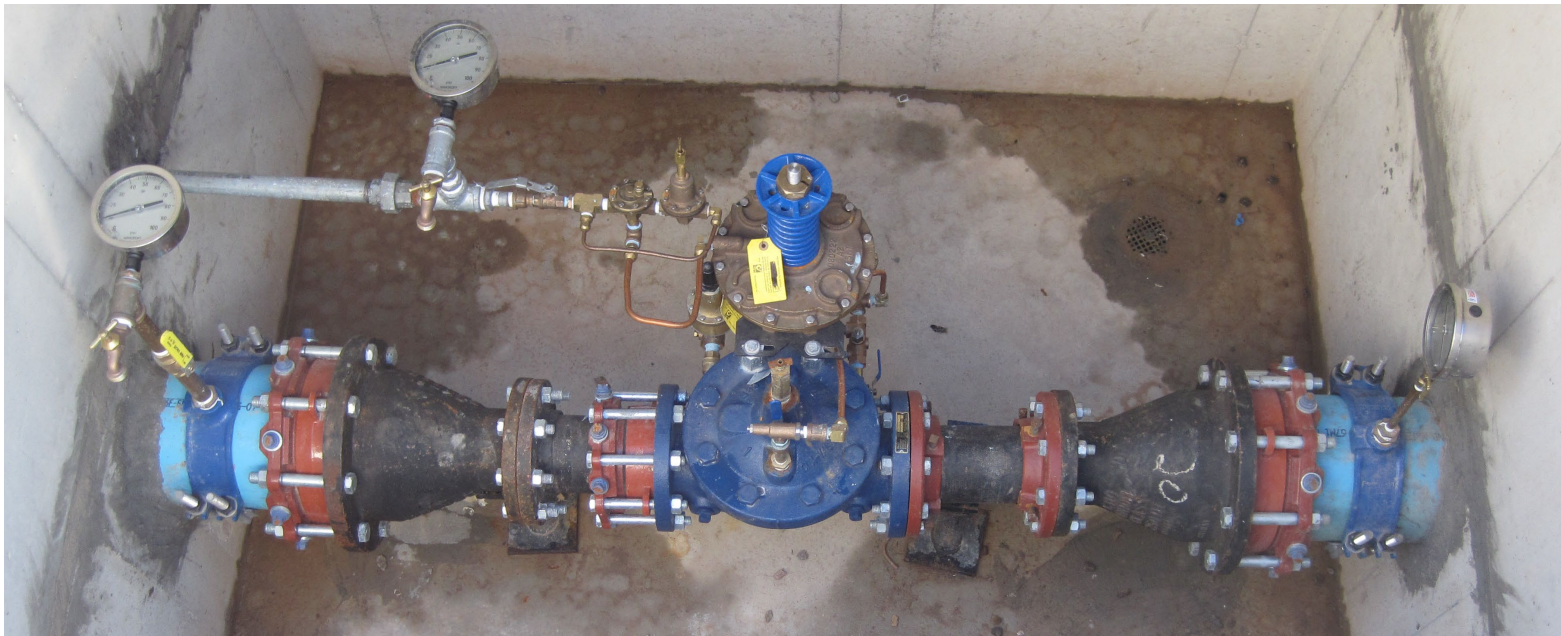
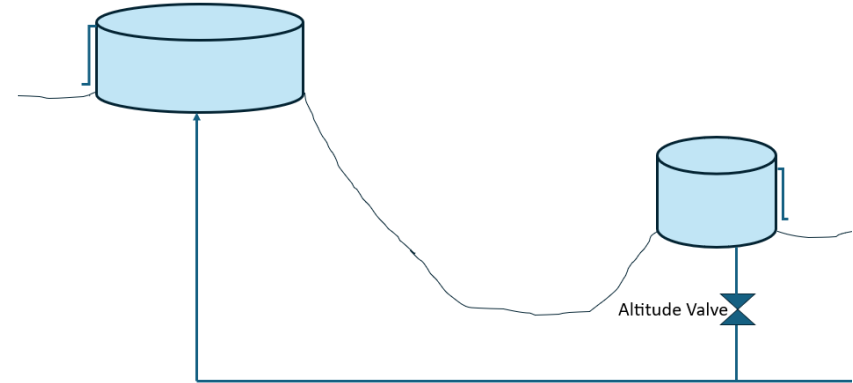




Valves – Control

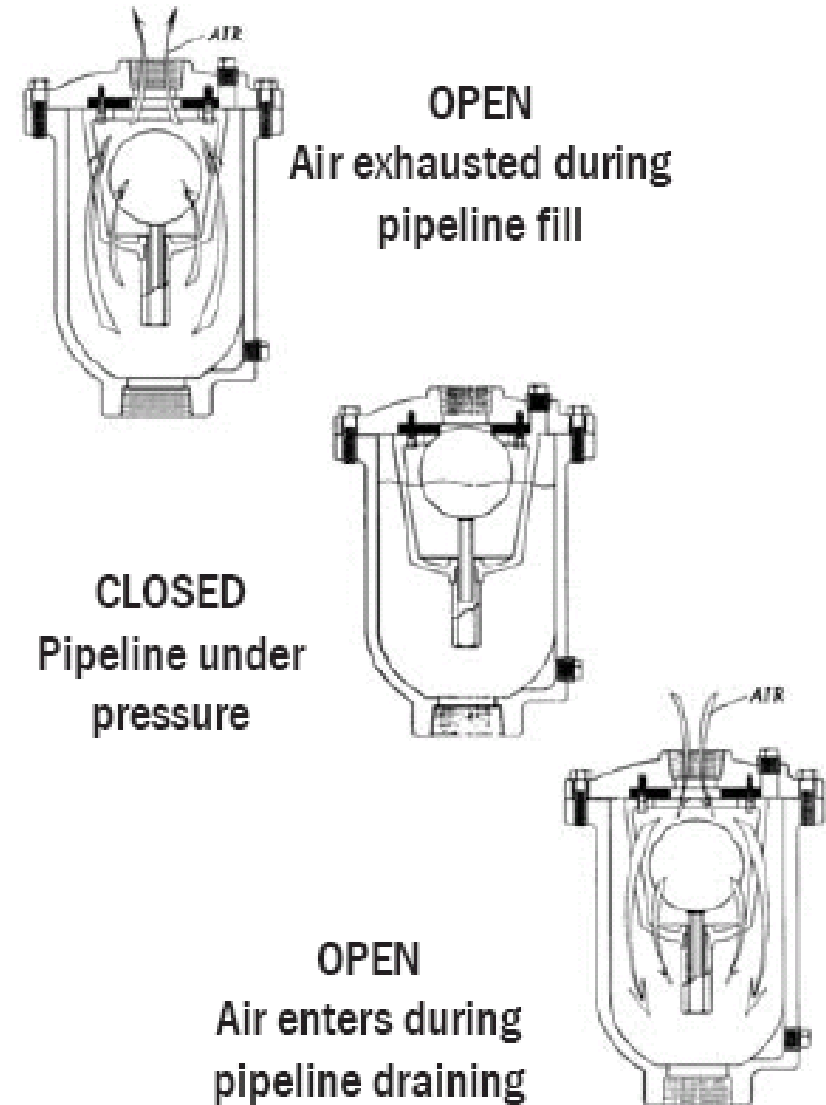
- **Altitude Valves**

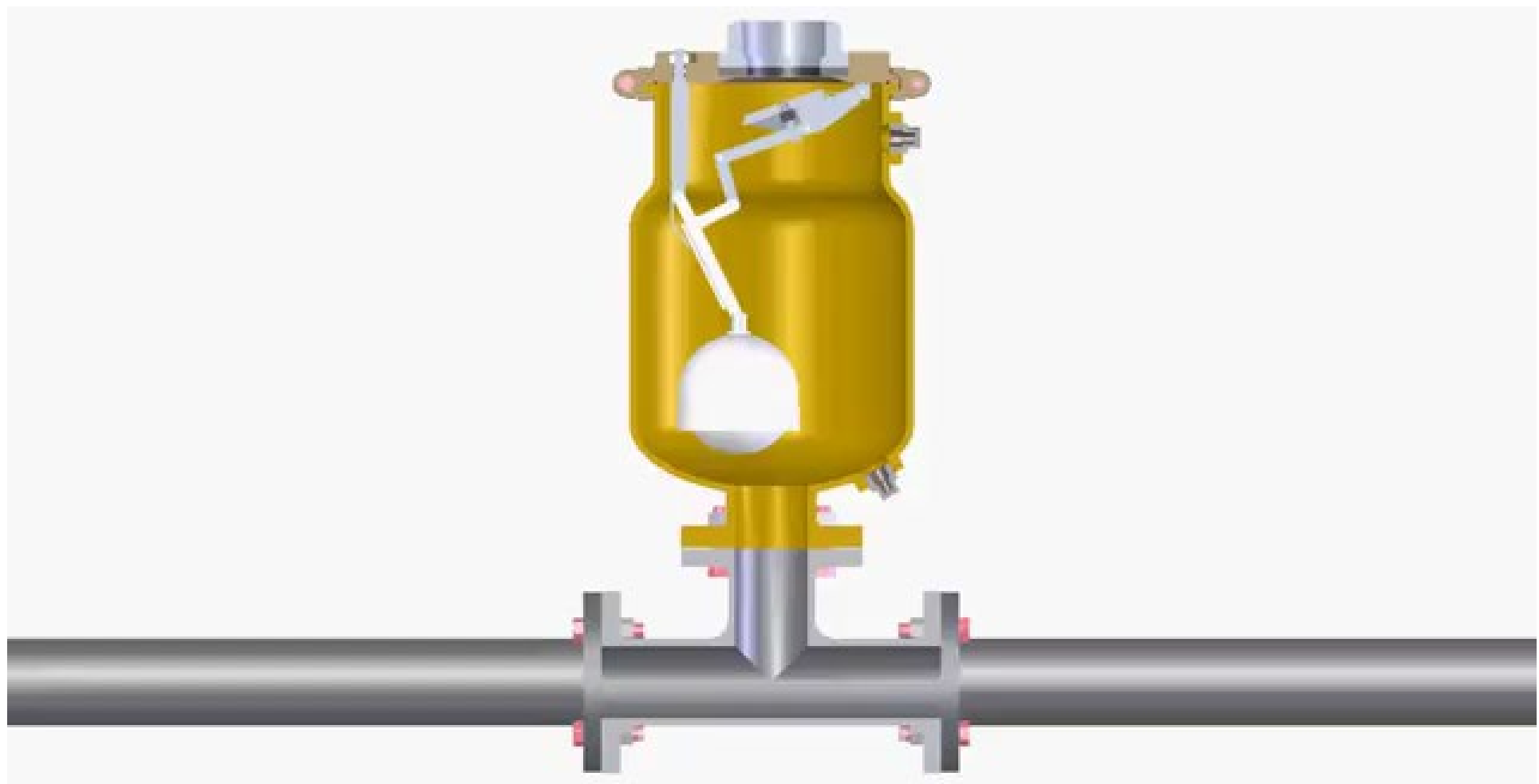
- Used when storage tanks are at different altitudes
- Placed on lower tank that is below the hydraulic gradient
- Closes when full to prevent overfilling



Valves – Air Vacuum Relief

- Allows trapped air to escape
- Allows air to enter when a vacuum occurs





Valves – Check

Purpose

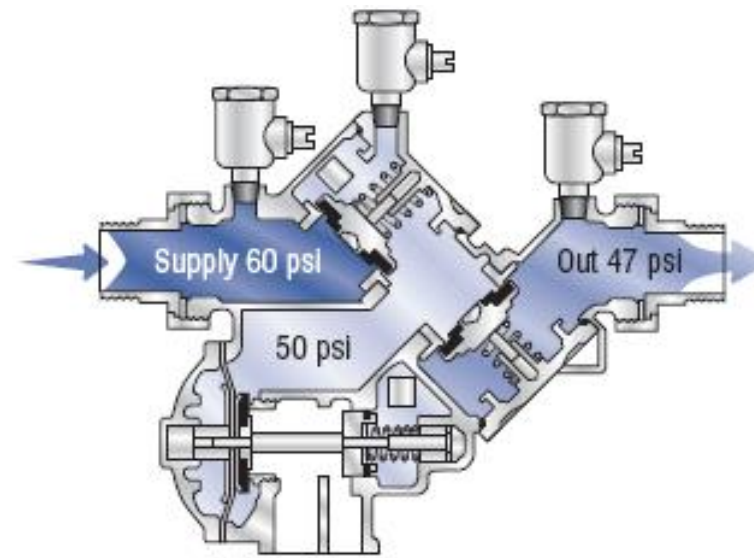
- Only allow flow in one direction
- Include:
 - single check
 - double check
 - reduced pressure zone backflow preventer
- Prevent non-potable water from mixing with potable water
- Prevent damage to pumps (check valve)
- If testable must be checked every year



Valves – Check

- **Reduced Pressure Backflow Preventer (RPZ)**

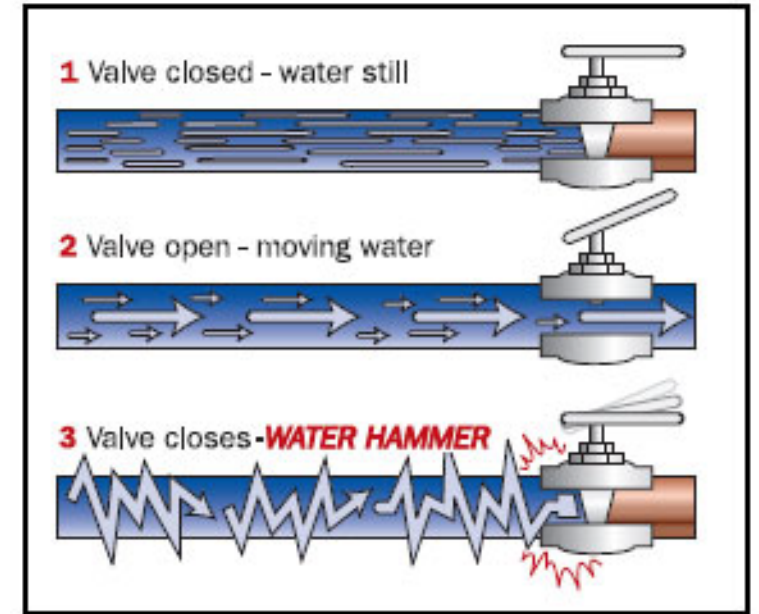
- The best/most protective mechanical solution but air gap is still the best non-mechanical cross connection control
- Check valves act independently
- Must be tested every year
- Must be installed at least 12-inches above grade
- Will spit when operating



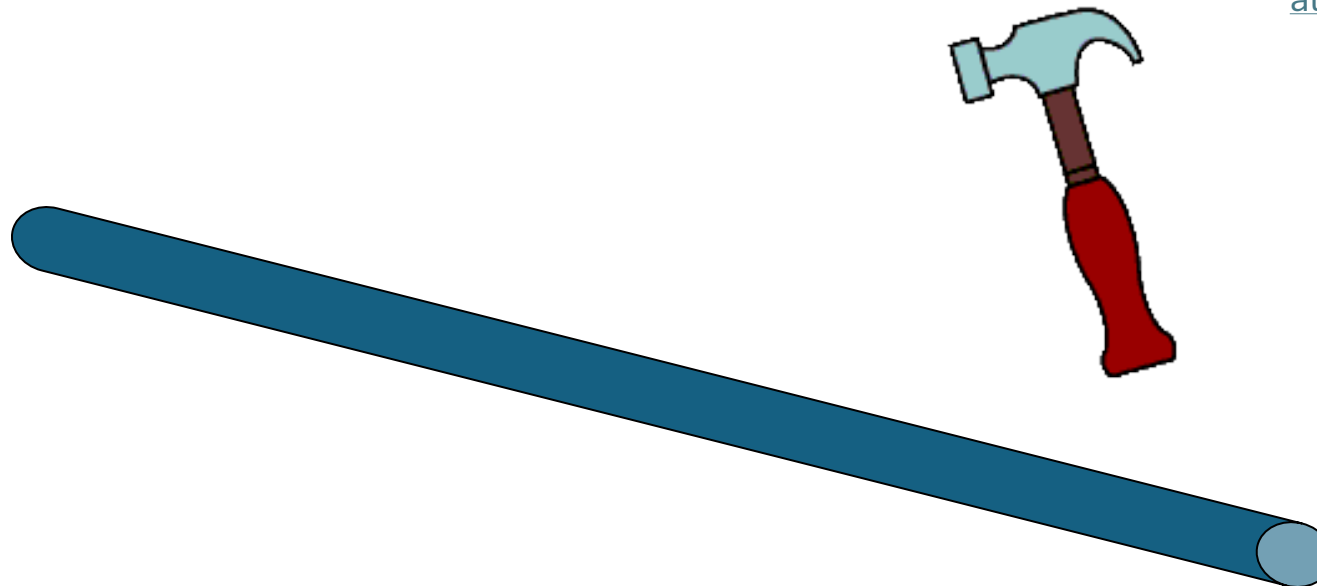
Valves – Operations

- **Water Hammer**

- A pressure wave in a pipe caused when closing or opening valves
- Occurs when opening or closing valves too quickly



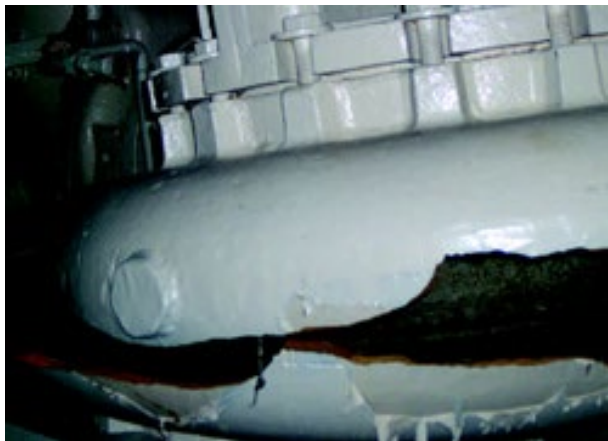
<http://www.plumbingmart.com/images/water-hammer-valve.jpg>



Valves – Operations

- **Water Hammer**

- Sounds like hammering on the pipe and can cause damage
- Can reduce water hammer by slowly opening the valve and letting the pipe fill before opening it all of the way



Cast Iron Pipe Broken from Water Hammer



Valves – Operations

- **Water Hammer**
 - Can be calculated

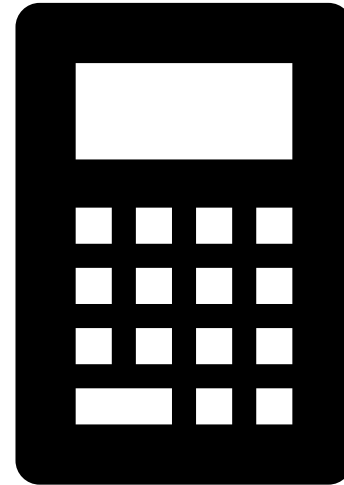
$$dp = 0.070vl/t$$

dp = increase in pressure (psi)

v = flow velocity (ft/s)

l = upstream pipe length (ft)

t = valve closing time (s)



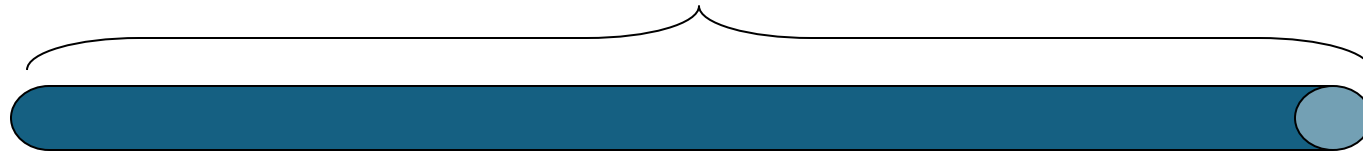
Valves – Operations

$$dp = 0.070vl/t$$

Water Hammer When Closing Solenoid Valve

Flow = $v = 6$ ft/sec

100 feet



Example 1 – What is the pressure increase if the solenoid valve closes in 0.1 seconds?

$$dp = 0.070(6 \text{ ft/s})(100 \text{ ft})/0.1 \text{ s} = \mathbf{420 \text{ psi}}$$

Example 2 – What is the pressure increase if the solenoid valve has a damper and closes in 1 seconds?

$$dp = 0.070(6 \text{ ft/s})(100 \text{ ft})/1 \text{ s} = \mathbf{42 \text{ psi}}$$

Valves – Maintenance

- **Location/Mapping**

- Where, type, date of install, maintenance done and date completed, direction of flow, how many turns to open and close gate valves
- Utilize permanent landmarks to establish permanent ties to assist in location of valve

- **Inspection**

- Exercise, inspect for leakage, housekeeping around valve and valve box, clean and oil screw on stem of gate valves

- **Exercising**

- Every valve, every year

Valves – Affect on Water Quality

- Closed valves create dead ends in distribution
 - Increased water age
 - Sediment build up
 - Possible biofilm growth





How many
valves do
you see?



Hydrants

Drinking Water Distribution Systems

Hydrants

- Uses
- Types
- Components
- Operations & Maintenance



Hydrants – Uses

- Provide large water flows to fight fires and flush the distribution system
- Provide large quantities of water for water trucks and for construction



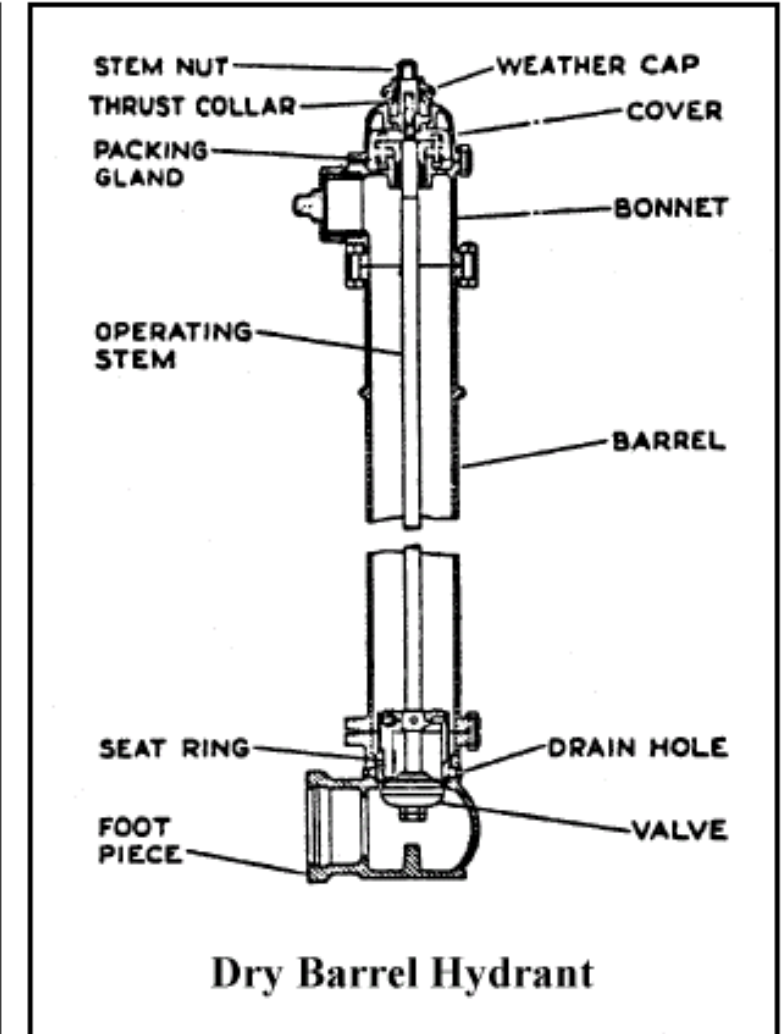
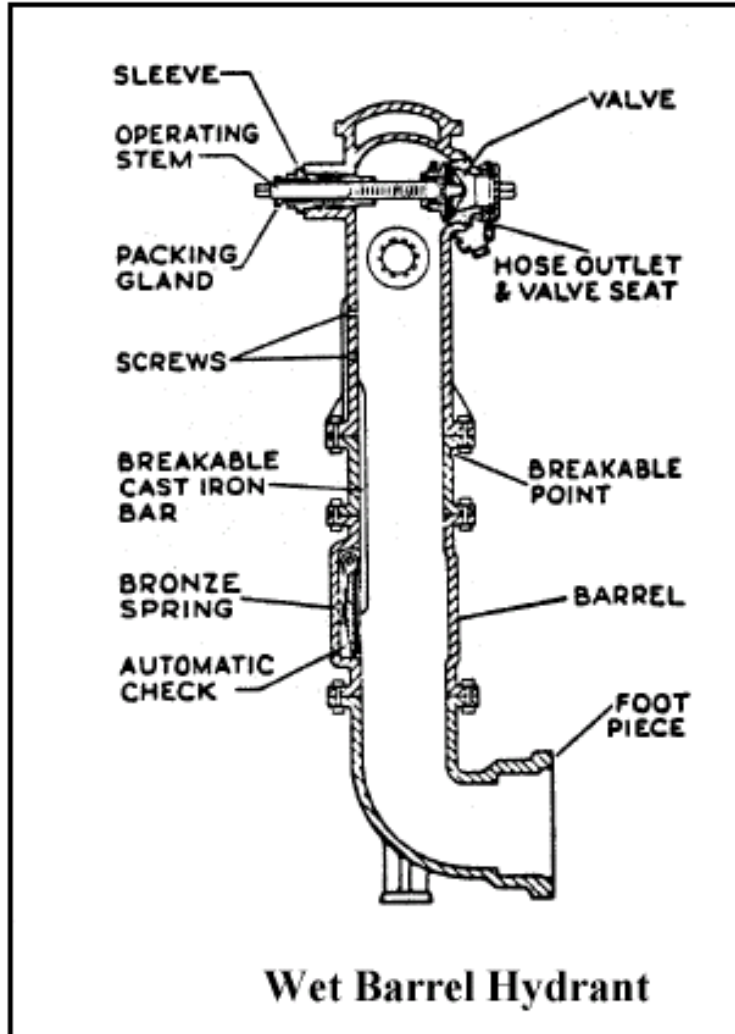
Hydrants – Types

- **Flush Hydrants**
- **Fire Hydrants**
 - Wet barrel
 - Dry barrel



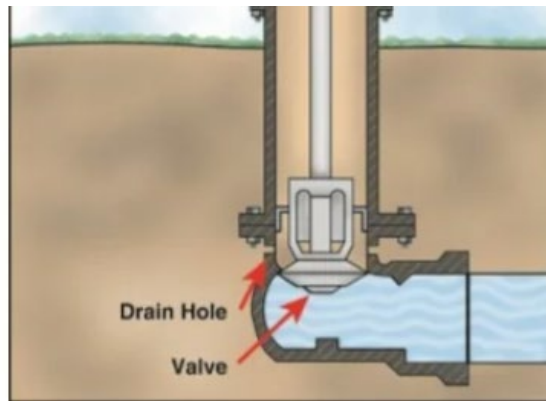
Hydrants – Components

- Inlet (base)
- Valve
- Barrel
- Head
- Gate valve
- Backflow protection



Hydrants – Operations & Maintenance

- Do not throttle flow on dry barrel hydrants, only operate fully open
- Close slowly to avoid water hammer
- Keep clear and free from obstructions
- Flush regularly to ensure operation
- Do not force hydrant to close



Hydrants- Operations & Maintenance

- Perform flow tests to determine capability
- Inspect regularly and keep detailed information
- Locations should be properly mapped and identified
- Control their use
- Repair if leaking
- For more information – <http://firehydrant.org>



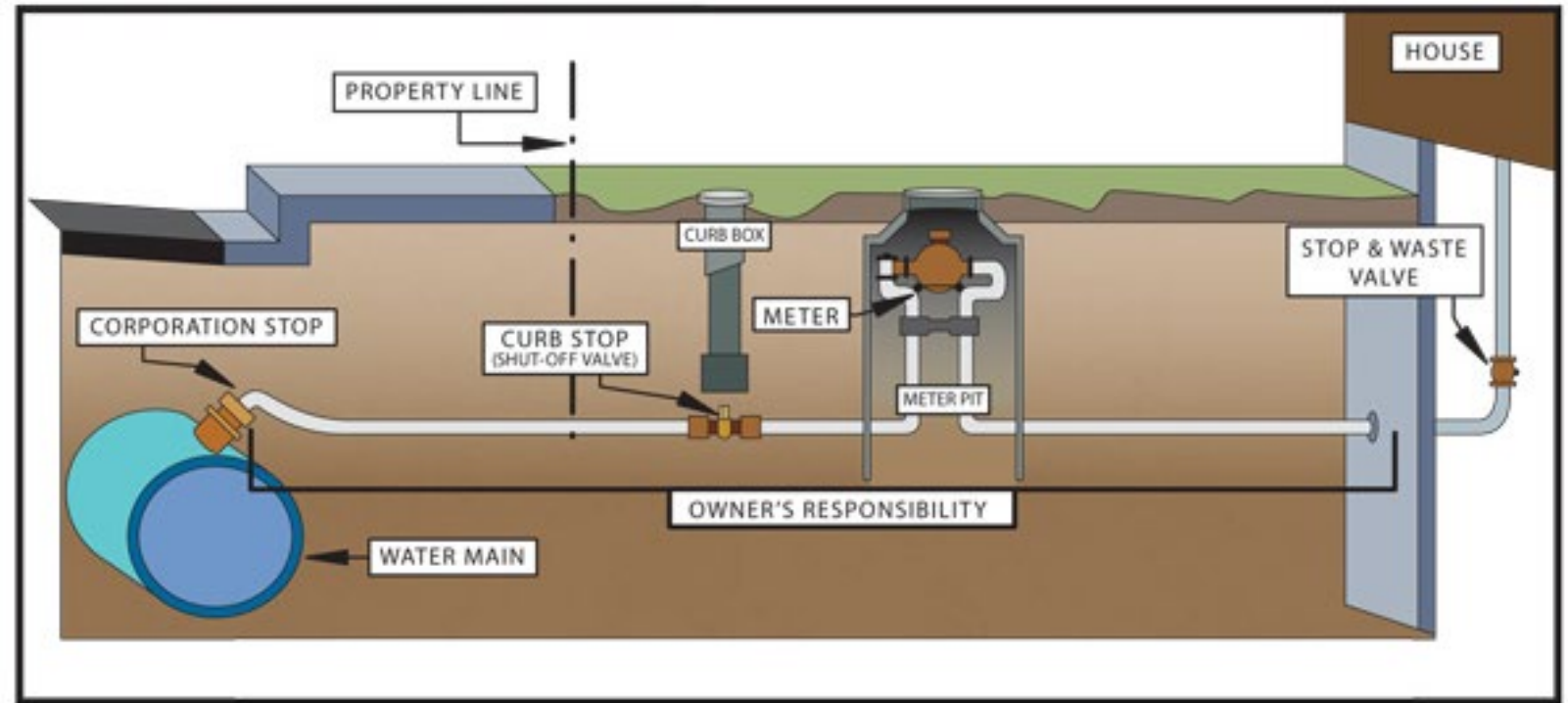
Purpose – To connect customers to distribution piping/water mains

Service Connections

Drinking Water Distribution Systems

Service Connections – Components

- Meter
- Meter box
- Meter setter
- Service line
- Curb Stop
- Corp Stop



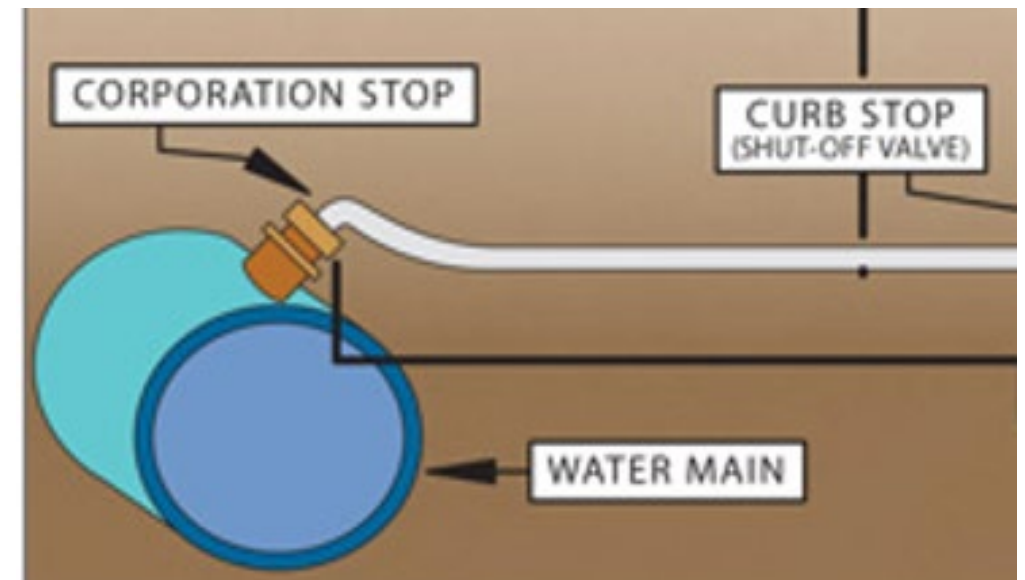
Service Connections - Installation

- Tapping machine drills into main and connects a corporation stop to the main (cuts out a coupon)
- Typically done while main is under pressure so service to other customers is not interrupted (“Hot” Tap or “Wet” Tap)



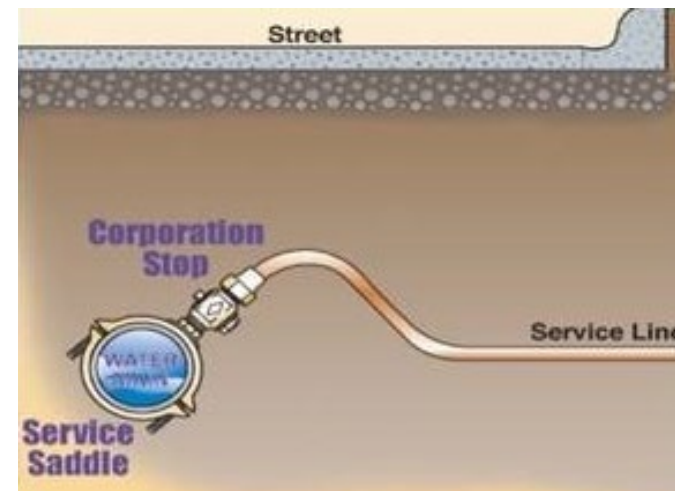
Service Connections - Installation

- Corporation Stop (Corp Stop) can be inserted directly into main or installed on a saddle that is strapped to the pipe
- Taps made at 45 angle from horizontal to avoid damage from backhoe



Service Connections – Service Line

- Copper, PVC or polyethylene
- Older galvanized and lead services can be problematic (corrosion and contamination) – must replace as part of Lead and Copper Rule Revisions
- Include a bend near the corp stop to allow for some flexibility during backfill, settling or shifting
- Installed below the frost line



Service Connections – Curb Stop

- Shut-off valve, copper
- Installed in easement so that the service can be isolated.
- Meter stop can be used in place of a curb stop



Service Connections – Corp Stop vs Curb Stop



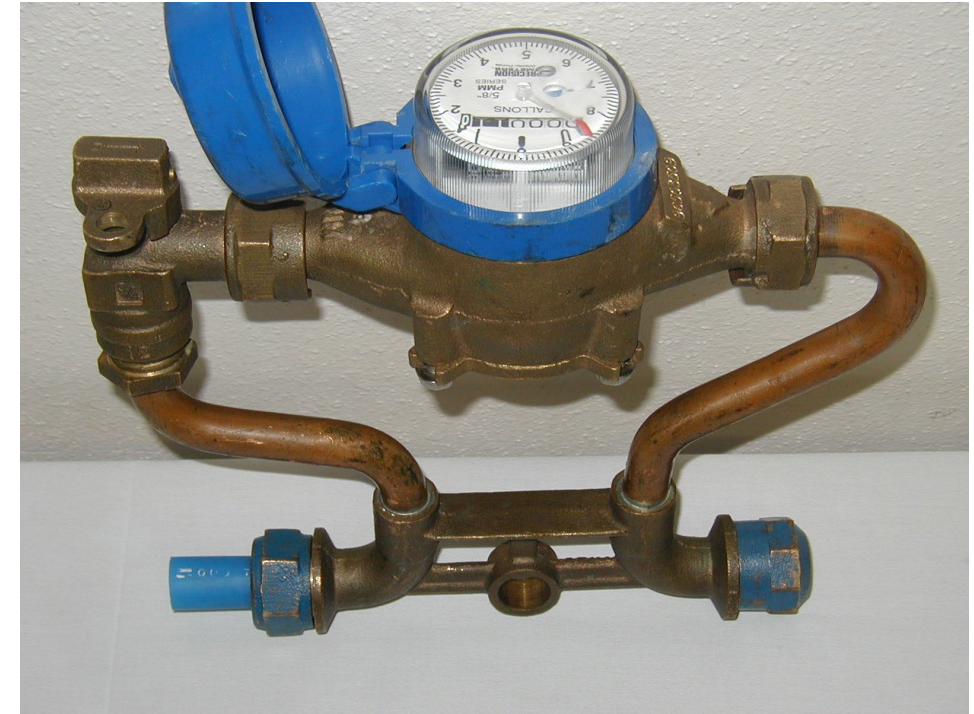
- Directly on main
- Joins customer service to main
- Designed for installation under pressure
- Buried



- Between corp. stop and new service
- Accessible
- Easy shutoff

Service Connections – Meter Setters

- Brass and copper device
- Allows service line to be buried at a safe depth and still have the meter within reasonable reach of the top of the meter box
- One way to maintain proper distance between meter fittings when replacing a meter



Service Connections – Meter Box

- Made from cast iron, concrete and plastic
- Gives access to the meter for the meter reader

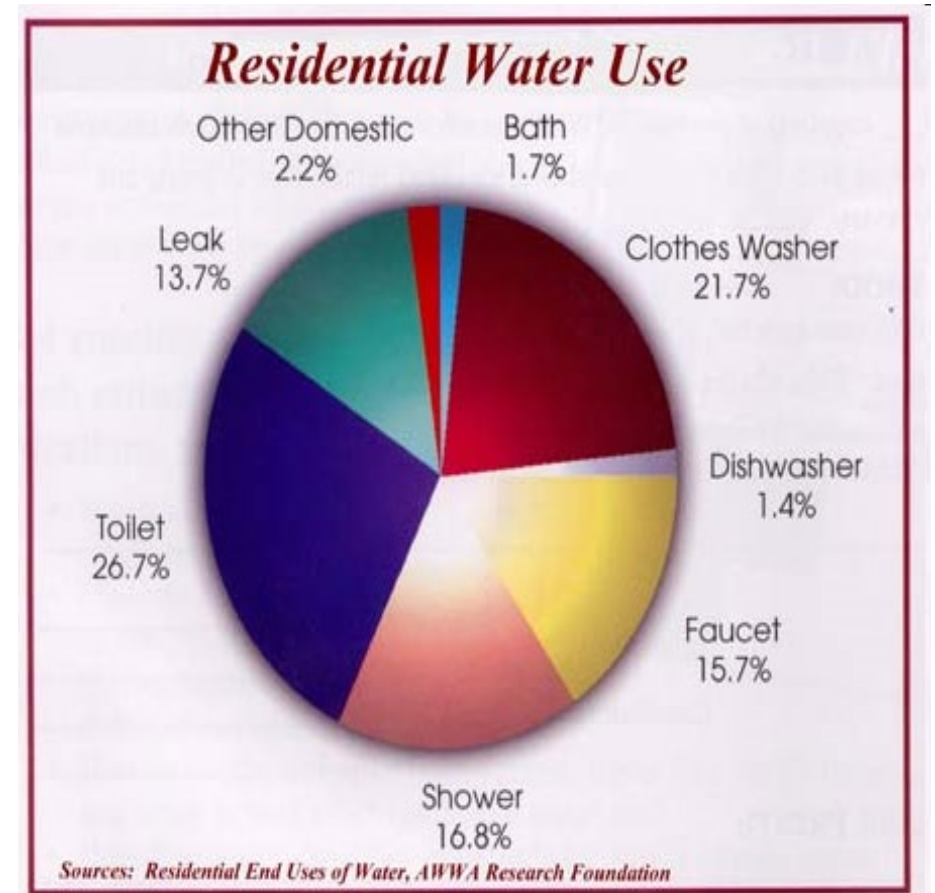


"Ford Meter Box, Wabash, Indiana, Water Meter Cover from New Iberia, Louisiana" by Uncommon Fritillary is licensed under CC BY-SA 2.0.



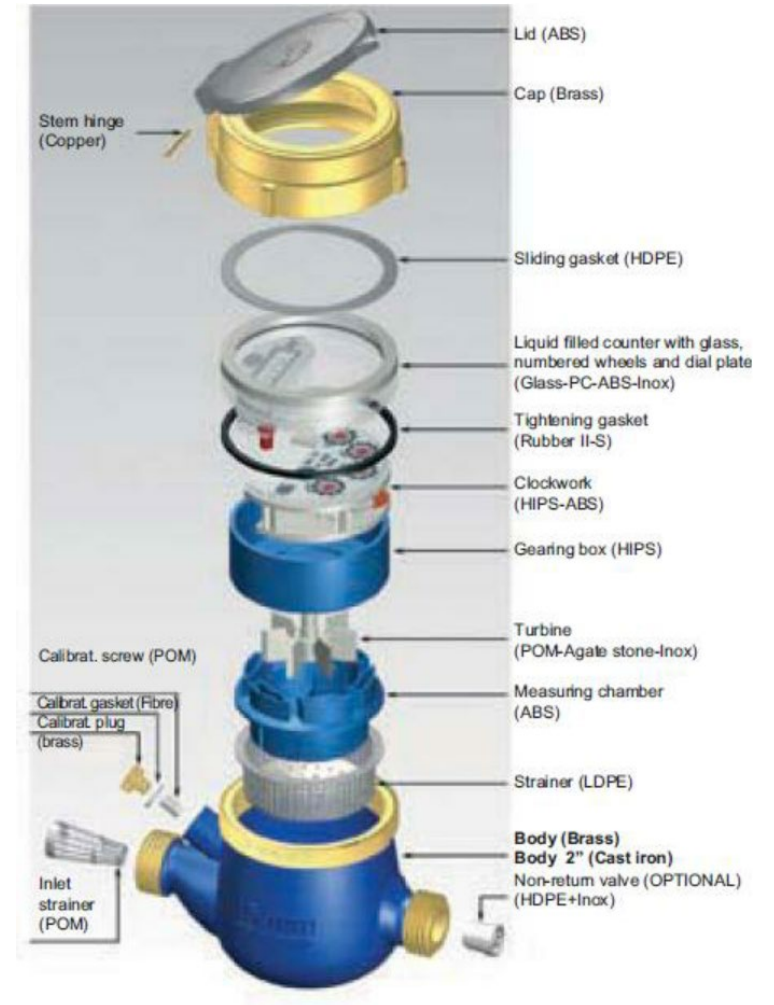
Service Connections – Meters Purpose

- Encourage conservation
- Distribute the cost of service fairly, in proportion to how much is used
- Allow system to know how much water is being pumped, used and lost to leaks and other uses



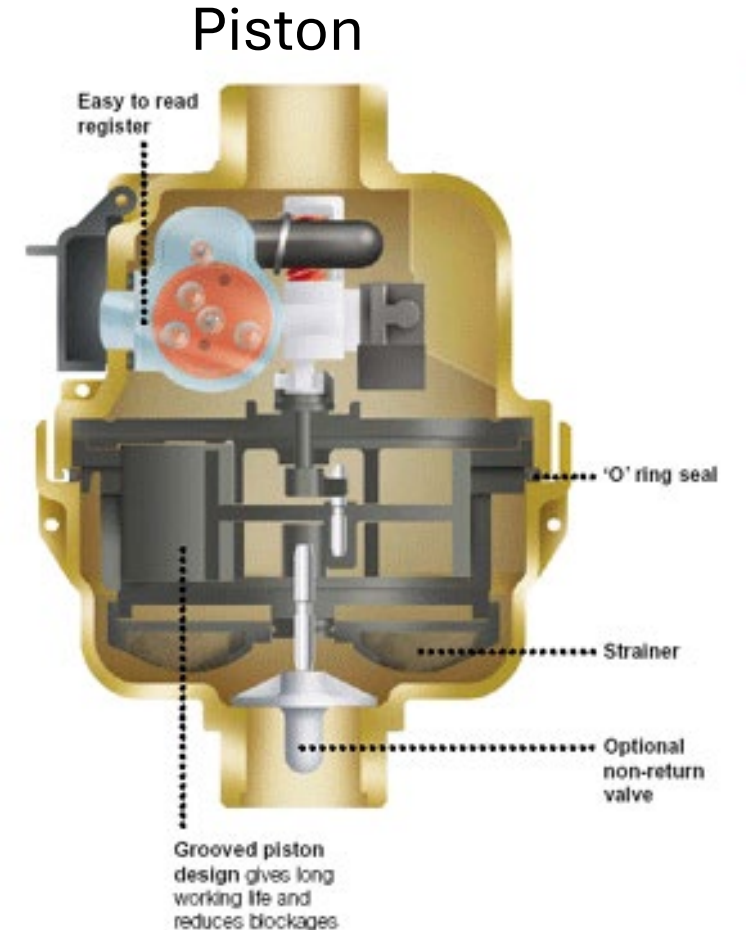
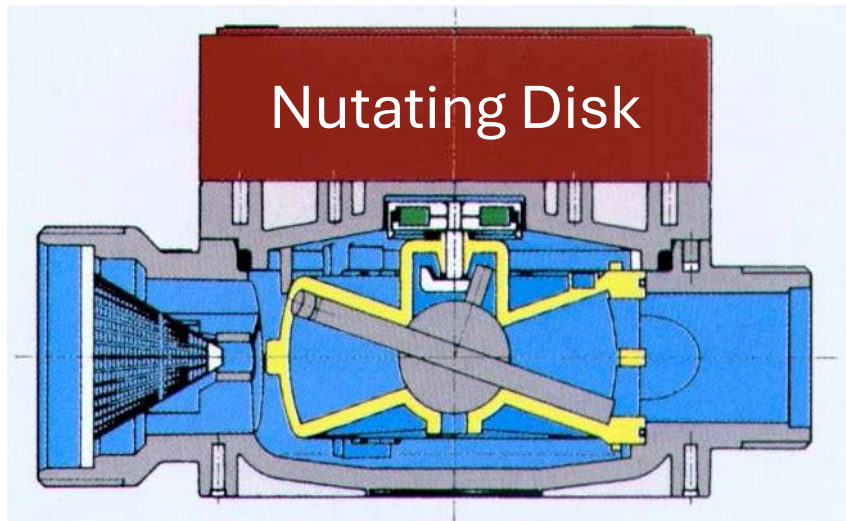
Service Connections – Residential Meters

- Standard sizes 5/8” to 1”
- Provide 20 to 30 gpm at 40 psi
- Consist of following components
 - Register that records water used
 - Magnetic connection to a rotating device
 - Strainer
 - Measuring Chamber
 - Body
 - Some cases, bottom plate that will break when frozen to prevent damage to the meter



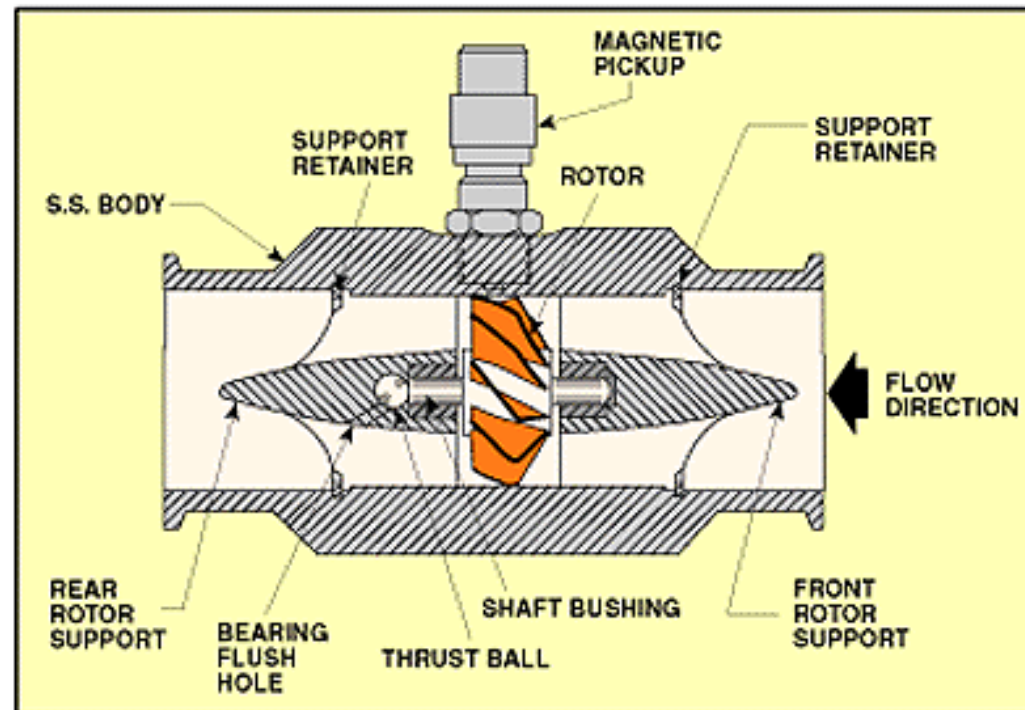
Service Connections – Residential Meters

- **Positive Displacement Meters** – measuring chamber with a fitted disc or piston, chamber fills and empties, predetermined amount of water is displaced as disc or piston makes one rotation



Service Connections – Residential Meters

- Turbine Meters
 - Vaned wheel that is rotated by the flow of water
 - Wheel attached to register, indicating water use



Service Connections – Commercial Meters

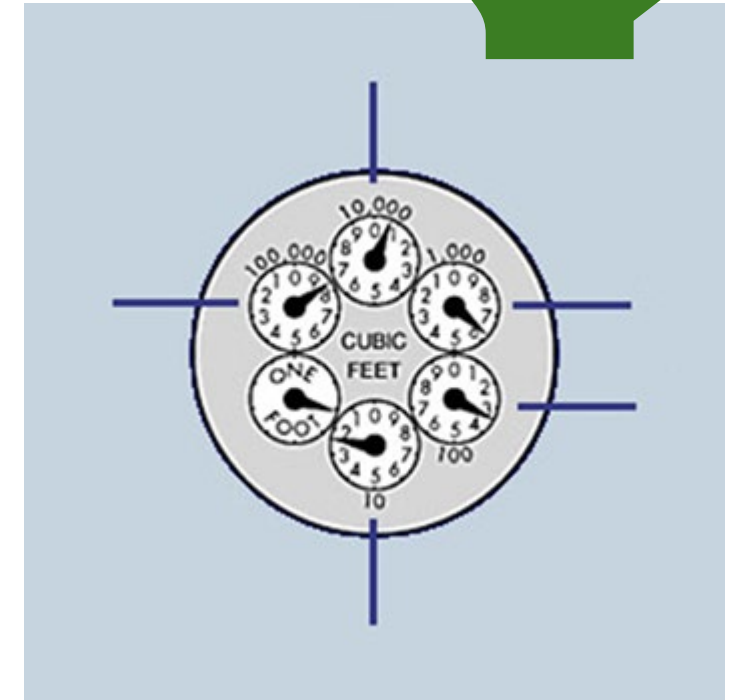
- Usually considered to be any services serving more than a single household, having a service line one inch or larger in size
 - **Compound Meter** – two measuring chambers, one for low flow, one for high flow
 - **Turbine Meter** – pinwheel mounted on a vertical shaft, usually a bypass meter, small amount of flow diverted to pass through chamber
 - **Propeller Meter** – use a prop blade mounted on a horizontal shaft
 - **Venturi Meters** – pressure differential meter
 - **Magnetic Flow Meter** – uses electromagnetic fields, no head loss created, high cost

Service Connections – Reading Meters



Circular Register Face

- Start with the scale with the highest number (100,000)
- Then read each of the lower scales until you reach the last scale (10)
- When the hand is between two numbers record the lower number
- When the hand is directly on a number, look at the next scale to see if it is in front of or behind the 0

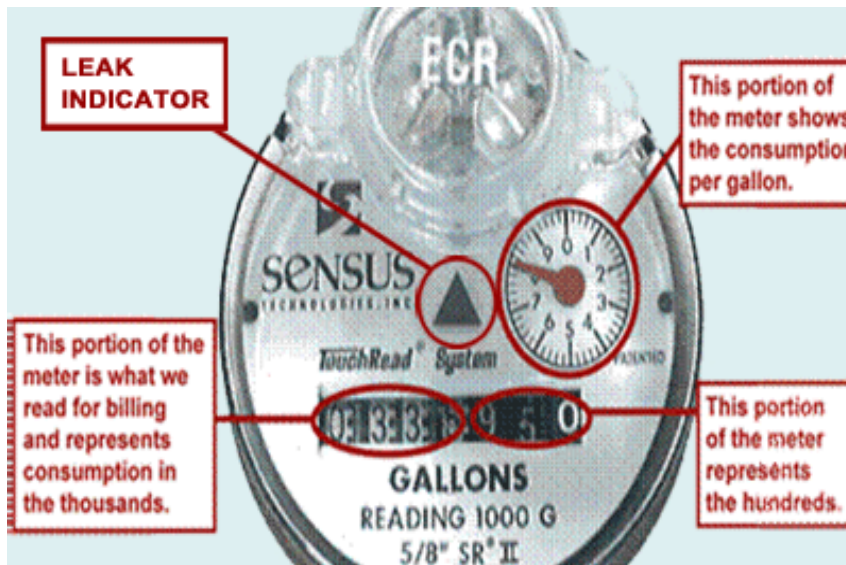


80,632 cubic feet

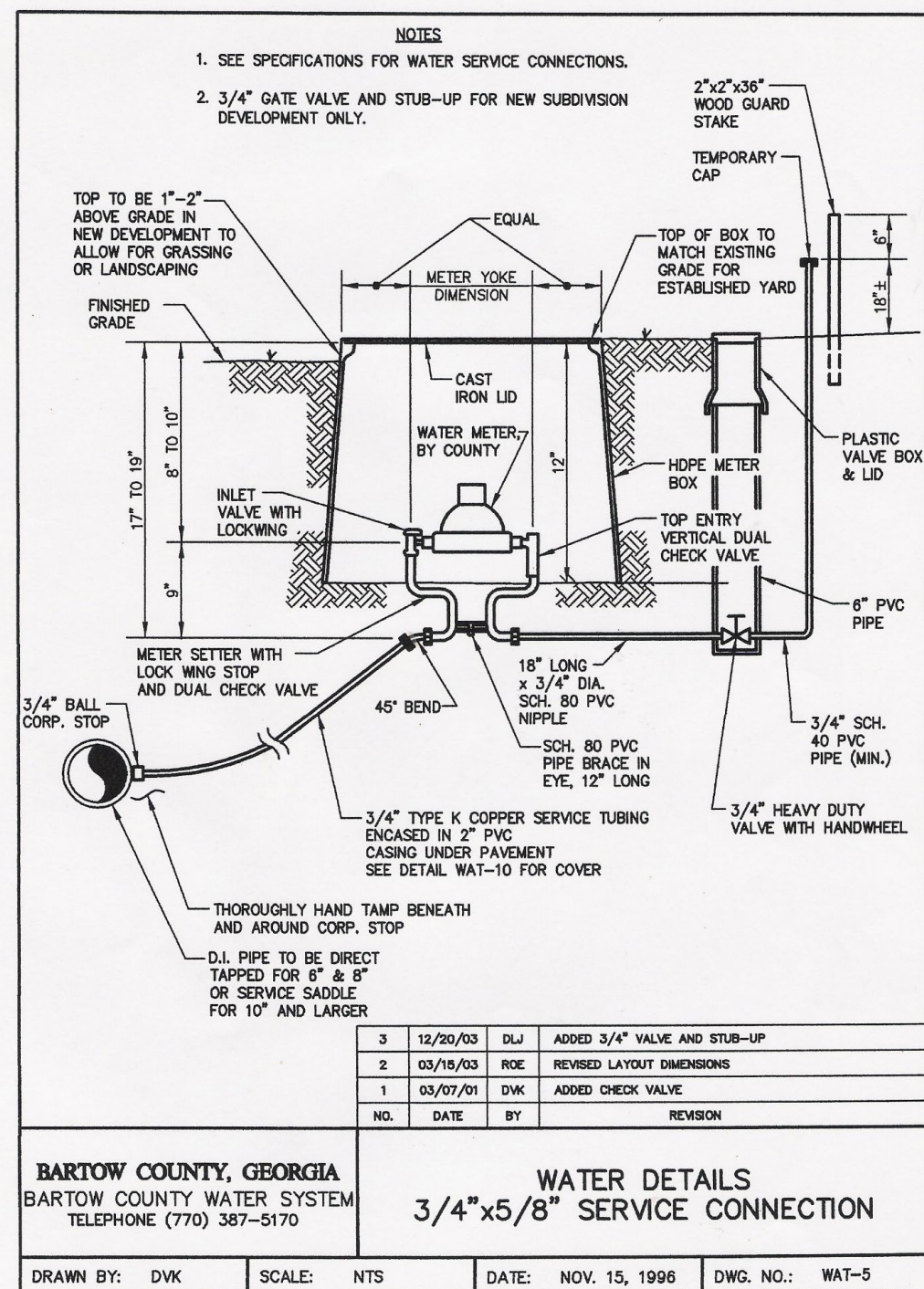
Service Connections – Reading Meters

Dial Face Meter

- Typically, just read the number listed
- Might have to add a zero or two if it says “hundreds of gallons”



Service Connections – Detail Drawing



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CONTACT INFORMATION



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