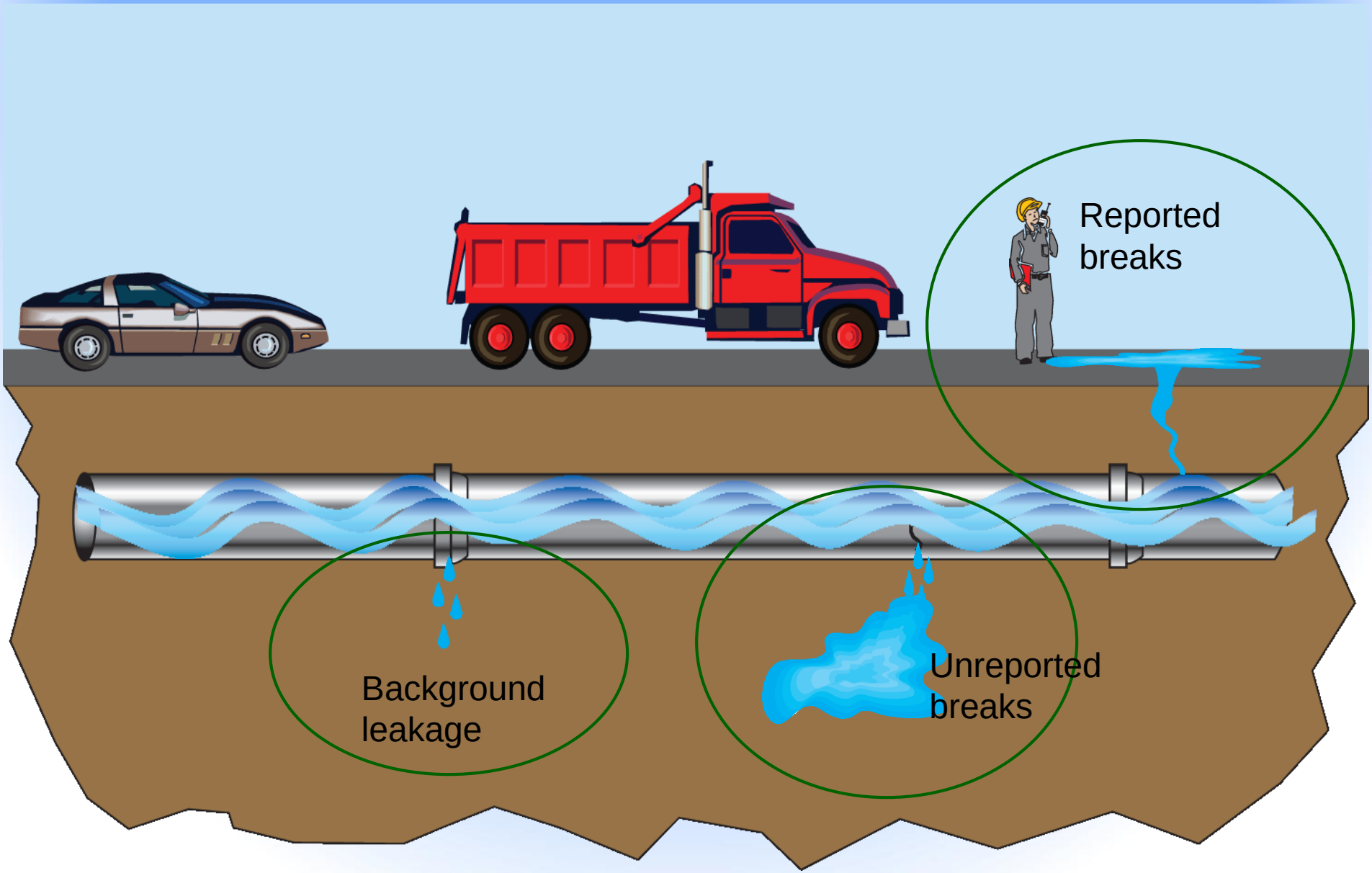
How Can I Minimize Water Loss and Pipe Breaks in my Water Distribution System?

Presented by Jim Graber

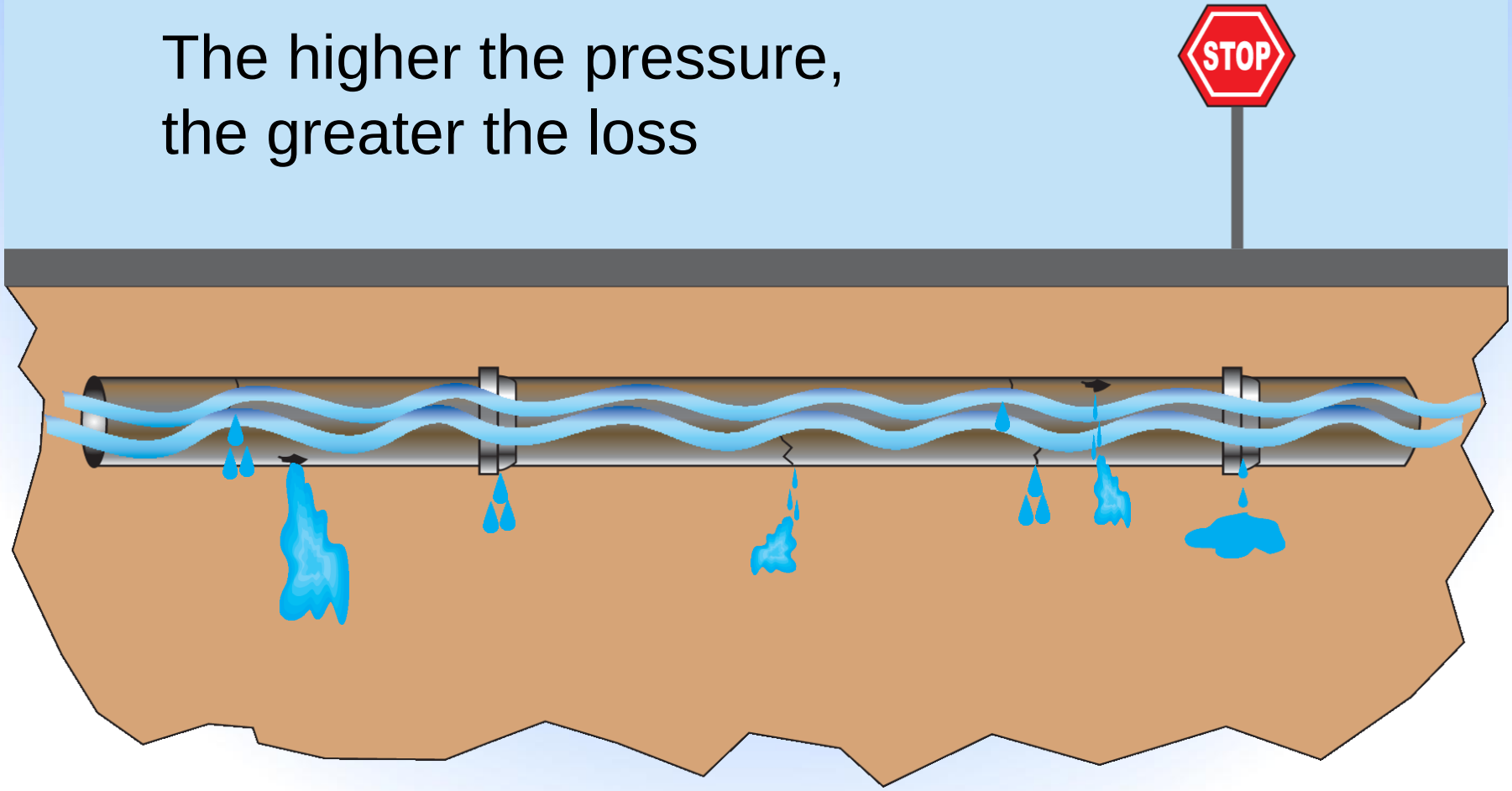
CLA-VAL

Three Common Causes of Water Loss



Background leakage can add up to significant water loss over time

The higher the pressure,
the greater the loss

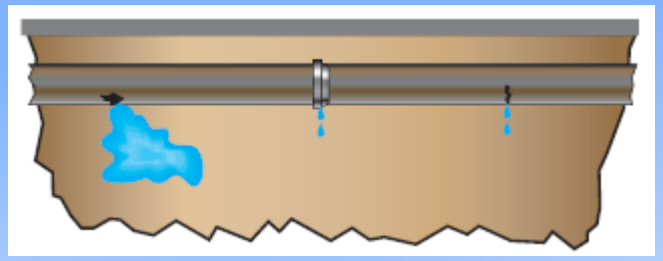


High Nighttime Pressure is a Major Source of Pipe Breaks and Leakage

- During approximately six hours at night most systems are nearly static (no flow).
- System pressure at this critical point rises to the highest pressure of the day resulting in pipe breaks and increased leakage rates in pipelines and other areas of the distribution system.

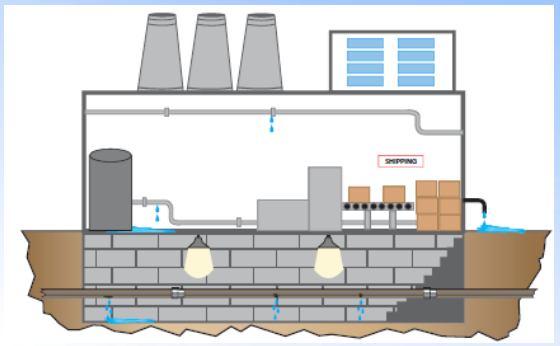
Municipal

Possible culprits:
- Aging pipelines
- Joints
- Flanges
- Shifting ground



Industrial

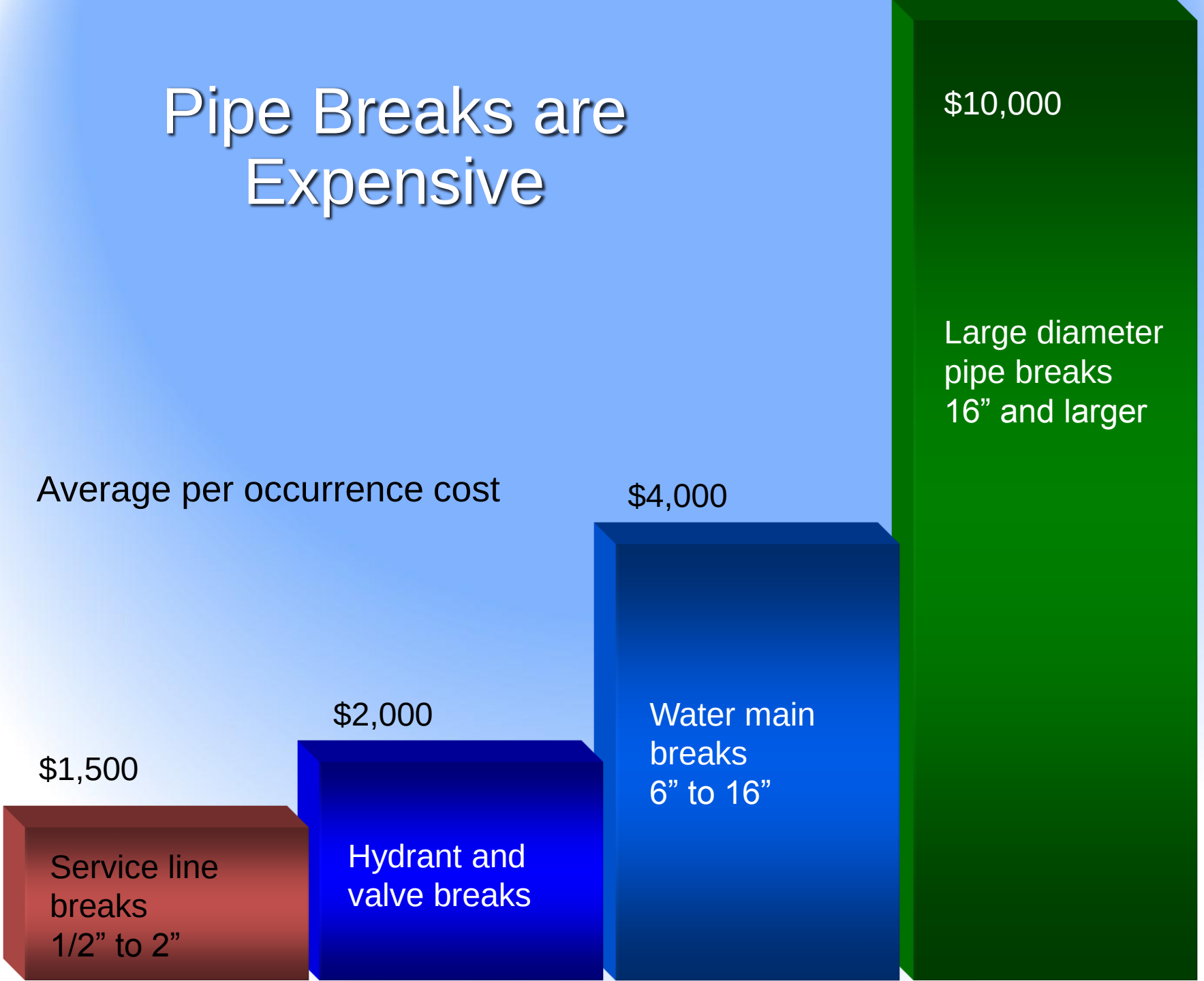
Also under suspicion:
- Storage tanks
- HVAC piping
- Process piping
- Hidden or seldom inspected piping



Residential

All the usual suspects:
- Faucets
- Showerheads
- Water heaters
- Garden hoses

Pipe Breaks are Expensive



Source: Veritec Consulting Inc.

How Can I Minimize Water Loss and Pipe Breakage?

Actions for Leakage Abatement

- Replace the complete leaking system - to practically eliminate leakage
- Use multiple feeds - to minimize line loss which allows a lower system pressure
- Use advanced valve control schemes - to effectively deal with line loss

Replace Leaking System

- Most expensive solution
- Practically eliminates leakage
- Logistically it is very difficult
- Most difficult solution for existing customers

Multiple Feed System

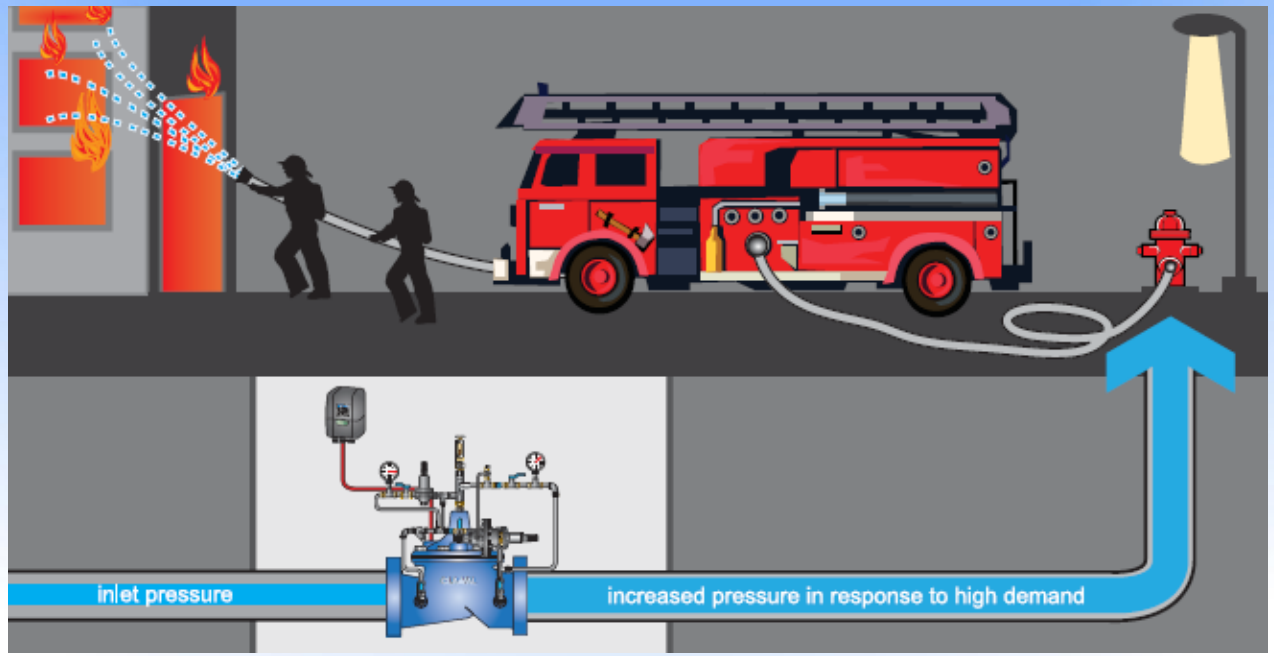
- Minimizes line loss
- Reduces velocities in the system
- Lower cost than replacing the system
- Less intrusive to customers than replacing the system

Advanced Valve Controls

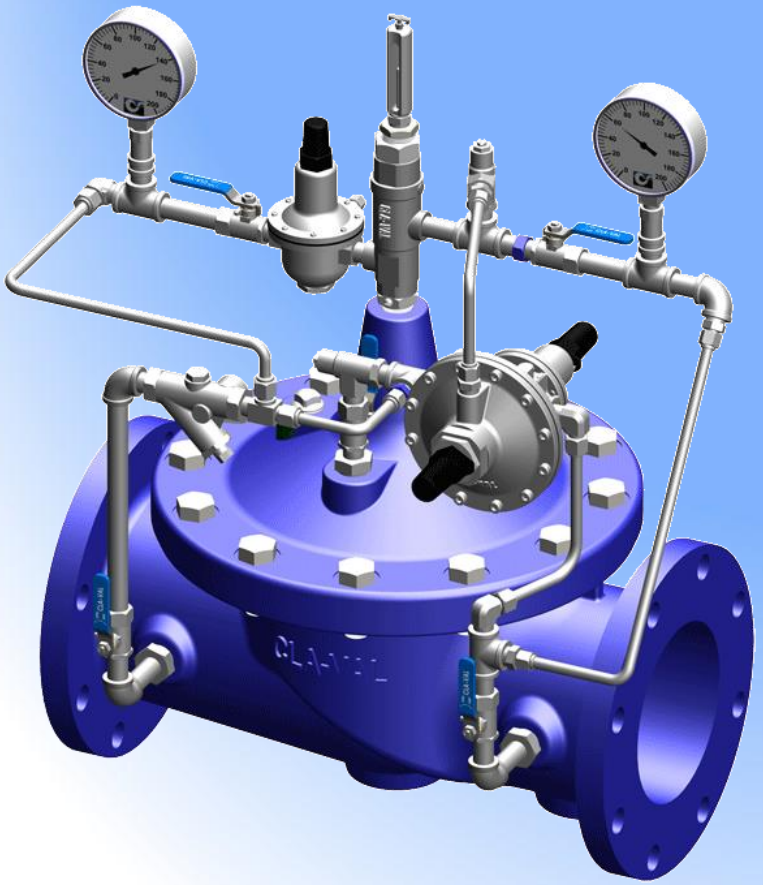
- Quickest Solution
- Lowest cost solution
- Least intrusive to existing customers
- May be retrofitted to existing valve
- Keeps pressure low when high pressure is not required
- Allows high pressure for fire flow

Sometimes a Single Set Point Pressure Reducing Valve is not Enough

- Ideally, you would like to be able to adjust pressure based on flow demand in the system.
- During times of low demand, system pressure would be lowered which cuts down on leakage and pipe breaks.
- As demand increases, pressure will increase to ensure customers and fire departments have adequate pressure and flow.



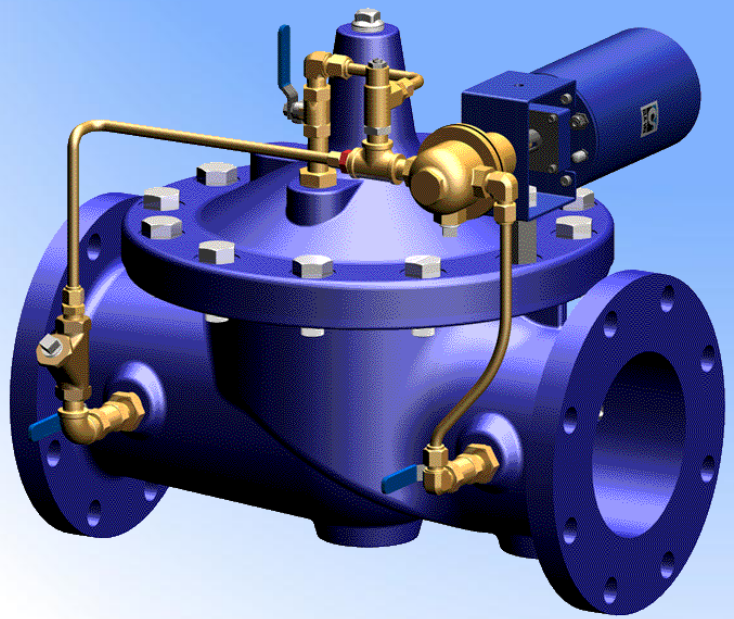
98-06 Pressure Management Valve



- Two adjustable set points for high and low downstream pressure
- Smooth transition from high to low pressure
- Pilot system quickly reacts to fire flow demand
- 100% hydraulic operation
- Can be retrofitted to an existing valve

Is there another option?

- Another method is to use advanced electronic control valves and control schemes.



SCADA

Electronic Measurement Devices

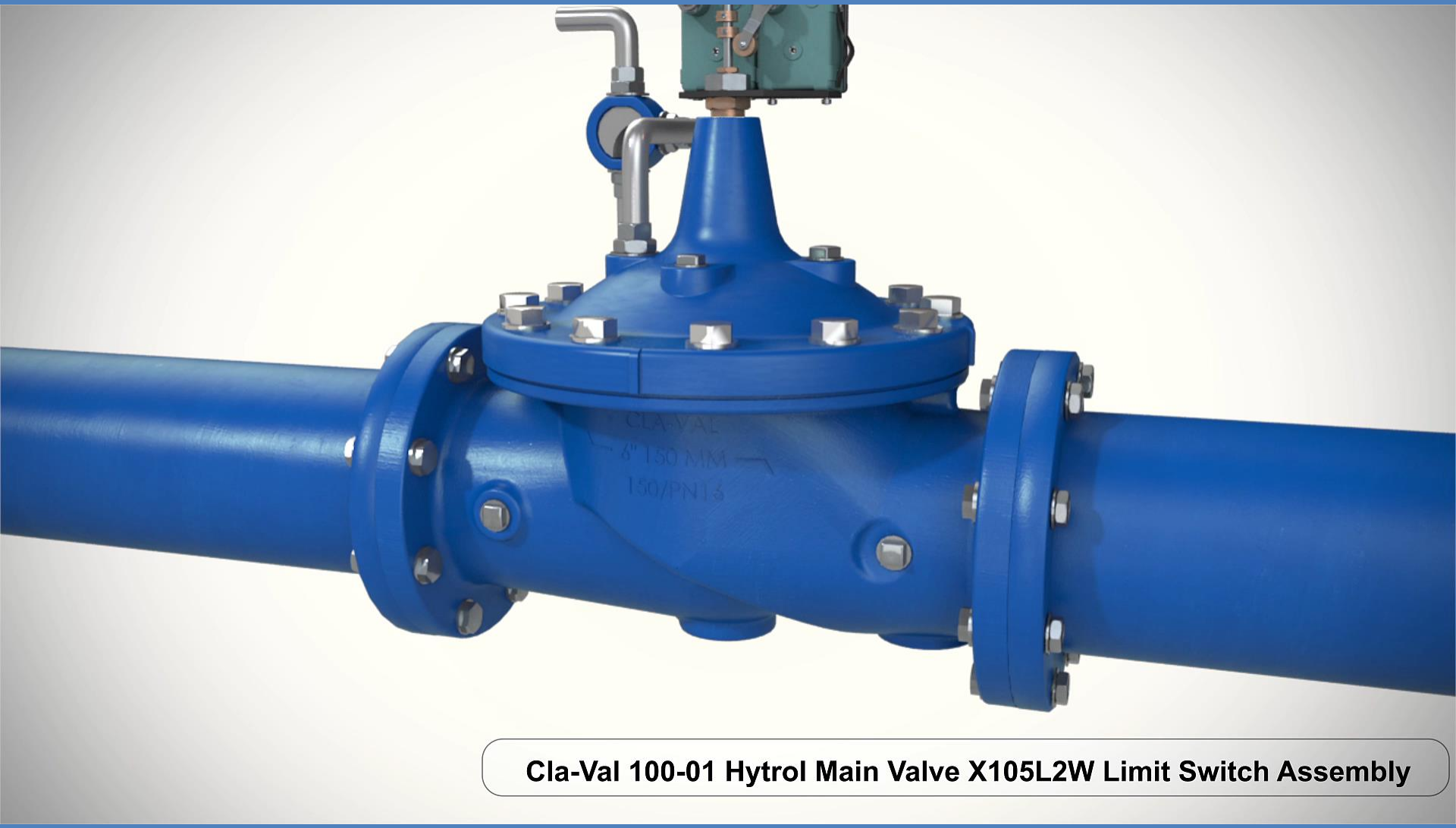
What Kind of Information Can I Get From A Control Valve?

- Is the valve open or closed?
- How far open is the valve?
- What is my pressure upstream and/or downstream of the valve?
- What is the pressure differential / pressure drop across the valve?
- How much flow is going through the valve?

Limit Switches

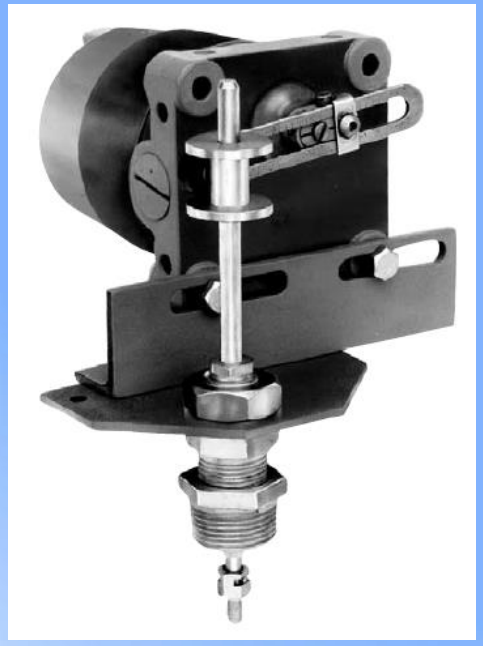
- Function: Provide a digital signal through an electrical contact when the valve is in a specific position.
- Available in single or multiple switches
- Tied to the movement of the valve by a stem extension piece with stop collar(s) to actuate switch

Limit Switches



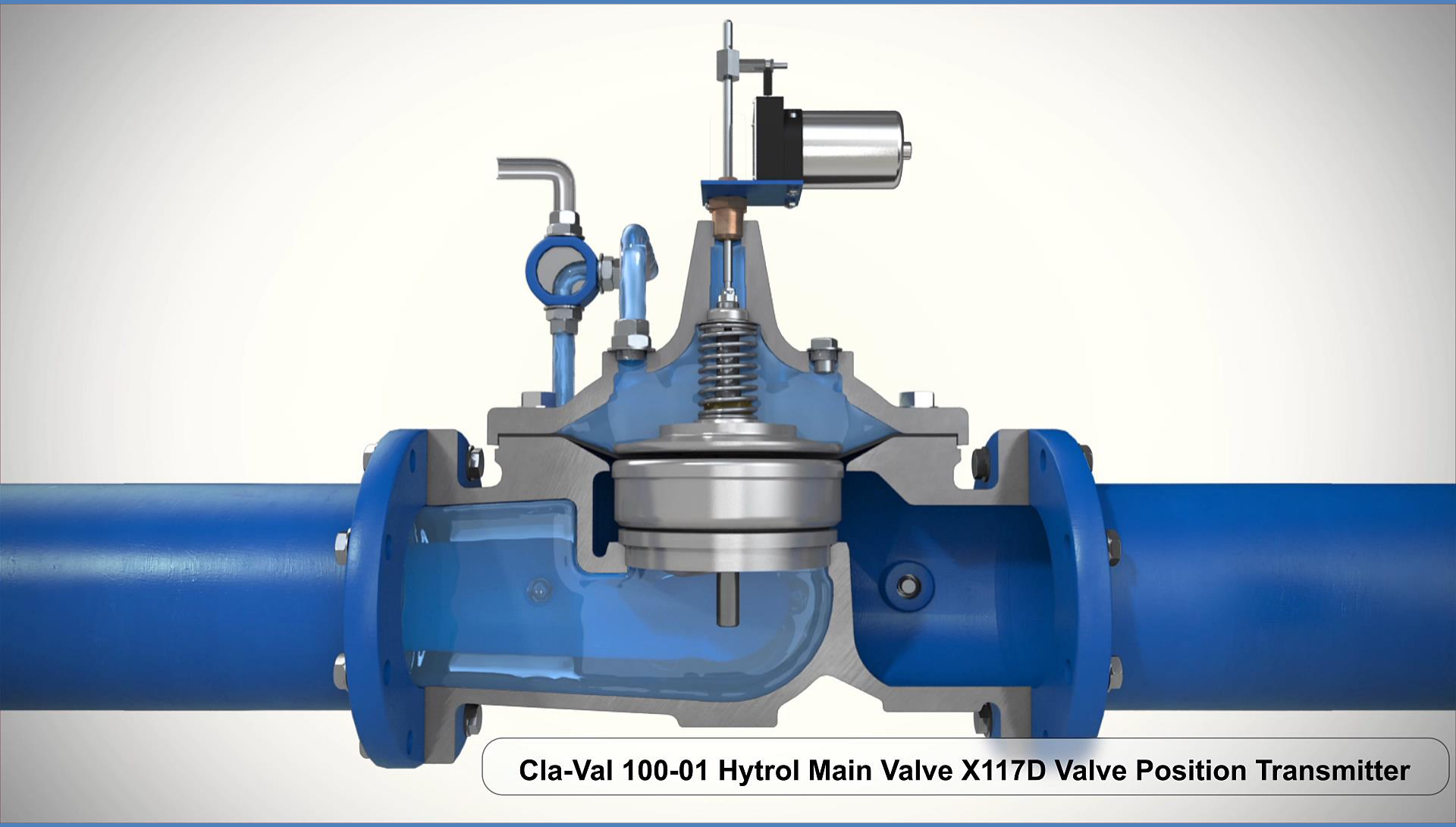
Cla-Val 100-01 Hytrol Main Valve X105L2W Limit Switch Assembly

Valve Position Transmitter



- Function: Measures valve position from 0 - 100% of valve travel
- Provides a 4 - 20 mA analog output signal proportional to the travel of valve

Valve Position Transmitter

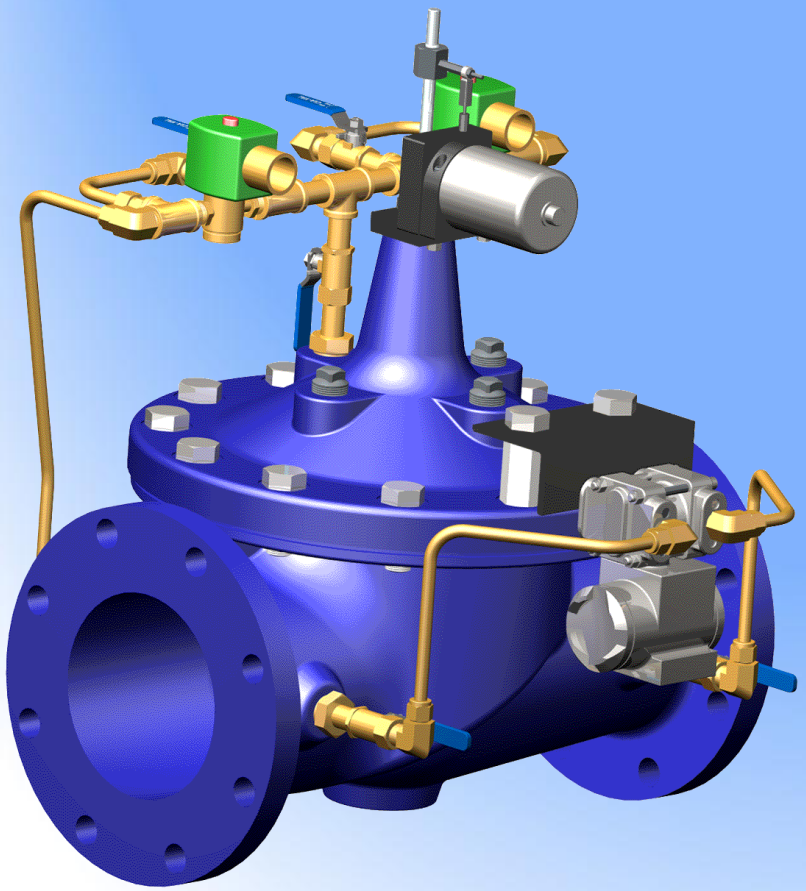


Cla-Val 100-01 Hytrol Main Valve X117D Valve Position Transmitter

Pressure Transmitters

- Measures inlet pressure, outlet pressure, or differential pressure across a valve
- 4 - 20 mA output proportional to pressure
- Available in multiple ranges

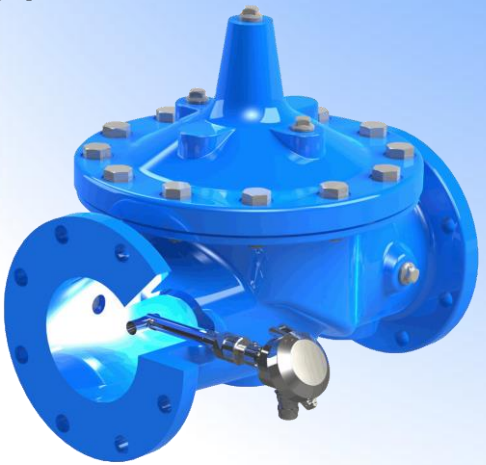
Flow Calculator Module

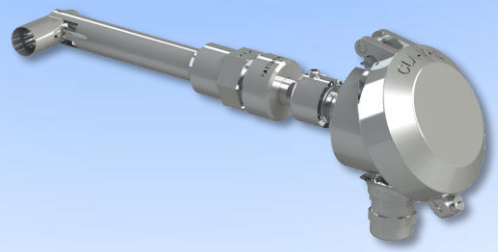


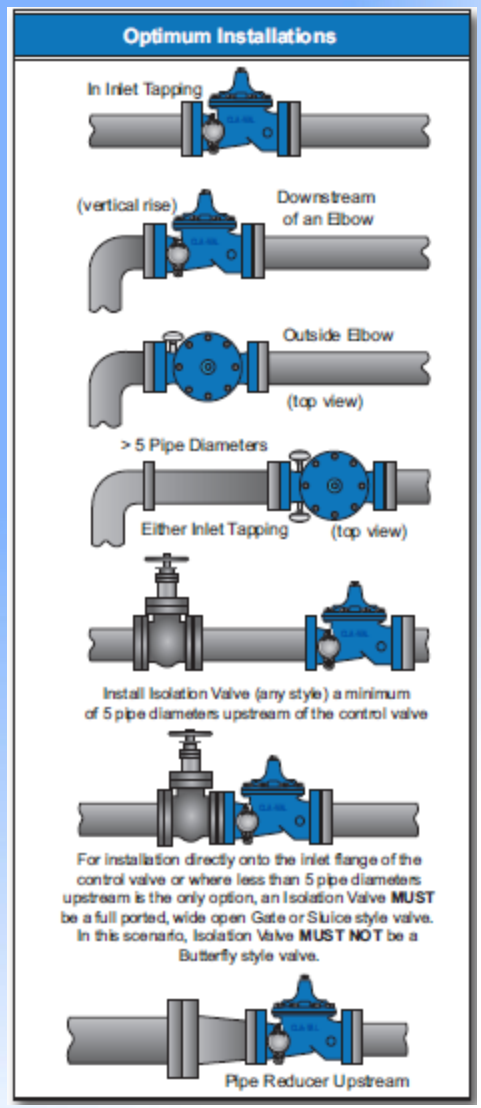
- Function: Calculates the flow rate through a control valve based on electronic signals from valve position transmitter and differential pressure transducer or individual inlet/outlet transducers
- Calculation based on valve size and seat design
- 4 - 20 mA inputs
- 4 – 20 mA flow signal output

Insertion Flow Meter

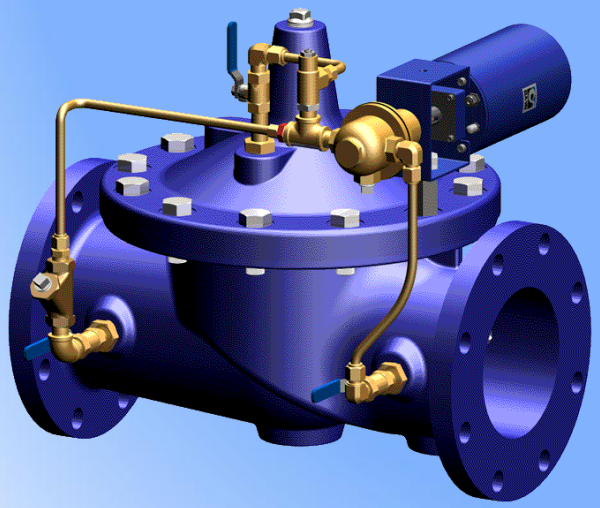
- This meter is designed to be inserted on the inlet side of a control valve
- Provides a 4-20 mA signal that is proportional to flow rate
- Typical accuracy of +/- 2% of full scale – used for information or control of valve
- Can be retrofitted to an existing control valve
- There are restrictions on upstream piping and isolation valve configuration with this type of meter

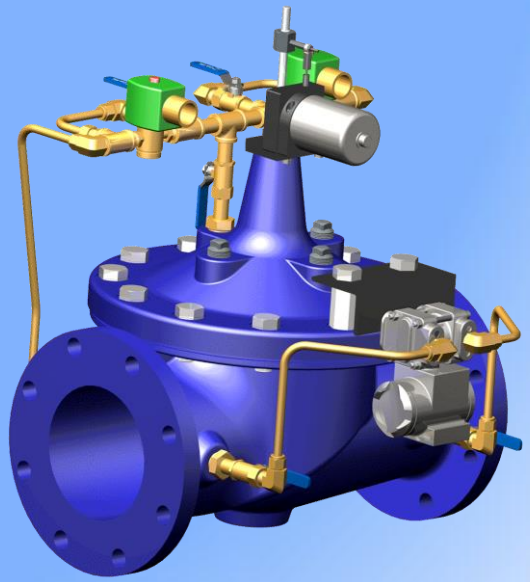


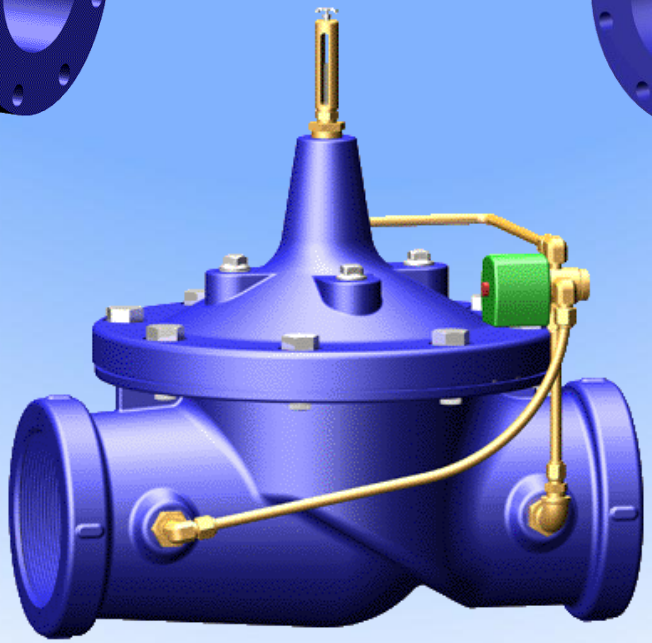




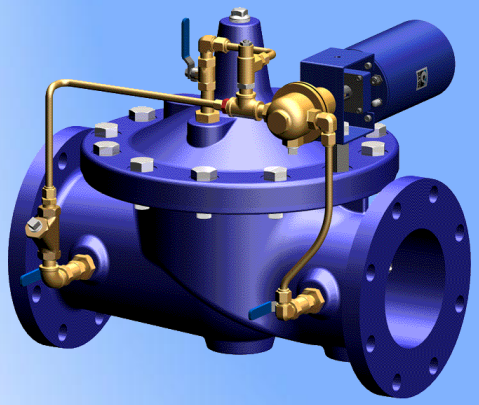
Electronic Control Valves



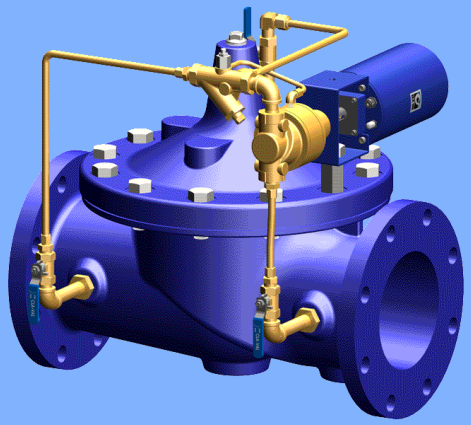




Hydraulic Valve with Motorized Pilots

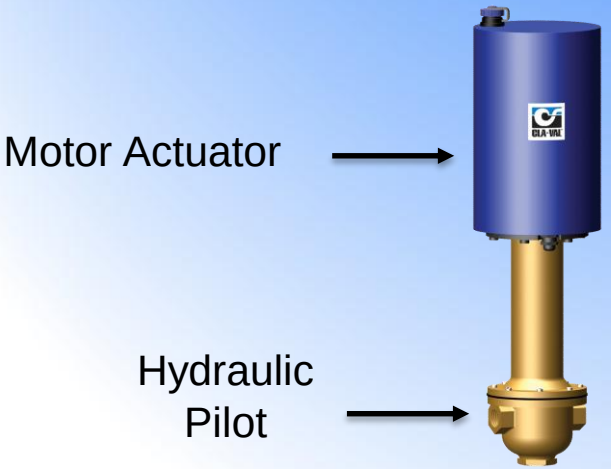


Pressure Reducing



Pressure Relief

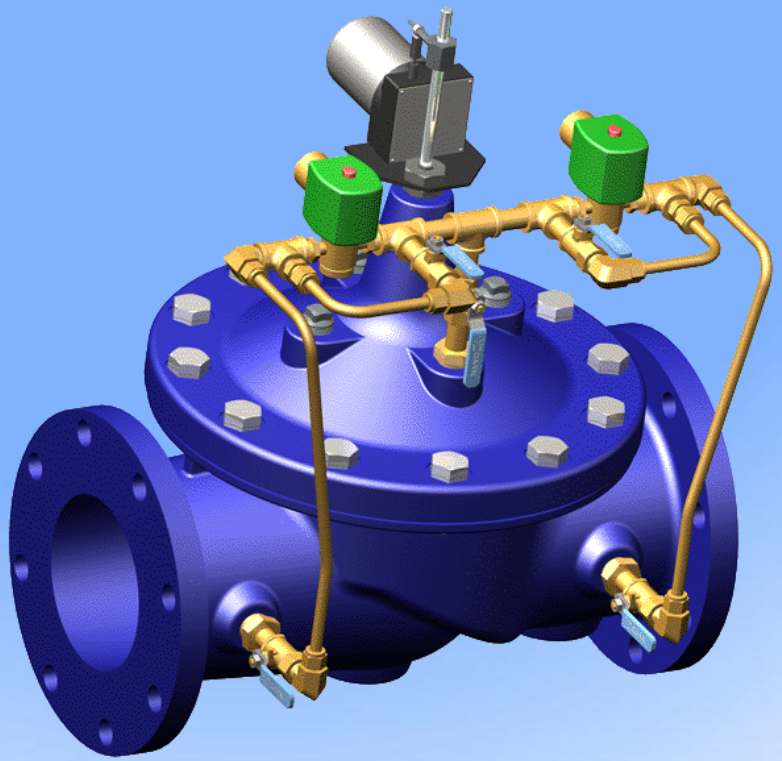
Rate of Flow /
Differential Pressure



- Allows remote pressure/flow rate changes
- 4-20 mA input
- Pre-calibrated – no field calibration required
- Multiple adjustment ranges available – can be re-scaled within factory range

Dual Solenoid Control Valves

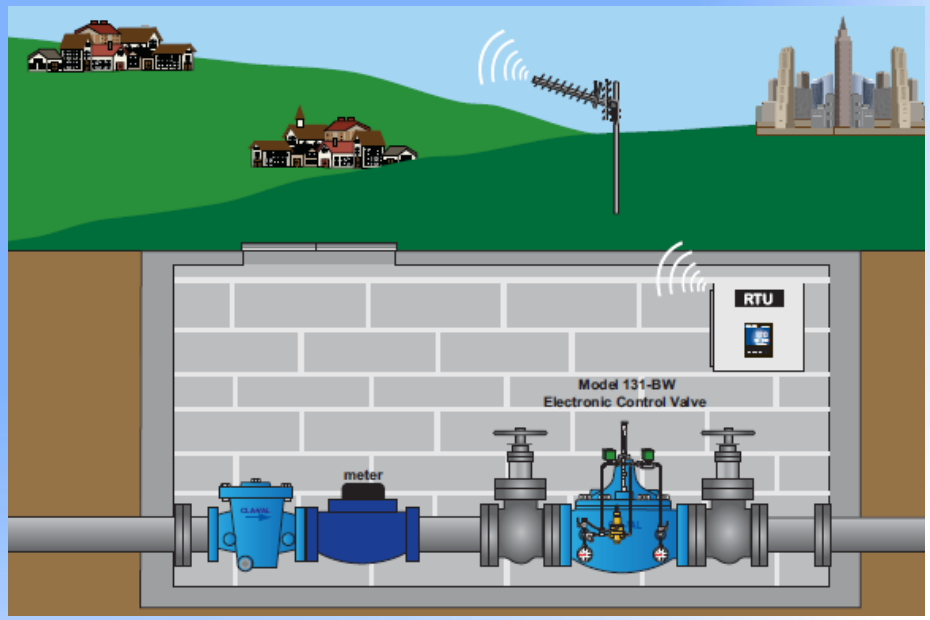
- Pilot system consists of an opening and a closing solenoid
- Remote analog and digital signals are used to tell valve what to do
- Solenoids are controlled by a PLC, SCADA, or a valve controller combined with electronic feedback signals to achieve many different functions
- Can be paired with hydraulic pilot controls to perform multiple functions or as backup in case of a power failure



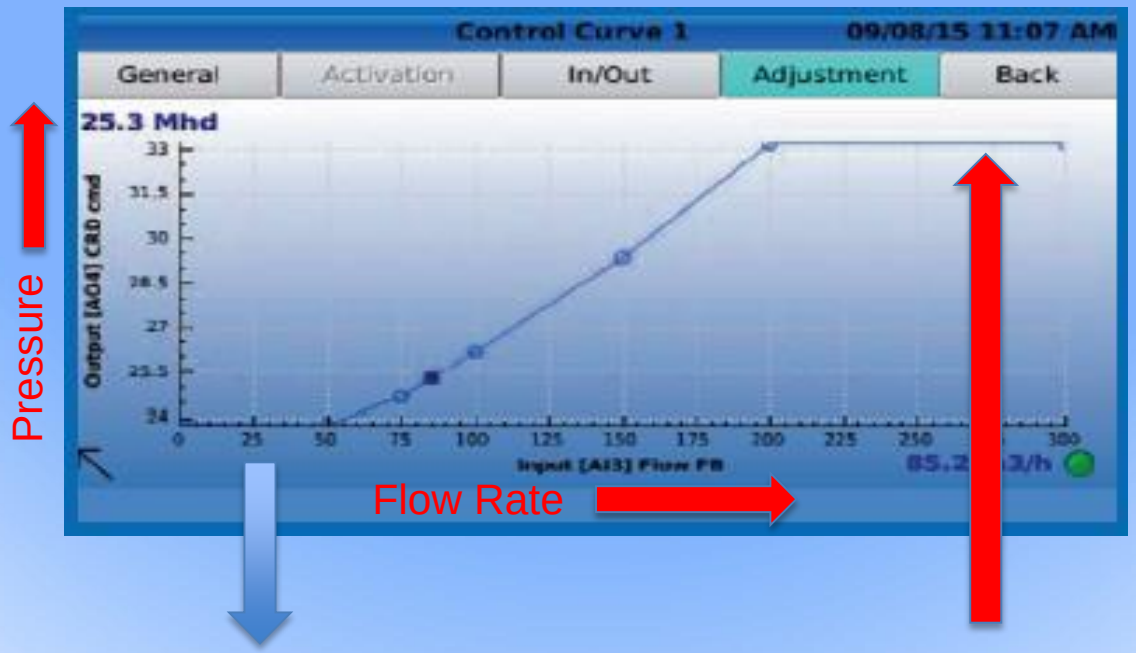
SCADA

How Do I Use These Valves to Minimize Water Loss and Pipe Breaks?

- Electronics are used to monitor pressure, flow rate, and/or the time of day.
- These signals are fed into a control system, which may consist of PLC's, a SCADA system, or a Cla-Val electronic valve controller.
- The control system uses these signals to determine when pressure needs to be adjusted and sends an electronic signal back to the valve.
- The electronic controls on the valve adjust the position of the valve to deliver the appropriate system pressure.

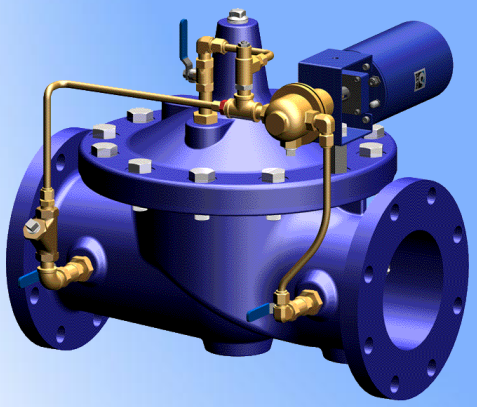


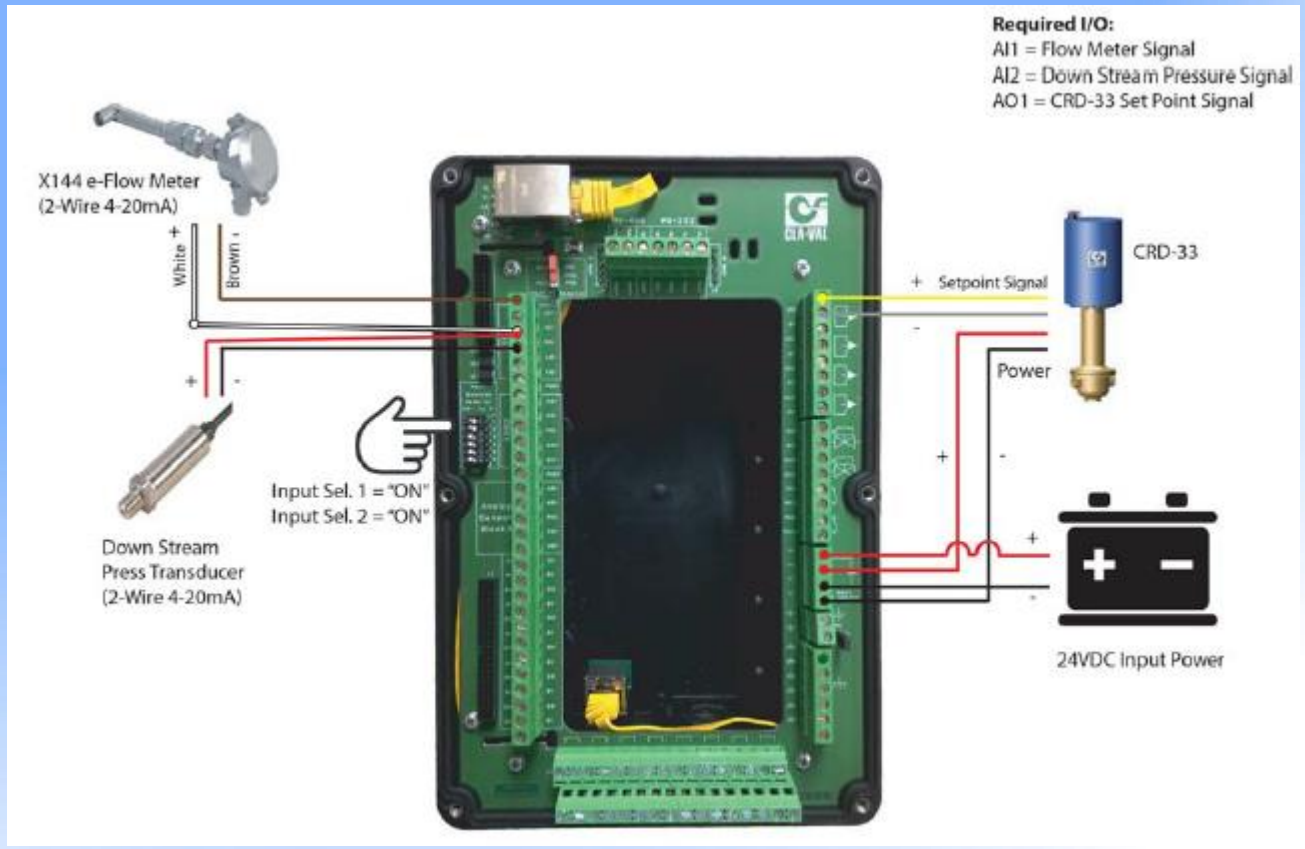
Pressure Optimization Control Scheme



- During times of low demand or at night, system pressure is reduced.
- During times of high demand or during the day, system pressure is increased.

Electronic Controller Wiring Diagram – Pressure Optimization with Motorized Pilot

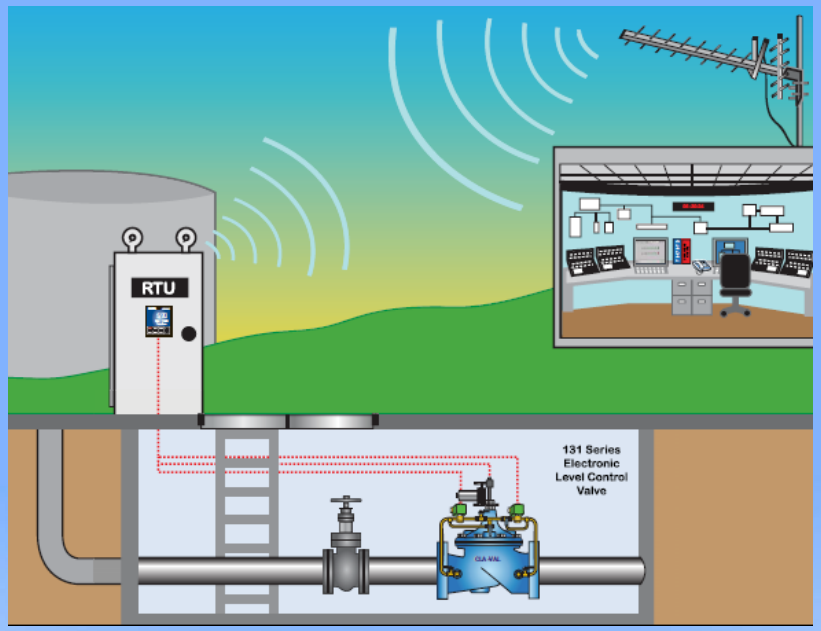




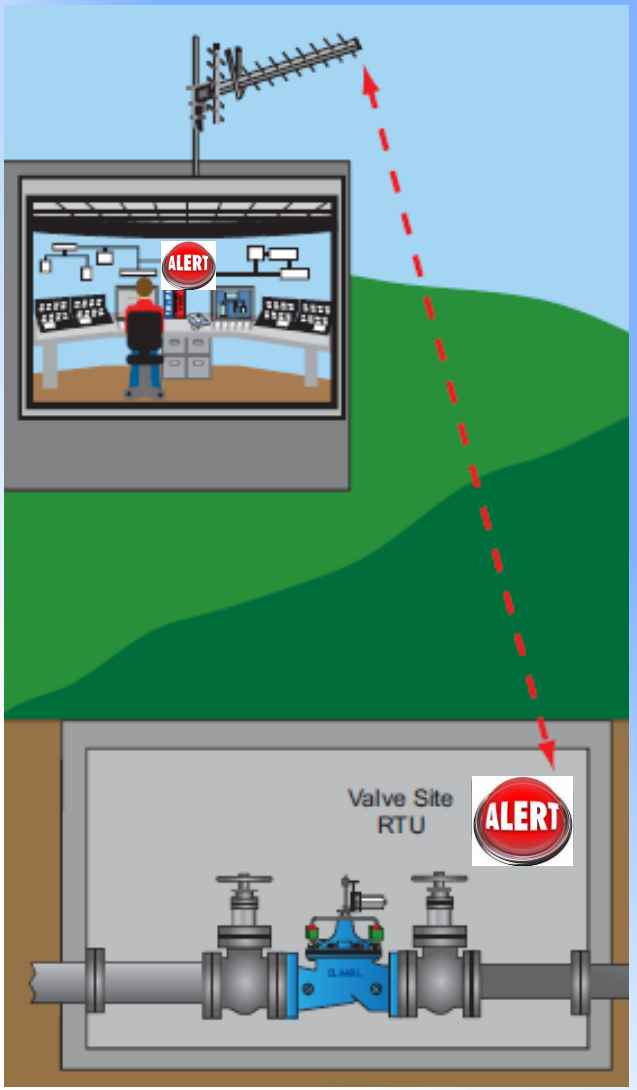
What are other ways electronic measurement devices and electronic control valves can be used to help save water, time, and money?

Electronics Allow You to Adjust Valves in Difficult Locations

- Remote
- Controlled Space
- Hazardous
- Elevated
- Buried Vaults
- Manholes

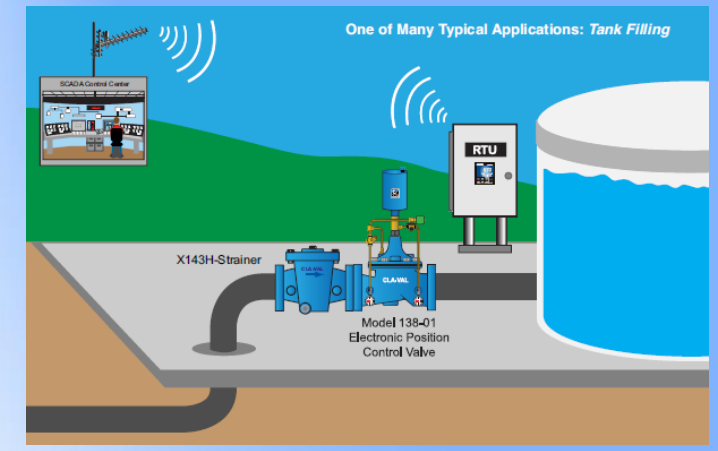


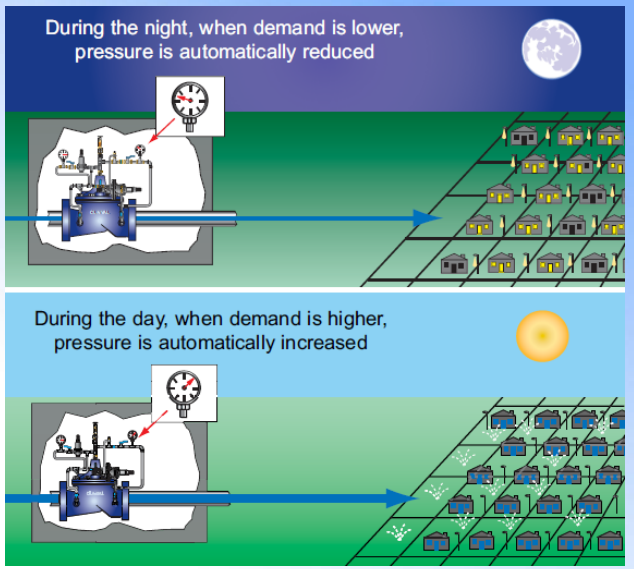
Electronics can Trigger Alarms



- Valve limit switches can trigger an alarm if a valve opens or closes at the wrong time.
- Pressure transducers can indicate if pressure is too high or too low.
- Flow meters can indicate if flow goes above a maximum rate or drops below a minimum rate.

Electronics can Automatically Adjust to Changing Conditions

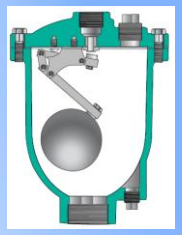




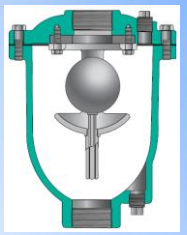
- Electronic valve controllers can be used to automatically adjust flow or pressure based on feedback signals
  - They can be programmed to adjust fill rates as tank levels change.
  - They can adjust pressure based on flow rate, tank level, or time of day.

What are some other ways to minimize pipe breaks and leakage?

Air and Vacuum Valves



- ***Air Release*** - Relieve small pockets of air while the pipeline is under pressure



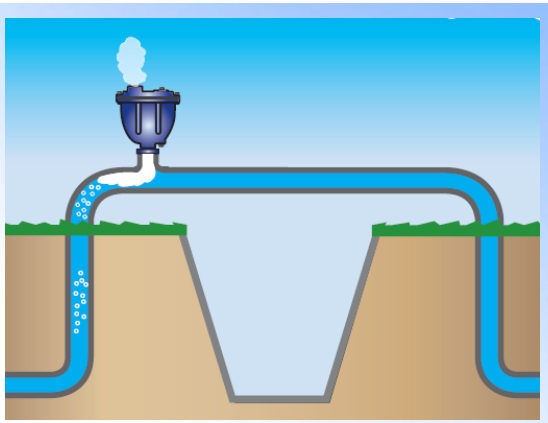
- ***Air & Vacuum*** – Relieve large volumes of air while filling & draining the pipeline but not while under pressure.

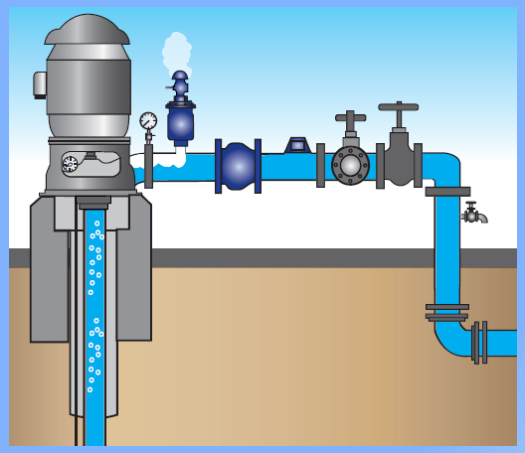
- ***Combination*** – Relieve large volumes of air while filling & draining and also relieve small pockets of air while under pressure

Why Use Them?

What causes entrapped air in water distribution systems?
The build-up of entrapped air at high points in a water distribution systems is an everyday occurrence. It will occur during pipeline filling, whenever a pump starts or stops, and if there is a power failure where pumping suddenly ceases.

Unless this entrapped air is exhausted, over time, it will restrict flow, make the pump work harder than necessary (wasting energy), and create conditions that can cause water loss.

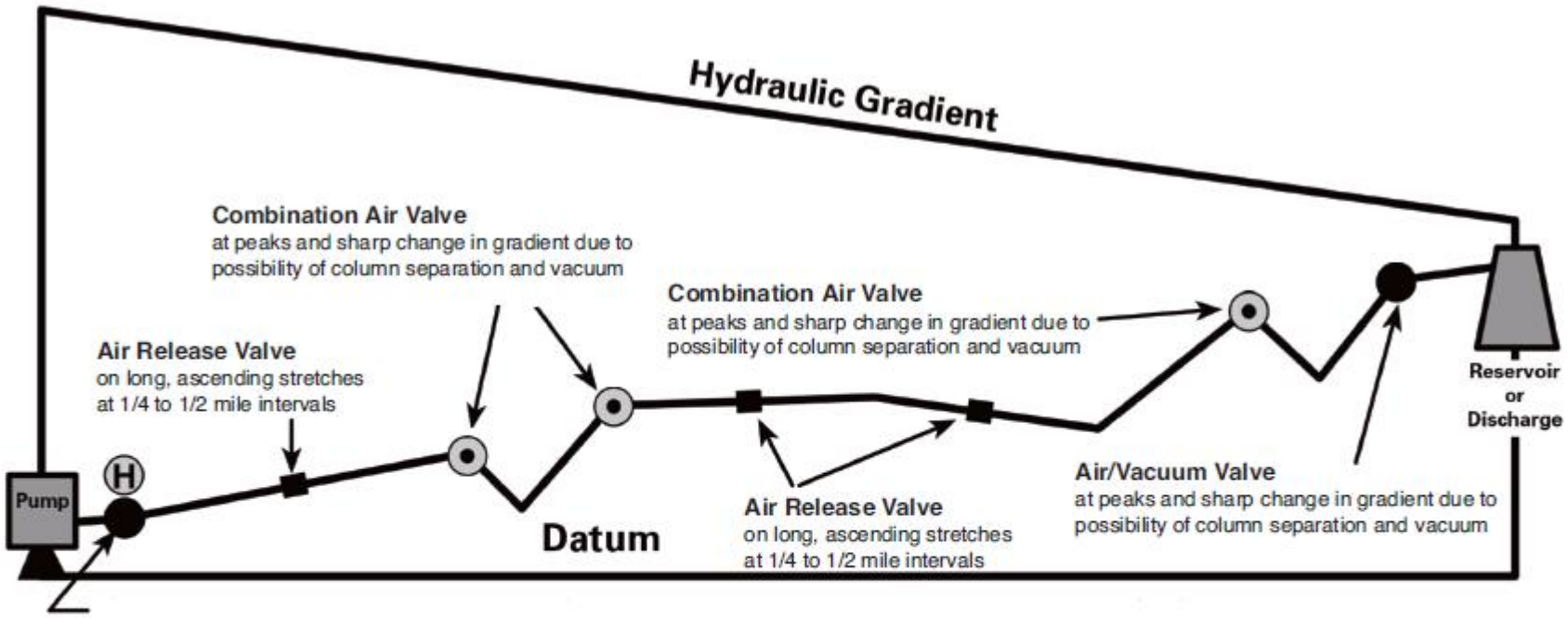


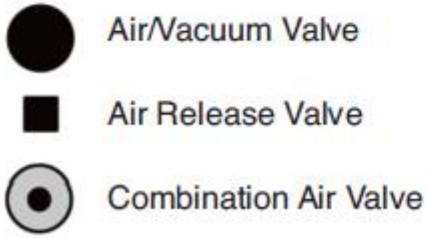


What can happen to a water distribution system if entrapped air is not discharged?

- If not discharged, entrapped air can result in water column separation and extreme pressure fluctuations
- High pressure surges can occur when an air pocket is suddenly pushed down a pipeline, causing ruptures or bursts, potentially wasting thousands of gallons of water before the leak is repaired
- Vacuum conditions can also develop which can stop the flow of liquid in your piping altogether

Where do you use each type?





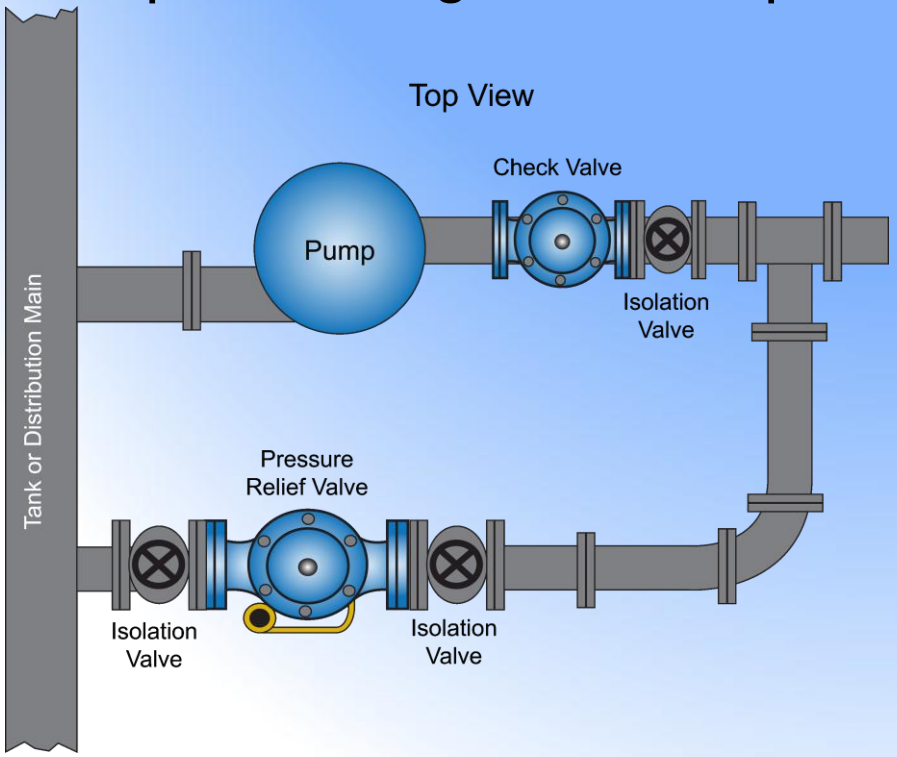
Other Issues?

- If air gets into the pilot system of a pressure reducing valve, the valve will lose the ability to regulate pressure, causing system pressure to increase, resulting in pipe breaks and/or increased leakage. An air release valve on the cover of the valve can help prevent this.

- Vacuum valves ensure pipelines do not enter into a negative pressure situation which can cause a pipeline to collapse.

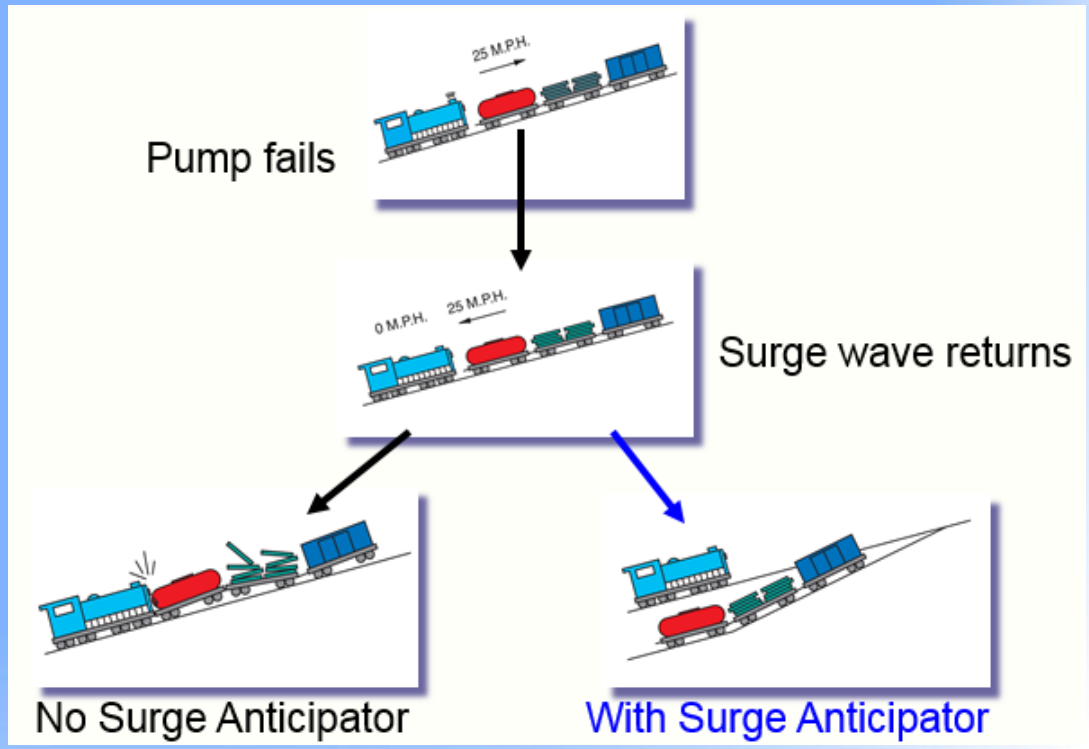
Pressure Relief Valves

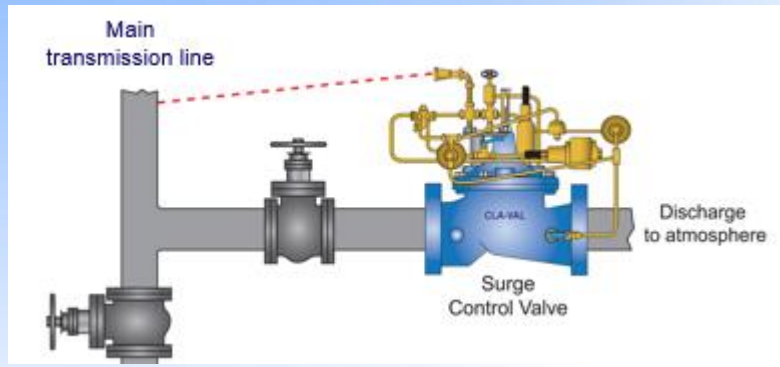
- Pressure Relief Valves are typically used on the discharge piping of a booster pump station. They are designed to open when inlet pressure goes above the pilot setting to relieve pressure surges in piping systems.



Surge Anticipator Valves

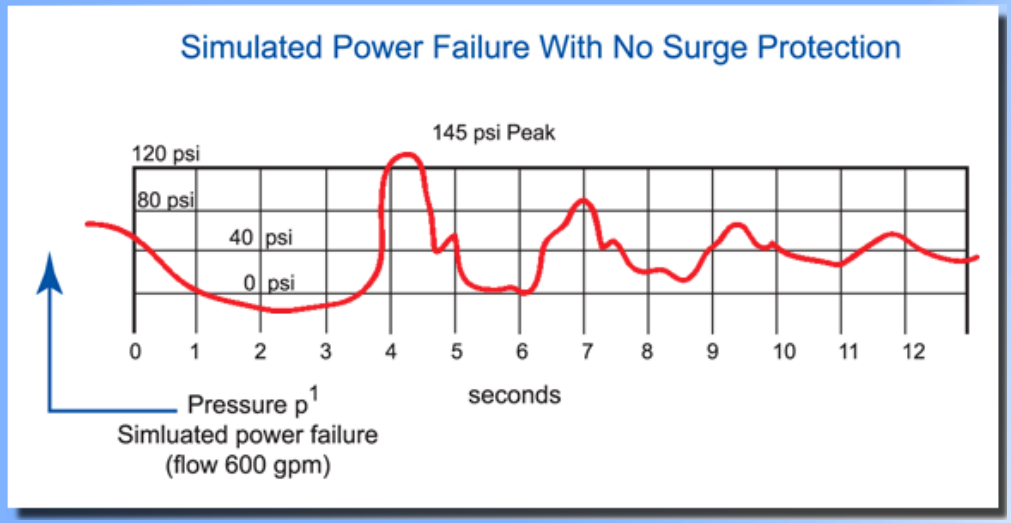
- Surge Anticipator Valves are a special version of relief valves that virtually eliminate pressure spikes in the event of a sudden stoppage at a pump station due to a power failure or emergency stop on a pump.
- This valve has a special pilot system that senses this sudden stoppage in flow and helps minimize pressure spikes under this difficult condition.

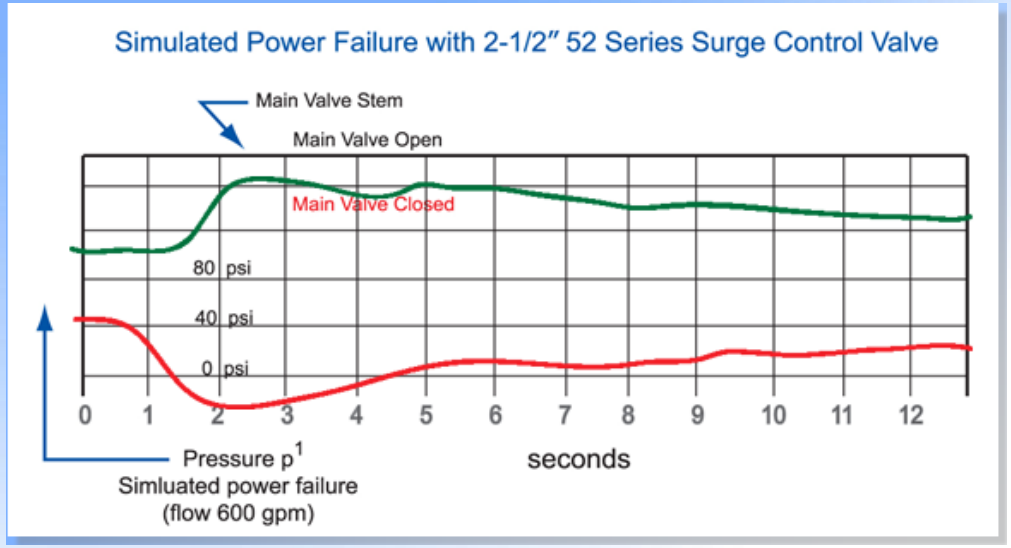




How Do They Work?

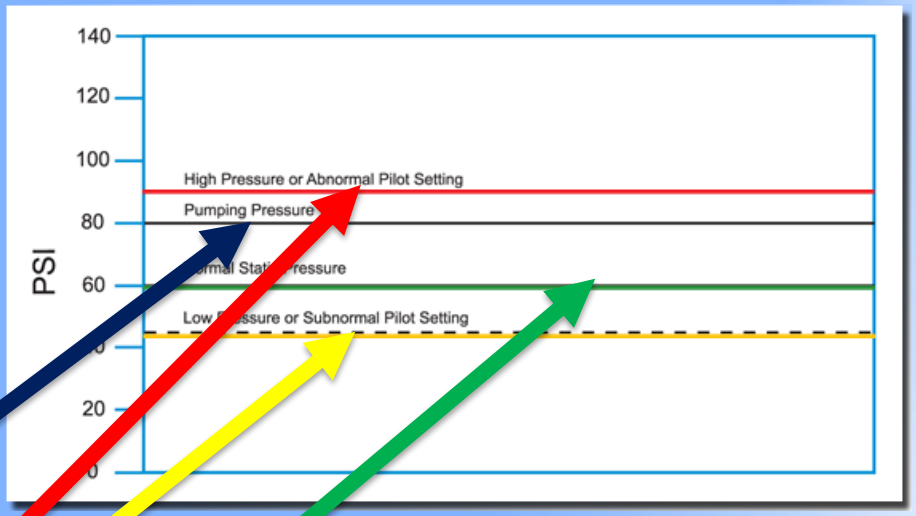
- When there is a sudden stoppage in flow, pressure in the pipeline will drop below normal static pressure. The valve has a low pressure pilot that senses this drop and opens the valve. Some valves have a flow limiting device to limit the amount the valve opens. When the pressure wave comes back, the water exits through the open valve, which virtually eliminates any spike in pressure.

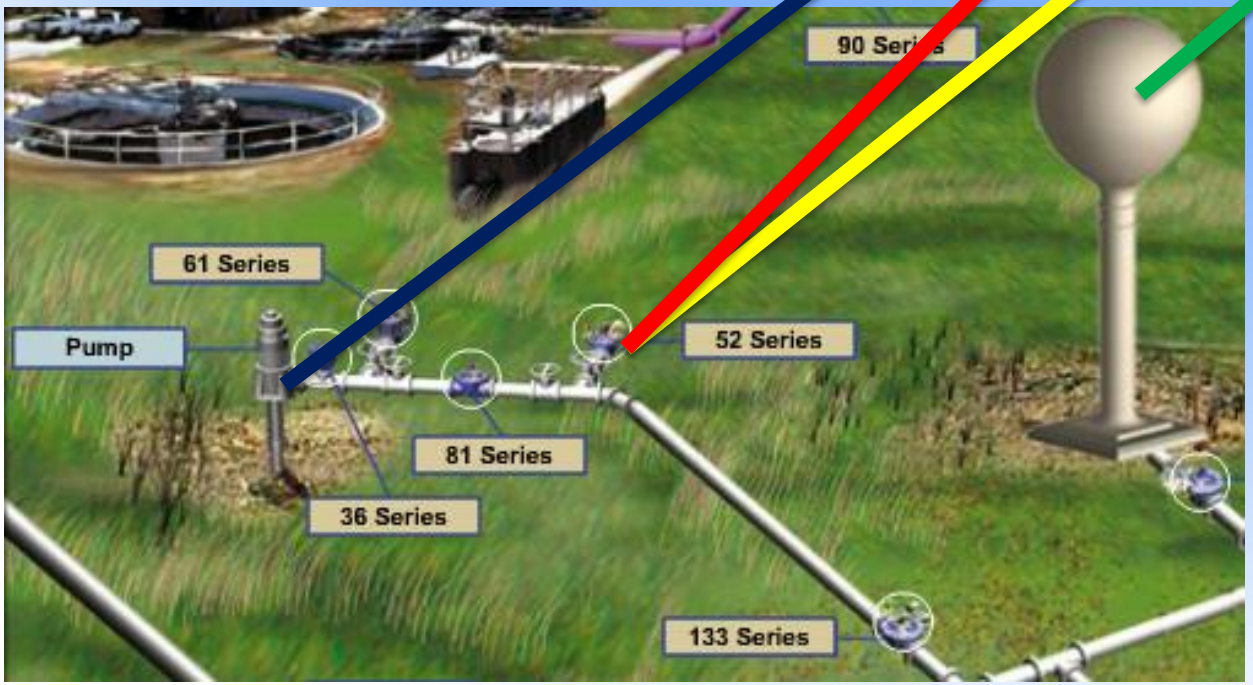




Are There Any Limitations?

- When using a surge anticipator valve, you need to ensure there is a source of static pressure in your distribution system that will give pressure at the inlet of the valve when all pumps are off. Typically, this means there is a water tower downstream of the pump station.





Questions?

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