Basics of Backflow
&
Detector Assemblies

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Topics to Cover

- Definitions
- Short history of
- Basic Hydraulics of DC & RP
- Detector Assemblies, what are they used for?
- What is a Type II Detector Assembly
- Are they legal?
- Questions

Definitions

- Pressure
- Flow, Velocity
- Pressure Drop vs. Flow
- Water Hammer
- Backflow
- Back Siphonage
- Back Pressure
- Cross Connection
- Degree of Hazard
- Potable / Non-Potable
- EPA
- Check Valves
- Authorities having Jurisdiction (AHJs)
- Shutoff Valves

Pressure

- **Atmospheric Pressure** (psi_{atm}) also known as Barometric Pressure
  - Force per unit area of air around us
  - 14.7 psi (at sea level)

- **Gauge Pressure** (psig)
  - Expressed reading on a Gauge Identifying the Pressure in a Piping System.
  - Gauge pressure is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure. Negative signs are usually omitted.
  - Gauge Pressure reads approximately 14.7 psi less than that of absolute pressure.

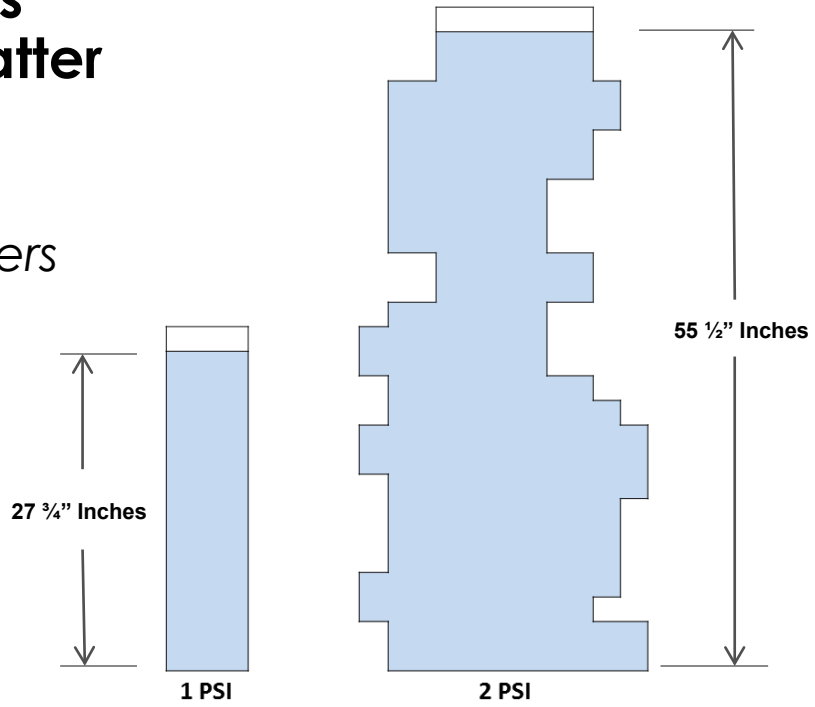
- **Differential Pressure** (psid)
  - The difference in pressure between two measured points
  - i.e. – Test cock #1 = 100 psi, Test cock #2 = 95 psi. Differential pressure = 5 psid

Pressure

Diameter or Volume of a Fluid's Space or Container Doesn't Matter

*It's the **Depth** of the Water That Matters*

27 ¾" inches of water = 1 PSI



Water Always Flows From a Higher Pressure To a Lower Pressure

Flow

Flow Rate = Velocity x Area

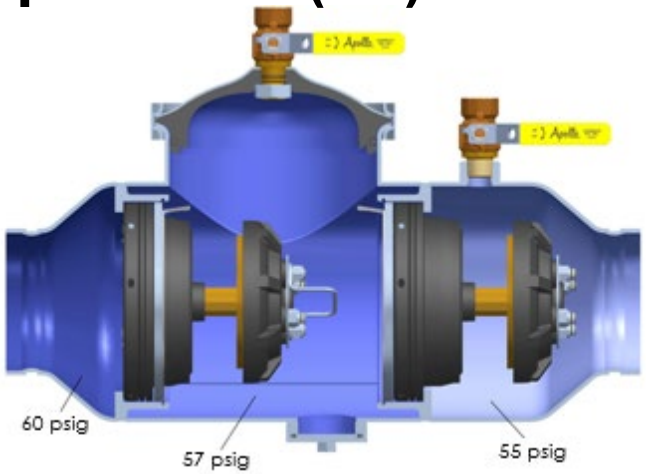
- **Flow Rate** being the volume per unit of time
  - Gallons per Minute (GPM)
  - Cubic Feet per Minute (CFM)

- **Velocity** being the speed of media movement within a piping system
  - Feet per Second (FT/S)

What is Pressure Drop?

To determine Delta P across a backflow preventer, subtract the outlet pressure (P2) from the inlet pressure (P1)

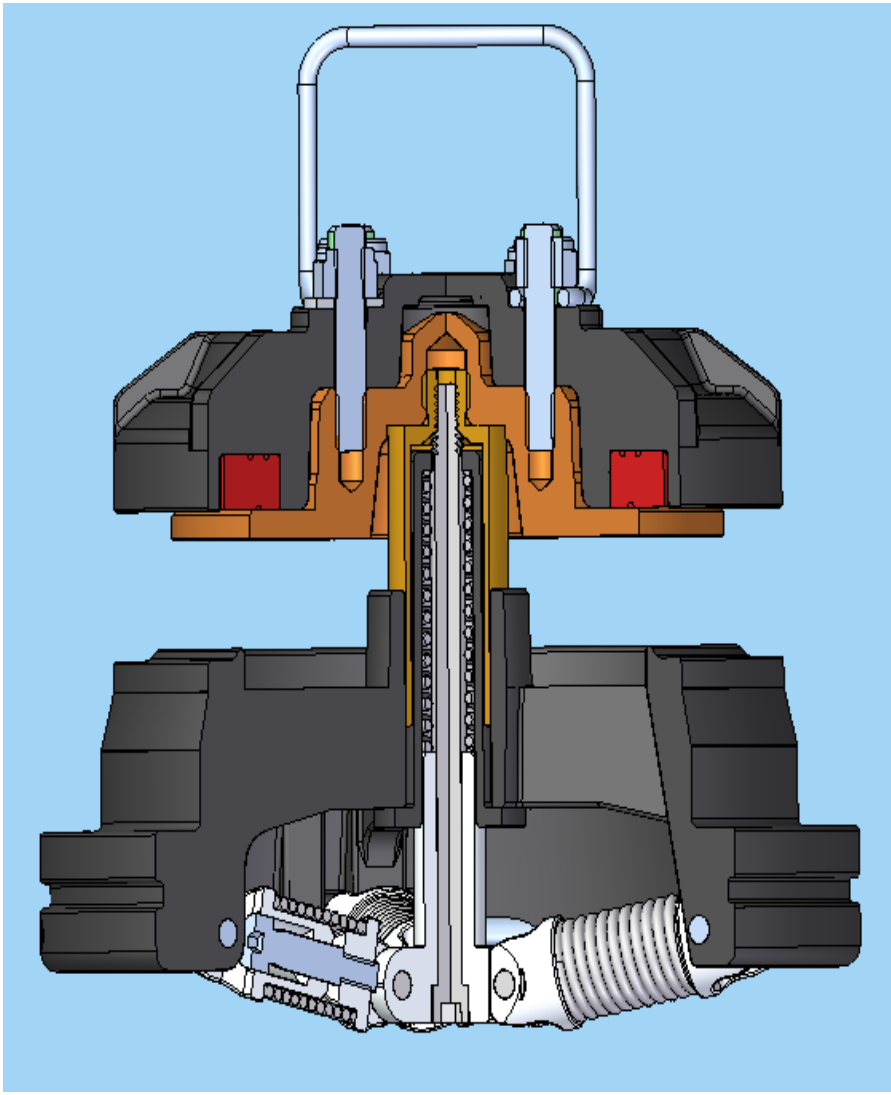
The equation is (P1) - (P2) = △P



Cause of PSI Drop = Backflow Preventer Check Valve

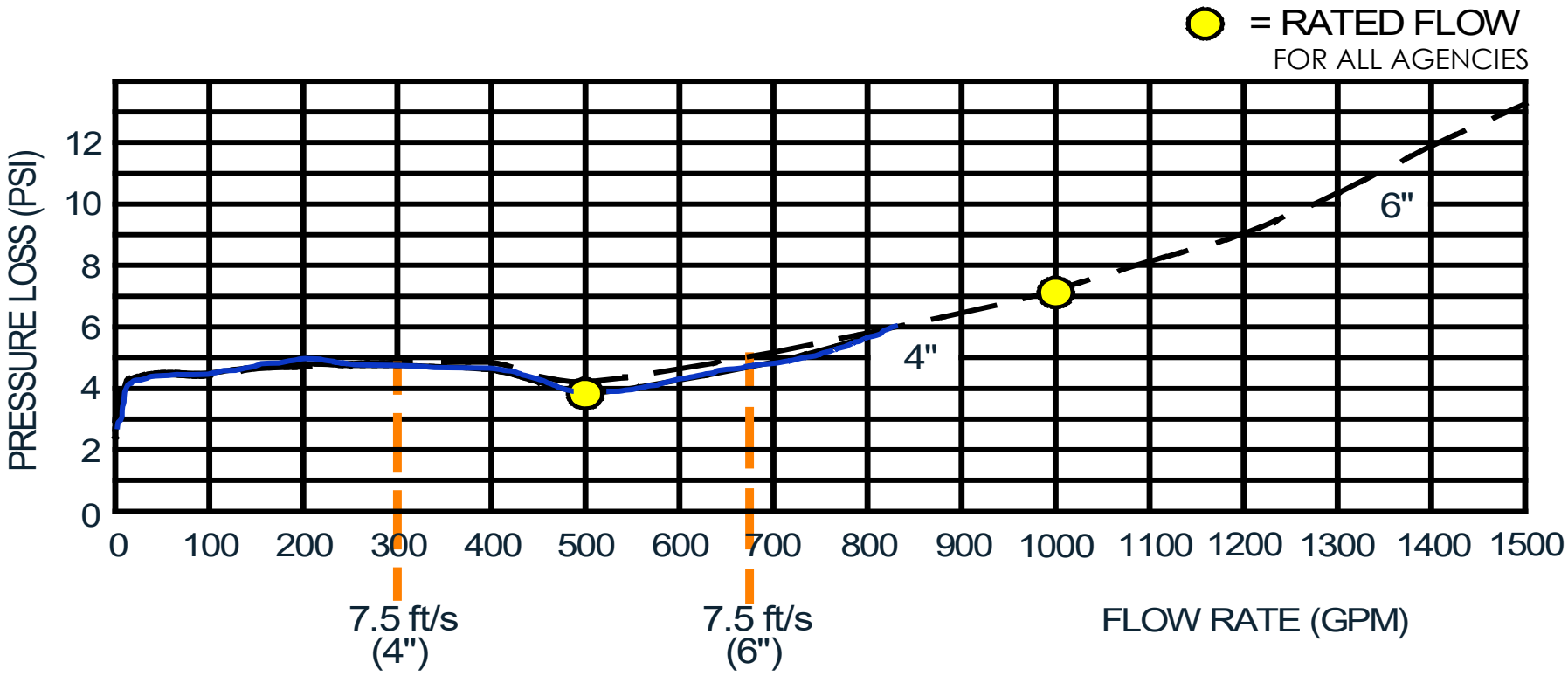
Critical Engineered Parts

- Closing Force Springs
- Guiding Components
  - 1. Center Stem Guided “Poppet” Check
  - 2. Clapper or Swing Check
- Hard Seat, machine or molded
- Soft Seat Disc or Seal
- Hard Stop



Pressure Drop / Loss At System Flow Rates For Dbl. Checks

Maximum Allowable Pressure Drop Is 10 psig For Any Size, at any flow from closed to full rated flow. All Approval Agencies (USC, ASSE, CSA)



UL test to 1.5 times the rated flow (yellow dots)

Irrigation Design Flow Rate: 5 ft/s
Plumbing Design Flow Rate: 7.5 ft/s
Fire Protection Design Flow Rate: ? ft/s

DEFINITION OF BACKFLOW

- **Backflow is a Hydraulic Condition Caused by the Unwanted Reversal of Flow**

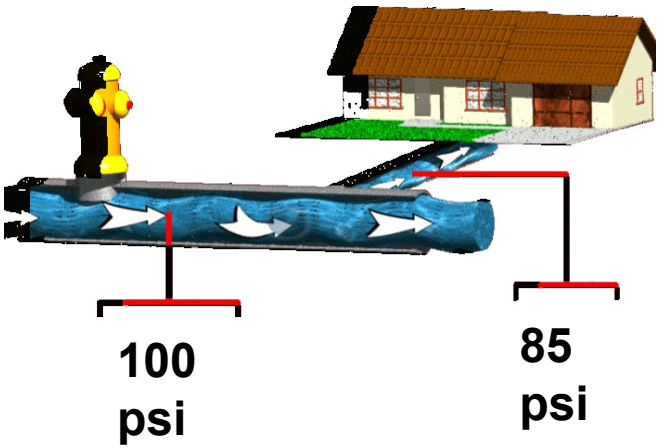
BACKFLOW CAN BE CAUSED BY ONE OF TWO WAYS

BACKSIPHONAGE
OR
BACKPRESSURE

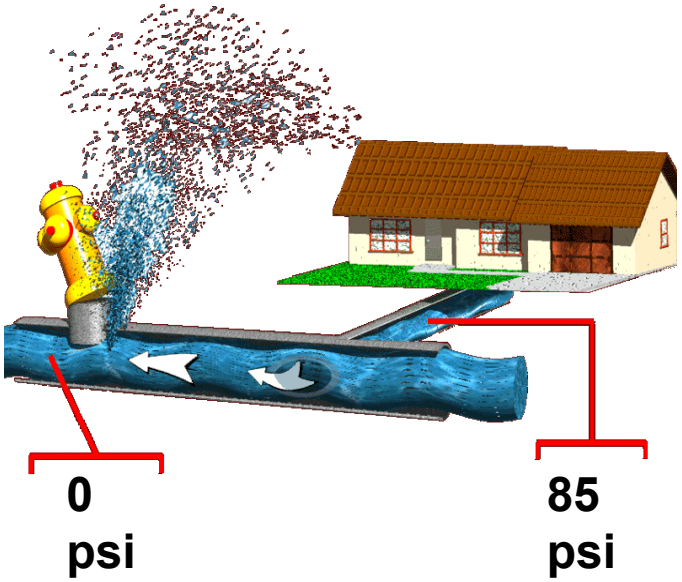
Back-Siphonage

Situation - when Supply Pressure becomes less than Piping System Pressure, Siphoning (Drawing) Water Back into The Lower Pressure

All Backflow Preventers Protect Against Back Siphonage



Normal Flow



Back-Siphonage

Back-Siphonage

Situation - when Supply Pressure becomes less than Piping System Pressure, Siphoning (Drawing) Water Back into The Lower Pressure

All Backflow Preventers Protect Against Back Siphonage

In 2017 AWWA Estimated

" Over 240,000 Water Main Breaks in the US Each Year" That's over 650 per day

Guesses at how many gallons/yr?

An estimated 6 billion gallons/yr!

Estimated by ASCE

BACKPRESSURE

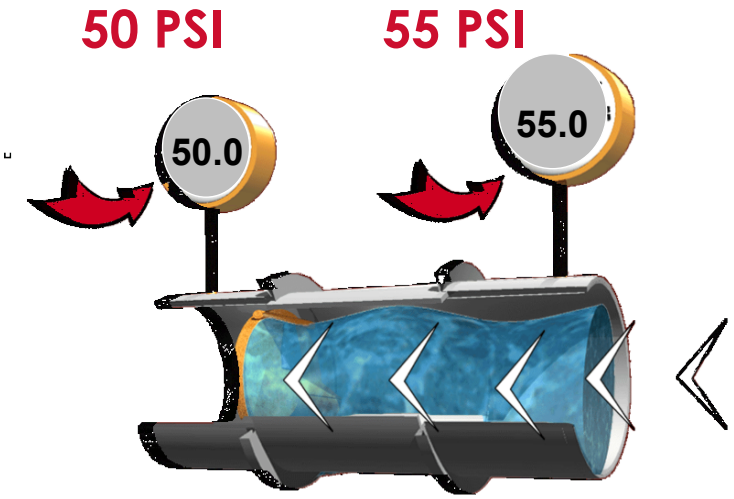
- Pressure in the Downstream Piping System That is Greater Than That of Supply Pressure

Back Pressure

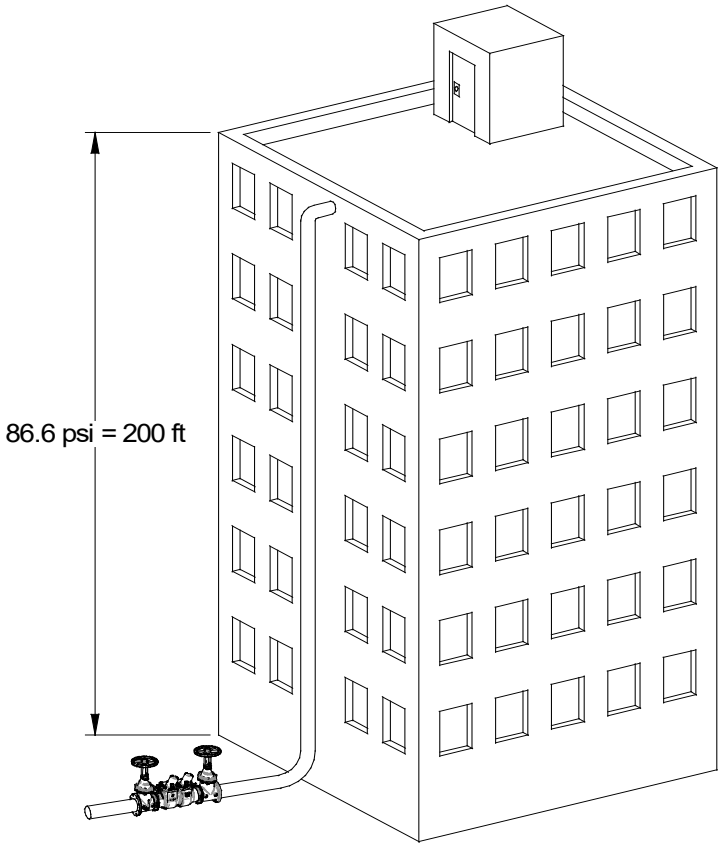
Situation - when Piping System Pressure Becomes Greater than Supply Pressure Pushing the Water Back to The Lower Supply Pressure

What Causes Back Pressure?

- Elevation (Weight of Water)
- Pumps
- Thermal Expansion
- Water Hammer



EXAMPLES of BACKPRESSURE



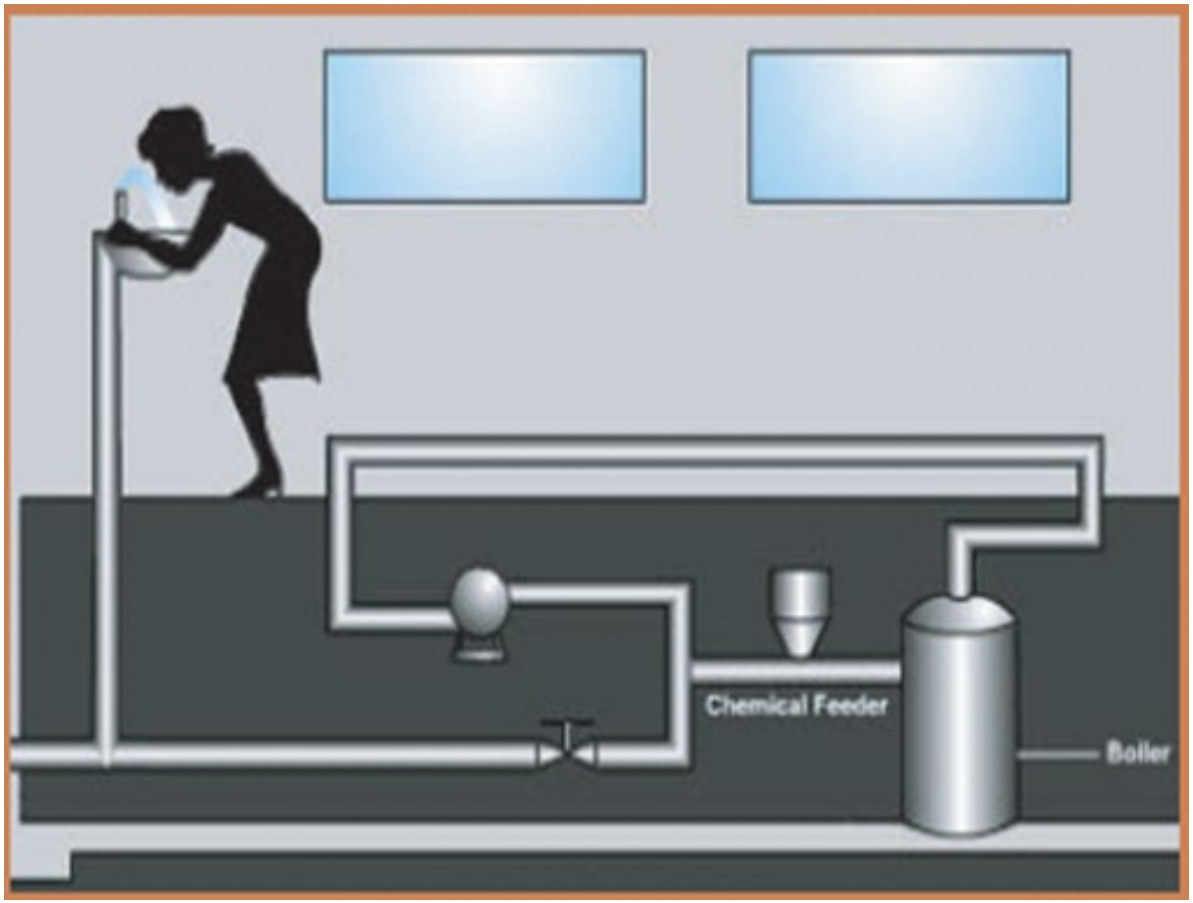
Cross Connection

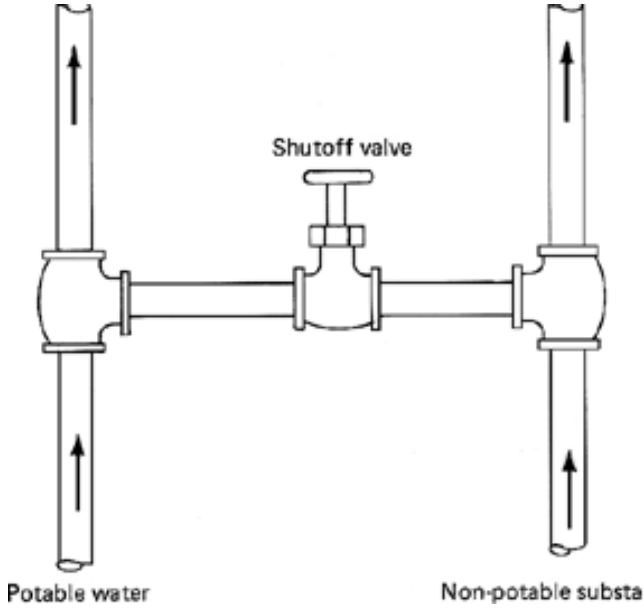
Any actual or potential connection to a drinking water line where a non-potable material could come in contact with that drinking water.

Two Types:

- Direct (fixed) connection
- Indirect (temporary) connection

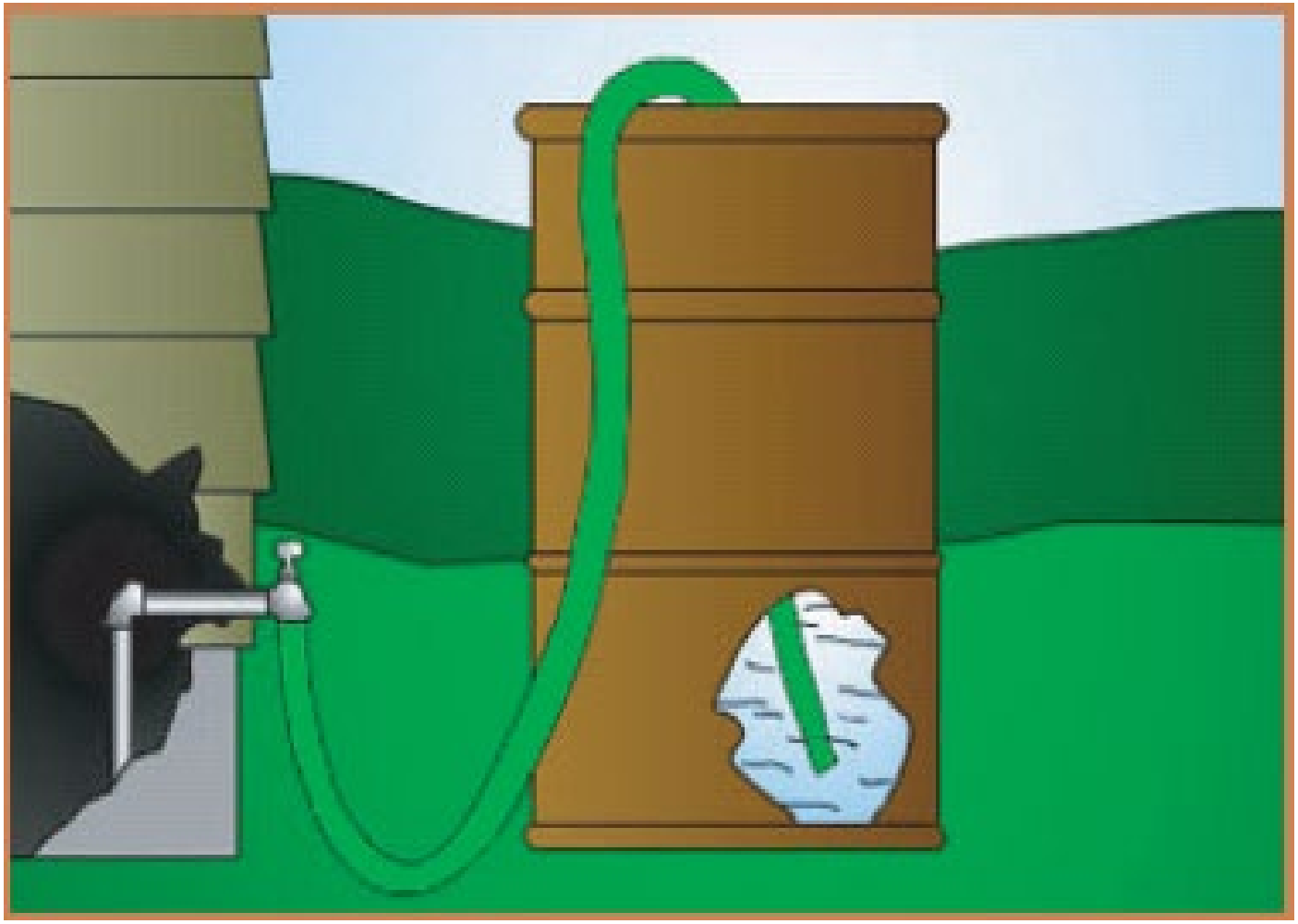
Cross Connection





Direct (fixed) connection

Cross Connection



Source: www.watercenter.montana.edu

Indirect (temporary) connection

Degree of Hazard

- **Non Health Hazard** (Pollutant)
  - Non-Health, or Aesthetic Hazard, or Non-Toxic, or Pollution Hazards
  - All Backflow Preventers Protect Against Non-Health Hazards
    - Food Products
    - Non-Toxic Fluids
    - Static Water Lines

- **Health Hazard** (Contaminant)
  - Health, Toxic, Contaminant Hazards
    - Chemicals
    - Sewage
    - Industrial fluids

Potable Vs. Non-Potable – Source Water

- **Potable**
  - EPA interprets "potable services" to be services or applications that provide water suitable for:
    - for human ingestion (e.g. drinking, teeth brushing, food preparation, dishwashing.
    - maintaining oral hygiene.
  - "**Before the Meter** "
- **Non-Potable**
  - Water that is not of drinking water quality, but which still be used for many other purposes
    - Reclaimed/recycled (Gray)
    - Rainwater
    - Sea Water
  - **"After the Meter"**

Selection of Proper Backflow Prevention Products

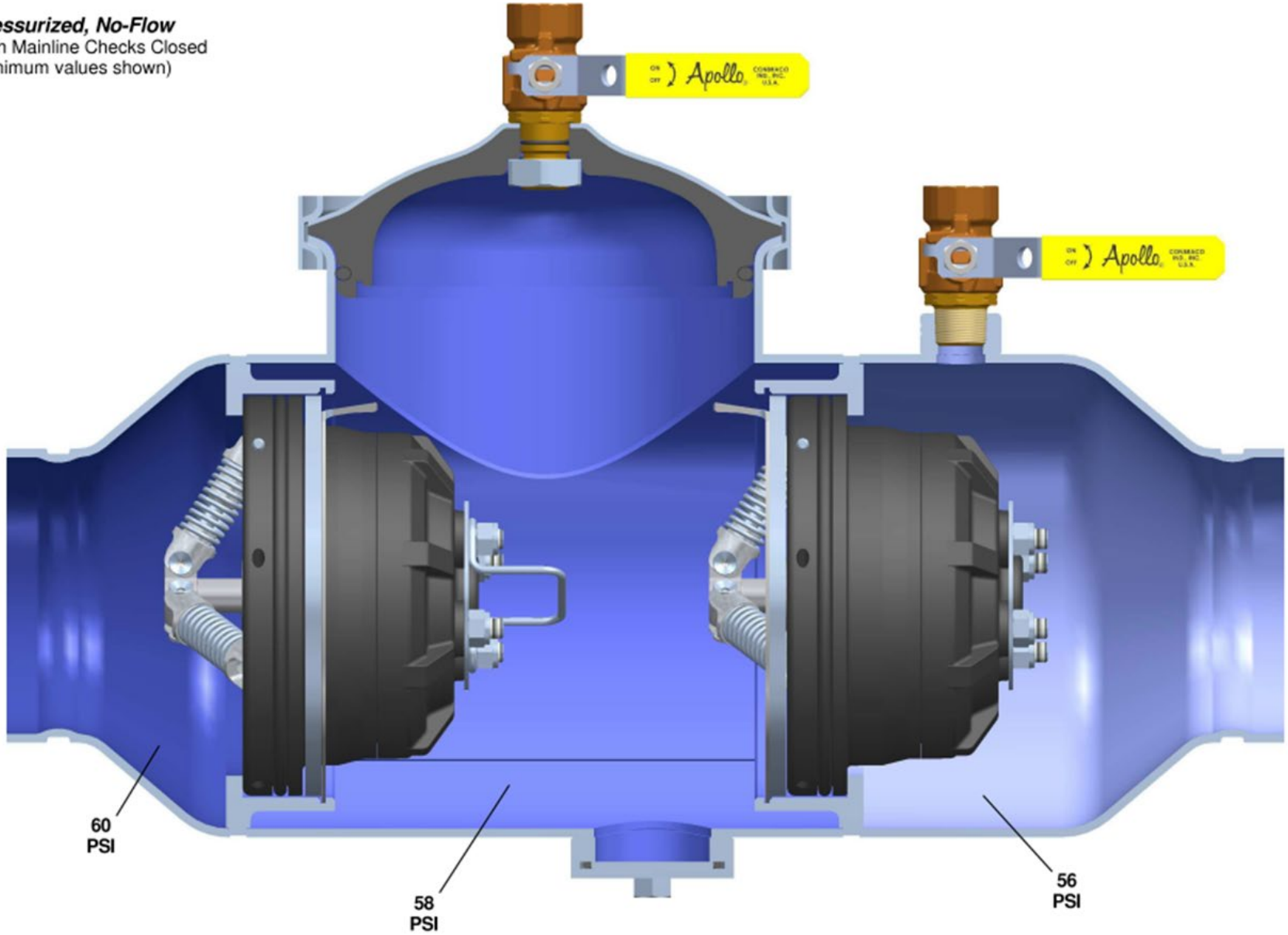
- **<u>Always</u> Refer to Local Jurisdictional Authority (AHJ) And Prevailing Codes!!**
- Possibility of Back Pressure? (**<u>Always</u>** a Possibility of Back-Siphonage)
- Possibility of Health-Hazard Cross Connection?
- Constant Pressure Requirement?
- Need for Vertical installation ?

Double Check

Protects against only **non-health** hazard applications for both backpressure and backsiphonage.

How a Double Check Backflow Preventer Works

Pressurized, No-Flow
Both Mainline Checks Closed
(Minimum values shown)



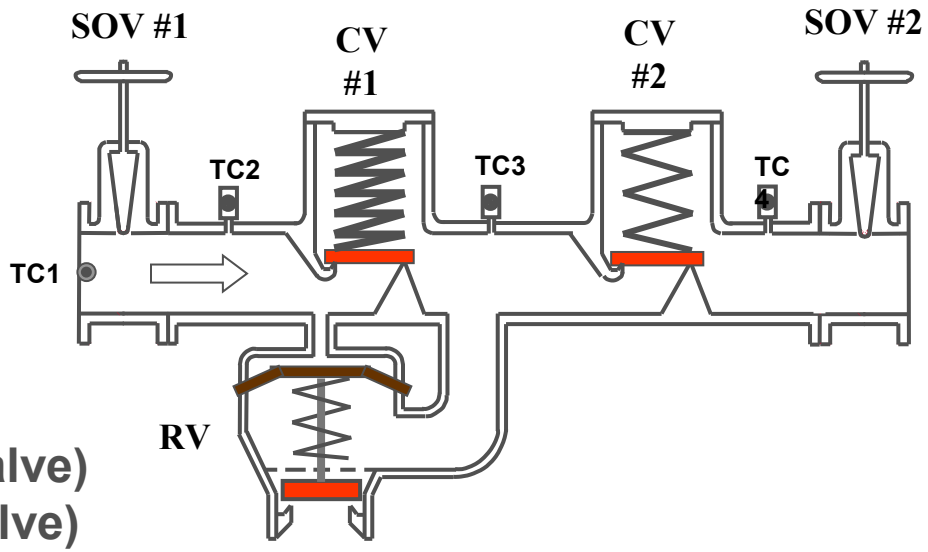
Reduced Pressure Principle

Protects against **health** and **non-health** hazard applications for both backpressure and backsiphonage

How a Reduced Pressure Principle Backflow Preventer Works

RP Operation

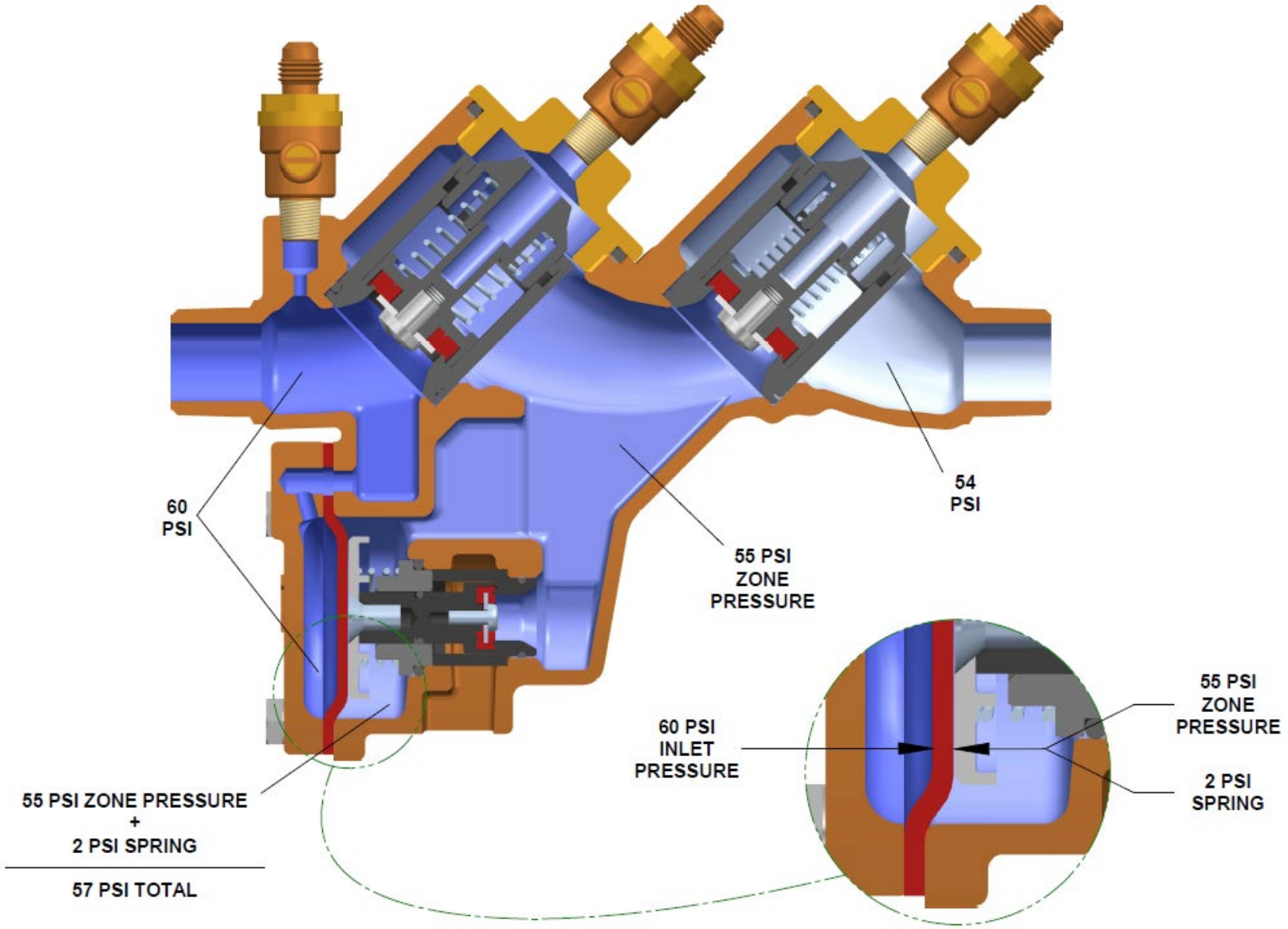
Pretty Easy Right?



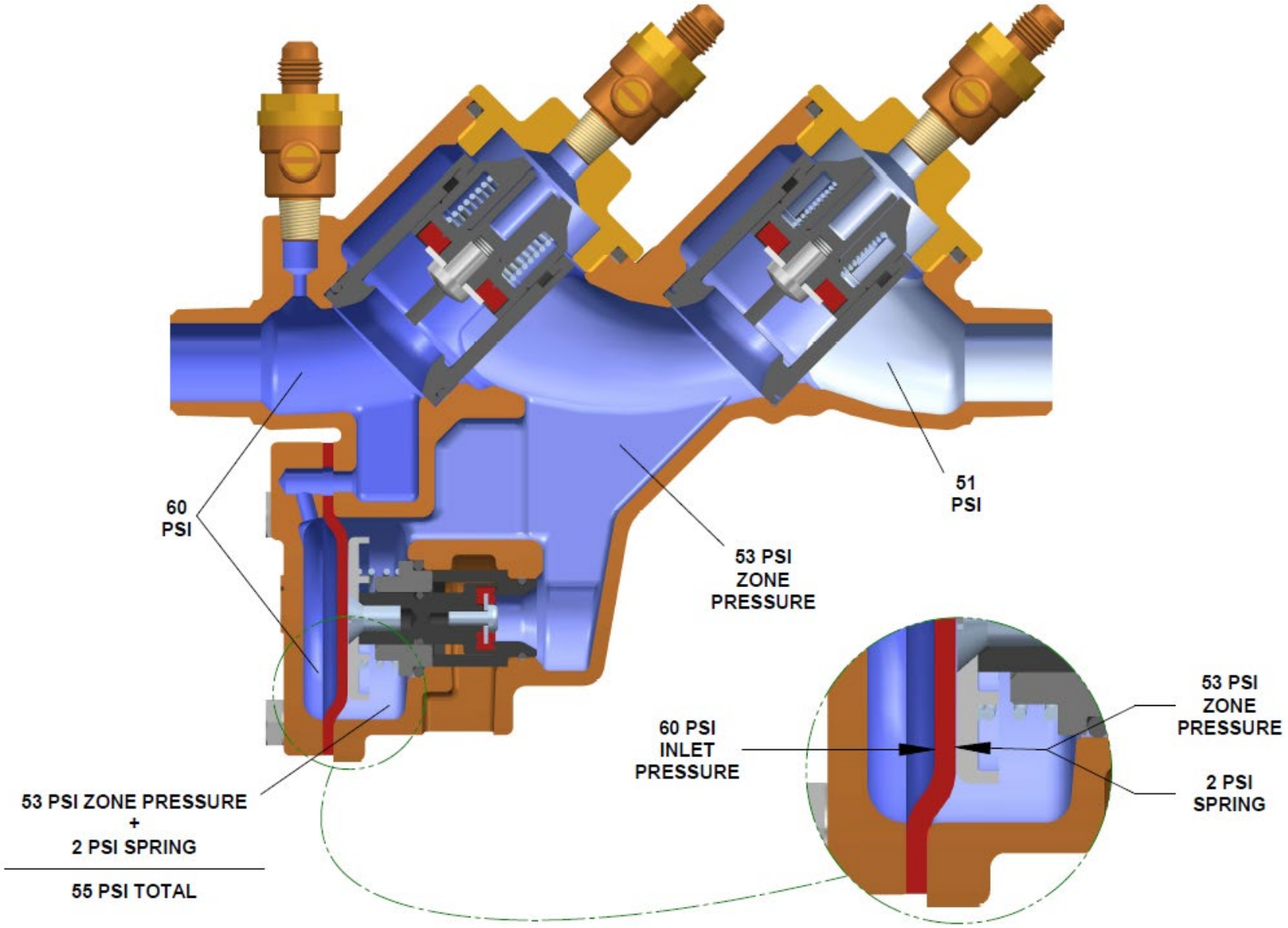
CV #1 ≥ 5 PSID
CV #2 ≥ 1 PSID
RV ≥ 2 PSID

CV (check valve)
RV (relief valve)
TC (test cock)
SOV (shut-off valve)
PSID (pounds per square inch differential)

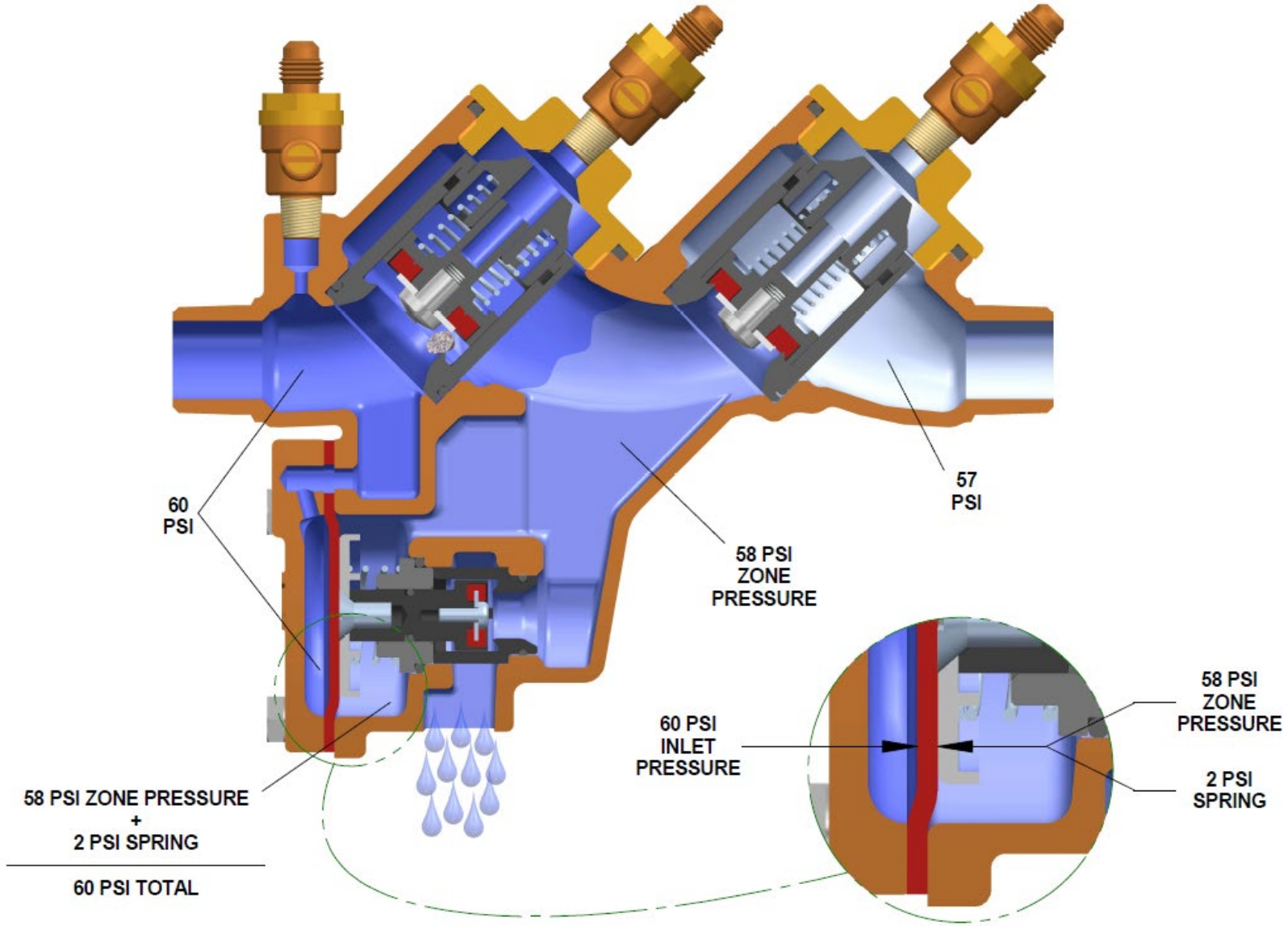
RP Operation – Static (no flow)



RP Operation – Flowing



RP operation – first check fouled (RV dripping)

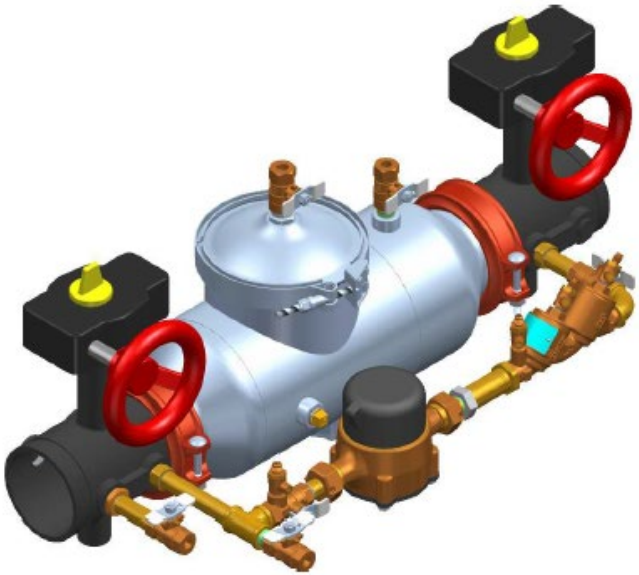


Detector Assemblies for Fire Systems

DCDA TYPE I vs TYPE II

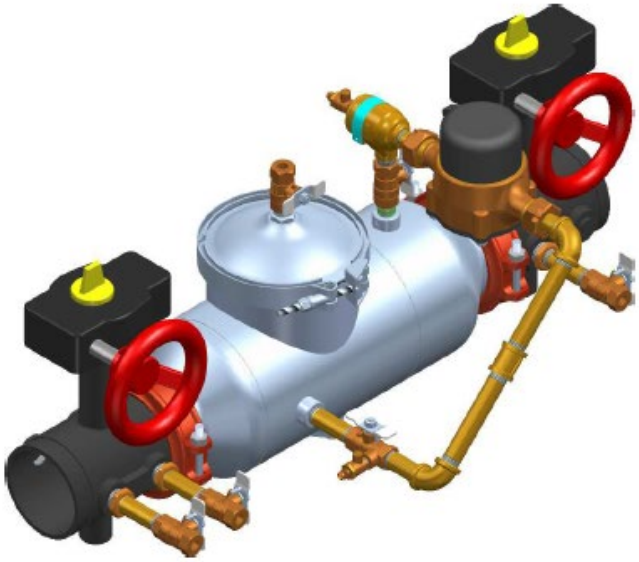
Features

- Typically installed in fire protection systems.
- Must include indicating shut-off valves.
- Mainline of DCDA is identical to DC.
- Mainline of RPDA is identical to RP.
- Bypass line monitors low flow (first 2 gpm) downstream and includes backflow prevention.



DCDA "Type I"

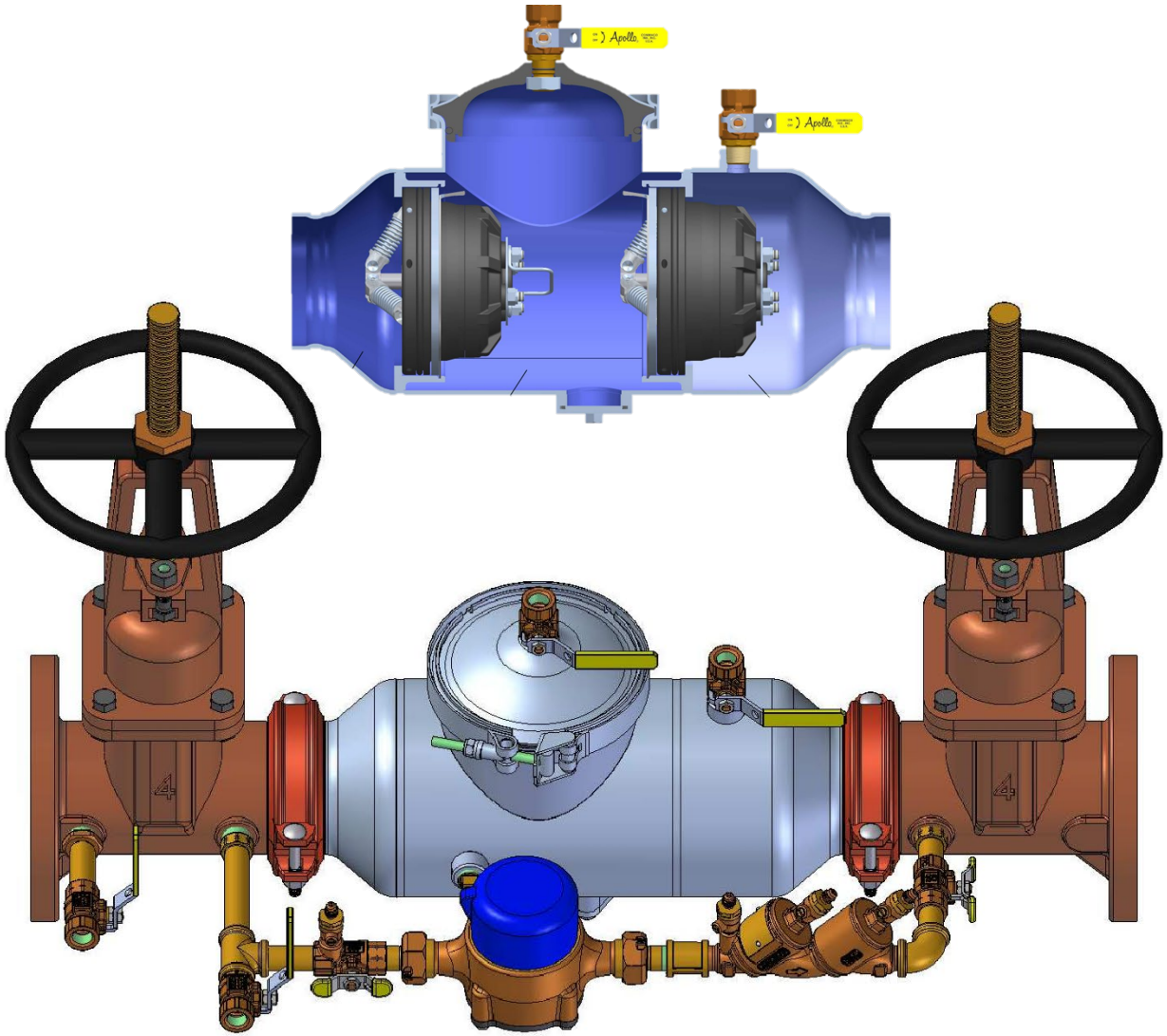
- Original design
- Bypass line bypasses 1st and 2nd checks.
- Double check required on the bypass line.



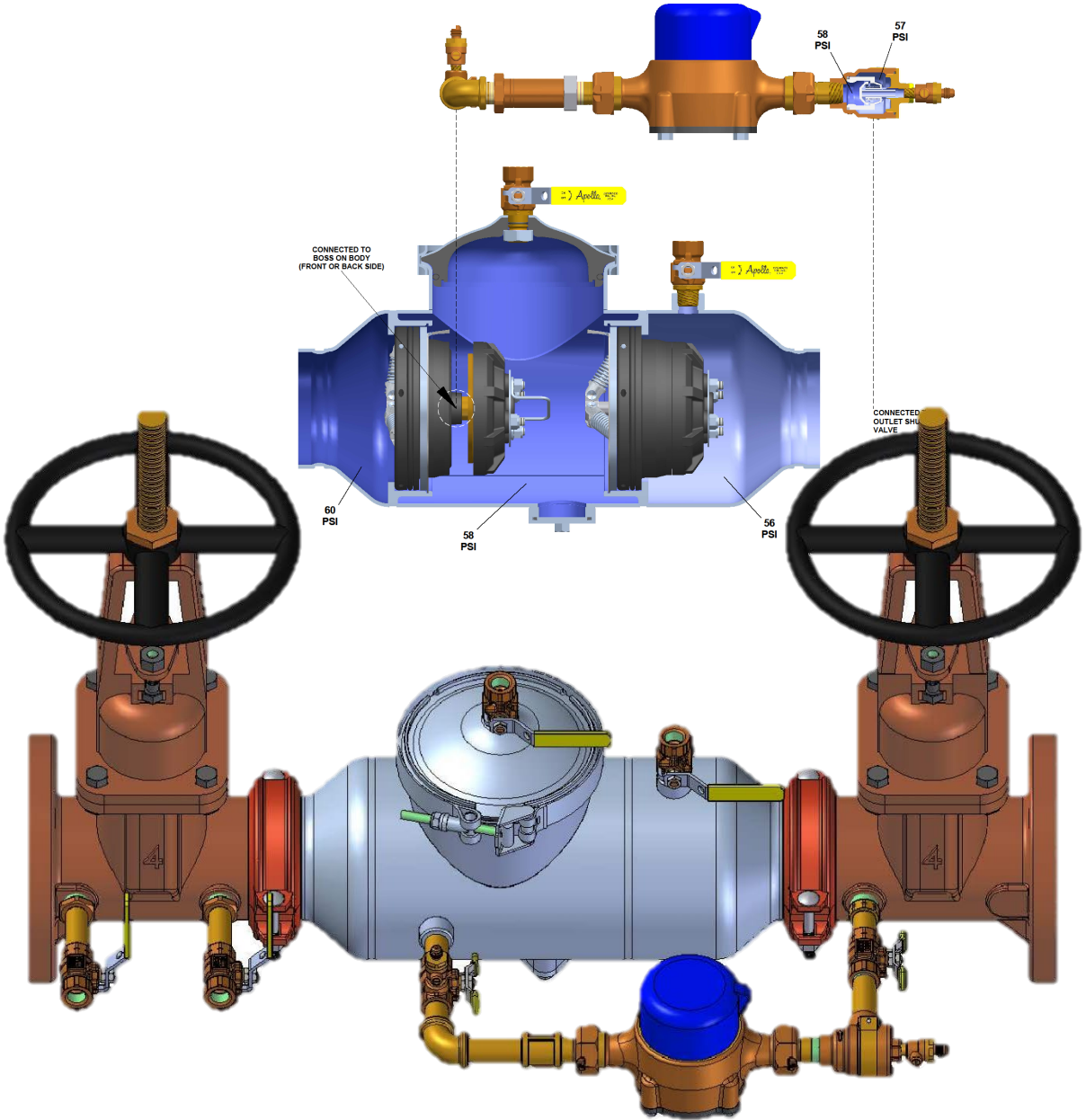
DCDA "Type II"

- Newer design (~2009)
- Bypass line bypasses 2nd check only.
- Single check required on the bypass line.

DCDA 4A Type 1 Bypass



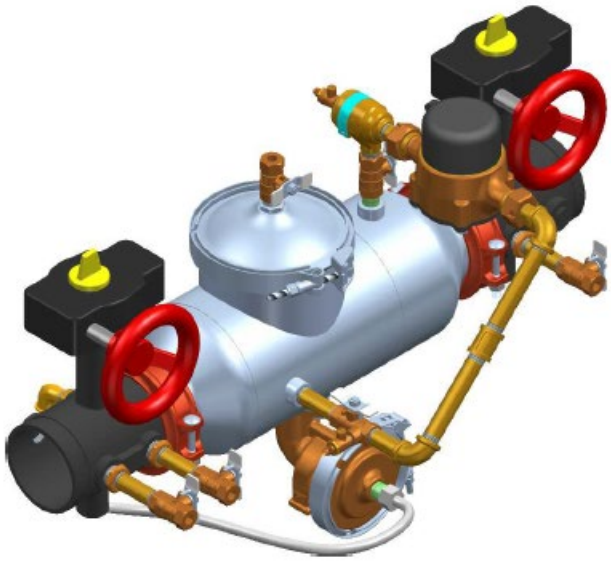
DCDA2 4A Type 2 Bypass



RPDA TYPE I vs TYPE II

RPDA "Type I"

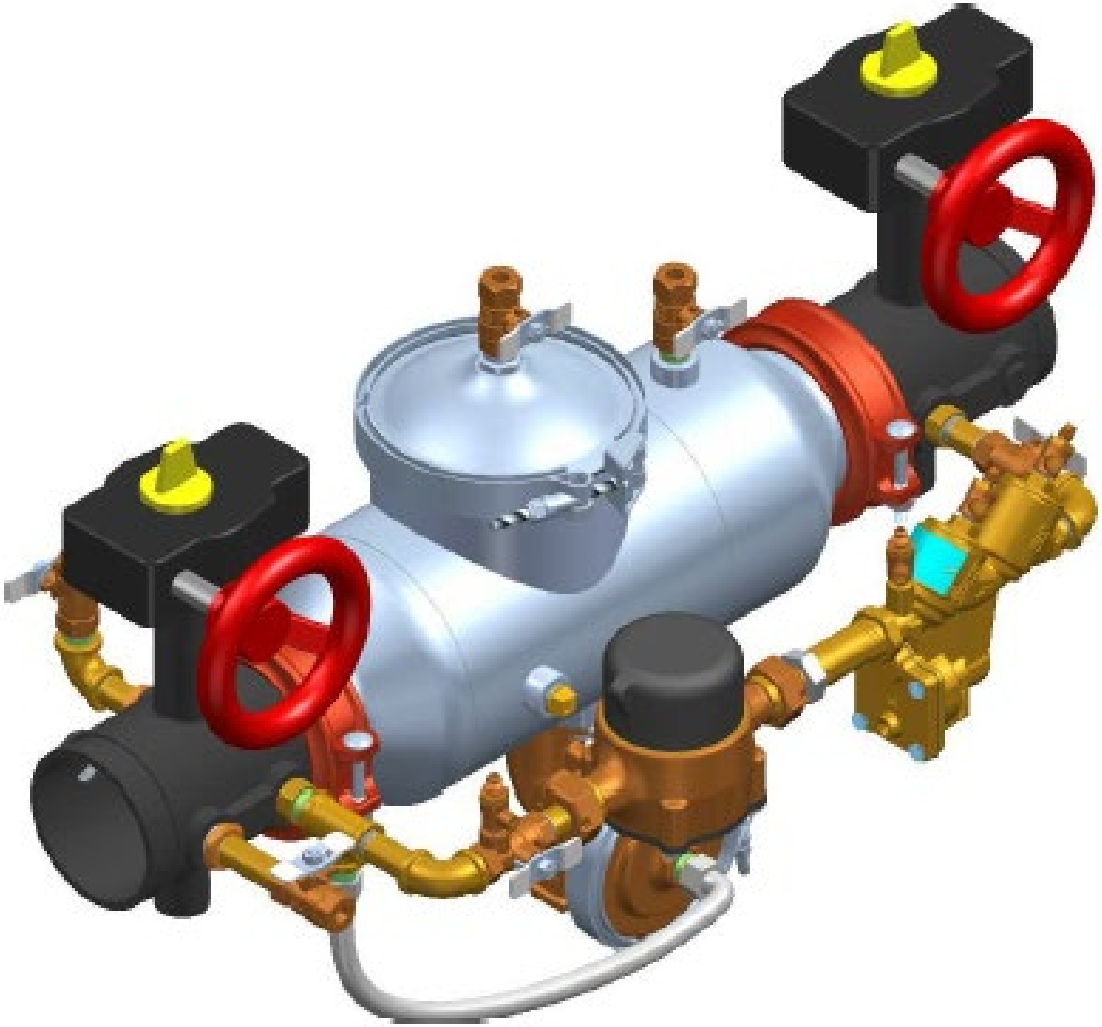
- Original design
- Bypass line bypasses 1st and 2nd checks.
- RP required on the bypass line.



RPDA "Type II"

- Newer design (~2009)
- Bypass line bypasses 2nd check only.
- Single check required on the bypass line.

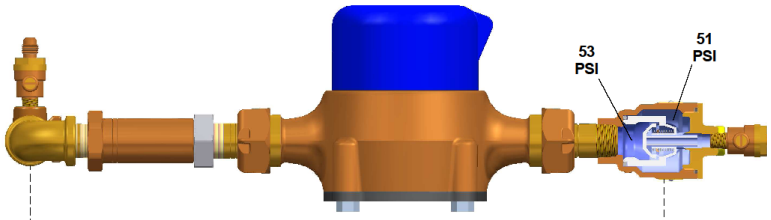
RPDA TYPE I

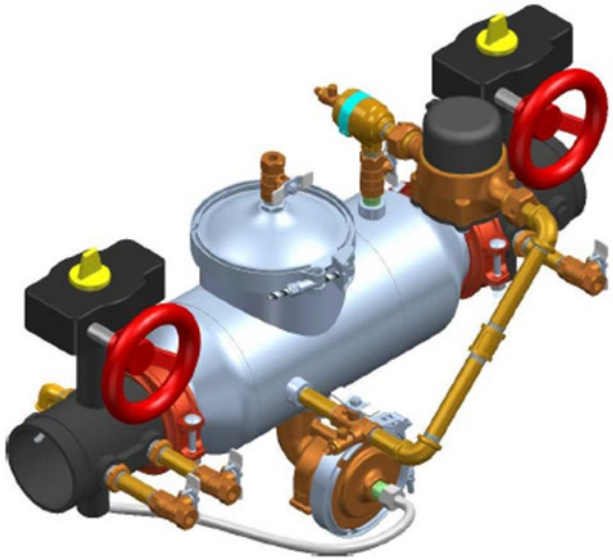


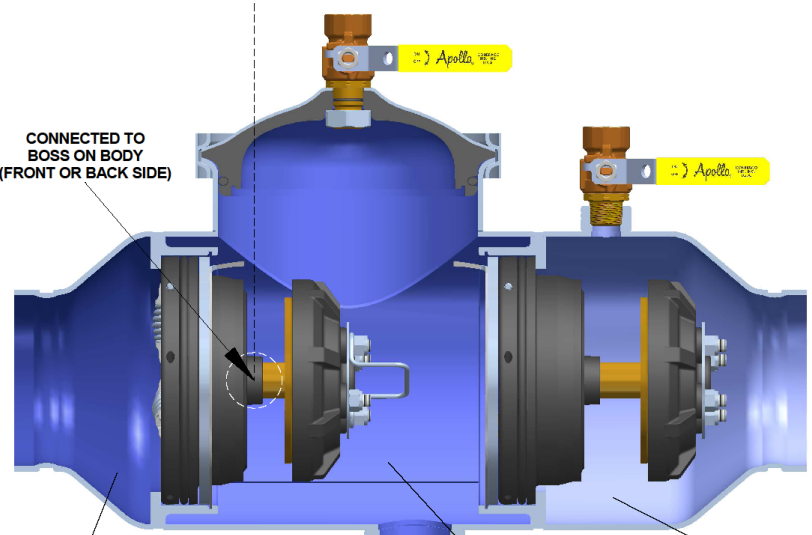
RPDA TYPE 2

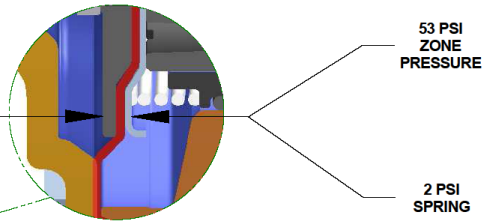
Apollo Valves MODEL RPDA2 4A

Fire Flow
Both Mainline Checks Open
By-Pass Check Open
Relief Valve Closed
(Minimum values shown)







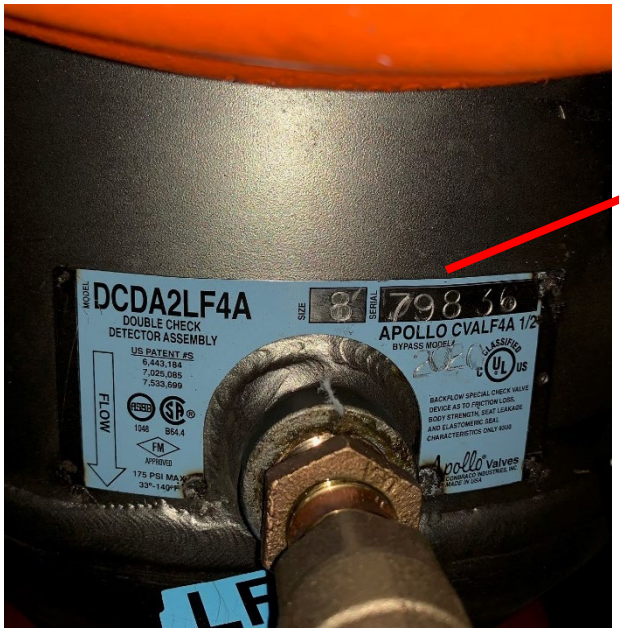


Questions on Type II DA's?

- **Why is the alphabet in that order? Is it because of that song?**
- **Why doesn't glue stick to the inside of the bottle?**
- ***Are they approved and how do you test them?***

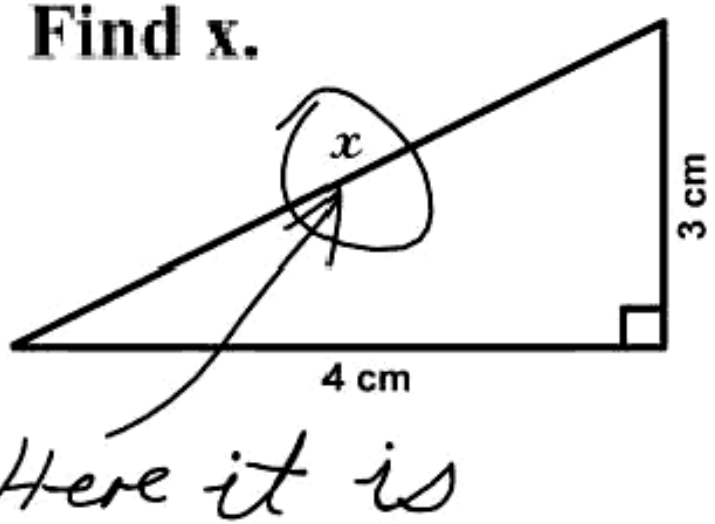
How do you know they are approved?

- Check the name plate
- Verify on manufacturers website
- Or Verify on approval agencies website



Testing of Type II's

1. Different organization testing procedures cover Type II's
2. Software manufacturer's have Type II options now
3. Type II's have two serial numbers just like traditional DA's
4. Always check with the authority having jurisdiction
5. Find x.



Sample test form

BACKFLOW PREVENTION ASSEMBLY FIELD TEST FORM

1

Service Name/Address:	Service Number:	Owner Name/Address:	☐ RP ☐ DC ☐ PVB ☐ SVB	☐ DCDA ☐ RPDA ☐ DCDA II ☐ RPDA II
	Assembly Location:			

Mainline Mfr:	Model	Size	Orientation	Serial Number
Bypass Mfr:	Model	Size	Orientation	Serial Number

2 Bypass Water Meter Reading Before Test: _____ After Test: _____

MAINLINE ☐ DCDA **BYPASS**

☐ DC ☐ DCDA II

3

	Check Valve 1	Check Valve 2	Check Valve 1	Check Valve 2	Bypass Check
INITIAL TEST	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐
REPAIR DETAILS	☐ Cleaned ☐ Replaced _____	☐ Cleaned ☐ Replaced _____	☐ Cleaned ☐ Replaced _____	☐ Cleaned ☐ Replaced _____	☐ Cleaned ☐ Replaced _____
FINAL TEST	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐	Leaked _____ PSID ☐

MAINLINE ☐ RPDA **BYPASS**

☐ RP ☐ RPDA II

4

	Check Valve 1	Check Valve 2	Relief Valve	Check Valve 1	Check Valve 2	Relief Valve	Bypass Check
ITIAL TEST	_____ PSID	☐ Closed Tight	_____ PSID	_____ PSID	☐ Closed Tight	_____ PSID	_____ PSID

*** University of Southern California Foundation for Cross-Connection Control and Hydraulic Research**

Three Step RP Trouble Shooting Guide
If relief valve is discharging, it is doing its' job

Step 1 Close 2nd Shut-Off Valve to stop flow. If relief valve discharge stops when the 2nd Shut-Off Valve is closed, fouled 2nd check most likely WITH backpressure in the system.

Step 2 If discharge continues, fully open #4 test cock or create downstream flow equal to or greater than discharge amount. If discharge stops or slows, most likely problem is fouling of the first check.

Step 3 If relief valve discharge continues, or gets worse with downstream flow, most likely it is a fouled relief valve.

IF DISCHARGE IS INTERMITTENT, IT IS MOST LIKELY PRESSURE FLUCTUATIONS

Address the cause of the line pressure spikes, which can be either supply or down stream.

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