

Hydraulics and How Backflow Happens
Paul H. Schwartz – USC FCCCHR
12 November 2008

**Ontario
Backflow
Prevention
Association**

**Backflow
Seminar**

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Chief Engineer
Foundation for Cross-Connection Control
and Hydraulic Research

12 Nov 2008



Presentation

Hydraulics and How Backflow Happens

Normal view of a hydraulics lecture

Communicate Effectively

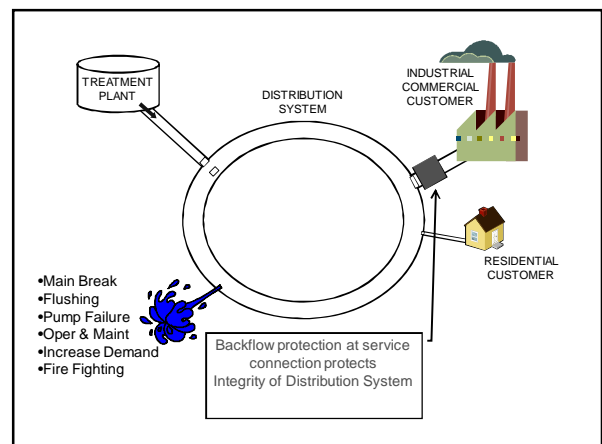
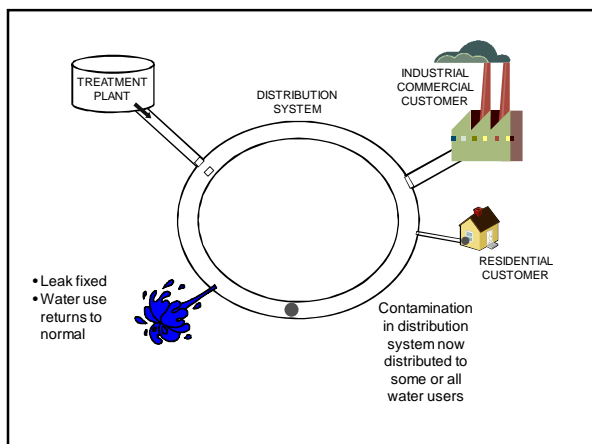
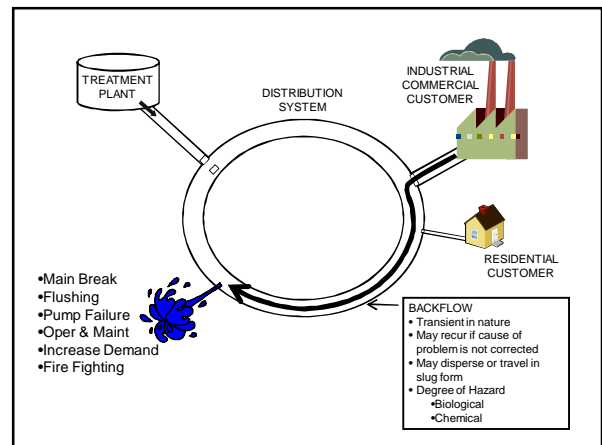
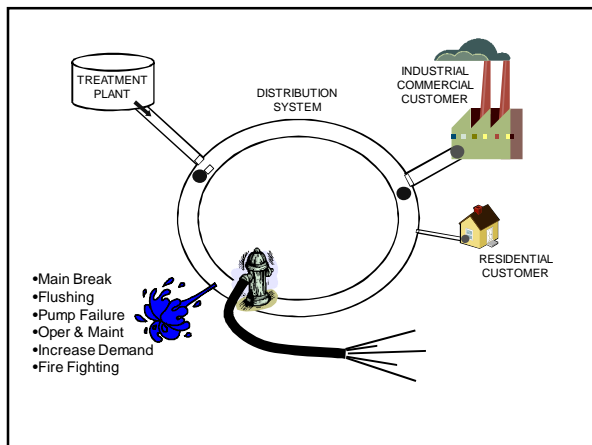
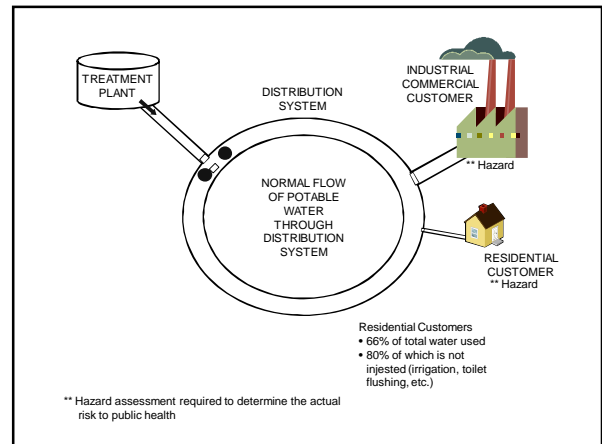
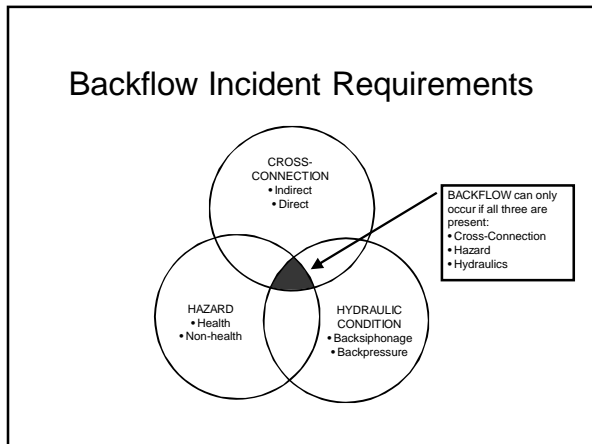
- Consider your audience
- General knowledge of water distribution systems
- Previous misunderstandings

EPA Presentations – January 2008

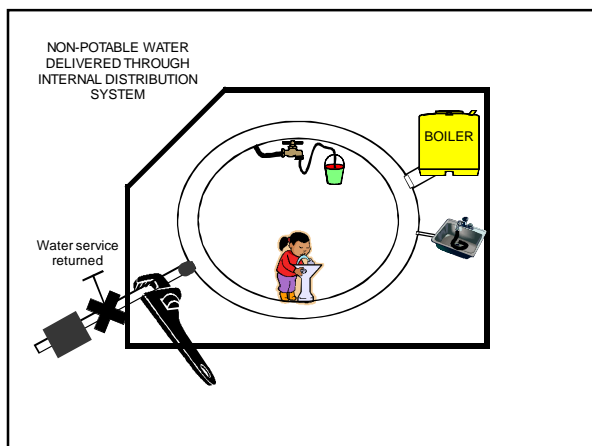
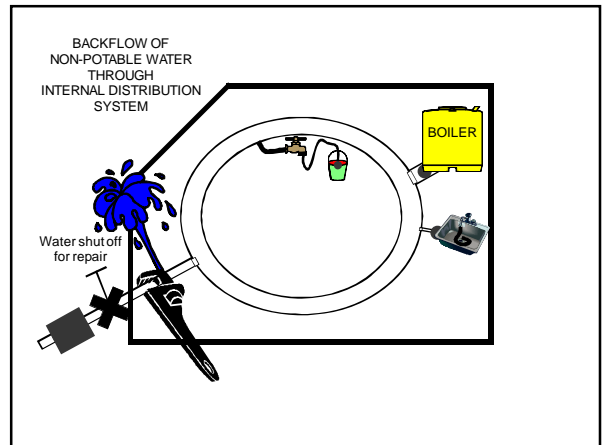
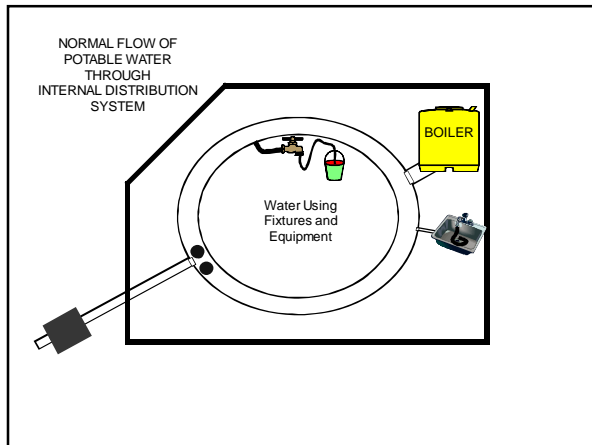
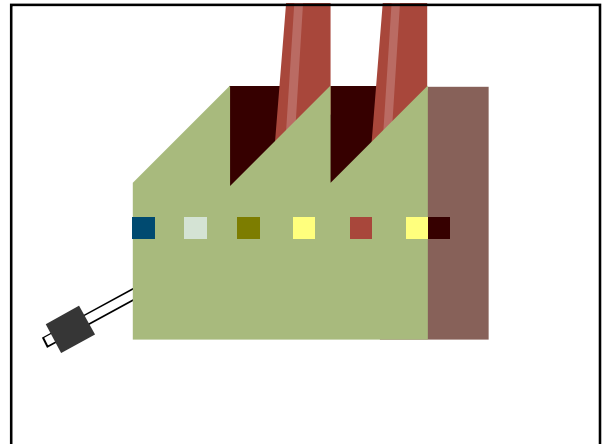
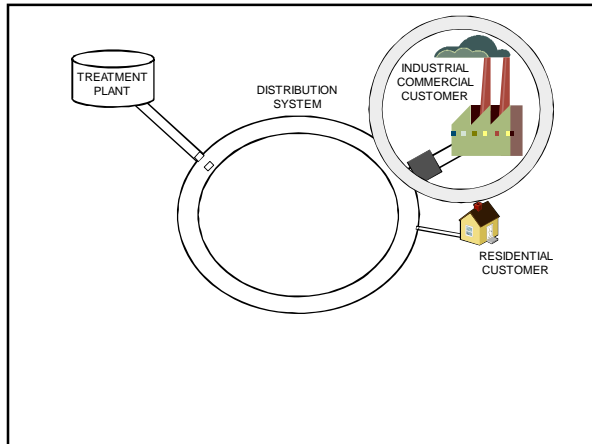
- What we know about backflow
– Including basic hydraulics animation
- What we don't know about backflow,
and the research needs

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- Today's Overview**
- Hydraulic Principles
 - Hydraulics and Backflow
 - Hydraulics and Backflow Prevention Assemblies

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Hydraulics

- Backflow is all about Hydraulics
- Backflow is not typically taught in hydraulics courses (i.e., don't blame the engineers !)

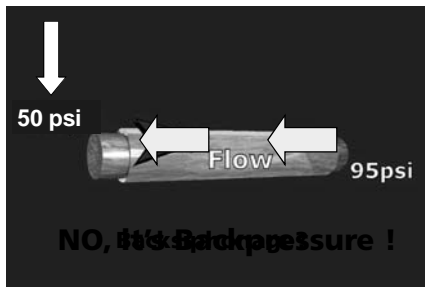
My Boss
Dr. J.J. Lee
Director, FCCCHR



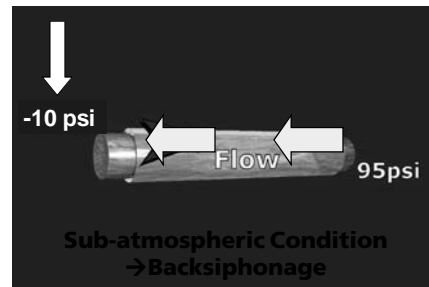
Backflow is generally caused by a Difference in Pressure

- Backsiphonage
- Backpressure

Example



Example #2



Conclusion

Water always flows from a higher pressure to a lower pressure

NO

Common Misunderstanding

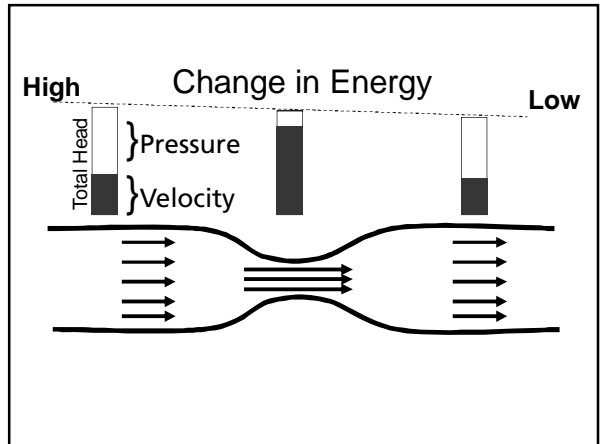
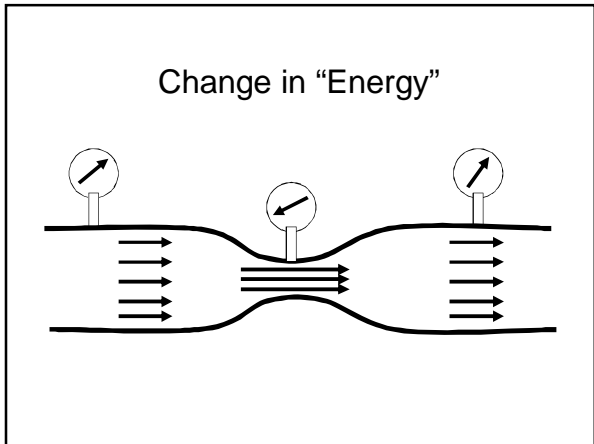
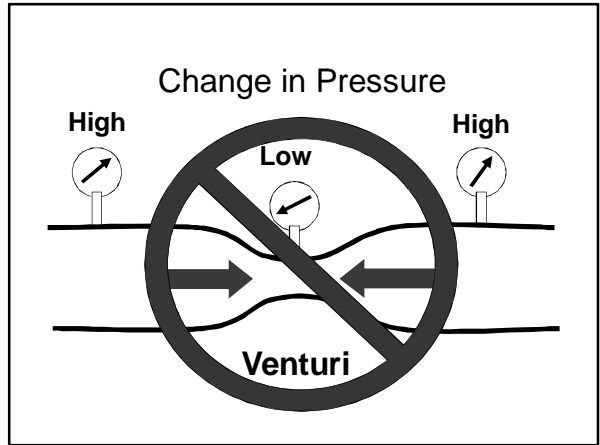
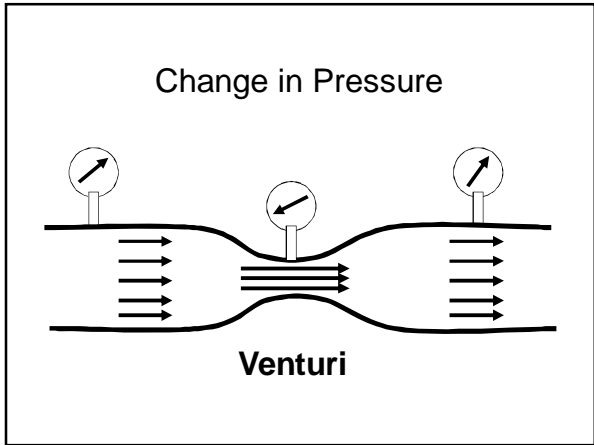
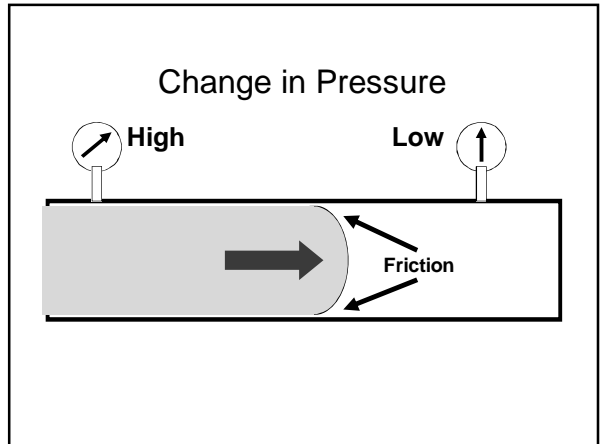
- 60-70% of Engineers taking Professional Engineering Exam miss that question
- Confirms P.E. stands for Partially Educated

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Conclusion Should Be...

Water always flows from a higher energy region to a lower energy region

Bernoulli's Equation



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Hydraulics in Plumbing

Simple plumbing experiences pressure loss due to friction

Hydraulics in Plumbing

Adding Elbows and Tees, etc. will create more pressure loss.

Hydraulics in Plumbing

- Elevation in piping can be a large factor in pressure loss too.
 - Elevation Head (Z)

Hydraulics in Plumbing

- Fixed orifice or opening
 - Pipes
 - Fittings
 - Valves

Hydraulics in Plumbing

- Pressure loss can be identified by C_v
 - Valve constant
 - Characteristic of each type and size valve.

Hydraulics in Plumbing

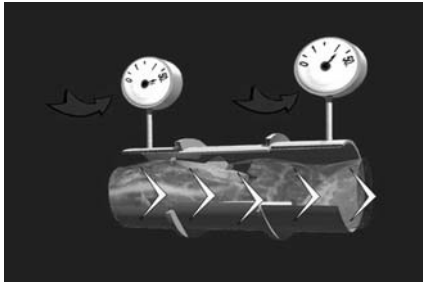
- Pressure loss can be identified by C_v
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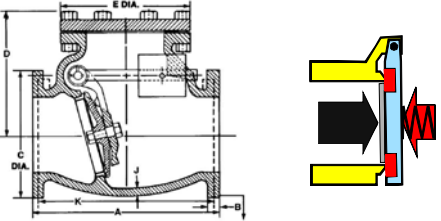
Hydraulics in Backflow Prevention Assemblies

- Backflow prevention assemblies don't have fixed openings/orifices
- Check valves are biased closed
 - Weight loaded
 - Spring loaded

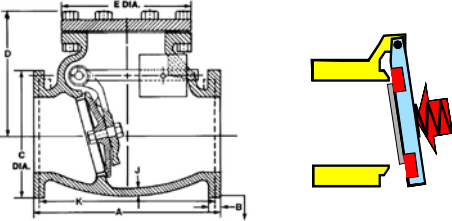
Hydraulics in Check Valves



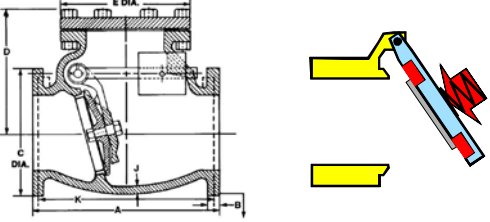
Hydraulics in Check Valves



Hydraulics in Check Valves

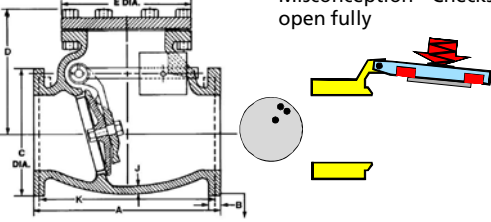


Hydraulics in Check Valves

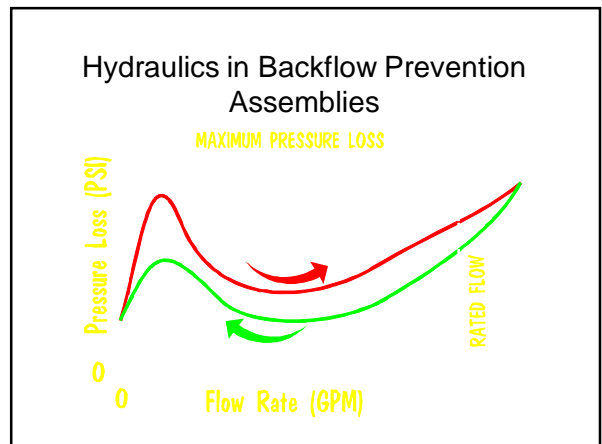
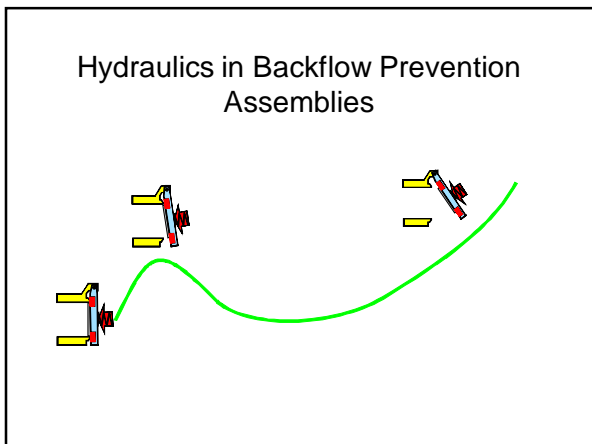
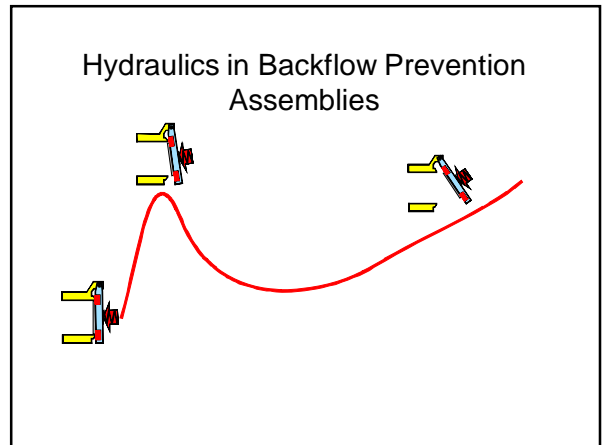
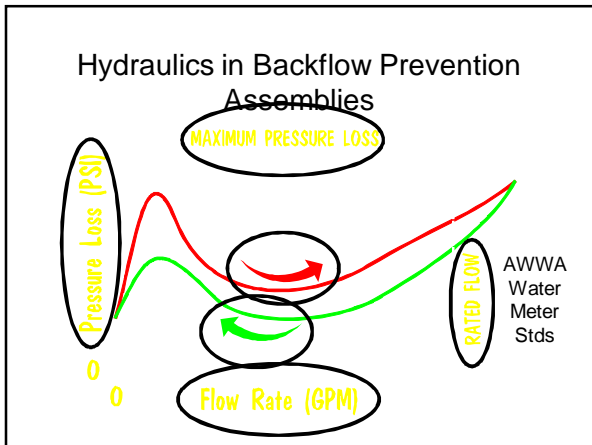
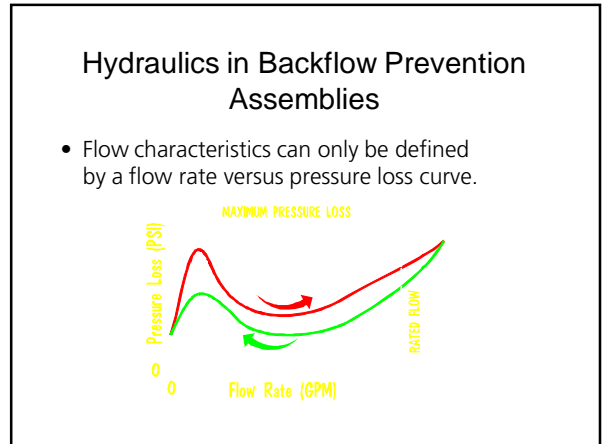
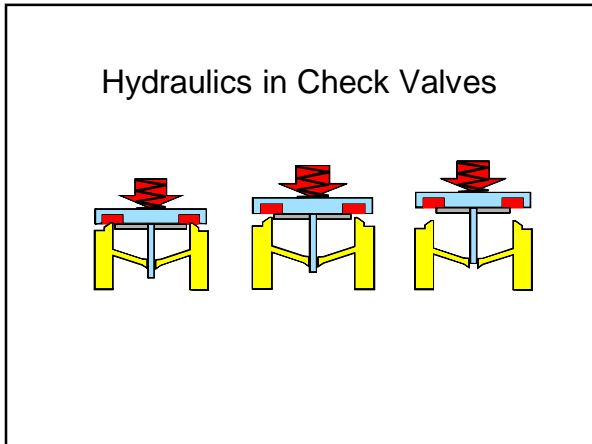


Hydraulics in Check Valves

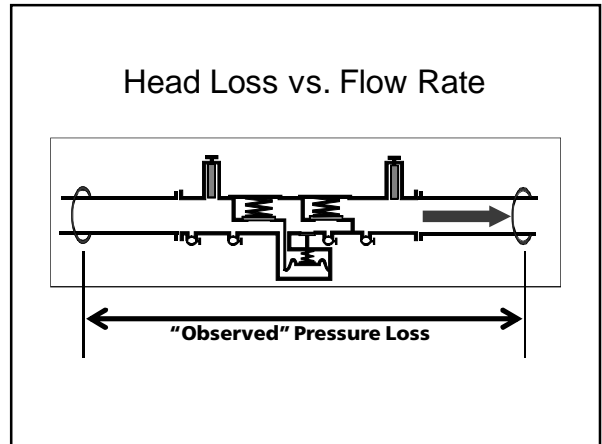
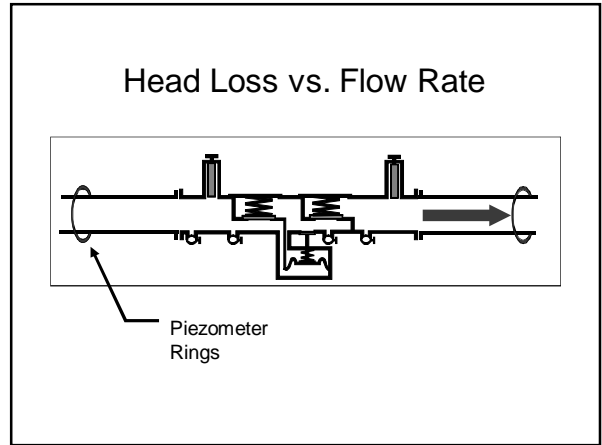
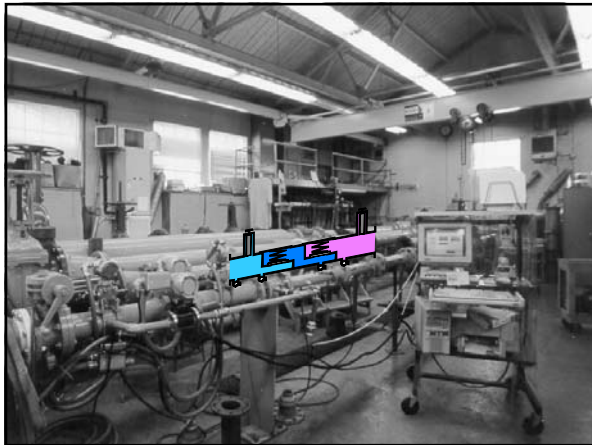
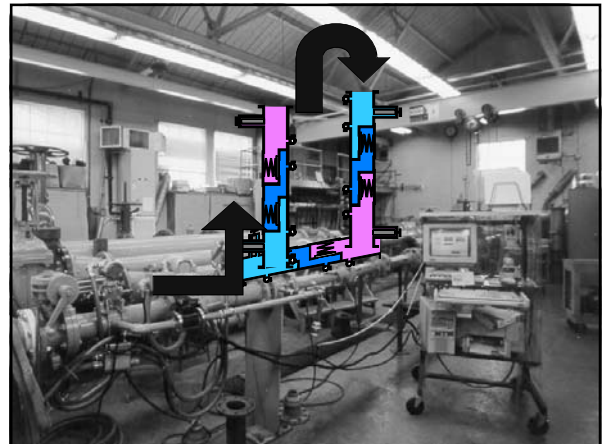
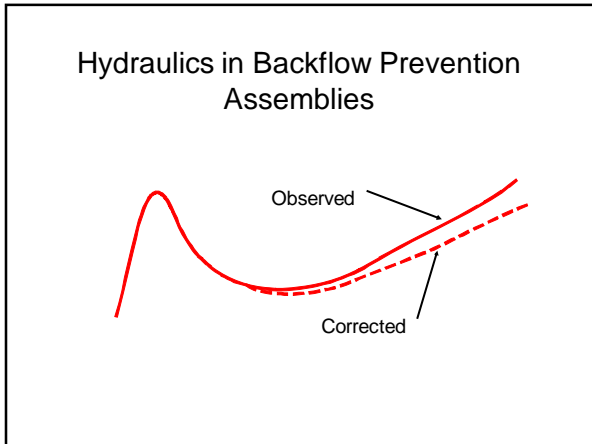
Misconception – Checks open fully



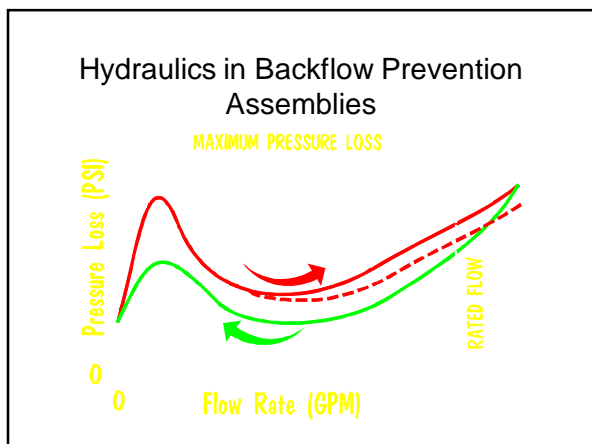
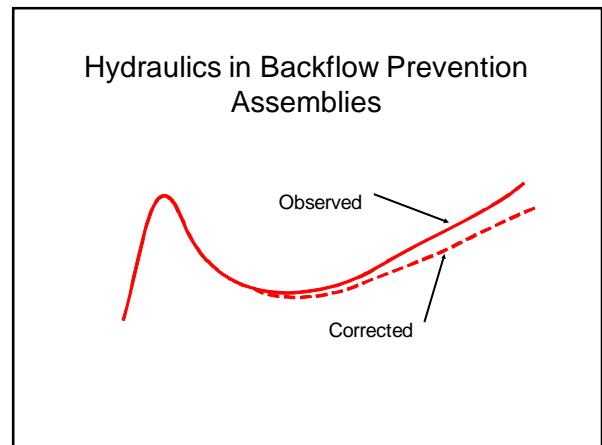
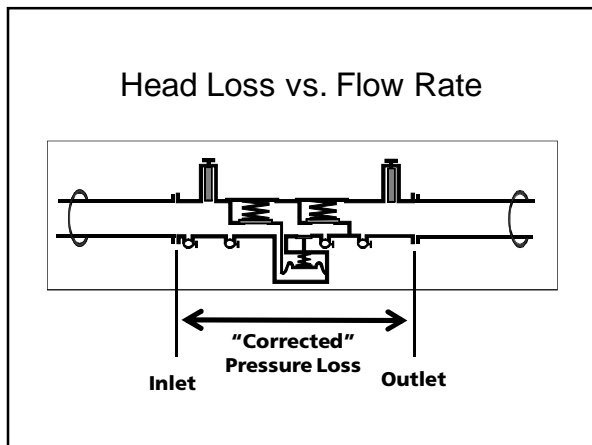
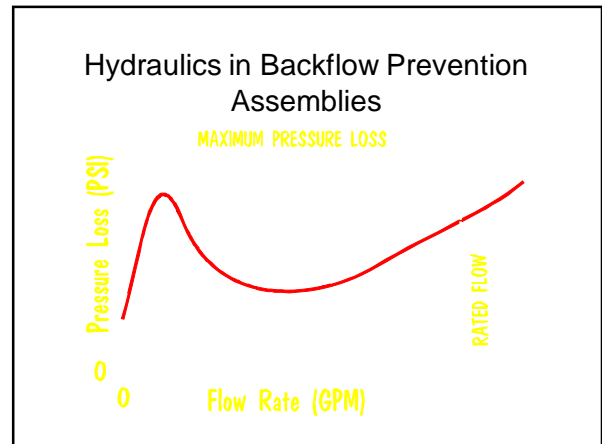
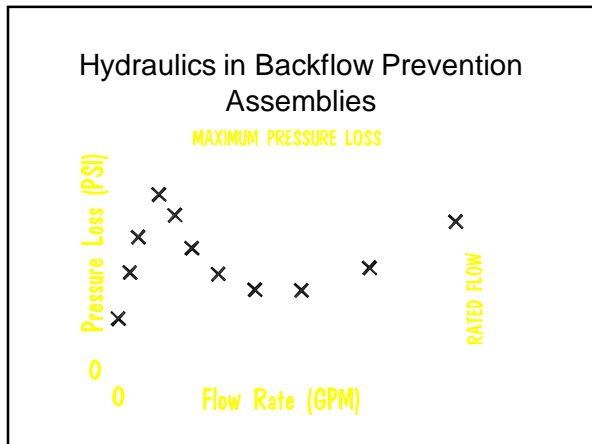
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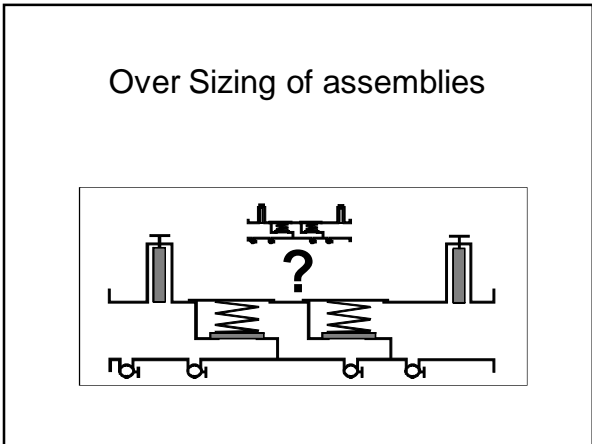


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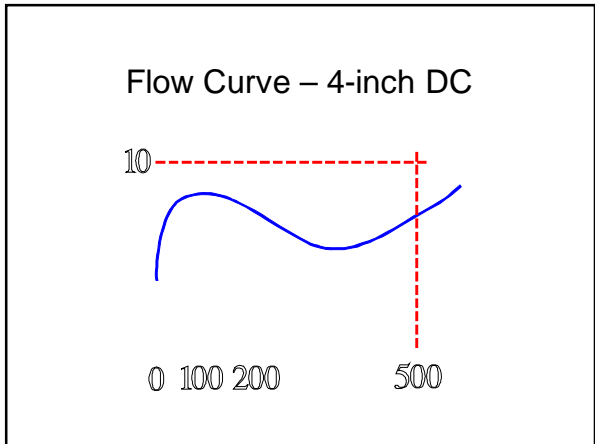
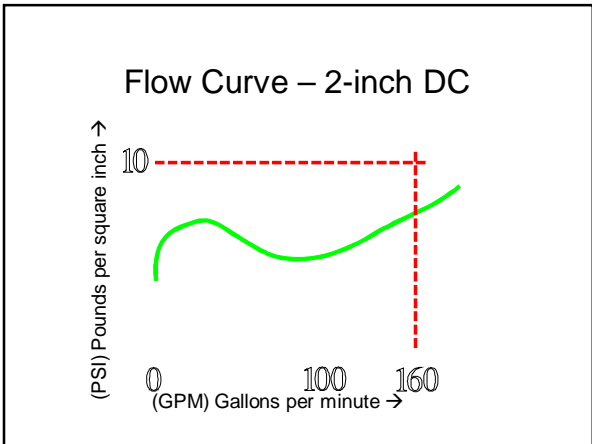
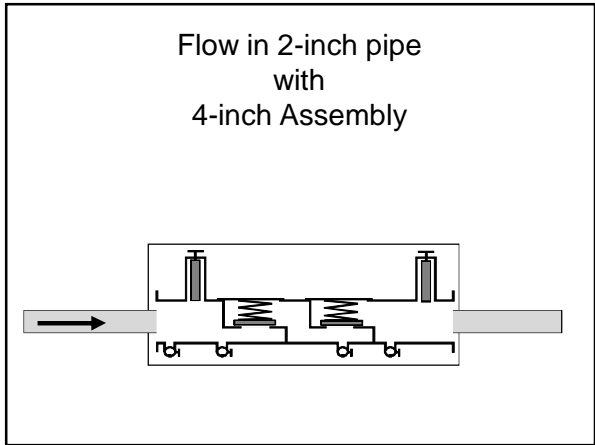
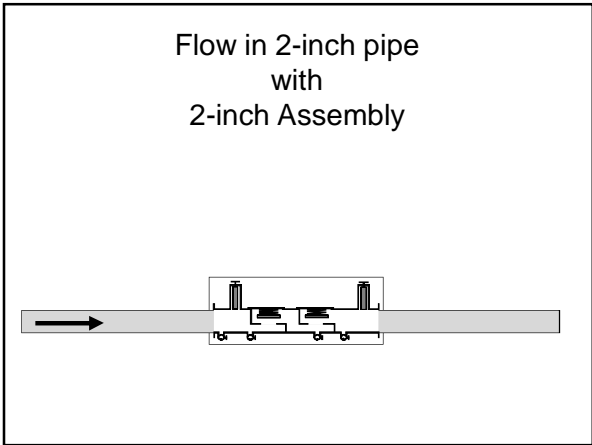


- Over sizing of Assemblies**
- Bigger means better?
 - Affects operation of assembly?

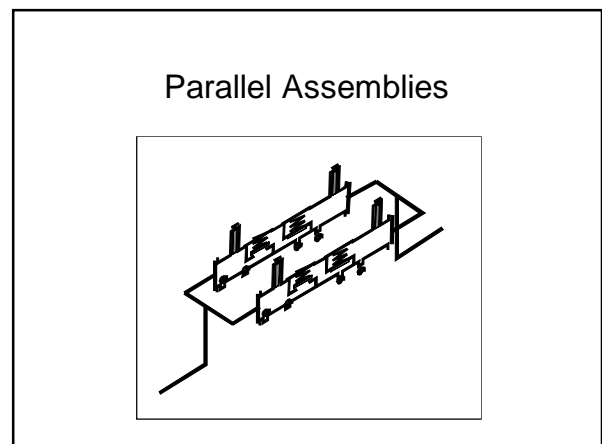
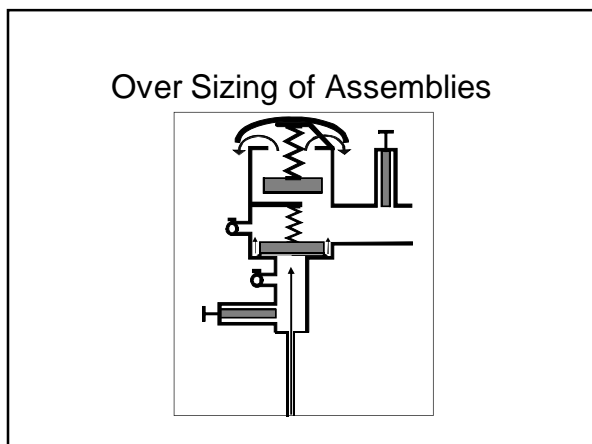
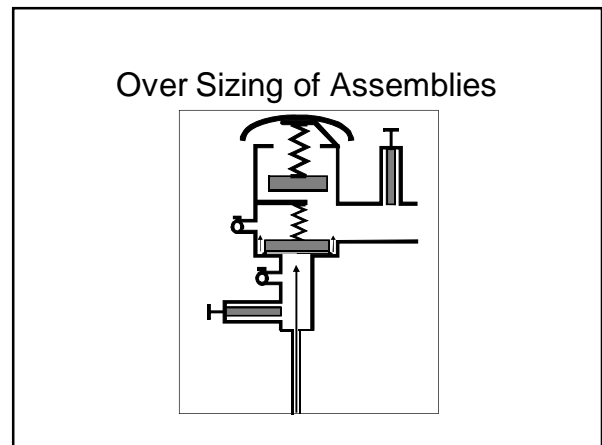
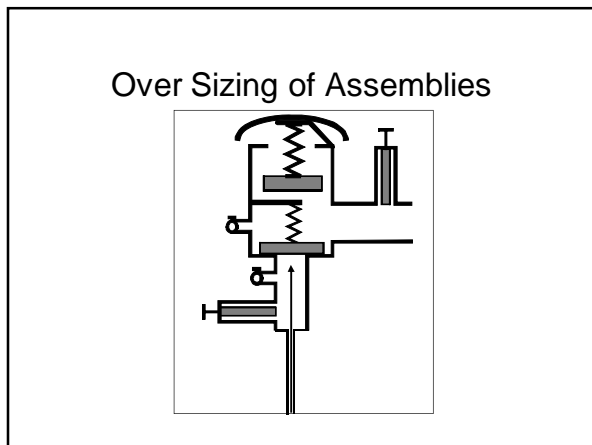
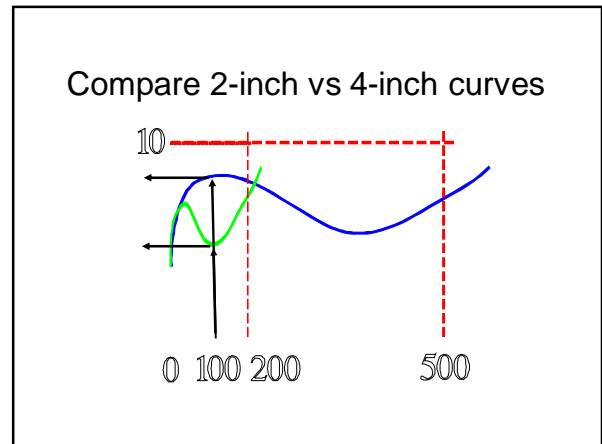
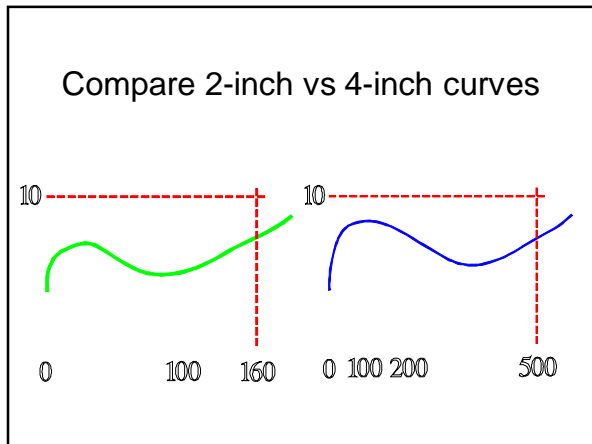
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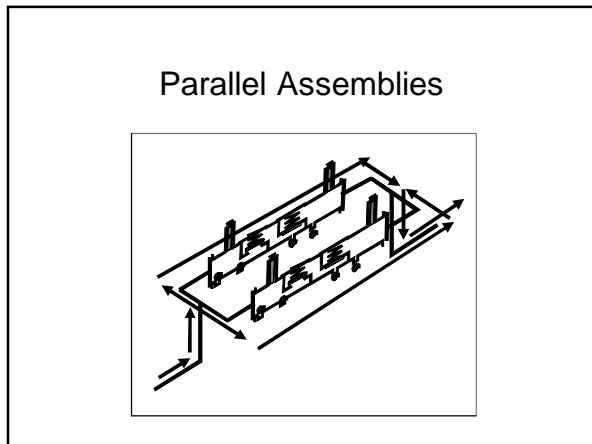
- Adequate flow and pressure?
- Oversize backflow preventer
 - Provide more water?
 - Provide more pressure?
 - Compare flow curves



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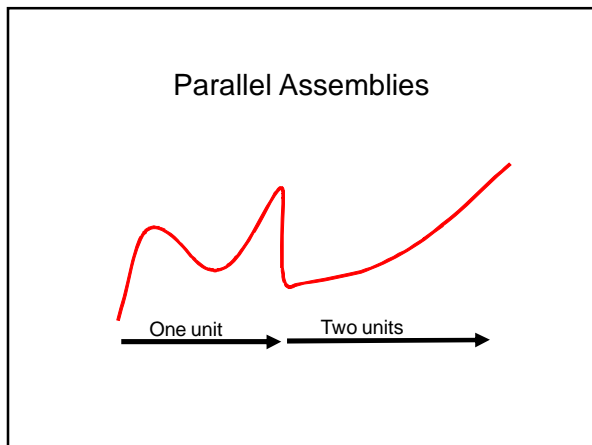


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Parallel Assemblies

- Operate independently
 - Primary
 - Secondary
- Path of least resistance
 - No two assemblies are identical
- Maintenance/Repair records may differ



Hydraulics

- Backflow and Backflow Prevention are all about Hydraulics
- Much more info can be covered
- Presentations
 - Size-up your audience appropriately
 - Don't assume they understand even the basic hydraulic issues about backflow

Manual - 10th Edition

- Chapter 3
 - Hydraulics
 - Properties of fluids
 - Principles of backflow
 - Operation of backflow preventers
 - Detailed operating characteristics of DC, RP, PVB, SVB
 - Head loss vs flow rate curves
 - Parallel installations

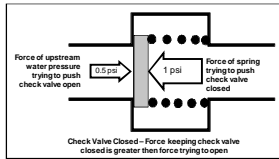
Chapter 3 - Hydraulics

- Properties of water

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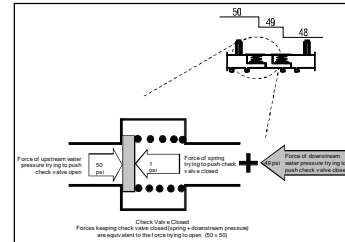
Chapter 3 - Hydraulics

- Operation of check valves



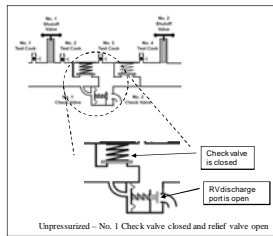
Chapter 3 - Hydraulics

- Operation of check valves



Chapter 3 - Hydraulics

- Operation of components in RP



QUESTIONS