

# DriscoPlex<sup>®</sup> HDPE Pipe Working Pressure Rating

- AWWA C906  
Working Pressure  
Rating
- AWWA C906  
Pressure Class



# Legal Disclaimer

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# Design Parameters

Design parameters for all water-distribution and transmission pipes (including HDPE) are:

- Steady working pressure (continuously applied)
- Intermittent or transient surges
- Operating temperature

AWWA **Working Pressure Rating** takes into account all of these factors incorporating both steady working pressure and surge pressure.

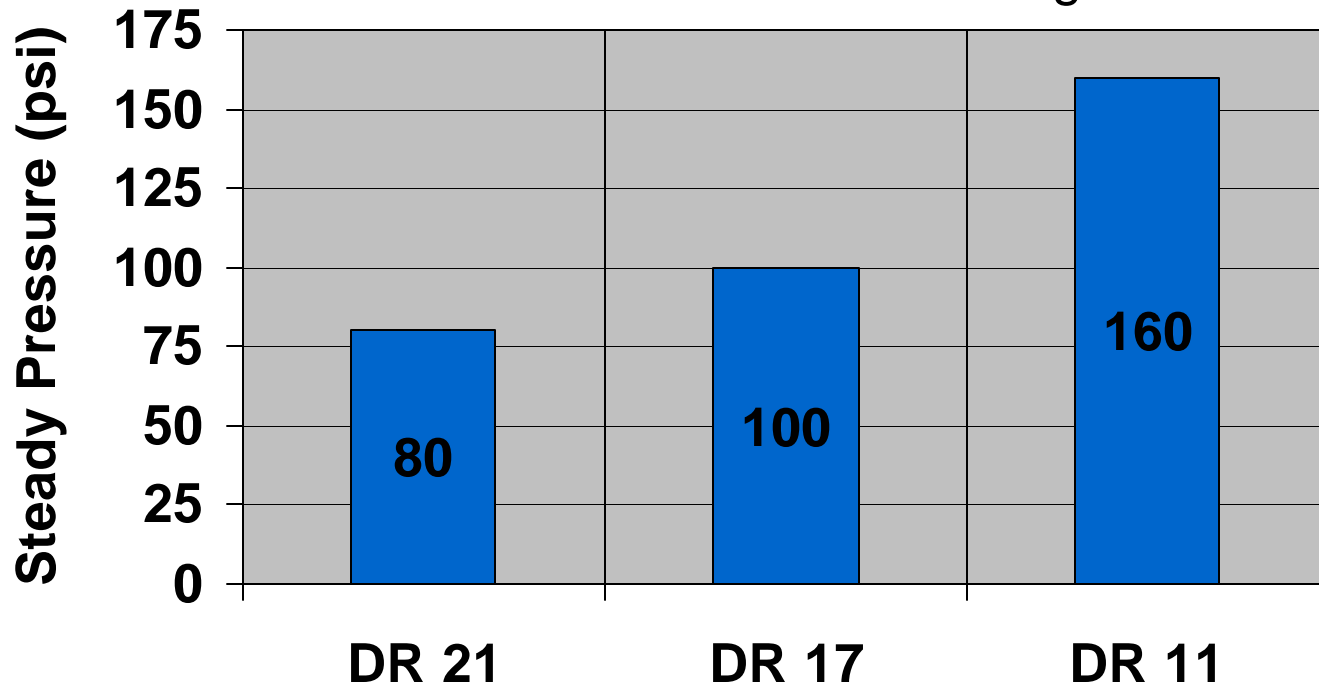
# Steady Pressure Rating

- For a given diameter, steady pressure is a function of the allowable hoop stress and pipe thickness.
- Obtain the allowable hoop stress (HDS)
  - testing plastic pipe at various internal pressures (ASTM D1598)
  - analyzing the test data
  - categorizing the result following the requirements and protocol of ASTM D2837 to obtain the long-term strength (HDB)
  - Apply a safety factor to the HDB to get the allowable hoop stress
- HDB for a standard PE3408 Material

Service Temperature	Hydrostatic Design Basis (HDB)
73°F	1600 psi
140°F	800 psi

# Steady Pressure Rating at 73°F

No consideration for surge



Pressure Class (PC) Value = Steady Pressure Rating

# AWWA C906 Surge Pressure Events

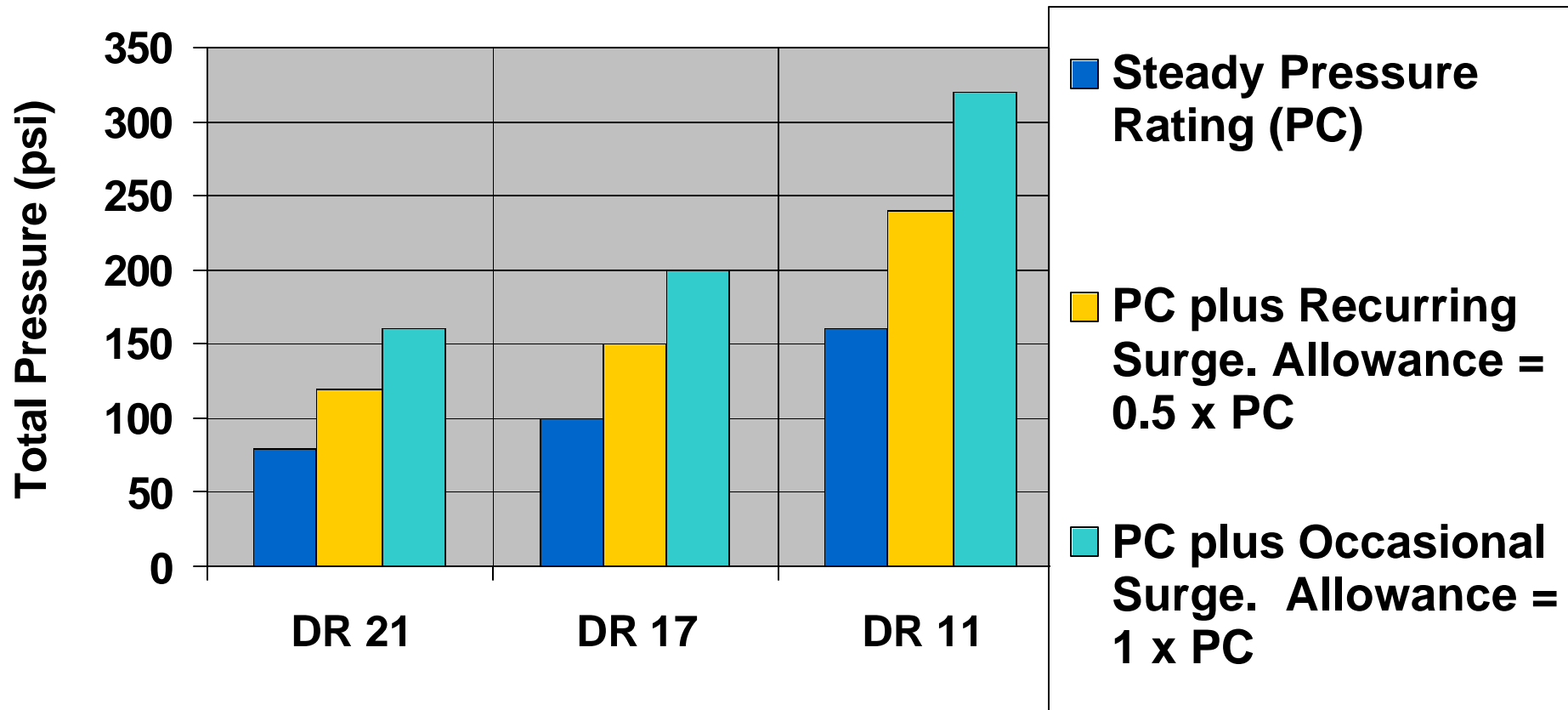
- Recurring Events
  - Normal system operation
  - Valve actuation, pump start/stop
- Occasional Event
  - Associated with system failure
  - Broken valve stem, power failure, pump seize



# HDPE Surge Allowance

- Unlike many other pipe materials, HDPE pipe can withstand repeated surge pressures above its steady pressure rating.
  - The strength of HDPE pipe increases with increasing rate of pressurization.
    - Higher capacity for surge pressure than for continuous pressure.
  - Excellent fatigue strength.
    - Pressure rating not reduced by repeated surges.

# Pressure Rating and Surge Allowance for HDPE



**Total Pressure = Surge Pressure Allowance + Steady (Working) Pressure**



# Surge Pressure Comparison

- **Compare:**

- 8” HDPE DR 17.0, PC = 100
- 8” PVC SDR 18.0, PC = 150
- 8” DI CL 50, PC = 350

- **Conditions:**

- Working Pressure = 100 psi
- Flow Velocity = 5 fps
- Fluid flow velocity changes to zero, instantaneously

# Surge Pressure Comparison

<b>Pipe</b>	<b>Pumping Pressure</b>	<b>Surge Pressure</b>	<b>Total Pressure</b>
	<b>(psi)</b>	<b>(psi)</b>	<b>(psi)</b>
<b>PE DR 17</b>	100	56	156
<b>PVC DR 18</b>	100	88	188
<b>DI CL 50</b>	100	268	368

# Working Pressure Rating vs. Pressure Class

## **AWWA C906 Working Pressure Rating (WPR)**

- A pipe's steady pressure rating at the design flow velocity (and temperature) of the specific project.
  - Equivalently, a pipe's ability to handle steady pressure and the project-specific surge pressure.

## **Pressure Class (PC)**

- A pipe's steady pressure rating with consideration for a predetermined surge.
  - HDPE - surge equal to 50%-100% of pressure rating
  - DI - 100 psi surge (approximately 2 fps flow velocity).
  - PVC C900 - surge resulting from 2 fps flow velocity

# Working Pressure Rating vs. Pressure Class

## **AWWA C906 Working Pressure Rating (WPR)**

- Use WPR for comparing different types of pipe.

## **Pressure Class(PC)**

- Pressure Class definition for each different product has different surge limit. Do not use for comparing products
  - HDPE - surge equal to 50%-100% of pressure rating
  - DI - 100 psi surge (approximately 2 fps flow velocity).
  - PVC C900 - surge resulting from 2 fps flow velocity

# Working Pressure Rating

- WPR establishes pipe's pressure capacity for the anticipated temperature and surge pressure.

# AWWA C906

## WPR Formula for HDPE Pipe

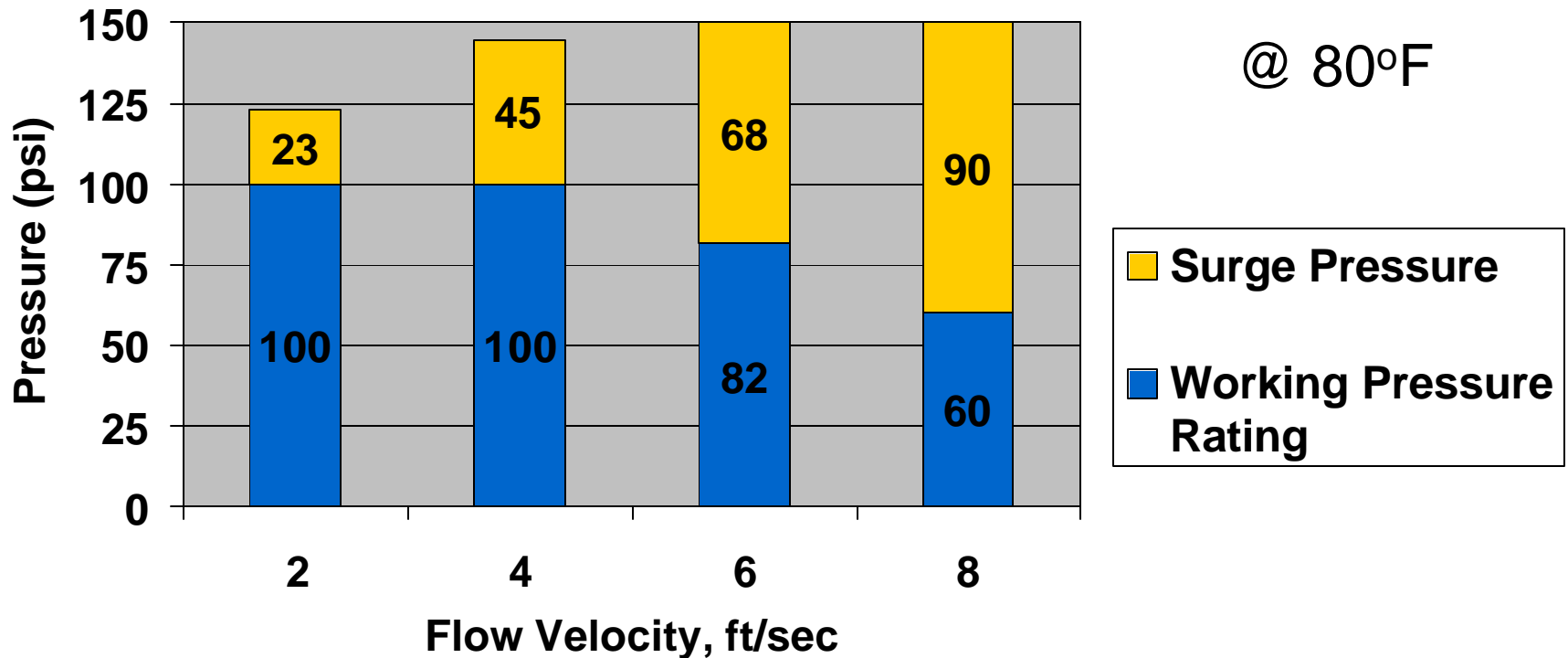
- For Recurring Surge Pressure  $\leq 0.5 PC$

$$\mathbf{WPR = PC}$$

- For Recurring Surge Pressure  $>0.5 PC$

$$\mathbf{WPR = 1.5 PC - Surge Pressure}$$

# AWWA C906 PC 100 (DR 17) HDPE Pipe



DR 17 HDPE pipe has a capacity for total pressure (surge plus working) of 150 psi. When the surge exceeds 50 psi, subtract surge pressure from 150 psi to get WPR. Note WPR cannot exceed PC of 100 psi. At 6 ft/sec, subtract 68 psi from 150 psi to get WPR of 82 psi.

# WPR Formula for Pressure Class PVC Pipe

- $WPR = PC - (V - 2 \text{ fps}) P_S$

Where:

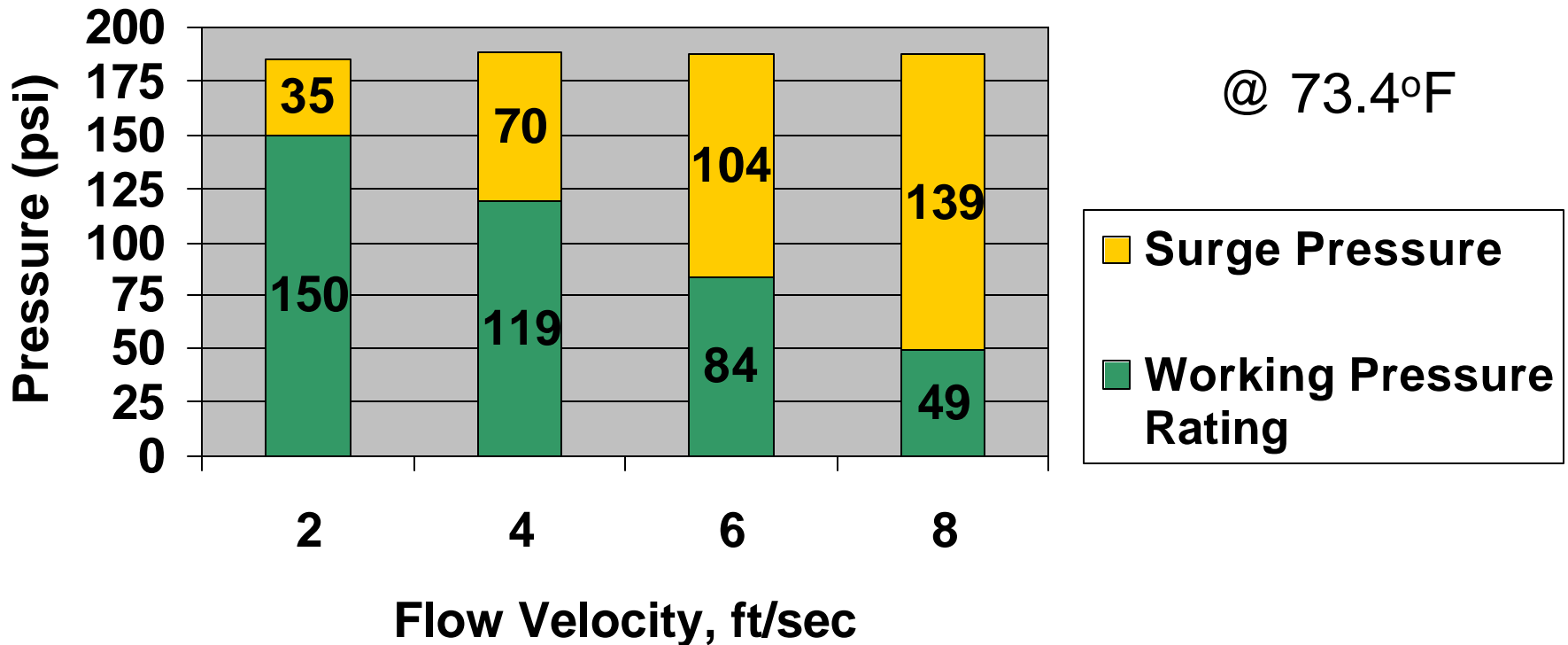
PC = Pressure Class

V = Flow Velocity, fps

$P_S$  = Pressure Surge @ 1 fps velocity change



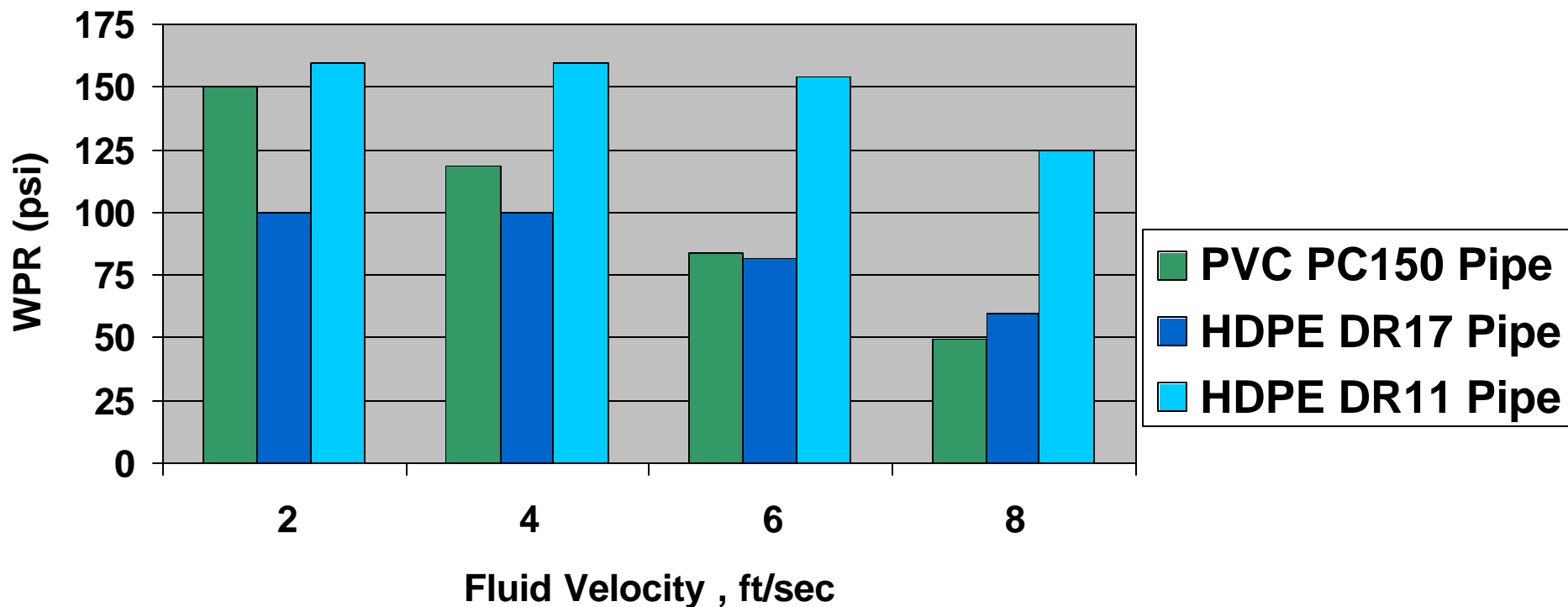
# AWWA C900 PC 150 (DR 18) PVC Pipe



Working Pressure Rating for PVC decreases with velocity faster than WPR for HDPE. At 80°F, derate PVC 12%.

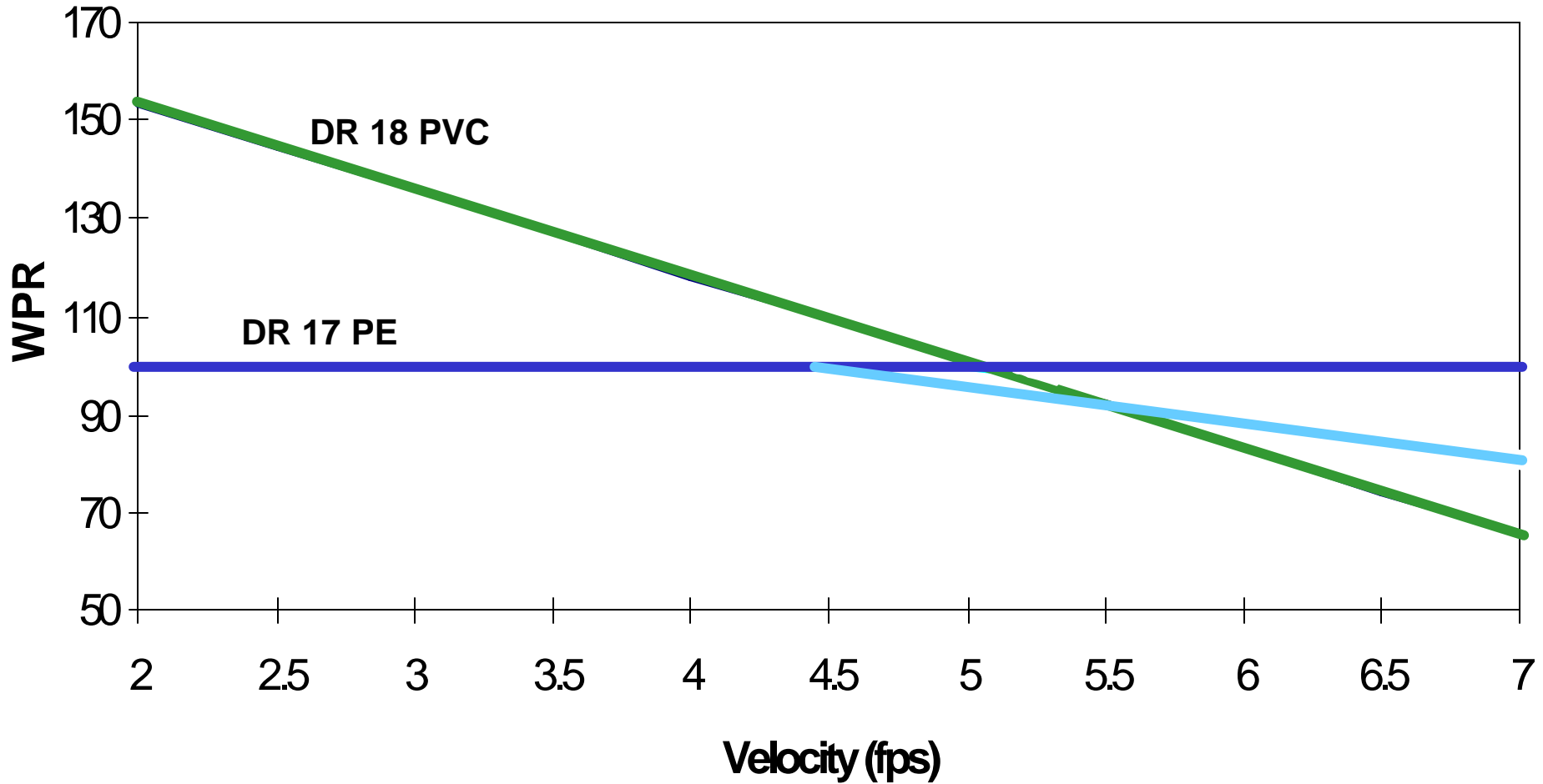
# Working Pressure Rating Comparison

## Working Pressure Rating (WPR)



For velocities  $\geq 4$  fps, HDPE DR17 pipe compares more favorable with PVC PC150 (DR18) than does HDPE DR11 pipe.

# Working Pressure Rating Comparison



# Working Pressure Rating Summary

- Do not compare pipe by PC. Use your expected surge, not a pre-defined value, to find WPR.
- Typically for distribution piping, HDPE can provide the same WPR as PVC with almost the same DR when actual system conditions are considered.
  - DR17 HDPE equivalent to DR18 PVC @ approx. 5 fps
- Working Pressure Rating (WPR) is a safe and effective method of designing pressure pipes.