**PACE**

**Pipeline Analysis & Calculation Environment**

**Pipe Selection**

- **PE Pipe Type:** PE4710 DIPS 10" DR17
- **DI Pipe Type:** DI DIPS 10" Thickness = 0.26"
- **PVC Pipe Type:** PVC12454-B CIOD 10" DR18

**Input Summary**

- **Pipeline Length:** 1000 ft
- **Design Velocity for Recurring Surge:** 4 ft/s
- **Design Velocity for Occasional Surge:** 8 ft/s
- **Anticipated Recurring Surges:** 55 per day
- **Temperature:** 57 degrees Fahrenheit
- **Working Pressure:** 70 psi
- **Minimum Design Life:** 100 years

**Calculated Results**

<table>
<thead>
<tr>
<th>Standard</th>
<th>AWWA-C906</th>
<th>AWWA-C151</th>
<th>AWWA-C900</th>
</tr>
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<tbody>
<tr>
<td>Resin</td>
<td>PE4710</td>
<td>DI</td>
<td>PVC12454-B</td>
</tr>
<tr>
<td>Pipe Rating at 57°F</td>
<td>125</td>
<td>350</td>
<td>235</td>
</tr>
<tr>
<td>Working Pressure (no surge) Check</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>Nominal OD [in]</td>
<td>DIPS 10</td>
<td>DIPS 10</td>
<td>CIOD 10</td>
</tr>
<tr>
<td>Dimension Ratio / Thickness</td>
<td>17</td>
<td>0.26</td>
<td>18</td>
</tr>
<tr>
<td>Average Inside Diameter [in]</td>
<td>9.72</td>
<td>10.46</td>
<td>9.79</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Head Loss [psi]</td>
<td>2.0</td>
<td>7.4</td>
<td>2.1</td>
<td>7.7</td>
<td>2.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Surge Pressure [psi]</td>
<td>45</td>
<td>90</td>
<td>204</td>
<td>408</td>
<td>70</td>
<td>139</td>
</tr>
<tr>
<td>Total Pressure [psi]</td>
<td>115</td>
<td>160</td>
<td>274</td>
<td>478</td>
<td>140</td>
<td>209</td>
</tr>
<tr>
<td>Allow. Total Press. (with surge) [psi]</td>
<td>188</td>
<td>250</td>
<td>450</td>
<td>450</td>
<td>235</td>
<td>376</td>
</tr>
<tr>
<td>Surge Pressure Check</td>
<td>OK</td>
<td>OK</td>
<td>x</td>
<td>OK</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>Number of Cycles To Failure</td>
<td>9.2 x 10^8</td>
<td>N/A</td>
<td>N/A</td>
<td>2.3 x 10^9</td>
<td></td>
<td></td>
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<tr>
<td>Design Fatigue Life [years; SF = 2]</td>
<td>&gt;100</td>
<td>N/A</td>
<td>N/A</td>
<td>58</td>
<td></td>
<td></td>
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<tr>
<td>Design Fatigue Life Check</td>
<td>OK</td>
<td>OK</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Design Parameters**

<table>
<thead>
<tr>
<th>Dynamic Elastic Modulus [psi]:</th>
<th>150,000</th>
<th>24,000,000</th>
<th>400,000</th>
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</thead>
<tbody>
<tr>
<td>Hydrostatic Design Stress [psi]:</td>
<td>1,000</td>
<td>N/A</td>
<td>2,000</td>
</tr>
<tr>
<td>Temperature Derating Factor:</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hazen-Williams Factor:</td>
<td>150</td>
<td>140</td>
<td>150</td>
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</tbody>
</table>
Calculation Procedures

- **PPI-PACE** is an online tool developed by eTrenchless Group Inc. that follows the design procedures in well-established and accepted water standards (ANSI/AWWA C150/151, ANSI/AWWA C900, ANSI/AWWA C901, ANSI/AWWA C905, ANSI/AWWA C906, ANSI/ASTM D2241).
- Per the recent AWWA and ANSI approvals of AWWA C906-15, the Hydrostatic Design Stress (HDS) of PE4710 is 1000 psi.
- Users can change the default values per project requirements.
- For **Recurring Surge**, PPI-PACE defaults to 4 fps for design velocity; the software allows for a 4-8 fps range.
- For **Occasional Surge**, PPI-PACE defaults to 8 fps for design velocity; the software allows for a 5-15 fps range.
- For **Working Pressure**, PPI-PACE defaults to 70 psi - which is the average working pressure in the US. The minimum allowable value in PPI-PACE is 40 psi.
- For **Anticipated Recurring Surges**, PPI-PACE defaults to 55 cycles per day per AWWA C900-07 and AWWA C905-10 (Appendix B/Design Example); this results in about 1 million cycles for a 50-year design life and about 2 million cycles for a 100-year design life. It was recommended by one consultant to design for 3.5 million cycles or 96 cycles per day at a 100-year design life. The minimum allowable value in PPI-PACE is the default 55 cycles/day.
- For **Temperature**, PPI-PACE defaults to 57°F which is the average water temperature in the US; the software allows 40-100°F; consult the manufacturer for other temperatures.
- For **Minimum Design Life**, PPI-PACE defaults to 100 years; the software allows a minimum recommended design life of 50 years.
- The definition of pressure rating and pressure class differ between the implemented standards (AWWA C900, AWWA C905, AWWA C906, ASTM F714, ASTM D2241). The calculations on this site, provided by eTrenchless Inc., provide an unbiased interpretation of these standards so that an equivalent comparison of pipe materials can be conducted.
- Temperature derating factors for PE pipe in AWWA-M55 are limited to 100°F with a reference to manufacturers literature for temperatures greater than 100°F. ASTM F714 (PE) and AWWA-M23 (PVC) publishes temperature derating factors up to 140°F but these higher temperatures are not included in this design tool.
- The design fatigue life for PVC is determined using the calculation method stated in AWWA C900 and C905 Appendix B using a 2:1 design factor. Data from tests with PE 4710 pipe are consistent with the UKWIR and Marshall/Brogden reports; see above reference and link to PP XVI Barcelona, 2012. For PE the design fatigue life is determined using fatigue curves provided in Marshall, G.P., Brogden, S: Final report of Pipeline Innovation Contract to UKWIR, 1997 using a 2:1 design factor. For additional information on fatigue life and flow velocities see the Jana Laboratories report here. The design fatigue life of Ductile Iron (DI) pipe is not shown in PPI-PACE since these calculations are not available or referenced in the DI AWWA Standards or Manuals.
- Pressure rating should be reduced for systems operating under special or unusual conditions or where the pipe transports fluids that are known to have some degrading effect on the properties of polyethylene or where specified in Codes or Regulations or by the authority having jurisdiction. Water is the assumed transport fluid on PPI-PACE.
- Occasional transients caused by emergency pump and valve operations are usually severe. The system should be designed to withstand positive and negative pressures caused by these emergency operations. Water column separation may occur if the negative pressure is reduced to the vapor pressure of the liquid. Rejoining of the separated water column typically results in a large pressure rise, which will possibly damage the pipe system. Whenever possible, water column separation should be avoided.
- These are preliminary calculations for product comparison only, not for final design. Qualified professionals should be contracted to consider all aspects of the design for pressure pipe design.

For more information contact support@ppipace.com
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This website is constructed to assist water distribution professionals in the selection of their product pipe by providing a pressure pipe design tool that is consistent with the existing standards. For polyethylene pipe, AWWA-M55 "PE Pipe - Design and Installation", ASTM F714-10 "Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter", AWWA C901-08 "AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) through 3 In. (76 mm), for Water Service", and AWWA C906-15 "AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks" are the applicable documents. For polyvinyl-chloride pipe (PVC), AWWA-M23 "PVC Pipe - Design and Installation", ANSI/AWWA C900-07 "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution", AWWA C905-10 "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm)", and ASTM D2241-05 "Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)" are the applicable documents. For ductile iron pipe (DI), AWWA-C150-14 "Thickness of Ductile Iron Pipe" and AWWA C151-09 "Ductile-Iron Pipe, Centrifugally Cast" are the applicable documents.

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Last Updated: May 15, 2015

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