

Polybutylene: To Bend or Not to Bend – That is the Question !

By PPN Editor



In the world of plumbing, the seemingly simple act of bending a plastic pipe has become a subject of debate and confusion. Many polybutene (PB) pipe manufacturers recommend a minimum bending radius of 10 times the pipe's outer diameter (OD), a “rule” that has become widely cited in installation guides. However, the origins and practicality of this guideline are increasingly being called into question.

The Elusive 10x Rule

While the 10x OD rule is commonly referenced, its origins remain unclear. More importantly, the practical application of this rule in real-world installations is dubious at best. Plumbers rarely work with precision measuring tools or protractors on job sites, making it nearly impossible to consistently achieve and verify a specific bending radius.

The Reality of Pipe Bending

In practice, bent pipes rarely conform to a uniform radius of curvature (i.e. a circle). Instead, the radius can vary significantly along the length of the bend, creating what mathematicians would call an eccentric curve. This eccentricity, with values between 0 and 1, makes accurate measurement of the bending radius a complex and time-consuming task that's impractical in most installation scenarios.

Regulatory Silence

Perhaps most puzzling is the absence of clear bending guidelines in official standards. The Australian Standard for PB pipes AS/NZS 2642 and the broader AS3500 plumbing standard are conspicuously silent on allowable bending values. If the bending radius is truly critical to PB pipe performance and longevity, one would expect such crucial information to be prominently featured in these regulatory documents.

Practical Considerations

While it's obvious that extreme bending leading to kinks in the pipe is unacceptable, the rigid adherence to a 10x OD rule may be very subjective. Plumbers have been successfully installing PB pipes for years, often relying on experience and judgment rather than strict numerical guidelines.

PB is Particularly Sensitive to Bending

The study by Fujii (2017) – ‘Durability Evaluation to Residual Chlorine on Plastic Pipes for Hot Water Supply’ found that bent polybutylene (PB) pipes cracked after just 50 months at 5 ppm in 90 °C, after 55 months at 10 ppm in 80 °C and after for 61 months at 5 ppm in 80 °C.

However only the bent polybutylene (PB) pipes with six times radius of the diameter of the pipe cracked while the bent polybutylene (PB) pipes with ten times radius of the diameter of the pipe at 80 °C did not crack. Notably bent crosslinked polyethylene pipes (PEX) bent at a radius of 6 or 10 times the pipe diameter in the chlorine solution immersion test did not crack at all even after for 65 months.

These findings show:

- PB pipes are very sensitive to bending radii when operated in hot chlorinated water and that they survive longer at bending levels of 10 times the pipe OD or greater
- PEX pipes are more tolerant to bending stress than PB pipes and even at tight bends of 6 times OD in hot chlorinated water they do not fail in less than 5 years.

The Way Forward

Rather than clinging to an arbitrary and difficult-to-implement rule, the industry would be better served by:

1. Conducting rigorous studies to determine the actual impact of various bending radii on PB pipe performance and longevity.
2. Developing practical, easily verifiable guidelines for PB pipe installation.
3. Updating official standards to include clear, evidence-based recommendations for PB pipe bending.
4. PB pipes can be extruded with a skin layer of a polymer containing *mechanophores* that changes colour when under strain (i.e. when bent or stretched). The colours then alert the installer or plumber to the level of strain on the pipe for instance with green being low 'safe' strain and red being the highest bending strain.

In the meantime, plumbers should continue to use their expertise to avoid extreme bends while maintaining efficient and effective PB pipe layouts. The question of "to bend or not to bend" may not have a simple answer, but with further research and practical guidelines, we can ensure that PB pipes are installed safely and effectively, without unnecessary constraints.

References

Fujii, T., et. al., *Proc. ANTEC 2017*, 1982-1988 (2017).