Technical Note PP 831-TN

PE4710 Pipe in Compressed Air or Compressed Gas Service

When compressed gases are to be conveyed in high-density polyethylene piping, the system designer must account for chemical and environmental effects, installation related effects and conditions, and other application-related limitations such as possible regulatory requirements.

Chemical Effects

Some gases such as argon, helium, methane, carbon dioxide and nitrogen have little or no known chemical effect on polyethylene. Other gases such as oxygen, oxygen in air, chlorine, fluorine and bromine can impair polyethylene to varying levels of severity by oxidizing or directly attacking the material. Further, when compressed gases are combined with other gases or vapors, deleterious effects from the combination may occur. For example, chemicals such as vapors from compressor oils that may be present in compressed air or other compressed gases can deposit and liquefy on the pipe surface and reduce material strength by chemical solvation. Overall chemical effects will vary depending upon the aggressiveness of the chemical gas and possible combinations with other chemicals and vapors. Chemical effects are increased by higher applied stress (higher internal pressure) and by increased service temperature. **Degrading chemical effects act to reduce service life, and in some cases, service life can be severely compromised.** Polyethylene pipe may not be suitable for use with some aggressive gases, especially in combination with some chemical vapors.

Installation

The system designer must address the mechanical safety aspects of compressed gas piping installations. The installation must not expose the pipeline to significant impact or possible mechanical damage, particularly in very cold conditions.
Underground installation is recommended. When properly buried, the pipe is restrained against movement and protected against most potential sources of mechanical damage. Underground installations should comply with ASTM D 2774, and be buried below grade at least 12” or one pipe diameter whichever is greater.

Surface or above grade installations require special precautions to protect the pipe against mechanical damage.

WARNINGS:

- **Severe mechanical damage can puncture HDPE pipe, and in some cases smaller pipe or tubing can be severed. If an unrestrained, pressurized HDPE line is severed, it can whip around and cause property damage or injury or death to persons.**
- **Significant impact under extreme cold conditions can shatter pressurized PE piping. Escaping gas can propel pipe fragments that can present a hazard of injury or death to persons.**
- **Where surface or above-grade PE compressed gas piping may be subject to extreme cold and the potential for mechanical impact, the piping must be installed so that the line is restrained and the risk of mechanical damage is minimized.**

Appropriate installation measures for surface or above grade pressurized gas piping can include:

- Continuous encasement in a shatter-resistant casing or enclosure;
- Frequent clamps or anchors; and
- Routing the pipe "out of harm's way", so that little or no possibility of external mechanical damage exists.

Polyethylene piping for transporting or distributing fuel gases such as natural gas, propane, butane, LP gas or landfill gas must be installed and operated in accordance with applicable Federal, State and Local regulations.

Internal Pressure

PE 4710 HDPE pipe is rated for internal pressure as follows:

$$P = \frac{2(HDB) f_E f_T}{(DR\text{-}1)}$$

Where P = internal pressure rating, lb/in^2
HDB = hydrostatic design basis at 73°F, lb/in^2 (1600 lb/in^2 for PE 4710)
f_E = environmental design factor
f_T = service temperature design factor
DR = pipe dimension ratio

$$DR = \frac{OD}{t}$$

OD = pipe outside diameter, in
t = pipe minimum wall thickness, in

The environmental design factor, f_E, addresses chemical effects. The service temperature design factor, f_T, addresses thermal effects for suitable dry, oil-free gases. The designer should determine appropriate design factor values for the application. Some values are presented below, however, other values may be appropriate depending upon chemical and application conditions. ***CAUTION - Compressed air or oxygen service at elevated temperatures is not recommended.***

Environmental Design Factor, f_E	
≤ 0.63	Suitable dry, oil-free gases
≤ 0.32	Clean, dry, oil-free gases having mild oxidizing effects (air, oxygen, et.) at 73° F or below
≤ 0.25	Gases having mild oxidizing effects (air, oxygen, etc.) that contain solvating or permeating chemical vapors (lubricants, solvents, etc.) at 73° F or below

Temperature Design Factor for PE 4710 for suitable dry, oil-free gas only, f_T					
Temperature	60° F	73° F	100° F	120° F	140°F
f_T	1.08	1.00	0.78	0.63	0.50

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