

HIGH-PRESSURE FLEXIBLE PIPE

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Until recently, most piping for natural gas applications has been either conventional steel line pipe for high-pressure applications or polyethylene (“poly”) pipe for low-pressure applications. New high-pressure flexible piping systems can provide the pressure capabilities of steel pipe with the installation ease and corrosion resistance of poly pipe, at a reduced cost.

A flexible high-pressure pipe system consists of concentric layers of thermoplastic (inner and outer layers) and a core of reinforcing material (steel or fiber). The pressure rating is derived from the strength of the reinforcing material, with the inner and outer layers providing corrosion and abrasion resistance. In the case of a steel reinforcing system, flexibility is obtained by using multiple layers of helically-wrapped steel, which is left unbonded to the thermoplastic layers.

The advantages of these systems are as follows:

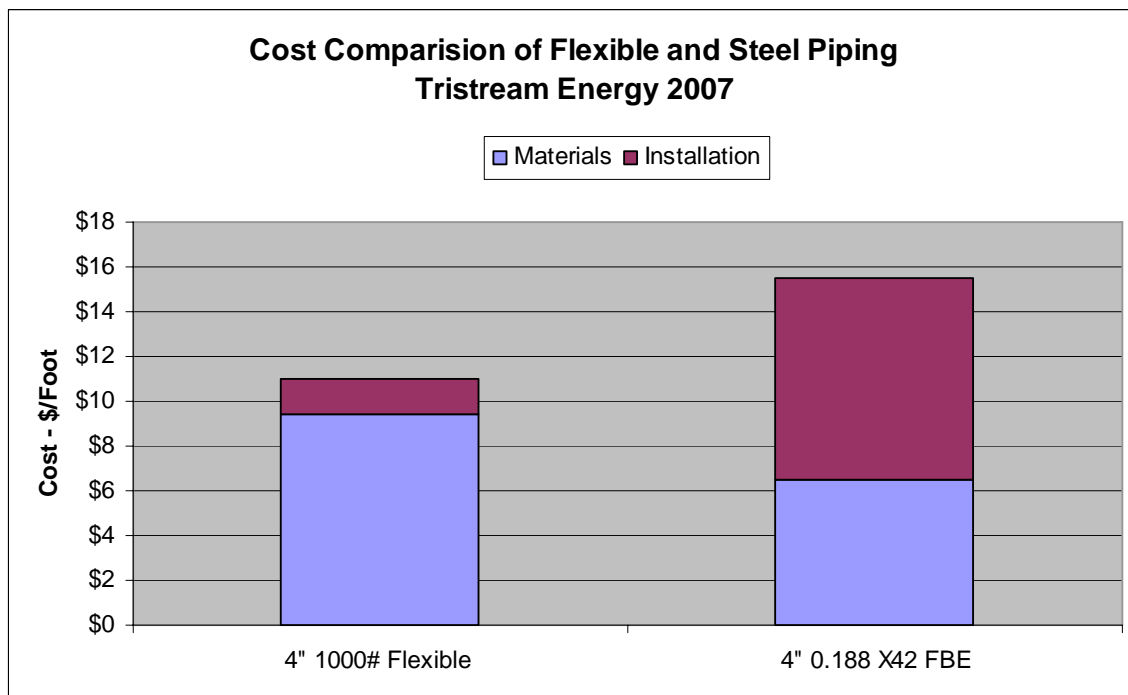
- Fewer joints: Pipe is delivered on spools over 8,000 feet long for 2-inch pipe, and over 2800 feet for 4-inch pipe. Conventional line pipe is typically 40 feet long. By having far fewer welds, flexible piping can be installed quickly, resulting in much lower installation cost.
- Easier installation: Due to the spool length and strength of the material, these products can be “plowed” into place, often avoiding conventional trenching.
- Environmental: Plowing in place reduces the environmental impact of the installation and may reduce right-of-way width requirements.
- Salvage opportunity: The ability to respool used pipe can provide the option of retrieval and reuse in another location.
- Corrosion and abrasion resistance: The inner and outer layers are much thicker (over 1/8 inch) than a conventional “coating” and will provide superior corrosion and abrasion resistance compared to coated steel.
- The protective thermoplastic jacket may avert the need for cathodic protection.
- Low-flow resistance: The inner layer has a lower surface roughness than steel; this increases flow efficiency and tends to reduce debris buildup.

Some of the new flexible piping systems were originally developed for offshore oil and gas applications, where the operating conditions can be quite severe. Flexible piping for onshore use is currently available in 2”, 3”, 4”, and 6” sizes, at pressure ratings up to 2250 psi. Special versions with high (20 year) UV resistance are available for above-ground installations. Fluid compatibility is excellent with sweet natural gas streams, and

these systems can also be placed in limited sour gas service where carbon dioxide and hydrogen sulfide are present.

Joining of the piping is accomplished with swaged end fittings that are applied to each end of the pipe spool using a hydraulic ram. Each end fitting consists of a body and a jacket that are welded together by the manufacturer. The body is a steel tube that fits inside the pipe. The jacket is a concentric steel pipe that fits outside the pipe. These fittings are available in carbon steel or stainless steel, with either attached flanges or weld stubs used to join the spools together.

The cost for flexible piping materials (including pipe and stainless steel weld end fittings) is higher than for steel pipe, but installation is typically far lower, resulting in a lower total cost:



It is important to keep the following considerations in mind when considering the use of flexible high pressure piping systems:

- Flexible high pressure piping systems are ideally suited for rural high pressure gathering systems due to their lower installed cost and superior corrosion resistance.
- They are also ideal for “temporary” above-ground gathering systems where a producer may wish to perform long-term (multi-month) flow tests on a new development before committing to a large permanent gathering system. If the wells are not successful, the pipe can be retrieved easily, resulting in reduced pipeline “dry-hole” costs.

- They are not suitable for some submerged applications. The reinforcing material provides tremendous strength against internal pressure but only limited collapse resistance from external water pressure.
- As a new technology, these products do not yet fit the definitions of piping recognized DOT regulations (49 CFR Part 192). Therefore, the use of these products in a transmission pipeline would require approval from the DOT and the appropriate state regulatory agency (Texas Railroad Commission, Louisiana Department of Natural Resources, etc.). We believe that the offshore pedigree of these systems and their onshore non-regulated performance should provide ample data for the regulatory agencies to look favorably upon a waiver request.