Raise the bar on polyethylene pipe performance
Is your pipeline infrastructure cracking and crumbling beneath your feet? City, county, and state governments across the U.S. are deciding on strategies to replace their rapidly deteriorating pipelines. The good news is the most important decision to be made – choosing the best pipe material – is also the easiest.

Longer life. Improved durability. Virtually no leaks.

These characteristics are not only desirable in a pipeline system, they are critical for exceptional pipeline performance. CONTINUUM™ Polyethylene Resins from Dow meet or exceed a range of performance requirements for both ASTM PE4710 and ISO PE100 standards.

CONTINUUM resins can enhance the efficiency, durability, and integrity of your pipe system, while offering an opportunity for reduced material, installation, operating, and maintenance costs.

Bottom line: CONTINUUM resins can differentiate a pipe system and offer municipalities the potential to realize lower total life cycle costs.
Why polyethylene?

The fast rise of polyethylene pipe installations can be attributed to the many advantages it delivers over traditional materials like steel, ductile iron, concrete, clay, and PVC:


Polyethylene has continued to provide easy, worry-free handling and installation and resistance to a wide variety of harsh materials. It can also offer excellent resistance to slow crack growth (SCG) and rapid crack propagation (RCP) – all critical properties to potentially save time and money and improve the life expectancy of a pipeline system.

2. Virtually no leaks – one continuous homogenous system

Pipe made with polyethylene can be fused together to provide a continuous length of virtually leak-free pipe. Polyethylene pipe does not require mechanical fittings or gaskets, which may corrode or leak over the lifetime of the pipeline.

3. Lightweight and flexible

Because of its light weight, polyethylene pipes are easier to handle than concrete and steel, and a greater number of pipe lengths can be transported at once, reducing transportation costs. The flexibility of polyethylene pipe allows smaller diameter pipes to be coiled, which also improves handling and transportation efficiency.

In addition, hills and valleys are less of a concern during installation, because polyethylene pipe can follow the curves of the land. This minimizes the use of fittings and makes for a much more economical and efficient installation process. And, polyethylene is ideal for trenchless installation methods. Its flexibility allows for smaller entry pits, creating minimal social disruption.1

4. Chemical and corrosion resistance

Polyethylene can resist some of the harshest materials and environmental factors. From abrasive slurries; to corrosive acids, bases, and salts; to fungi occurring in the most aggressive soils, polyethylene outlasts more costly, traditional materials.

5. Excellent hydraulic properties

Pipe extruded from polyethylene offers smoother surfaces than traditional materials, allowing for the potential to transport larger volumes of liquid with less drag and turbulence at high flow rates, and a greater resistance to scaling and biological buildup commonly found in pipes made from concrete, ductile iron, and steel. These excellent hydraulic fluid flow properties last throughout the lifetime of the pipeline.

6. Low thermal conductivity

Polyethylene makes it possible to maintain more uniform temperatures throughout the pipeline system – greatly reducing the need for insulation and allowing for consistent performance.

7. Temperature range benefit

Depending on the type of material used, polyethylene can also offer performance in a wide temperature range, while maintaining its SCG and RCP resistance properties.
CONTINUUM™ Resins – a higher standard for pressure pipe applications

Dow’s 25-plus years selling resins in the pipe industry and its unique, advanced technology has yielded an industry-leading family of polyethylene resins for pressure pipe, suitable for natural gas distribution pipes, industrial piping, mining, sewage, and municipal water service lines:

- CONTINUUM™ DGDC-2480 Polyethylene Resin
  - HDPE resin
  - Meets or exceeds ASTM PE4710 and ISO PE80 standards
- CONTINUUM™ DGDA-2490 Polyethylene Resin
  - HDPE resin
  - Meets or exceeds both ASTM PE4710 and ISO PE100 standards
  - Used for wall thicknesses up to 2 inches
- CONTINUUM™ DGDA-2492 Polyethylene Resin
  - HDPE resin
  - Meets or exceeds both ASTM PE4710 and ISO PE100 standards
  - Used for heavy wall pipe up to 4 inches thick

Advanced process technology

CONTINUUM™ Polyethylene Resins for PE4710/PE100 pipe are bimodal resins produced using UNIPOL™ II Process Technology, Dow’s dual reactor, gas phase process. Compared to traditional unimodal technology, bimodal technology provides increased resin design flexibility and yields materials with an even broader range of molecular weight distribution and a wider window of high performance characteristics.

Expanded operating windows

Elevated temperature and pressure ratings

High elevated temperature ratings are important to a pipeline system due to the extreme temperature changes a pipeline must endure. From night to day, winter to summer, Alaska to Texas, pipelines must perform in a wide range of conditions.

A Maximum Operating Pressure (MOP) can be determined for a pipeline at various temperatures using HDB or MRS ratings. CONTINUUM DGDA-2490 resin was the first ISO PE100 pipe material produced in North America to be listed with a 100-year rating1 at 20°C (68°F) by the Plastics Pipe Institute (PPI). It was also given a 90-year rating2 at 40°C (104°F) and an 11-year rating2 at 60°C (140°F), making it the first PE100 resin to be listed at elevated temperatures.

Figure 1 illustrates how pipe made with a PE100-grade resin (or the comparable ASTM standard PE4710-grade resin) can be operated at much higher pressures when compared to current ASTM PE3408 materials in water pipe.

The potential to operate at higher pressure provides increased end-use flexibility. By using CONTINUUM Polyethylene Resins for PE4710/PE100 pipe, you may choose to increase pressure, thereby increasing throughput efficiency. Or, you may decide to maintain the same pressure and use a thinner wall thickness for an increased inside diameter and potential material savings.

Figure 1: Comparison of maximum operating pressure ratings for SDR 11 pipe

Figure 2: Comparison of resistance to slow crack growth

\[^1\] PPI TR-4 100-year pressure rating at 20°C MRS 10.0 using ISO 9080
\[^2\] PPI TR-4
\[^3\] ISO 4427 pressure rating

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**Tough and durable**

**Long life expectancy**

There are many factors that determine a pipeline’s life expectancy. One of the most important measurements is resistance to Slow Crack Growth (SCG). SCG is a pipe failure resulting from defects or damage to the pipe that can occur during manufacturing, shipping, installation, or service, and it is the most common failure mechanism of polyethylene pipe. Both ASTM and ISO standards require SCG resistance data.

As illustrated in Figure 2, at a nominal stress of 2.4 MPa (350 psi), CONTINUUM™ DGDA-2490 and DGDA-2492 resins offer greater than 10,000 hours for the Pennsylvania Notch Test (PENT), compared to the ASTM D2513 requirement of only 100 hours for natural gas pipe and the D3035 requirement of a mere 10 hours for water pipe. That’s more than 100 and 1,000 times longer, respectively, than materials meeting the minimum ASTM standards for natural gas and water pipe. CONTINUUM DGDC-2480 Bimodal Polyethylene Resin achieves >4,000 hours for the PENT or >40 times that of the minimum ASTM D2513 requirement.

**Impact and scratch resistance**

No matter how well a resin can perform under normal or even extreme conditions, such as temperature and internal pressure, the resin, when properly extruded, must also be able to withstand certain uncontrollable external impacts.

In addition to the excellent scratch resistance, CONTINUUM Polyethylene Resins also offer excellent resistance to Rapid Crack Propagation (RCP). RCP is a catastrophic pipe failure which can happen to pipe made from any material and is caused by third-party impact (initiated by digging equipment, extreme load, etc.). RCP failure is rare, but when it does occur, a crack can move (propagate) at speeds up to 984 feet (300 meters) per second.

ASTM standards do not make provisions for such an occurrence. ISO standards, on the other hand, require specific RCP test data be gathered before certification can be completed. CONTINUUM DGDC-2480, DGDA-2490, and DGDA-2492 resins are at least three times more resistant to RCP than the most demanding ISO PE100 requirements and lessens the risk of RCP failure at temperatures above -17°C (~0°F).

See Figure 3.

**A virtually leak-free system**

Two lengths of polyethylene pipe can be joined by heat fusion to form a continuous, virtually leak-free pipeline system. The quality of the fusion joint is critical to the integrity of the pipeline and, when fused properly, is actually stronger than the pipe itself due to the extra material at the joint. In terms of cross-fusion between PE100 or PE4710 and PE3408 materials, CONTINUUM resins offer a similar flow index to unimodal PE3408 resins for high quality joints. Tests conducted by third-party industry professionals have demonstrated high-quality, cross-fusion joints (using the DOT generic butt fusion procedure as documented in PPI Technical Report 33).

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Figure 3: RCP-free zone of operation

![Figure 3: RCP-free zone of operation](image)

1 MOP using ISO 4437 pressure rating

CONTINUUM™ Polyethylene Resins offer outstanding lifetimes and world-class integrity for a range of pressure pipe applications, including natural gas distribution and potable water.

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**Trend watch**

**Natural gas pipe**
- Over the last 40 years, polyethylene has grown to dominate gas distribution piping, accounting for greater than 95% of all new installations.
- PE100 resins have dramatically changed natural gas pipe in Europe over the last 15 years. And, demand continues to grow in North America for PE4710 resins, as pipe specifiers strive for increased durability, integrity, and lower life cycle costs in natural gas pipelines.

**Water pipe**
- Every day in the U.S., more than 2.45 billion gallons of treated drinking water are lost due to leaking pipelines.¹ That’s enough water to fill 3,780 Olympic-size swimming pools² or the amount of water that flows over Niagara Falls every 27 minutes.³
- Over the next 20 years, an expected $662 billion dollars will be spent on replacing the aging and failing water and wastewater pipe infrastructure.⁴
- Cities big and small across the country are realizing the advantages of polyethylene pipe and are specifying these materials for new pipeline systems and rehabilitating failing pipelines.

**Lower overall life cycle costs**
Some life cycle costs will be almost immediate, and some will be realized over time. PE4710/PE100 resins and, more specifically, CONTINUUM™ Polyethylene Resins for PE4710/PE100 pipe can deliver both. This adds up to greater total savings compared to traditional materials, including:

**Pipeline savings**
- Down gauging can potentially save material and energy costs during pipe production and allows for an increased inside diameter, which raises the transport capacity of the pipeline.

**Installation savings**
- Polyethylene pipe is lighter and therefore easier and less expensive to handle and transport.
- Its excellent scratch, impact, and abuse resistance also contribute to a more trouble-free installation, with lower rejects due to abuse or damage (assuming good installation practices are followed).
- Due to the outstanding resistance to slow crack growth; improved tensile strength and modulus; and flexibility, pipe made with CONTINUUM resins offer significant installation advantages utilizing a variety of low-cost trenchless rehabilitation techniques – pipe bursting, horizontal directional drilling, slip lining, and others.

**Reduced maintenance**
- After installation, a pipeline made with CONTINUUM resins gives infrastructure owners confidence the pipeline will need minimal repairs throughout its lifetime, due to the excellent resistance to RCP; exceptional resistance to SCG; low temperature toughness; chemical, corrosion, and abrasion resistance; and fused joint integrity.
- All of these resin characteristics, along with the first-ever 100-year PPI listing, also means that pipes made with CONTINUUM DGDA-2490 and DGDA-2492 resins have a much longer life expectancy than pipe made with many traditional materials.

¹ AWWA
² Based on 648,000 gallons in one Olympic swimming pool
³ Based on an estimated 1.5 million gallons of water per second flowing over Niagara Falls

**The PPI TR-33 generic butt fusion procedure can be performed on site, forming joints that are actually stronger than any other point along the pipe and providing one continuous, virtually leak-free system.**

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In 2004, Public Service Electric & Gas Company (PSE&G) and New Jersey Natural Gas began a major natural gas pipeline installation using pipe made with CONTINUUM™ DGDA-2490 Polyethylene Resin.

Experts with answers when you need them

Dow continues its quest to be your best plastics supplier for pipe – best in products and best in service. With 19 polyethylene manufacturing sites worldwide; the world’s largest ethylene capacity; and feedstock flexibility, pipe manufacturers can be confident that Dow will do its very best to deliver product – on time, anywhere.

For more information on Dow resins for pipe, including the ASTM PE4710 and ISO PE100 polyethylene resins discussed here, contact your Dow representative. And, visit www.dowplastics.com.

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