

Borealis PE-X pipe solutions

Exceptional performance for a competitive edge



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Reliable and committed industry leader with a global reach

Global population growth and aging infrastructure have increased the need for durable, dependable, and sustainable plumbing and heating pipe systems. As a leading global innovator with a track record of over 50 years in the industry, Borealis offers breakthrough polyolefin solutions that have revolutionized the piping sector. Our high-performance resins are based on proprietary technologies and offer unparalleled production efficiency, ease of installation, and peace of mind to end users. Our collaboration with Borouge, a joint venture with the Abu Dhabi National Oil Company (ADNOC), enables us to supply a broad portfolio of high-performance resins for the full range of pipe applications to customers around the world from our state-of-the-art, ISO 9001-qualified production facilities.

The Borealis hot and cold water resin family consists of two main product groups: polyethylene for crosslinked polyethylene (PE-X) pipe production, and polypropylene for PP-RCT pipe and fitting production.

Designation	Crosslink Technology
PE-Xa	Peroxide crosslinking
PE-Xb	Silane crosslinking
PE-Xc	Irradiation crosslinking
PE-Xe	UV crosslinking

Table 1: Industry Designations according to Crosslinking Technology

PE-X pipe production

Crosslinked polyethylene, or PE-X, results from the chemical or physical joining of individual polyethylene (PE) molecules to produce a matrix of interconnected molecules. PE-X pipe is typically produced using one of three primary crosslinking technologies: peroxide, silane, and irradiation. More recently, crosslinking with ultraviolet (UV) radiation has entered the pipe market.

When properly produced using one of these primary methods, PE-X pipes offer exceptional toughness, durability, and temperature resistance, providing long-term serviceability in hot and cold water applications. PE-X pipes are deployed widely in both residential and commercial construction, and also in industrial applications, thanks to their inherent flexibility, ease of installation, and overall cost-effectiveness.

PE-X pipe and tubing can be used across a very broad range of service conditions. Applications include hot and cold potable water distribution, hot water recirculation systems, hydronic heating systems, snow and ice removal, and district heating. Moreover, larger diameter PE-X pipes have also been utilized for demanding industrial applications in especially aggressive conditions (environmental, service temperature, wear, types of fluids etc.) in oil and gas, chemical industry, and mining.



Tailored solutions for PE-X pipe production

Each production technology requires specific resin types and pipe manufacturing equipment and the pipe manufacturer typically choose the most suitable method to meet their production needs and budgets.

Borealis has developed a family of PE resins for PE-X pipe production that is suitable for the most widely used PE-X production technologies. Our selection of PE-Xa natural powder grades are designed for efficient and cost-effective processing with different technologies. Moreover, they provide the highest flexibility for the customer to combine our resins with individual additive packages and crosslinking agents. This allows the pipe producer to design tailored recipes and to optimize the pipe performance according to specific application needs. Our PE-Xa mini-pellet is a natural fully formulated ready-made compound with listed formulation which enables quick commercialization of pipes in the US plumbing market. Finally, our fully formulated ready-made natural PE-Xc compound in pellet form allows high quality pipe extrusion and already includes a stabilizer package which is optimized for maximum effectiveness of the electron irradiation process. All Borealis PE-X-grade resins are designed to meet the performance requirements of EN ISO 15875, ASTM F876, or CSA B137.5, when properly extruded using the PE-X technology for which they are designed.

Benefits of Borealis PE-X pipe resins

The Borealis family of PE-X pipe grade resins offers distinct benefits to the producer, designer, and end user:

Over 30 years proven experience producing PE resin formulations for the PE-X pipe industry

A family of PE resins optimized for

- minimally stabilized powder resins for maximum flexibility in PE-Xa pipe producer formulation and manufacturing
- fully formulated mini-pellet resin designed for US plumbing market for rapid path to commercial PE-Xa production
- fully formulated pellet resin for efficient pipe and plumbing component production and PE-Xc irradiation

Formulations designed for PE-X pipe or tube to be fully compliant with globally recognized standards such as ISO 15875, ASTM F876, CSA 137.5, DIN 16892, DIN 16893 and NSF/ANSI Standard 14

Superior long-term performance capability due to excellent hydrostatic strength and resistance to slow crack growth

Industry-leading technical support

Resin	PE-X Technology	Nominal Melt Flow Rate ⁽¹⁾ (g/10 min)	Nominal Resin Density ⁽²⁾ (kg/m ³)	Form	Processing
HE1878	PE-Xa	3.0	955	Natural powder	RAM extrusion
HE1878E	PE-Xa	10.0	951	Natural powder	Screw extrusion
HE1878E-C3	PE-Xa	9.0	952	Fully formulated natural mini-pellet	RAM or screw extrusion
HE2591	PE-Xa	10.0	944	Natural powder	Screw extrusion
HE2590	PE-Xc	8.5	944	Fully formulated natural pellet	Screw extrusion

(1) In accordance with ISO 1133 (190 C/21.6 kg)

(2) In accordance with ISO 1183 (base resin density)

Table 2: Industry Designations according to Crosslinking Technology



Borealis HE1878E-C3: The benchmark for performance in the North American plumbing market

Crosslinked PE and PE-X piping systems have been established for over 40 years. At the same time, crosslinking technologies, pipe production equipment, and pipe performance requirements have evolved extensively over this time. This is why Borealis continuously refines its product offering for PE-X pipes, with each iteration in the evolutionary cycle to provide optimal performance. Borealis HE1878E-C3 mini-pellet is the state-of-the-art resin for PE-Xa pipe production which has been specifically designed to meet the requirements of chlorine and UV resistance for the North American plumbing market.

Rapid path to commercial production

The HE1878E-C3 resin is a fully compounded mini-pellet with uniform geometry tailored for PE-Xa production using modern twin-screw extrusion equipment and offers consistent and efficient processing. Because the HE1878E-C3 is already fully stabilized when it leaves Borealis' production facilities, there is no need for time-consuming and costly research into additive package systems at the pipe production level. Pipe producers can focus on the pertinent aspects of PE-X pipe production such as peroxide let-down, dimensional control, and irradiation of the extruded pipe to initiate the crosslinking. The unique mini-pellet configuration, in conjunction with the extensively researched Borealis additive package, provides the pipe producer a rapid path to qualification and commercialization of PE-Xa pipe or tube for hot and cold potable water application.

Hydrostatic strength

The long-term hydrostatic strength of PE-X pipes is of critical importance. Properly crosslinked PE-X pipes produced using fully formulated Borealis HE1878E-C3 meet the rigorous requirements set by the Plastic Pipe Institute's Hydrostatic Stress Board (PPI HSB) listing program. Its designation as a PEX 5106 pipe compound per ASTM F876 verifies its long-term serviceability in demanding PE-X pipe applications.

Temperature: ° F (° C)	Hydrostatic Design Basis: psi
73° F (22.8° C)	1250
180° F (82.2° C)	800
200° F (93.3° C)	630

Table 3: Borealis HE1878E-C2, PPI-HSB Hydrostatic Listing



Chlorine resistance

PE-X pipes produced using the HE1878E-C3 compound have been evaluated for their resistance to the effects of chlorine. The pipes were tested at accredited, third-party laboratories under the conditions defined in ASTM F2023.

Under these demanding test conditions, PE-X pipes produced using HE1878E-C3 exhibit exceptional resistance to the effects of chlorine ions at elevated temperatures. In addition, test results support the highest achievable Class 5 designation in accordance with the ASTM F876 classification system. This means pipe designers, producers, and end users can depend on maximum serviceability in potable water applications.

Test Parameter	Test Value
pH	6.8
Chlorine concentration	4.3 ppm
Oxidation reduction potential	> 825 Mv
Test temperature #1	203° F (95° C)
Test temperature #2	221° F (105° C)
Test temperature #3	239° F (115° C)

Table 4: ASTM F2023 Chlorine Test Conditions

UV resistance

In accordance with the AWWA C904 standard of the American Water Works Association, PE-X pipes and tubing are required to demonstrate a minimum of six months' resistance against UV degradation. PE-Xa pipe and tubing producers usually ensure UV resistance by coextruding a UV-resistant colored outer layer.

Independent, third-party testing has shown that natural (uncolored) PE-Xa pipe, produced using HE1878E-C3 and standard industrial PE-Xa pipe production practices, qualifies for a minimum UV-resistance of one month when tested in accordance with ASTM F2657. Consequently, Borealis' HE1878E-C3 resin is listed with NSF, PPI and ICC as a UV-rated PE-Xa resin. The UV-resistance of PE-Xa pipe produced with the Borealis HE1878E-C3 can be further enhanced through the coextrusion of an outer color skin by the pipe or tubing manufacturer designed for that purpose. The coextrusion approach positions the pipe or tubing producer to meet or exceed the 6-month UV resistance required by the American Water Works Association's AWWA C904 standard.

The Borealis quality commitment

HE1878E-C3 manufactured in our industry-leading, ISO 9001-qualified production facilities meets or exceeds all requirements for PE-X piping for international markets, including North America.

Pipe produced using the Borealis HE1878E-C3 is compliant with the following North American standards:

- ASTM F876 – Standard Specification for Crosslinked Polyethylene (PE-X) Tubing
- CSA 137.5 – Crosslinked polyethylene (PE-X) tubing systems for pressure applications

Borealis HE1878E-C3 is listed with NSF International in accordance with the requirements of NSF/ANSI Standard 14 for use in potable water and radiant floor heating applications. This gives pipe manufacturers faster access to the North American plumbing market at reduced costs.

Borealis pipe solutions: enabling life's essentials



As a trusted and experienced partner with more than 50 years of experience (since 1967), Borealis offers market leading polyethylene and polypropylene materials for pipe systems in water and gas distribution, waste water and sewage disposal, plumbing, heating, and industrial, along with multi-layer steel pipe coating solutions for onshore and offshore oil and gas pipelines. With the proprietary Borealis Borstar® technology as the main foundation, complimented by selected other processes, Borealis can offer a wide variety of tailored pipe solutions.

In addition, **Borcycle™ M** and the **ISCC Plus certified Borcycle™ C** compounds based on mechanically and chemically recycled feedstock as well as the **ISCC Plus certified Bornewables™** compounds using renewable-based feedstock meet a growing demand for high-sustainability building and infrastructure pipe polymers. At the same time, they align with Borealis's **EverMinds™** platform to promote and accelerate the transformation of the plastics industry towards circularity.

By offering more durable and reliable as well as circular pipe solutions, Borealis' step-change innovations continue to boost the sustainability of pipe networks by making them safer, leak free, longer lasting and more efficient with installation costs reduced by up to 60% compared to the traditional pipe material.

Based on Borealis' European assets, its **Middle Eastern joint venture Borouge** as well as the **American joint venture Baystar®**, Borealis confirms its position as a partner of choice for global pipe customers, helping to meet the growing needs and requirements of the building and infrastructure industry today and in the future.

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Borealis and Borouge polyolefin infrastructure solutions for pipes and fittings are enabling life's essentials

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Borealis is one of the world's leading providers of advanced and sustainable polyolefin solutions. In Europe, Borealis is also an innovative leader in polyolefins recycling and a major producer of base chemicals. We leverage our polymer expertise and decades of experience to offer value-adding, innovative and circular material solutions for key industries such as consumer products, energy, healthcare, infrastructure and mobility.

With operations in over 120 countries and head offices in Vienna, Austria, Borealis employs around 6,000 people. In 2022, we generated a net profit of EUR 2.1 billion. OMV, the Austria-based international oil and gas company, owns 75% of our shares. The Abu Dhabi National Oil Company (ADNOC), based in the United Arab Emirates (UAE), owns the remaining 25%.

In re-inventing essentials for sustainable living, we build on our commitment to safety, our people, innovation and technology, and performance excellence. We are accelerating the transformation to a circular economy of polyolefins and expanding our geographical footprint to better serve our customers around the globe. Our operations are augmented by two important joint ventures: Borouge (with ADNOC, headquartered in the UAE), and Baystar™ (with TotalEnergies, based in the US).

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