

## *Hostalen* PP "XN" Series Pipe

Leading the way



# Leadership in Technology and Innovation

An innovator and leader in the production of resins used in piping systems, LyondellBasell and its predecessor companies have been working hand-in-hand with customers in the pipe industry for more than 50 years. Steadily replacing traditional materials such as cast iron, steel, clay and concrete; plastic pipes have proven a strong, durable and cost-effective solution.

Polypropylene-Random (PP-R) has been a material of choice for producing plastic pipes for hot and cold water installations for more than 20 years. Like its metal pipe predecessors, PP-R provides excellent stiffness and a high melting temperature, but at the same time offers the typical advantages of plastic pipes such as light weight, fast and reliable jointing by welding and corrosion resistance.

Compared to pipes made of other highly effective materials, like PE-X or PB-1, pipes made of PP-R have historically required higher wall thickness, due to their intrinsic pressure resistance characteristics. The opportunity for reduction in wall thickness has been the key driver to seeking improvements in the polymerization process and product development that has resulted in this next generation of PP-R resins, called the XN Series.

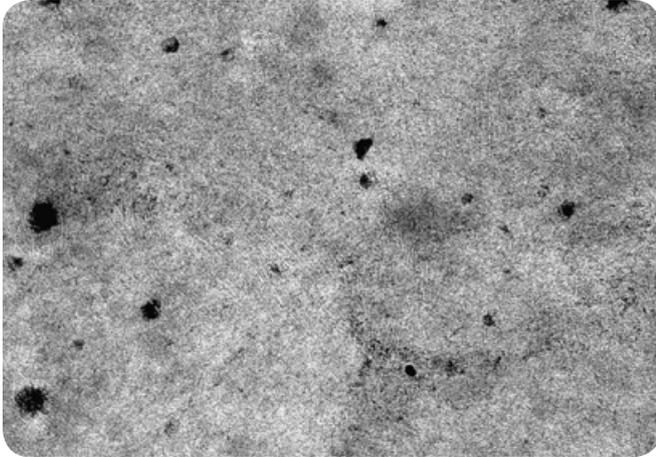
This is the next step in advancing polyolefin technology used by the pipe industry. The first new benchmark products, *Hostalen* PP XN125-P and *Hostalen* PP XN112-I resins have shown high temperature performance and excellent pressure resistance in customers' applications, providing opportunities for weight reduction and material savings.



Spherizone Process Technology

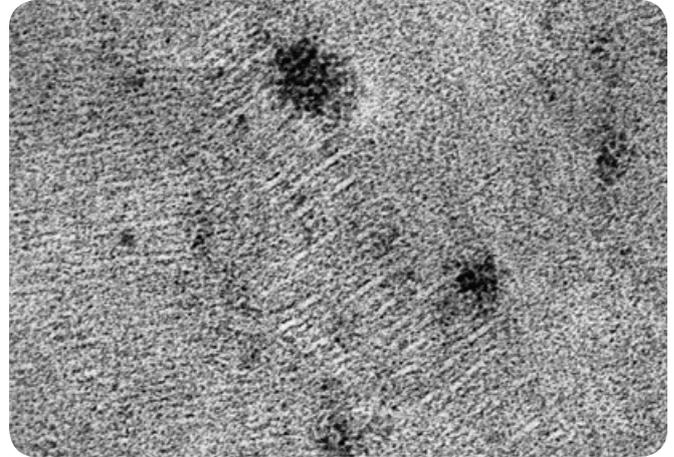
# New Generation of Resins

## Propylene Based Random Copolymers Comparison (Propylene-Hexene vs Propylene-Ethylene)



**Note:** Transmission electronic microscopy (TEM) image for **propylene-hexene** copolymer (x65000) (MFR 1.3 g/5Kg)

PP Random C6 based shows a quite peculiar structure, with short and thin lamellas, without the cross-hatching morphology, leading to a more isotropic morphology.



**Note:** Transmission electronic microscopy (TEM) image for **propylene-ethylene** copolymer (x65000) (MFR = 1.3 g/10' 5Kg)

PP Random C2 based shows a continuous crystalline matrix coming from isotactic polypropylene sequences and the typical cross-hatching lamellas texture. A well dispersed phase coming from the amorphous fraction is observed.

## A Unique Combination

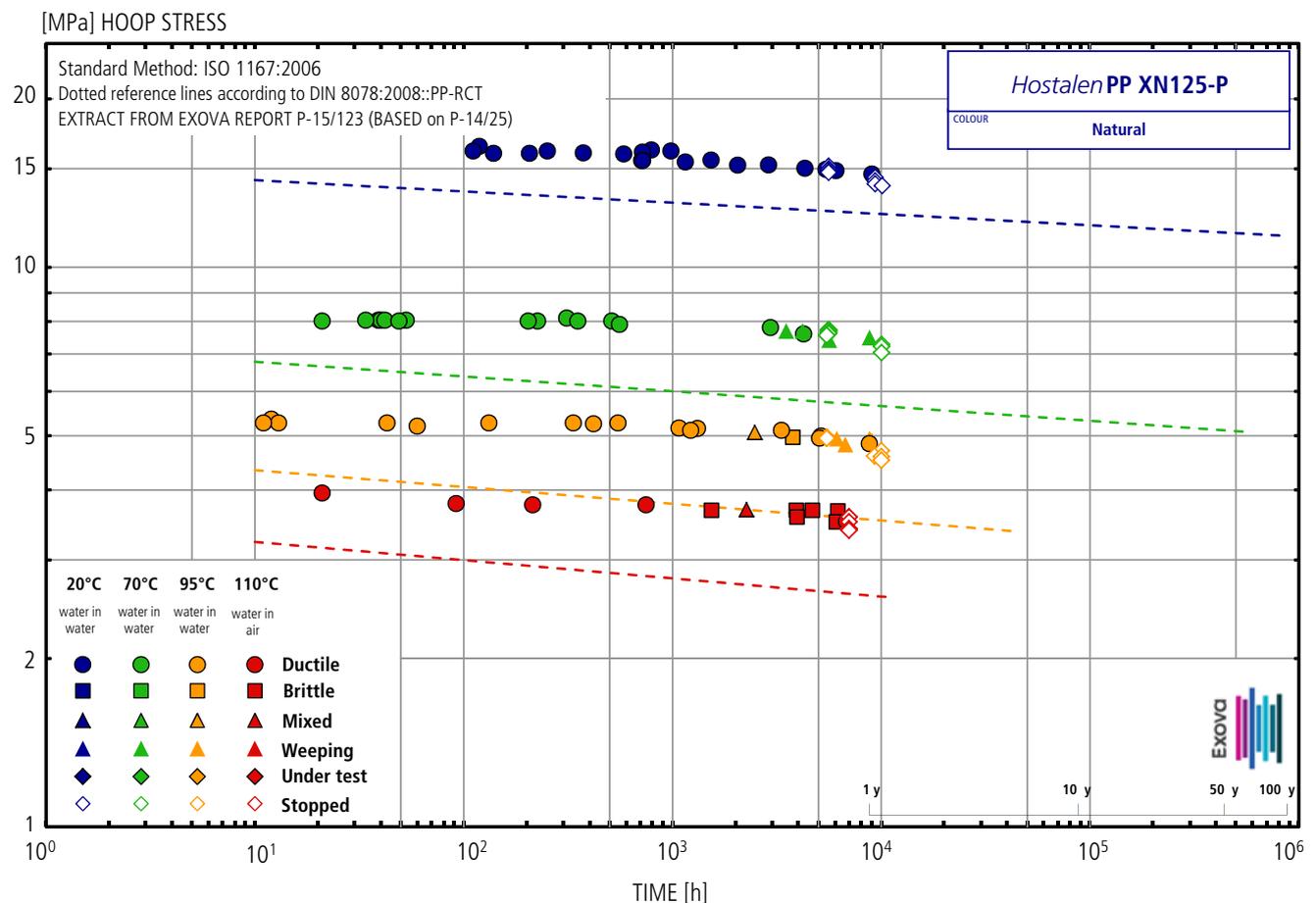
The advanced property mix of higher creep resistance and pressure performance in the *Hostalen* PP XN Series materials is the result of a unique combination of proprietary polymerization process and chemical structure. As opposed to other PP-RCT grades, *Hostalen* PP XN Series materials do not derive their superior strength from a crystallization form which is complicated to achieve and less stable than the normal alpha form. Apart from the enhanced pressure performance, our customers confirm that XN Series materials are fully compatible with standard PP-R materials, therefore can be welded to standard PP-R fittings. As a further benefit to the XN Series, the resins are available in natural color, allowing maximum flexibility for pipe producers to color as desired to meet customer needs.

LyondellBasell's experience and reputation for technology and innovation in the development and production of grades used in the pipe sector spans more than five decades. Our portfolio includes polyethylene, polypropylene and polybutene-1 used by customers in the production of pipe for plumbing, heating and cooling, water and gas distribution, industrial application and sewage and drainage systems, among others. This new generation of PP-R is yet another example of what LyondellBasell *Amazing Chemistry* can do.

# Value and Performance

The thickness of a pipe is often determined by the strength of the material, not only when the pipe is new, but most importantly after long-term use at a specific pressure and temperature. The higher the strength of a given material, the thinner the pipe wall can be.

Tests carried out at the Exova materials testing institute confirmed that the new grade can provide a high level of performance when used in hot and cold water pipe applications. Through long term testing and extrapolation in accordance with ISO 9080 standards, two important parameters are calculated: Minimum Required Strength (MRS), extrapolating the minimum strength of a material after 50 years at room temperature, and Categorized Required Strength (CRS), extrapolating the strength of a material after 50 years at 70°C.



ISO 9080 regression lines for *Hostalen* PP XN125-P fall well above the reference lines of PP-RCT classifying the resin as both PP-RCT and PP125 (ISO 12162). The second product in the XN series, *Hostalen* PP XN112-I, also classifies as PP-RCT and PP112 and is characterized by a special balance between pressure performance and impact strength, designed for pipes where superior impact performance is needed.

	H5416	XN125-P	XN112-I
MRS (MPa)	10.0	12.5	11.2
σ LPL(20°C, 50y)	10.02	12.68	11.97
σ LPL(70°C, 50y)	3.63	5.93	5.38
ISO 12162 Classification	PP100	PP125	PP112

# Benefits and Opportunities

## Hostalen PP "XN" Series Pipe

The actual pipe dimension is regulated by EN ISO 15874, where dimensions depend on material classification and service conditions such as pressure and temperature, broken down into application classes. Due to the higher material strength, the new *Hostalen* PP XN series materials allow the use of higher S series (reduced wall thickness) for the same application class.

Customers also report that the significant reduction in weight provides opportunities for material savings and other possible benefits such as faster processing, easier handling and a higher degree of sustainability. Secondly, an increase within the inner flow section is observed. By keeping the outer diameter constant and reducing the wall thickness, the inner diameter is larger, increasing flow or reducing pressure loss.

Smaller pipes and fittings  
at same cross section flow  
(hydraulic capacity)  
weight saving **45–50%**

**28%** less weight  
less mat'l consumption  
increased cross section  
flow (hydraulic capacity)



(Drawings are for exemplification only, not in scale)

In Application Class 2, the most common for PP-R pipes, in larger diameter pipes the change in size is such that it is possible to achieve the same or greater inner diameter even with a smaller outer diameter. Tests show weight reductions reaching up to 50% of comparative materials.

OPERATING PRESSURE 8 bar	PP-R	PP-RCT	
<b>Application Class 1</b> 60°C hot water supply	S 3.2 SDR 7.4	S 4 SDR 9	➔ Average weight saving <b>15.9%</b> (15.2%–17.4%)
<b>Application Class 2</b> 70°C hot water supply	S 2.5 SDR 6	S 4 SDR 9	➔ Average weight saving <b>28.3%</b> (27.9%–28.8%) at same OD
			➔ Average weight saving <b>46.6%</b> (42.8%–54.1%) at same ID
<b>Application Class 4</b> Under-floor heating and low temperature radiators	S 3.2 SDR 7.4	S 4 SDR 9	➔ Average weight saving <b>15.9%</b> (15.2%–17.4%)
<b>Application Class 5</b> High temperature radiators	S 2 SDR 5	S 3.2 SDR 7.4	➔ Average weight saving <b>26.4%</b> (25.9%–26.8%)

For all application classes it is possible, by simple geometrical calculation of cross-sections as prescribed by EN ISO 15874, to determine the weight savings as described in this table.



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