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Founded on February 24, 1999, the PE100+ Association is an industry organisation of several polyethylene (PE) manufacturers whose objective is to guarantee consistent quality at the highest level in the production and use of PE100 pipe material.

By monitoring the most critical properties of enhanced requirements, the Association is able to issue a "PE100+ Association Positive List of Materials" on a regular basis. The Association also aims to create a marketing platform to promote the use of PE piping in general.

Plastics an performance excellence

The plastic industry continues to innovate. Tailor-made solutions must always be a combination of functional excellence, long life and technological advancement. Plastics can play an important role in the pursuit of sustainable development, a vital challenge for society at the dawn of the new millennium.

The use of plastics in gas and water distribution

At the beginning of the gas industry in the last century, only metals were used for piping. Their use started with grey cast iron followed by nodular iron and mild steel up to high performance steel today. Plastics were first used in the US where various studies were carried out, resulting in networks in different types of plastic: ABS, PVC, PA, and PE.

Of all the tested, evaluated and used plastics for gas distribution, not taking into account a few exceptions, only polyethylene has been retained with very good results, thanks to its exceptional resistance against all sorts of failures that might happen in the field, including absence of brittleness and corrosion. Additional advantages make PE pipe an excellent choice:



don't crack under pressure

- Ease of handling thanks to flexibility and light weight
- Leak-tight installation thanks to excellent fusion-welding possibilities
- Long life with low operational costs
- Capability for relining existing pipelines
- Chemical resistance

In water distribution, which started more than one millennium ago, the range of materials is even more wide, ranging from metals or wood, over all sorts of brick and ceramic materials to, more recently, plastic materials. Today, both plastic and non-plastic materials are used and the actual choice depends upon the local situation. However, it is clear that both polyvinylchloride (PVC) and polyethylene (PE) have taken important parts of this market.

At first, the use of polyethylene was limited to low pressures, both in gas and water distribution. At the end of the eighties, PE80 was the standard material for such applications, especially in the lower diameter range.

The introduction of PE100 compounds offered gas and water engineers an excellent opportunity

The introduction of PE100, about one decade ago, enabled end users to extend the advantages of the well-known PE80 beyond the technical or economical limits they were faced with.

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Indeed, gas engineers were looking for a type of polyethylene that would be able to withstand pressures of above 4 or 5 bar in all safety, without risking rapid crack propagation (RCP). PE100 offered this possibility and end users such as British Gas (UK) and Electrabel (B) used this new material almost immediately for their medium pressure gas distribution (5-7 bars). Other countries followed later on and PE100 is being used for pressures up to 10 bar in natural gas distribution today.

Water engineers were continuously looking for large diameter polyethylene pipes withstanding higher pressures or having greater hydraulic surfaces. They used the 25% higher long term strength offered by PE100 to reduce wall thickness or to increase pressure rating, thus enabling more economical solutions to their problems than ever before.

Therefore, PE100 is the high-density polyethylene compound that is the reference material for these demanding applications today. Several suppliers of this material are available now.

Quality insurance for PE100 pipes

PE100 is a well-established pipe material, offering reliable operational performance under extreme loading conditions. To guarantee the material's high performance standard, strict quality control tests must be adopted. A whole range of end user specifications, as well as both national and international standards determine the requirements that have to be met by PE100 materials today. These will shortly be replaced by new and binding European Standards that will constitute a uniform, pan-European basis of minimum requirements. However, these Standards are, in fact, based upon a series of compromises, the result being minimal performance requirements and, specifically, no systematic material quality control is mandatory. With the aim of offering a "safety plus" by raising the performance requirements of PE100 compounds above those demanded by future European Standards (CEN), three leading PE manufacturers took the initiative to join together and form the "PE100+ Association" (see figure 1). The PE100+ Association was launched at the 24th of February 1999 by polyethylene manufacturers Borealis, Basell and Solvay Polyolefins Europe SA. Further members are Atofina, as a fourth member joined the Association in 2000, and DSM as the fifth member early 2001.



Figure 1: The logo of the Association

Tests on three fundamental properties

First of all, the PE100+ Association bases its material acceptance on the ISO and CEN Standards: the relevant to be tested materials must conform to EN 1555-1 and ISO 4437, or EN 12201-1 and ISO 4427. To comply with this, fully documented data sets have to be provided demonstrating a long-term strength of at least 10 Mpa at 20°C over a period of 50 years according to ISO 12162.

The PE100+ Association also organises regular controls on three critical properties, which ensures the secure operation of PE100 pipes. These three properties are:

- A high degree of long-term Strength
Creep Rupture Strength
- Excellent resistance to Slow Crack Growth
Stress Crack Resistance
- Good behaviour in Rapid Crack Propagation
Resistance to Rapid Crack Propagation

Property	Test Method	EN/ISO Standard requirement	PE100+ requirement
Creep Rupture Strength	Internal pressure test at 20°C and 12.4 MPa ISO 1167	≥ 100 h	≥ 200 h
Stress Crack Resistance	Pipe notch test at 80°C and 9.2 bar ISO 13479	≥ 165 h	≥ 500 h
Resistance to Rapid Crack Propagation	S4 test at 0°C ISO 13477	$P_c \geq \frac{MOP}{2.4} \cdot \frac{13}{18}$ <small>P_c: critical pressure MOP: max. operat. pressure</small>	≥ 10 bar

All tests are performed on 110mm SDR 11 pipes

Figure 2: PE100+ Requirements compared with European Standards

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In addition, the PE100+ Association aims to set higher performance targets for these three properties than those which will become the norm in future CEN Standards (see figure 2) for the following reasons:

- PE100 products are designed for higher pressure operation in gas applications. Performing tests on the Rapid Crack Propagation (RCP) behaviour of such materials guarantee a safe operation of the pipeline. PE80 products have demonstrated that for many years.
- By performing creep and notch tests, we assure that we take both possible failure modes of PE pipe material into account: deformation and ageing (Slow Crack Growth - SCG). In order to have a quick estimation of this SCG phenomenon on PE pipe material, a design life time of 50 years is shown by the regression curve. This is demonstrated via the so-called pipe notch test, which uses two acceleration factors, high temperatures and artificial stress concentration. The pipe notch test is performed on V-shaped notched pipes.

All tests are performed on 110mm SDR 11 pipes. In accordance with the scheme below (see figure 3), independent laboratories carry out the tests at seven month intervals under supervision of Gastec, an internationally recognised testing institute.

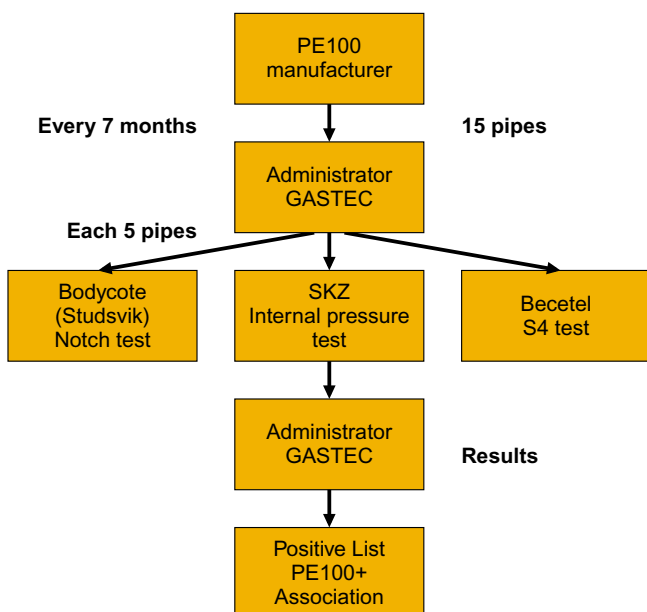


Figure 3: PE100+ Testing schema

The PE100+ Association publishes the "PE100+ Association Positive List of Materials" showing the materials that successfully meet the PE100+ requirements. In order to keep the "safety plus" objective of the PE100+ Association, only materials which are controlled regularly can be part of that positive list. In addition, materials have to pass two successive test rounds in order to be listed, thus not only ensuring quality control, but quality consistency as well. The current positive list is published on the Associations web site www.PE100plus.net.

The PE100+ Association is open to any manufacturer whose materials comply with our enhanced requirements, and who is able to produce consistent compound quality according to ISO 9000 standards.

The PE100+ Association's advisory committee

The PE100+ Association has an Advisory Committee of representatives from the gas and water industries, pipe and fitting manufacturers and contractors. Their main tasks are market guidance and feedback, but also to ensure that industry requirements are fulfilled.

More information can be obtained at the following address: PE100+ Association, c/o Gastec, Wilmersdorf 50, NL-7327 AC, Apeldoorn, the Netherlands and under contact@pe100plus.net.

Please also visit our Internet site: www.pe100plus.net.

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