Raw Material Pre-PUR®

General: Polyurethanes are not all the same!

As with all raw materials and finished goods, there are large differences in quality here as well.

For many of its hoses, NORRES uses a special mixture called Pre-PUR®, containing an ester-polyurethane or an ether-polyurethane. Compared to many other plastics, rubber formulations and "simple" polyurethanes, the block copolymers, which consist of hard and soft Pre-PUR® segments, have superior properties. The hard segments of Pre-PUR® provide extremely high mechanical stability, while at the same time the soft segments give the material high flexibility and dynamic load capacity.

Our hoses made from Pre-PUR® raw materials differ as follows from many of the hoses commercially available:

- NORRES Pre-PUR® consists of **special and high-quality, premium ester- and ether-polyurethanes.**
  Choosing a polyurethane just **one** level of quality lower can cause a reduction **of more than 30%** in abrasion resistance.
  The use of **high-purity** raw materials and a **narrow tolerance range** ensure a high level of quality.
  → excellent mechanical stability
  → low abrasion
  → excellent chemical and hydrolytic resistance
- NORRES Pre-PUR® has **extremely long molecular chains** (high molecular weight and a lot of crystalline domains and morphology).
  During chemical, hydrolytic and thermal degradation, molecular chains are generally shortened as a result of chain scission. Consequently, longer molecular chains generally result in longer service life. The length of the molecular chains is also a determining factor in the softening point of a hose. Thus products made from Pre-PUR® have above average residual strength when subjected to heat, while at the same time demonstrating better flexibility at low temperatures.
  → improved chemical and hydrolytic stability
  → higher softening points
  → greater residual strength at high temperatures
  → higher compression strength
  → greater safety due to material stability
  → better hot air aging properties
  → better low temperature flexibility
  → lower "bending force" when cold
  → lower risk of bending fracture at low temperatures
- NORRES Pre-PUR® contains **special stabilizers** for hose technology, developed in partnership with our raw material suppliers. Without these additives, hoses generally are more vulnerable to chemical, hydrolytic and thermal attack and occasionally wear out significantly faster.
  → improved chemical and hydrolytic stability
  → improved oxidation resistance
  → better hot air aging properties
  → improved resistance to weathering

The ether-polyurethane Pre-PUR® used in many of our hoses has the following advantages over ester-polyurethane Pre-PUR® (and also over other ester-polyurethanes):

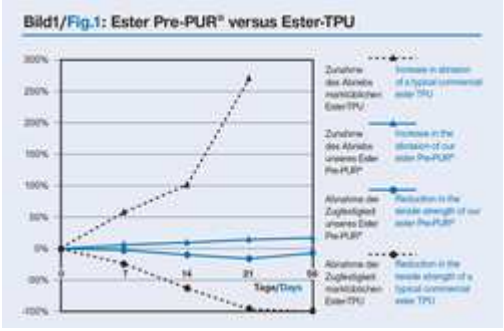
- Resistant to microbes (This is critical for extended contact with soil or similar substances or heavy contamination under conditions favourable to microbes. The chemical structure of ether-polyurethanes gives the materials permanent resistance to microbial attack. We believe this is clearly a better solution than ester-polyurethanes that are often stabilized with for health not completely harmless additives for this purpose. With these ester-polyurethanes there is a risk that the additive will leach out, causing the level to fall below that required for protection as the additive migrates to the surface of the hose and comes in contact with the user and the material transported.)
- Resistant to hydrolysis (This is critical for wet applications at higher temperatures and for use in tropical climates.)
- Its chemical stability is far superior to ester-polyurethanes
- Its flexibility at low temperatures is superior to comparable ester-polyurethanes

In summary:

→ longer service life
→ greater safety
→ significant added value and greater benefits

An example of stability:

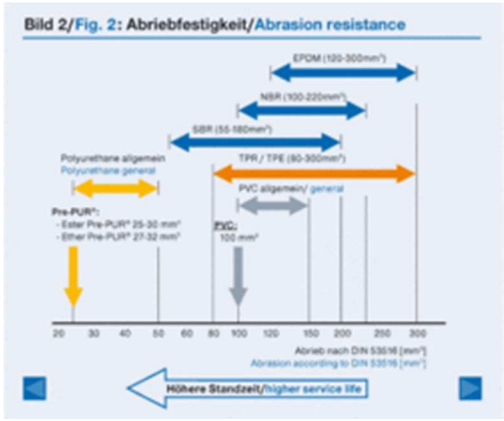
Our high-quality Pre-PUR® raw materials with special stabilizers demonstrate considerably better stability and significantly longer service life than can be obtained with many other products.
An appropriate measure of this is hydrolysis testing in water at 80°C, since the mechanism of chemical degradation of polyester-polyurethane is frequently hydrolysis of the polyester chains. Our ester Pre-PUR® is shown in Figure 1, compared with an other typical commercial ester TPU.



Variation diagram abrasion resistance Ester Pre-PUR® versus Ester-TPU

Example of abrasion resistance:

According to standard tests, the **abrasion resistance** of our Pre-PUR® polyurethanes is about two and a half to five times higher than for many rubber raw materials and about three to four times higher than for many soft PVC's (measured at 20°C). In applications, the differences are frequently even greater, because the excellent damping and impact resilience of Pre-PUR® polyurethanes does not come into play with the standard test method.



Example of abrasion resistance

Engineering modifications subject to change.