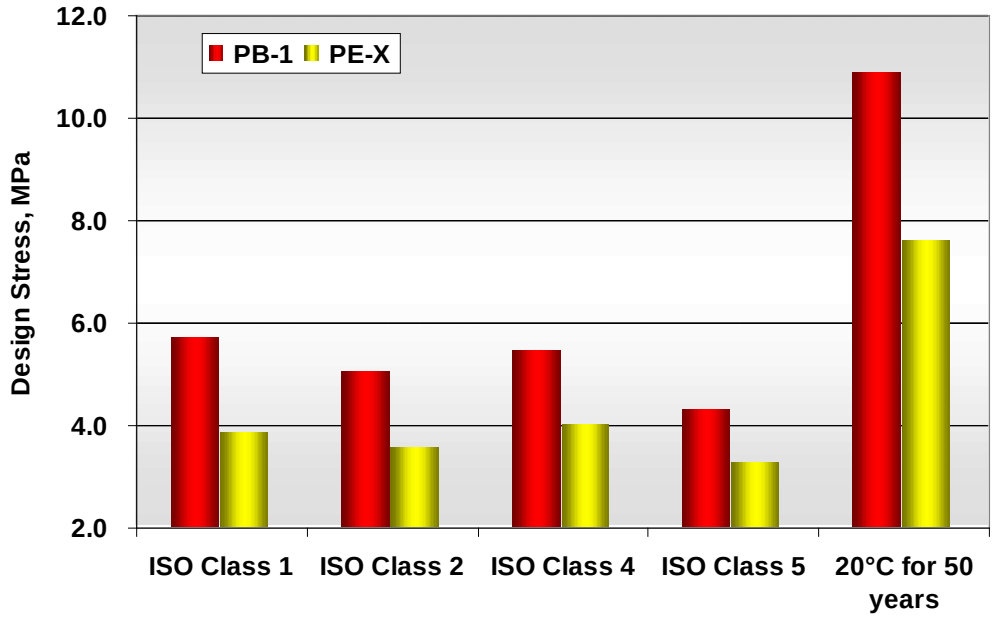
# Temperature – Pressure - Resistance

## 1) Basic Information

The resistance of pipes to deformation and burst is determined by testing to international/ national standards. The test results are then used to calculate the maximum permitted hoop stress for hot water transportation according to a defined set of conditions, referred to as temperature classes. These temperature classes are compiled to reflect the likely cross-section of service conditions for a 50-year period for a range of different heating and water supply applications. The internationally accepted temperature classes are stipulated in ISO Standard 10508, and referred to in other systems standards for plastic piping systems.

## 2) Grafic Overview




| Classification according to ISO 10508 for lifetime of 50 years | | | | | | | |
|---|---|---|---|---|---|---|---|
| Temperature/Time profile | | | | | | | |
| Class | Application | Standard ($T_D$) | | Maximus ($T_{max}$) | | Mal-function ($T_{mal}$) | |
| | | Temp °C | Time in years | Temp °C | Time in years | Temp °C | Time in hours |
| 1 | Warm water supply at 60°C | 60 | 49 | 80 | 1 | 95 | 100 |
| 2 | Warm water supply at 70°C | 70 | 49 | 80 | 1 | 95 | 100 |
| 4 | Underfloor and low temperature Radiator applications | 40 | 20 | 70 | 2.5 | 100 | 100 |
| | | 60 | 25 | | | | |
| 5 | High temperature radiator applications | 60 | 25 | 90 | 1 | 100 | 100 |
| | | 80 | 10 | | | | |

For standard **Hot Water Heating** applications the ISO Temperature classes can be applied for the following polyolefine materials as follows:

| Maximum allowable Hoop Stress (MPa) of Polyolefin Pipes For Hot Water Transportation | | | | |
|---|---|---|---|---|
| | **PB-1** | **PEX** | **PE-RT** | **PP-R** |
| **Temperature Class** | **Polybutene-1 (ISO 15876-2)** | **Cross-linked Polyethylene (ISO 15875-2)** | **Raised Temperature Resistance Polyethylene (ISO standard under development)** | **Polypropylene Random-Copolymer (ISO 15874-2)** |
| Class 1 | 5,73 | 3,85 | 3,30 | 3,09 |
| Class 2 | 5,06 | 3,54 | 2,70 | 2,13 |
| Class 4 | 5,46 | 4,00 | 3,26 | 3,30 |
| Class 5 | 4,31 | 3,24 | 2,4 | 1,90 |

These calculations indicate that the required wall thickness of Polybutene-1 pipes could be less than the other candidate materials for equivalent stress resistance performance. However the calculation of wall thickness depends on other additional standardised requirements with the result that with pipe diameters of less than 20 mm, all polyolefin pipes must comply to a minimum fixed thickness standard defined for a specific material.

For pipes with the same wall thickness these calculations indicate that the performance benefit of Polybutene-1 pipes leads to an increase of the performance of +33% in comparison with cross-linked polyethylene and more than 50% when compared with PE-RT.

**Polybutene-1 Pipe Size Determination**

| **Class** | **S-value*** | **S.D.R. (Standard Dimension Ratio)** |
|---|---|---|
| 1 und 2 | 5 | 11 |
| 3 | 6.3 | 13.6 |
| 4 | 5 | 11 |
| 5 | 4 | 9 |

## 3) Results

District Heating systems are usually operated at various flow temperatures according to the necessary heat load. When the actual temperature profile is deviating from the standard profile, the system supplier shall provide calculations applying **Miners Rule**.
Assuming a typical temperature/pressure profile for district heating networks determines an expected life time >50 years.
In **District Heating** PB-1 is providing extra pressure resistance at the same pipe wall thickness – e.g.
8bar/95°C for PB-1 +33,3%
6bar/95°C for PEX

Technical data are subject to alteration.