## PE & HDPE PE100 Pipe Properties

* Minimum Required Strength (MRS): 10.0 MPa (1450 psi)
* Hydrostatic Design Basis (HDB) Pressure: 1600 psi (11 MPa)
* Allowable Compressive Strength: 7.93 MPa
* Tensile Strength at Yield: 23 MPa
* Elongation at Break: >600%
* Modulus of Elasticity (50 years): 200 MPa
* Flexural Modulus: 1000 MPa
* Poisson’s Ratio: 0.45
* Thermal Expansion Co-efficient: 1.3 x 10-4 °C-1

Friction Co-efficients:

* Colebrook-White: 0.00152mm
* Hazen-Williams: 150-155
* Manning: 0.009 (water); 0.010 (sewage)

**Temperature Resistance of PE pipe**

**The properties of HDPE PE100 pipe** are determined at standard temperatures of 20°C or 23°C. These properties can be significantly affected by temperature, so at higher temperature the properties, including MRS, decrease. At higher temperatures it may be necessary to apply reduction factors to MRS, and consequently MOP. Some Codes and Standards define the reduction factors that must be applied; AWWA C901 and C906 for example. Otherwise there are standard reduction factors that can be applied in design. ISO13761:1996 defines reduction factors to be applied to MOP at higher temperatures. These are shown below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temperatue °C** | 20 | 25 | 30 | 35 | 40 |
| **Pressure Reduction Factor** | 1.00 | 0.93 | 0.87 | 0.80 | 0.74 |

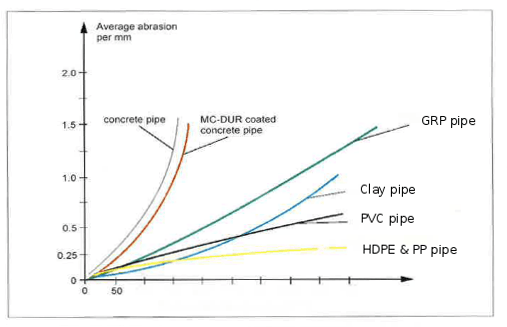
In the USA the Plastics Pipe Institute Handbook of [Polyethylene Pipe](https://www.pe100plus.com/PE-Pipes/Technical-guidance/Trenchless/Methods/PE-Pipe-i1341.html) Table A.2 includes the following reduction factors. The correlation with the ISO factors is clear.

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Temperatue °F (°C)** | 73 (32) | 80 (27) | 90 (32) | 100 (38) |
| **Pressure Reduction Factor** | 1.00 | 0.94 | 0.86 | 0.78 |

**Abrasion Resistance**

This is a consideration in wastewater rising/force mains in which there are solids transported with the water and pump operation sequences can result in solids rubbing along the pipe invert. PE100 has the best abrasion resistance of the commonly used pressure pipe materials. This is illustrated in the Figure below.



The magnitude of wear depends on the angle of impingement and the type of material being eroded. At close to 90 degree impingement angles (*impact abrasion*), the erosive wear rate is highest in brittle materials and lowest in ductile materials. In ductile materials, the repeated impinging particles plastically deform the surface to generate wear debris. With brittle materials, the impingement causes particles of material to be fractured off as wear debris. Brittle materials are less wear resistant than ductile materials in an impact erosion condition. At low angles of impingement (*abrasive erosion*), the reverse is the case. Harder materials better resist the gouging or ploughing action of abrasive particle flow.

There is an approximate relationship between hardness and the ultimate strength of the material. The amount of abrasive wear decreases as the strength/hardness of the piping material increases. To resist abrasion, the piping system must be harder than the material being conveyed. The wear rates of various piping materials are often similar, so long as their hardness is greater than the slurry so selecting a pipe material considerably harder than the conveyed material offers no wear advantage and typically costs more. Conversely when the mineral is harder than the pipe, there is a very sudden and steep rise in the abrasive wear rate.

There are distinct types of wear experienced in a typical piping system. The straight sections most commonly experience abrasive erosion. Size transitions and directional changes experience both abrasive erosion and impact abrasion and should be designed with this in

| **Property** | **Units** | **Test Method** | **PE80B** | **PEPE100100** |
| --- | --- | --- | --- | --- |
| Density | kg/m3 | ISO 1183D, ISO 1872-2 | 950 | 960 |
| Tensile Yield Strength | MPa | ISO 527 | 20 | 23 |
| Elongation at Yield | % | ISO 527 | 10 | 8 |
| Tensile Modulus  – short term | MPa | ref. AS/NZS2655.1 | 700 | 950 |
| Tensile Modulus – long term | MPa | ref. AS/NZS2655.1 | 200 | 260 |
| Hardness Shore D |  | DIN 53505 | 59 | 64 |
| Notched Impact Strength  (23°C) | kJ/m2 | ISO 179/1eA | 35 | 26 |
| Melt Flow Rate 190/5 | g/10 min | ISO 1133 | 0.7-1.0 | 0.3-0.5 |
| Thermal Expansion | x 10-4/°C |  | 2.4 | 2.4 |
| Thermal Conductivity  (20°C) | W/m.k | DIN 52612 | 0.43 | 0.4 |
| Crystalline Melting Point | °C |  | 125 | 132 |
| Dielectric Strength | kV/mm |  | 70 | 53 |
| Surface Resistivity | Ohm |  | >1015 | >1015 |
| Volume Resistivity | Ohm.cm |  | >1015 | >1015 |
| Poissons Ratio | μ |  | 0.4 | 0.4 |