

2.1 The material

The universal Jentro PEX pipe consists of high molecular high-density strong PE, cross-linked with peroxide. The cross-linkage above the crystallite melting point is characteristic for high-pressure cross-linkage.

The cross-linking reaction occurs during the pipe formation in the tool. This cross-linking procedure ensures a regular cross-linkage across the whole wall thickness, even in the case of thick-walled pipes.

The different molecules of the polyethylene link up to a three-dimensional network. The already excellent material properties still considerably improve during this process (principally the temperature and pressure resistance, the impact resistance at low temperatures and the stress crack resistance).

The co-extruded oxygen barrier consists of ethylene vinyl alcohol (EVAL), the best high barrier polymer.

The requirements in the area of oxygen permeation according to DIN 4726 are largely exceeded. In addition, the adhesive layer between the basic pipe and the barrier layer guarantees a very strong bond.

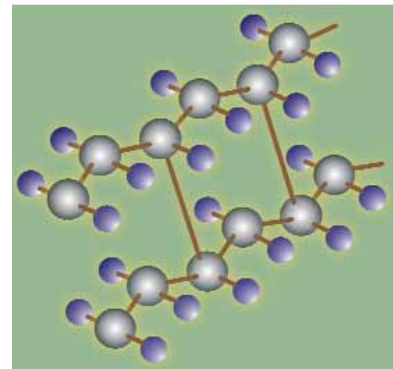
With regard to the wear resistance and weather stability, the water-insoluble EVAL layer offers a very large reserve, making the pipe resistant to the roughest building site circumstances.

Drinking water

The Jentro universal PEX pipe is used for drinking water transport in accordance with DIN2000 for cold and warm water, up to an operating overpressure of 10 bars and can be used continuously at a temperature of 70° C. Short-time (failure) up to 100° C.

Heating

For application in heating systems, the pipe can be used with a maximum flow temperature of 90° C. Short-time (failure), temperatures up to 100° C are possible.



▲ Fig. 1: Cross-linked polyethylene

2.2 Technical data

- Material
- Colour:
- Density
- Modulus of elasticity
- Notch impact resistance
 - at 20° C
 - at - 20° C
- Average expansion Coefficient
- Caloric conductivity
- Oxygen diffusion as per DIN 4726
- Pipe roughness k
- Material constant C
- Max operating temperature
- Short-time max temp. (failure)
- Minimum bend radius without tools

PE-Xa with EVAL coat
 grey Ral 9006
 0.93 g/cm³ (as per DIN 53497)
 approx. 600 N/mm²

no rupture
 no rupture
 0.15 mm/m°K
 0.35 W/m°K
 oxygen tight
 0.007 mm
 12
 90° C
 100° C
 8 x d

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2.3 Properties of PEX pipes

Thanks to the cross-linkage of PE, the main material properties are still considerably improved: The Jentro Universal PEX pipe has the following characteristics:

- Excellent durability, even at higher temperatures.
- Insensible to the formation of stress cracks.
- An ample choice of joints and accessories.
- Reliable connection technique:
Permanent tight compression sleeve joint.
No use of O-rings.
Visual checking.
Can be immediately put under pressure.
- Form stable.
- Same compression sleeve for PEX and STABIL.
- Optimum relation flexibility/ pressure resistance.
- Excellent resistance to ageing due to heat.
- Very good impact and notch impact resistance at temperatures under 50° C.

- High wear resistance and excellent notch resistance.
- No damage to the material as a result of buckling of the pipe.
- Excellent recovery capabilities (memory effect).
- Outstanding chemical resistance.
- Oxygen tight in conformity with DIN 4726, thanks to a barrier layer of ethylene vinyl alcohol (EVAL).
- High caloric stability.
- Resistant to ageing.
- Little flow noises inside the pipe.
- Little pressure loss.
- Free of heavy metal ions.
- Corrosion resistant.
- Free of incrustations, even after years of use.
- Flexible installation.
- Use of the same accessories for STABIL and PEX pipe: pipe series 2, SDR 7.4.
- Pipe dimensions PEX: 16 - 63 mm

Warning!
The values indicated in the contiguous specifications are reference values.
Simultaneous loading up to the limit values of both pressure and temperature under operating conditions is NOT permitted!

2.4 Long term behaviour

When polymer materials are exposed to a certain mechanical load, the creep behaviour must be taken into account. This implies that the deformation and the strength depend on the temperature and the load duration.

In order to determine the permitted values under sustained load, one must therefore analyse the mechanical behaviour under loads for a longer period and at different temperatures. This also applies to pipes that are exposed to a high internal compression load. Based on more than twenty-five years of experience - in the laboratory and in practice - and on numerous experiments and tests with polyethylene pipes cross-linked at high pressure, the required parameters were determined.

The results of these durability/internal pressure tests are expressed in diagrams. For this purpose, an extrapolation procedure that has proven its usefulness for over 50 years is used to calculate the results on a longer term than the measurement period. This extrapolation procedure, which is also applied to the construction of steel installations with heated steam, is based on the projection of high test temperatures at low operating temperatures.

The results of the numerous durability/internal pressure tests are represented in a so-called durability/internal pressure diagram. In order to make this diagram applicable to all pipe dimensions, not the internal pressure load, but the so-called comparison stress is used as comparison value.

The relation between the internal pressure strength and the comparison stress can be calculated by means of the so-called "Ketelformule" (Ketel formula).

$$\sigma_v = p \times \frac{(D-s)}{20 \times s}$$

σ_v = comparison stress in N/mm²
 p = internal pressure in bar
 D = outer diameter of the pipe in mm
 s = wall thickness of diameter of pipe in mm

(see figure 2)

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2.5 Operating circumstances according to DIN 1988, part 2 for PEX pipes and pipe joints

DRINKING WATER INSTALLATIONS

According to the DVGW directive, all pipelines of drinking water installations must be dimensioned for a permissible operating overpressure (PB) of 10 bars with a safety factor of ≥ 1.5 .

The Jentro pipes comply with DIN 16892 (quality requirements) and 16893 (dimensions). Permissible operating overpressures according to DIN 16893 for Jentro PE-Xa pipes

Operating Temperature	Operating Duration	Pipes series SDR 7.4 Nominal pressure PN 20 Operating overpressure PB
°C	Years	
20	50	20
70	50	11.2
95	10	8.6

▲ Table 1

CENTRAL HEATING

In conformity with the DIN 4726, all pipelines of drinking water installations must be dimensioned for a permissible operating overpressure (PB) of 3 bars with a safety factor of ≥ 2.5 .

Figure 2 shows the results for pipes of PE cross-linked at high pressure. These are minimum curves, and therefore the measured values lie above these curves. At 95° C, values of over 120,000 hours without buckling behaviour are observed (a typical value for cross-linked PE).

Additionally, it can be observed that a comparison stress of 5.3 N/mm² is reached for an operating duration of 50 years at 70° C. For a 16 x 2.2 PEX pipe (outer diameter 16 mm, wall thickness 2.2 mm), this value corresponds to an internal pressure of 16.9 bars. This means that even after an operating duration of 50 years at 70° C,

the pressure strength of the pipe is still 5.6 times the max. operating pressure of 3 bars. This value is called the safety factor.

The safety factor required in accordance with DIN 4726 of > 2.5 at 70° C is therefore easily achieved by all Jentro PEX pipes.

2.6 Dimensioning requirements of the DVGW

- Permanent operating pressure 10 bars
- Permanent operating temperature 70 °C
- Life cycle 50 years
- After that another safety factor ≥ 1.5 times

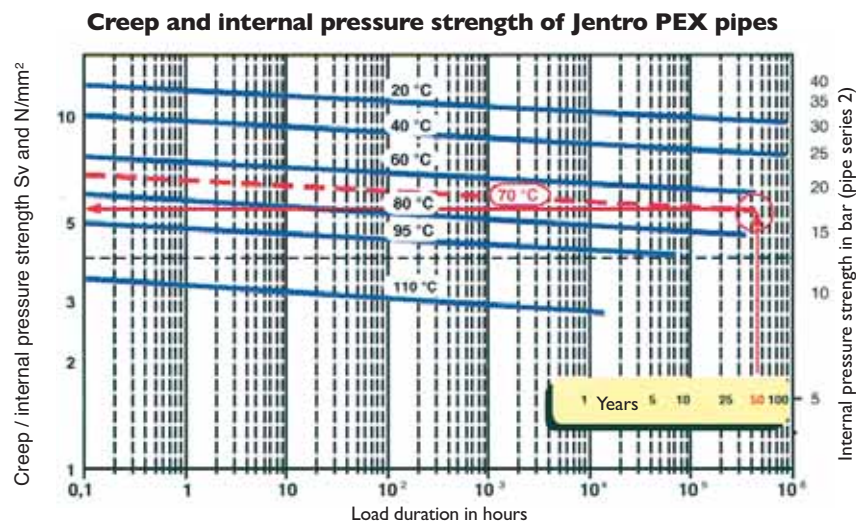
The Jentro pipes comply with these requirements:

As from fig. 2, it results: 70°C, 50 years, 17 bars

Safety: 17 bars: 10 bars = 1.7 times

2.7 Dimensioning requirements according to DIN 4726

- Permanent operating pressure of 3 bars
- Permanent operating temperature 70° C
- Life cycle 50 years
- After that another safety factor of > 2.5 times



◀ Fig. 2: Creep and internal pressure strength of Jentro PEX pipes.

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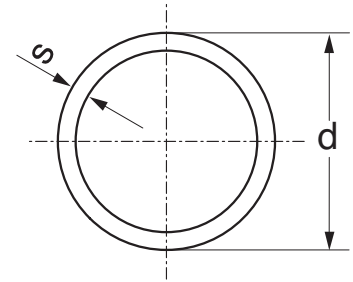
2.8 Pipe dimensions PEX

- Material: Polyethylene cross-linked at high pressure according to DIN 16892
- Colour: Aluminium grey. RAL 9006,
- Oxygen tight according to DIN 4726, thanks to the EVAL barrier layer.
- Suitable for drinking water.

Caution!

When making a compression sleeve joint, original Jentro fittings, compression sleeves, universal Jentro pipes and tools must always be used.

Pipe series 2 according to DIN 16892				
DN DIN 1988	d mm	s mm	Weight kg/m	Content /m
12	16	2.2	0.098	0.10
15	20	2.8	0.153	0.16
20	25	3.5	0.238	0.25
25	32	4.4	0.382	0.42
32	40	5.5	0.594	0.66
40	50	6.9	0.926	1.03
50	63	8.7	1.470	1.63



▲ Table 2

2.9 Indications on the pipe

At an intermediate distance of 1 m, at least the following information is indicated on the pipes:

- Continuous meter indication
- Indication of manufacturer
- Base material of the pipe and cross-linking method
- Dimensions
- DIN number
- Max. permissible operating temperature and max. operating pressure
- Max. permissible temperature PEX
- Control mark of pipe with registry number DVGW
- Control mark Jentro system with registry number DVGW
- Russian approval
- Production no.
- No. of pipe manufacturer
- Manufacturing date

Example of an indication on a Jentro PEX pipe

M 25

Logo Golan-Logo Jentro

PE-Xa

16 x 2,2

Universalrohr Sauerstoffdicht DIN 4726

70° C / 10 bar

90° C max

DW-8301AF2000

DW-8501BQ0347

PCT

No 1234

469

01.09.07

Continuous meter indication: 25M

Indication of pipe manufacturer – system supplier

Base material of the pipe and cross-linking method

Dimensions

DIN number for central heating pipe

oxygen tight

Max. permissible operating temperature and

max. operating pressure for drinking water

DVGW

Maximal permissible temp. for PEX

DVGW control mark and register number of pipe

DVGW control mark of Jentro system (pipe + fitting)

Russian approval

Production number

No. of pipe manufacturer

Manufacturing date

Example of an indication on a Jentro PEX pipe

M 25 / Golan-Jentro / PE-Xa / 16 x 2.2 / Universalrohr Sauerstoffdicht DIN 4726 / 70 ° C / 10 bar / (90max) / DW-8301AF2000 / DW-8501BQ0347 / PCT / Nr 1234 / 469 / 01.09.07



▲ Fig. 3: Universal Jentro PEX pipes 16 - 63 mm.

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