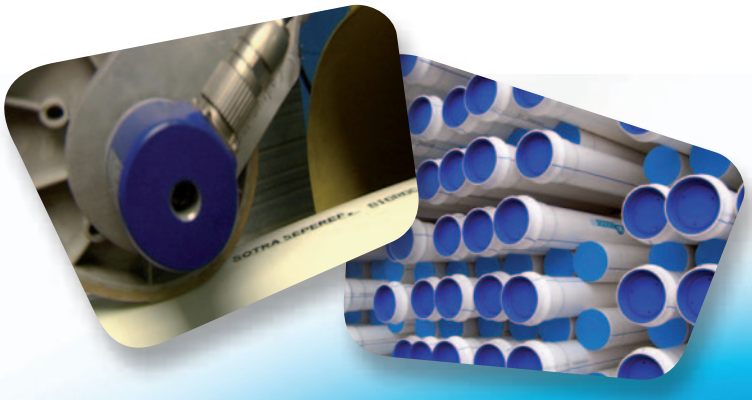
SOTRA SEPEREF



The advantages of Bi-orientation technology… and all the PVC qualities

BI-OROC® PN 16

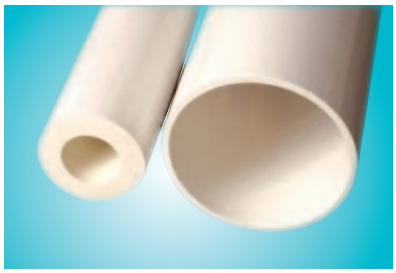
www.sotra-seperef.com

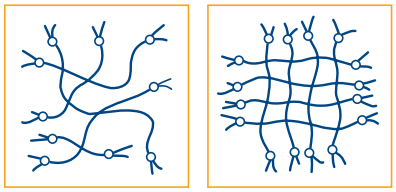
Bi-Orientation

Basic principle

BI-OROC® tubes from SOTRA SEPEREF are manufactured following a specific technology: the Bi-orientation.

Bi-orientation consists of rearranging molecular chains in order to improve the physical and mechanical properties of the material.
During fabrication, the extruded polymer structure of the PVC is subjected to double drawing in order to form a web/chain unit in two axes: circumferential and longitudinal, which gives BI-OROC® **exceptional characteristics** within the plastic industry.





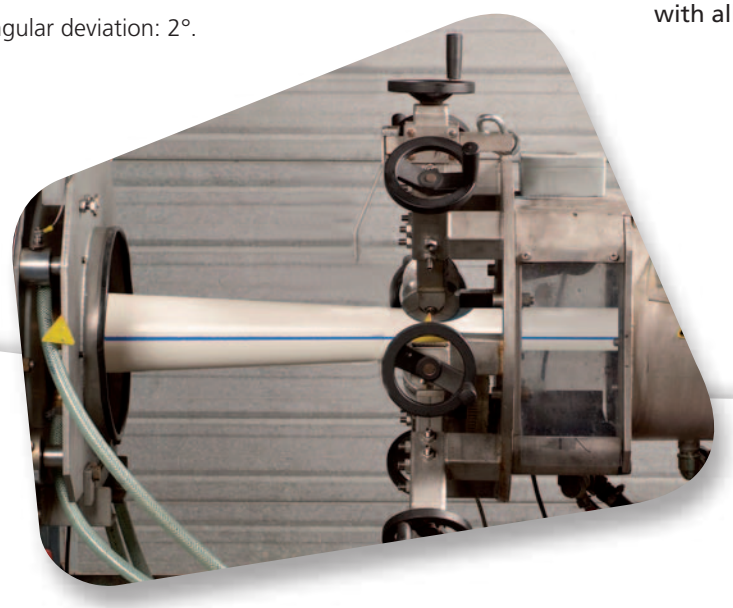
Extruded PVC | *Bi-oriented extruded PVC*

Mechanical resistance

> MRS *(Minimum Required Strength)*: Class 450.
> The sockets have the same mechanical resistance as the pipe.
> High resistance to puncture and to shock even at low temperature.
> Resistance to differential settlements when used in underground installations.
> Can be installed under the surface, with gentle gradients or ground water.

Hydraulic characteristics

> Roughness coefficient: k = 0.003 mm.
> Wave velocity pressure: a = 290 m/s.
> Resistance to joint deformation: - 0,8 bar *(in accordance with NF EN ISO 13844 standard and test report CSTB n° 593078 103906/1).*
> Thermal expansion coefficient: 0,08 mm/m/°C.
> Angular deviation: 2°.



Resistance to chemical attack

> Resistance to aggressive soil conditions (acidity), ground with high salt content, to products used in agriculture, to wastewater effluent as well as H_2S and H_2SO_4.

Sensory supply capacity properties

> Certificate of supply capacity.

Only use of wet connection pipe rings for 'single range' PVC guarantees perfect functioning of the network system. All other wet connection pipe rings will be prohibited.

A list of the compatible ring is available on our website www.sotra-seperef.com

BI-OLUB lubricant must be used with all socketed joints.

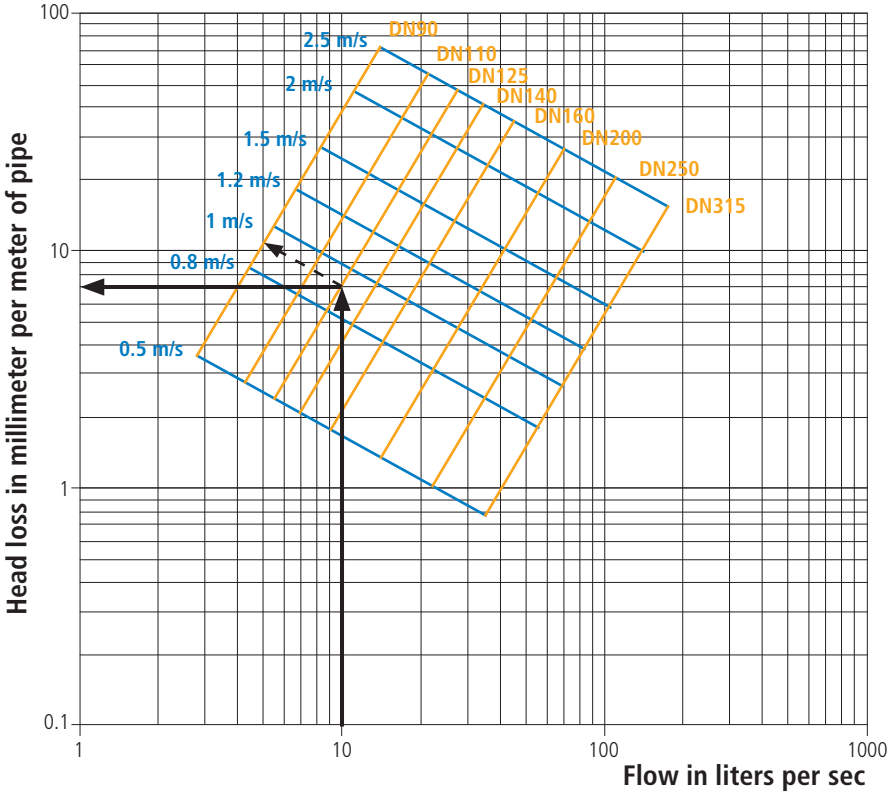
Abacus for calculating head losses

This abacus has been set up following the Colebrook formula taking into consideration the internal diameters of the pipes. The calculation has been set up for cold water with a temperature of 15 °C.

> Method

Using a flow rate of 10 L/s with a DN125 PN16, a vertical line is drawn from the coordinate 10 up to the intersection with the straight line diameter 125.

Using this figure, one obtains a direct reading that the pressure loss is 7 mm/m of pipe. In the present case, for a length of 1 000 m, the global pressure loss is therefore 7 m of water head equaling 0.7 bar.



Temperature use

The BI-OROC® has a design life in access of 50 years, at an operating pressure of 16 bars, according to the nominal pressure, and at temperature up to 20°C.

When pipe is to be used with a temperature range between 20°C and 45°C, it is necessary to apply a decalibration coefficient in order to guarantee a service life of 50 years that is:

$AOP = f_T \times f_A \times PN$

with *AOP = Allowable Operating Pressure,*
f_T = decalibration coefficient related to temperature
f_A = decalibration coefficient related to application (see NF T54-034 standard).

Water temperature	f_T : coefficient to apply to the nominal pressure
0°C < T ≤ 25°C	1
25°C < T ≤ 35°C	0.8
35°C < T ≤ 45°C	0.63

Example

Using at 30 °C : AOP = 16 x 0.8 = 12.8 bar.

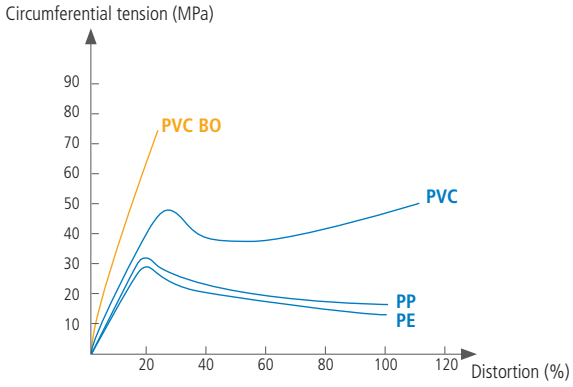
Bi-orientation advantages...

Mechanical performances

The double orientation of the BI-OROC® pipe offers **uniform performance along the entire pipe.**

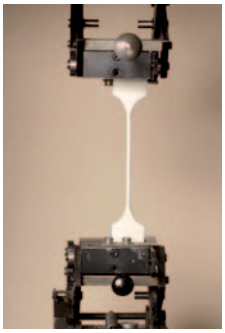
> Traction resistance

Even under stress, the BI-OROC® PN16 will **deform less** than other material.
As shown in the opposite graph, the **modulus of elasticity** of PVC bi-oriented is **much higher** than the one for other materials.



> Punching resistance

Due to its stratified structure, BI-OROC® offers a distinctly **superior resistance** to punching compared to that of extruded PVC.
In addition, there is high resistance to cracking.



> Resistance to shocks

BI-OROC® PN16 shock resistance is **highly improved** compared with traditional PVC, even at low temperature.

A bi-oriented tube will withstand to a 2 meters fall of a 15 kg weight.

Hydraulic performances

> Resistance to water hammer

The water hammer corresponds to a violent change in pressure resulting from a sudden modification of the liquid flow velocity in the pipeline.

The result is the creation of a wave of depression and/or suppression along the pipeline at a speed called **wave velocity.**

For the BI-OROC®, at identical speeds and diameter, the intensity of the water hammer is 2,5 times lower than that found in PVC JK PN16.

The wave velocity pressure of a material is calculated as follow:

$$a = \frac{1}{\rho \left(\frac{1}{\varepsilon} + \frac{D}{E \times e} \right)}$$

BI-OROC® PN16: a = 290 m/s
PVC JK PN16: a = 580 m/s

This phenomenon is measured perpendicular to the hydraulic head using the formula:

$$\Delta H = \frac{a \times \Delta v}{g}$$

ρ = *volumetric liquid mass (kg/m³)*
ε = *modulus of liquid elasticity (N/m²)*
D = *internal diameter of the pipe (m)*
E = *modulus of elasticity of the material (N/m²)*
e = *width of the pipe (m)*
a = *wave velocity (m/s)*
Δv = *speed difference entering before and after the water hammer (m/s)*
g = *gravity acceleration = 9,8 m/s²*

> Hydraulic capacity

With similar external diameter, the **reduced wall thickness of PVC bi-oriented compared to other material** (PVC, PE) enables the internal diameter to be increased which in turn increases the hydraulic capacity of the pipe.

For a 1 m/s speed, the hydraulic capacity is improved by 16% to 25% depending on the diameter. The BI-OROC® PN16 enables to significantly increase the allowable flows.

The BI-OROC® PN16 DN110 has a capacity of 60 m³/h flow in respect with the EN 805 standard *(capacity less than 2 m/s).*

Example

DN		Ø int.		Flow (m³/h)				
				30	40	50	60	70
110	BI-OROC® PN16	103.8	Speed (m/s)	1.0	1.3	1.6	2.0	2.3
			Head loss (bar)	2.9	3.9	4.9	5.8	6.8

> Head loss

Head loss is calculated using the COLEBROOK formula: $\frac{1}{\sqrt{\lambda}} = -2\log_{10}\left(\frac{k}{3{,}71D} + \frac{2{,}51}{Re\sqrt{\lambda}}\right)$

λ = *head loss coefficient*
k = *roughness coefficient (m)*
D = *internal diameter of the pipe (m)*
Re = *number of Reynolds*

The roughness coefficient is the same between PVC and bi-oriented (k= 0.003 mm).
Head loss is calculated according to the water speed and the internal diameter.
At similar speeds and diameter, the BI-OROC® PN16 has a 10% lower head loss from 30% to 40% compared to PVC compact.

See previous abacus.

Fire fighting

In either rural or urban locations the size of the potable water main is dictated by **the requirements of the fire service criteria** *(the regulation requirements: flow= 60 m³/h and pressure = 1bar minimum)*.

With PVC JK PN16, diameter DN110 does not fulfill those criteria, a larger diameter (DN125) must be then used.
The BI-OROC® PN16 DN110, it fulfills all this criteria.

	BI-OROC® DN 110	JK DN 125
Internal diameter (mm)	103,8	106,6
Water flow (m/s)	1,97*	1,87*
Head loss (for 1000 ml)	3,5	3,1
Water hammer intensity (bar)	8	11,7

*Reasonable following the NF EN 805 (0,5 < V < 2m/s).

Environmental performances

Thanks to its manufacturing process, the PVC is already a **high performing** product when it comes to environment. The bi-orientation pipe has **reduced wall thickness** and subsequently the **weight** of pipes, therefore the environmental impact is further reduced, over its full life cycle.

... and all PVC qualities

Lightness

The lightness of the BI-OROC® PN16 **makes handling and transport easier.**
This **reduces the time of installation and Health and Safety issues** around handling the pipe.

Chemical inertness

The constituent material of BI-OROC® is PVC.
PVC has been recognized for its **corrosive resistance qualities and inertness** in relation to numerous types of liquid environment, that is to say:

- electrolytic corrosion *(aggressive soils)* have no effect on the pipe,
- high chemical resistance is recognized as being satisfactory, notably in the presence of hydrogen sulphide and sulfuric acid (H_2SO_4) which can be released from wastewater or domestic sewage.

Watertightness

Tubes and fittings watertightness is a key element for **efficiency** and **performance** of potable water networks. BI-OROC® tubes, equipped with insert seals, fulfill perfectly to this requirement.

Food contact

BI-OROC® fulfills **health requirements** for the tube and the seal: circular DGS/VS4/N°96/155 from the 1st March 1996 and decree from the 29th May 1997.

The certificate of supply capacity can be downloaded on our website: www.sotre-seperef.com

Recyclability

BI-OROC® PN16 is **recyclable**.

By SOTRA SEPEREF, the waste from manufacturing is crushed in the plant and reused in other products we manufacture.

The BI-OROC® manufacturing plant is certified ISO 14001.

The BI-OROC® PN16 range, developed in accordance with the NF T 54-948 standard, holds the NF Mark.
The certificate can be downloaded from our website: www.sotra-seperef.com

DN (mm) (Dext)	Reference	Dint (mm)	Overall lenght (m)	Tube number / pallet
90	36849	84,40	6	69
110	36405	103,80	6	48
125	36406	118,00	6	40
140	36407	132,20	6	28
160	36408	151,20	6	33
200	36409	189,00	6	23
250	84539	237,80	6	14
315	84540	299,60	6	8

Pipe fittings

BI-OROC® PN16 tubes can be used with the majority of traditional assembly parts from the potable water network.

A list with compatible parts has been made following a test procedure determined by the PVC association between the bi-oriented tube manufacturers and some fittings manufacturers, in order to guarantee the best reliability.

> Note

The 'wide range' wet connection pipe rings will be prohibited. Only use of PVC 'single range' wet connection pipe rings guarantees perfect functioning of the networks system.

SOTRA SEPEREF, membre de TESSENDERLO GROUP
25 route de Brévillers - 62140 Sainte Austreberthe - FRANCE
Tel: + 33 (0)3 21 86 59 00 - Fax: + 33 (0)3 21 86 59 01
www.sotra-seperef.com