FLOOR HEATING / SANITARY

KILMA FLEX-PERT PIPE

CT1484.0_03
EN
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331

A508

PRODUCTION RANGE

Code	External diameter [mm]	Thickness [mm]	V water [m/s]	Volume of water per metre of pipe [litres/metre]	Maximum operating pressure* [bar]	Roll length [m]
1484.16.22	16	2	Refer to head loss diagram on last page.	0.113	10 (class 1) 8 (classes 2, 4 and 5)	120
1484.16.12						200
1484.16.32						240
1484.16.02						600
1484.17.12	17	2		0.133	8 (classes 1, 2 and 4) 6 (class 5)	120
1484.17.02						240
1484.17.22						600
1484.18.22	18	2		0.154	8 (classes 1, 2 and 4) 6 (class 5)	600
1484.20.02	20	2		0.201	6 (classes 1, 2, 4 and 5)	500
1484.25.12	25	2.3		0.327	6 (classes 1, 2 and 4) 4 (class 5)	240
1484.25.02						310

Field of application	Thermal conductivity	Modulus of elasticity	Pipe roughness (Ra)
+5 ÷ +100°C	0.40 W/mK	645 MPa	1.0 µm

DESCRIPTION

The *KILMA FLEX-PERT* pipe is a product consisting of three layers:

- The *inner layer*, in *PE-RT* (polyethylene with raised temperature resistance, not cross-linked), has an extremely smooth surface that allows a drastic reduction in head loss compared to the traditional metal pipe used in the heating and plumbing sector.
- The *outer layer*, in *EVOH* (ethylene-vinyl-alcohol), is a barrier of a few tens of µm which makes the pipe practically impermeable to oxygen**, allowing a drastic reduction of corrosion problems in heating systems where the plastic pipes are combined with materials susceptible to such phenomena.
- The *middle layer* is instead a very thin layer of polymeric material (highly adhesive) that keeps the above described layers together.

The product complies with standard *EN ISO 22391-2* "Plastics piping systems for hot and cold water installations – Polyethylene of raised temperature resistance (PE-RT)" and with standard *DIN 4726* regarding requirements on the oxygen permeability of the EVOH barrier and on minimal radial curvature of the pipes.

Also, the *KILMA FLEX-PERT* pipe complies with *Italian Ministry of Health Decree no. 174 of 6 April 2004* ("Regulation on materials and objects which can be used in stationary water collection, treatment, supply and distribution systems intended for human consumption" - published on 17th July 2004 in the Italian Gazzetta Ufficiale [Official Journal] General series no. 166).

The tests that ensure compliance with the above are regularly performed in the *I.I.P. laboratories.* (Italian Institute of Plastics) and SKZ (German Institute of Certification).

THE PURPOSE

KILMA FLEX-PERT pipe was designed to convey water and other hot fluids under pressure.
In particular, the product was conceived to allow for an ideal application when it is completely buried, for example, within concrete screeds.

THE USE

KILMA FLEX-PERT pipe is perfect for use in floor and wall radiant heating systems, even if it has not undergone a cross-linking process.
In such systems, indeed, the pipe must be completely "drowned" in the concrete screed and, thanks to the high modulus of elasticity that characterises it, the product (new) allows perfect containment of any stresses generated in the wall due to the impediment (caused by burying the tube) of the variations of length that would be recorded in temperature gradients application.

However, the particular features of the product:

- the oxygen barrier;
- the lengthy duration;
- the high resistance also to temperatures nearing 100°C (in case of malfunction);
- the very low roughness (which entails head loss that is often insignificant);
- the non-toxicity (which allows use with food fluids and drinking water);
- the lightness, flexibility and resistance to scratches

make the product competitive compared to the conventional metal pipe; in fact, more and more frequently, the *KILMA FLEX-PERT* pipe is preferred for heating and plumbing distribution systems and heating systems with radiators or fan coil units.

* The operating pressures may vary with variation of the product's class of use: for further details, refer to the relative section of this technical sheet.

** At a temperature of 40°C, the amount of oxygen that bypasses the pipe in a day is no more than 0.1 grams per cubic metre.

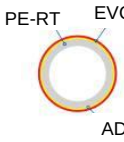
EXAMPLE OF MARKING

The information supplied is used only to allow for a quick read of the product's features: the marking may be different from the one indicated in the example

KILMA FLEX-PERT PE-RT Type II EVOH Ø17X2.0 C – SKZ X 000 – IIP UNI 000 EN ISO 22391-2 – Application class 1/8 bar, 2/8 bar, 4/8 bar, 5/6 bar – oxygen barrier complying with DIN 4726 – XX00X – Made in Italy – (--)/(--)/(--) – (--):(--) – X0.00.000.00 – 000m – >I<

KILMA FLEX PE-RT	Trademark
PE-RT Type II EVOH	Polyethylene thermal resistance increased with oxygen barrier
Ø17X2.0 C	Outside diameter and wall thickness; dimensional class: C
SKZ X 000	Indicates that compliance with the Standard is guaranteed by the "SKZ" Institute and trademark no. issued by SKZ
IIP UNI 000	Indicates that compliance with the Standard is guaranteed by the Italian Institute of Plastics and trademark no. issued by IIP
EN ISO 22391-2	Standard
Application class	Application classes (see relative section in this technical sheet)
Oxygen barrier complying with DIN 4726	The impermeability to oxygen was verified by tests in compliance with DIN 4726
XX00X	Anti-fraud alphanumeric code
Made in Italy	Identifies the country of production
(- -)/(- -)/(- -) – (- -):(- -)	Date of production and time of production
X.00.0000.00	Batch no.
000m – >I<	No. of metres

CONSTRUCTION FEATURES

Type of pipe		- Inner layer: pipe in PE-RT; - Middle layer: adhesive surface in polymeric material; - Outer layer: oxygen barrier in EVOH.

TECHNICAL FEATURES (First Part)

Dimensions	[mm]	16 x 2	17 x 2	18 x 2	20 x 2	25 x 2.3
Weight per metre of pipe	[Kg/m]	0.088	0.096	0.100	0.115	0.168

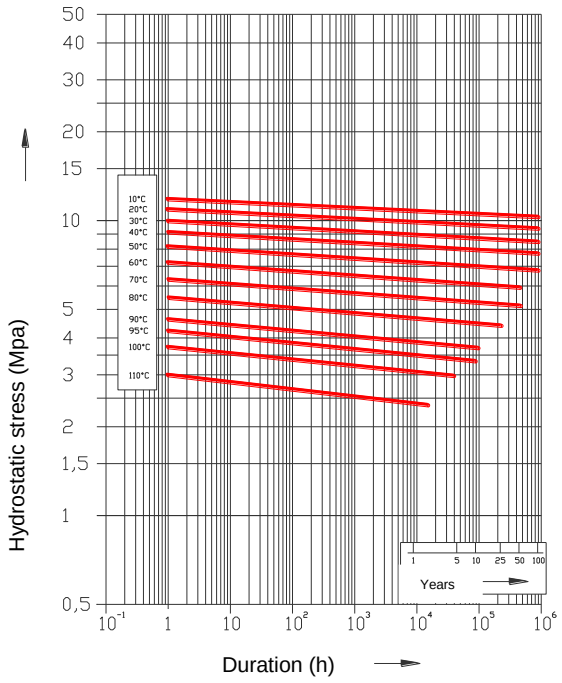
Ownership	Value	Unit of measurement
Volumic mass (density) at 23°C	941	Kg/m^3
Field of application	+5 ÷ +100	°C
Transportable fluids	The pipe, being non-toxic and thus compliant with Italian Ministerial Decree 174/2004, allows for the transport of water intended for human consumption*. Also, in general, all fluids that meet the requirements imposed by EN ISO 22391-2 Standard and are also compatible with the composition material of the pipe are transportable (in this regard see the technical report ISO/TR 10358: "Plastics pipes and fittings – Combined chemical – resistance classification table).	
Roughness of the pipe (Ra according to DIN EN ISO 4287, ASME B46.1)	1.0	µm
Thermal conductivity (at 60°C)	0.40	$\frac{W}{m \times K}$
Coefficient of thermal expansion	0.18	$\frac{mm}{m \times °C}$
Oxygen permeability at 40°C (Barrier check is performed by a verification system within the company)	≤ 0.1	$\frac{g}{m^3 \times d}$
Modulus of elasticity	645	MPa
Internal stress on the length (tested as indicated in EN ISO 22391-2)	≤ 2	%
Yield strength	≈ 20.3	MPa
Minimum bend radius allowed** (reference: DIN 4726)	5d	mm
Breakage length	780	%
Resistance to internal pressure (tested as indicated in EN ISO 22391-2)		
– At 20°C with σ=10.8 MPa stress	≥ 1	hour
– At 95°C with σ=3.9 MPa stress	≥ 22	hours
– At 95°C with σ=3.7 MPa stress	≥ 165	hours
– At 95°C with σ=3.6 MPa stress	≥ 1000	hours
Check of the appearance and dimensions of the pipe	The test is performed according to EN ISO 22391-2 using an ultrasound system, manually and with laser.	
Check of defects in the pipe wall	Performed during the cross-linking process.	
Recommendations for product storage	The pipe is supplied in packaging to protect it during the storage period: the product has been stabilised against ultraviolet rays, but continuous exposure over time will damage it irreparably, **therefore it must not be exposed to direct sunlight.**	

* Water intended for human consumption means water that is treated or untreated, intended for drinking, preparing food and drinks, or other domestic purposes, regardless of its origin, whether it is provided through a distribution network, via cisterns, in bottles or containers; also included is water used in a food enterprise for manufacturing, processing, preservation or marketing of products or substances intended for human consumption*. For more details, refer to the regulations in force and, in particular, read the standards and decrees mentioned.

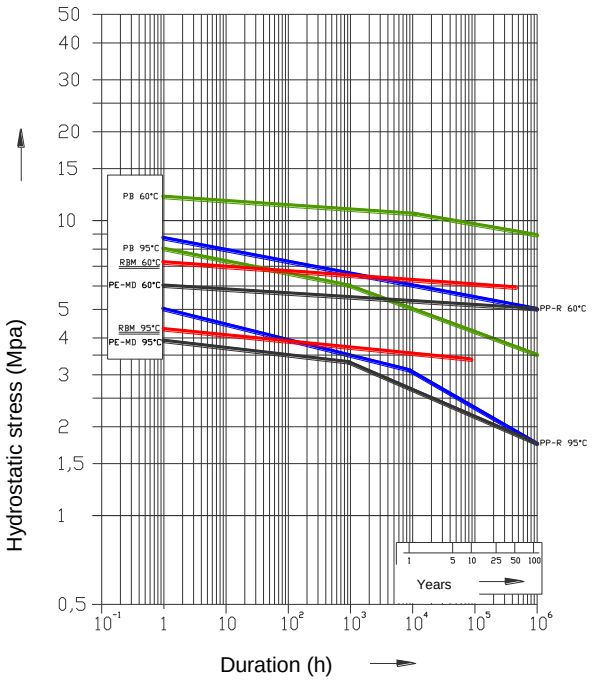
** Means the minimum radius measured on the plane of the axis of the pipe at the point of curvature; furthermore, for d refer to the mean outside diameter of the pipe.

TECHNICAL FEATURES (Second Part)

Diagrams of regression: of only the *KILMA FLEX-PERT* pipe and pipe compared to PP-R, PB or PE-MD pipes



Graph 1 - Diagram according to EN ISO 22391-2



Graph 2 - Compared regression curves: PE-RT, PP-R, PB, PE-MD

The above graphs show the regression curves relative to the circumferential stress σ in the *KILMA FLEX-PERT* pipes. Graph 2 compares the curves relative to the pipes (shown in red) in PP-R (in blue), PB (in green) and PE-MD (in black).

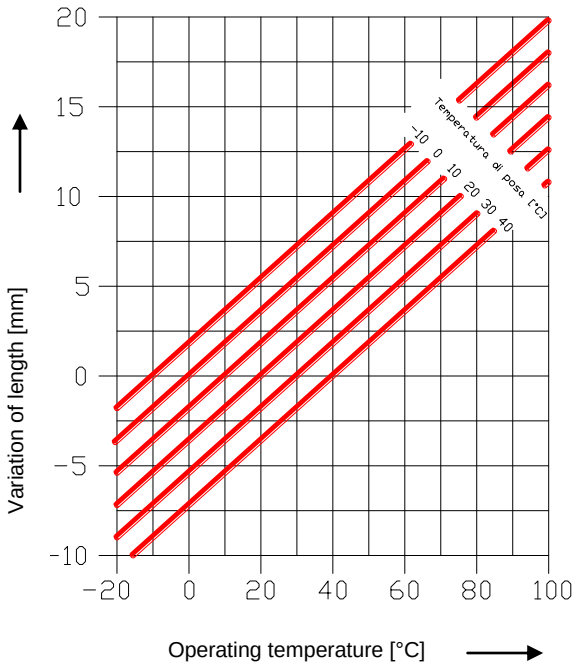
As can be noted, the regression curves of the pipes do not have the "knee" feature of the PP-R, PB or PE-MD pipes regression curves and allow for linear extrapolation.
Until not long ago, moreover, these diagrams were necessary to calculate (by means of simple mathematical formulas) the maximum operating pressure against certain conditions of use.
Under the new legislation, however, the regression graphs are used only to provide qualitative indications, whilst to have quantitative information, the following tables can be used:

Code	Dimension	Operating pressure [bar]			
		For application class*			
		Class 1	Class 2	Class 4	Class 5
1484.16.X2	16 x 2	10	8	8	8
1484.17.X2	17 x 2	8	8	8	6
1484.18.X2	18 x 2	8	8	8	6
1484.20.X2	20 x 2	6	6	6	6
1484.25.X2	25 x 2.3	6	6	6	4

Application Class **	Operating conditions for a period of 50 years and 100 hours of which	Field of Application
1 * **	49 years at operating temperature (T_D) of 60°C, 1 year at maximum temperature (T_{max}) of 80°C and 100 hours at malfunction temperature (T_{mal}) of 95°C	Hot water supply (60°C)
2 * **	49 years at operating temperature (T_D) of 70°C, 1 year at maximum temperature (T_{max}) of 80°C and 100 hours at malfunction temperature (T_{mal}) of 95°C	Hot water supply (70°C)
4	2.5 years at operating temperature (T_D) of 20°C, 20 years at operating temperature (T_D) of 40°C, 25 years at operating temperature (T_D) of 60°C, 2.5 years at maximum temperature (T_{max}) of 70°C and 100 hours at malfunction temperature (T_{mal}) of 100°C	Low temperature floor heating and radiators
5	14 years at operating temperature (T_D) of 20°C, 25 years at operating temperature (T_D) of 60°C, 10 years at operating temperature (T_D) of 80°C, 1 year at maximum temperature (T_{max}) of 90°C and 100 hours at malfunction temperature (T_{mal}) of 100°C	High temperature floor heating and radiators

* The classification per application class is obtained by EN ISO 22391-2 Standard to which we refer for further details
** All systems which satisfy the conditions of any of the above listed application classes are also usable for conveying cold water at 20°C for a period of 50 years and at an operating pressure of 10 bar.
*** The operating temperature is in accordance with national legislation.

Linear thermal expansion diagram.



Graph 3 – Expansion of 1 m of *KILMA FLEX-PERT* **pipe**

The diagram considers the linear expansion of 1 m of pipe (measured at a laying temperature of T_{laying}), as soon as it is put into operation.

The variations in length were calculated using the known formula:

$$\Delta L = \alpha \times L_{posa} \times \left(T_{esercizio} - T_{posa}\right)$$

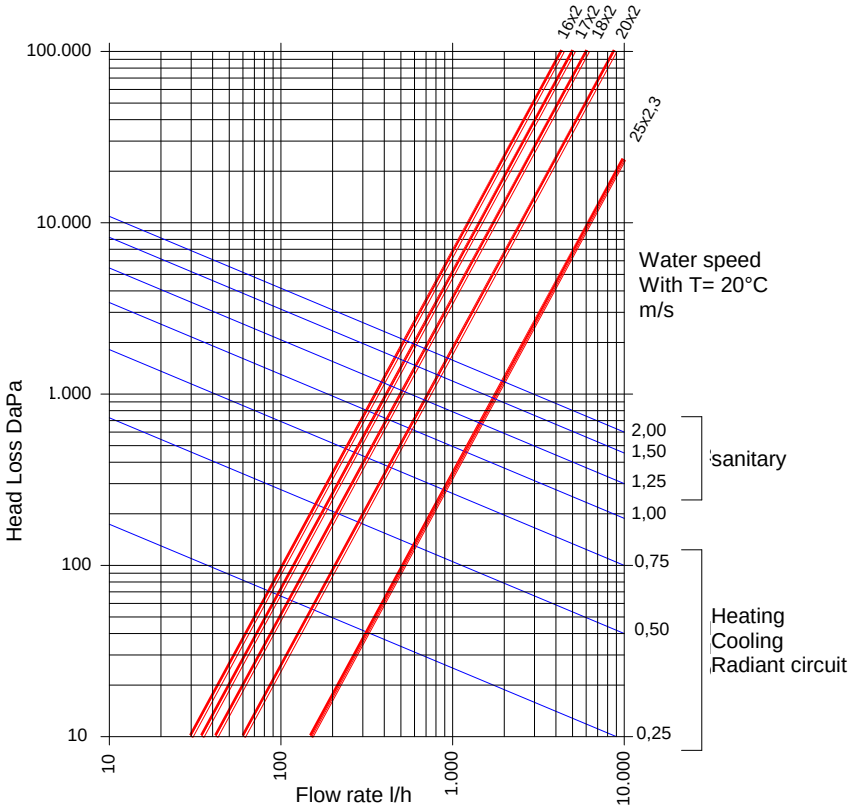
Where

ΔL	is the variation in length of the pipe in mm;
α	is the linear expansion coefficient (0.18 $\frac{mm}{m°C}$);
L_{posa}	is the length of the pipe at the laying temperature (1 m);
T_{posa}	is the temperature at which the pipe is installed;
$T_{esercizio}$	is the temperature at which the pipe is used.

Please remember, however, for the parts of the system that are ducted, the expansion effect is insignificant because, as the tube is unable to dilate, it autonomously absorbs this effect.
Furthermore, as already mentioned in the description of the product, thanks to the high modulus of elasticity, the new pipe allows perfect containment of the stresses generated in the wall.

FLUID DYNAMICS FEATURES

Head loss in the *Kilma flex PE-RT* pipes new water routes in environmental conditions (T=293.16 K; P=1 atm)



Graph 4 – Head loss in *KILMA FLEX-PERT* **pipe**

D [mm]	Di [mm]	Kv [m³/h]
16x2	12.00	4.40
17x2	13.00	5.10
18x2	14.00	6.16
20x2	16.00	8.90
25x2.3	20.40	22.00