UNIDELTA

TUBI DI POLIETILENE RETICOLATO
CROSSLINKED POLYETHYLENE PIPES

Technical Handbook T4001

U n i d e l t a S . P . A

1. Unidelta PEX pipes: features

Unidelta PEX pipes with and without an oxygen diffusion barrier are made using the silane method. The main physical and mechanical properties of this material are set out in the table below.

Table 1.1. Physical and mechanical properties of Unidelta PEX pipes

Property	Unit	Value	Method
Density at 23^{0}C	kg/m^3	944	ASTM D-792
Melt flow rate at 190^{0}C weight 2.16 kg (MFR 190/2.16)	g/10·min	0.33	Supplier test method
Tensile strength at break	MPa	20	ASTM D-638
Elongation at break	%	400	ASTM D-638
Tensile creep modulus:			ISO R527
at -40^{0}C	MPa	2240	
at 0^{0}C	MPa	1350	
at 23^{0}C	MPa	670	
Flexural creep modulus:			ISO 178
at -40^{0}C	MPa	498	
at 0^{0}C	MPa	312	
at 23^{0}C	MPa	183	
Hot elongation, 15 min, 200^{0}C, 0.2 N/mm^2			IEO 811
on load	%	30	
after cooling	%	0	
Softening point temperature Vicat	^{0}C	126	ASTM D-1525
Specific heat at 23^{0}C	kJ/kg·K	1.92	
Thermal conductivity	W/m·k	0.38	
Linear thermal expansion coefficient	K^{-1}	1.9·10^{-4}	ADTM D-696

Pipes made of this material display lots of advantages.

Resistance to chemical and electrochemical corrosion

PEX is highly resistant to both acids and alkalines; as a result it can be used to convey such chemical substances without reducing its physical and mechanical properties.
Given that PEX is a bad conductor of electricity, it is not prone to destruction by stray current, which perforates metal pipe systems.

Resistance to abrasion

PEX pipes are highly resistant to abrasion. This feature makes them suitable for conveying solids in water or relining operations where the outer wall of the pipe slides along the inner wall of the pipe to be relined.
Absence of scale and mould
Metal pipes are rough inside, this causing scaling which reduces the bore of the pipe. Plastic pipes on the other hand are extremely smooth so that the risk of obstruction caused by the build-up of scale and mould is considerably reduced.

Low head loss

The surface of plastics is extremely smooth as it is free from the cracks and microflows, typical of metal pipes traditionally used for conveying water. This feature results in high flow rates and low head losses.

Low thermal conductivity

The low load conductivity of plastics with respect to metal is a very important factor in energy saving, the thermal conductivity of PEX being a mere 0.38 W/m·^{0}C, as against 45 W/m·^{0}C for steel, 52 W/m·^{0}C for cast iron, and 348 W/m·^{0}C for copper. Plastic pipes in fact reduce the formation of condensate on the outer surface, which is not hte case with metal pipes.

Low noise

One of the main features of PEX is its high coefficient of acoustic insulation, which considerably reduces the noise level during operation, even in presence of water hammering.

Rheological memory

This is a particular feature of PEX. When the pipe is heated to the softening temperature of around 130^0 C (i.e. the temperature at which the material becomes transparent), it is possible for the pipe to return to its original shape. This means that wrong bending or squashing can be easily corrected. However this operation must not be done on piping with an oxygen diffusion barrier as this would affect the multi-layer structure of the pipe.

Excellent workability

PEX pipes used in private dwellings usually come in coils. Since this material is extremely lightweight they can be handled without any special equipment. The average specific weight of PEX is 0.95 g/cm^3 as against 7.85 g/cm^3 for steet and 8.9 g/cm^3 for copper. A 100-metre coil of 2-mm pipe, diameter 16 mm, weighs around 9 kg.

Cold bending of PEX pipes can be done without any particular equipment. The radius of curvatrre can be up to eight times the diameter of the pipe. Hot bending is necessary for very small curvatures or high-pipe diameters. The pipe is heated by hot air to the softening temperature; when it becomes transparent it can be shaped as required. Once the pipe cools, it keeps its new shape. Due to its rheological memory, wrong bending can be corrected by reheating and repeating the operation. This must not be done on piping with an oxygen diffusion barrier as this would affect the multi-layer structure of the pipe.

Long life

Taking into account the normal pressure and temperature values in private dwellings and thanks to the excellent properties of PEX, pipe systems made up using this material have a life expectancy comparable to that of masonry. A pipe undergoes mechanical stress because of the inside pressure and thermal stress due to the temperature. Considering the property of PEX, the working temperature can range from - 100^{0}C to +110^{0}C.

At working temperature below 0^{0}C the pipe does not become brittle, as metal pipes typically do. However this does not mean that the pipe can withstand the huge stresses generated by the water freezing and expanding inside the pipe.

At temperatures above 0^{0}C, the regression curve of PEX gives the working pressure values for different temperatures for a working life of 50 years.

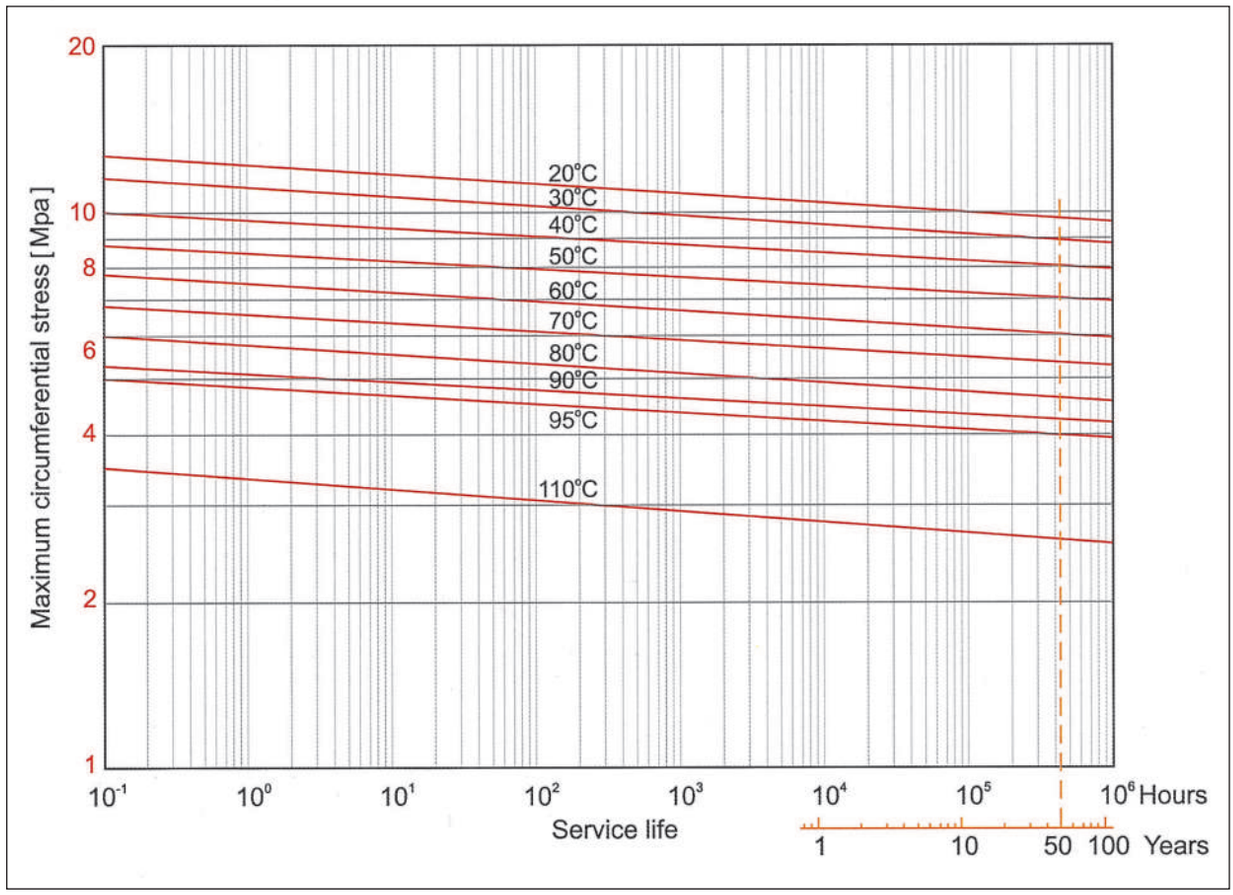
Non-toxicity

PEX pipes are hygienically and toxicologically suitable for conveying drinking water and meet the most rigorous standards, such as the Spanish, French, Irish and Italian ones.

2. Principles to select the size of PEX pipes

The mechanical features of cross-linked polyethylene, depending on the working temperature and life expectancy, are shown by regression curves (diagram 2.1) obtained from pressure tests carried out at different temperatures. The same curves show how the mechanical features of polyethylene decrease with time and as temperature increases.

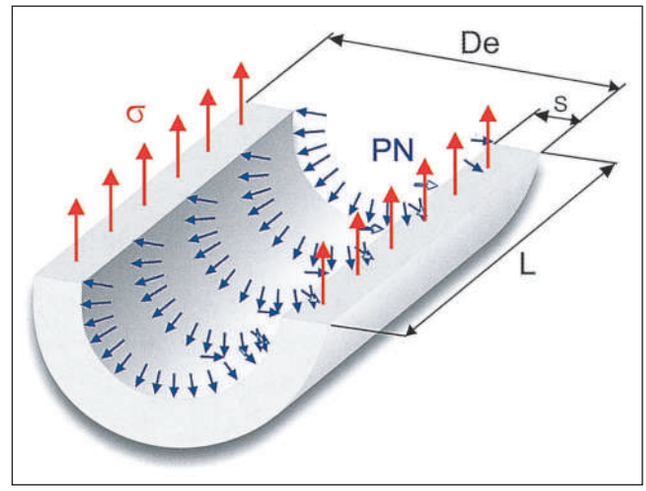
Diagram 2.1. Typical regression curves of cross-linked polyethylene (PEX)



The thickness of the pipe is based on design stress, generally indicated by σ (sigma). This value is obtained from the ratio between the maximum expected stress derived from the regression curves of temperature and established duration and a safety factor Cs that takes into account the variability of the working conditions.

The Cs factor may assume different values, depending on the reference standards. The European Standard EN ISO 15875 and the German DIN 16893 call for a value of 1.3 for temperatures less than or equal to 60°C and for higher temperatures.

Figure 2.1. Stresses acting into the axial cross section of the pipe



3. Physical and mechanical requirements

The physical and mechanical requirements of Unidelta PEX pipes to EN ISO 15875 are set out in the following table.

Table 3.1 Physical and mechanical requirements of Unidelta PEX pipes

Requirement	Unit	Value	Method
Internal stresses	%	$\leq$3	EN ISO 15875
Grade of cross-linking	%	$\geq$65	EN ISO 15875
Resistence to thermal oxidation (in oven at 160^{0}C, >16 hours)		No alterations	EN ISO 15875
Defects in the pipe wall (σ_1 = 7.5 MPa, σ_2 = 10 MPa)		No leakage	EN ISO 15875
Resistence to internal pressure (σ = 4.8 MPa, 95^{0}C, >1 hour)	hours	>1	EN ISO 15875
Resistence to internal pressure (σ = 4.6 MPa, 95^{0}C, >170 hours)	hours	>170	EN ISO 15875
Resistence to internal pressure (σ = 4.4 MPa, 95^{0}C, >1000 hours)	hours	>1000	EN ISO 15875

Conditions of use

The conditions of Unidelta PEX pipes to the European Standard EN ISO 15875 and the German standard DIN 16892 / 16893

Water temperature	Safely factor Cs	Service life [years]	Maximum working pressure [bar]	
			PN 16	PN 20
up to 60^{0}C	1.3	50	10	16
over 60^{0}C up to 80^{0}C	1.3	50	6	10
over 80^{0}C up to 95^{0}C	1.3	10	6	10

4. Dimensional features

The dimensional features of Unidelta PEX pipes to EN ISO 15875 are set out in the following table.

Unidelta PEX pipes PN16 (SDR 11) according to EN ISO 15875

De [mm]	s [mm]	Di [mm]	Ar [cm^2]	Au [cm^2]	J [cm^4]	Pt [kg/m]	Vf [l/m]
$10\ ^{+0.3}_{0}$	-	-	-	-	-	-	-
$12\ ^{+0.3}_{0}$	-	-	-	-	-	-	-
$14\ ^{+0.3}_{0}$	-	-	-	-	-	-	-
$15\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	11.0	0.82	0.95	$1.766 \cdot 10^{-1}$	0.081	0.095
$16\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	12.0	0.88	1.13	$2.199 \cdot 10^{-1}$	0.088	0.113
$17\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	13.0	0.94	1.33	$2.698 \cdot 10^{-1}$	0.094	0.133
$18\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	14.0	1.01	1.54	$3.267 \cdot 10^{-1}$	0.100	0.154
$20\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	16.0	1.13	2.01	$4.637 \cdot 10^{-1}$	0.112	0.201
$22\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	18.0	1.26	2.54	$6.346 \cdot 10^{-1}$	0.125	0.25
$25\ ^{+0.3}_{0}$	$2.3\ ^{+0.2}_{0}$	20.4	1.64	3.27	$1.067 \cdot 10^{0}$	0.162	0.33
$28\ ^{+0.3}_{0}$	$3.0\ ^{+0.3}_{0}$	22.0	2.36	3.80	$1.867 \cdot 10^{0}$	0.234	0.38
$32\ ^{+0.3}_{0}$	$3.0\ ^{+0.3}_{0}$	26.0	2.73	5.31	$2.904 \cdot 10^{0}$	0.27	0.53
$40\ ^{+0.4}_{0}$	$3.7\ ^{+0.3}_{0}$	32.6	4.22	8.35	$7.022 \cdot 10^{0}$	0.42	0.83
$50\ ^{+0.5}_{0}$	$4.6\ ^{+0.4}_{0}$	40.8	6.56	13.07	$1.708 \cdot 10^{1}$	0.65	1.31
$63\ ^{+0.6}_{0}$	$5.8\ ^{+0.5}_{0}$	51.4	10.42	20.75	$4.306 \cdot 10^{1}$	1.03	2.07
$75\ ^{+0.7}_{0}$	$6.9\ ^{+0.6}_{0}$	61.2	14.76	29.42	$8.645 \cdot 10^{1}$	1.46	2.94
$90\ ^{+0.9}_{0}$	$8.2\ ^{+0.8}_{0}$	73.6	21.07	42.54	$1.780 \cdot 10^{2}$	2.09	4.25
$110\ ^{+1.0}_{0}$	$10.0\ ^{+1.0}_{0}$	90.0	31.42	63.62	$3.966 \cdot 10^{2}$	3.11	6.36

Unidelta PEX pipes PN20 (SDR 7.4) according to EN ISO 15875

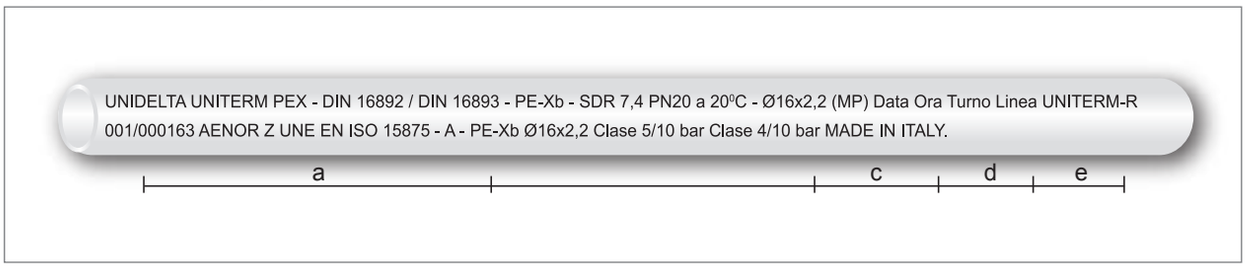
De [mm]	s [mm]	Di [mm]	Ar [cm^2]	Au [cm^2]	J [cm^4]	Pt [kg/m]	Vf [l/m]
$10\ ^{+0.3}_{0}$	$1.8\ ^{+0.1}_{0}$	6.4	0.46	0.32	$4.085 \cdot 10^{-2}$	0.046	0.032
$12\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	8.0	0.63	0.50	$8.168 \cdot 10^{-2}$	0.063	0.050
$14\ ^{+0.3}_{0}$	$2.0\ ^{+0.2}_{0}$	10.0	0.75	0.79	$1.395 \cdot 10^{-1}$	0.075	0.079
$15\ ^{+0.3}_{0}$	$2.5\ ^{+0.2}_{0}$	10.0	0.98	0.79	$1.994 \cdot 10^{-1}$	0.097	0.079
$16\ ^{+0.3}_{0}$	$2.2\ ^{+0.2}_{0}$	11.6	0.95	1.06	$2.328 \cdot 10^{-1}$	0.094	0.106
$17\ ^{+0.3}_{0}$	$2.3\ ^{+0.2}_{0}$	12.4	1.06	1.21	$2.939 \cdot 10^{-1}$	0.105	0.121
$18\ ^{+0.3}_{0}$	$2.5\ ^{+0.2}_{0}$	13.0	1.22	1.33	$3.751 \cdot 10^{-1}$	0.120	0.133
$20\ ^{+0.3}_{0}$	$2.8\ ^{+0.2}_{0}$	14.4	1.51	1.63	$5.743 \cdot 10^{-1}$	0.148	0.163
$22\ ^{+0.3}_{0}$	$3.0\ ^{+0.3}_{0}$	16.0	1.79	2.01	$8.282 \cdot 10^{-1}$	0.177	0.20
$25\ ^{+0.3}_{0}$	$3.5\ ^{+0.3}_{0}$	18.0	2.36	2.54	$1.402 \cdot 10^{0}$	0.233	0.25
$28\ ^{+0.3}_{0}$	$4.0\ ^{+0.3}_{0}$	20.0	3.02	3.14	$2.232 \cdot 10^{0}$	0.295	0.31
$32\ ^{+0.3}_{0}$	$4.4\ ^{+0.5}_{0}$	23.2	3.82	4.23	$3.725 \cdot 10^{0}$	0.38	0.42
$40\ ^{+0.4}_{0}$	$5.6\ ^{+0.6}_{0}$	28.8	6.05	6.51	$9.189 \cdot 10^{0}$	0.60	0.65
$50\ ^{+0.5}_{0}$	$6.9\ ^{+0.8}_{0}$	36.2	9.34	10.29	$2.225 \cdot 10^{1}$	0.92	1.03
$63\ ^{+0.6}_{0}$	$8.7\ ^{+1.0}_{0}$	45.6	14.84	16.33	$5.610 \cdot 10^{1}$	1.46	1.63
$75\ ^{+0.7}_{0}$	$10.4\ ^{+1.0}_{0}$	54.2	21.11	23.07	$1.130 \cdot 10^{2}$	2.08	2.31
$90\ ^{+0.9}_{0}$	$12.5\ ^{+1.0}_{0}$	65.0	30.43	33.18	$2.344 \cdot 10^{2}$	2.99	3.32
$110\ ^{+1.0}_{0}$	$15.2\ ^{+1.0}_{0}$	79.6	45.27	49.76	$5.216 \cdot 10^{2}$	4.41	4.98

De = outer diameter, s = thickness, Di = inner diameter, Ar = cross-sectional area of the pipe, Au = fluid cross-sectional area, J = geometric moment of inertia with respect to a diametrial axis, Pt = weight of pipe per linear metre, Vf = volume of fluid contained per linear metre.

5. Marking

Every metre of Unidelta PEX pipe to EN ISO 15875 is marked and full details are given as to pipe dimensions and application together with any other information necessary to find the product. (Figure 5.1)

Figure 5.1 This Marking comply with DIN 16892 / DIN 16893 and the new ISO 15875



6. Dezincification-resistant brasses

Dezincification resistant brasses for hot working or diecasting have been given a sub-section of their own because they are alpha-beta brasses above about 550°C but alpha brasses in the heat-treated conditon in which they are used. The most important dezincification resistant brass is CZ132/CW626N. It is most used, in the form of hot stampings and items machined from rod or bar, for the production of water fittings for use in areas where the supply causes meringue dezincification of alpha-beta brass. In the illustration of a stop tap, note the 'CR' mark indicating that fittings of the same type, supplied by the same manufacturer, have been tested for dezincification resistance, as laid down in the BS2872 and BS2874 specifications for CZ132/CW626N, and are approved by the water industry's Fittings Approvals Board.

Proprietary dezincification-resistant brasses, formulated on the same principle as CZ132/CW626N but usuallycontaining silicon and/or mangenese for greater fluidity, are used as diecastings for valve and water meter bodies, etc. The need for heat-treatment after casting, to ensure an all-alpha structure, can sometimes be avoided by controlled slow cooling through the temperature range 550°C to 450°C.
CW617N Brass is also available in Unidelta fittings range.

7. Bronze Fittings:

Bronze fittings are available in Unidelta production range. Bronze fittings are highly resistance to corrosion.

Unidelta Bronze alloy is C84400 with the following components

Components	Symbol	Percentage
Tin	Sn	2.5-3.5%
Lead	Pb	6-8%
Zinc	Zn	7-9%
Copper	Cu	Remaining

Pex Pipe

COD.	Ø
933816	16X2.2
933820	20X2.8

Female Elbow

COD.	Ø
3315	16 x 1/2
3320	16 x 3/4
3335	20 x 1/2

Plain Female Elbow

COD.	Ø
6001	16mmx1/2 "
6002	20mmx1/2 "

Female Elbow with neck

COD.	Ø
6003	16mmx1/2 "
6004	20mmx1/2 "

PVC Box with Screws

COD.
PEXA 0051

Coupling

COD.	Ø
5120	16 mm
5130	20 mm

Female Adaptor

COD.	Ø
5006	16 x 1/2
5008	16 x 3/4
5014	20 x 1/2
5016	20 x 3/4

Male Adaptor

COD.	Ø
6560	16 x 1/2
6565	16 x 3/4
6580	20 x 1/2
6585	20 x 3/4

Elbow 90

COD.	Ø
7210	16 x 16
7220	20 x 20

Male Elbow

COD.	Ø
3550	16 x 1/2
3555	16 x 3/4
3570	20 x 1/2

* All threaded/fittings are available in Bronze material.

Equal Tee

COD.	Ø
140505	16x16x16
140515	20x20x20

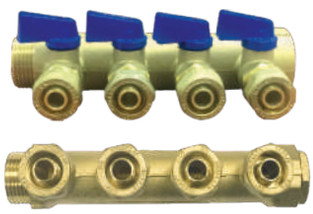
Female Thread Tee

COD.	Ø
160122	16x1/2x16
160128	20x1/2x20

Male Thread Tee

COD.	Ø
260122	16x1/2x16
260128	20x1/2x20

Brass Manifold



COD.	Ø
10700	1"x2way
10705	1"x3way
10710	1"x4way
10715	1"x5way
10755	3/4"x2way
10760	3/4"x3way
10765	3/4"x4way
10770	3/4"x5way

Female threaded coupling with wall disk

COD.	Ø
77150	16 x 1/2
77170	20 x 1/2

CONDUITS

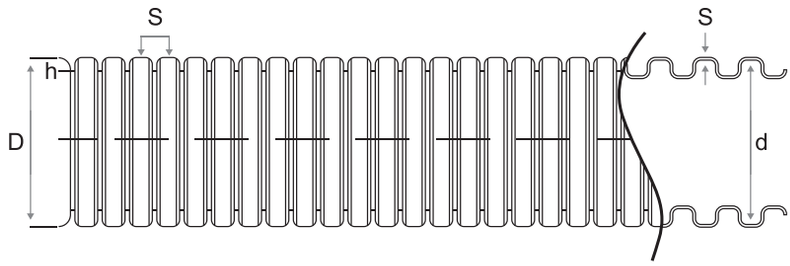
Made of 100% Virgin High Density Polyethylene used as protective sleeve for PEX Pipes installed in concrete.

Available In

Red Blue

Advantages:

- 100% Virgin raw material ensures unique flexibility
- Higher inner diameter
- Green Product
- Higher impact resistance thanks to smaller pitch distance between corrugations



Sym	Description	D25		D32	
		Value	Unit	Value	Unit
d	Avg./ Inside dia	20.13	mm	24.70	mm
D	Avg. Outside dia	24.89	mm	30.22	mm
S	Average Thickness	0.48	mm	0.67	mm
W/m	Meter-weight	47.69	g	66.79	g
P	Pitch Corrugation	4.05	mm	4.13	mm
h	Height Corrugation	2.46	mm	2.60	mm
Raw Material		Hight density Polyethylene Polypropylene			

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