

Ductile iron pipe solutions
for highly aggressive soils

TT PE / TT PUX range

**Water supply
and distribution**

DN 80 to 2000

N E W

EN 545: 2010

ISO 2531: 2009

**Compliant with
European standards**

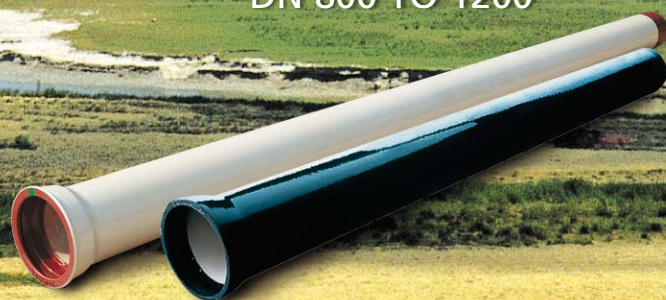
**EN 14628, EN 14901,
EN 15189, EN 15655**

**STANDARD TT PE
DN 600 TO 700**

**UNIVERSAL TT PE
DN 80 TO 700**

**UNIVERSAL TT PUX
DN 800 TO 1200**

**UNIVERSAL FITTINGS
DN 800 TO 1200**



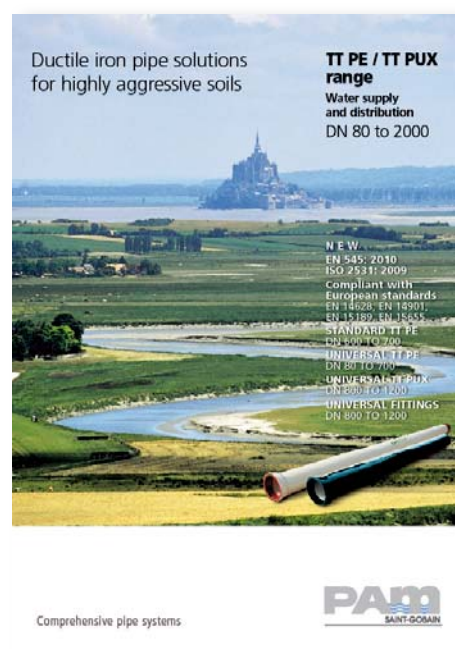
Comprehensive pipe systems

PAM
SAINT-GOBAIN



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Mont Saint-Michel is known all over the world for its architecture and the natural beauty of the site. It has been listed as a UNESCO world heritage site since 1979.

For decades, Saint-Gobain PAM has been using the surrounding salt marshes as a test bed for its new coatings, including the TT range of coatings.

The polders surrounding the mount are a particularly corrosive environment. Resistivity of the soil in the salt marshes near Mont-Saint-Michel is almost 100 Ω .cm, making the location an excellent natural test facility in which to assess the performances of ductile iron pipe coatings.

introduction

Ductile iron pipes are appreciated for their outstanding durability. Whenever water supply players require high quality of service, particularly in terms of performance, leaktightness and reliability, they systematically turn to ductile iron products. This applies both in industrialized nations (Europe, USA, Japan, etc.) and in the emerging countries such as China, India and Middle Eastern countries, where ductile iron is used to build hydraulic infrastructures. Not only is this infrastructure of strategic importance to their economic and industrial development, it also plays a key role in their populations' wellbeing.

Quality of the external coatings that protect pipes against the damaging effects of the soil is crucial. Saint-Gobain PAM has developed zinc-based active protection solutions to ensure durability of its buried ductile iron pipes. Although these coatings originally used pure zinc, ZINALIUM zinc-aluminium alloys is now gradually being introduced into the ranges. However, in extremely aggressive soils with marine water table, acidic peaty soils, soils contaminated by industrial pollution or subject to stray currents, for example, these active protection systems do not ensure the required durability. In these circumstances, rarely encountered in practice, the solution is to use products with passive coatings that totally isolate the pipe network.

Saint-Gobain PAM is the only European and global manufacturer to offer customers passive coatings for all such situations. Our comprehensive range of solutions includes pipes, fittings, anchored and non-anchored joints from DN 80 to DN 2000.

Saint-Gobain PAM plants manufacturing these products work with a number of cutting-edge technologies, including:

- TT PE: polyethylene coatings for pipes from DN 80 to 700
- TT PUX: epoxy polyurethane coatings for pipes from DN 800 to 2000*
- Thick epoxy coating for fittings
- Polyurethane coating for large-diameter fittings

These products comply with recently-introduced European standards relating to special coatings for ductile iron pipes intended for highly corrosive soils: EN 14628 for TT PE, EN 15189 for TT PUX, EN 14901 for epoxy coating for fittings, and EN 15655 for polyurethane coating for large-diameter fittings.

Compliance with these standards is the guarantee of a highly demanding level in terms of performances, production and quality control.

* Available on request in DN 100 to 700.

Highly aggressive soils

Buried pipes are subjected to various loads and aggressions, including soil and backfill corrosivity. Standard version of Saint-Gobain PAM pipes feature either a conventional zinc coating or the new ZINALIUM coating, which provide a sufficient level of corrosion resistance for most situations. However, the soils's corrosivity must be assessed to determine whether special protective measures and high performance coatings are required. Saint-Gobain PAM engineering teams carry out soil analyses on customers' request.

General corrosion indicators

General corrosion indicators are determined with a detailed map which indicates:

- Ground contours: high spots are drier and better aerated, therefore less corrosive; low spots are wet and unaerated, therefore likely to be more corrosive,
- Water-courses to be crossed, as well as wetlands, ponds, marshes, lakes, peatlands and other low areas rich in humic acids and bacteria, and often polluted,
- Estuaries, polders, salt marshes and saline soils bordering the sea.

Pollution and specific corrosion indicators

Using plans (available from public authorities), the following are determined:

- Areas polluted by various effluents, such as liquid manure, distillery, dairy, papermaking waste, or by sewage, mainly from households,
- Industrial wastes like slag, clinker, etc.,
- Nearby structures such as leaking effluent mains,
- Industrial plants or equipment using direct current electricity (cathodically protected structures, electric traction systems, plants, etc.).

This survey indicates the various strata crossed and provides information on the nature of the soil and its natural corrosivity





Highly aggressive soils

Based on an initial analysis, soil can be categorized as:

> Low risk: <ul style="list-style-type: none">• Sand and gravel• Hardcore materials• Limestone	> High risk: <ul style="list-style-type: none">• Marl• Clay	> Very high risk: <ul style="list-style-type: none">• Gypsum• Pyrites (iron pyrite, chalcopyrite: copper pyrite)• Salts for chemical industries (sodium chloride, lime sulphate)• Fossil fuels (lignite, peat, coal, bituminous materials).
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Any information relating to fossil present in the soil is valuable. In particular, the presence of pyritised ammonites indicates that the soil contains pyrites (iron sulphide) and is consequently highly corrosive, especially with its associated anaerobiosis.

Hydrogeology

Moisture is an aggravating factor in soil aggressivity.

A hydrogeological study can be conducted to identify aquifers and areas of impermeable land likely to trap water. The boundary of such areas is often marked by springs. Particular attention must be paid to this boundary as impermeable land can be highly corrosive. The same applies to water-bearing land, if water drains into it from neighbouring areas of land that contain sodium chloride, calcium sulphate or other soluble minerals.

Topographical and geological data can be corroborated and supplemented by visual observations, resistivity measurements and soil sample analyses performed during a field study.

The resistivity of a soil is indicative of its ability to sustain electrochemical corrosion of the metal in a pipe. This is a particularly significant parameter, as:

- It includes nearly all the factors that influence corrosivity (salt content, presence of water, etc.),
- It is very easy to measure on-site (using the "four points" Wenner method).

The various measurement points are chosen along the pipeline's forecast route. They are spaced at intervals determined by the topography of the land and the measured values. Soils with low resistivity tend to be highly corrosive and vice versa. Where the measured resistivity is less than 3,000 Ω per cm, it may be necessary to confirm the measurements with a soil sample at the depth at which the pipe is to be laid, and having its pH and its gross and minimum resistivity measured in a laboratory.



Protection solutions for highly aggressive soils

Experience acquired by Saint-Gobain PAM over several decades shows that a large proportion of soils is only weakly or moderately corrosive, enabling Saint-Gobain PAM pipes to be safely used with their standard, zinc, or ZINALIUM external protection.

Saint-Gobain PAM's offering is structured around 2 levels of protection:

- Standard solution – ZINALIUM for DN 60 to 600 (700 to 1000 alternatively) range and zinc for DN 700 to 2000 products for the vast majority of circumstances
- Special solution – TT PE for the DN 80 to 700 range, and TT PUX for DN 800 to 2000 products

Active versus passive protections?

The standard external protection for ductile iron pipes is generally based on the "active protection" principle.

Active protections Zinc: 200 g/m ² • ZINALIUM		Passive protections TT PE • TT PUX	
Advantages	Limitations	Advantages	Limitations
Long service life in most soils Easy transport and installation Self-healing process if damaged Suitable for use with natural backfill Excellent value for money	Not suitable for use in extremely aggressive soils (a few % of cases) Not suitable for use in the presence of stray currents	Resistant to extremely aggressive soils Suitable for use in the presence of stray currents	Susceptible to damage during transport Particular attention required when selecting and laying backfill No self-healing process Higher cost

The technical solutions implemented in the TT PE and PUX ranges are covered by the following European standards:

	DN 80 to 700	DN 800 to 1200	DN 1400 to 2000
Pipes / Standard	TT PE / EN 14628	TT PUX / EN 15189	TT PUX / EN 15189
Fittings / Standard	Epoxy / EN 14901	Epoxy / EN 14901	Polyurethane / EN 15655

Material	Specifications
Polyethylene	Polyethylene is produced by polymerization of ethylene monomer (CH ₂ = CH ₂) into a complex structure with the generic formula: – (CH ₂ – CH ₂) _n – High-density polyethylene has a density in excess of 0,94 g./cm ³
Polyurethane	Polyurethane is obtained by polymerizing urethane, an organic molecule. Urethanes are produced by a reaction between an isocyanate and an alcohol
EPOXY	Epoxy is the short form of the word epoxide. The term epoxy covers several epoxide molecules and, by extension, polyepoxide polymers. Once polymerized, epoxy is almost inert to oxygen and acts as a barrier

Tramways - TT PE and TT PUX offer the ideal solutions

Over the last few years, tramways have been making a comeback as a means of urban public transport. Stray currents generated by the tramway's electric power supply system can corrode metal unless appropriate protective measures are taken.

TT PE and TT PUX coatings are the best answer to this problem. The dielectric properties of the polyethylene or polyurethane layers dependably insulate ductile iron pipes against the effects of stray currents. Alternative coatings, particularly those based on cementitious materials, are unable to compete with this level of electrical insulation.



Field of use - Different coatings for different soil conditions

Specifications for ductile iron pipes' external coatings in accordance
with the European Standard EN 545: 2010 and international Standard ISO 2531: 2009.

External coating			
Location	ZINALIUM ZnAl 85-15 400 g/m ²	Zn 200 g/m ²	Range TT, PE or PUX
Above the water table	No limit (except specific situations described below)	Approved for soils with resistivity** greater than 1500 Ω.cm	APPROVED
In the water table	Approved for soils below the water table with resistivity greater than 500 Ω.cm	Approved for soils below the water table with resistivity** greater than 2500 Ω.cm	APPROVED
Acidic soils	PROHIBITED in acidic peaty soils	PROHIBITED in soils with pH ratings below 6 or with high acid reserves	APPROVED
Mixed soils	APPROVED	CAUTION! Additional analysis required on a case-by-case basis	APPROVED
Soils containing refuse, ash, slag or pollution resulting from solid or liquid industrial waste	PROHIBITED	PROHIBITED	APPROVED
Stray currents	PROHIBITED	PROHIBITED	APPROVED
Available in the PAM range	DN 60 to 600***	DN 700 to 2000*	DN 80 to 2000

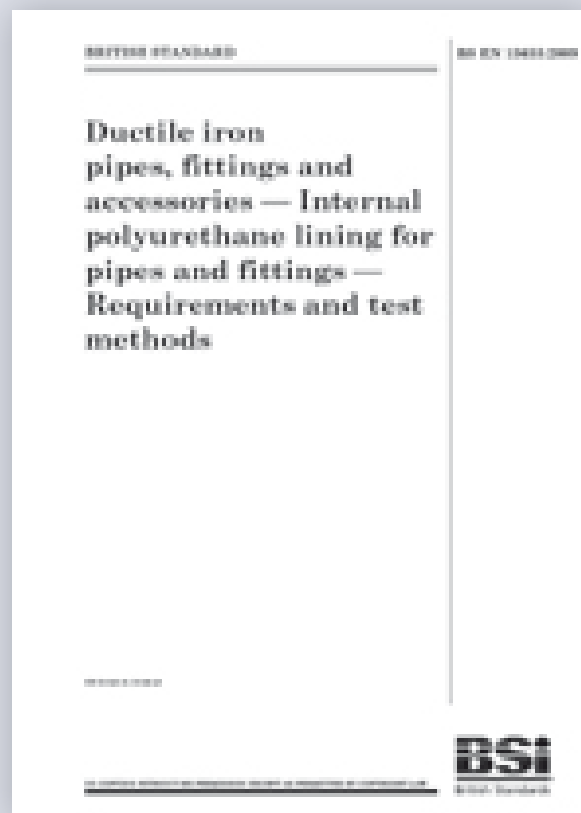
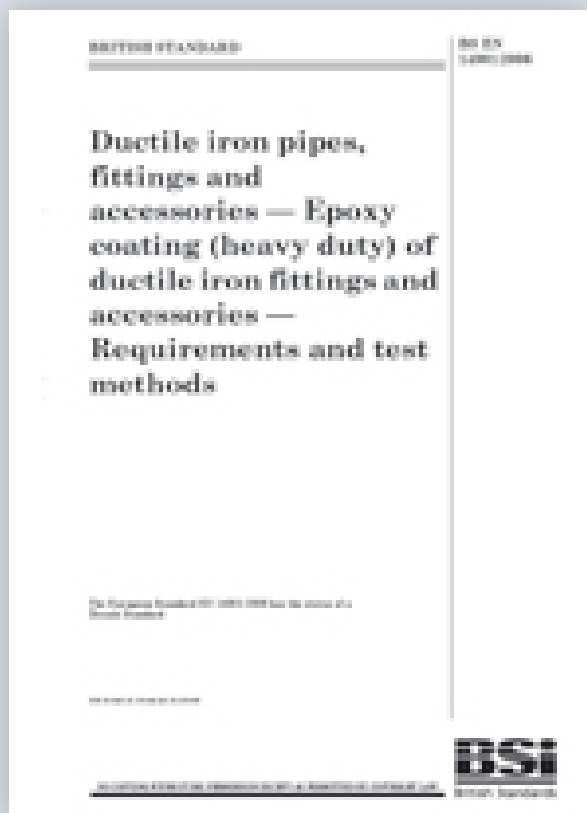
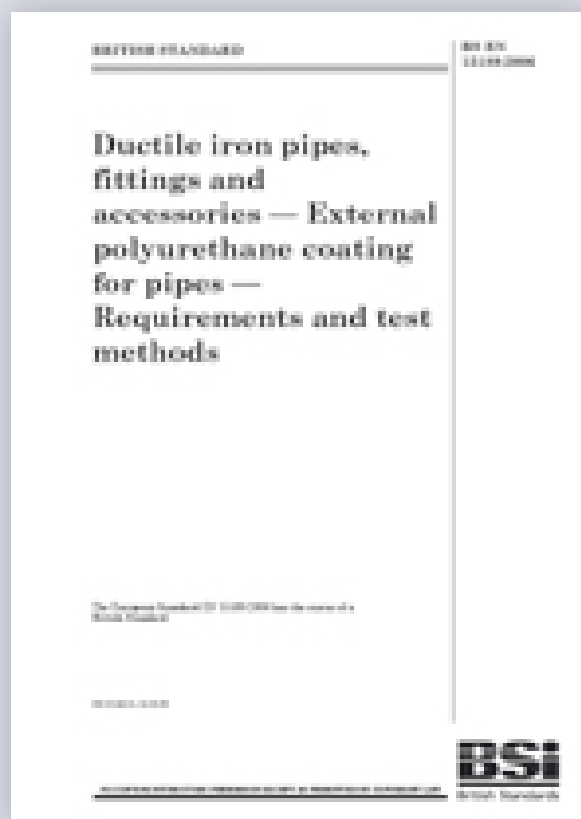
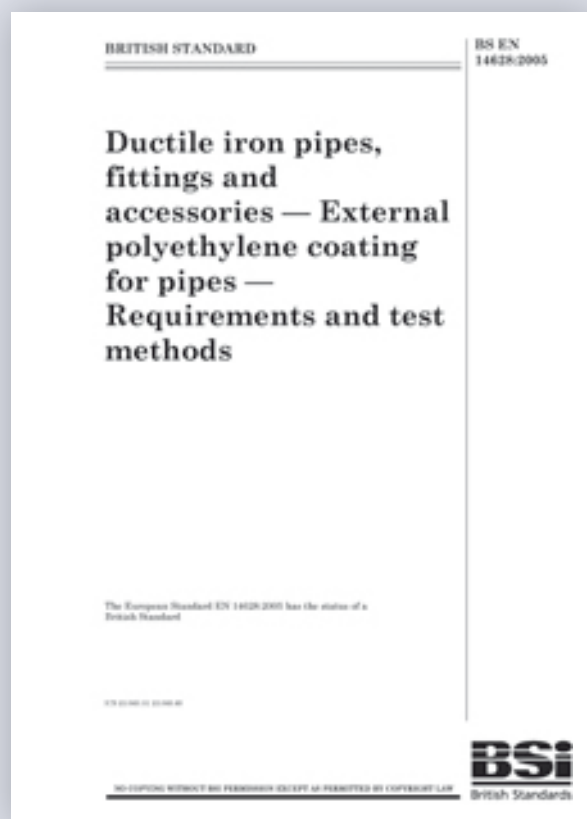
* Available on request in DN 100 to 600

** Resistivity measured of the laying depth of the pipe

*** Available on request from DN 700 to 1000

New European standards

The TT range complies with the four recently-introduced European standards relating to special coatings for ductile iron pipe systems.



Standards available at www.afnor.org
and www.bsigroup.com

The TT range on-site!





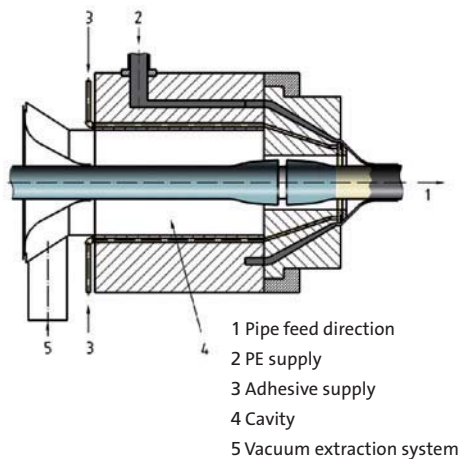
TT PE range - DN 80 to 700

A polyethylene coating applied in Saint-Gobain PAM factories

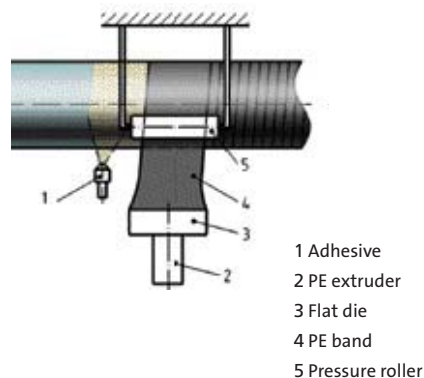
The polyethylene coating is extruded over the pipes at Saint-Gobain PAM plants. By performing this process in-house, the company is able to carefully monitor and control the conditions in which the coating is applied. After being coated, each pipe is individually tested using a holiday detector, to check that the coating affords uninterrupted protection by forming a sealed barrier against the external environment.

Two different manufacturing processes are used, depending on the diameter range:

Annular coextrusion for DN 80 to 500



Lateral extrusion for DN 600 and 700



Appearance of the TT-PE coating for DN ≤ 500



Appearance of the TT-PE coating for DN > 500

Exacting specifications

The polyethylene layer is thick enough to totally protect ductile iron pipes both in extremely aggressive soils and during transport and handling operations.

Thickness of the HDPE layer, as specified in EN 14628

	DN 80 to 100	DN 125 to 250	DN 300 to 450	DN 500 to 700
Thickness (μm)	1800	2000	2200	2500

NB:
1 mm = 1000 μm

Beware of imitations!

Lateral extruded TT PE pipes should not be confused with pipes covered with self-adhesive strips of PE material.

Lateral extrusion ensures that pipes are continuously protected and the PE layers fully welded.

Only PE coatings applied by annular coextrusion or lateral extrusion comply with the European standard EN 14628.

TT PE range - DN 80 to 700

Coating of the TT PE range satisfies an extremely detailed set of specifications that ensure outstanding performances.

Technical specifications of the high-density polyethylene coating, as specified in EN 14628

N°	Parameter	Requirement Refer to EN 14628 for precise definition of the test methods
1	Peeling resistance	10 N (on zinc-plated surface)
2	Shock resistance	Figure 2, category A
3	Indentation resistance	< 0,3 mm
4	Rupture elongation	> 200 %
5	Specific resistance of the coating when placed in a 0.1 M NaCl solution	> 10 ⁸ Ωm ²
6	Ratio of resistance	> 0,8
7	Thermal ageing, 100 days, 100°C	< ±35 %
8	Light ageing, 100 days, xenon arc lamp	< ±35 %
9	Saponification properties of the adhesive	Saponification value < 3 mg KOH/g

High-density polyethylene specifications, as defined in EN 14628

Property	Standard	Requirement
Fluidity value	EN ISO 1133	0,2 g/10 min at 1,0 g/10 min
Density	EN ISO 1183-1	0,910 g/cm ³ at 0,960 g/cm ³

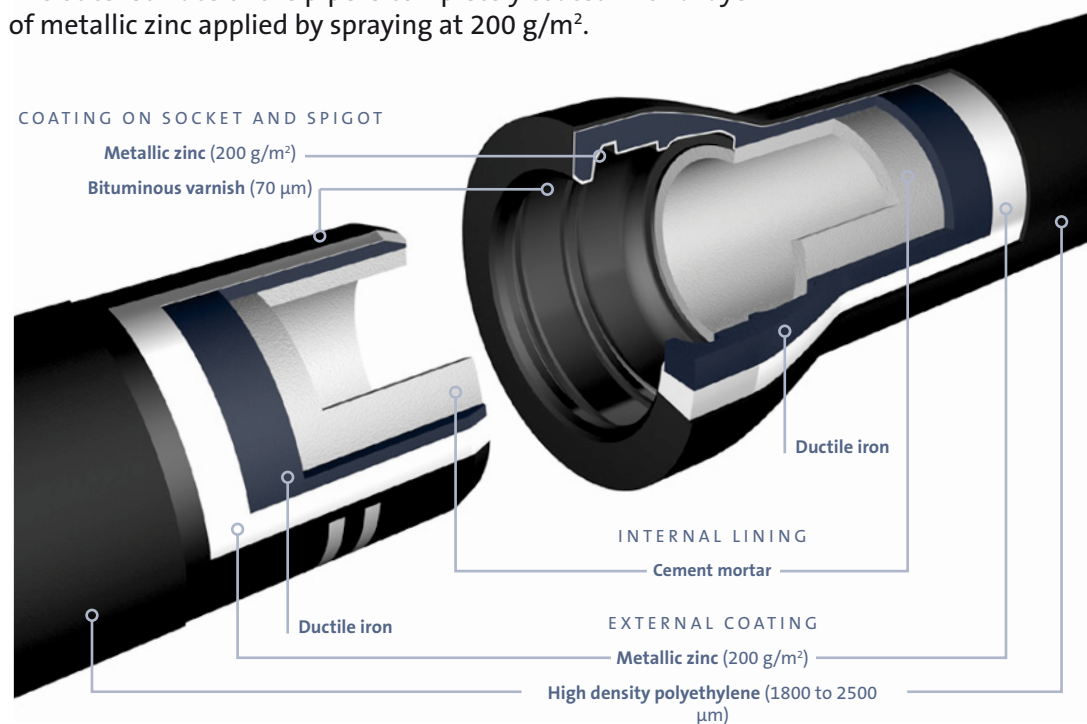
Polyethylene adherence is ensured on the whole surface of the pipe by a regular layer of high-performance adhesive, specially chosen for its durability.

Adhesive specifications, as defined in EN 14628

Property	Standard	Requirement
Softening point	EN 1238	70 to 112°C
Saponification value	EN ISO 3681	< 3 mg KOH/g
Viscosity	EN ISO 3219	> 4 000 mPa.s at 180 °C Thermosel Brookfield Sp 21/5 min ⁻¹

Detailed view of the TT PE pipe protection system

The outer surface of the pipe is completely coated with a layer of metallic zinc applied by spraying at 200 g/m².



The STANDARD TT PE coating is intended for use at permanent operating temperatures up to 50°C. For further information about applications involving high storage temperatures, please contact our sales engineers.

Joints' specific protection

Joints' protection system consists of:

- An elastomer sleeve, for DN 80 to 300
- A heat-shrink collar, for DN 350 to 700

When using pipes with anchored joints (STANDARD Vi, UNIVERSAL Vi or STANDARD Ve) in a saline external environment, a heat-shrink collar must be used instead of the standard elastomer sleeve.



DN 80 to 300

Joints protected by an elastomer sleeve



DN 350 to 700

Joints protected by a heat-shrink collar



TT PUX range - DN 800 to 2000

A polyurethane coating applied in Saint-Gobain PAM factories

The polyurethane coating is applied on pipes at Saint-Gobain PAM plants. By performing this process in-house, the company is able to carefully monitor and control the conditions in which the coating is applied. After being coated, each pipe is individually tested using a holiday detector, to check that the coating affords uninterrupted protection by forming a sealed barrier against the external environment.

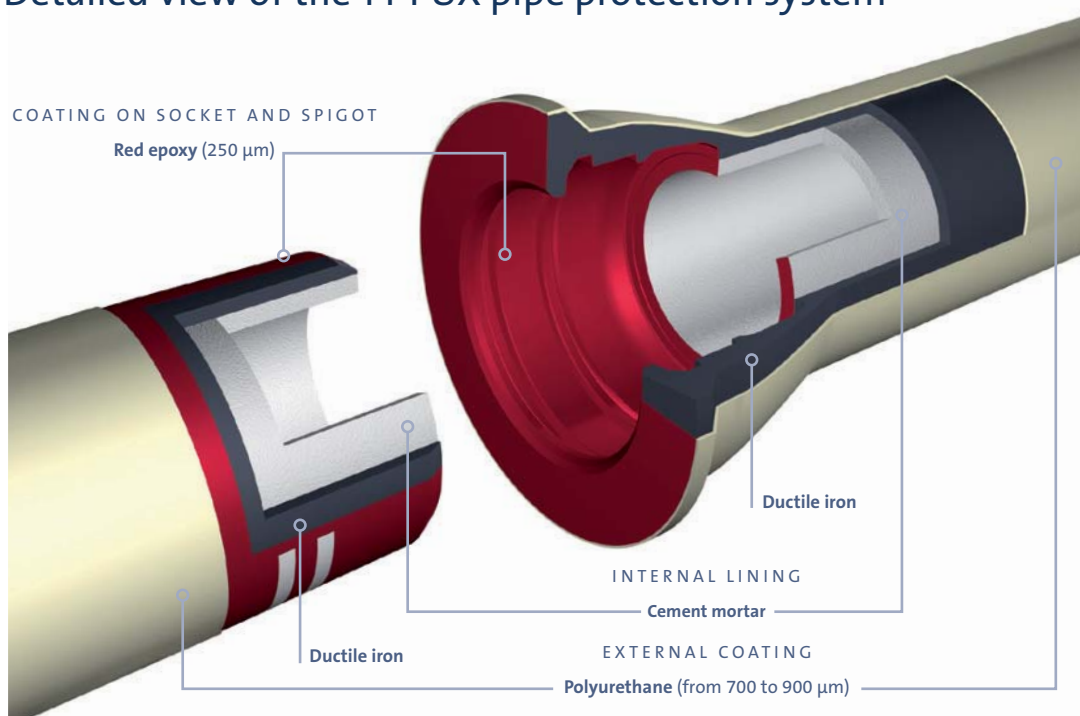
The polyurethane used by Saint-Gobain PAM is a solvent-free two-component system. The pipe is prepared by shotblasting it and then heating it to a temperature at which the coating can be applied by spraying it on.

For the pipes of Saint-Gobain PAM's TT PUX range:

- The pipe barrel is coated with polyurethane
- The spigot and socket are coated with epoxy resin

Epoxy resin (which complies with the standard EN 14901) is used instead of polyurethane at the spigot end and inside the socket as it provides equivalent protection with a thinner coating. This enables greater control over joint's insertion conditions.

Detailed view of the TT PUX pipe protection system





"Hot climate" applications

In countries with hot climates (in particular certain African and Middle Eastern countries). Saint-Gobain PAM can provide TT PUX pipes for DN 100 to 700.

Contact our sales engineers for more detailed specifications relating to these complementary products, and the situations in which it is better to choose the TT PUX range.

TT PUX range - DN 800 to 2000

Exacting specifications

The polyurethane layer is thick enough to totally protect ductile iron pipes both in extremely aggressive soils and during transport and handling operations.

Coating thickness of TT PUX pipes

	Barrel	Socket	Spigot
Average thickness (µm)	900	250	250
Minimum thickness (µm)	700	200	200
Material	Polyurethane	Epoxy	Epoxy

NB : 1 mm = 1000 µm

Technical specifications of the polyurethane coating, as per EN 15189

N°	Parameter	Requirement
		Refer to EN 15189 for precise definition of the test methods
1	Chemical resistance	Less than 15% weight increase after being submerged in deionised water. Less than 2% weight loss after drying.
1	Chemical resistance	Less than 10 % weight increase after being submerged in sulphuric acid. Less than 4 % weight loss after drying.
2	Shock resistance	8 J/mm of PU on the polyurethane-coated pipe barrel
3	Indentation resistance	< 10 % at 10 MPa
4	Rupture elongation	> 2.5 %
5	Specific resistance of the coating when placed in a 0.1 M NaCl solution	> 10 ⁸ Ω.m ²
6	Resistance ratio	> 0.8
7	Adherence	> 8 MPa at 23°C
8	Non-porosity	No electrical puncture when holiday detector is used

The TT PUX coating is suitable for use at permanent operating temperatures up to 50°C.

Simplified specific protection for joints

Like other ductile iron pipe systems, TT PUX pipes are easy to lay, thanks to the epoxy coating on both ends of pipes. No additional protection operations are required on site after pipe sections have been assembled, except where anchored joints are used. (a special coating must be applied on the joints, see the "Working with the TT PUX range" section).

Fittings coatings

An epoxy coating compliant with the European standard EN 14901

The epoxy coating process for fittings involves shotblasting and heating of the fitting before application of epoxy powder. Two processes can be used to apply the powder:

- Spraying with an electrostatic spray gun
- Dipping in a fluidized bed

The blue epoxy coating has an average thickness of at least 250 µm (see technical specifications in the table below)

The surface to be coated must be perfectly clean and free from oil, grease and moisture. It must comply with the requirements for preparation standard Sa 2.5, as defined in EN ISO 8501-1.

Fittings coated with this type of coating are suitable for use buried in corrosive and highly-corrosive soils, or for carrying aggressive or corrosive water.

Technical specifications of the epoxy coating, as per EN 14901

N°	Parameter	Requirement
		Refer to EN 14901 for a precise definition of the test methods
1	Shock resistance	No electrical puncture permitted following a 5 J shock.
2	Indentation resistance	The measured indentation depth must not exceed 30% of the coating thickness initially measured.
3	Non-porosity	The coated surface must remain non-porous when subjected a voltage of 1,500 V (except in designated singular areas).
4	Epoxy coating cross-linkage	Methylisobutylcetone test.
5	Resistance to thermal ageing in air	No electrical puncture permitted.
6	Resistance to thermal ageing in water	Adherence ≥ 6 MPa.
7	Adherence	Average value ≥ 8 MPa.
8	Thickness	≥ 250 µm.



Applying powder using a spray gun



Applying powder by dipping in a fluidized bed

When used in the conditions for which they are designed, in permanent or temporary contact with water intended for human consumption, coatings applied to ductile iron fittings and accessories must not under any circumstances affect the quality of the piped water to the extent that it no longer satisfies national regulatory requirements. Powder-deposited blue epoxy coating is compatible with tap water and has been granted health approval certification in France (Attestation de Conformité Sanitaire) as well as in many other countries.

The epoxy coating is suitable for use at permanent operating temperatures up to 50°C.



A polyurethane coating compliant with the European standard EN 15655

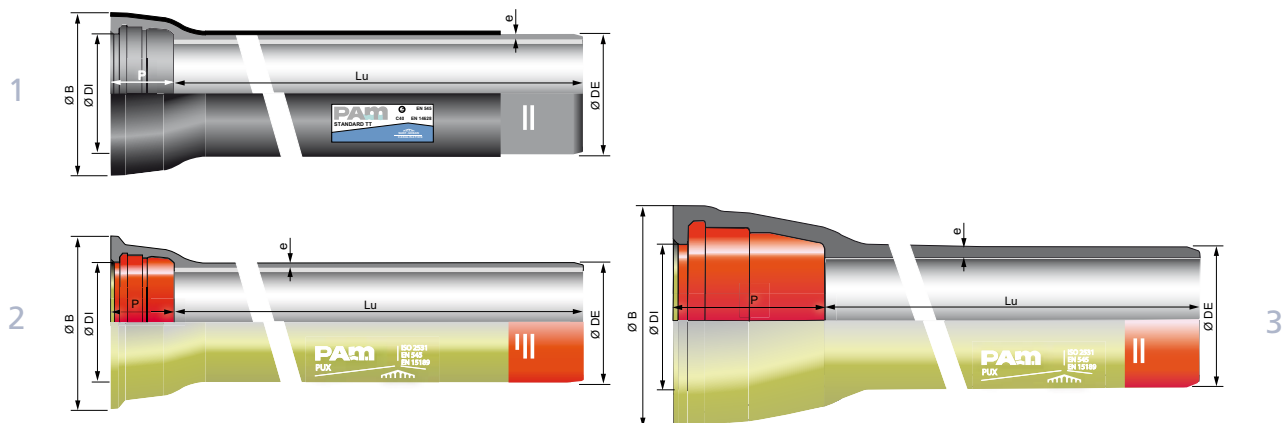
The polyurethane coating can be used as an alternative to the epoxy coating applied to fittings. Polyurethane is of particular benefit when manufacturing very large products.

The average thickness of the polyurethane coating is greater than 1300 µm in the case of products up to DN 200, and exceeds 1500 µm for larger diameters.* The polyurethane coating has very similar technical specifications to the epoxy coating, albeit adapted for the material's specificities (refer to the standard EN 15655 for detailed specifications). The polyurethane coating is suitable for use at permanent operating temperatures up to 45°C.



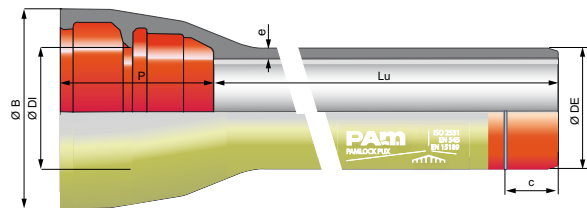
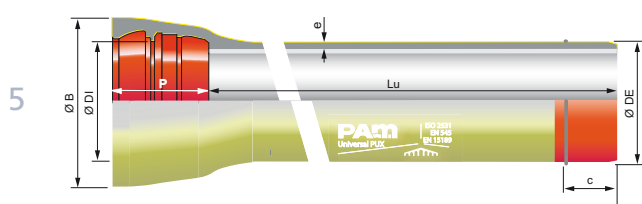
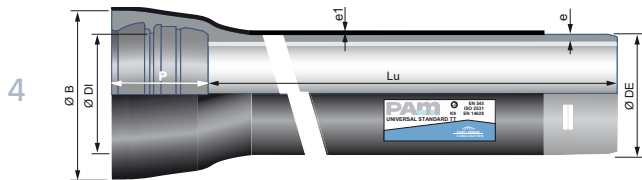
* Minimum thickness > 800 µm

Pipe specifications



STANDARD TT PE and PUX pipes

DN	L m	Class	e nominal mm	DE mm	DI mm	P mm	B mm	TT weight kg	Coating type	Min. thick coating µm
80	6.00	C40	4.4	98.0	101.4	92.5	167.0	76.8	PE	1800
100	6.00	C40	4.4	118.0	121.4	94.5	188.0	93.5	PE	2000
125	6.00	C40	4.4	144.0	147.4	97.5	215.0	115.3	PE	2000
150	6.00	C40	4.5	170.0	173.4	100.5	242.0	140.1	PE	2000
200	6.00	C40	4.7	222.0	225.2	106.5	295.0	190.8	PE	2000
250	6.00	C40	5.5	274.0	276.8	105.5	352.0	267.3	PE	2000
300	6.00	C40	6.2	326.0	328.8	107.5	409.2	351.1	PE	2200
350	6.00	C30	6.4	378.0	380.9	110.5	464.2	425.5	PE	2200
400	6.00	C30	6.5	429.0	431.9	112.5	516.2	501.7	PE	2200
450	6.00	C30	6.9	480.0	483.0	115.5	574.2	590.9	PE	2200
500	6.00	C30	7.5	532.0	535.0	117.5	629.2	704.7	PE	2500
600	6.00	C30	8.7	635.0	638.1	132.5	738.5	942.0	PE	2500
700	6.00	C25	8.8	736.6	741.0	145.0	863.0	1161.3	PE	2500
800	6.95	C25	9.6	840.4	845.0	145.0	974.0	1591.7	PUX	700
900	6.95	C25	10.6	943.2	948.0	145.0	1082.0	1940.2	PUX	700
1000	6.95	C25	11.6	1046.0	1051.0	155.0	1191.0	2323.0	PUX	700
1100	8.19	C25	12.6	1151.0	1154.0	160.0	1300.0	3238.1	PUX	700
1200	8.18	C25	13.6	1252.3	1258.0	165.0	1412.0	3775.9	PUX	700
1400	8.17	C25	15.7	1462.0	1465.0	245.0	1592.0	5182.5	PUX	700
1500	8.16	C25	16.7	1565.0	1568.0	265.0	1710.0	5877.8	PUX	700
1600	8.16	C25	17.7	1668.0	1671.0	265.0	1816.0	6589.4	PUX	700
1800	8.14	C25	19.7	1875.0	1878.0	275.0	2032.0	8109.7	PUX	700
2000	8.13	C25	21.8	2082.0	2085.0	290.0	2253.0	9837.6	PUX	700



UNIVERSAL and PAMLOCK TT PE and PUX pipes

DN	L m	Class	e* nominal mm	DE mm	DI mm	P mm	B mm	Bead mm	TT weight kg	Coating type	Min. thick coating µm
80	6.00	C100	6.1	98.0	100.5	112.0	159.0	-	97.9		1800
100	5.95	C100	6.1	118.0	128.0	140.0	188.0	90	120.4	PE	2000
125	5.95	C64	6.1	144.0	153.0	140.0	215.0	87	149.4	PE	2000
150	6.00	C64	6.2	170.0	180.0	148.0	230.0	95	179.8	PE	2000
200	5.96	C64	6.5	222.0	232.0	155.0	290.0	100	246.9	PE	2000
250	5.95	C50	6.8	274.0	284.0	166.0	350.0	110	320.9	PE	2000
300	5.95	C50	7.4	326.0	336.0	180.0	408.0	115	413.9	PE	2200
350	5.97	C40	7.7	378.0	389.0	184.0	463.0	115	512.9	PE	2200
400	5.97	C40	8.1	429.0	440.0	176.0	510.0	113	602.9	PE	2200
450	5.97	C40	8.6	480.0	491.0	190.0	570.0	120	718.9	PE	2200
500	5.97	C40	9.3	532.0	544.0	200.0	625.0	125	854.2	PE	2500
600	5.97	C40	10.9	635.0	647.0	209.0	740.0	135	1148.8	PE	2500
700	5.97	C30	10.8	736.6	741.7	256.0	855.0	158	1399.9	PE	2500
800	6.89	C30	11.7	840.4	845.8	261.0	980.0	150	1915.5	PUX	700
900	6.87	C30	12.6	943.2	948.9	280.0	1087.0	155	2332.1	PUX	700
1000	6.88	C30	13.5	1046.0	1052.0	279.5	1191.0	165	2696.6	PUX	700
1200	8.15	C30	16.5	1252.3	1260.0	279.5	1415.0	170	4515.8	PUX	700
1400	8.12	C25	17.1	1462.0	1465.0	300.0	1620.0	170	5601.8	PUX	700
1500	8.11	C25	18.0	1565.0	1568.0	315.0	1758.0	180	6330.8	PUX	700
1600	8.11	C25	18.9	1668.0	1671.0	325.0	1868.0	195	7069.4	PUX	700
1800	8.08	C25	20.7	1875.0	1878.0	350.0	1950.0	222	8602.4	PUX	700
2000	Contact us	Contact us	Contact us	Contact us	Contact us	Contact us	Contact us	Contact us	Contact us	PUX	700

* : PAM internal specifications. Pipe wall thickness may be higher than the values specified in ISO 2531:2009 or EN 545:2010 in order to guarantee the PFA, PMA and PEA values given in tables pages 24 and 25 of the anchored joints.

Pipe specifications

Standard TT PE range DN 80 to 700

	STANDARD TT PE	UNIVERSAL TT PE ^A	Flange ^B
Pipe coating	PE	PE	Epoxy powder
Fittings coatings	Epoxy powder	Epoxy powder	Epoxy powder
Pipe	DN 80 to 700	DN 80 to 700	DN 40 to 700
Bend	DN 60 to 700	DN 80 to 700	DN 40 to 700
1/8 Bend	DN 60 to 700	DN 80 to 700	DN 40 to 700
1/12 Bend	-	DN 80 to 700	-
1/16 Bend	DN 60 to 700	DN 80 to 700	DN 40 to 700
1/32 Bend	DN 60 to 700	DN 80 to 700	DN 40 to 700
Duckfoot bend	-	-	DN 40 to 700
Taper	DN 60 to 700	DN 100 to 700	DN 40 to 700
Collar	-	-	DN 40 to 700
3-Spigot tee	-	-	DN 40 to 700
Washout tee	DN 250 to 700	-	DN 40 to 700
Level invert tee	DN 150 to 700	-	DN 40 to 700
Cross	-	-	DN 80 to 600
Flanged socket	DN 60 to 700	DN 80 to 700	-
Flanged spigot	DN 60 to 700	DN 80 to 700	-
Blank flange	-	-	DN 80 to 700
Reducing flange	-	-	DN 100 to 700
Non-anchored joint	STANDARD DN 60 to 700	DN 80 to 700	Reinforced flat joint
Anchored joint with inserts	STANDARD Vi DN 60 to 600	UNIVERSAL Vi DN 80 to 600	-
Anchored joint with bead	-	UNIVERSAL Ve DN 100 to 700	-

^A UNIVERSAL fittings DN 350 and 450 not yet available

^B Flanged parts with PN 10, 16 and 25 flanges. PN 40 flanges for certain DN's. Please contact us.

Other flanged parts also available. Please contact us. DN 40 to 600: Rotatable flanges. DN 700: Fixed flanges.

Joint's protection

-	DN 80 to 300	DN 350 to 700
STANDARD TT PE	Elastomer sleeve	Heat-shrink collar



Standard TT PUX range - DN 800 to 2000

	STANDARD TT PUX	UNIVERSAL/PAMLOCK TT PUX ^A	Flange ^B
Pipe coating	PU	PU	Epoxy powder or PU
Fittings coatings	Epoxy powder or PU	Epoxy powder or PU	Epoxy powder or PU
Pipe ^D	DN 800 to 2000	DN 800 to 1800	DN 800 to 2000
Bend	DN 800 to 1000	-	DN 800 to 1200
1/8 Bend	DN 800 to 2000	DN 800 to 1800	DN 800 to 2000
1/16 Bend	DN 800 to 2000	DN 800 to 1800	DN 800 to 2000
1/32 Bend	DN 800 to 2000	DN 800 to 1800	DN 800 to 2000
Duckfoot bend	-	-	DN 800 to 1200
Taper	DN 800 to 2000	DN 1400	DN 800 to 2000
Collar	Use EXPRESS collar ^C	-	DN 800 to 1200
2-Socket tee	DN 800 to 2000	DN 800 to 1800	-
3-Socket tee	DN 800 to 2000	-	-
3-Spigot tee	-	-	DN 800 to 2000
Washout tee	DN 800 to 2000	-	DN 800 to 1600
Level invert tee	DN 800 to 1600	-	DN 800 to 2000
Flanged socket	DN 800 to 2000	DN 800 to 1800	-
Flanged spigot	DN 800 to 2000	DN 800 to 1800	-
Blank flange	-	-	DN 800 to 2000
Reducing flange	-	-	DN 800 to 1600
Non-anchored joint	STANDARD DN 800 to 2000	DN 800 to 1800	Reinforced flat joint
Anchored joint with bead	STANDARD Ve DN 800 to 1200	UNIVERSAL Ve/PAMLOCK DN 700 to 1800	-

^A UNIVERSAL Ve from DN 800 to 1200 and PAMLOCK from DN 1400 to 1800. UNIVERSAL DN 1100 not available. For DN 2000, please contact us.

^B Flanged parts with PN 10, 16 and 25 flanges. PN 40 flanges for certain DN's. Other flanged parts also available. Please contact us.
DN 40 to 600: Rotatable flanges. DN 700 and above: Fixed flanges.

^C EXPRESS collar available in DN 800, 900, 1000, 1100, 1200, 1400 and 1600. The DN 1500, 1800 and 2000 are currently under development (release date: 2011)

^D For DN 80 to 700, Please consult us.

Note: Certain fittings may not exist in DN 1100. Please contact us.

Joint's protection

-	DN 80 to 300	DN 350 to 700	DN 800 to 2000
STANDARD TT PUX	No additional protection	No additional protection	No additional protection

However, where anchored joints are used, a special coating must be applied on the joints (see the "Working with the TT PUX range" section).



Joints and anchoring solutions' performances

TT PE range - DN 80 to 700



Protection of
TT PE pipes
for transport

DN	Class				PFA bar				PMA bar				PEA bar				Angular deflection (°)			
	STANDARD TT PE	STANDARD TT PE Vi	UNIVERSAL TT PE Vi*	UNIVERSAL TT PE Ve*	STANDARD TT PE	STANDARD TT PE Vi	UNIVERSAL TT PE Vi	UNIVERSAL TT PE Ve	STANDARD TT PE	STANDARD TT PE Vi	UNIVERSAL TT PE Vi	UNIVERSAL TT PE Ve	STANDARD TT PE	STANDARD TT PE Vi	UNIVERSAL TT PE Vi	UNIVERSAL TT PE Ve	STANDARD TT PE	STANDARD TT PE Vi	UNIVERSAL TT PE Vi	UNIVERSAL TT PE Ve
80	C40	C40	C100	-	40	16	60	-	48	19	72	-	53	24	77	-	5	5	3	-
100	C40	C40	C100	C100	40	16	56	64	48	19	67	77	53	24	72	82	5	5	3	3
125	C40	C40	C64	C64	40	16	52	64	48	19	62	77	53	24	67	82	5	5	3	3
150	C40	C40	C64	C64	40	16	48	60	48	19	58	72	53	24	63	77	5	5	3	3
200	C40	C40	C64	C64	40	16	43	52	48	19	52	62	53	24	57	67	5	4	3	3
250	C40	C40	C50	C50	40	16	39	46	48	19	47	55	53	24	52	60	5	4	3	3
300	C40	C40	C50	C50	40	16	34	41	48	19	41	49	53	24	46	54	5	4	3	3
350	C30	C30	C40	C40	30	16	25	38	36	19	30	46	41	24	35	51	4	3	3	3
400	C30	C30	C40	C40	30	16	20	35	36	19	24	42	41	24	29	47	4	2	3	3
450	C30	C30	C40	C40	30	13	16	32	36	16	19	38	41	21	24	43	4	2	3	3
500	C30	C30	C40	C40	30	11	16	30	36	13	19	36	41	18	24	41	4	2	2	3
600	C30	C30	C40	C40	30	10	16	30	36	12	19	36	41	17	24	41	4	2	2	2
700	C25	C25	C30	C30	25	-	-	27	30	-	-	32	35	-	-	37	4	-	-	2

* : refer to note page 21

Note: Contact us for Standard TT PUX Ve in diameter 100 to 700.



TT PUX range - DN 800 to 2000

DN	Class				PFA bar				PMA bar				PEA bar				Angular deflection (°)			
	STANDARD TT PUX	STANDARD TT PUX Ve	UNIVERSAL TT PUX Ve*	PAMLOCK TT PUX*	STANDARD TT PUX	STANDARD TT PUX Ve	UNIVERSAL TT PUX Ve	PAMLOCK TT PUX	STANDARD TT PUX	STANDARD TT PUX Ve	UNIVERSAL TT PUX Ve	PAMLOCK TT PUX	STANDARD TT PUX	STANDARD TT PUX Ve	UNIVERSAL TT PUX Ve	PAMLOCK TT PUX	STANDARD TT PUX	STANDARD TT PUX Ve	UNIVERSAL TT PUX Ve	PAMLOCK TT PUX
800	C25	C25	C30	-	25	16 ^A 20 ^B	25	-	30	19 ^A 24 ^B	30	-	35	24 ^A 29 ^B	35	-	4	2	2	-
900	C25	C25	C30	-	25	16 ^A 20 ^B	25	-	30	19 ^A 24 ^B	30	-	35	24 ^A 29 ^B	35	-	4	1.5	1.5	-
1000	C25	C25	C30	-	25	16 ^A 20 ^B	25	-	30	19 ^A 24 ^B	30	-	35	24 ^A 29 ^B	35	-	4	1.5	1.2	-
1100	C25	C25	-	-	25	16 ^A 20 ^B	-	-	30	19 ^A 24 ^B	-	-	35	24 ^A 29 ^B	-	-	4	1.5	-	-
1200	C25	C25	C25/ C30**	-	25	16 ^A 20 ^B	20/25	-	30	19 ^A 24 ^B	24/29	-	35	24 ^A 29 ^B	29/55	-	4	1.5	1.2	-
1400	C25	-	-	C25	25	-	-	25	30	-	-	30	35	-	-	35	3	-	-	1
1500	C25	-	-	C25	25	-	-	25	30	-	-	30	35	-	-	35	3	-	-	1
1600	C25	-	-	C25	25	-	-	25	30	-	-	30	35	-	-	35	3	-	-	1
1800	C25	-	-	C25	25	-	-	16	30	-	-	19	35	-	-	24	2.5	-	-	0.8
2000	C25	-	-	C25	25	-	-	-	30	-	-	-	25	-	-	-	2	-	-	-



Protection of
TT PUX pipes
for transport

* : Refer to note page 21

** : available in C25 or C30

^A Values obtained with iron bolts

^B Values obtained with specific bolts and support plates

The EXPRESS joint of collars has a PFA of 25 bar.





Working with the TT PE range

Storing pipes and fittings

Pipes and fittings must be stored on flat ground that has been cleared of any projecting stones.

Fittings should be stored arranged by type and by diameter, on planks or timber supports. They should not be stacked unless suitable protection is inserted between its parts to prevent damage to the epoxy coating.

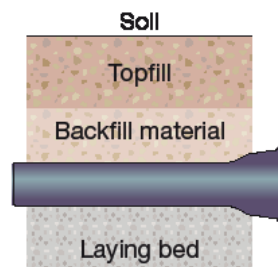
Earthworks

If the ground at the site is likely to damage the coating (due to the presence of rocks, blocks of stone, etc.), a laying bed of at least 10 cm deep should be prepared.

After laying the pipeline, the same precautions apply to the backfill with which the pipeline is covered.



Markings
on TT PE pipes



Protection of joints - pipes and fittings from DN 80 to 300

- Check the chamfer at the spigot end.
- Slide the sleeve onto the pipe's spigot (phases 1 and 2).
If necessary, use lubricant paste.
- Socket the pipe and inspect the joint (phase 3).
- Fold back the sleeve (phase 4).
- Slide the sleeve over the socket to protect the joint (phases 5 and 6).



These holes make the sleeve
easier to fit. Handy!



Working with the TT PE range

Protection of joints - Pipes and fittings from DN 350 to 700

- Check the chamfer at the spigot end.
- Mark the heat-shrink collar, dividing it into three thirds (phase 1).
- Slide the collar behind the socket (phase 2).
- Socket the pipe and inspect the joint (phase 3).
- Use a cloth to clean the area to be protected.
- Use abrasive paper to key an area of the polyethylene equivalent to the width of the collar, on spigot and socket (phase 3).
- Use a gas burner to warm the keyed polyethylene area (phase 4). Warm the area but do not allow the temperature to exceed 60°C.
- Remove the protective sheet inside the collar.
- Centre the collar on the joint to be protected (phase 5), with one third over the socket.
- Using a gas burner (set to low heat), heat-shrink the collar by sweeping the flame across its entire surface several times, starting at the large-diameter end of the socket (phases 6 7 8).
- The procedure is complete when adhesive can be seen overlapping slightly on each side of the sleeve (phase 9).



Cutting DN 80 to 700 pipes

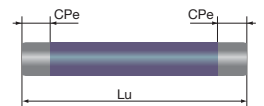
Pipe sections cannot be assembled with the polyethylene coating. The polyethylene coating must be removed and the cut prepared for as follows:

- When cutting pipes with DN up to 300, use only 2/3 of the pipe; when DN 350 or larger pipes must be cut, use only "calibrated" pipes.
- These pipes should be specified when ordering.
- Draw the cut (along the working length (Lu)), taking into account the socket's depths.
- Cut the pipe



Cutting the polyethylene coating

- Mark the boundaries of the area of polyethylene to be cut off (CPe)



Polyethylene removal area ("CPe") (mm)

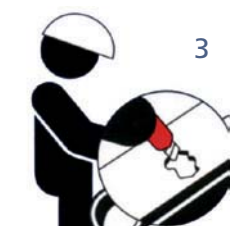
DN	80	100	125	150	200	250	300	350 - 400	450	500	600	700
STANDARD TT pipes	95	100	105	105	110	115	120	120	125	125	140	200
UNIVERSAL TT pipes	115	145	145	155	160	170	185	190	200	210	220	270

- Cut the polyethylene coating back to the metal. Use a coal chisel, cutter or pipe cutter, taking care not to chip or gouge the iron. ¹
- If using a pipe cutter, bring the wheels into contact with the iron and then back them off a half-turn before making the cut.
- Make a longitudinal cut to enable the polyethylene to be lifted off.



Pre-heating and removing the polyethylene

- Use a gas burner to warm the area of polyethylene to be removed from the inside of the pipe, taking care to avoid damaging the cement mortar lining.
- Slowly raise the temperature without exceeding 40°C (it should be possible to place your bare hand on the cement lining).
- After allowing the heat to diffuse, use a coal chisel to lift the polyethylene and tear it off with pliers. The adhesive should also be removed, remaining bonded to the polyethylene. ²



Repairing DN 80 to 700 pipes

- Cut the damaged PE coating evenly and cleanly. It is essential to remove any torn polyethylene. ^{1 2}
- Clean and dry the damaged area.
- Preheat the ductile iron to 60°C and apply mastic M to the bare metal. ³
- Smooth the mastic with a knife.
- Place the repair strip over the area thus prepared. This strip should extend for 50 mm on either side of the repair. ⁴
- Use a gas burner to heat the repair strip until the heat-sensitive paint changes colour. ⁵
- Complete the procedure by pressing down firmly on the strip, wearing a glove.





Working with the TT PUX range

Storing pipes and fittings

Pipes and fittings must be stored on flat ground that has been cleared of any projecting stones.

Fittings should be stored arranged by type and by diameter, on planks or timber supports.

They should not be stacked unless suitable protection is inserted between its parts to prevent damage to the polyurethane or epoxy coatings.

Earthworks

If the ground at the site is likely to damage the coating (due to the presence of rocks, blocks of stone, etc.), a laying bed of at least 10 cm deep should be prepared.

After laying the pipeline, the same precautions apply to the backfill with which the pipeline is covered.

Protection of joints

Considering the nature of the coating applied to these pipes and fittings, no additional protection is required for the standard joints used with these products. In case of anchored joint, a protection of the junction by a heat-shrink collar must be applied (see p.28).

Cutting DN 800 to 2000 pipes

Pipe sections can directly be assembled with the polyurethane coating.

Unless "calibrated" pipes have been ordered, a circumference meter must be used to measure the external diameter of the pipe before cutting.

Maximum external diameter, including the polyurethane coating (mm)

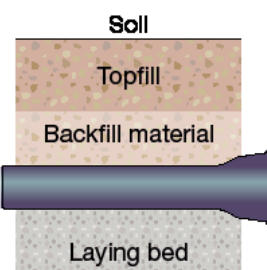
DN	800	900	1000	1100	1200	1400	1500	1600	1800	2000
Max. DE	844.2	947.2	1050.2	1153.2	1257.0	1464.2	1567.2	1670.2	1877.2	2084.2

Repairing DN 800 to 2000 pipes

- Strip the damaged area, removing any areas of coating that do not adhere to the metal. Clean any surface oxidation. **1**
- Use abrasive paper to key the coating around the damaged area to form a good bonding surface. **2**
- Clean, degrease and preheat the surface before applying the repair product (at a temperature of approximately 50°C). **1**
- Mix equal quantities of resin and hardener. Prepare small amounts at a time because the repair material remains usable for only 30 minutes at 40°C.
- Apply the mixture using a spatula. **2**
- Self-adhesive strip may be applied to protect the repair, provided that the polymerization reaction is already well underway, i.e. if the product feels dry to the touch. **3**



Markings
on TT PUX pipes





Saint-Gobain PAM packages TT range products with great care, to ensure that they are supplied in perfect conditions. These products should be handled using appropriate tools.

Saint-Gobain PAM supplies special handling hooks designed specifically for the TT product range. Contact us for more information.

Repairing the epoxy coating on DN 60 to 2000 fittings and accessories

- Strip the damaged area and clean any surface oxidation.
- Use abrasive paper to key the coating around the damaged area to form a good bonding surface.
- Clean, degrease and preheat the surface before applying the epoxy resin (at a temperature of approximately 50°C).
- Mix equal quantities of resin and hardener.
Prepare small amounts at a time because the repair material remains usable for only 30 minutes at 40°C.
- Apply the epoxy compound using a spatula or paintbrush.
- Allow to dry, away from moisture. Do not handle while the epoxy is drying



Packaging and repairing

- Packaging of TT fittings is designed to keep the protective coating intact all along the supply chain.
- In the event of damage despite these precautions, Saint-Gobain PAM supplies a range of repair products for TT pipes and fittings, to ensure that affected areas are once again fully protected.



Connecting TT PE pipes

Connecting collars, available in sizes DN 80 to 250, can be fitted directly over the HDPE coating on TT PE pipes. Bolts should be tightened to at least 8 m.daN.

For DN 300 to 700 pipes, the PE polyethylene coating must be removed before fitting the collar. The assembly must then be corrosion-protected with a heat-shrink collar (or equivalent protection).

PAM supplies a range of connecting collars with reinforced coatings for TT products.



Depending on the corrosivity risk of the soil, a heat-shrink collar may be required to provide additional protection to the connection. For further information, please contact our sales engineers.

Horizontal directional drilling

Innovative technology to minimize pipelaying-related nuisances

Economic development, technological advances and population growth have led to a huge increase in the number and diversity of buried networks' systems.

If required, trenchless pipelaying techniques such as guided horizontal directional drilling and pipe bursting offer an effective, targeted solution for limiting the impact of pipelaying works.

The pipes fitted with UNIVERSAL Ve joints and coated with special external coating of type TT PE and TT PUX are ideally suited for horizontal directional drilling and in situ laying.

The exceptional mechanical strength of UNIVERSAL Ve type anchored joints combined with their ability to high angular deflection enable to draw lengths of several hundred meters without any risk of dislocation when pulling loads are applied.

Permissible pulling forces (kN) for various pipe diameters and pulling lengths

DN	Pipe pulling lengths in horizontal directional bores - in km									
	0 to 0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	
100	87	84	80	77	73	70	66	63	59	
125	114	109	105	100	96	91	87	82	78	
150	136	131	125	120	114	109	104	98	93	
200	201	193	185	177	169	161	153	145	137	
250	271	260	250	239	228	217	206	195	184	
300	342	329	315	301	287	274	260	246	233	
350	426	409	392	375	358	341	324	307	290	
400	506	486	465	445	425	405	384	364	344	
450	579	556	533	510	486	463	440	417	394	
500	667	640	614	587	560	533	507	480	453	
600	855	821	787	752	718	684	650	616	581	
700	1000	961	921	881	841	801	761	721	681	
800 to 1000	Contact us									

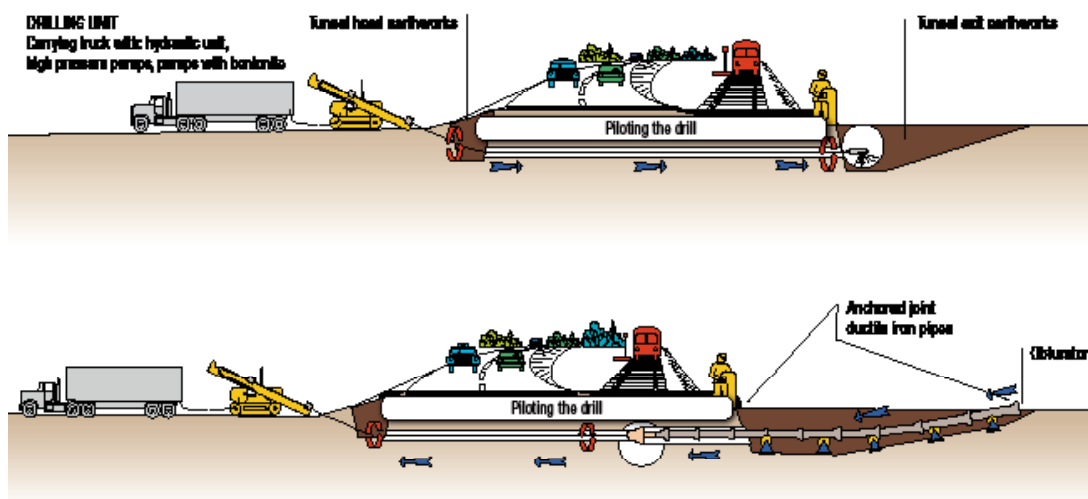


TT PE pipe train
ready to be pulled
by horizontal directional drilling

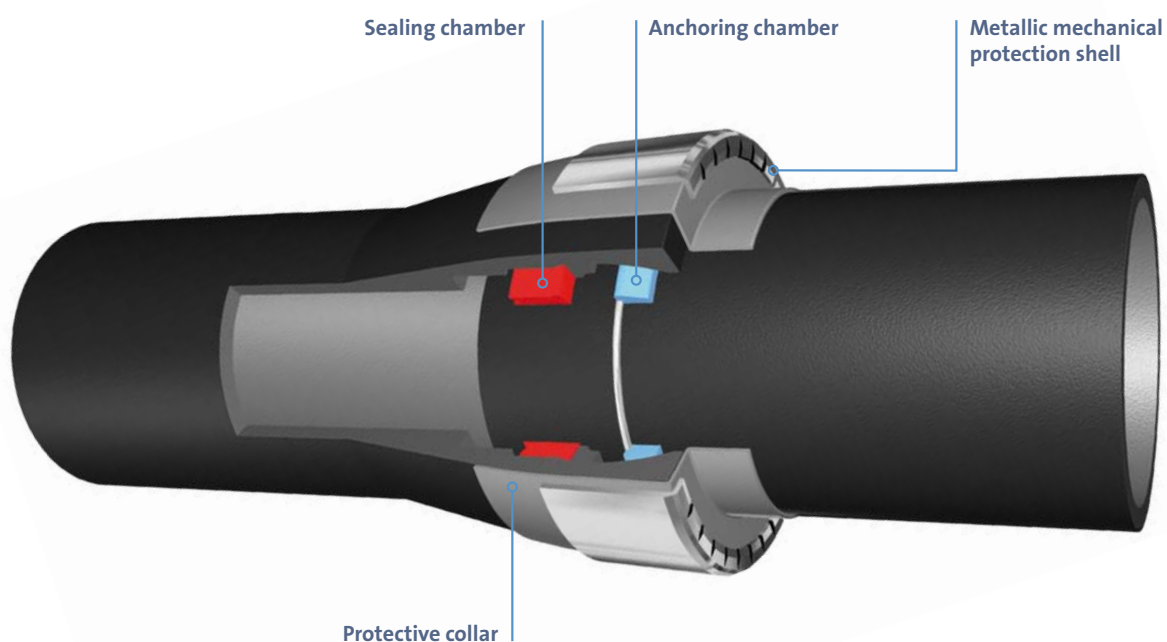
For DN exceeding 300, ballasting of pipes is a solution which allows the contractor to reduce the pulling forces.

These recommendations are based upon Saint-Gobain PAM knowledge of the products and their use. It is the contractor's responsibility to ensure that installation is carried out according to the best rules of practice.

Refer to our brochure "There are places where discretion is a paramount" for further information about PAM horizontal directional drilling range.



Detailed view of a joint used in horizontal directional drilling



Quality and environmental organization

ISO 9001

Saint-Gobain PAM develops pipe systems solutions within the framework of an ISO 9001-compliant quality management system. ISO 9001 compliance is certified by Bureau Veritas, an independent organization. This certification covers an extremely wide scope, including design, manufacturing and sales activities.

ISO 14001

As of 2009, Saint-Gobain's French facilities have all been awarded ISO 14001 certification by accredited independent organizations (Bureau Veritas and AFAQ). The Group has introduced an environmental policy with regularly-monitored, measurable objectives. This approach has set in motion a virtuous circle of continuous improvement in terms of environmental performances. This certification system is the bedrock of the environmental aspect of Saint-Gobain PAM's commitment to sustainable development

EN 545, EN 14901, EN 14628, EN 15189 and EN 15655

TT range coatings are compatible with the general standard relating to ductile iron pipelines dedicated to water supply and distribution. They also comply with the standards EN 14901, EN 14628, EN 15655 and EN 15189 (see page 8)

ACS health approval certification

TT range coatings comply with French statutory requirements relating to materials in contact with tap water. The (epoxy and black varnish) external coatings liable to come into contact with tap water (in particular at the spigot end of pipes) have been awarded a certificate of conformity (*Attestation de Conformité Sanitaire - ACS*). The same applies in the other European countries that have equivalent systems (Germany, UK, Italy, Belgium, Netherlands, etc.).



SAINT-GOBAIN PAM worldwide

ALGERIA

SAINT-GOBAIN PAM ALGERIE
Z.I. Sidi Abdelkader-Ben Boulaid - BP 538
09000 - BLIDA - Algeria
Phone: + 213 (0) 25 36 00 60

ARGENTINA

SAINT-GOBAIN PAM ARGENTINA
Bouchard y Enz
1836 - LLAVALLOL - BUENOS AIRES - Argentina
Phone: + 54 11 42 98 9600

AUSTRALIA

SAINT-GOBAIN PAM
15 Edgars Road -
THOMASTOWN VIC 3074 - Australia
Phone: + 61 (0) 3 9358 6122

AUSTRIA

**SAINT-GOBAIN GUSSROHRVERTRIEB
OSTERREICH GmbH**
Gussrohr Vertriebs Österreich - Archenweg, 52
A6020 - INNSBRUCK - Austria
Phone: + 43 5123 417 170

BELGIUM

SAINT-GOBAIN PIPE SYSTEMS
Raatshovenstraat, n°2
B-3400 - LANDEN - Belgium
Phone: + 31 21 88 01 20

BRAZIL

SAINT-GOBAIN CANALIZACAO LTDA
Praia de Botafogo 440 7° andar
22250-040 - RIO DE JANEIRO - RJ - Brazil
Phone: + 55 21 2128 1677

CHILE

SAINT-GOBAIN PAM CHILE
Antillanca Norte 600
Parque Industrial Vespucio, Comuna de Pudahuel
SANTIAGO DE CHILE - Chile
Phone: + 562 444 13 00

CHINA

SAINT-GOBAIN PAM CHINA (SHANGAI)
1716 Ocean Tower
550 Yan'An East Road - SHANGAI 200001 - China
Phone: + 86 21 6361 2142

SAINT-GOBAIN PAM CHINA (XUZHOU)

Jinshangqiao Development Zone
PC 221004 - XUZHOU - China
Phone: + 86 516 8787 8107

SAINT-GOBAIN PAM CHINA (MAANSHAN)

Hua Gong Road Cihu
PC 243052 - MAANSHAN Anhui Province - China
Phone: + 86 555 350 8003

COLOMBIA

SAINT-GOBAIN PAM COLOMBIA
Terminal terrestre de carga de Bogota
Etapa 1, Bodega 9, Modulo 3
Km 3,5 costado sur autopista - Medellin
COTA CUNDINAMARCA - Colombia
Phone: + 57 (1) 841 5832

CZECH REPUBLIC

SAINT-GOBAIN PAM CZ S.R.O.
Polygon House - Doudlebska 5/1699
14000 PRAHA 4 - Czech Republic
Phone: + 420 246 088 611

FINLAND

SAINT-GOBAIN PIPE SYSTEMS OY
Nuijamiestentie 3A
FIN-00400 - HELSINKI - Finland
Phone: + 358 207 424 600

FRANCE & DOM-TOM

SAINT-GOBAIN PAM (HEAD OFFICE)
91 Avenue de la Libération
54076 NANCY CEDEX - France
Phone: +33 3 83 85 20 00

SAINT-GOBAIN PAM

(France Commercial Department)
CRD – Chemin de Blénod – B.P. 109
54704 PONT A MOUSSON CEDEX - France
Phone: +33 3 83 80 73 00

SAINT-GOBAIN PAM

(Europe and International Commercial Departments)
21 avenue Camille Cavallier
54705 - PONT A MOUSSON CEDEX - France
Phone: + 33 3 83 80 73 50

SAINT-GOBAIN PAM

(Local Agency of The Antilles)
Rue Alfred Lumière - ZI de Jarry - BP 2104
97122 - BAIE MAHAULT - Guadeloupe
Phone: + 33 590 26 71 46

SAINT-GOBAIN PAM

(Local Agency of Indian Ocean)
16, Rue Claude Chappe - ZAC 2000
97420 - LE PORT - Reunion Island
Phone: + 33 262 55 15 34

GERMANY

SAINT-GOBAIN PAM DEUTSCHLAND
Saarbrucker Strasse 51
66130 - SAARBRUCKEN - Germany
Phone: + 49 681 87 010

GREECE

SAINT-GOBAIN SOLINOURGEIA
5 Klissouras Street
GR 14410 - METAMORFOSI - ATHENS - Greece
Phone: + 30 210 28 30 043

HONG KONG

SAINT-GOBAIN PIPELINES
H15/F Hermes Commercial Centre - 4-4A Hillwood Road
TSIM SHA TSUI - KOWLOON - Hong Kong
Phone: + 852 27 35 78 26

INDIA

SAINT-GOBAIN PAM
Grindwell Norton Ltd
5th Level, Leela Business Park - Andheri-Kurla Road
MUMBAI - 400059 - India
Phone: + 91 22 402 12 121

ITALY

SAINT-GOBAIN PAM ITALIA SPA
Via Romagnoli n°6
I-20146 - MILAN - Italy
Phone: + 39 02 42 431

JORDAN

SAINT-GOBAIN PAM REGIONAL OFFICE
Abu Zaid Center - Office # 8
35 Saad Bin Abi Waqqas St, - PO BOX 831000
11183 AMMAN - Jordan
Phone: + 962 6 551 4438

MEXICO

SAINT-GOBAIN PAM MEXICO
HORACIO 1855-502 - Colonia Los Morales - Polanco
11510 - MEXICO D.F. - Mexico
Phone: + 52 55 5279 1657

NETHERLANDS

SAINT-GOBAIN PIPE SYSTEMS
Markerkant 10-17
NL-1316 - ALMERE - Netherlands
Phone: + 31 36 53 333 44

NORWAY

SAINT-GOBAIN VAN OG AVLØP AS
c/o Maxit - Brobekkveien 84
N-0584 - OSLO - Norway
Phone: + 47 23 17 58 60

PERU

SAINT-GOBAIN PAM PERU
Avenida de los Faisanes N° 157 - Chorillos
LIMA 09 - Peru
Phone: + 511 252 40 34/35

POLAND

**SAINT-GOBAIN CONSTRUCTION PRODUCTS POLSKA
SP Z.O.O**
Ul. Cybernetyki 21
PL-02-677 WARSZAWA - Poland
Phone: + 48 22 751 41 72

PORTUGAL

SAINT-GOBAIN PAM PORTUGAL
Est. Nac. 10 - Lugar de D. Pedro -Apartado 1708
P-2691-901 - SANTA IRIA DE AZOIA - Portugal
Phone: + 351 218 925 000

ROMANIA

SAINT-GOBAIN CONDUCTE
S Park - Str. Tipografilor nr. 11-15
Sector 1 - Cod 013714
BUCURESTI - Romania
Phone: + 40 21 207 57 25

SLOVAKIA

SAINT-GOBAIN CONSTRUCTION
Stara Vajnorska 139
83104 - BRATISLAVA - Slovakia
Phone: + 421 265 45 69 61

SOUTH AFRICA

SAINT-GOBAIN PIPELINES SOUTH AFRICA
275 Stephenson Road
Pretoria Industrial - Gauteng - PO BOX 631
PRETORIA 0001 - South Africa
Phone: +24 12 380 46 79

SPAIN

SAINT-GOBAIN PAM ESPANA SA
Paseo de la Castellana n°77 - Edificio Ederra - Planta 10
E-28046 - MADRID - Spain
Phone: + 34 91 397 20 00

UNITED ARAB EMIRATES

SAINT-GOBAIN PAM
PO BOX 47102 - Building N° 1092 - Villa N° 7
Muroor Road - ABU DHABI - United Arab Emirates
Phone: + 971 2 448 20 10

UNITED KINGDOM

SAINT-GOBAIN PAM UK
Lows Lane - Stanton-by-Dale
ILLKESTON - DERBYSHIRE - DE7 4QU
United Kingdom
Phone: + 44 115 930 5000

VIETNAM

SAINT-GOBAIN PAM
17 Ngo Gia Thieu, Ward 7 - District 3
HO CHI MINH CITY - Vietnam
Phone: +84 8 393 07273

www.pamline.com

SAINT-GOBAIN PAM

Head office

91, avenue de la Libération
54076 NANCY CEDEX
FRANCE

Marketing Department

21, avenue Camille Cavallier
54705 PONT-A-MOUSSON CEDEX
FRANCE
Phone: +33 (0)3 83 80 73 50