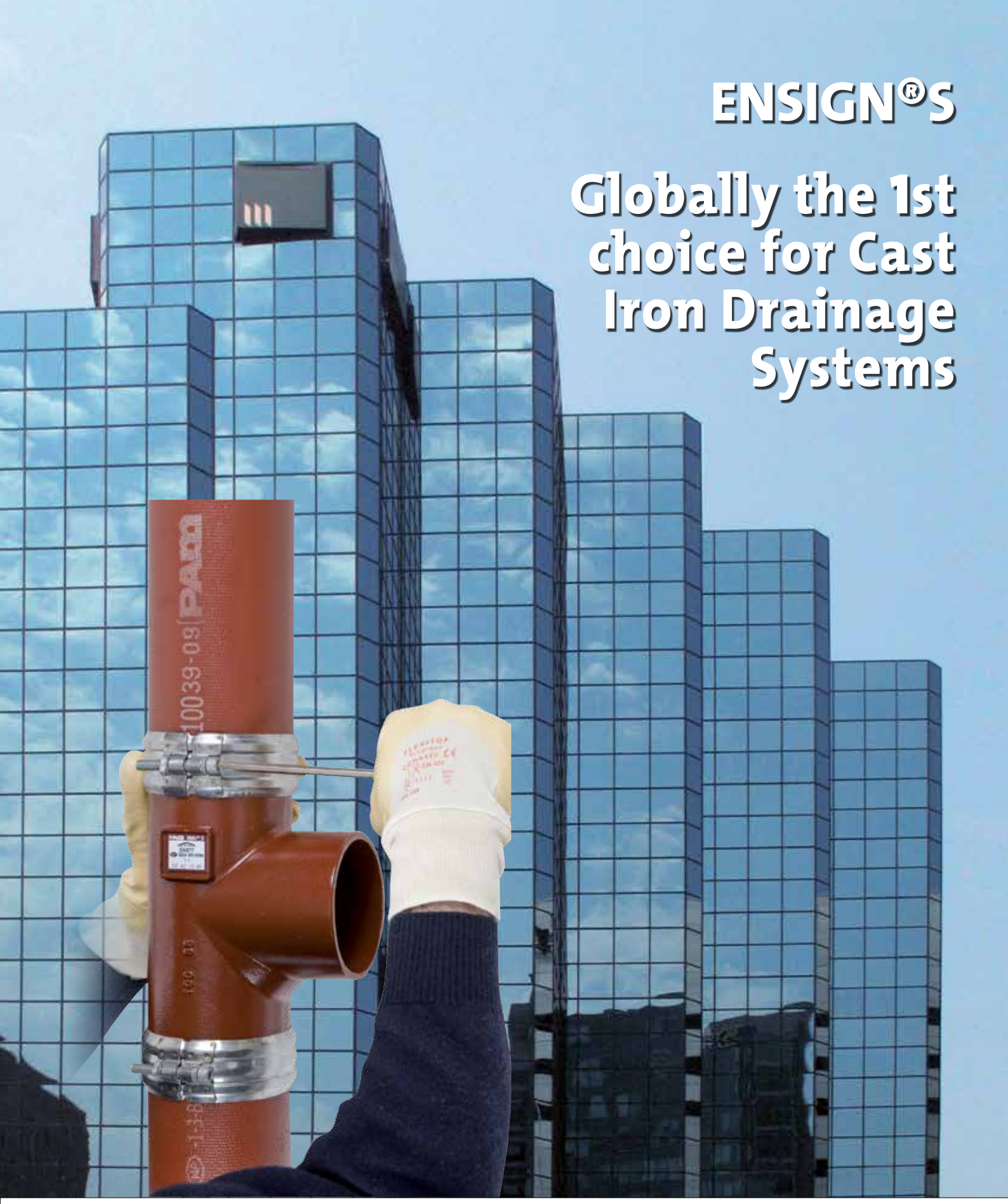
ENSIGN®S

Globally the 1st choice for Cast Iron Drainage Systems



India Technical Catalogue

PAM
SAINT-GOBAIN

Summary

This catalogue is an extract from the Saint-Gobain global 'Cast Iron Drainage Catalogue' and is specifically fine tuned to the Indian market requirements and the items that Saint-Gobain PAM is promoting in India. The global catalogue remains as the reference document for a comprehensive view of all the PAM technical solutions for cast iron drainage systems.

Certain product range like EPAMs and Ensign Plus range are only mentioned in brief and the global technical catalogue need to be referred for more details on these specific products. This catalogue also includes a section on the technical parameters and solutions for the Indian market.

Section 1

Sales Arguments

SAINT-GOBAIN PAM –GLOBALLY 1ST CHOICE FOR CAST IRON DRAINAGE SYSTEMS.

- **High strength / Durability over time**
- **Non-combustible / No smoke hazard**
- **Silent in operation / Excellent acoustics**
- **Fast & Easy installation – Fit & Forget**
- **Easy to repair – Modular + taking rodding knocks**
- **Excellent aesthetics & finish**
- **Stable + No deterioration with age**
- **100% recyclable / sustainable / green**

Why choose SAINT-GOBAIN PAM cast iron pipe systems ?

As a leading manufacturer and the world's top-ranking exporter of cast iron pipe systems for building application, SAINT-GOBAIN PAM is an essential partner for designers of waste water and rainwater drainage systems.

The SAINT-GOBAIN PAM cast iron products are safe, easy to install and efficiently meet the requirements of project engineers.

Advantages of Cast Iron

- CI remains as the best material for waste water applications in view of its durability over time, ease of maintenance, non combustible nature and significantly better mechanical properties including acoustics.
- PAM system has been designed to overcome most of the problems faced with old generation CI waste water pipes used in India such as corrosion resistance, aesthetics, ease in installation and compatibility with plastics.

Wide range of products and complete system offering

- Global experience and track record is a key enabler for this.
- Products meet EN 877 standards which covers the full system
- Systems for connecting other materials (plastics) to PAM pipes

Technical and sales support

- Well trained team – PAM India and distributors

Logistics support

- Stocks are now available in India for most of the fast moving range

"Waste water and rainwater drainage systems are like the arteries of buildings, calling for strong and long lasting material, so that their lifespan is at least the same as the buildings expected life.

Watertight, non combustible and silent in operation PAM cast iron allows specifiers to design safe and reliable drainage systems.

Combining unrivalled longevity and minimal maintenance, PAM cast iron spigot systems are definitely the first choice to maintain a sustainable and comfortable environment as required in your building projects."

Comprehensive Product Range

Components

Saint-Gobain PAM pipes and fittings are of hubless design which are lighter and easy to install and maintain. They are designed for optimal safety, reliability and long service life.

Joints

The hubless pipe systems are connected by mechanical metal coupling which are equipped with elastomer gasket ensuring flexible assembly with excellent water tightness.

To meet specific requirements for pressure resistance, grip collars or self anchoring coupling are also available to lock these couplings.

Connectors to other materials

Recognising the need for using different pipe and fitting materials based on installation criticality and economics, Saint-Gobain PAM also offers solutions for connection of PAM cast iron to other materials such as PVC, HDPE, PP, Steel, etc. There are also solutions for connecting to rigid pipes of old designs which are commonly encountered in projects involving renewal of old installations.

Coatings

The durability of cast iron systems has been demonstrated over more than a century of history. The purpose of the coatings is to protect cast iron products against corrosion in order to further increase their service life. Saint-Gobain PAM has conducted extensive research on coatings and continuously works towards improving their performance.

Spun pipes and cast iron fittings and accessories are provided with –

- External coating to withstand aggressive environments (climate effect + ground conditions in case of buried pipes)
- Inner linings to withstand thermal and chemical stresses from the effluents drained.

Consistency

The principle adopted for a given product range is to offer consistent performance for pipes, fittings and accessories without any weak points, i.e. all the components of the pipe system provide the same level of performance in withstanding the constraints in each specific field of use.

Ability to transport effluents

ENSIGN®S

Engineered for end use – Normal Applications

Resistance to domestic fluids:

Building waste water drainage systems - grey and black water- must be able to withstand all types of normal domestic effluents.

In recent years, following changes have been noticed in the types of these fluids:

- Higher concentration of household detergents,
- Use of more aggressive hygiene products,
- Rise in operating temperatures.

The demands on sanitary drainage systems are constantly increasing. SAINT-GOBAIN PAM coatings have been adapted to meet those constraints.

■ **Basic inner lining for pipes**

The standard inner lining for PAM pipes is a sound, adherent epoxy resin which prevents the fluid transported from coming into contact with the metal.

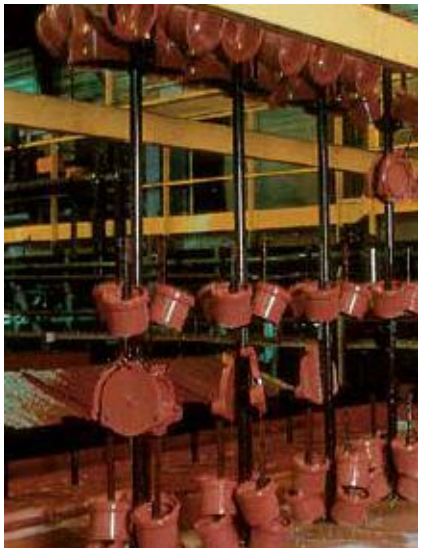
The composition of the epoxy coating is controlled to minimise porosity, and its homogeneity is monitored in real time.

The smoothness of this coating increases flow rate and limits head losses.

■ **Basic coating for fittings and accessories**

The common coating for fittings is an epoxy resin deposited through an cataphoresis process. However other processes like fluidised powder coating can be used to meet specific requirements.

The average thickness of standard coatings for fittings can vary from 70 µm to 150 µm, according to the targeted performance.



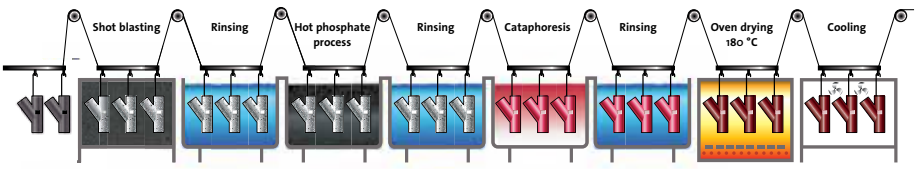
Cataphoresis, Fittings and accessories are coated with an epoxy resin deposited by cataphoresis which ensures a uniform deposit and excellent covering of edges. The optimised process by SAINT-GOBAIN PAM is based on a careful shot-blasting and entails interposing a chemical surface treatment during the coating cycle, between rinsing after shot-blasting and the cataphoresis bath in order to enhance the coating's covering power.

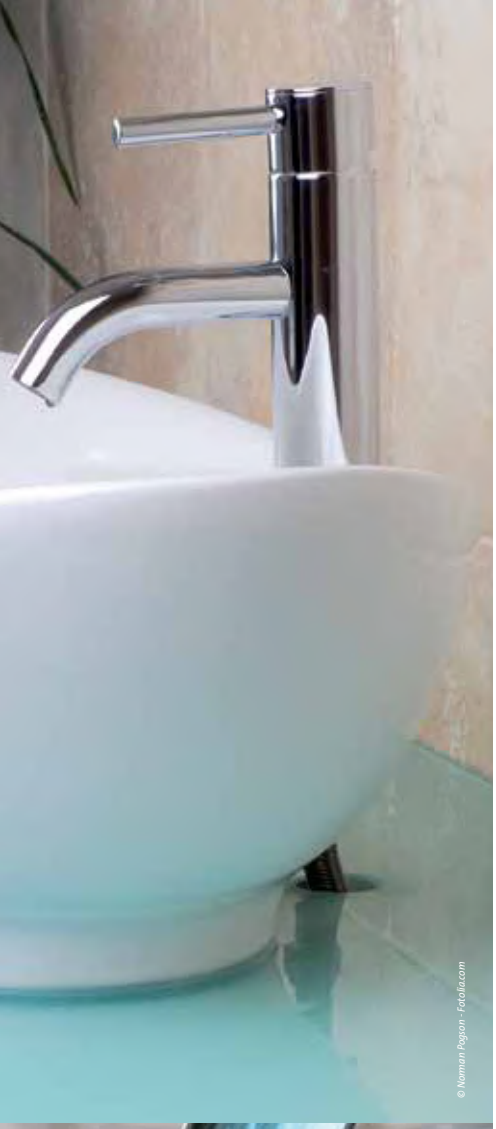
At the end of the cycle, the parts are oven-dried to complete the reticulation of the epoxy film.

Substantial improvements in:

- the epoxy film's adhesion to the cast iron,
- the corrosion resistance of the coated cast iron.

FOCUS





ENSIGN®PLUS

Engineered for end use – Aggressive Applications

Resistance to corrosive or/and hot effluents

The inside of cast iron systems can be subjected to chemical and thermal aggressions when they transport fluids that are corrosive and/or at high temperatures.

■ **Superior inner lining for pipes:** two-part epoxy resin applied in **two layers** to obtain a film with no porosity.

Resistance to aggressive backfills or severe climatic stresses

The outside of a pipe may also be subjected to the aggressive effects of climate or backfills, in the case of buried systems.

■ **External anticorrosion coating for pipes**
Zinc coating for pipe protection by galvanic effect.

FOCUS

Zinc metallization

The zinc metallization is an active protection provided by the galvanic action of a zinc/iron cell.

Twofold action:

- Formation of a stable protective layer of insoluble zinc salts,
- Self-healing of any damage.

Zinc metallization is an excellent corrosion inhibitor and is extremely effective in extending the lifespan of products submitted to backfills or climatic stresses.

Tests carried out by the SAINT-GOBAIN PAM Research Centre: two identical notches are made on samples before immersing them in a highly corrosive medium.

Without zinc protection
Corrosion beyond notch

With zinc protection
Zinc salts on notch

Solutions for intense stresses on fittings and accessories

According to the principle of continuity with no weak points, coatings for hollow components must withstand the same stresses as pipes. There is an anticorrosion coating process for these parts to face major stresses, due to the fluids transported or to the environment.

■ **Superior coating for fittings and accessories: epoxy powder coating in fluid bed.**

A **thick anticorrosion** coating to guarantee long service life for products.

Preheated parts are moved through a tank containing epoxy powder in suspension, to be coated. They are then stove dried to ensure perfect reticulation of the polymerised epoxy film. Perfect control of both temperature and immersion time determines the coating thickness: 300 µm in average.

For more than 100 years of testing and market research, SAINT GOBAIN PAM has built up great expertise in cast iron. Increasingly effective coatings have been developed to keep pace with the changing utilisations and requirements.

ENSIGN®S

For common domestic use

For conventional grey water, black water and rainwater applications, For systems installed above ground, in ducts, raft foundations or included into concrete.

To provide clearer guidance on the chemical resistance of S range in domestic applications, SAINT-GOBAIN PAM has carried out 20 additional tests to the EN 877 Standard requirements on detergent products (floor cleaning product, laundry detergents...) and special products (stain remover, drain cleaner...) of common use.

The tests were carried out on samples, under the temperature of use recommended by the manufacturers and where it was relevant, up to 70°C since hot water is normally supplied in dwellings around 50 – 60°C.

After stopping the test, the pipes and fittings shall be washed immediately to eliminate any stains and the coatings shall be examined with regard to blistering and rusting both according to ISO 4628-2 and 3. (Accepted levels according EN 877)

The duration of the test is considered equivalent to the extrapolation of a real chemical stress undergone during 7 or 10 years (a 10 to 15 min stress per day). This test method however simulates a severe stress since the samples lies in direct contact with the solution, the temperature is being maintained and the test includes no rinsing over its duration.

S ranges and EPDM gaskets

		Dilution*	pH	23°	50°	65°	70°	Test (Days)
SALT WATER *	Same as sea water	30g/l						
DETERGENTS								28
Laundry detergents	Phosphate free wash	2ml / l	7.7					28
	Softener	2ml/l	7.6					28
Dish washer detergents	Washing tablet	3g/l	9.3					28
	Washing gel	3g/l	9.8					28
	Washing up liquid	2ml/l	7.65			not applicable		28
Stain remover	Type “ACE GENTLE”		7.7					28
COMBINATION	Wash + stain remover	2ml/l + 3ml/l	7.7					28
	Wash + Softener	2 ml + 3ml/l	7.7					28
CLEANING PRODUCTS	Floor cleaning product	8ml/l	8.2				not applicable	28
	Bleach	8ml/l	8.25		not applicable			28
WC CLEANERS	Toilet bowl cleaner (gel)	20ml/l	5.45					28
	Drain cleaner gel	0,33 ml/l	13		not applicable			4
	Liquid descaler	80ml/l	2.07					28

** according to the manufacturer*

Recommended ranges for these applications

S ranges equipped with EPDM gaskets are fully adapted to fit all the constraints involved in the above-mentioned uses.

S – Systems: complete ranges of cast iron pipes & fittings and their gaskets.

ENSIGN spigot range: diameters from DN 50 to DN 600

Recommendations – ENSIGN®S

Resistance to conventional domestic fluids, in compliance with EN 877

Grey water, black water and rainwater

■ **Pipes**

Basic external coating

■ **Fittings and accessories**

cataphoresis coating, red brown colour

Basic external primer paint:
Acrylic paint, red brown colour
Dry film average thickness: 40µm
Basic inner lining:
Two part epoxy resin ochre colour
Dry film average thickness: 130µm in one layer

ENSIGN®PLUS

For intense/professional use

Above and below ground waste water drainage for aggressive discharge.

Aggressive effluents are characterized by: Their content (acids, bases, solvents, hydrocarbons...), their combinations and their temperature. Owing to its anti-corrosion thick linings, the Plus range provides a greater chemical resistance and is particularly well adapted for intense uses.

Hot water resistance: 24 h at 95°C continuous and thermal cycles (1500 cycles of 5 min between 15° and 93° C)

Salt spray resistance: 1500 h
Chemical resistance: 1 < pH < 13

Compulsory use of PLUS range+ EPDM gasket Acids and bases, saline solutions common temperatures of use				
	pH	20°C	60°C	80°C
WATER Salt water NaCl 30g/l	5.6			
Demineralised water, Waste water	6.6-6.9			
DETERGENTS	7.4-10			
SPOT REMOVER, OXIDANTS	4.2-10.3			
MINERAL ACIDS				
Hydrochloric HCl 5%, Sulphuric H2S04 10%	1			
Sulphuric H2SO4 1%	2			
Phosphoric H3PO4 10%	1.3			
Phosphoric H3PO4 5%	1.8			
Phosphoric H3PO4 2,5%	2			
Nitric HNO3 10%	2			
ORGANIC ACIDS				
Lactic 1%-10%	1.1-2.2			
Citric 5%	2			
Vinegar 10%-30%	2.9-3.2			
BASES				
Soda NaOH	12			
Soda NaOH	13.6			
Ammonia NH3, Potash KOH	12.1-13.6			
Bleach 10%-100%	12-12.5			
SALTS KCL3%, NaH2PO4 3%, (NH4)2SO4 3%	4.2-6.7			
SOLVENTS (except Acetone)				
Ethanol, Methanol, Glycol, Xylene	–			
White Spirit, Gasoline, Diesel, Petroleum	–			
Lubricants, Petroleum derivates	–			
High temperatures OILS	–			

For non described or intense industrial uses, please contact us

In the application table above, light green means S range still possible, heavy green means Plus range compulsory.

This being two-dimensional, the boarder between S and Plus ranges is only determined by the type of the fluids and the operating temperature. But the selection of the appropriate range is also directly related to the duration of daily exposure, the reason why we called this chapter intense of professional use.

The combination of high pH products (base and alcaline products) **and** high temperatures systematically calls for the use of the Plus range.

Recommendations ENSIGN®PLUS

Resistance to aggressive and/or hot effluents

■ Pipes

Inner lining: two part epoxy resin ochre colour.
Two layers for a lining with no porosity.
Dry film average thickness: 250µm in two layers.

■ Fittings and accessories

Thick polymerised epoxy powder coating, grey colour
Dry film average thickness: 300µm.

Robustness and mechanical strength

Pipe system components must withstand hazards before they reach the job site such as accidental impact before and during installation, during storage, handling and transit. In service, outdoor exposed pipes may be damaged by accidental impacts or vandalism. To avoid breakages, which can be expensive, or minor stress cracks which can have serious consequences in operation, the choice of material should be carefully considered.

Impact strength and crush resistance

Cast iron is well-known for its robustness. The quality of PAM products is ensured by careful control of both metal composition and manufacturing process.

The spinning of pipes in the De Lavaud process, followed by heat treatment, gives these products outstanding mechanical properties.

Key mechanical characteristics required by the standard EN 877 are controlled by three tests, carried out on pipes when coming out of the heat treatment furnace to assess tensile strength, ring crush resistance and hardness.

In addition, operators have opted to maintain a further test which gives a good indication of the quality of heat treatment: the guillotine impact test.

FOCUS

De Lavaud process

In this process, a constant flow of molten metal at perfectly controlled temperature and composition is gradually input into a steel mould rotating at high speed. The mould external wall is cooled by circulating water and the evenly distributed molten metal cools on contact with the wall before extraction.

The process is characterised by a quick cooling that gives a finer solidification matrix and thus a more homogeneous metallurgical structure.

Heat treatment

The spun pipes are placed and rotated in a heat treatment furnace at 950°C and then gradually cooled again. This step is essential to the process as it transforms the cast iron's metallurgical structure. The reduction of iron carbides and the increase of ferrite content considerably improve the mechanical properties of cast iron and reduce its surface hardness. The graphite of the cast iron resulting from the SAINT-GOBAIN PAM process forms clustered graphite, halfway between lamellar and ductile iron.

The pipes	Saint Gobain PAM process	Others	EN 8777 requirements
Tensile Strength on samples in MPa (average value)	300	270	200 min.
Ring Crush Strength in MPa (average value, DN 100 pipes)	450	360	350 min.
Brinnell Surface Hardness in HB degree (average value)	220	245	260 max.

These results indicate greater resistance to impacts and crushing, easier machining and cutting. This also means the products are easier to install on job sites.

Resistance to thermal expansion

Most solids expand when they are heated and are liable to elongate under temperature increase.

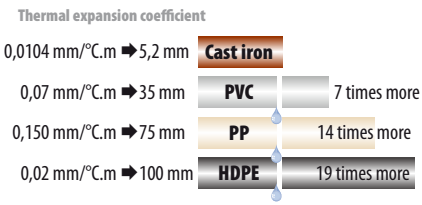
For pipe systems made of materials that are subjected to high levels of thermal expansion, precautions have to be taken at design stage.

Cast iron which expands very little does not require specific bracketing nor expansion collars. It makes the specifers' design work easier and avoids extra cost at installation stage.

Thermal expansion coefficient of cast iron and other materials

The thermal expansion coefficient for cast iron – 0.01 mm/m/°C – is very low and very similar to that of steel and concrete; the building and the pipe systems will move and will expand together.

Thermal expansion of cast iron and other materials for 10m and a temperature rise of 50°C.



For cast iron, the bracketing system is designed to only carry the weight of the pipe and its content, which makes the designers work easier. (See our recommendations in the Specifier's Manual p 54).

Plastic pipes, for themselves, expand considerably with increasing temperature. Their bracketing system must be designed and adapted accordingly, as it can deeply affect the stability of a pipework and its performance over time.

Thermal expansion of plastics

To allow expansion without damaging the drainage network, plastic pipe systems demand specific accessories – expansion collars or joints, brackets allowing axial movement, in general one out of two.

If these precautions were not taken, expansion could be absorbed by the pipework and cause distortion.

Cast iron can do without these expensive accessories. It makes the design work easier and decreases the risk of mistakes at installation stage.

These properties of cast iron pipe systems are also valuable for engineering structures such as bridges where important expansions have to be carefully addressed to secure the construction project.

Water tightness

Sanitary drainage systems, whether exposed or not, must remain water tight over time. Any defects can cause serious damage, leakages, dripping or slow permeation and generate costly repairs, and disruption.

SAINT-GOBAIN PAM cast iron mechanical assemblies are designed to reach easily instant water tightness and are not dependent on process control (gluing or welding...)

Water tightness of cast iron systems

Cast iron is a dense and non-porous material. Cast iron pipe systems are water tight and impervious.

Cast iron components, straight and rigid are assembled using metal couplings fitted with elastomer gaskets which ensure that the system is completely water tight.

Assemblies benefit from a conventional approach. Made with only simple tools, they allow installation tolerance with no risk of leakage.

This ease of installation ensures that the specified performance is always obtained, even in adverse conditions - unlike for plastics when either gluing or welding can be affected by installation hazards (ambient conditions such as temperature or damp) or when personnel with special skills are required.

Water tightness over time

Failure of water tightness can occur on drainage systems in operation. They are then due to breaks, misalignments, crushes or cracks...

Long-lasting water tightness depends on two main factors:

- **No deterioration of pipes:**

Cast iron is highly resistant to ovality. Their specified mechanical properties and their stability enable cast iron systems to withstand operating stresses extremely well.

- **No deterioration of assemblies:**

Elastomers are carefully selected for the long-term stability of their physico chemical characteristics to ensure the lasting water tightness of the rubber gaskets.

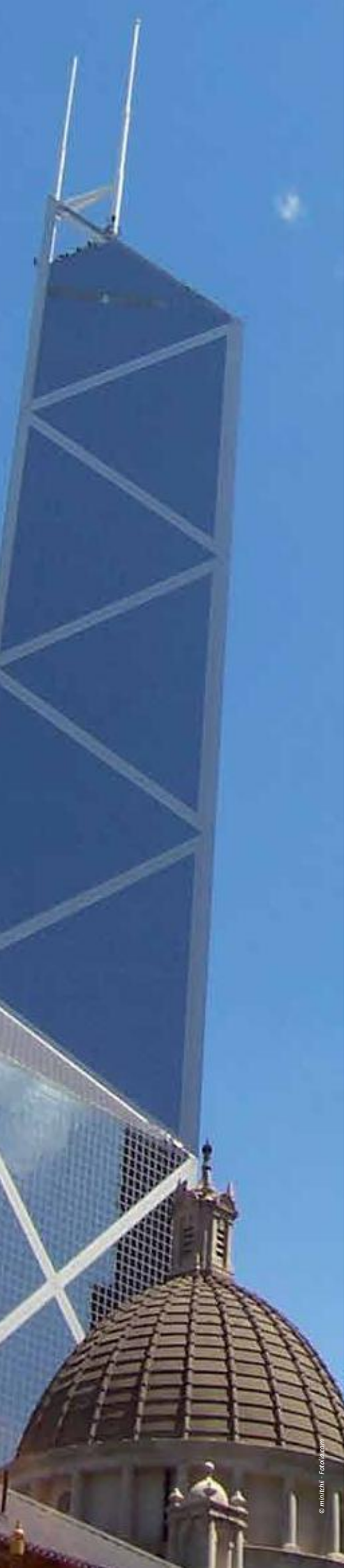
The S and Plus ranges, being assembled and anchored, have successfully passed a high-pressure jetting test: cleaning pressure of 120 bar from the pump, which means 100 bar at the nozzle outlet, without leakage or misalignment.

Water tightness and maintenance

Sometimes blockages occur in drainage networks; the pipework materials must be resistant so that the maintenance is easy.

The S and Plus systems can resist without damage all normal maintenance processes including high-pressure jetting. They have been submitted to a high pressure test according to the Swiss standard SN 592 012.

Robustness and dimensional stability of cast iron components along with the careful selection of elastomer ensure pipe installations give high performance and long service life.



Internal pressure resistance

Internal overpressure in drainage networks rarely occurs and is always accidental. Thrust efforts in the overloaded sections have to be addressed to guarantee both water tightness and mechanical stability.

As the robust cast iron components can address any pressure hazard, then the couplings will be submitted to the strain.

The quality of the couplings and their careful selection according to their field of use will prevent misalignment or disconnection of the pipework.

Resistance of the couplings to hydrostatic pressure

◆ Standard pressure mechanical couplings:

Waste water drainage systems – which differ from rainwater drainage systems as regards pressure – are connected to sanitary appliances installed on each storey which may serve as outlets in case of accidental overloading (due to blockages, for example).

The pressures that occur cannot therefore exceed the pressure corresponding to the height of one storey, i.e. about 0.3 bar.

The couplings we describe as "standard" are perfectly suitable for this common type of application.

◆ High-pressure mechanical couplings:

In some rare cases, a waste water drainage system may pass through a number of storeys without any outlet and there could be a risk of overloading (blockage due to operation or saturation of the sewer main).

The pressure resistance required to ensure that these systems remain leaktight and stable in such cases depends on the height of the water column liable to occur and calls for high-pressure couplings able to withstand the resulting pressure (up to 10 bars).

See p 48 in the Specifier's Manual section.

FOCUS

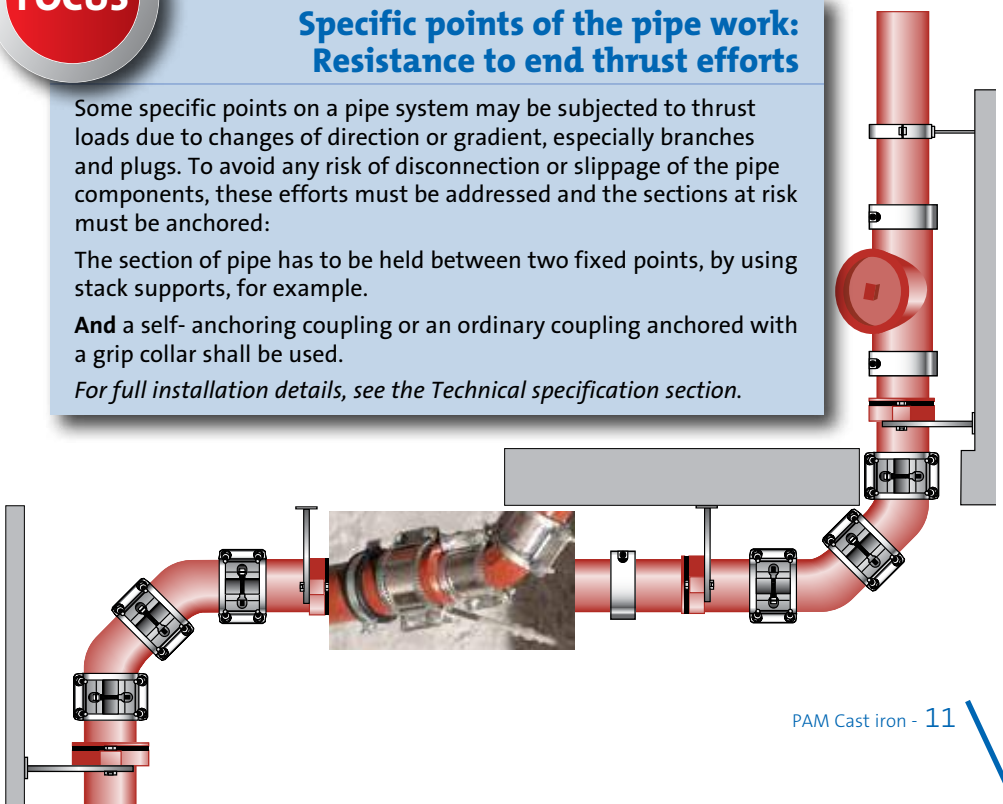
Specific points of the pipe work: Resistance to end thrust efforts

Some specific points on a pipe system may be subjected to thrust loads due to changes of direction or gradient, especially branches and plugs. To avoid any risk of disconnection or slippage of the pipe components, these efforts must be addressed and the sections at risk must be anchored:

The section of pipe has to be held between two fixed points, by using stack supports, for example.

And a self- anchoring coupling or an ordinary coupling anchored with a grip collar shall be used.

For full installation details, see the Technical specification section.



Ageing behaviour

As components that are integrated in buildings, waste water and rainwater drainage systems must remain in a serviceable condition over the long term in spite of adverse operating conditions.

Ageing refers to any gradual, irreversible change in a material's structure and/or composition, liable to affect its behaviour or serviceability.

When a material is selected, the stability of its properties ensures operational reliability over time.

Stability of cast iron mechanical properties

The ageing of a material may be due to its own instability, to environment or chemical stresses, to mechanical strains, or a combination of any of those causes.

It is an established fact that cast iron offers long service, owing in particular to the stability of its mechanical properties over time.

- Cast iron is not sensitive to thermal ageing

- Its mechanical strength remains stable.
- Its thermal expansion is very low compared to plastics.
- Cast iron pipe systems are not liable to creep at operating temperatures.

- Cast iron does not deform under mechanical strain

- Its ring stiffness (cold measurement) around 700 kN.m is not affected by temperature and is 87 times that of PVC pipes. It is mainly appreciated for buried pipework.
- Its longitudinal stiffness, which eases bracketing and protects water stream in horizontal sections, remains intact. Its Young modulus of elasticity is ranking from 80 to 120 GPa vs 2 to 5 GPa for PVC.
- Cast iron's tensile strength is 8 times that of PVC: 200 MPa vs 25. (residual resistance, after 50 years according to the standards). This property is of utmost importance in case of network overloading.

The properties of cast iron ensure the stability of systems and long lasting operational safety.

Resistance to climatic stresses

The properties of materials are extremely important when they are stored or exposed to adverse conditions (extended exposure to ultraviolet light or wide temperature variations...).

Cast iron undergoes no structure modification under climatic stresses.

FOCUS

Ageing of polymers:

Deterioration of mechanical properties under temperature stress.

Under temperature effect plastics can suffer two kinds of deteriorations, including at operation temperatures:

- **Creeping** is an irreversible elongation under the combined action of both temperature and an important mechanical strain. Plastic pipe system like PVC or HDPE are particularly sensitive; in horizontal sections, they can bend between two support brackets under their own weight.
- **Modification of the elastic limit:** most plastic materials will soften under temperature increase. Under temperature decrease on the contrary, they crystallize. PVC for example become rigid and may crack under mechanical strain – their operating temperature range is generally between -20°C to 80°C, but depending on their nature, the range can be much narrower.

Photochemical ageing

Depending on their nature, climatic stresses (such as solar radiation, damp or heat) will cause more or less severe photochemical ageing to plastic materials.

They can just alter their surface finish, but also deeply modify their mechanical properties and then adversely affect their serviceability.

The same can happen through slow chemical attack by solvents or even in aqueous media.

Compliance with standards and quality marks

Quality Management System

The plants which manufacture our products are certified for their compliance with the ISO 9001 standard which specifies requirements for a quality management system. The scope of this standard covers product design and development and the quality control of procurements, training, and administrative follow-up.

Products performances

PAM pipe systems comply with European standard **EN 877**, applicable to a system (cast iron pipes and fittings, couplings and accessories for building drainage). **This standard, specifying the technical requirements for cast iron products, is the most demanding in the market.**

In particular, it lays down requirements regarding:
- Reaction to fire (product range),
- Resistance to internal pressure,
- Dimensional tolerances,
- Tensile strength, crushing strength,
- Joints and their leaktightness,
- Inner lining and external coatings and their suitability.

It also defines test methods and the quality management system. EN 877 is a self-declared standard; the manufacturer is allowed to self declare that his product complies with this standard.

Only compliance with EN 877 that is validated by a third party for all criteria and periodically tested can guarantee the performance of the systems you specify.

The quality of the SMU / ENSIGN S, SMU / ENSIGN Plus, product ranges are guaranteed by the following marks of approval: BBA, Kitemark and/or Marque NF.

	European standards	International standards
Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance	EN 877/A1	
Cast iron drainage pipes and fittings (spigot)		ISO 6594
Elastomeric seals - Material requirements	EN 681-1	ISO 4633
Requirements for a quality management system design, product development, production, installation and after sales support		ISO 9001
Environmental management system Requirements with guidance for use		ISO 14001
Testing standards		
Fire tests Fire classification of construction products and building elements. Classification using data from reaction to fire tests	EN 13501	
Reaction to fire tests for building products - Part 1 Building products excluding floorings exposed to the thermal attack by a single burning item	EN 13823	
Measurement of noise Laboratory measurement of noise from waste water installations	EN 14366	

Fire safety

Protect people and property

For fire safety in a building, the major responsibility rests with the project manager who must respect the Regulation in force.
In buildings at risk like multi storey buildings, materials with reduced flammability should be selected to apply precautionary principle.
The following two concepts are applied as regards fire safety:
Reaction to fire and fire resistance.

Reaction to fire

It is the instant behaviour when a fire breaks out, its propensity to ignite or feed a fire. This behaviour is assessed on the basis of standardised tests and described in an EUROCLASS classification.

FOCUS

CE marking

The **mandatory** CE marking is required by the European Construction Products Directive (DPC 89/406/CEE) and **must be affixed to products before allowed pass into the European market.**

- To ensure their free movement within the European Union and the EEA.
- To ensure those products do not constitute a hazard for the occupants or users of buildings.
- To implement the same safety criteria throughout Europe it is referred to **Essential requirements** concerning public health, safety and consumer protection.

The CE marking on products certifies that they comply with the harmonised part of their reference standards.

Reaction to fire for PAM cast iron systems

For drainage systems, **safety in case of fire** is the only essential safety requirement.

For cast iron systems, the tests and technical specifications are defined in the amended standard EN 877, **and the section "Reaction to fire" alone requires a mandatory certificate, issued by an independent laboratory, to obtain CE marking.**

Cast iron as a material itself is classified as A1 in the Euroclass classification for reaction to fire.

In tests carried out by the CSTB accredited laboratory, the **SAINT-GOBAIN PAM cast iron ranges** (pipes, fittings and accessories including elastomer gaskets and coatings) received the following excellent Euroclass ranking:

A2 -s1, d0

For smoke emission and the production of flaming droplets, the SAINT-GOBAIN PAM products respectively achieved the highest possible rating: **s1 et d0.**

EUROCLASS classification is based on harmonised test methods and defines a reaction to fire ranking so to make it possible to compare construction products.

A1 and A2 are reserved for products that are not, or only slightly, combustible.

So, cast iron remains one of the safest drainage material for fire safety.

SAINT GOBAIN PAM cast iron ranges comply in every respect to the standard EN **877**.

This compliance is validated by complete Quality Marks, is periodically tested by accredited third part laboratories and brings you the performance guarantee for the systems you specify.

Sub-Class SMOKE production

s1 : Low smoke production
s2 : Medium smoke production
s3 : High smoke production

FLAMING DROPLETS sub-classification

d0 : No flaming droplets
d1 : Flaming droplets that persist for less than 10 s
d2 : Flaming droplets

EUROCLASSES			Former French classification
A1	-	-	Incombustible
A2	s1	d0	M0
A2	s1	d1	M1
A2	s2		
A2	s3		
B	s1	d0	
B	s2	d1	
B	s3		
C	s1	d0	M2
C	s2	d1	
C	s3		
D	s1	d0	M3
D	s2	d1	M4 no flaming droplets
D	s3		
Classes other than E-d2 and F			M4

National Building Code, India 2005

Many buildings are not protected enough against fire hazards. It means that fire can spread rapidly, can destroy the building and the properties in a few hours and jeopardize the occupants' lives.

When a fire breaks out, the first objective is to slow down its spreading both horizontally and vertically.

Drainage systems must be selected so that they resist the passage of fire and do not feed it.

Compartmentation: Clause C-9

"The building shall be suitably compartmentalized so that the fire and smoke remain confined to the area where the incident has occurred and does not spread to the other part of the building."

ANNEX B (Clause 3.8 and 3.14)
High Rise Buildings – 15 m in height +

B-1.8.1 : Specifically mentions...
"Care shall be taken to ensure that the construction of the drain pipe does not allow spread of fire/smoke from floor to floor."

Fire resistance

It is a construction component's ability to withstand fire **for a given period of time** and to retain its serviceability in the event of fire.

If a fire breaks out, it is essential to prevent any early collapse of the structure, and then to limit the extent of the damage so as to ensure that occupants can be evacuated and/or the belongings will be protected.

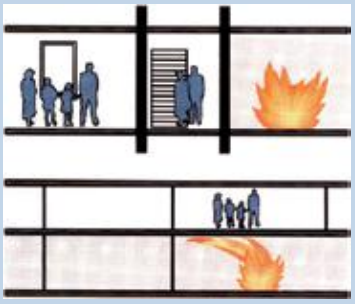
FOCUS

Compartmental principle

Fire Safety Regulation for buildings, when it exists is based on **compartmental principle**.

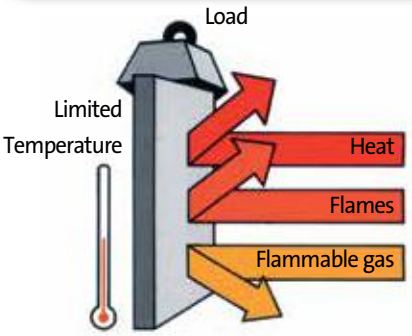
Within a building, a compartment is a fire rated space designed to stop the fire for a given period of time. The fire-stopping requirement for walls (shells and slabs) is generally 2 hours or less – and exceptionally 4 hours.

The requirement depends on the nature of the building and its level of occupancy, and can be very different from one country to another.



Waste water drainage systems and fire stopping requirements

Drainage systems passing through structures designed to withstand fire, should not provide open breaches. For a given time, specified in the applicable Regulations, they should not allow the passage of fire, smokes, heat or combustion products from one compartment to the other.



For plastics, the fire-stopping rule consists in "plugging the hole". This function is ensured by the fire collars recommended by the manufacturers. Plastic materials which are highly sensitive to heat will not withstand the fire, will not remain in place, even in the case of a contained fire.

As shown by laboratory tests, if the fire collars are not activated or do not operate correctly, and depending on the type of plastic material, the greatest hazard is posed by combustion products (flaming droplets) or smokes.*

SAINT-GOBAIN PAM's solutions

SAINT GOBAIN PAM cast iron, non-combustible material has a melting point over 1000°C.

In most cases it requires no additional fire protection.

SAINT-GOBAIN PAM carried out a non-exhaustive series of tests on its cast iron pipe systems in order to offer precise guidance for fire resistance. For most configurations, exist protections made of mineral wool.

With the active fireproof solution PAM-Protect combined with a fireproof mortar to seal wall and slab penetrations, PAM cast iron pipe systems proved to meet integrity and insulation requirements up to 240 minutes (4 hours)*.

Complete report available on request.

SAINT-GOBAIN cast iron is non-combustible, it does not feed the fire, nor gives off either gases or smokes liable to delay fire fighters or damage other equipment.

** Furnace tests carried out in* 2011-2012 *according to* EN 1366 -3 *at the EFECTIS testing centre, the European leader in fire science, engineering, tests, inspection and certification*

Acoustics

Noise in buildings is considered to be detrimental to health and the quality of life. Efforts have been made, in the last 30 years, to attenuate the sounds coming from the street, worsening the perception of the sounds emitted within the buildings. Heat insulation policies aiming at reducing energy consumption will also heighten these perceptions.

Among the priority criteria in the comparative performances of drainage materials, acoustic performance is reckoned to be second only to fire safety: cast iron pipe systems have intrinsic acoustic properties. Owing to the development in accessories equipment, they offer outstanding performances.

Pipe systems and equipment noise

Noise from waste water pipe systems is classified under the regulation in the "equipment noises".

Noise originating from pipe systems is due to the sound energy produced by water/air turbulence, but mostly by the mechanical effect of the water-flow on the internal pipe walls.

Acoustics and SAINT-GOBAIN PAM cast iron pipe systems

Airborne noise

When a material is dense and thick, the pipe walls prevent air transmission; as is the case with cast iron which offers intrinsic acoustic properties.

Structure-borne noise

When the noise produced in a pipe is not transmitted by the air, the residual noise is transmitted by structural vibrations.

Whilst the mass of the cast iron limits the vibratory level, the junctions and fixing to the building will propagate noise. **Objective: Dampen the vibrations at the connections with the solid structure.**

FOCUS

Noise and regulations requirements

Noise is an energy affecting air pressure and is transmitted through vibration.

Sound is measured in decibels (dB) using a nonlinear scale.

For noise from equipment apparels, the following categories are identified and measured:

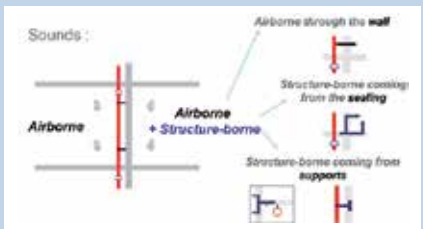
- **Airborne noise**: air vibrations that are propagated

In the case of waste water pipe systems, this noise is mainly heard in the room where the pipe is located.

- **Structure-borne noise**: vibration of a building's structure

This noise will be noticed in rooms adjacent to the pipe.

Statutory requirements on "equipment noise" for structure-borne noise differentiate between noisy rooms and quiet rooms with sound-attenuation requirements. For noisy rooms the noise level requirements is generally 35 dB or more. For quiet rooms, which are generally living, resting rooms and work rooms, the noise level requirements are generally around 30 dB, in cases where noise regulations exist.



Acoustic comfort is a differentiation criterion that indicates construction quality. The building project manager and the specifier may define together specific requirements to improve the final construction.

SAINT-GOBAIN PAM's solutions

Vibrations transmitted to the building structure are dampened by installing "sound absorbers" and by combining:

- couplings equipped with elastomer sealing gaskets which reduce metal to metal contact and prevent the transmission of vibrations.
- if required, rubber lined insulating brackets or acoustic dampeners, and stack supports equipped with elastomer gaskets.

In 2008, SAINT-GOBAIN PAM commissioned a series of comparative tests on airborne and structure-borne noises in installation conditions described by standard EN 14366, at the Fraunhofer Institute for Building Physics in Stuttgart.

As all waste water pipe systems manufacturers apply the standard test protocol, it allows building project managers to compare their results.

Test results for the PAM pipe systems, in accordance with standard EN 14366.

	Flow rate l/s	Airborne noise			Structure-borne noise		
		2	4	8	2	4	8
ENSIGN	Ductile iron brackets	45	48	54	27	32	34
	Ductile iron brckts + PAM Acoustic	45	47	54	5	11	19

** test results for 100 mm diameter.*

FOCUS

PAM Acoustic: acoustic dampener

The acoustic dampener is designed to reduce structure-borne noise propagating through connections between the pipe system and the building.

This accessory, made of a stainless steel casing surrounding an elastomer shock absorber, is fitted between the back of the bracket and the structure (wall, ceiling, etc...).

It can be used on any cast iron pipe brackets whatever their diameter, from DN 50 to DN 150, installed horizontally or vertically.

Airborne or structure-borne noise: All installations with brackets supplied by SAINT-GOBAIN PAM meet the common requirements of applicable standards.

In the event of special requirements, the PAM Acoustic dampeners used with plain brackets give outstanding results far exceeding usual target performances.

In addition to the acoustic properties of the pipe systems and their accessories, the results obtained may be affected by a number of factors: nature of the partition walls or slabs sealing. To provide clear guidance, SAINT-GOBAIN PAM has carried out additional tests more in conformity with known sites practices: open hopper or not, changes in the partitions densities.

A complete report is available on request

Environment

100% recyclable indefinitely without losing any of its properties

Cast iron is made from recycled raw materials and so saves natural resources. Unlike plastics, it can be completely and systematically recycled at the end of its life through processes that are not harmful to the environment.

PAM pipe systems can be recycled without any deterioration of their properties, so they can be reused for exactly the same purpose. In other words, a pipe can be recycled as pipe.

Owing to the stability of their mechanical properties, it is currently considered that the service life of PAM cast iron pipe systems is twice that of alternative products made of plastic materials.

Nothing is wasted: everything is recycled

Cast iron pipe systems are based on the principle of modular ranges of removable components. Their mechanical assemblies are reversible. You can change your mind today or even tomorrow.

When pipe systems are disassembled or modified, these components can be reused, which cuts down waste dumping.

FOCUS

Environmental Product Declaration

To help customers make a better-informed choice, SAINT-GOBAIN PAM published in 2006 an updated Environmental Product Declaration (FDES: Fiche de Déclaration Environnementale et Sanitaire) for its waste water and rainwater ranges.

In response to a worldwide need for harmonisation, the international standard ISO 21930 provides the principles and requirements for environmental declarations (EPD) of building products. This standard retains the complete life cycle of products "from the cradle to the grave" as the relevant analysis.

As the French standard was even more demanding, it was decided to keep this information model as described in the French standard NF P 01 010: objective analysis of the life cycle "from the cradle to the grave" and energy consumption with reference to a functional unit (UF)*.

Some figures for the PAM pipework:

At production stage, cast iron, supposedly energy consuming, actually consumes:

- **1,94 Mj of total primary energy / UF**
  As a reminder: yearly energy consumption for a family of three living in a 65 sqm flat = Primary Energy= 62382.5 Mj
- **118g of CO2 / UF** = reference emission target adopted by the European Union for a new motor vehicle.
- **10 litres of water from all sources/ UF**
  Average daily individual water consumption in developed countries= 150 l

It should be noted that most of the water consumed is process cooling water which is discharged back to the natural environment without any treatment being required.

** 1 ml = ratio including all the necessary components to make the pipe system required to collect and drain waste water and rainwater in a 4-storey building over a period of one year".*

Enhancing processes and optimising ease of installation

At design stage, the aims are to make the cast iron products lighter and easier to install on work sites and to improve installers' safety.

With the objective of reducing the impact on the environment, automation and inspections are increased in number in order to cut down on the consumption of raw materials and energy required whilst optimising product quality.

As a result of continued improvements in the spinning process, the profile and the weight of cast iron pipes have been optimised over the last 20 years while maintaining their robustness.

10 kg less to carry for a diameter of DN 100 means greater productivity on work sites.

A manufacturer's commitment: protect the environment and the health of personnel

For SAINT-GOBAIN, commitment to sustainable development actions by ensuring their plants' absolute compliance with regulations in force is just the start.

The plants in the metallurgical industry call for greater vigilance and strict compliance with instructions as the risks of serious accidents are particularly high.

European cast iron plants have introduced an Environment Management System.

The comprehensive approach adopted led to the ISO 14001 certification for the Telford plant in the UK in 2004, and to the same certification covering product development for the Bayard plant in France, end of 2006.

As the world leader in construction products, SAINT-GOBAIN aims to provide innovative solutions to take up the challenges for the future posed by environment protection and energy savings.

All its products are designed with a view to making full allowance for environmental issues and enhancing the energy efficiency of buildings.

The Group is committed to protecting the health and safety of its employees, preventing its processes from having any detrimental environmental consequences, and fully integrating all the social and societal aspects of its operations into its business management.

Its adoption of the United Nations' World Pact in 2003 confirmed its commitment to responsible and sustainable development, as Saint-Gobain undertook to implement the pact's 10 principles as part of its strategy and its daily actions.

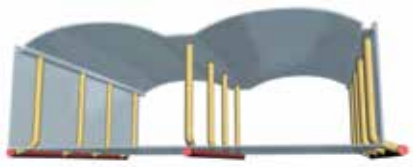
EPAMS® stimulate your networks

A modern technique based on a dynamic principle

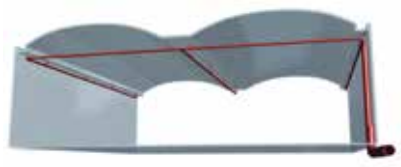
Traditionally, the rainwater is collected from a building roof at regular points, by gravity flow. The larger the roof area is the more numerous the points are.

In the alternative method, called "syphonic", the run-off water is drained in pipeworks operating at full bore, harnessing the principle of mechanical energy conservation between high spots, the rainwater outlets, and a low spot which is the main drain.

The EPAMS® system is a combination of anti-vortex outlets preventing air entering the pipework and cast iron SMU / ENSIGN pipe system. You can thus benefit from the technical reliability of cast iron for this specific application.



Gravity flow drainage



Syphonic drainage system

Field of use.

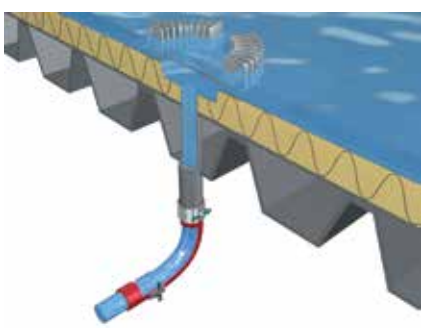
Syphonic rainwater drainage system EPAMS® is devoted to drain run-off water from building roofs. It is particularly adapted to drain large roofs and minimize risks of overloading: Logistic building, commercial buildings, public buildings like stadiums or airports.*

Or, for roofs in high rise buildings.

**when the type of roof is covered by the Technical Approval.*

Operation and economy of a syphonic drainage system

In case of intense rainfall, the rainwater flows towards the outlet equipped with an anti-vortex mechanism. When the grid is half covered by rainwater -30mm- the mechanism limits the entering of air into the pipe system and initiates negative pressure.



As the speed and the water flow still increase the air entering the system decreases; it creates suction of the water into the roof outlets. When no air is entering the pipework, the drainage capacity of the syphonic system is at its optimum level.

An EPAMS® pipework consists of one or several horizontal pipes installed with no slope, connected to a downpipe.

At the bottom of the downpipe, the pipework is increased by generally two diameter sizes – causing decompression and reduction in the flow velocity. Before connection to the main drain the system returns to gravity flow.

Compared to a gravity flow system, syphonic drainage system allows long sections of horizontal small diameter pipes with no slope. The syphonic system has a greater compactness and save useable square meters. The global cost of a syphonic drainage system and a gravity flow are differently apportioned but a syphonic project has the ability to save below ground pipeworks.

Syphonic safety over gravity flow

To harness the potential energy of the water drained in the pipework, in total safety, the syphonic system has to be accurately dimensioned. It must be designed by precise rules so that the flow velocity is always under control and the pressures within the pipework are always balanced. Furthermore, to protect the lifespan of the EPAMS syphonic pipe systems, SAINT-GOBAIN PAM design fixes that the dynamic pressure within the system should never exceed 5 bar.

FOCUS

EPAMS® syphonic system: a reliable solution for total safety.

- At full bore, a syphonic system operation calls for resistance to negative pressure. The mechanical properties of cast iron and their stability allow the use of even smaller diameters for pipes, for a greater compactness and higher drainage capacity. Specific care was brought to the design of outlets to enhance their absorbing capacity and prevent any risks of roof overloading. EPAMS® all metal system is stable and serviceable in total safety, in the long term.
- The thorough management of the EPAMS® projects - feasibility study, project follow-up – is made to ensure the system efficiency and guarantee the project manager with total peace of mind.

The system safety lies in the accuracy of the design study, the system installation and the full respect by the building operator of maintenance requirements.

All these arrangements have allowed the EPAMS® system registering no claim for the past 12 years it has been sold.

The EPAMS® system is run by a Technical Approval (14+5/01-656 and add-on 14+5/01-656*01 Add), and undergoes precise controls.

EPAMS®: rely on the outstanding properties of the PAM cast iron systems.

Cast iron properties – mechanical strength and stability, thermal expansion coefficient, resistance to negative pressure, acoustic properties, resistance to fire and outstanding service life – make the EPAMS® system the best choice to design a safe and reliable syphonic system.

Rigor and professionalism.

SAINT-GOBAIN PAM salesmen, trained to the EPAMS® system are at your service to evaluate your roof drainage project.

When feasibility is confirmed, a technical team designs both technical study and networks sizing. People specifically in charge with your project will remain at your disposal till the acceptance of work. Their knowledge of the system will allow them the find the best solution for your drainage project.

The installation of the EPAMS® system is generally performed by installers trained to our products. The traditional assembly at work progress allows to thoroughly cope with the reality and constraints of the job site, so that 100% of the expected performances are effectively achieved.
SAINT-GOBAIN PAM is liable for the technical studies carried out. Before the acceptance of work, it delegates a staffer or third party control office on site, to check that the installation fully meets the last study.
A certificate of technical compliance is delivered, after this pre-acceptance control.

Total cost of ownership

The cost of failure

Building projects should always be considered as a whole. In most developed countries, building trade represents 40% of energy consumption and more likely, in coming years, managers will prioritise conservation of properties and favour refurbishment.

It is accepted that cast iron drainage systems are least likely to fail in any situation. In order to establish which materials are most appropriate, consider first the relative seriousness of the consequences arising from failure: disturbance, hygiene and noise issues.

Product cost and installation costs

Cast iron is certainly not the cheapest material when considered initially and compared to other materials. However PAM cast iron means:

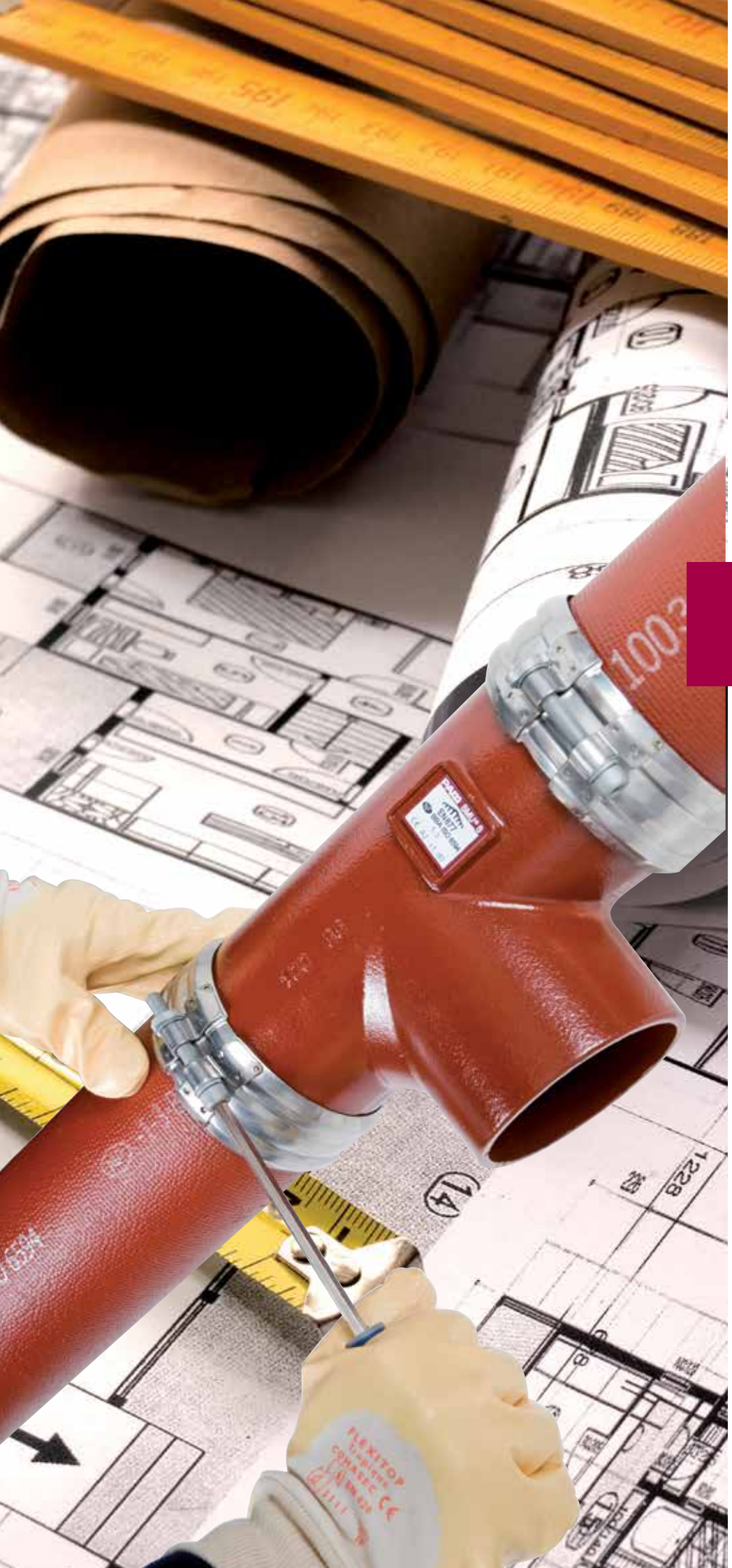
- **Quick traditional installation** with mechanical or push-fit couplings assembled with simple tools, without gluing or welding, **can save time and labour cost.**
- **No expansion joints** and therefore eases design and save expensive thermal limiters.
- **No systematic fire protection** or fire collars due to its fire behaviour
- **Less protection for acoustic insulation** due to its acoustic properties, and therefore means savings in plasterboards to reach the same performance.
- **Less embedment than other materials** in buried applications where ground disturbance or extra loading is likely.

Durability and less maintenance:

Cast iron has a proven lifespan far exceeding 50 years due to its outstanding mechanical properties and safety margin in operation.

- SAINT-GOBAIN PAM is continuously carrying out research on its coatings to protect this lifespan.
- PAM cast iron in exposed sections of the drainage system, ie. basement car parks is **more resistant to damage** than other drainage materials. It is also less sensitive to cracks and breakage before installation.
- Cast iron below ground offers **greater resistance to ground movement**, and is less likely to fail in unfavourable conditions.
- PAM cast iron drainage **needs minimal maintenance** during the lifetime of the building in normal conditions and makes it the first choice for concealed, built-in or otherwise inaccessible systems where repair or maintenance would cause major inconvenience to the occupants.
- Where necessary, removable mechanical couplings make **repairs easier and cheaper** without cutting into the stack. An extensive range of access parts, provides **ease of maintenance** at vital points in the stack to relieve any blockages which may occur.

SAINT-GOBAIN PAM cast iron drainage systems combining
More safety: fire protection, pressure resistance
More comfort: acoustic properties
More flexibility: possible extensions or retro-fit
Fully meeting environmental and sanitary requirements,
should lead you to move from the lowest tenderer to the lowest responsible bidder who selects the best quality- price ratio for the service life of the building.



Section 2

Products catalogue

PRODUCT CALATOGUE

SAINT-GOBAIN cast iron pipe systems
SMU – ENSIGN S.

- Consistent performances for above ground and below ground drainage applications
- Ease of installation with mechanical assembly allowing adjustments onsite
- Easy versatile assembly - retro-fitting of additions or changes to soil stacks

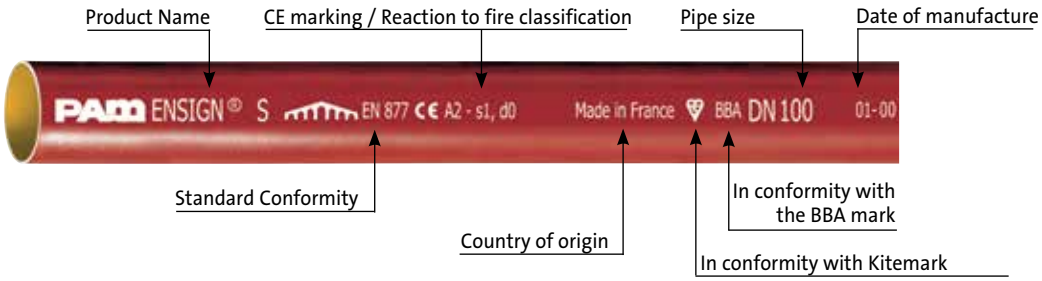
This products catalogue lists only items promoted in India.

PAM SMU / ENSIGN®S

PRODUCTS IDENTIFICATION

Pipes

PAM ENSIGN® S, above ground



According to standard EN 877, pipes, fittings and accessories as well as the couplings or clamping components and the gaskets shall be legibly and indelibly marked and shall bear at least the following information:

- the manufacturer's name or mark
- the identification of the production site
- the period of manufacturing, coded or not
- the reference to this European standard
- the DN, or DNs where applicable
- the design angle of fittings
- the identification of the accredited third party where applicable

In the case of pipes the above markings shall be applied at least once per metre length.

Fittings

The identification marking for Ensign fittings is a label.

PAM-SMU® S

EN 877 =
In conformity with Standards

NF/BBA =
In conformity with Quality marks

PAM-ENSIGN® S

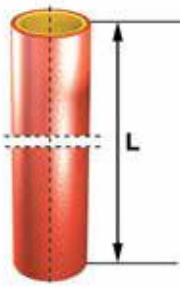
EN 877 =
In conformity with Standards

Kitemark/BBA =
In conformity with Quality marks

CE Marking = A2 -s1, d0 (see p 14)

Double spigot pipes (L= 3 m) - PAM ENSIGN®S

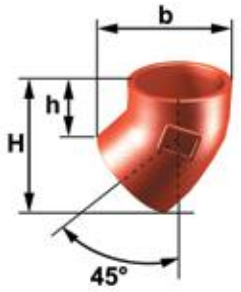
Pipe marking (example for a pipe of DN 300)



DN	DE*	Product code	Weight
50	58	156363	13.00
75	83	156452	18.30
100	110	156563	25.50
150	160	156827	43.00
200	210	156951	69.30
250	274	157049	99.80
300	326	157114	129.70

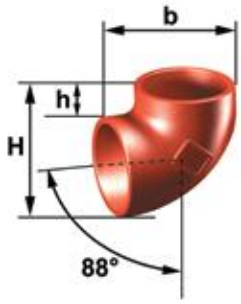
** External Diameter*

45° Bends



DN	Product code	b	H	h	Weight
50	156384	84	106	65	0.55
75	156476	112	132	73	0.85
100	156593	142	158	80	1.57
150	156850	199	210	97	3.19
200	156970	256	262	113	5.25
250	157069	324	319	125	10.00
300	157134	387	380	149	18.82

88° Bends



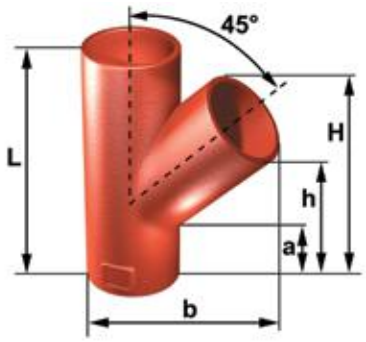
DN	Product code	b	H	h	Weight
50	156379	104	107	49	0.80
75	156471	138	140	57	1.20
100	156588	166	169	59	2.22
150	156844	227	230	70	4.34
200	156966	267	291	81	8.10
250	157065	360	363	89	13.50
300	157130	427	431	105	27.67

Bends of 15°, 22°, 30° and 45° can also be made available on specific requirements.
All dimensions are in mm and nominal weights in kg

PAM SMU / ENSIGN®S

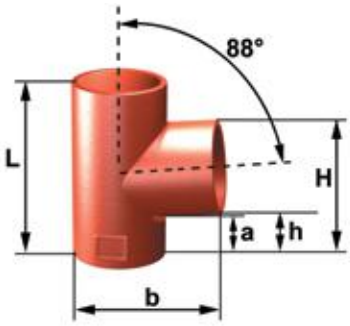
BRANCHES

45° single branches



DN	dn	Product code	L	b	H	h	a	Weight
50	50	156435	185	144	165	124	36	1.15
75	50	156490	180	156	161	120	43	1.80
	75	156544	215	179	198	140	40	2.35
100	50	156618	200	191	172	131	47	2.45
	75	156625	235	214	209	151	46	3.18
	100	156701	275	238	253	175	45	3.95
150	75	176733	255	265	220	161	54	5.10
	100	156879	295	287	262	185	54	6.10
	150	156931	355	323	333	219	53	8.70
200	75	176734	260	303	218	159	64	7.40
	100	156982	310	340	275	198	67	9.33
	150	156989	375	383	353	240	66	12.32
	200	157030	455	418	428	280	68	15.80
250	100	157073	330	398	276	198	72	13.60
	150	157075	405	440	358	245	75	17.25
	200	157078	480	486	440	291	75	24.30
	250	157106	580	537	530	335	70	32.80
300	100	157138	350	445	287	208	88	19.30
	150	157140	415	487	359	246	81	23.20
	200	157141	485	547	454	305	81	28.40
	250	157142	580	588	540	347	80	37.20
	300	157169	660	634	661	431	115	50.60

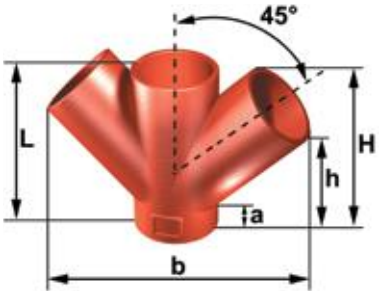
88° single branches



DN	dn	Product code	L	b	H	h	a	Weight
50	50	156431	145	110	111	53	31	1.10
75	50	156486	160	132	117	59	42	1.50
	75	156538	180	138	140	57	37	1.95
100	50	156613	170	161	127	69	45	2.25
	75	156620	190	166	145	62	40	2.55
	100	156695	220	172	174	64	41	2.65
150	50	156870	200	221	134	76	51	3.90
	75	156872	220	221	161	78	55	4.95
	100	156874	245	227	190	80	52	4.90
	150	156925	300	237	243	83	55	6.50
200	100	156980	270	282	206	96	64	9.80
	200	157024	365	388	296	86	67	11.10
250	250	157102	455	366	375	101	77	18.50
300	300	157165	530	433	437	111	87	34.00

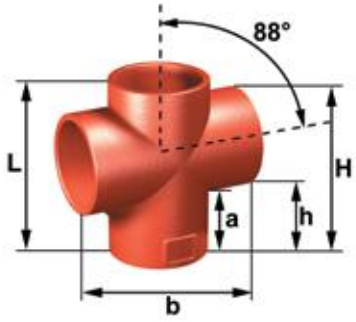
BRANCHES

45° double branches



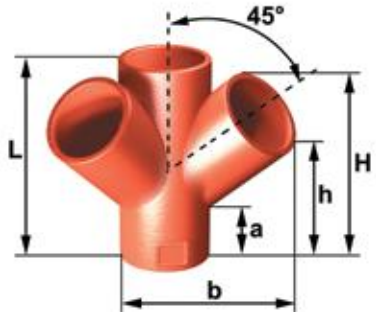
DN	dn	Product code	L	b	H	h	a	Weight
100	100	156709	260	346	243	165	46	4.50
150	100	156865	280	394	252	174	54	7.30
	150	156936	355	488	334	277	55	11.70
200	200	157034	455	627	428	280	67	18.40

88° double branches



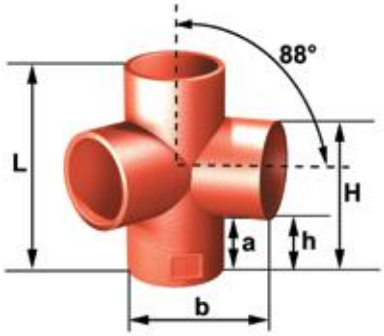
DN	dn	Product code	L	b	H	h	a	Weight
100	50	155825	170	212	127	69	45	2.20
	100	156704	230	243	179	69	49	3.20
150	100	155907	245	294	190	80	52	7.10

45° corner branch



DN	dn	Product code	L	b	H	h	a	Weight
100	100	156716	260	227	242	166	46	5.20

88° corner branches

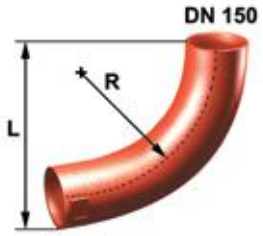


DN	dn	Product code	L	b	H	h	a	Weight
100	100	156712	230	177	179	69	44	3.40
150	100	155919	245	227	190	80	52	7.10

PAM SMU / ENSIGN®S

LONG FITTINGS

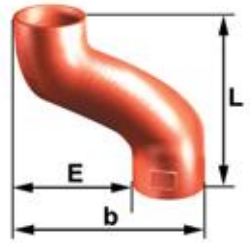
88° long radius bends



DN	Product code	L	R	Weight
100	156606	324	230	4.23
150	156860	349	210	8.00

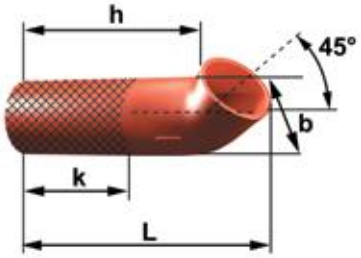
At the base of soil and rainwater stacks, we recommend the use of long radius bends in order to enhance hydraulics and avoid deposits or blocking up.

Offset bends 65, 75, 130, 150, 200 mm



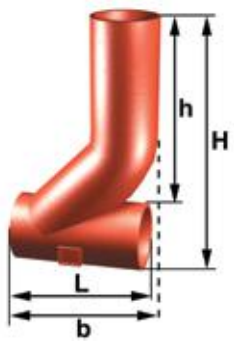
DN	Product code	L	b	E	Weight
50	156386	185	133	75	1.09
	156390	210	208	150	1.51
75	156478	200	158	75	1.51
	156482	230	233	150	2.32
100	155812	205	175	65	2.30
	156596	215	185	75	2.47
	156602	270	240	130	3.65
	156604	250	260	150	3.32
	155822	340	310	200	4.15
150	156853	255	235	75	5.05
	156858	300	310	150	6.66
200	156972	295	285	75	8.30
	156976	350	360	150	10.77

45° and 88° bends • Long tail



DN	Angle	Product code	L	b	h	k	Weight
100	45°	155824	338	143	260	180	3.50
100	88°	155823	305	165	195	140	3.75

45° branch • Single long arm

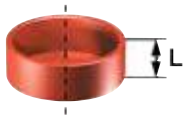


DN	dn	Product code	L	b	h	a	Weight
100	100	156726	260	282	450	340	6.30

The single long arm 45° branch is specially used to connect to a downpipe when the space is limited. It is also used for wall penetration.

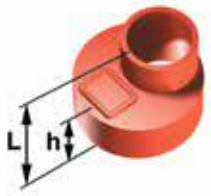
All dimensions are in mm and nominal weights in kg – k= maximum zone of possible cut

Blank Ends



DN	Product code	L	Weight
50	156376	30	0.25
75	156466	35	0.45
100	156581	40	0.80
150	156841	50	1.70
200	156963	60	3.20
250	157062	70	5.90
300	157127	80	9.40

Tapered pipes • Reducers



DN	dn	Product code	L	h	Weight
75	50	156424	80	47	0.70
100	50	156426	80	45	1.00
	75	156526	90	45	1.10
150	50	156430	95	55	1.90
	75	156530	100	57	1.70
	100	156686	105	60	2.30
200	75	156532	115	72	3.35
	100	156688	115	70	3.65
	150	156919	125	65	3.85
250	75	156534	125	82	5.95
	100	156690	125	82	5.70
	150	156921	135	82	5.90
	200	157020	145	80	6.10
300	75	156536	140	97	9.90
	100	156692	140	95	9.10
	150	156923	150	97	9.70
	200	157022	160	95	9.70
	250	157100	170	95	10.10

Obsolete pattern

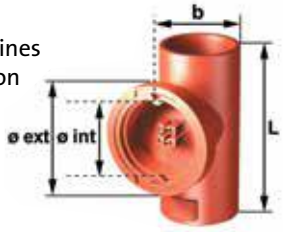
PAM SMU / ENSIGN®S

ACCESS-FITTINGS / PLUGS

Short access pipes

The access short access pipe combines reliability, ease of use and operation safety:

- **Operation safety:**
  Possible bleeding before opening in case of accidental overpressure =(1)
- **Respect of the water stream and turbulence elimination:**
  Shape of the elastomer plug inside = (3-4)
- **Convenience:**
  Ease of opening and closing the cast iron plug with standard tools or a T-handle operating wrench. Short access pipe are available for S and Plus ranges.



DN	Product code	L	b	Ø int	Ø ext	Weight
50	156414	160	102	75	108	1.90
75	156513	205	132	101	134	3.00
100	156659	250	157	128	160	4.50
150	156905	320	222	181	224	10.40
200	157015	360	270	181	224	12.75
250	157098	380	333	181	225	17.60
300	157161	400	385	181	227	26.30

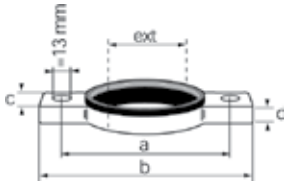
Expansion plugs

Expansion plugs with bleeding valve are available on request for the 125/150 and DN 200 (for water tightness tests).

DN	DE	Product Code	L	h	Weight	Vis
50	62	156374	45	20	0.34	M8x50
75	90	156464	70	25	0.7	M8x50
100	118	156579	85	28	1.25	M8x60
150	168	156839	88	35	2.4	M10x60
200	220	156961	100	46	5.2	M10x70

See page 49 for information on resistance to accidental pressure

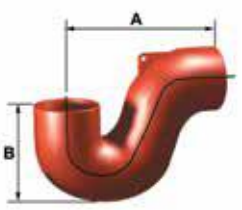
Stack support pipes



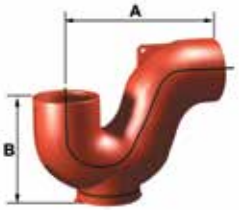
DN	Product code	L	a	b	c	d	e	Ø ext	Weight
50	156413	220	150	195	30	17	8	108	2.10
75	156512	220	175	218	30	19	8	133	3.00
100	156657	220	214	259	32	20	8	162	4.50
150	156904	220	255	300	32	22	8	222	7.20
200	157014	220	310	362	36	22	8	278	10.00
250	157097	300	394	444	40	25	8	354	18.50
300	157160	300	448	498	40	30	8	406	30.75

Weights are in kg

PAM ENSIGN® S Traps



Plain

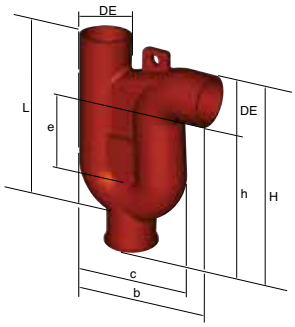


Bottom access

DN	Product code	A	B	Weight
	Traps – Plain – EF034			
100	156666	255	160	1.80

DN	Product code	A	B	Weight
	Traps – With access– EF037			
50	156419	160	115	2.00
100	156667	255	175	5.20
150	156911	350	240	12.10

Anti-Syphon Traps

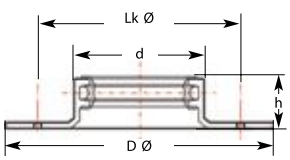


DN	DE	Product code	b	L	c	h	e	H	Weight
50	58	229107	165	262	-	187	80	245	2.75
75	83	156522	240	300	192	189	80	272	4.75
100	110	179013	316	382	255	240	80	350	9.20
150	160	156916	412	531	372	360	80	470	24.80

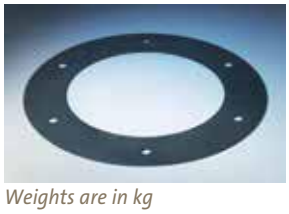
Special design for DN 50

Suitable for all waste water drainage systems, the Anti-Syphon Trap is particularly suited to systems without secondary ventilation. It ensures the retention of a water seal within the body of the trap to prevent odours travelling backwards through the system and fouling the atmosphere around sinks, washbasins, baths, rainwater outlets etc.
The Anti-Syphon Trap works by preventing the siphoning effect of a heavy discharge through the system. It does this through the internal partition within the trap allowing the air to by-pass the water, thus breaking the vacuum created by the discharging water.

Roof penetration: ductile iron flange fitting



DN	Product code	D mm	d mm	Lk Ø mm	Weight kg
80	205922	286	135	215	6,1
100	205924	324	158	246	6,6



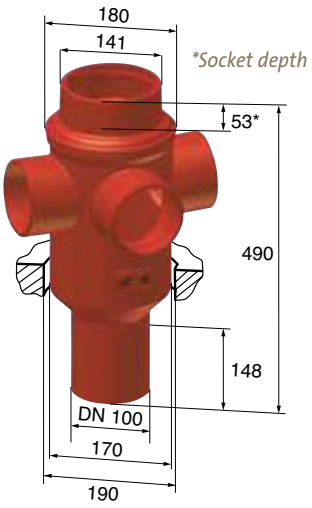
DN	Product codes		Weight
	EPDM gasket	NBR gasket	
80	179894	179895	0.2
100	207320	207319	0.3

Weights are in kg

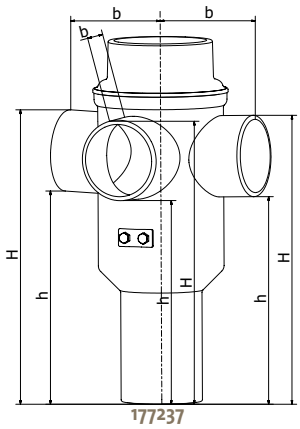
PAM SMU / ENSIGN®S

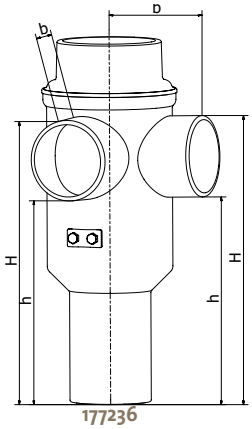
SPECIAL FITTINGS

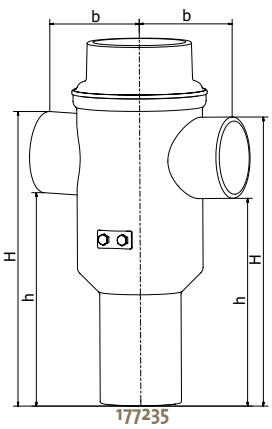
Branches for single downpipe 2 to 3 inlets • combined networks



DN	Product code	Lateral adjustments	H	h	b	Weight
100	177237	3 consecutive DN at 88°	392	282	140	11.0
	177236	2 DN at 88°				10.4
	177235	2 DN at 176°				10.8



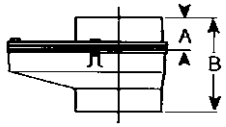


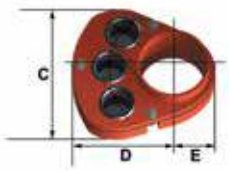


See P 53 for installation details

The branch for single downpipe allows wastewater drainage in a combined network without secondary ventilation according EN 12056. It simplifies plumbing by grouping pipework from 3 or 4 times more sources than a conventional installation. Maximum connexions for each floor level:
2 toilets, 2 bathtubs and all the usual sanitary facilities for two flats (sinks, basins, showers...)
Particularly suitable for narrow service shafts, for hotel rooms, student flats or any other building with adjacent sanitary blocks.

PAM ENSIGN® Multi manifold





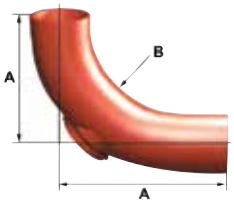
DN	Product code	B	C	D	E	Weight
Manifold Connector – EF094						
100	175626	43	125	200	142	62	3.20
150	175629	70	165	290	184	81	6.10

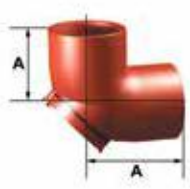
Replacement Plugs can be supplied on request

See p 52 for installation details

The multi-waste manifold simplifies waste plumbing by grouping all associated pipework from various sources such as sinks, basins, bidets, urinals and showers to one internal point above the finished floor level.

PAM ENSIGN®S 88° bends • Short and Long radius - Door back





DN	Product code	A	Weight
88° Bend – Short Radius Door Back – EF005			
100	156589	110	3.30
150	156845	145	6.10

DN	Product code	A	B	Weight
88° Bend – Long Radius Door Back – EF05L				
100	156607	269	180	1.80

All dimensions are in mm and nominal weights in kg

Obsolete pattern

PAM RAPID NG couplings • New PAM design, unbeatable performance

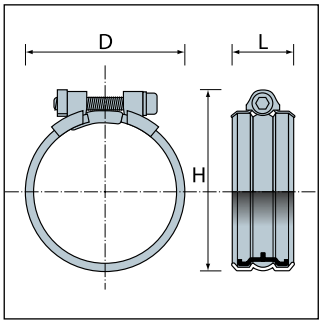
The PAM Rapid NG coupling, single bolt, allows fast and reliable installation.
SAINT GOBAIN PAM new design ensures optimized water-tightness and pressure resistance and better than ever corrosion resistance.

Standard version W2 technical specifications:

- Strap, clamps: 1.4510 /11 (AISI 430Ti / 439)

PAM RAPID-S NG couplings W2

DN	Product code W2 - S	D	H≈	L≈	Weight
50	210424	70	80	42	0.10
75/80	210426	90	103	42	0.12
100	210427	125	139	48	0.18
150	210429	172	187	56	0.32
200	210430	223	240	70	0.60
250	228759	290	315	95	1.10
300	228771	350	375	95	1.25



All stainless steel version W5 technical specifications:

- Strap, clamps: 1.4404 / 1.4571 (AISI 316 L/316Ti)
- Screw and nut: austenitic stainless steel A4-70 or AISI 316

The PAM Rapid NG is designed for a full tightening “nul gap”, there is no need for checking the torque.
For DN 250 and 300, apply the following torque: 25 N.m

PAM Rapid NG • All stainless steel couplings W5

DN	Product code Stainless steel W5	Product code W5 + NBR Gasket	D	H	L	Weight
50	185635	212705	70	80	42	0.10
75/80	207819	212708	90	103	42	0.12
100	185636	212709	125	139	48	0.18
150	207831	212711	172	187	56	0.32
200	185637	212712	223	240	70	0.60
250	228773	212713	290	315	95	1.10
300	228775	212714	350	375	95	1.25

Recommended for pipe systems exposed to climatic stresses, i.e rainwater spigot systems, drainage systems for bridges, or open multi-storey car parks.

Specific offer for a complete Nitrile coupling.

For waste water liable to contain hot oil, solvents or hydrocarbons, it is recommended to use couplings equipped with specific NBR gaskets.

PAM SMU / ENSIGN®S

COUPLINGS

SMU PAM R couplings • All stainless steel

"R" for Repair: This coupling with full opening strap is particularly fit for repairs and retrofit. It is installed in two separate parts. (see details, same as PAM CV-CE couplings)

DN	Product codes	A	B	ØC	ØD	Weight
50	233899	19	50	88	67	0.19
80	233900	19	50	110	91	0.22
100	233901	19	58	138	118	0.30
150	233903	19	58	180	167	0.37
200	233904	19	58	227	223	0.47

All stainless steel

- Steel strap: austenitic stainless steel - 1.4404/1.4571 (AISI 316L/316Ti)
- Barrels: austenitic stainless steel - 1.4404/1.457 (AISI 316/316L/316Ti)
- Screw: stainless steel A4-70, with anti-seizing coating.
  (thrust collar : AISI 316/316L)
- Sealing gasket: EPDM

PAM GRIP COLLARS

Rainwater pipe systems or drainage pipe systems can undergo accidental overpressure due to overloading or to the saturation of the sewer main. In specific sections - changes of direction and gradient, branches and plugs - the leak tightness and the pipe work stability call for joints able to address end thrust efforts. Depending on the diameter and the pressure level targeted combinations of couplings and grip collars or self-anchored high pressure couplings can equally be used. Where couplings are used with grip collars, the pressure performance of the assembly is defined by the weaker of the two products.

Refer to the products specifications page 46.

PAM grip collars

Designed by SAINT GOBAIN PAM, the PAM grip collar combines outstanding mechanical properties with very good pressure performance same as those of the PAM designed couplings, far over the Standard requirements.

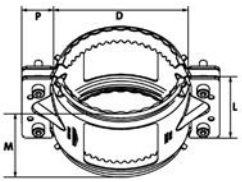
The thorough selection of the steels also ensures a very good corrosion resistance.

This grip collar tightens "null gap", there is no use checking the torque.

Technical specifications
Frames : Galvanised steel
Grips : Stainless steel + treatment
Tightening plates : Galvanised steel
Screws : Coated steel - class 8-8

PAM grip collars for couplings

Totally versatile, the PAM grip collar is compatible with all the PAM designed couplings or of equivalent shape.



Pressure resistance
DN 50-125: 10 bar
DN 150 -200: 5 bar
DN 250-300: 3 bar

DN	Product code	D ≈	P ≈	L ≈	M ≈	Wrench dim.	Weight
50	221261	88	22	72	76	6	0.45
75 SMA	221266	110	22	74	79	6	0.54
75/80	221268	105	25	73	78	6	0.53
100	220750	145	33	88	93	6	0.90
150	221270	196	32	96	102	6	1.23
200	221271	252	32	115	118	8	1.72
250	227039	318	38	131	140	8	2.25
300	227040	371	38	131	140	8	2.50

PAM Grip collars for expansion plugs

DN	Product code	D ≈	P ≈	L ≈	M ≈	Wrench dim.	Weight
50	222092	88	22	43	47	6	0.33
75 SMA	222093	110	22	43	47	6	0.42
75/80	222127	105	25	41	47	6	0.40
100	221563	145	33	45	50	6	0.61
150	222131	196	32	51	56	6	0.89
200	222133	252	32	60	64	8	1.20

Pressure resistance
DN 50-125: 10 bar
DN 150 -200: 5 bar

For DN 250 and DN 300 use plain plugs + couplings with PAM grip collars for couplings.

All dimensions are in mm and weights in kg. See p 44 for grip collars and couplings compatibility.

PAM SMU / ENSIGN®S

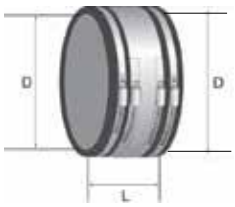
CONNECTORS

Stepping rings for connection to other materials

Use with a PAM-SMU® Rapid 2 or a PAM CV-CE

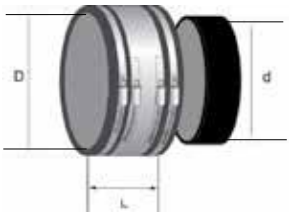
DN	roduct code	DE*	Weight	Materials
50	156399	50	0.02	HDPE and PVC
75	156495	63	0.06	HDPE
75	156494	77	0.03	PVC
100	156555	91	0.10	HDPE
100	156635	100	0.05	PVC
200	157000	200	0.15	HDPE and PVC
250	157085	250	0.45	HDPE and PVC

Adapting collar



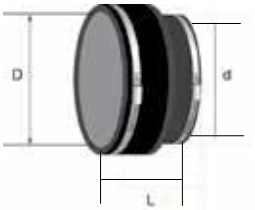
DN	Product code	D mini	D maxi	L	Weight
75	155001	75	90	100	0.40
100	155002	100	115	100	0.70
100	TXB10NP01	110	121	120	0.70
150	TXB15NM0J	150	175	120	1.00
200	TXB20NL0K	200	225	150	1.50

Adapting collar and stepping ring



DN	Product code	D mini	D maxi	d mini	d maxi	L	Weight
200	TXB20NN0K	200	225	192	201	150	1.90

Adapting joint



DN	Product code	D mini	D maxi	d mini	d maxi	L	Weight
150	155003	155	170	130	145	120	0.80
200	155004	170	193	210	235	150	1.50

EPDM plugs: possible branch connection

EPDM plugs 1 or 2 inlets

DN 50

DN 75

DN 100

EPDM plug 3 inlets

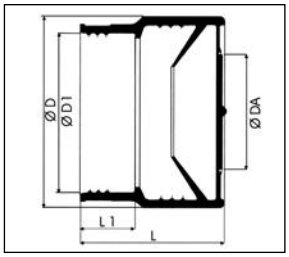
DN 100

DN	Product code	1st aperture Ø in mm	2nd aperture Ø in mm	3rd aperture Ø in mm	Weight
		with stainless steel collar			
50	156394	32 or 40			0,10
75	156492	(32 or 40) or (42 or 50)			0,18
100	156628	32 or 40	32		0,29
		without stainless steel collar			
100	156629	(32 or 40) or 42	(32 or 40) or (42 or 50)	(32 or 40) or (42 or 50) or 54	0,36

All dimensions are in mm and nominal weights in kg

PAM Konfix – For transitional connections

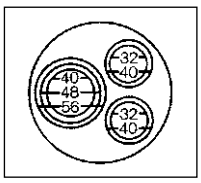
DN	Product code	D1	D	Ø Da Connecting pipe mm	L1	L	Insert depth mm	Weight
50	155759	57	72	40-56	20	58	35	0,11
100	155833	108	126	102-110	27.5	89.5	57	0,30
125	155883	132	151	125	35.5	108.5	65	0,65



Transitional connectors DN 50- 125 are devoted to connecting cast iron ranges S and Plus to other materials, be they steel or plastic. The connections with these flexible connectors are easy and safe: one pre-cut lid and a lip seal inside (see figure).
EPDM and hose clamp made of chrome steel n° 1.4016

PAM Konfix-Multi – For transitional connections

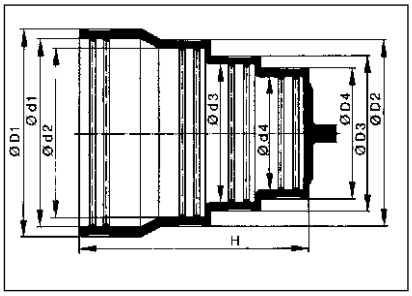
DN	Product code	D1	D	Ø Da Connecting pipe mm	L1	L	Insert depth mm	Weight
100	176811	108	134	32-56	35.5	90.5	40	0.30



To connect up to three pipes, 32-56 mm, made of other waste materials to a cast iron pipe system DN 100.
EPDM and hose clamp made of chrome steel n° 1.4016

PAM Multiquick – For transitional connections

DN	Product	ØD1	ØD2	ØD3	ØD4	Ød1	Ød2	Ød3	Ød4	H	Weight
100 x 70	176812	117	111	101	81	108	104	94	74	107	0,15



The Multiquick connector DN 100x70 allows connections between other waste materials, with outside diameter ranking from 72 to 110 mm, to our cast iron range DN 100 with a maximum outside diameter of 115 mm. Several pre-cut options.
EPDM and hose clamp made of chrome steel n° 1.4016

Section 3

Specifier's Manual

SAINT-GOBAIN CAST IRON PIPE SYSTEMS
1ST CHOICE FOR PROJECT MANAGERS AND PROFESSIONAL INSTALLERS

- Project support - assistance from our Technical Departments and commitment of our sales teams, to advise and help you to make the right choice.
- Traditional and precise mechanical assembly – with simple tools, without gluing or welding, to overcome on site difficulties.
- Simple to install, cast iron systems do not require specially trained installers to complete the installations.
- Dependable installation– SMU-Ensign ranges minimise the risk of error and help reach the expected performances immediately .

Design recommendations

Installation features

Preparation

Cast iron pipe systems for drainage mainly consist of spigot pipes - generally supplied in 3 m length - and fittings of various shapes (bends, branches, etc.). The cast iron pipes can be cut to length. Where pipes are cut on site, ends shall be cut clean and square with burrs removed and then re-coated with the adequate touch-up paints .

Cutting techniques

SMU pipes can be cut easily and quickly using either of the following methods. It should be ensured that cutting procedures comply with the safety guidelines from the cutting tool manufacturer's operating manual.

WARNING Chain or compression type cutters should not be used.



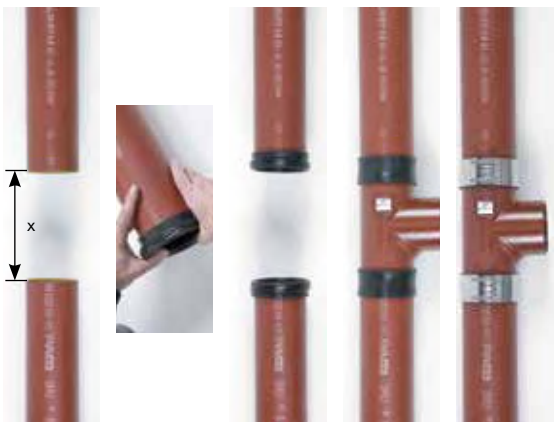

	Hacksaw	Pipe cutter	Band saw	Powered disc cutter
S And Plus ranges				
DN40	■	■	■	■
DN50	■	■	■	■
DN75	■	■	■	■
DN100		■	■	■
DN125		■	■	■
DN150		■	■	■
DN200			■	■
DN250			■	■
DN300				■

Reciprocating saw can be used, but is not fully adapted.

Modifications to an existing installation.

Typical example spigot system

1. *Measure length of branch, adding a further 15mm in total to allow for coupling's central register top and bottom.*
2. *Make sure existing pipework is adequately supported from above.*
3. *Mark pipe position for cutting.*
4. *Cut pipe using powered disc cutter or wheel cutter and remove sharp edges.*
5. *Coat cut ends with appropriate touch-up (epoxy coating).*
6. *Push the rubber gaskets onto the spigot cut ends top and bottom, ensuring the central registers are abutted against each spigot edge.*
7. *Position fitting in the stack within each rubber gasket abutting against the central registers.*
8. *Loosely assemble the coupling around each gasket.*
9. *Check alignment of assembly before tightening the bolts, to recommended level, depending on the couplings technical recommendations.*
10. *Test new stack for successful joints.*



X = fitting + 15mm

Jointing methods

Stainless steel couplings

Some models can be assembled in two parts and other can be assembled as a sleeve.

Assembly as a sleeve

PAM Rapid NG couplings

Couplings are supplied pre-assembled.

Push the supplied assembled coupling onto the pipe spigot so that it abutts on the central register of the elastomer gasket.

Push the next pipe pigot into the other end of the coupling.

Tighten the screw to "nul gap" position, that is fully closed, with a ratchet spanner or an electric screwdriver.

The PAM Rapid NG from DN 50 to 200 is designed to be tightened to fully closed there is no need for checking the torque.

PAM Rapid 250-300 coupling - Special design:

can be assembled two different ways, depending on if an open strap is required.

Standard assembly:

1 Open the stainless steel strap.

2 Slide the stainless steel strap loose, around the first pipe component.

3 Push the sealing gasket onto the component spigot so it abuts on the central register of the gasket.

4 Push the second component into the sealing gasket, so that it abuts on the central register.

5 Bring the steel strap over the sealing gasket.

6 Tighten the bolt with a ratchet spanner or a power tool applying the following tightening torque: DN 250 and DN 300=25 N.m.

Open strap assembly:

An open strap is sometimes required to ease access: stack installation etc...

1 Push the rubber gaskets onto the spigot ends top and bottom, ensuring the central registers are abutted against each spigot edge.

2 Twist the stainless steel strap to ease the wrapping around the pipe components.

3 Clip the bolt and loosely assemble the coupling around the gasket.

4 Check alignment of assembly before tightening the bolt with a ratchet spanner or a power tool applying the following tightening torque: DN 250 and DN 300= 25 N.m.

Wherever couplings can be submitted to end thrust forces, they must be secured with grip collars. See p48 for installation details.

Technical characteristics

Couplings technical features

	PAM Rapid NG W2	All stainless steeel PAM Rapid NG W5	Rapid S NG 250-300	All stainless steel Rapid NG 250-300
Strap/case material (1)	Stainless steel 1.4510 /11 (430Ti / 439)	Stainless steel 1.4404 / 1.4571 (316L/316Ti)	Stainless steel 1.4510 /11 (430Ti / 439)	Stainless steel 1.4404 / 1.4571 (316L/316Ti)
Screws	Allen			
Wrench dimension (in mm)	DN 50-150: 6 DN 200: 8		DN 250-DN 300:8	
Number	1	1	1	1
Screws Material	Coated steel class 8.8	Coated stainless steel A4-70 1,4404/1,4571	Coated stainless steel A2-70	Coated stainless steel A4-70
Tightening torque (in N.m)	Nul gap tightening. No use checking torque		DN 250-300 : 25 N.m	
Clamp and barrel	Clamps		Barrels	
Material (1)	Stainless steel 1,4301 or 1.4510 /11 (304 or 430Ti / 439)	Stainless steel 1.4404 / 1.4571 (316L/316Ti)	Stainless steel 1,4301 or 1.4510 /11 (304or 430Ti / 439)	Stainless steel 1.4404 / 1.4571 (316L/316Ti)
Number	2	2	2	2
Sleeve (gasket)	EPDM	EPDM or NBR	EPDM	EPDM
Performances	In In compliance with EN 681-1 December 1996 -Type WC			
Maximum deflection (4)	DN 50-200: 3° DN 250-600: 1,45° (5)			
Maximum misalignment (4)	Corresponding to a shearing load of 10 X DN in Newton, limited to 6mm, under an internal pressure of 1 bar			
Hydrostatic test pressure	Beyond EN 877 requirements- DN 50 to 125: 10 bar DN 150 to 200: 5 bar - DN 250-300: 3 bar			

(1) First grade is according to EN 10027-2, grade in brackets to the closest AISI one considering equivalences between standards.
(2) As per EN ISO 3506-1
(3) Standard tightening to reach EN 877 requirements. For higher requirements on pressure resistance, "nul gap" tightening should be applied.
(4) See EN 877 for more details
(5) Where couplings are used with grip collars, or for SMU-S Autogrip couplings, deflection should be applied before tightening the bolts/screws
Note: 1 bar = 100 kPa = 0.1 MPa ≈ 1 daN/cm²≈10 m water column

Couplings + grip collars: performance level

Couplings	Grip collars	DN	Address end thrust effort for a pressure of (in bars)									
					3b		5b					10b
Expansion plug 	Expansion plug 	50 - 125										**10b**
		150 - 200					**5b**					
		250 - 300			**3b**							
Expansion plug 	PAM Grip Collars for Expansion plugs 	50 - 125										**10b**
		150 - 200					**5b**					

** Grip collars are unecessary for couplings on straight runs between two fix points*
*** Same for the self-anchored couplings like the PAM HP GRIP which can be replaced under the same circumstances by couplings able to withstand the required hydrostatic pressure.*

Design recommendations

Connection to other materials

Branch connections to waste pipes in small diameters

The easiest way to connect cast iron systems to other drainage materials is to use rubber connectors or plugs. Flexible couplings and stepping rings are also available to ease connections where variances in diameters have to be compensated.

Konfix

Konfix-Multi

Rubber transitional connectors PAM KONFIX and PAM KONFIX-Multi are used to connect waste pipes made of other material (steel or plastics) to a PAM cast iron pipe system.

1.*Insert the PAM KONFIX rubber connector loosely onto the pipe until the stop point is reached. Then secure to the pipe by tightening the hose clamp screw.*

2. *Cut the precut rubber to size with a knife and remove the lid. WARNING: Do not cut too deep as may damage the lip seal inside!*

3. *Mark the insert depth on the connecting pipe. Apply a lubricant and push in. The assembly is completed*

4.*The connecting steel pipe illustrated here is only an example. The PAM KONFIX rubber connectors can be used to connect all waste pipe materials to the PAM cast iron systems.*

EPDM plugs

The plugs can be pierced to the appropriate groove from 32mm up to 54mm waste connections and tear out centre disc where required.

EPDM plugs 1 or 2 inlets

DN 50

DN 75

DN 100

EPDM plug 3 inlets

DN 100

PAM MULTIQUICK, transitional connector.

To connect PAM cast iron pipes with an outside diameter of 109-112 mm (tolerance range for PAM cast iron pipes DN 100) to other rigid materials with an outside diameter range 110-72 mm.

To connect PAM cast iron pipes with an outside diameter of 109-112 mm to waste pipes with an outside diameter up to 115 mm maximum. The connection is made with two hose clamps both suitable to address larger diameter tolerances.

1. *Push the open end of the PAM MULTIQUICK connector over the pipe end and place the hose clamp to its tightening position.*

2. *Then use a knife to cut open the pre cut lid to the corresponding outside diameter of the connecting waste pipe. Then push the second hose clamp loose over the connecting rubber end.*

3. *Push the connecting pipe into the PAM MULTIQUICK connector and tighten the hose clamp in the right position. Ensure that the sealing zones (face ends of pipes or fittings) are clean: remove paint flakes and cement residues. The hose clamps should only be tightened manually with a screwdriver in order to avoid any damage to the PAM MULTIQUICK rubber connector.*

Design recommendations

Connections to other materials

PAM cast iron connections to other material may be frequently required in new construction projects or for renovation. Different solutions can be used with products from our catalogue (see figures below).

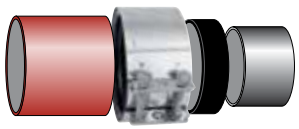
Depending on the outside diameters, solutions exist for compensation.

If you have a doubt as for the circumference of the material to connect, you can use a circumference tape

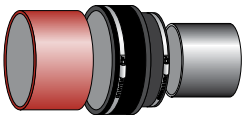
The range of tolerance of the different joints can help you find the required solution.

You will find in the table below, the solutions to connect PAM cast iron to the most frequently met material.

1. *PAM CV NG + Stepping ring (SR)*

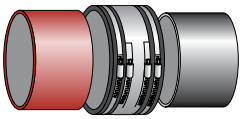


2. *Adapting joint= AJ*



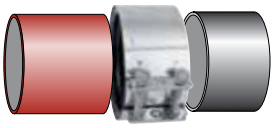
Max Pressure 0,6 bar Stainless steel 304

3. *Adapting collar = AC*



Max Pressure 1,5 bar Stainless steel 304

4. *A=B*



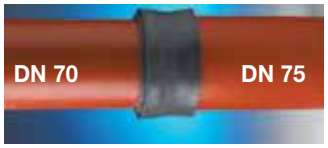
PAM Rapid NG couplings 0can also be used but are not recommended for type 1 installation for aesthetical reasons.

Admissible tolerance couplings (mm)				Material to connect	DN/OD (mm)	Circumference (mm)	
Special joints		PAM couplings					
DN/OD	Circumference	DN/OD	Circumference				
49-52	153-163	55-60	172-188	P.V.C HDPE	50	157	
				HDPE	56	176	
62-65	194-204	81-86	254-270	P.V.C HDPE	63	197	
75-79	235-248			P.V.C HDPE	75	235	
75-90	235-282			P.V.C	80	251	
89-92	279-288	107-112	335-351	P.V.C HDPE	90	282	
99-102	310-320			P.V.C.	100	314	
				P.V.C HDPE	110	345	
100 - 115	314-361			Steel	114	358	
123-127	386-398	133-138	417-433	P.V.C HDPE	125	392	
130-150	408-471			Steel	125	436	
130-145	408-455			P.V.C	140	439	
155-170	486-534						
		158-164	496-514	P.V.C HDPE	160	502	
150-175	471-549			Steel	168	527	
198-202	621-634	207-213	649-668	P.V.C HDPE	200	628	
200-225	628-706			Steel	219	688	
248-252	778-791	271-276	850-868	P.V.C HDPE	250	785	
					273	857	
310-335	973-1051			P.V.C HDPE	315	989	
		323-328	1014-1031	Steel	324	1017	

Specific DN 70 / 75 connection with PAM CV-CE coupling

Product code : 156494 210413
1. Stepping ring + PAM CV-CE NG coupling

2. Fit the stepping ring onto the DN 70 pipe end, first.



3. Fit the rubber gasket of the PAM CV-CE to the pipe end mounted with the stepping ring till it abuts the central register, then fit the DN 75 pipe end into the rubber gasket so that it abuts the central register as well.

4. Apply the PAM CV-CE NG steel strap around the sealing gasket and tighten as described p41.

PAM cast iron DN (mm)	DN/OD (mm)	DN/OD Tolerance (mm)	Solution	Junctions product codes	Figure
50	58	+ 2 -1	PAM CV NG + BC	210398 -156399	1
			SMU PAM R + BC	233899 - 156399	
			PAM CV NG	210398	4
			SMU PAM R	233899	
75	83	+2 -1	PAM CV NG + BC	210413 -156495	1
			SMU PAM R + BC	233900 -156495	
			PAM CV NG +BC	210413 -156494	1
			SMU "MA"	155001	3
100	110	+2 -1	PAM CV NG + BC	210416 -156555	1
			SMU PAM R + BC	233901 - 156555	
			PAM CV NG +BC	210416 - 156635	1
			PAM CV NG	210416	4
			SMU "MA"	155002	3
125	135	+2 -2	PAM CV NG + BC	210417 + 156778	1
			SMU "MA"	TXB12NLOG	3
150	160	+2 -2	SMU "RA"	155003	2
			PAM CV NG	210418	4
			SMU "MA"	TXB15NMOJ	3
200	210	+2,5 -2,5	PAM CV NG + SR	210420 + 157000	1
			SMU "MA"	TXB20NLOK	3
250	274	+2,5 -2,5	PAM CV NG + SR	210422 + 157085	1
			PAM CV NG	210422	4
300	326	+2,5 -2,5	SMU"MA"	TXB30NN02	3
			PAM CV NG	210423	4

Design recommendations

Requirements and permissible pressure load

Standard requirements according to EN 12056

Gravity waste water drainage systems and ventilation systems generally operate without pressure. This does not exclude however, the possibility of pressure arising in the systems under specific operating conditions.

EN 12056-1, Section 5.4.2 Water and Gas Tightness, states that drainage installations must be sufficiently water and gas tight to withstand pressures arising in operation.

Furthermore, EN 12056-5, Section 6.3 states relating to securing pipe systems: Non anchored pipes must be secured and/or supported in such a manner that they cannot be disconnected during use. The arising reaction forces must be addressed.

Definitions

Fluid pressure is the force the fluid exerts by surface unit, perpendicularly to this surface.

Pressure change **applied** to the surface of an enclosed **fluid** is transmitted evenly and undiminished in all directions. Robust cast iron components can address any pressure hazard, so the couplings will be submitted to the strain.

Couplings designed by SAINT-GOBAIN PAM are tested in hydrostatic pressure; grip collars and autogrip collars only are tested under end thrust forces.

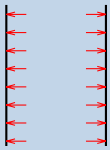
FAQ

Pressure definitions

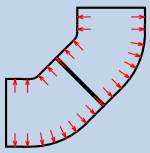
Hydrostatic pressure: outward pressure exerted by a non-moving (static) fluid everywhere perpendicular to the pipe walls or any other pipework element, like joints.

When it is stated that a coupling withstands a 5 bar hydrostatic pressure it comes to considering the coupling water tightness under this pressure only, whilst considering that the two spigots are affixed so that dislocation forces are addressed.

End thrust effect: resultant forces from the pressure exerted by a static fluid on specific pipework elements (or direction changes) i.e:
- Straight run (pipes): the stresses cancel



- Specific (for i.e fitting): the resultant force tends to disconnection



PAM grip collars installation

Position the two half parts of the PAM grip collar uniformly so it encircles the pipe in parallel . The grip collars must be positioned so that the apertures fit over the fixing bolts of the coupling and the teeth are directly located onto the pipe.

Insert the four screws to fix the two parts together loosely.

Tighten the screws crosswise alternatively so that the two plates are put in parallel with the same spacing.

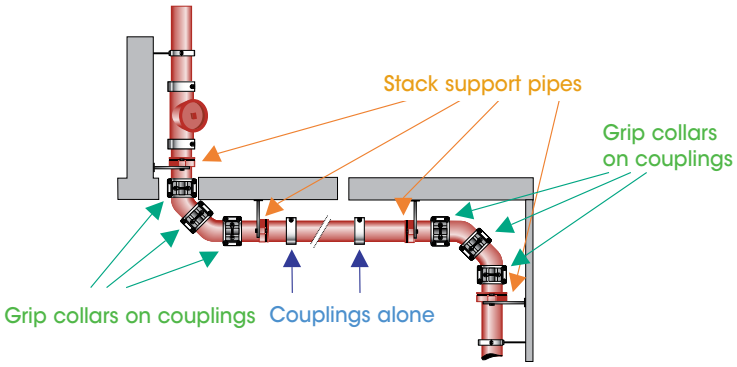
The assembly is completed when the external edges of the plates are in contact on both sides.

Requirements and permissible pressure loads for couplings
Conditions when drainage pipeworks may be exposed to an internal pressure higher than 0.5 bar:
1. Pipes laid under the groundwater table
2. Rainwater pipes or wastewater pipes running through several storeys without outlets
3. Pipework operating under pressure for wastewater pumped installations

Straight runs of the pipework
Straight runs between two fixed points do not experience exceptional forces, grip collars are then not necessary.
In case of accidental overloading, the couplings will only have to address hydrostatic pressure. They generally withstand:
5 bar for couplings like PAM Rapid S or SMU PAM R from DN 50 to 200
3 bar for the same couplings for DN 250 and 300

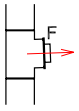
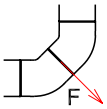
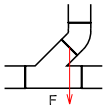
Changes of direction and specific elements
End thrust forces can exert in changes of direction, gradient and specific components like branches and plugs for example. In these areas, the forces have to be addressed to avoid any risk of disconnection or slippage of the pipe system:
• isolating the section subjected to thrust forces between two fixed points, like stack support pipes i.e **and**
• adapting the joints (selection of couplings + installation of grip collars) between these fixed points.
To address the thrust forces, other solutions can be resorted to, like anchoring in concrete, or using mechanically-welded devices...

Remark: under end thrust forces, where a coupling is secured with a grip collar, the maximum performance of both is limited by the weakest performance of the two products.



PAM Couplings and grips collar have been designed to reach the same pressure performance and beyond the standard requirements.

End thrust force under a 1m water column (kg.F)

		DN 50	DN 75	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300	DN 400	DN 500	DN 600
Expansion plug		2	5	9	13	19	32	55	79	136	210	301
2 45° bends		3	7	12	19	26	46	78	111	192	297	426
Stack bottom		2	5	9	13	19	32	55	79	136	210	301

Ensure that the installation instructions for couplings and grip collars are observed.
See coupling performances on page 44

Specific applications: Rainwater pipes
EN 12056-3, Section 7.6.4., stipulates: Internal rainwater pipes shall be able to withstand the head of water likely to occur in the event of a blockage.
The same precautions as on a pipework liable to undergo accidental overloading should be taken: securing of bottom bends and joints with the adequate grip collars.

Design recommendations

Ventilation

A drainage pipe is normally at neutral air pressure compared to the surrounding atmosphere. When a column of waste water flows through a pipe, it compresses air in the pipe, creating a positive pressure that must be released or will push back on the waste stream and downstream traps' water seals. As the column of water passes, air must flow in behind the waste stream or negative pressure (suction) results. The extent of these pressure fluctuations is determined by the fluid volume of the waste discharge.

The purpose of ventilation stack is to control pressure in the pipework in order to prevent foul air from the waste water system entering the building. You will find below some major configurations principles, but combinations and variations are often required. **See standard EN 12056-2**

Black water and grey water can be drained either in separate or in a single discharge stack. According to the selected option, the rules for duct sizing are different.

Primary ventilated system configurations:

Control of pressure is achieved by air flow in the discharge stacks. The soil stacks extend in main roof vents to above and out of the roof. Alternatively, air admittance valves may be used. They are pressure-activated, one-way mechanical vents, used in a plumbing system to eliminate the need for conventional pipe venting and roof penetrations.

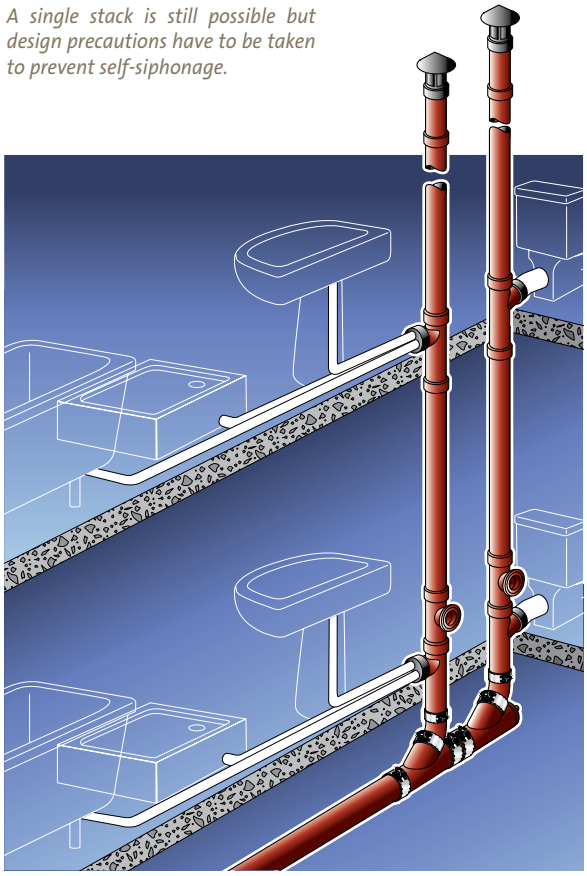
Secondary ventilated system configurations

In buildings of three or more storeys - if the air pressure within the stack becomes suddenly higher than ambient, this positive transient could cause waste water to be pushed into the fixture, breaking the trap seal.

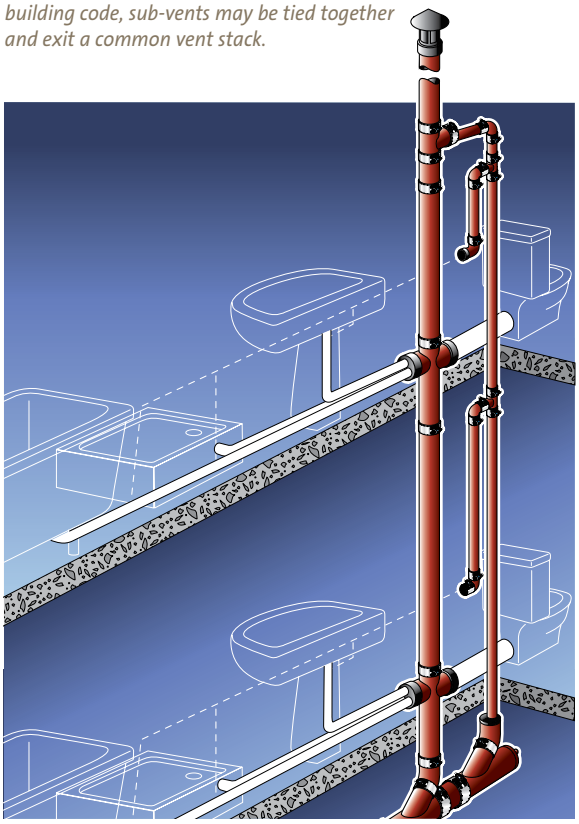
Vent stacks are put in parallel to waste stacks to allow proper venting and prevent such disorders. Air admittance valves may also be used, in this configuration.

Under many building codes, a vent stack, a pipe leading to the main roof vent, is required to the draining fixtures (sink, toilet, shower stall, etc.).

A single stack is still possible but design precautions have to be taken to prevent self-siphonage.



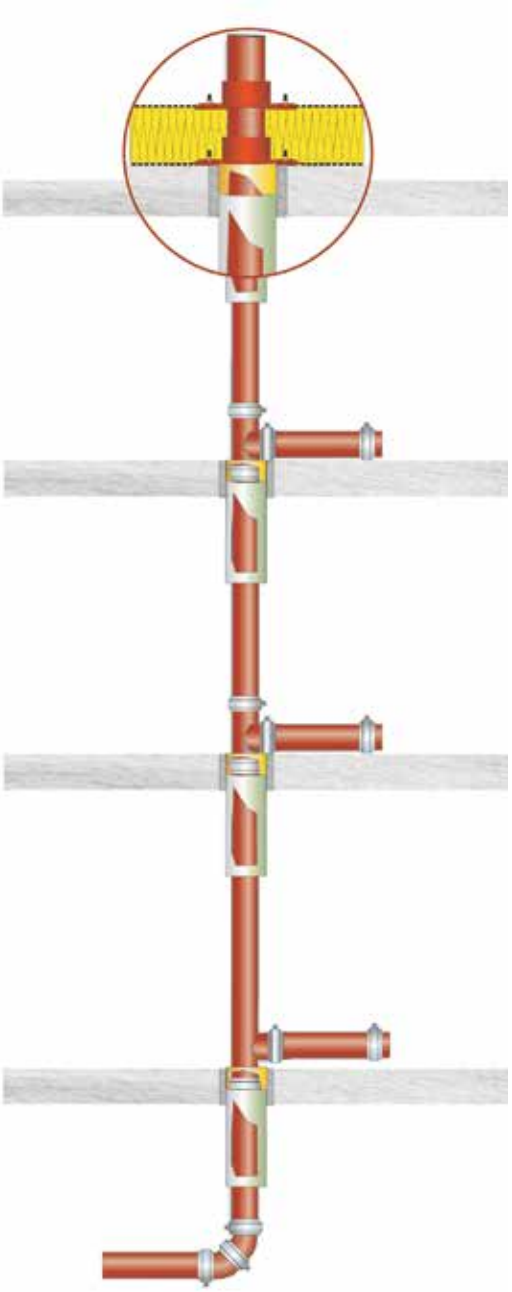
To allow only one vent stack, and thus one roof penetration as permitted by local building code, sub-vents may be tied together and exit a common vent stack.



Roof penetration device

To secure roof watertightness, which is of crucial importance, the number of roof penetrations should be limited. SAINT-GOBAIN PAM has designed for its pipe systems, a roof penetration device that is watertight and quick to install.

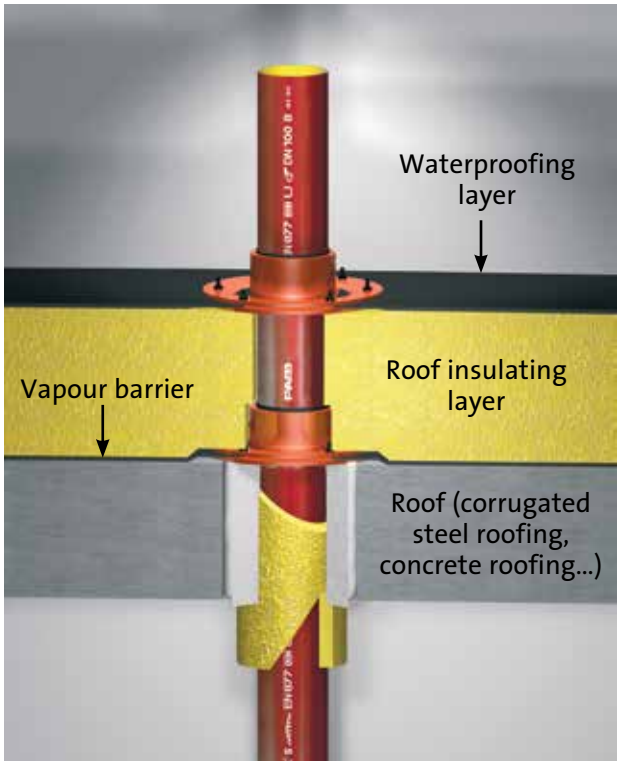
The system was developed to ease installation of perfectly watertight roof penetration for cast iron primary ventilation pipes or vent pipes. The flanged fittings clamp both the vapour barrier and the waterproofing layer.



The roof penetration device is a set of two ductile iron flanged fittings – one of the flanges is fixed, the second is movable - equipped with rubber gaskets.

Rubber gaskets are available in EPDM or NBR quality where hydrocarbons can be feared.

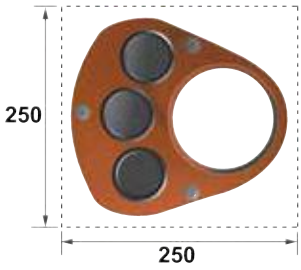
See product codes p 31



The first flange fitting, installed above the roof clamps the vapour barrier under the roof insulating layer, the second, above the insulating layer clamps the waterproofing layer, be it polymer or bituminous.

Design recommendations

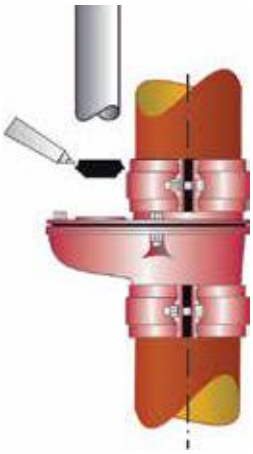
Multi waste manifold



The multi-waste manifold simplifies waste plumbing by grouping all associated pipework from various sources such as sinks, basins, bidets, urinals and showers to one internal point above the finished floor level.

The manifold will permit the connection of three 32/38mm copper/plastic waste inlets to any new or existing 100mm diameter PAM SMU / Ensign pipe stack and three 50mm copper/plastic waste inlets to 150mm diameter pipe stack.

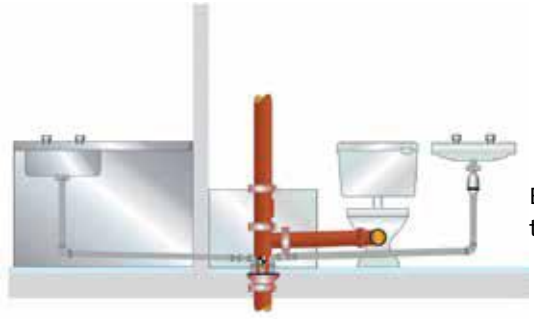
The manifold main body is connected to the stack using standard couplings. On the 100mm manifold to achieve a 32mm waste connection, remove the inner rubber ring, 38mm utilising the outer ring (for waste pipe maximum lengths see EN 12056-2). Pipework connecting discharge appliances to the manifold, should be designed not to cause self siphonage.



Fixing instructions

1. Remove grommets, pierce the appropriate groove for 32mm or 38mm waste (100mm manifold only) connections and tear out centre disc where required.
2. Apply an appropriate silicone grease (not provided) to the outside of the grommet and re-fit into manifold ensuring that the retaining groove of the grommet is located correctly in the casing.
3. Lubricate pipe ends and insert into grommet with a rotational movement. Pipe ends may be chamfered for ease of insertion.
4. Any grommet not fitted with a waste pipe must also follow instruction 2 above.

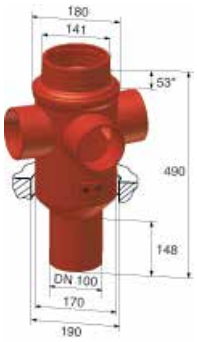
Typical manifold installation

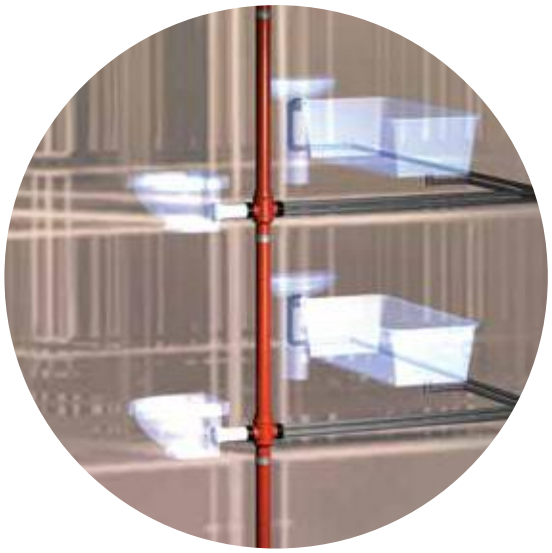


Beware the manifold is not made to vent the stack.

Single stack branch

The CEBTP branch is a patented device made to allow wastewater drainage without vent pipes.





Given that the maximum number of connected sanitary appliances is respected, the single stack branch CEBTP properly drains waste water in a single stack, without vent pipes, whilst limiting the risks of self siphonage. This device complies with the Regulation in force and with Standard EN 12056.

Consult local requirements for compliance.

Field of use:

- Multi connection of sanitary appliances for adjacent flats, or sanitary blocks
- Compactness when the space is limited
- No secondary vent pipes being required.

Drivers:

It simplifies plumbing by grouping the pipeworks from 3 or 4 times more sources than a conventional installation. Maximum connections for each floor level: 2 toilets, 2 bathtubs and all the usual sanitary facilities for two flats (sinks, basins, showers...) The single stack branch is particularly suitable for narrow service shafts, for hotel rooms, student flats or any other building with adjacent sanitary blocks.

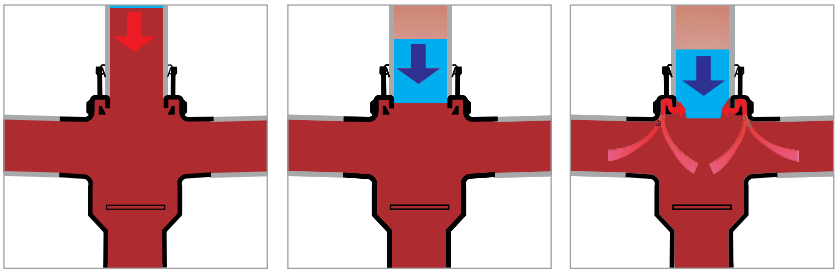
Operation features

-Prevents excessive pressure variations in the stack system.

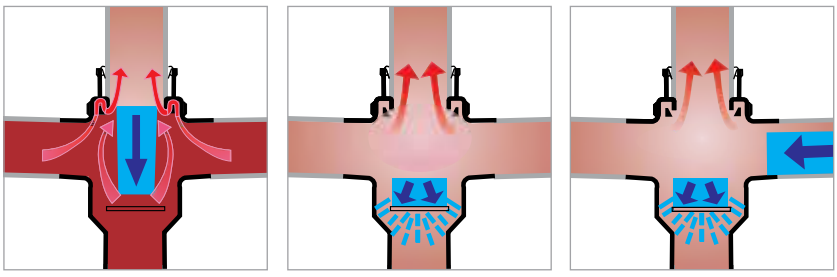
-Limits negative pressure by optimal venting and prevent self siphonage.

The single stack branch DN 100 main body is connected to the stack using standard couplings and a traditional jointing method. Their water tightness is ensured by the rubber gaskets which equip the SMU® S, SME and SMU® Plus product lines, proposed by SAINT-GOBAIN PAM.

The plumbing works overall shall be executed in compliance with standard EN 12056: the appliances are to be installed with traps in compliance with the specifications of the same standard.



Owing to the special design of the branch, after a flush, the column of water is directed so that air can pass over the flow and naturally vent the stack.



Inside the branch, at the bottom of the body, a rubber deflector sprays the column of water to prevent draught or self siphonage.

Products:

The single stack Branch now exists in long tail to allow connection to the main stack under the slab and thus ease installation either in new or renovation works.

Three different products, 2 or 3 inlets:
- Corner branch two inlets 88°
- Double branch two inlets 88°
- A consecutive branch, three inlets 88°

Rubber plugs with several pre-cut lids will permit from one to three different connections.

Design recommendations

Pipeworks stability

Stack support pipe for open hoppers.

A pipework is submitted to different forces liable to affect its stability. Stack supports are cast iron components designed to address these efforts when a stack is installed through open hoppers.

On straight runs, stack support pipes should be installed to address the pipes weight. At the bottom of the stack, the first stack support pipe addresses both pipes weight and end thrust effort. For the last case, it is recommended that the support and fixings should be adapted accordingly.

We recommend to position the first stack support pipe at the base of the first floor, and then every subsequent fifth floor, in case of a standard average 2.5 m between floors, or more generally every 15 m.

In case of closed hopper, no stack support pipe is required.

Stack support pipe and acoustic insulation

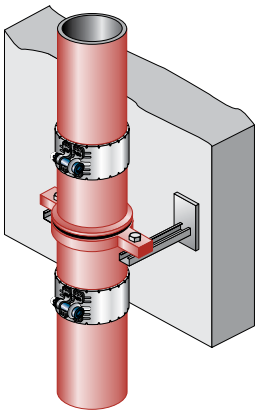
The support bracket of the stack support is covered with rubber gasket to limit the transmission of structure-borne noise emitted by the drainage network at slab level.

During lab tests carried out in 2002*, a stack assembly including a stack support pipe on console support and a rubber lined bracket, both affixed to a wall with a surface density of 220 kg/m² showed results slightly better than the same installation made with two fixings with rubber lined brackets. In this particular installation, the use of stack support pipes does not affect acoustic performance.

**Tests carried out according to standard EN 14366.*

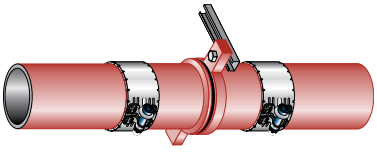
Stack support pipe installed vertically

Either on cantilever arms or stack support consoles for DN 100.



Stack support pipe installed horizontally

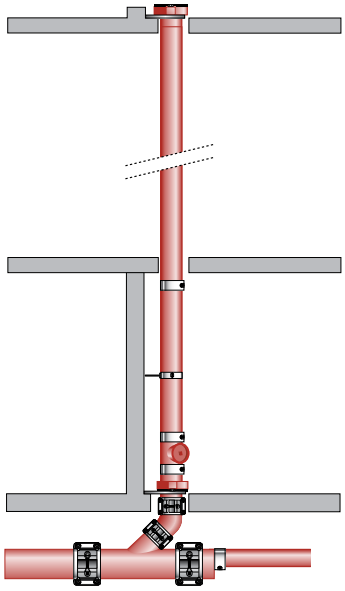
Wall bracketing system in mild steel, for use with stack support pipes and brackets, is available.



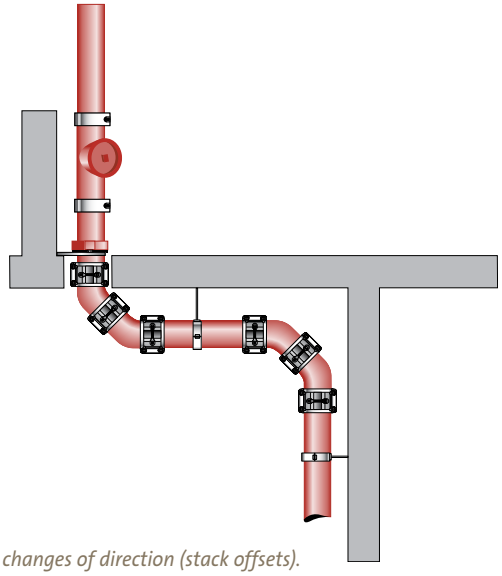
Access to the pipework

Access to the pipework must be ensured so that tests, inspections and maintenance can be performed. Access may be obtained using a short access pipe.

On downpipes



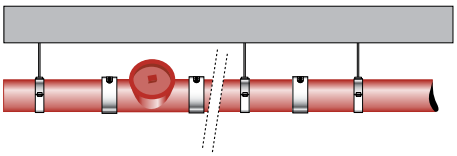
At the bottom of the stack



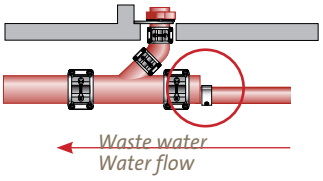
At changes of direction (stack offsets).

On horizontal collectors

On horizontal runs, the short access pipe will be installed in a slightly sloped position with respect to the pipe crown.

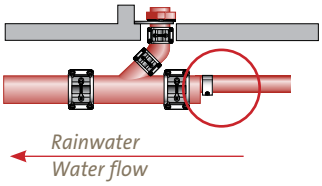


Water flow and air circulation, according to the standard 12056-2 & 12056-3.



The internal diameter of pipes cannot be reduced in the direction of the water flow, except in the case of pipeworks operating at full bore, under negative pressure such as in the siphonic roof drainage system EPAMS.

The addition of branch connections, or changes of fall liable to increase the water flow rate, may require an increase of internal pipe diameter. This increase can be made upstream of the new branch connection, using a tapered pipe reducer (see page 31).



Rainwater horizontal pipelines

In horizontal and near horizontal pipelines, increases in size shall be installed such that the soffit is continuous in order to prevent air from being trapped.

Design recommendations

Bracketing: technical

Pipe support except for the EPAMS system

For cast iron, the bracketing system is designed to only carry the weight of the pipe and its content, which makes the specifiers' design work easier.

Pipe weight in kg per metre.

	40	50	75	100	125	150	200	250	300	400	500	600
Empty pipe	3	4	6	8	11	14	22	32	42	60	82	107
Full pipe	4	6	11	16	24	31	54	82	113	185	278	390

Note: The technical specifications for threaded rods and metal brackets shall be established on this basis.

Bracketing recommendations for cast iron pipe system elements

		Number of brackets
Vertical run	Pipes	1 (2)*
	Fittings**	1
Horizontal run	Pipe length≥2m	2
	Pipe length<2m	1
	Fittings**	1

Consult local requirements for compliance.

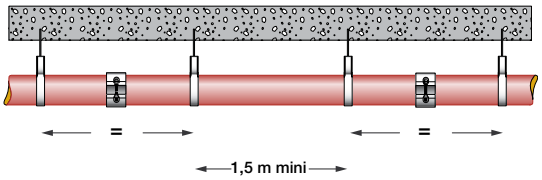
** for SMU pipes L ≥ 2,7 m installed outdoor.*
*** when the shape of the fitting permits*

It is also recommended to use one bracket per length or fitting (when the shape allows it, i.e branches...)

Support for horizontal pipework

The general recommendation for horizontal pipework is two load bearing brackets per pipe. For an indication, they should be installed at 0.75 m from each spigot so that, ideally, the distance between two brackets should be 1.5m. Installation shall respect a slight fall, around 1 or 2%, and 0.5% at a minimum, (0.5 cm per metre).

Horizontal collectors

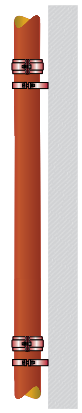


Support for vertical pipework

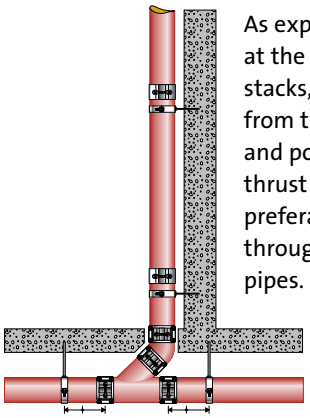
For vertical waste or rainwater stacks, the brackets aim at preventing the pipework to fall over. It is recommended that one bracket should be fitted for each floor level.

Ideally the bracket should be installed on the first third from the upper spigot, and even closer to a socket joint.

ENSIGN



Bottom of stacks



As explained on p101, at the bottom of the stacks, the forces from the pipes weight and possible end thrust efforts will be preferably addressed through stack support pipes.

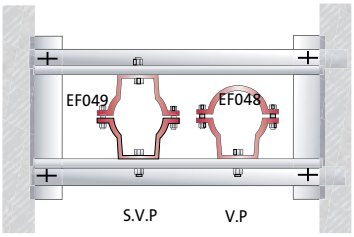
Bracketing installations, openings and sealings are prohibited in prestressed girders.

ENSIGN®S pipe systems and ductile iron brackets

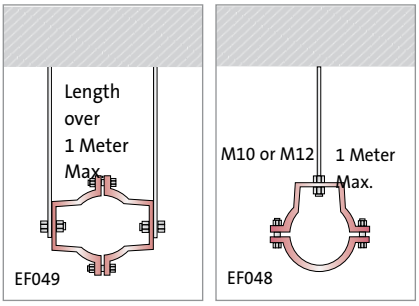
Pipe support bracket

The unique, all-purpose, lightweight, ductile iron bracket incorporates an elongated slot at the fixing point. This allows both vertical and lateral adjustment without dismantling the pipe system.

Typical support arrangement for vertical pipework



Typical support arrangement for horizontal pipework



Design recommendations

Specific Bracketing for acoustic insulation

The evacuation of waste, soil and rainwater generates structure-borne and airborne sound between rooms and usually occurs as the result of a mixed flow, when the pipe is filled with water and air. In such circumstances a pipe will radiate noise outwards and transfer it to any lightweight ceilings, cupboards and similar areas wherever it makes contact.

PAM Acoustic dampener

All brackets within the SAINT-GOBAIN PAM range meet the requirements of the most demanding standards. For exceptionally high levels of acoustic performance, the standard ductile iron or steel brackets fitted with a new acoustic dampener should be used. The different assemblies have been tested to EN14366: Laboratory measurements of noise from waste water installations.

The PAM acoustic dampener has been developed to meet the increasing demand for buildings which require a high level of acoustic performance over regulations requirements.

PAM pipe installation fitted with acoustic dampener*
Structure-borne noise: 2l/s = 5 dB - 4l/s = 11 dB
** IPB results, November 2006 installation according to EN 14366*

Material:

1. *Dampener –elastomer EPDM*
2. *M8-M10 nut – galvanised bichromated steel*
3. *Retainer cup – AISI 304 stainless steel*
4. *Small dish – AISI 304 stainless steel*
5. *M8-M10 tapped base - galvanised bichromated steel*

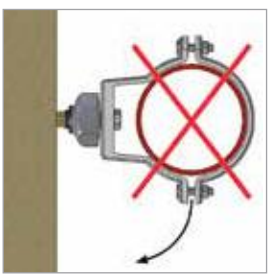
Acoustic bracket installation

Vertical

For vertical pipe stack: one acoustic bracket minimum per 3 metres

Horizontal

Horizontal suspended pipework: two acoustic brackets minimum per 3 metres.



Horizontal pipework: fixing brackets on side as per diagram is not recommended. This will lead to product failure

Cast iron protection: additional coating or overpainting

FAQ

Do cast iron pipes need to be overpainted before installation?

The acrylic paint on the pipes is a primer which can be over painted with most top coats. Finish paint is necessary where the pipeworks are visible, indoor or outdoor. What types of paint can be used? Any alkyd resin, or glycerophtalic paint dedicated to metal care and suitable for the requirements of the local environment.

The system should be gently rubbed down with suitable abrasive paper, in order to provide a good adhesion key for the finish coating. Where the finish paint should be used on zinc coated pipes to rejuvenate them, rub them down gently to remove possible zinc salts.

Where incipient rust has already appeared on cast iron products, corrosion inhibitors can be used before painting. Some existing metal finishes including anti-corrosive pigment can be applied directly to rust.

Condensation on drainage pipework

Condensation may appear whenever the temperature of the drainage pipes walls is lower than the dew point. This happens when the temperature of the fluid transported is much lower than that of the surrounding atmosphere and when the hygrometry level is high.

Possible local regulation or preventive solutions fall within the competence of the engineering and design department, after taking the building project specificities into account. According to the anticipated results and the requirements as regards fire protection of the building, solutions such as mineral wool, anti-condensation painting or finally, insulating strip can be considered.

Aggressive atmospheres

Pipes and fittings installed within an aggressive chlorine environment (swimming-pools) should be over-painted with a special air dry epoxy coating. Please refer to paint manufacturers to select the appropriate product to resist this specific stress.

In such atmosphere all stainless steel couplings are compulsory.

Aggressive soil conditions

According to Annex C of EN 877, for pipes buried in contact with soils with a lower pH than 6, it is recommended they should be additionally protected with polyethylene sleeve or any other type of external coating as appropriate.

Design recommendations

Buried pipe systems

The SMU - Ensign Plus pipes can be used in below ground applications. Buried pipes are subject to mechanical strain due to the weight of grounds and possibly wheel loading when they are laid under a circulating area.

The mechanical performance of a buried pipework is to be considered as a pipe/ soil system: the interaction of the pipes with the surrounding soils depends on their stiffness or flexibility, and the selected type of laying condition.

The choice of bedding and backfilling depends on the depth at which the pipes have to be laid, the size and the strength of the pipes. The standard EN 1610 “Construction and testing of drains and sewers” applies to drains normally buried in the ground and normally operating under gravity.

You will find below the hypothesis for **rigid** pipes retained for the calculation of allowable depth of cover.

	DN 100 to DN 300
Modulus of Young :	110000 N/mm²
Poisson’s ratio :	0.25
Max. stress :	350 N/mm²
Strain coefficient :	1.5
Buckling Coefficient :	2.5
Geometrical defect :	1.2 + DN/2000 mm

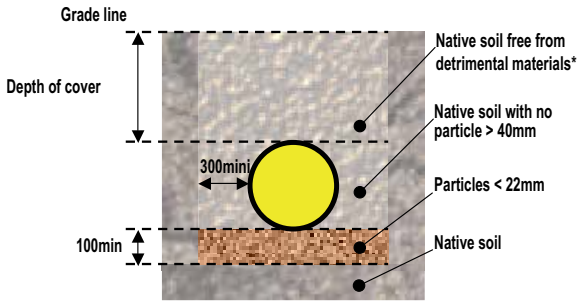
Installation parameters are laid down according to:
- Soil type (see groups below)
- Quality of compaction of the embedment
- Behaviour of the pipe (rigid for cast iron)
- Presence of wheel loads or not
- Particular conditions (groundwater table...)

Backfilling recommendations from DN 100 to DN 300, with or without traffic loads (according to EN 1610).

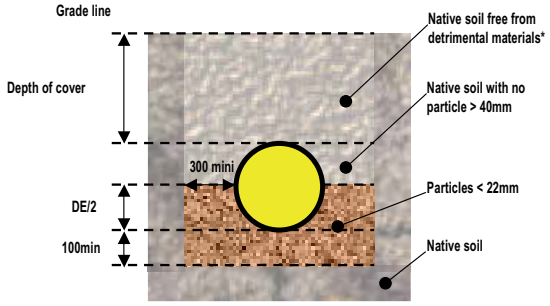
Two main solutions have been retained out of the EN 1610 recommendations, taking into account both ease of installation and knowledge from experience of rigid pipe systems. For compaction, the more adverse hypothesis was retained.

These solutions maximise the advantage from cast iron’s mechanical properties: depth of cover they can withstand, possible backfilling with native soil removed, thereby limiting the damage to the environment...

Case N°1



Case N°2



Dimensions are in mm

* Detrimental materials = stones; tree roots; rubbish; organic material; clay lumps (>75 mm); snow and ice.

From our experience in buried pipe systems and the French origin of our company, we have retained French Fascicule 70 calculation model (recommendations for sewage pipe systems according to the pipe material).

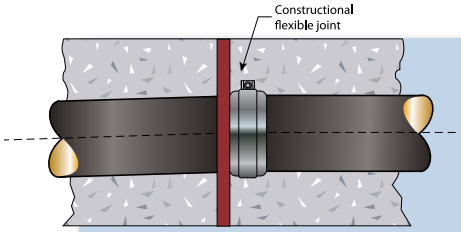
The table below gives values for depths of covers according to the Fascicule 70 calculation, considering rigid pipes.

		Depth of cover values (m)	
		Without traffic loads	With traffic loads
Solution 1	Mini**	0.3(1)	1
	Maxi	3.2	2.4
Solution 2	Mini**	0.3(1)	0.3
	Maxi	6 (or 9)	6 (or 9)

*** does not take into account the frost free arrangements*
(1) The calculation allows shallower depth of cover, but this figure includes safety margin / ground surface proximity and related hazards.

Other precautions:
- Clearance at each joint between the couplings and the granular bed to allow sufficient space and to prevent the pipe from resting on the joints. (see EN1610 §8.5.4)
- Testing for pipe system leak tightness according to EN 1610 §13.
- Identification of the pipework with a netting for example.
- Furthermore, check that these specifications do not contravene to other local or national regulation or recommendations for installation.

For any other case, other diameters or buried systems under the bottom slab, please refer to the technical support.



Systems embedded in concrete

Where SMU-Ensign pipe system is to be set in concrete, a minimum 2.5 cm width of concrete on every side has to be respected because during its curing and after, the concrete will be subject to shrinkage and carbonation.

To reduce the natural rigidity of the concrete and its strain, a suitable flexible joint can be installed at intervals. This could be made of a compressible material (eg. expanded polystyrene) be placed next to a pipe joint, and conform to the full cross section of the concrete. (See Fig).Refer to local good practice.

Furthermore, the pipe system should not be in contact with the metallic reinforcements of the concrete.

Surround should not be carried out until the pipework has been tested and inspected.

Standards specifications

EN 877:1999 + Amendment / A1: 2006 + Corrigendum / AC: 2008

Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings – Requirements, test methods and quality assurance.

Scope:

This European Product Standard applies to cast iron pipework elements used for the construction, normally as gravity pipe systems, of discharge systems for buildings and of drains. The range of nominal diameters extends from DN40 to DN600 inclusive. This standard specifies the requirements for the materials, dimensions and tolerances, mechanical properties, appearance and standard coatings for cast iron pipes, fittings and accessories. It also indicates performance specifications for all components, including joints. It covers, above ground soil, waste, rainwater and buried systems and performance requirements in these applications.

The concerned ranges:

PAM-SMU S and Plus, PAM-ENSIGN S and Plus: DN 40 to 600
Rainwater range: DN 75 to 150

Definitions:

Discharge system for buildings: system of pipes, fittings, accessories and joints used to collect and drain waste water and rainwater from a building; it comprises discharge pipes, ventilation stacks and rainwater pipes, installed within the limits of a building or attached to the building.

Drain: system of pipes, fittings, accessories and joints installed outside the limits of a building in order to connect the discharge system of this building to a soil and drain or a septic tank.

Sewer: system of pipes designed to collect waste water and rainwater from buildings and surface water and to convey them to the point of disposal or treatment.

Requirements:

Adhesion see 4.6
Hot water resistance: 24 H at 95°C and thermal cycles (1500 cycles of 1min between 15 and 93°C)
Salt spray resistance: 350 h
Chemical resistance: 2 >pH > 12 at 23°C
To test the chemical resistance of cast iron products standard EN 877 defines that product samples shall be immersed - for 30 days and held at (23 + 3)°C, the pH being constantly monitored - in the following test liquids:
- a solution of sulfuric acid at pH 2, for the first sample;
- a solution of sodium hydroxide at pH 12, for the second sample.
- a solution of waste water at pH 7 for the third sample.

Dimensions - External diameter (DE) see 4.2.2
Coatings for pipes and fittings: general see 4.6
Specific requirements for coatings for buried systems and rainwater systems installed outside buildings are given in 4.8.3 and 4.9.2 respectively.

Water tightness Joints water tightness – Performance requirements see 4.7.5
Reaction to fire see EN 877:1999/A1:2006/AC -4.6.3 External coatings and 5.7.3.3
Noise protection see EN 877:1999/A1 - 4.1.4

CE Marking

(see Section 1 p 15)

To allow free circulation of industrial products within the European Union, while guaranteeing the safety of European consumers and users of the products, construction products must meet essential requirements covering public health, safety and consumer protection.

Based on EN 877, CE marking became mandatory on cast iron wastewater products leaving the European factory, from 1st September 2009.

Do not hesitate to compare the reaction to fire classifications of the materials you specify.
Remember that CE marking is not a Quality mark or label. Its scope is limited to **health and operation safety.** It is intended mainly for the authorities in charge of market control.

Product standards and Quality marks

Standard EN 877, which defines the requirements for cast iron wastewater pipe systems, is a self-declared standard. This means that the manufacturer is allowed to self declare that his product complies with this standard except for reaction to fire classification of the range which requires an initial type test by a notified test laboratory.

Quality Marks, proof of conformity with EN 877

Voluntary Quality marks aim at fitness for purpose. They add value to the product in terms of customer-supplier relationships.

Only compliance with EN 877 that is **validated by a third party for all criteria, and periodically tested**, can guarantee the performance of the systems you specify.
Look for cast iron products fully complying with EN 877, bearing a quality mark, such as a Kitemark, NF or Watermark for example, being delivered by an accredited certification body.

BS EN 877:1999 Kitemark KM51733
Ensign (S and Plus) is the only cast iron system to be tested and awarded Kitemark approval to the product standard in the UK.

NF EN 877:1999 NF

SMU S and Plus ranges, SME

EN 12056

Gravity drainage systems inside buildings

It covers waste water drainage systems which operate under gravity. It is applicable for drainage systems inside dwellings, commercial, institutional and industrial buildings and sets out principles to be followed for both layout and calculation. It makes limited provision for drainage systems conveying trade effluent and also makes limited provision for fluids removed by pumps.

Differences in plumbing within Europe have led to a variety of systems being developed. Some of the major systems in use are described in this standard.

Part 1: General and performance requirements.
Part 2: Sanitary pipework, layout and calculation.
Part 3: Roof drainage, layout and calculation.
Part 4: Wastewater lifting plants - Layout and calculation.
Part 5: Installation and testing, instructions for operation, maintenance and use.

Design data

Discharge capability of PAM S pipes according to EN 877 and DIN 19522

Filling level 50 (*h/d*=0.5)

	DN 70		DN 75		DN 100		DN 125		DN 150		DN 200		DN 250		DN 300	
	d_i = 71		d_i = 75		d_i = 103		d_i = 127		d_i = 152		d_i = 200		d_i = 263		d_i = 314	
J	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.5	0.8	0.4	0.9	0.4	2.1	0.5	3.7	0.6	6.0	0.7	12.5	0.8	25.8	1.0	41.3	1.1
0.6	0.9	0.4	1.0	0.4	2.3	0.6	4.1	0.6	6.6	0.7	13.7	0.9	28.3	1.0	45.3	1.2
0.7	0.9	0.5	1.1	0.5	2.5	0.6	4.4	0.7	7.1	0.8	14.8	0.9	30.6	1.1	48.9	1.3
0.8	1.0	0.5	1.1	0.5	2.7	0.6	4.7	0.7	7.6	0.8	15.8	1.0	32.7	1.2	52.3	1.4
0.9	11	0.5	1.2	0.6	2.9	0.7	5.0	0.8	8.1	0.9	16.8	1.1	34.7	1.3	55.5	1.4
1.0	1.1	0.6	1.3	0.6	3.0	0.7	5.3	0.8	8.5	0.9	17.7	1.1	36.6	1.3	58.5	1.5
1.1	1.2	0.6	1.4	0.6	3.2	0.8	5.5	0.9	8.9	1.0	18.6	1.2	38.4	1.4	61.4	1.6
1.2	1.2	0.6	1.4	0.6	3.3	0.8	5.8	0.9	9.4	1.0	19.4	1.2	40.1	1.5	64.2	1.7
1.3	1.3	0.6	1.5	0.7	3.4	0.8	6.0	1.0	9.7	1.1	20.2	1.3	41.8	1.5	66.8	1.7
1.4	1.3	0.7	1.5	0.7	3.6	0.9	6.3	1.0	10.1	1.1	21.0	1.3	43.4	1.6	69.3	1.8
1.5	1.4	0.7	1.6	0.7	3.7	0.9	6.5	1.0	10.5	1.2	21.7	1.4	44.9	1.7	71.8	1.9
1.6	1.4	0.7	1.6	0.7	3.8	0.9	6.7	1.1	10.8	1.2	22.4	1.4	46.4	1.7	74.1	1.9
1.7	1.5	0.7	1.7	0.8	3.9	0.9	6.9	1.1	11.1	1.2	23.1	1.5	47.8	1.8	76.4	2.0
1.8	1.5	0.8	1.7	0.8	4.1	1.0	7.1	1.1	11.5	1.3	23.8	1.5	49.2	1.8	78.7	2.0
1.9	1.5	0.8	1.8	0.8	4.2	1.0	7.3	1.2	11.8	1.3	24.5	1.6	50.6	1.9	80.8	2.1
2.0	1.6	0.8	1.8	0.8	4.3	1.0	7.5	1.2	12.1	1.3	25.1	1.6	51.9	1.9	82.9	2.1
2.5	1.8	0.9	2.0	0.9	4.8	1.2	8.4	1.3	13.5	1.5	28.1	1.8	58.0	2.1	92.8	2.4
3.0	1.9	1.0	2.2	1.0	5.3	1.3	9.2	1.5	14.8	1.6	30.8	2.0	63.6	2.3	101.7	2.6

Filling level 70 (*h/d*=0.7)

	DN 70		DN 75		DN 100		DN 125		DN 150		DN 200		DN 250		DN 300	
	d_i = 71		d_i = 75		d_i = 103		d_i = 127		d_i = 152		d_i = 200		d_i = 263		d_i = 314	
J	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.5	1.3	0.4	1.5	0.5	3.6	0.6	6.2	0.7	10.1	0.7	20.8	0.9	43.1	1.1	68.9	1.2
0.6	1.4	0.5	1.7	0.5	3.9	0.6	6.8	0.7	11.0	0.8	22.9	1.0	47.2	1.2	75.5	1.3
0.7	1.6	0.5	1.8	0.5	4.2	0.7	7.4	0.8	11.9	0.9	24.7	1.1	51.1	1.3	81.6	1.4
0.8	1.7	0.6	1.9	0.6	4.5	0.7	7.9	0.8	12.7	0.9	26.4	1.1	54.6	1.3	87.3	1.5
0.9	1.8	0.6	2.1	0.6	4.8	0.8	8.4	0.9	13.5	1.0	28.1	1.2	58.0	1.4	92.6	1.6
1.0	1.9	0.6	2.2	0.7	5.1	0.8	8.8	0.9	14.3	1.1	29.6	1.3	61.1	1.5	97.6	1.7
1.1	2.0	0.7	2.3	0.7	5.3	0.9	9.3	1.0	15.0	1.1	31.0	1.3	64.1	1.6	102.4	1.8
1.2	2.0	0.7	2.4	0.7	5.5	0.9	9.7	1.0	15.6	1.2	32.4	1.4	67.0	1.6	107.0	1.8
1.3	2.1	0.7	2.5	0.7	5.8	0.9	10.1	1.1	16.3	1.2	33.8	1.4	69.7	1.7	111.4	1.9
1.4	2.2	0.7	2.6	0.8	6.0	1.0	10.5	1.1	16.9	1.2	35.0	1.5	72.4	1.8	115.6	2.0
1.5	2.3	0.8	2.7	0.8	6.2	1.0	10.9	1.1	17.5	1.3	36.3	1.5	74.9	1.8	119.7	2.1
1.6	2.4	0.8	2.7	0.8	6.4	1.0	11.2	1.2	18.1	1.3	37.5	1.6	77.4	1.9	123.7	2.1
1.7	2.4	0.8	2.8	0.9	6.6	1.1	11.6	1.2	18.6	1.4	38.6	1.6	79.8	2.0	127.5	2.2
1.8	2.5	0.8	2.9	0.9	6.8	1.1	11.9	1.3	19.2	1.4	39.8	1.7	82.1	2.0	131.2	2.3
1.9	2.6	0.9	3.0	0.9	7.0	1.1	12.2	1.3	19.7	1.5	40.9	1.7	84.4	2.1	134.8	2.3
2.0	2.7	0.9	3.1	0.9	7.2	1.2	12.5	1.3	20.2	1.5	41.9	1.8	86.6	2.1	138.3	2.4
2.5	3.0	1.0	3.4	1.0	8.0	1.3	14.0	1.5	22.6	1.7	46.9	2.0	96.9	2.4	154.7	2.7
3.0	3.3	1.1	38	1.1	8.8	1.4	15.4	1.6	24.8	1.8	51.4	2.2	106.1	2.6	169.6	2.9

Filling level 100 (*h/d*=1.0)

	DN 70		DN 75		DN 100		DN 125		DN 150		DN 200		DN 250		DN 300	
	d_i = 71		d_i = 75		d_i = 103		d_i = 127		d_i = 152		d_i = 200		d_i = 263		d_i = 314	
J	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v	Q	v
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.5	1.6	0.4	1.8	0.4	4.2	0.5	7.4	0.6	12.0	0.7	24.9	0.8	51.6	1.0	82.6	1.1
0.6	1.7	0.4	2.0	0.4	4.7	0.6	8.2	0.6	13.2	0.7	27.4	0.9	56.6	1.0	90.5	1.2
0.7	1.9	0.5	2.1	0.5	5.0	0.6	8.8	0.7	14.2	0.8	29.6	0.9	61.2	1.1	97.8	1.3
0.8	2.0	0.5	2.3	0.5	5.4	0.6	9.4	0.7	15.2	0.8	31.6	1.0	65.4	1.2	104.6	1.4
0.9	2.1	0.5	2.4	0.6	5.7	0.7	10.0	0.8	16.2	0.9	33.6	1.1	69.4	1.3	111.0	1.4
1.0	2.2	0.6	2.6	0.6	6.0	0.7	10.6	0.8	17.1	0.9	35.4	1.1	73.2	1.3	117.1	1.5
1.1	2.3	0.6	2.7	0.6	6.3	0.8	11.1	0.9	17.9	1.0	37.1	1.2	76.8	1.4	122.8	1.6
1.2	2.4	0.6	2.8	0.6	6.6	0.8	11.6	0.9	18.7	1.0	38.8	1.2	80.3	1.5	128.3	1.7
1.3	2.5	0.6	2.9	0.7	6.9	0.8	12.1	1.0	19.5	1.1	40.4	1.3	83.6	1.5	133.6	1.7
1.4	2.6	0.7	3.1	0.7	7.2	0.9	12.5	1.0	20.2	1.1	41.9	1.3	86.7	1.6	138.7	1.8
1.5	2.7	0.7	3.2	0.7	7.4	0.9	13.0	1.0	20.9	1.2	43.4	1.4	89.8	1.7	143.6	1.9
1.6	2.8	0.7	3.3	0.7	7.7	0.9	13.4	1.1	21.6	1.2	44.9	1.4	92.8	1.7	148.3	1.9
1.7	2.9	0.7	3.4	0.8	7.9	0.9	13.8	1.1	22.3	1.2	46.3	1.5	95.6	1.8	152.9	2.0
1.8	3.0	0.8	3.5	0.8	8.1	1.0	14.2	1.1	22.9	1.3	47.6	1.5	98.4	1.8	157.3	2.0
1.9	3.1	0.8	3.6	0.8	8.3	1.0	14.6	1.2	23.6	1.3	48.9	1.6	101.1	1.9	161.7	2.1
2.0	3.2	0.8	3.7	0.8	8.6	1.0	15.0	1.2	24.2	1.3	50.2	1.6	103.8	1.9	165.9	2.1
2.5	3.5	0.9	4.1	0.9	9.6	1.2	16.8	1.3	27.1	1.5	56.2	1.8	116.1	2.1	185.6	2.4
30	3.9	1.0	4.5	1.0	10.5	1.3	18.4	1.5	29.7	1.6	61.6	2.0	127.2	2.3	203.3	2.6

References

Asia

China	Jin Mao Tower, Shanghai
Hongkong	International Finance Center PH. 1&2, Hongkong
Indonesia	International Airport, Jakarta
Macau	Macau Tower, Macau
Philippines	Pacific Plaza Tower
Singapore	Esplanade Theatre on the Bay, Singapore
Sri Lanka	Kelanitissa Combined Cycle Power Plant, Wellampitiya
Taiwan	Der-Shing Baseball Stadium, Hua-Lien
Vietnam	Opera Hilton Hanoi, Hanoi
Australia	Stadium Australia (2000 Olympic Stadium), Sydney
New Zealand	Ascot Integrated Hospital, Auckland

Eastern Europe

Bosnia and Herzegovina	Raiffeisen Bank, Sarajevo
Bulgaria	Sofia Airport and Catering Facilities, Sofia
Czech Republic	Four Seasons Hotel, Prague
Estonia	Radisson SAS Hotel, Tallin
Hungary	Bridge Köröshegy, Balaton
Kazakhstan	Hotel Intercontinental, Astana
Latvia	National Bank, Riga
Lithuania	President Residence, Vilnius
Macedonia	Macedonian Academy of Science and Art, Skopje
Poland	Warsaw Trade Center, Warsaw
Romania	Sofitel Hotel, Bucharest
Russia	Gazpron Tower, Moscow
Serbia	Mercator Center, Belgrade
Slovenia	Technology Park, Ljubljana
Turkmenistan	President Palace, Ashgabat
Ukraine	Reko Hotel, Kiev
Uzbekistan	Cigarettes Factory Building BAT

Middle East

Bahrein	Diplomat Hotel
Irak	Aana Rawa Centre
Jordan	Princess Aya Hospital
Kuwait	Meridien Hotel
Lebanon	Beyrouth Terminal Airport, Beyrouth
Lybia	Tripoli Airport
Sultanate of Oman	Salalah Hilton, Salalah
Pakistan	Karachi Airport
Qatar	Sidra Hospital, Doha
Saudi Arabia	King A. Financial District, Riyadh
Syria	Damas University, Damas
Turkey	Kanyon Shopping Mall and Residentials, Istanbul
United Arab Emirates	Landmark Tower, Abu Dhabi

Europe

Belgium	New European Union building, Brussels
Cyprus	University of Cyprus, Nicosia
Denmark	Mariott Hotel, Copenhagen
Finland	Nokia, office Building Center, Helsinki
France	Stade de France, Paris Plaine St Denis
Germany	World Exhibition Center, Hannover
Great Britain	St Pancras International Station, London
Greece	Athens Metro, Athens
Ireland	Dublin Castle (Re-fit of Soil Pipe), Dublin
Iceland	Keflavik Airport, Reykjavik
Italy	N.A.T.O. Military Bases, Napoli
Luxembourg	European Community Conference Center
Malta	Stock Exchange, Valletta
Netherlands	Tramway Tunnel, The Hague
Norway	Central Oslo Station, Oslo
Portugal	Stadium Benfica, Lisbon
Spain	Prado Museum, Madrid
Sweden	Sky City, Stockholm
Switzerland	Philippe Morris International, Lausanne

America

Argentina	Newspaper Building “Diaro de la Nación”, Buenos Aires
Bresil	Copacabana Palace Hotel, Rio de Janeiro
Mexico	French Embassy, Mexico
Peru	Hotel Libertador, Urubamba
Venezuela	Metro, Caracas

Africa

Algeria	World Trade Center, Algiers
Angola	Sonangol – Corporate Headquarters, Luanda
Botswana	Ministry of Health, Gaborone
Egypt	El Tebbin Power Station, Cairo
Gabon	Tower TOTAL Head Quarter, Libreville
Madagascar	Galaxy II, Antananarivo
Morocco	Grande Mosquée Hassan II, Casablanca
Niger	Gawage Hotel, Niamey
Nigeria	New Central Bank of Nigeria CBN, Abuja
South Africa	United States of America Embassy, Cape Town
Tanzania	British High Commission
Tchad	Five Stars Hotel, N’Djamena
Tunisia	Hammamet Sheraton Hotel, Hammamet

Soil and Drain

- SAINT-GOBAIN PAM subsidiaries
- Agents for Soil and Drain

www.pam-cast-iron.com
SAINT-GOBAIN PAM
Head Office
91, avenue de la Liberation
54076 Nancy Cedex, France

SAINT-GOBAIN