Technical Assessment 5+14/14-2386

Cancels and supersedes Technical Assessment 14+5/09-1338

Designed in compliance with the Common CPT (Technical Specifications) (e-book CSTB 3600)

Système d'évacuation des eaux pluviales par effet siphoïde

Syphonic rainwater drainage system

Druckstrom-Regenwasser-abflussleitungssystem

Epams

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Commission in charge of issuing Technical Assessments
(by-law of 21 March 2012)

Specialised Group no. 5

Roofs, roofing, waterproofing

Specialised Group no. 14

Heating, air-conditioning and rainwater drainage systems

Presented for registration on August 27th, 2014

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The Specialized Groups No. 5 "Roofs, roofing, waterproofing" and No. 14 "Heating, air-conditioning and rainwater drainage systems" of the Commission in charge of issuing Technical Assessments, have examined on 28 April 2014 and 17 April 2014 respectively the request relative to the "Epams" syphonic rainwater evacuation system, presented by Saint-Gobain PAM. This document, to which the Technical File is appended, as issued by the requester, transcribes the Note formulated by the Specialized Groups No. 5 " Roofs, roofing, waterproofing" and No.14 "Heating, air-conditioning and rainwater drainage systems" on the provisions of implementation proposed to use the process in the target field of use and in the conditions of European France. This document cancels and supersedes the Technical Assessment 14+5/09-1338

1. Brief description

The EPAMS system is a rainwater drainage system that operates by sub-atmospheric pressure. The pipes are completely filled thanks to the use of special roof inlets and to the design and calculation of the size of the pipes.

2. ASSESSMENT

2.1 Field of application

2.11 Accepted field of application

The field of use accepted, in a plain climate, is as follows:

- Roofing by discontinuous elements as per the P 30 - series 200 standards (ref. DTU series 40), featuring an evacuation network by outer gutters (minimum width 400 mm beside the springer), excluding copper or lead roofing (DTU 40.45 and DTU 40.46), whatever the structure (all water heights);
- Inaccessible pitched roofs and deck roofs, technical service roofs - equipment zones, with waterproofing covering that is visibly self-protected or protected by loose aggregate or by precast concrete flags on isolating layer only by aggregate or non-woven mat (maximum water height 55 mm):
  - zero-slope flat deck roofs and pitched roofs with masonry bearing elements in compliance with standards NF P 203 (DTU ref. 20.12) and NF P 84-204 (DTU ref. 43.1), including deck roofs with inverted insulation,
  - roofs in cellular concrete slabs compliant with a Technical Assessment or Technical Application Document,
  - roofs of waterproofing substrate corrugated steel sheets in compliance with standard NF DTU 43.3, including zero-slope roof valleys, and bearing elements of corrugated steel sheets with an open ripple depth of over 70 mm, as described under common CPT "Waterproofing substrate non-bearing insulation panels installed on bearing elements of corrugated steel with an open ripple depth of over 70 mm, in European departments" (*e-Book of CSTB* 3537_V2),
  - roofs with bearing elements of timber and wood derivative panels in compliance with NF DTU 43.4, including zero-slope valleys,

  associated with waterproofing coverings given a Technical Application Document:
  - SBS or APP bituminous sheets,
  - PVC-P based synthetic membranes.

The siphonic system can also be used when repairing roof waterproofing structures according to NF P 84-208 (DTU ref. 43.5).

This is the application field covered by the document "Siphonic rainwater drainage systems - Minimum Common Technical Specifications for design and installation." (1), *e-Book of CSTB* 3600.

2.12 Limits to the application

- Minimum roof surface drained by a downpipe according to a rainfall intensity of 3 l/ min.m^2: 60 m^2;
- Maximal surface drained by the DN roof inlet:

DN (mm)	**Maximal surface drained** (m²)
50	260
75	460
100	520
125	520

- Minimum building height compatible with the siphonic effect: 3 m. This height corresponds to that measured between the roof inlet and the end of the siphonic network, as shown in the *figure* under *section* 1.3 of the Technical file.

2.13 Application fields excluded

- Roofing by discontinuous elements according to P 30 series-200 standards (DTU [Unified codes of practice] ref. series-40), including a drainage network by inside gutters, whatever the structure;
- Inaccessible deck-roofs designed with a provisional rainwater hold-back drainage system;
- Deck-roofs accessible to pedestrians and vehicles;
- Roofs with waterproofing, the concrete slab protection of which is poured in place (car parks in particular) or covered with a mortar embedded underlay (embedded tiling);
- Use associated with an asphalt waterproofing coat, with a liquid waterproofing system, or in synthetic membrane other than those referenced in *paragraph 2.11* above;
- Use of slabs on pedestals, set directly on waterproofing covering because of servicing problems;
- Garden deck roofs;
- Green roofs and green deck roofs;
- Application in mountain climate zones;
- Use in French overseas departments and regions (DROM);
- And any field of use other than inaccessible roofs or with technical zones.

2.2 Assessment of the system

2.21 Compliance with the laws and regulations in force and other aspects of suitability for the application

Fire safety regulations

Depending on the type of building involved (residential buildings, public-access buildings, high-rise buildings, offices, classified facilities), the fire safety regulations may feature specifications governing the pipework (piping and unions) and pipework installation.

In particular, the fire safety regulations may dictate that the products meet a given fire performance class, in which case it will be necessary to check conformity to the performance class in a currently-valid flame retardant certificate or test report.

Safety in case of earthquake

As set out by the seismic regulations defined by:

- Decree No. 2010-1254 on the prevention of seismic risks;
- Decree No. 2010-1255 outlining the seismic zones in the French territory;
- By-law of 22 October 2010 amended on the classification and rules of paraseismic construction applicable to buildings of "normal risk" class.

The process may be used, while applying the provisions of the Technical file, to buildings of a category of importance I, II, III and IV, situated in seismicity zone 1 (very low), 2 (low), 3 (moderate) and 4 (medium), on terrains class A, B, C, D and E.

(1) Termed Common CPT (*e-Book of CSTB* 3600) in the continuation of this document.

Prevention of accidents and risk control during implementation and maintenance

The process has a Material Safety Data Sheet (MSDS). The purpose of the MSDS is to inform the user of this process about the hazards linked with its use and on the preventive measures to be applied to prevent them, particularly by wearing Personal Protection Equipment (PPE).

Environmental data

The Epams process has no Environmental Statement (ES), and therefore no particular environmental performance may be claimed by it. We remind that the ES are not considered in the analysis of the product's suitability for use.

Application in mountain climate zones

The claimed level of system performance of the rain water evacuation process does not extend to use in mountain climate zones.

Use in ultraperipheral regions

The claimed level of system performance of the rain water evacuation process does not extend to use in French overseas departments and regions (DROM).

2.22 Durability

Facilities using the Epams system are built in cast-iron pipes and fittings in compliance with standard NF EN 877.

These pipes and fittings are all classical-range parts that offer satisfactory durability.

The roof inlets used feature stainless steel and aluminium-built components. Their durability is satisfactory.

The system is non-traditional essentially due to its concept (calculation and design method and shape of roof inlets).

2.23 Manufacture

The companies involved in manufacturing the various system components work to an ISO 9001-certified quality assurance system.

2.24 Calculation, design and sizing

The calculation, design and sizing of the installations are carried out by Saint-Gobain PAM, on the basis of data appearing in the Special Contract Documents (SCD). The list of supplies necessary to ensure the proper operation of the installation is prepared at the same time. Consequently, the installing contractor firms are completely freed of the work involved in:

- Network calculations,
- Dimensioning,
  - network,
  - parts for connecting to the rainwater drains.

it being understood that the corresponding provisions in standards P 30 and P 84 series-200 (DTU ref. series 40 and 43) and NF DTU 60.11 P3 do not apply to sub-atmospheric pressure calculation and design.

Saint-Gobain PAM provides technical assistance on providing installers with complementary training.

After the works, Saint-Gobain PAM agrees to carry out itself or to mission its assigned engineering firm to carry out control checks to verify compliance of the installation with the calculations, design and recommendations as stipulated under the provisions of the Common CPT (*e-Book of CSTB* 3600) (see *section* 1.52 of the Technical File).

2.25 Installation

Pipework installation is performed in compliance with the provisions set out under standard NF DTU 60.2 "Cast-iron piping for rainwater, blackwater and wastewater drainage systems" and standard NF P 52-305 (DTU ref. 65-10) "Hot or cold pressure water piping and wastewater and rainwater drainage piping systems installed inside buildings".

Compliance with a certain number of special instructions (*section 1.5* of the Technical File) is also necessary, without however causing any particular difficulties.

The installation of the roof inlets connected to the waterproofing is done in compliance with series-200 P 84 standards (DTU ref. series-43) or with the Technical Guidance Files on coverings.

2.26 Servicing

The provisions in *section* 1.7 of the Technical File comply with the requirements of the common CPT.

2.3 Technical Specifications

The minimum common specifications set down in the Common CPT (*e-Book of CSTB* 3600), reviewed below, shall be complied with.

Unless otherwise or complementarily specified and clearly set down in the Common CPT (*e-Book of CSTB* 3600) or herein, all the provisions of the series-200 P 30 and P 84 standards (DTU ref. series-40 and series-43) shall be complied with.

Where available, any specifications set out under DTU-standards governing the installation of pipework according to piping type shall also be complied with.

2.31 Design

2.311 Rainfall intensity

The installations are designed, calculated and sized, taking into account standardized rainfall intensities.

For European France, the value to be considered is 3 l/min.m^2 (NF DTU 60.11 standard P3).

2.312 Laying out the roof inlets (rainwater entry) depending on type of roof

The laying out of the roof inlets (rainwater entries) shall be checked by the roofing or waterproofing contractor in compliance with the Common CPT (*e-Book of CSTB* 3600) and according to the study by Saint-Gobain PAM.

2.313 Accounting for the risk of on-roof pooling

The principle of rainwater drain systems by siphonic effect has no theoretical limit in terms of surface areas served by a single downpipe.

Thus, to limit the risks of water accumulation, to cover the event of obstruction of that single downpipe, arrangements are to be made and applied to enable water drainage to continue, as stipulated in the Common CPT (*e-Book of CSTB* 3600).

Depending on the case, according to covering/roof type and the roof-space surface area being served, these arrangements shall prompt the installation of overflows, downspouts or doubling headers.

Note that in the context of iterative calculations designed to check roof structure behaviour in response to pooling and water accumulation, given that there is no difference between gravity drainage systems and the Epams system in terms of either approach adopted or calculation details, then the rules for verifying structural framing components shall be those set out under standard NF DTU 43.3 P1, whether the bearing element is in sheets made of corrugated steel, wood or wood-based panels.

When installing overflows, note that the following requirement applies:

- Roofs with waterproofing coating: Overflow run-off height > height of the pressure head of the roof inlet (55 mm maximum), but shall not exceed 70 mm with relation to the valley's bottom water flow perpendicular to the nearest roof inlet;
- outer gutters (roofs DTU series 40): Flow level of the overflow > height of the pressure head of the roof inlet, but shall not exceed + 15 mm with relation to this pressure head height.

  In this case, the water load supported by the outer gutter shall be indicated to the project manager.

2.314 End of the siphonic network

The procedures for connecting to the gravity network shall make it possible to return to a flow speed close to the usual speeds encountered at this level of the installation.

The solutions used are described in the Technical File, see *section* 5.2.

The diameter of the pipes located downstream from this point shall be designed and calculated, taking into account the flow drained and the acceptable flow speed. The following shall be respected in particular:

- The rules mentioned in standard NF DTU 60.11 P3 when the drain pipes are located within the building's ground area,
- The provisions of leaflet 70, referring to technical instruction 77/284, for sewerage networks (provisions not applicable to valleys of roofing and roods with waterproofing coating).

The provisions making it possible to gain access to the gutter outlet are described in *section* 5.14 of the Technical File.

2.32 Installation

- The instructions in *section* 5 of the Technical File shall be complied with.
- It should be remembered that:
  - a flat metal sheet reinforcement shall be installed when the installation of a roof inlet leads to cutting a rib of the bearing steel sheets,
  - a trimmer shall be built in the cases provided for in the Common CPT (*e-Book of CSTB* 3600);
- The roof inlets shall be installed horizontally and a recess shall be provided according to professional practice. A maximum slope of 4% is, however, permitted;
- All temporary measures must be taken to prevent any water overloading on the roof before completing the installation of evacuation (e.g. closing the roof inlets with the waiting plug, provided overflows may be triggered, temporary additional evacuation by gravity, etc.);

- When fitting outer gutters(overflow outside the building), the height of the pressure head of the roof inlets can be over 55 mm; note, though, that this provision does not apply to the roofs with waterproofing coating.

2.33 Co-ordination

- The use of rainwater drain systems by siphonic effect makes co-ordination necessary between the contracting firms responsible for structure, waterproofing and rainwater downpipes. This co-ordination is the responsibility of the main contractor or of its representative. In particular, the main contractor shall communicate to the framer or structural shell contractor the loads occasioned by the weight of the full headers;
- The calculation, design and sizing of the installations are carried out by Saint-Gobain PAM.

  Consequently, the installation contracting firms are not responsible for the study and design work;
- The verification of the compliance of the completed installation, when compared with the design work accepted by the various parties, and the verification of the height of the overflows are the responsibility of the holder of the Technical Assessment, which can designate a representative.

2.34 Servicing and operation

- The use of a siphonic system requires more frequent roof servicing than what is prescribed in the series-200 P 30 and P 84 (DTU ref. series-40 and 43) standards. The drainage devices (sewage, gutters, eave valleys and roof inlets) shall be inspected and cleaned at least twice each year: in autumn and spring. In the event there is a risk particles may become detached from the roof's protection, the system is to be cleaned every three months during the first year;
- The water drainage systems by siphonic effect shall be identified by visible label, installed at one or several accessible locations, mentioning that this is a special drainage system which cannot be modified without the agreement of the holder of the Technical Assessment. This label must also re-state that regular servicing is a compulsory requirement.

2.35 Cases involving repair work

Note that it is the responsibility of the contracting authority or its representative to check beforehand, as set out under standard NF P 84-208 (DTU ref. 43.5), that on-roof pooling and water accumulation carry no risk to the stability of the building.

Conclusions

Overall assessment

The use of the system in the accepted application field (see *section* 2.1), as supplemented by the Technical Specification Book, is favourably assessed.

Validity

Until 30 April 2021.

For Specialised Group No. 5
The Chairman
François MICHEL

For Specialised Group No. 14
The Chairman
Marc POTIN

3. Complementary remarks from the Specialised Group

a) The publication of the NF DTU 60.11 P3 confirms that the pluviometry to be considered is 3 l/min.m^2 in European France.

b) The Technical File does not offer a solution for when the number of rainwater entries per bay length or valley span is greater than two, on corrugated steel sheet or timber/wood-based panel bearing elements.

c) As with all siphonic rainwater evacuation systems, the laying out of the roof valley inlets with waterproofing coating is fundamental (particularly with respect to the risk of collapse) and must observe the guidelines of the common CPT (*e-Book of the CSTB* 3600 of May 2007).

d) The system has been analysed by Specialised Group No. 17 Networks as to the conditions governing the link-up connecting the end of the siphonic system network to the gravity-drainage network. This Specialised Group signals the fact that the meshed or grilled access chambers do not offer a barrier to the transmission of gaseous emissions from the sewerage system. As a measure to preclude any olfactory pollution, the access chambers should be re-placed in more appropriate positions.

e) Conventional height of the pressure head is 55 mm for roofing with waterproofing coating. As stated in the Technical File, it is acceptable for outer gutters to exceed this value.

f) As with all siphonic rainwater evacuation processes, because of the waterproof connection between the valleys and the network, the loading of the network may lead to loading the roofing, in the absence of a buffer used as a valve at the siphonic network - roads and services connecting points. The roof may collapse if this system is not designed and implemented.

g) The flange / counter-flange principle for gutters requires particular care during construction.

h) In the case of a PVC-P membrane and when using inlets with flange and counter-flange, the maximum membrane thickness is 1.5 mm.

i) The minimum width of the gutter beside the inlet is 400 mm.

j) This revision integrates the extension of compatibility of the inlets with the entire family of waterproofing coatings by PVC-P based synthetic membrane benefiting from a Technical Guidance File.

The Rapporteur of Specialised Group No. 5
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Technical File
prepared by the requester

A. Description

1. General description

1.1 Identification

"EPAMS - Évacuation Pluviale A Mouvement Siphoïde" (Rainwater Drainage by Siphonic Effect) is the trade name of a rainwater drainage system which is different from gravity systems in that it operates by partial vacuum with full conduits. The pipes are completely filled thanks to the use of roof inlets, containing a specific anti-vortex system (DAV in French) combined with the accurate sizing of the cast iron pipes (SMU S or SMU Plus ranges from Saint-Gobain PAM).

1.2 Field of application

The Epams system drains rainwater from the surface of roofing coverings, deck roofs and pitched roofs of buildings of all usages, for example factories, offices, residential buildings, shops and warehousing, high-rise buildings (HRB), public-access buildings (PRP).

The applicable field corresponds to that stipulated in the Book of Common Technical Specifications (*e-Book of CSTB* 3600).

- Roofing by discontinuous elements as per the P 30 - series 200 standards (ref. DTU series 40), featuring an evacuation network by outer gutters (minimum width 400 mm beside the springer), excluding copper or lead roofing (DTU 40.45 and DTU 40.46), whatever the structure (all water heights);
- Inaccessible roofs, technical service roofs - equipment zones, with waterproofing covering that is visibly self-protected or protected by loose aggregate or by precast concrete flags on isolating layer only by aggregate or non-woven mat (maximum water height 55 mm):
  - zero-slope flat deck roofs and pitched roofs with masonry bearing elements in compliance with standards NF P 203 (DTU ref. 20.12) and NF P 84-204 (DTU ref. 43.1), including deck roofs with inverted insulation,
  - roofs in cellular concrete roof slabs compliant with a Technical Assessment or Technical Guidance File,
  - roofs of waterproofing-substrate corrugated steel sheets in compliance with standard NF DTU 43.3 P1, including zero-slope roof valleys, waterproofing-substrate insulation panels installed on bearing elements of corrugated sheet steel with an open ripple depth of over 70 mm (and ≤ 200 mm) as referred to under the Book of Common Technical Specifications (*e-Book of CSTB* 3537_V2),
  - roofs with bearing elements of timber and wood-based panels in compliance with NF DTU 43.4, including zero-slope valleys.

The siphonic system can also be used when repairing roof waterproofing structures to NF P 84-208 (DTU ref. 43.5), given that there is no difference in drainage principle between the siphonic drainage system and a gravity drainage system ([1]).

Fields of use not concerned:

- Roofing by discontinuous elements according to P 30 series-200 standards (DTU [Unified codes of practice] ref. series-40), including a drainage network by inside gutters, whatever the structure;
- Inaccessible deck-roofs designed with a provisional rainwater hold-back drainage system;
- Deck-roofs accessible to pedestrians and vehicles ([2]);
- Application associated with an asphalt waterproofing covering;
- Roofs with waterproofing, the concrete slab protection of which is poured in place (car parks in particular) or covered with a mortar embedded underlay (embedded tiling);
- Use associated with an asphalt waterproofing coat, with a liquid waterproofing system, or in synthetic membrane other than those based on PVC-P;
- Use of slabs on pedestals, set directly on waterproofing covering because of servicing problems;
- Roof gardens;
- Green roofs and green deck roofs;
- Application in mountain climate zones;
- Use in French overseas departments and regions (DROM);
- And any field of use other than inaccessible roofs or with technical zones.

1.3 Limits to the application

- Minimum roof surface drained by a downpipe according to a rainfall intensity of 3 l/ min.m^2, 60 m$^{2;}$
- The maximal surface areas drained by type of roof inlet (a type of roof inlet is defined by the DN of its outlet connecting pipe), corresponding to the conventional calculation and design flow, is indicated in the following *table* 1:

Table 1 – Maximum surface drained by type of roof inlet

DN (mm)	**Maximal surface drained** (m²)
50	260
75	460
100	520
125	520

- Minimum height compatible with the siphonic effect: 3 m. This height corresponds to that measured between the roof inlet and the end of the siphonic network, as shown in the diagrams of the *figure* below:

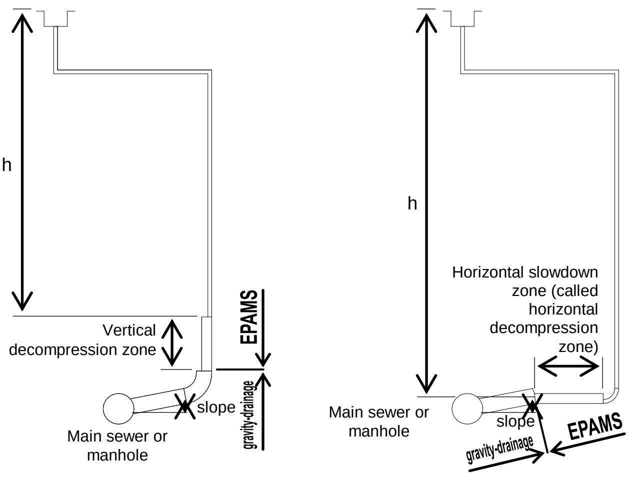


Figure – Minimum height

1.4 Manufacturing location

Roof inlets, pipes, unions, SMU joints, assemblies and accessories are manufactured and/or assembled in the Saint-Gobain PAM factory at Bayard-sur-Marne (Haute-Marne).

1.5 Organisation of study and design and of the worksite

1.51 Co-ordination

The main contractor or its representatives are responsible for coordinating all contracting firms (see § 6 of the Common CPT, *e-Book of CSTB* 3600).

In the Special Contract Documents (DPM) or in a rider, the main contractor shall provide for the supply of Epams roof inlets along with the rainwater downpipes, according to section 2.3 of Standard NF P 52-305-1 (DTU ref. 65.10), instead of providing this in the waterproofing under the waterproofing work package (Book of Special Clauses [CSS] to the standards – DTUs).

(1) The rainwater drainage system must be homogeneous for the entire roof either by means of a gravity system or a depression system; in this respect, two different systems may not be included to a same roof.

(2) Note that technical service roofs or roofs housing equipment are considered non-accessible.

1.52 Missions of the Saint-Gobain PAM company

Before the works

Based on elements communicated by the contracting authority, the principal contractor, the engineering firm or the contracting firms, Saint-Gobain PAM shall take responsibility for:

- the feasibility study;
- the calculations, design and recommendations prior to execution as well as the list of supplies necessary for the proper operation of the installation;
- providing contractorship with information on the loads occasioned by the weight of the full headers.

If necessary, Saint-Gobain PAM shall provide its technical assistance.

After the works

Saint-Gobain PAM or its missioned agency shall check the compliance of the installation with the technical study and design file and remit its conclusions to:

- The contractorship authority, by registered sign-on-delivery mail, together with a copy of the Epams system maintenance handbook (see § 1.7 Servicing below);
- The contractor;
- The installer.

This communication shall cite the provisions governing servicing described in § 1.7 and shall specify any modifications necessary for achieving compliance, which it is the responsibility of Saint-Gobain PAM or its assigned agency to ensure.

1.53 Missions of other contract packages

As stipulated under the CCS to standard NF P 52-305-1 (DTU ref. 65.10) and series-200 standards P 30 - P 84 (DTU ref. series-40 and 43):

- The installation of the EPAMS roof inlets and their connection to the waterproofing coverings are part of the waterproofing contract package, or in the case of outer gutters, the roof covering contract package;
- The supply of the EPAMS pipes, their installation and their connection are part of the rainwater downpipe work packages.

1.6 Design

1.61 Laying out the roof inlets (rainwater entry) depending on type of roof

Roof inlets layout shall follow that stipulated in the Book of Common Technical Specifications (*e-Book of CSTB* 3600).

1.62 Accounting for the risk of on-roof pooling

The provisions set out in the Book of Common Technical Specifications (*e-Book of CSTB* 3600) shall be followed.

Saint-Gobain PAM or its assigned agency have to verify the height of the overflow only in cases of installations containing outer gutters and where the water height over the inlet fittings is specified as greater than 55 mm.

Note that in the context of iterative calculations designed to check roof structure behaviour in response to pooling and water accumulation, given that there is no difference between gravity drainage systems and the Epams system in terms of either approach adopted or calculation details, then the rules for verifying structural framing components shall be those set out under standard NF DTU 43.3 P1.

1.7 Servicing

The use of a siphonic system requires more frequent roof servicing than what is prescribed in series-200 standards P 30 and P 84 (DTU ref. series-40 and 43). The drainage devices (sewage, gutters, eave valleys and roof inlets) shall be inspected and cleaned at least twice each year: in autumn and spring. In the event there is a risk particles may become detached from the roof's protection, the system is to be cleaned every three months during the first year.

An Epams system maintenance handbook is provided to the contracting authority along with the letter confirming conformity. It shall at least give:

- Reference to this Technical Assessment;
- The servicing obligation defined in the Book of Common Technical Specifications (*e-Book of CSTB* 3600);
- The role of the building's environment in dictating the frequency of servicing work;
- The cleaning procedure for the roof inlets (see *Appendix* 2);
- A provisional timetable of the first cleaning dates (season-year).

In order to inform the on-site people tasked with servicing duty on the specifics of the system, labels shall be placed at eye-level on the downpipe gutter outlets. The labels will state the servicing frequency, which must be at least twice-yearly, and will give reference to the maintenance handbook. The labels used are those defined under section 7 "Identifying and labelling the elements" below.

2. Operating principle

In conventional rainwater drainage installations, the conduits are only partially filled (about 1/3 water and 2/3 air in section). The air penetration is due to the Coriolis effect acceleration that results in a vortex in the middle of the throat of the inlet fitting which, because of this, sucks in air.

The Epams system is based on roof inlets of special design which prevent air penetration and enable complete filling of the network.

When rainfall is light, the system operates by gravity.

The sizing is based on standardised rainfall intensities. For European France, the value to be considered is 3 l/min.m^2.

3. Description of the constituents

The Epams system consists of specific roof inlets, in compliance with standard NF EN 1253 and a network of "Building" type cast iron pipes, including the pipes themselves, unions and accessories, in compliance with standard NF EN 877.

3.1 Roof inlets

3.11 Constituents

Each roof inlet is, at least, made up of the following two elements:

- the body of the roof inlet (connected to the waterproofing and to the pipe network);
- The anti-vortex barrier grid (Dispositif Anti-Vortex-Garde-Grève or DAV-GG in French).

3.12 Operating characteristics

3.121 General case with water height over the inlet ≤ 55 mm

The conventional calculation and design flows for which Saint-Gobain PAM is committed appear in *table* 2.

These figures correspond to the following conditions:

- rainfall intensity: 3 l/min.m²,
- roof inlet water cover height: 55 mm,
- downpipe height (building): 10 m.

In this *table*, the figures also show the flows determined under the conditions of standard NF EN 1253, that is:

- rainfall intensity: 3 l/min.m²,
- roof inlet water cover height: 55 mm,
- downpipe height (building): 4.2 m,

as well as the requirements of that standard.

The curves plotting water flow rate in relation to water height perpendicular to the roof inlet are given in *Appendix* (see *figure* 62).

Table 2 – Flows by type of roof inlet

DN	50	75	100	125
Conventional calculation and design flow (l/s)	13	23	26	26
Flow according to NF EN 1253 (l/s)	9	23	23	23
Requirements of the standard	6	14	-	-

3.122 Particular case of outer guttering installations

The advantage of the DN 125 roof inlet is in the "gutters" application where the water cover height can exceed the 55 mm figure.

3.13 Main types of roof inlets

The various models are based on the "roof inlet to be welded" on which are grafted various elements depending on the application field.

The range of Epams system roof inlets is presented in the following models:

3.131 Roof inlet to be welded (or brazed)

Figure 1 – Roof inlet to be welded

This roof inlet has a "body", an "Anti-Vortex Barrier Grid", also referred to by its French initials "DAV-GG", which is just one piece, 3 nuts and 3 nut caps (see *figure* 2).

Fixing the DAV-GGs by bolts was decided upon to ensure its hold in regions where high-speed winds are possible. The nut caps cover the visible bolts, once the installation is completed.

Figure 2 – Exploded view of a roof inlet to be welded

The "body" consists of a "bowl" under which is welded a "connecting pipe" of DN 50, 75, 100 or 125 mm.

For each DN, the outside diameter ('de' in French) of the connecting pipe is compatible with the products in lines SMU® S and SMU® Plus from Saint-Gobain PAM.

Table 3 – Outside diameters of the connecting pipe(s)

DN	50	75	100	125
de (mm)	58	83	110	135

Figure 3 gives the main overall dimensions (in mm) of the body and of the DAV-GG.

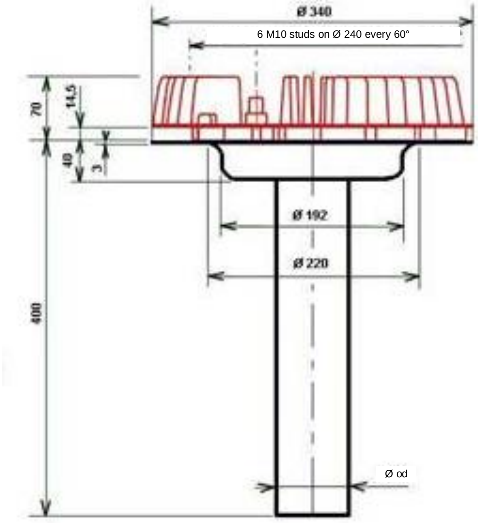


Figure 3 – Overall dimensions of the body and of the DAV-GG

The detail of the materials is:

- Body in grade 1.4301 stainless steel (X5CrNi18-10), according to NF EN 10088-1, including the M10 bolts;
- DAV-GG in aluminium A-S10G (EN AC-43000 according to NF EN 1706);
- The M10 nuts screwed onto the bolts are of stainless steel.

These roof inlets may, in certain cases, upon specific request, have a body made with another stainless steel grade offering at least equivalent anticorrosion performance.

Table 4 – Weights of the roof inlets to be welded

DN (mm)	50	75	100	125
Weight (kg)	5.4	5.7	6.4	8.3

Field of application

This roof inlet is especially designed to be welded (or brazed) in box gutters or valleys.

3.132 Roof inlet with plate

In principle, this roof inlet is a "roof inlet to be welded" with a body fitted with a stainless steel plate.

Figure 4 – Roof inlet with plate

Figure 5 – Exploded view of a roof inlet with plate

The plate is fixed to the roof inlet's body in the factory by bonding, then tightening with 6 nuts on the 6 bolts. This assembly can never be disassembled.

The stainless steel plate (grade 1.4301) is tinned on the two faces. Its dimensions are 500×500 mm^2 with a thickness of 0.4 mm. For the other dimensions, see section 3.131 "Roof inlet to be welded".

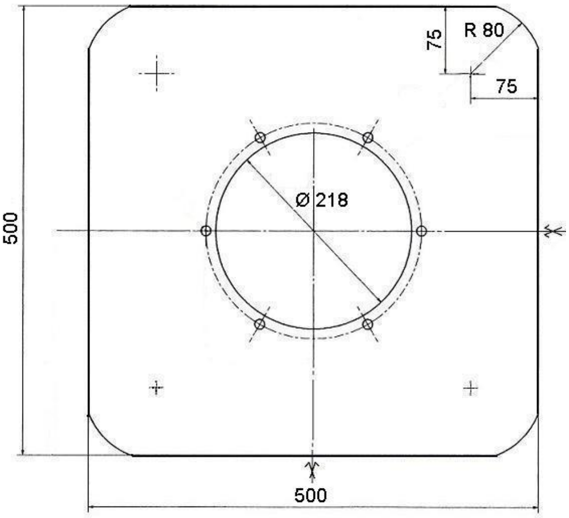


Figure 6 – Details of the tinned plate

Table 5 – Weights of the roof inlets with plate

DN (mm)	50	75	100	125
Weight (kg)	6.4	6.7	7.4	9.3

Field of application

These roof inlets are used on all the roofs covered under the field of application, except for those with waterproofing by synthetic membrane.

3.133 Roof inlet for flexible PVC-P membrane

In principle, this roof inlet is a "roof inlet to be welded" with a body fitted with a laminated steel-PVC-P plate.

The PVC-P-based synthetic membranes are given a Technical Guidance File.

Figure 7 – Roof inlet for flexible PVC-P membrane

Figure 8 – Exploded view of a roof inlet for flexible PVC-P membrane

The plate is fixed to the roof inlet body in the factory by bonding then tightening with 6 nuts on the 6 bolts. This assembly can never be disassembled.

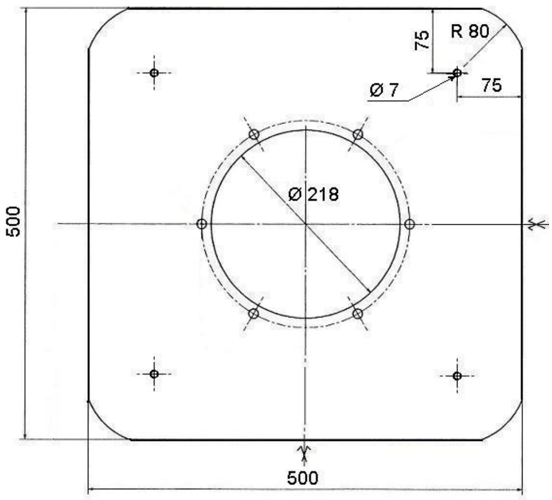


Figure 9 – Details of the laminated plate

Table 6 – Weights of the roof inlets for flexible membrane

DN (mm)	50	75	100	125
Weight (kg)	6.8	7.1	7.7	9.6

Field of application

This roof inlet is used on roofs that are non-accessible roofs and/or with equipment zones, and waterproofed by PVC-P based synthetic membranes and under a Technical Guidance File. Waterproofing is provided by a weld between the various PVC-P elements to seal it in a traditional way (see section 5 "Installing the products"). The membrane may be visible or may be given heavy mineral protection. For this latter case, it is possible to use gravel aggregate provided the roof inlet is to be fitted with an elevating kit for the DAV-GG (see section 3.14).

3.134 Roof inlet with flange

Figure 10 – Roof inlet with flange

Figure 11 – Exploded view of a roof inlet with flange

At the flanging zone, the thickness of the aluminium flange is: 4 mm (5 mm including the ribs).

The flange is to be oriented in such a way that the ribs will be in contact with the material to be flanged, and 6 bosses are provided as support for the 6 extra M10 fixing nuts.

Table 7 – Weights of the roof inlets with flange

DN (mm)	50	75	100	125
Weight (kg)	6.2	6.5	7.2	9.1

Field of application

This roof inlet can be used for roofs with box valleys or very thick metallic guttering (excluding roofing and copper or lead gutters) as well as for roofs waterproofed by PVC-P based synthetic membranes under Technical Guidance File with a thickness between 1.2 and 1.5 mm.

3.135 Applications fields of roof inlets, summary

Table 8 – Application field of roof inlets

Roof inlets	Application fields
With plate	Roofs covered by the field of application, except for those with a waterproofing by synthetic membrane
For flexible PVC-P membrane	Roofs waterproofed by PVC-P-based synthetic membranes
To be welded	Box gutters or valleys
With flange	Roofs containing extra-thick metal box gutters or valleys as well as roofs waterproofed by PVC-P-based synthetic membranes under TGF and with a thickness between 1.2 and 1.5 mm.

3.14 Kits for elevating the DAV-GG for roofs with inverted waterproofing or roofs with waterproofing protection by gravel aggregate or by flags on isolating layer (asphalt excluded)

3.141 General description

Two different elevating kits are proposed: the « kit 250 » and « kit 90 ». Each is technically adaptable to all the roof inlets and can be broken down into a DAV-GG, a grating cap, 3 spacers and 3 fixing nuts.

Figure 12 – Elevating kits

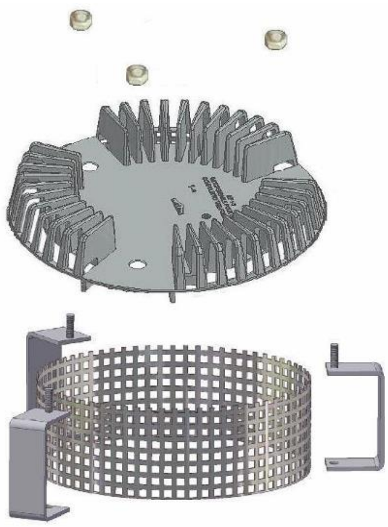


Figure 13 – Exploded view of the elevating kit

The grating cap has square apertures, 10 mm on each side. It is interposed between the two DAV-GGs by means of 3 spacers. The DAV-GG located between the body of the roof inlet and the grating cap is mandatory for the "anti-vortex device" function, while the one located above the grating cap is mandatory for the "barrier-grid" function.

The grating cap and the spacers are of grade-1.4301 stainless steel, as per NF EN 10027-2.

The weight of "kit 250" is 6.7 kg, that of "kit 90" is 4.0 kg.

If it is planned to lay a protection or isolating layer of gravel aggregate, its particle size grading will need to be from 15 to 30 mm (see *standard NF EN 13043*), with the highest possible particle size grading next to the rainwater entries.

For the installation of the kits, see § 5 "Installing the products".

3.142 Roof with inverted waterproofing

For this type of roof, "kit 250" is to be used. The maximal height of the insulation and/or gravel aggregate layer is to be 250 mm, height to be measured from the upper edge of the body of the roof inlet (see *figure* 14).

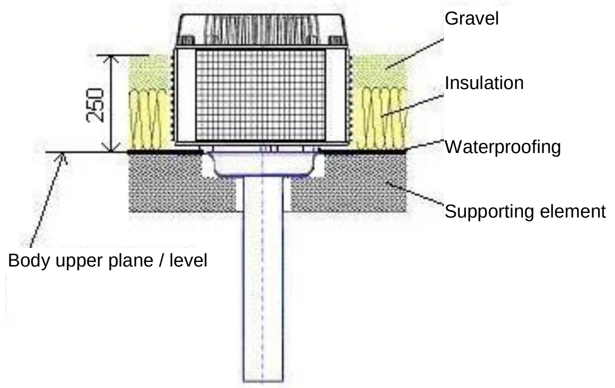


Figure 14 – Maximal height for the insulation and the gravel aggregate

3.143 Waterproofed roof protected under loose aggregate (via a gravel bed)

For this type of roof, with or without insulation between the bearing element and the waterproofing covering, "kit 90" is to be used. The maximal height of the gravel aggregate layer is to be 90 mm, the height to be measured from the upper edge of the body of the roof inlet (see *figure* 15). In compliance with the application field, only the roof inlets to be welded can be used for these applications.

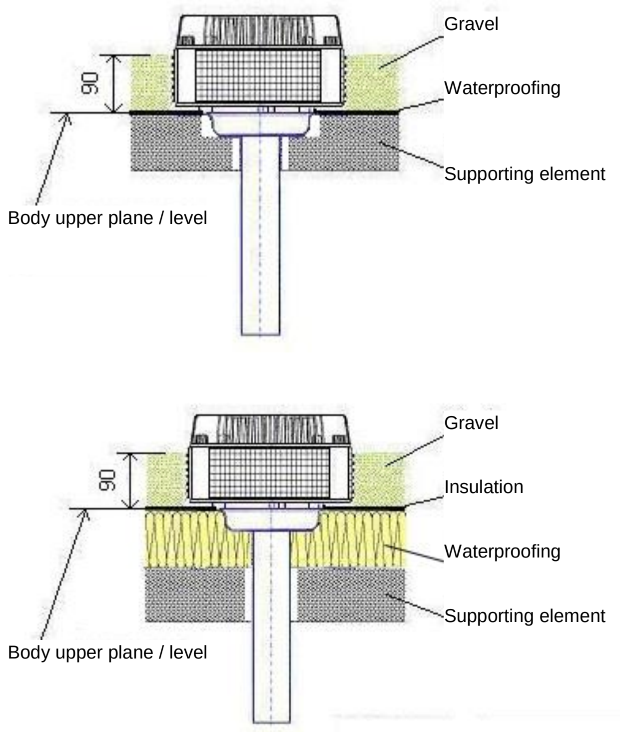


Figure 15 – Maximal height for the gravel aggregate

Field of application

The elevating kit can be used for the so-called inverted insulation roofs or for roofs with waterproofing protection by gravel aggregate or by flags on a gravel aggregate isolating layer.

3.2 Pipes

The cast iron piping elements from Saint-Gobain PAM hold the NF certification.

To optimise the acoustic performances of cast iron networks, Saint-Gobain PAM can furnish, to installers who so desire, brackets gripping the pipe and intrinsically fitted with a shock-absorbing device ("Antivibratils" or similar models), and corresponding to the worksite's needs (see § 5.11).

4. Description of the calculation and design method

The description below corresponds to a didactic explanation, based on a manual calculation.

The basic principle is that the operating energy of the Epams system is supplied by the potential energy of the pressure head considered. The calculations aim to optimise the use of that potential energy.

The flows taken into account in the calculations are, at a maximum, the conventional flows mentioned in §.3.12.

The water cover height, corresponding to the conventional flow, is:

- equal to or less than 55 mm for general cases, which makes it possible to comply with the requirements of NF DTU 43.3 P1-1 (Appendix D),
- or potentially greater than 55 mm for the particular case of outer gutter installations. This head needs to be taken into account in the calculation and design of the outer guttering.

4.1 Determining the quantity of rainwater which the installation will need to drain: Q

$$Q = \frac{A \times r}{60}$$

where:

Q = water quantity to be drained, in l/s,

A = total surface of the roof as a horizontal projection (see *figure* 16 below), in m^2,

r = maximum rainfall intensity in $l/min.m^2$; standard NF DTU 60.11 P3 sets this value at 3 $l/min.m^2$ for European France.

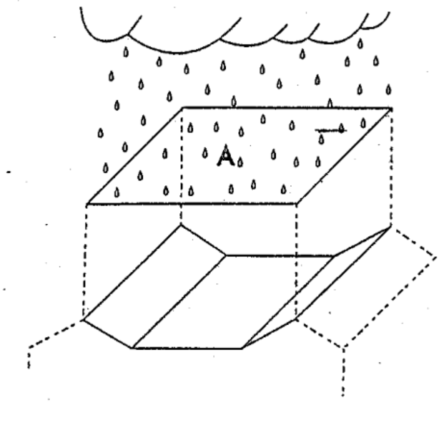


Figure 16 – Surface taken into account

4.2 Determining the number of roof inlets: N

4.21 Roofing by discontinuous elements (series-200 P 30 standards, DTU ref. series-40), including a drainage network by outer gutters, whatever the structure

Starting assumptions:

- Rainfall intensity of 3 $l/min.m^2$,
- Roof inlet water cover height: possible > 55 mm,
- Roof inlet flow: possible > conventional flow

$$n = \frac{Q}{q}$$

where:

n = theoretical number of roof inlets,

q = conventional flow of the roof inlet, in l/s.

The number of roof inlets N is then equal to the whole number equal to or greater than n.

4.22 Roofs of waterproofing substrate corrugated steel sheets in compliance with NF DTU 43.3, and wood-based panels in compliance with NF DTU 43.4, fitted with valleys

Starting assumptions:

- Rainfall intensity of 3 l/min.m^2;
- Roof inlet water cover height: possible up to 55 mm;
- Conventional flow of the roof inlet.

The reasoning to determine the number of roof inlets shall come into play for each bay length or span. We therefore obtain, for each surface element (A_i) representative of a bay length or span:

$$Q_i = \frac{A_i \times r}{60}$$

where:

Q_i = water quantity of a surface element to be drained, in l/s,

A_i = total surface of the roof element in a horizontal projection (see *figure* 16), in m^2,

and:

$A = \Sigma \{A_i\}$ and $Q = \Sigma \{Q_i\}$ (see *§ 4.1*)

Furthermore, and for each surface element A_i:

$$n_i = \frac{Q_i}{q}$$

where:

n_i = theoretical number of roof inlets,

q = conventional flow of the roof inlet, in l/s.

The number of roof inlets N_i necessary for the draining of surface A_i is at least 1 and is equal to the whole number equal to or greater than n_i.

Hence: $N = \Sigma \{N_i\}$.

For this type of roof, the constraint of one rainwater entry, mandatory for each bay length or span, can lead, for small roofs, to low flows for the roof inlets.

4.23 Masonry roofing and reinforced autoclaved cellular concrete roof slabs

Assumptions and approach identical those set out in § 4.2.1, except:

- Roof inlet water cover height: possible up to 55 mm;
- q = conventional flow of the roof inlet, in l/s.

4.3 Plot of an isometric projection of an installation, showing reference points of the lengthwise members, the roof inlets, and the flows, and determination of potential energy

The lengthwise members of the isometric projection in *figure 17* are delimited according to the principle described on *figure 18*.

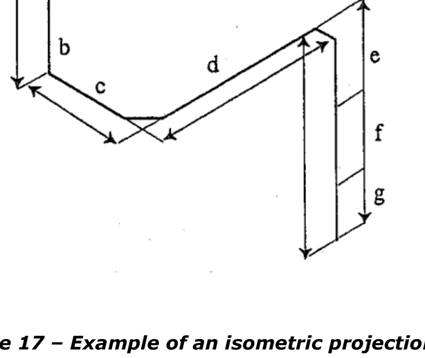


Figure 17 – Example of an isometric projection

h = total height of the installation (or height between "roof inlet(s)" and "end of the siphonic network"), in m:

$$h = a + b + e + f + g$$

L = effective length of the installation from the roof inlet to the end of the siphonic network, in m:

$$L = a + b + c + d + e + f + g$$

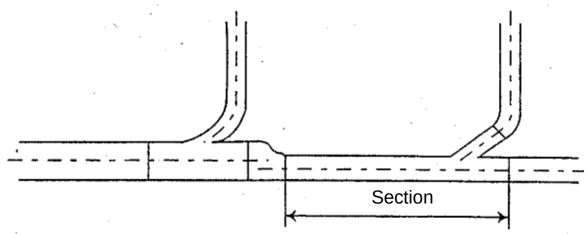


Figure 18 – Identification of a lengthwise member

The available potential energy that results from the installation's height is determined as follows:

$$E\,(pot) = \rho \times g \times h \times \frac{1}{a}$$

where:

E (pot) = potential energy, in mbar,

ρ = water weight per unit volume, in kg/m^3, that is 1000,

g = acceleration due to gravity, in m/s^2, that is, 9.81,

h = total height of the installation, in m,

a = Pascal's passage coefficient, in mbar, that is, 100.

The EPAMS system is sized beginning at the "roof inlets" and going to the "end of the siphonic network" (see § 5.13). Beginning at this point, the outflow is re-established according to gravity-system criteria and the conduits' dimensions are calculated according to the provisions of standard NF DTU 60.11 P3 or standard NF EN 752 for pipes located inside or outside buildings, respectively.

4.4 First estimate of the equivalent length: Lo

A flow line begins at a "roof inlet" and ends at the "end of the siphonic network".

The downpipe is a vertical part and can be common to several lines of flows.

In an initial approach, we consider that the individuated elements (roof inlets, elbows, branch fittings, etc.) are going to increase by 20% the pressure drops in the flow line when compared with a rectilinear conduit, hence:

$Lo = L \times 1.2$ (see the definition of L given in § 4.3)

4.5 Initial estimate of the pressure drops: Ro

$$Ro = \frac{E\,(pot)}{Lo}$$

where:

Ro = pressure drops, in mbar/m,

E (pot) = potential energy, in mbar,

Lo = equivalent length, in m.

4.6 Determination of the pipe diameters using a ready reckoner

See *figure* 62 in *Appendix* 1.

Select flow *Q* (total flow of the installation or of the flow line considered) at the abscissa, and *Ro* (estimated pressure drops) at the ordinate "pressure drop rP per meter of pipe". The intersecting point is located "on" or "to the left of" the oblique straight line which represents the diameter of the pipe, ''Dimensions of DN pipes", to be selected. In the conduit and for the flow considered, an effective pressure drop *Re* in mbar/m and a water speed *v* in m/s correspond to this diameter.

4.7 Determining the pressure drops in the individuated elements: Z

$$Z = \Sigma\{T\}\ (1/2\ \rho\ v^2\ \frac{1}{a})$$

where:

Z = sum of individuated pressure drops, in mbar,

T = coefficient of pressure drops specific to each individuated element and independent of the diameter, see *table* 9 below,

V = water speed at the point considered, in m/s (see § 4.6).

Table 9 – Coefficients of pressure drops of the individuated elements

Individuated elements	T
EPAMS roof inlet	1.8
Elbow 88°	0.8
Elbow 45°	0.3
2 consecutive elbows 45°	0.6
Branch fitting: passage outflow (*figure* 19)	0.5
Branch fitting: inlet flow at 45° (*figure* 20)	1.0
Gravity-drainage passage	1.8

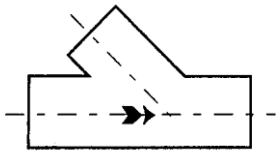


Figure 19 – Branch fitting, passage flow

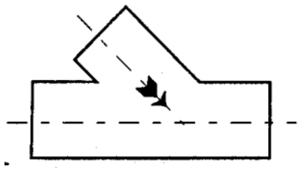


Figure 20 – Branch fitting, inlet flow at 45°

4.8 Determining total pressure drops: Rt

$$Rt = (L \times Re) + Z$$

where:

Rt = total pressure drops, in mbar,

L = effective length of the installation, in m (see § 4.3),

Re = effective pressure drops in mbar/m (see § 4.6),

Z = sum of individuated pressure drops (see § 4.7), in mbar.

4.9 Calculating the maximum sub-atmospheric pressure (vacuum)

To maintain favourable flow rates in the Epams vacuum system, it is important to make sure that the vacuum at each point of the network does not exceed the negative value of -900 mbar, and this is valid whatever the diameter of the lengthwise member considered. This limit results from the water's physical properties.

It is possible to determine the pressure at each point of the network by the calculation.

Should the vacuum be stronger than -900 mbar (example -950 mbar), it is necessary to redo the calculations in § 4.6 by increasing the diameters of certain lengthwise members, located downstream from the roof inlet and upstream from the point considered. The total pressure drops in the network located between the roof inlet and the point considered are reduced in this way.

4.10 Checking the proper operation of the installation

So that the Epams drainage installation will work, the potential energy resulting from the total height of the installation (see § 4.3) shall be equal to or greater than the total pressure drops *Rt* (see § 4.8).

$$E\ (pot) \geq Rt$$

If this inequality is not verified, the calculations need to be redone.

4.11 Balancing between the various roof inlets

From a hydraulic point of view, the Epams network needs to be balanced so that the system performs its drainage function. This produces the following condition: at each junction, the two calculated pressures, pressures representative of the lines which are located upstream from the junction, must differ by no more than 150 mbar.

$\Delta P \leq 150$

where:

ΔP = the pressure imbalance at a junction, in mbar.

This requirement implies an obligation to respect the study and design work carried out by Saint-Gobain PAM or by the engineering firm assigned by it.

If this requirement is not verified, the sizing of the network needs to be redone using the ready reckoner (see § 4.6). It is then necessary to adapt the diameters to either reduce the pressure drops in the line where they are greater, or increase the pressure drops in the line where they are lesser.

5. Installation

The Epams system is inseparably composed of the EPAMS roof inlets and SMU® S or SMU® Plus cast iron unions and pipes from Saint-Gobain PAM.

The Epams system is installed by conventional installers, in compliance with the series-200 P 80 standards (DTU ref. series-60 and 65), in particular standards NF P 41-220 (DTU ref. 60.2) and NF P 52-305-1 (DTU ref. 65.10), and according to the CCSs of the series 40 and 43 DTU standards, that is, rainwater downpipe contract package firms for the cast iron network and roof covering/waterproofing professionals for the roof inlets.

5.1 Features specific to the Epams network

5.11 Brackets

The only ones authorised are manufactured brackets which, first of all grip and clamp the pipe and second of all are fitted with a shock-absorbing device to attenuate the vibrations coming from the piping and transmitted to the structure. Saint-Gobain PAM can propose brackets which respond to this constraint to those installers who want them, (see *figure* 21 "Antivibratil" collars, etc.).

Figure 21 – Example of "Antivibratil" (shock-absorbing) collars

It should be noted that, for the collars mounted with the threaded rods, and in the absence of any system which aims to increase the rigidity of the supports (triangulation…), Saint-Gobain PAM recommends limiting the length of the threaded rods so that the distance between the bearing structure (concrete slab, steel framing, etc.) and the axis of the piping does not exceed 500 mm inclusive.

5.12 Bracing the Epams piping

This bracing is done in compliance with standards–DTUs with relation to the assessment of the loads to be handled. The installer will need to take into account the fact that, during the operation of the Epams siphonic system, each piping element (pipe, union, etc.) is completely full of water. It is up to the installer to design and brace its support to avoid any movement of the piping. The installer shall therefore select a bracing system with a strength compatible with the loads to be handled.

The number and the position of the fixing elements shall be determined and implemented in compliance with standard P 41-220 (DTU ref. 60.2), and the collocation of the fixing elements selected is, in every case, to be the one specified in the case "outside the buildings" in standard-DTU 60.2, Table of section 5.321 of this standard-DTU, concerning supports (also see *table* 10).

It should be noted that the installer is to collocate the brackets at regular intervals (at a maximum of 0.75 m from a joint).

In no event shall the piping brackets be implemented by fastening on the corrugated steel sheets or wood or wood-based panels supporting the waterproofing.

Table 10 – Review of certain elements of standard NF P 41-220 (DTU ref. 60.2)

Routing		Number of "Outside the buildings" supports
Vertical	For each straight element:	
	Length ≥ 2.70 m	1(EU) 2 (UU) (1)
	Length ≥ 1 m	1
	Length ≤ 1 m	
	For each union of type:	
	Y-fitting and branch element	1
	Direction change > 45°	1
Horizontal	Length ≥ 2 m	2
	Unions or lengths < 2 m	1
(1) EU: Cast iron piping element with socket, UU: Cast iron piping element with spigot.		

5.13 Locking and anchoring the Epams network

To assume the stresses due to the hydraulic activity level of the Epams siphonic system, locking systems are to be applied. These systems essentially entail the installation of grip collars on certain SMU-type joints (see *figure* 22) or on the assembly of "self-gripped" SMU-type joints (see *figure* 23) and on the fitting of anchoring unions (see *figure* 24). These devices, natures and locations are specified in the technical study and design.

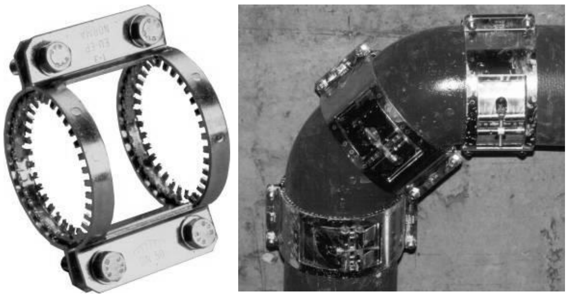


Figure 22 – Grip collar on SMU-type joints example of parts and of assembly

Figure 23 – Self-grip SMU joint, example of the part

The end of the Epams network is materialized as the inclusive decompression zone. This zone or lengthwise member generally contains an anchoring union (see *figure* 24) upstream in the flow direction.

Figure 24 – Anchoring union, example of the part

The anchoring union shall be on bearing surfaces on a machine-welded structure (see figures *25 and 26*) or directly on a concrete structure of the building (slab, etc.) (see *figure* 29). It should be noted that Saint-Gobain PAM can propose cantilever arms to support the anchoring unions (see *figure* 27) to those installers who want them.

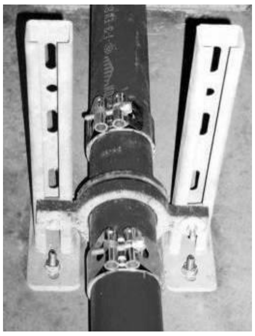


Figure 25 – Example of anchoring union on brackets

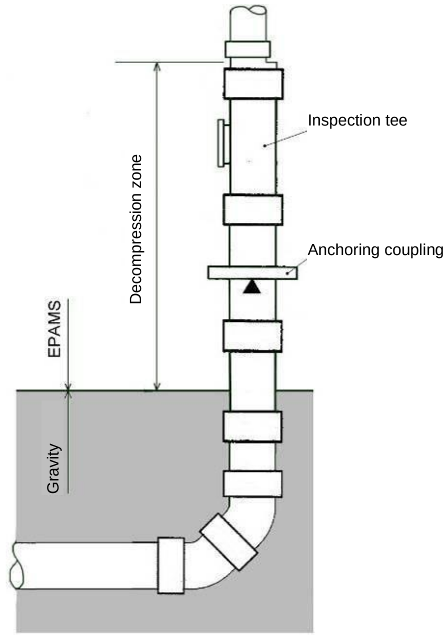


Figure 26 – Example of assembly with vertical decompression lengthwise member

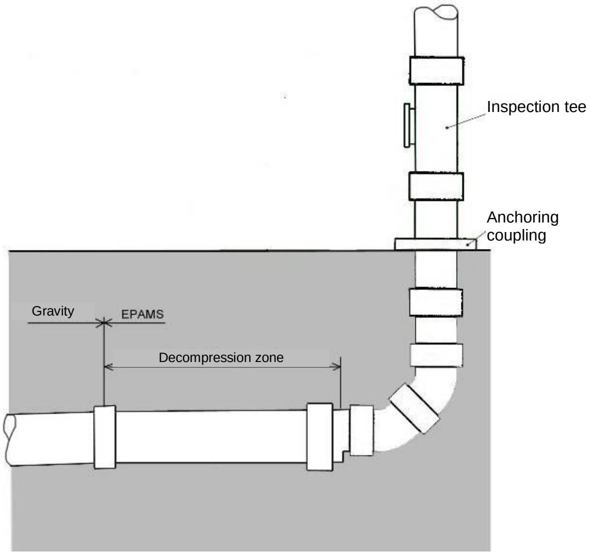


Figure 27 – Example of assembly with horizontal decompression lengthwise member

After the decompression lengthwise member, the flow is re-established according to gravity type criteria and the dimensions as well as the necessary lockings of the conduits are established according to the provisions of standard NF P 41-220 (DTU ref. 60.2) and standard NF DTU 60.11 P3 for pipes located inside buildings, or standard NF EN 752 for pipes located outside buildings.

5.14 Inspecting the networks

Each downpipe shall contain an access door pipe (see *figure* 28). A waiver is possible if, close to the downpipe, there is an inspection access chamber, dependent on the external works section (with masonry-block access chamber excluded), but this possibility is contingent upon an agreement from Saint-Gobain PAM (see *figure* 29).

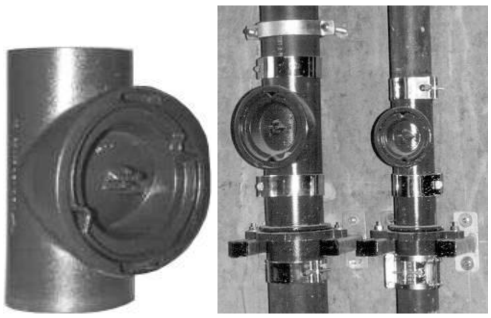


Figure 28 – Access door pipe, example of parts and of assemblies

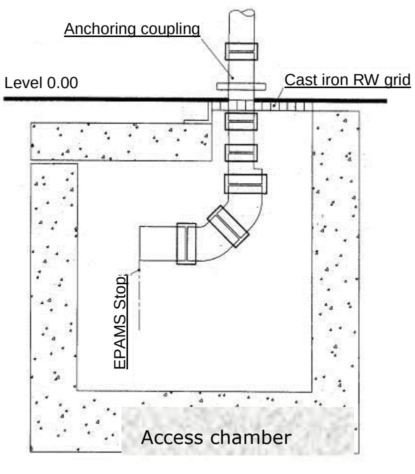


Figure 29 – Diagram of a network with inspection access chamber and without access door pipe

5.2 Connecting to the gravity-drainage network

The siphonic effect principle only applies up to the connection to the access chamber or the pick-up by the sewage system. Beginning at this point, pipework design and calculations are done according to the provisions set out in standard NF DTU 60.11 P3 when the drain pipes are located within the building's ground area, or leaflet 70 which refers to technical instruction 77/284 when sewage systems are involved, taking into account the flows to be drained away.

The end of the Epams network is materialized as an inclusive decompression zone. After this segment, connection to the gravity-drainage network can be achieved via:

- an access chamber, preferably ventilated;
- a direct connection to the sewerage system, performed according to the provisions set out in standard NF DTU 60.11 P3 when the drain pipes are located within the building's ground area, or otherwise, according to the provisions set out in leaflet 70;
- a detention basin or stormwater channel, which the main contractor will double-check to make sure the maximum water level cannot interfere with running operation of the siphonic drainage system.

5.3 Installing Saint-Gobain PAM roof inlets

The roof inlets and their installation are chosen based upon the characteristics of the roofs and of their final purpose, as well as based on the nature of the waterproofing. All the roof inlets, except for roof inlets to be welded, comply with the series-200 (DTU ref. series-43) P 84 standards. Roof inlets to be welded and which are without a plate are installed conventionally in the box gutters or valleys.

In the case of roofs with waterproofing coating, the layout of the roof inlets and their installation in the covering require a co-ordination between the contracting firms responsible for the structural shell work and for the installation of piping and waterproofing coverings.

Roof inlets with plated or flanges shall be installed horizontally and a containment system shall be produced according to professional practice. A maximum slope of 4% is, however, permitted.

Given the dimensions of the roof inlets, the presence of a trimmer is to be decided according to the collocation, in application of the Common CPT (*e-Book of CSTB* 3600)

In the case of metal valleys or gutters, the plate of a roof inlet with plate can be cut out, pressformed and/or brazed thanks to the nature of its material (tin-plated stainless steel).

All temporary measures must be taken to prevent any water overloading on the roof before completing the installation of evacuation (e.g. closing the roof inlets with the waiting plug, provided overflows may be triggered, temporary additional evacuation by gravity, etc.).

The roof inlets are defined by standard NF EN 1253 and series-200 P 84 (DTU ref. series-43), particularly the openings of the grating caps, dimension 15 mm. Consequently, whenever the protection of the waterproofing covering contains granules with smaller dimensions, devices such as gravel guards (not supplied by Saint-Gobain PAM) shall be provided to prevent the gravel from penetrating the roof inlet.

5.31 Two-ply bituminous membrane waterproofing

For this type of waterproofing covering, the roof inlet with plate must be used.

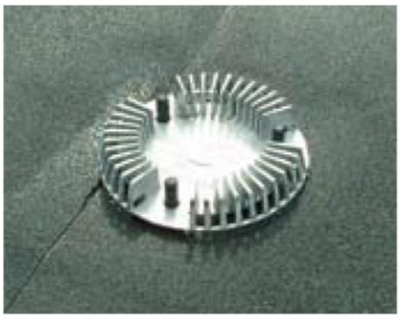
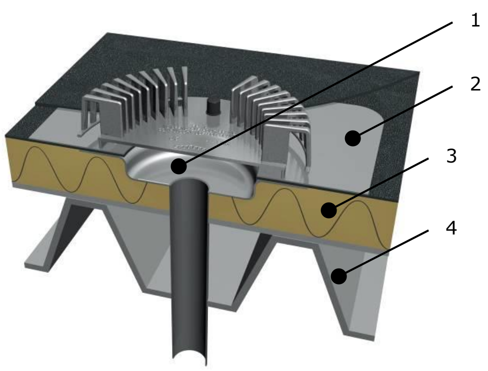


Figure 30 – Example installation of a roof inlet with plate in a two-ply waterproofing system



1. Roof inlet with plate
2. Plate integrated between the two waterproofing felt strips, with backer
3. Insulator substrate, with recess built to NF DTU 43.3
4. Corrugated steel sheet bearing element

Figure 31 – Cross-section of the installation of a roof inlet with plate in a two-ply waterproofing system

Installation advice

- Unscrew the 3 fixing screws so as to lift away the DAV-GG grating;
- Never unscrew the 6 factory-assembled and factory-tightened plate fixing screws;
- Coat both sides of the plate with a cold-lay lap cement.

Figure 32 – Applying cold-lay lap cement on the plate

- Recess the insulation by making a 60 × 60 cm cut down to 3 to 4 cm depth;
- At the centre of the recess, cut out a ∅ 22 cm circle down to a depth of 5 cm ready to embed the roof inlet bowl in the insulation.

Figure 33 – Forming the recess and the cut-out in the insulation substrate

- Fit the backer (as per the Technical Guidance File of the waterproofing coating) and the 1st-ply bituminous sheet, making sure it fits snugly to the shape of the recess, then cut a 25 cm diameter hole into the bituminous sheet to allow the bowl to pass through. Heat the bitumen and the underside of the plate, and press the plate down onto the hot bitumen;
- Roll out the 2nd-ply layer of bitumen sheet and cut it back over the bolts, i.e. cutting out a 26-cm diameter circle;
- Heat while keeping the bitumen sheet smooth to ensure effective waterproofing;
- Clean any impurities, bitumen splashes or other debris from inside the bowl;
- Fit the anti-vortex device grating, screw the nuts back on, and fit the 3 nut caps.

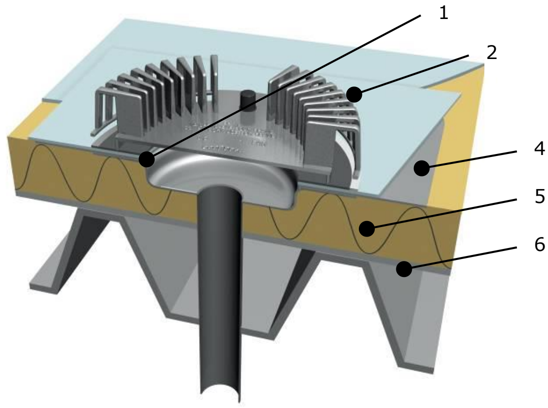
Note: It is equally possible to lay a 1 m × 1 m bitumen fascia (defined in the Technical Guidance File of the waterproofing coating), then heat it up and bond it onto the top face of the roof inlet plate. The fascia will then be heated and fixed between the bottom-ply and top-ply layers of the bituminous waterproofing system.

5.32 Waterproofing by PVC-P membrane

For this type of waterproofing covering (5), either the roof inlet with flange (with anchor plate for roofs covered under standard-DTU series 43 and 1.5 mm maximum coating thickness) or the roof inlet for flexible PVC-P membrane can be used.

5.321 Roof inlet with flange

Figure 34 – Example installation of a roof inlet with flange in a synthetic membrane waterproofing system



1. Roof inlet with flange
2. Bond-layer membrane
3. Flange
4. Anchor plate
5. Insulator substrate
6. Bearing element

Figure 35 – Cross-section of the installation of a roof inlet with flange in a synthetic membrane waterproofing system

Installation advice

- Unscrew the 3 fixing screws so as to lift away the DAV-GG grating;
- Unscrew the remaining 3 nuts so as to lift away the flange;

a) Preparation of the bond-layer membrane:

Use the flange to plot the position of the bolts and the roof inlet opening on a spare piece of membrane. Cut out the centre section and pierce holes for the bolts to pass through.

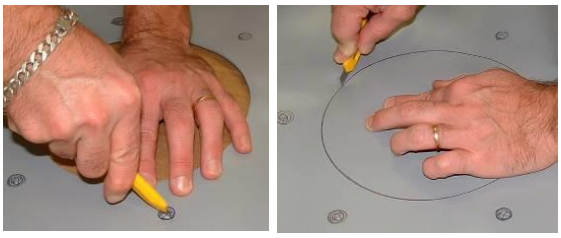


Figure 36 – Cutting the bond-layer membrane to size over the roof inlet

a) Fixing the bond-layer membrane:

Place the 1st EPDM seal and then the anchor plate in position over the body of the roof inlet fitted with its bolts.

Fit the bond-layer membrane into place and then position the 2nd EPDM seal over the top of the membrane.

Figure 37 – Fitting the bond-layer membrane and EPDM seals into position

c) Fixing the flange:

Fit the flange fixture into position and hand-tighten the nuts; once the nuts make contact with the flange, tighten them in the order given in *figure* 38 to a torque of 20 Nm.

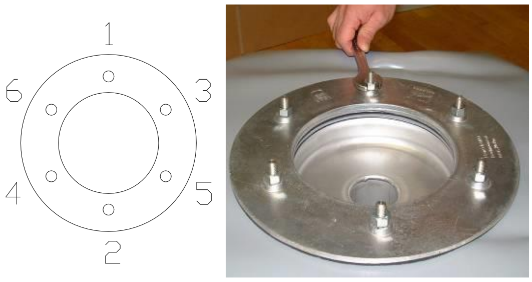


Figure 38 – Tightening the flange

d) Installing in the roof:

Recess the insulation by making a 60 × 60 cm cut down to 3 to 4 cm depth. Cut the membrane to fit the shape of the recess.

At the centre of the recess, cut out a 22 cm-diameter circle down to a depth of 5 cm ready to embed the roof inlet bowl in the insulation.

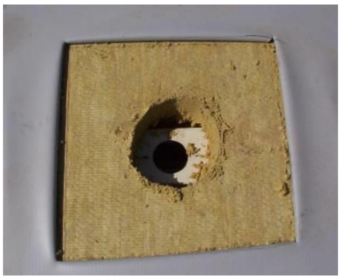


Figure 39 – Forming the recess and the insulation and membrane cut-outs

- Install the roof inlet together with its bond-layer membrane.

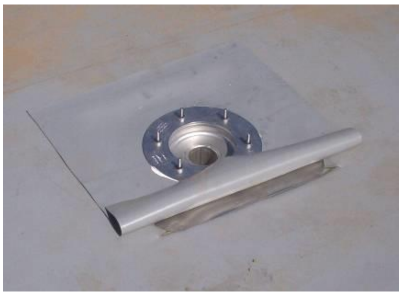
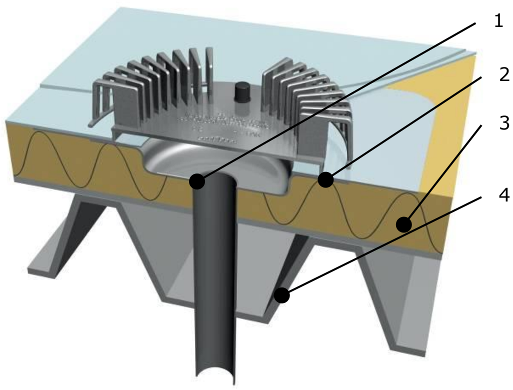


Figure 40 – Installing the roof inlet with its bond-layer membrane

- Join the bond-layer membrane to the roof according to the manufacturer's rules on system implementation.
- Clean any impurities from inside the bowl, fit the anti-vortex device grating, screw the nuts back on and fit the 3 nut caps.

5.322 Roof inlet for PVC-P membrane

Figure 41 – Example of installation of a roof inlet for a synthetic membrane system



1. Roof inlet for PVC-P membrane
2. PVC-P laminated steel plate
3. Insulator substrate
4. Bearing element

Figure 42 – Cross-section of the installation of a roof inlet for a PVC-P membrane system

Installation advice

- Unscrew the 3 fixing screws so as to lift away the DAV-GG grating;
- Recess the insulation by making a 60 × 60 cm cut down to 3 to 4 cm depth. At the centre of the recess, cut out a 22 cm-diameter circle down to a depth of 5 cm ready to embed the roof inlet bowl in the insulation;
- Fit the roof inlet in place;
- Cut out the waterproofing membrane over the inlet. The cut-out, which will need to enable the passage of bolts and nuts, is made according to a circle, diameter 260 mm, centred on the axis of the inlet (see *figure* 43).

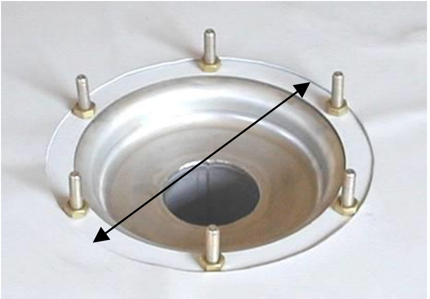


Figure 43 – Cutting the membrane to size over the roof inlet

The membrane is then bonded or welded to the PVC laminated steel plate of the inlet, bearing in mind the installation recommendations of the membrane manufacturer according to the Technical Guidance File of the PVC-P membrane waterproofing coating.

Figure 44 – Example of heat-welding the membrane onto the PVC-P laminated steel plate

Clean any impurities from inside the bowl, fit the anti-vortex device grating, screw the nuts back on and fit the 3 nut caps.

5.33 Installation in metal guttering

For installation in non-waterproofed guttering, either the roof inlet with flange, the roof inlet to be welded or the roof inlet with plate can be used.

For installation in waterproofed guttering, refer to the installation requirements and compatibility guidelines below according to type of waterproofing system.

5.331 Roof inlet with flange

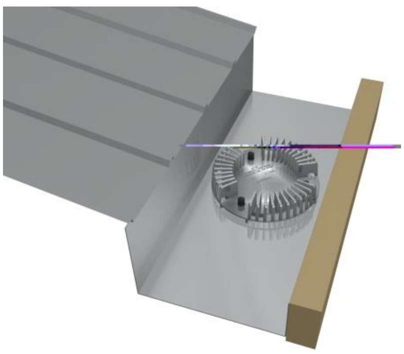
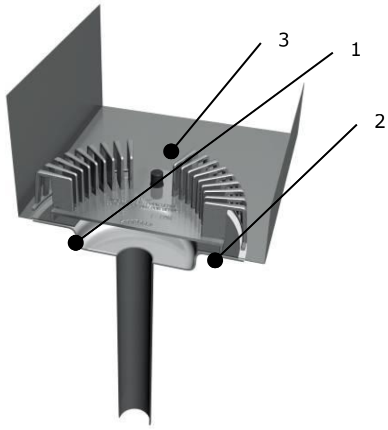


Figure 45 – Example of installation of a roof inlet with flange in a metal gutter



1. Roof inlet with flange
2. Flange
3. Metal gutter

Figure 46 – Cross-section of the installation of a roof inlet with flange in a metal gutter

As the overall width of the roof inlet is 340 mm, the minimum gutter width at the roof inlet position must be 400 mm. The roof inlet bolts are long enough to handle gutter thicknesses of up to 6 mm.

Installation advice

- Unscrew the 3 fixing screws so as to lift away the DAV-GG grating;
- Unscrew the remaining 3 nuts so as to lift away the flange;
- Position the flange in the spot designed for the roof inlet. Plot the position of the 6 bolts. Pierce to a diameter ∅ of 12 mm;
- Using a ruler, trace out two lines. Use the holes set aside for the bolts as reference points. The intersection of these two lines marks corresponds to the centre of the flange (see *figure* 47).

Figure 47 – Pinpointing the centre of the flange

- Working out from the centre, cut a round opening to a diameter of 190 mm;
- Place the 1st EPDM seal in position over the body of the roof inlet fitted with its bolts. Place the roof inlet into the gutter, on the top of the body. Add the 2nd EPDM seal, then, using the flange, fit the assembly into place.

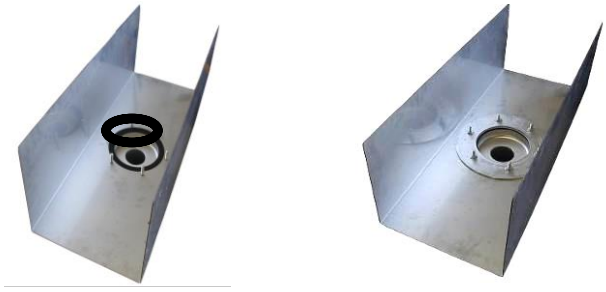


Figure 48 – Assembling the roof inlet in the gutter

Alternately tighten the 6 nuts to ensure uniform pressure on all the in-position parts. Tightening torque must not be greater than 20 Nm to make sure there is no damage to the gaskets (see *figure* 49).

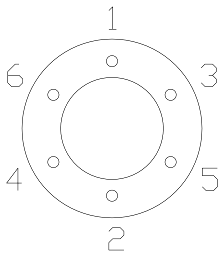


Figure 49 – Tightening the flange

Clean any impurities from inside the bowl, fit the anti-vortex device grating, screw the nuts back on and fit the 3 nut caps.

5.332 Roof inlet to be welded

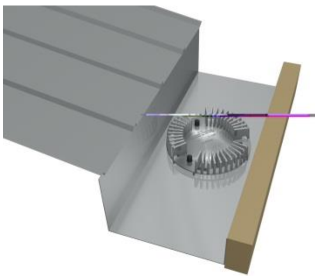
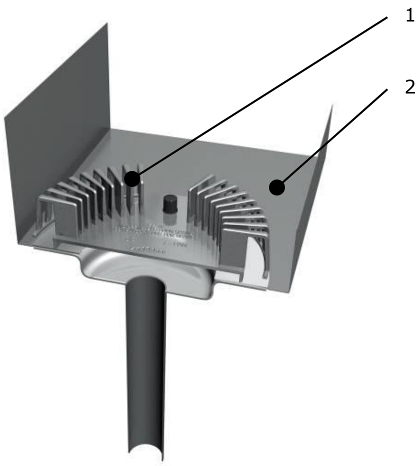


Figure 50 – Example of installation of a roof inlet to be welded in a metal gutter



1. Roof inlet to be welded
2. Metal gutter

Figure 51 – Cross-section of the installation of a roof inlet to be welded in a metal gutter

As the overall width of the roof inlet is 340 mm, the minimum gutter width at the roof inlet position must be 400 mm.

Check the feasibility of the weld or brazing between the stainless steel (grade 1.4301) of the roof inlet and the gutter build material.

Installation advice

- Unscrew the 3 fixing screws so as to lift away the DAV-GG grating;
- Cut the gutter into shape to position the roof inlet body. Cut-out diameter is 22 cm;
- A brazing surface must be prepared across a diameter of at least 25 cm that is spotlessly free of any rust, oil or moisture. The cut-out rim must be meticulously deburred and bevelled (see *figure* 52).

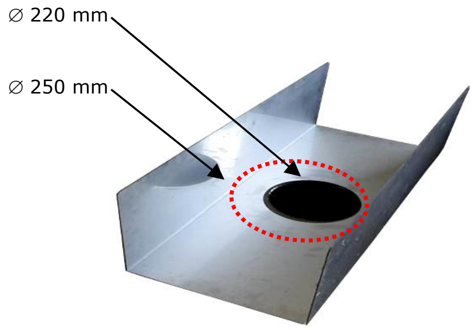


Figure 52 – Cutting out the gutter

- Engage the roof inlet in the gutter cut-out in such a way that the rim flange of the bowl carrying the bolts sits solidly on the gutter;
- Weld or braze the roof inlet onto the gutter.

Figure 53 - Roof inlet brazed into the guttering

For information: for brazing into stainless steel guttering:

- Grazing with silver-based filler; equipment: oxy-gas blowpipe;
- Alloy: Castolin's Cadfee® 57% silver brazing alloy (or equivalent);
- Soldering flux: Castolin's activaTec® 1000 (or equivalent), special-purpose for stainless steels;
- Process temperature: 400 - 820°C;
- Clean any impurities from inside the bowl, fit the anti-vortex device grating, screw the nuts back on and fit the 3 nut caps.

5.333 Roof inlet with plate

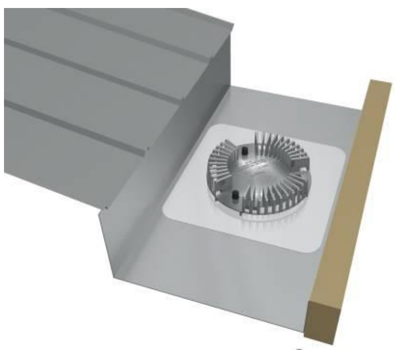
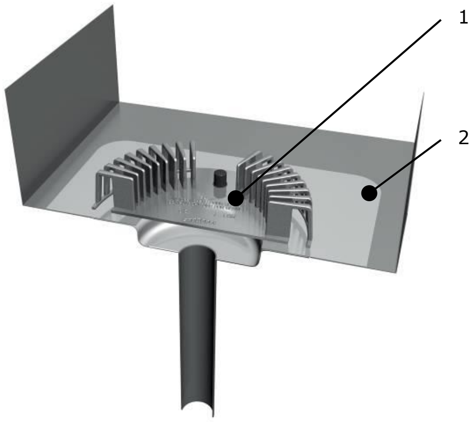


Figure 54 – Example of installation of a roof inlet with plate in a metal gutter



1. Roof inlet with plate
2. Metal gutter

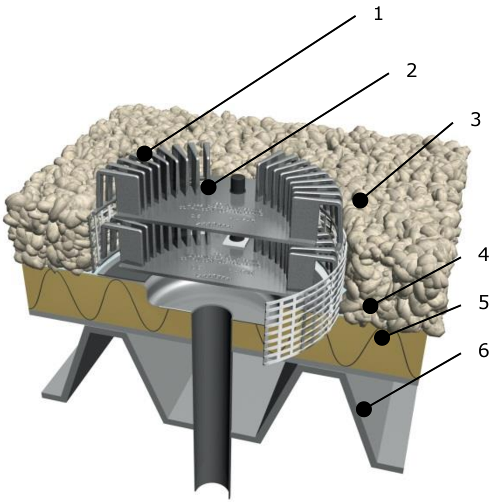
Figure 55 – Cross-section of the installation of a roof inlet with plate in a metal gutter

- As the overall width of the roof inlet is 340 mm, the minimum gutter width at the roof inlet position must be 400 mm;
- The feasibility of the weld or brazing between the tin-plated stainless steel of the roof inlet and the gutter build material must be studied and performed by a skilled welder.

Installation advice

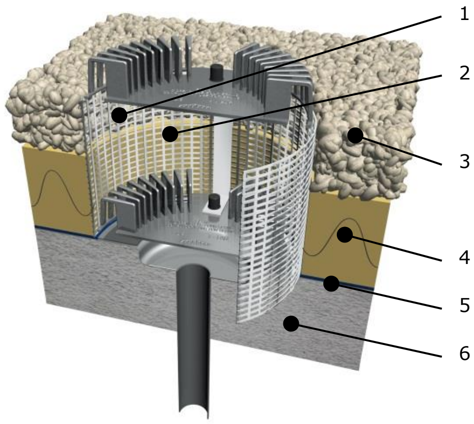
- Same as under section 5.332 "Roof inlet to be welded" above;
- The plate can be cut or pressformed to fit the shape of the guttering.

5.34 Elevating kit of the DAV-GG for roof with inverted waterproofing or for roof with waterproofing protection by gravel aggregate or by flags on isolating layer



1. Elevating kit, 90 mm
2. Roof inlet adapted to the waterproofing substrate
3. Gravel aggregate
4. Waterproofing
5. Insulator substrate
6. Bearing element

Figure 56 – Cross-section of an elevating kit for roof with waterproofing protection by gravel aggregate



1. Elevating kit, 250 mm
2. Roof inlet adapted to the waterproofing substrate
3. Gravel aggregate
4. Insulator substrate
5. Waterproofing covering
6. Bearing element

Figure 57 – Cross-section of an elevating kit for roof with inverted waterproofing

Installation advice

Whatever the type of roof inlet, begin its installation and stop at the placement of the DAV-GG on the bolts (absence of 3 nuts and of the 3 nut caps on the bolts, see *figure* 58).

Figure 58 – Roof inlet before installing the kit

Next, position the 3 spacers of the kit astride the outside of the grating cap, with regular spacing (1/3 of circle), with the bolts of the spacers directed upward. Position this four-part assembly on the DAV-GG of the roof inlet, sliding the 3 visible bolts of the roof inlet into the holes of the spacers (see *figure* 59).

Figure 59 – Installing the spacers and the grating cap

Fix this assembly to the roof inlet with the 3 remaining nuts of the inlet. Place the kit's anti-vortex device grating on the 3 bolts of the spacers (see *figure* 60), fix it using the 3 nuts from the kit and, onto the visible bolts fit the 3 unused nut caps of the roof inlet.

Figure 60 – Roof inlet, equipped with the kit

6. Manufacture of products and quality control operations

The various elements of the Epams system (pipes, unions, roof inlets, and so on) are produced or sold by Saint-Gobain PAM.

The elements which constitute the drain piping (pipes, unions, assemblies, joints, couplings and accessories) are covered under standard NF EN 877 and Saint-Gobain PAM's Bayard-Sur-Marne (Haute-Marne) factory, for these products, benefit from the right to use the "Cast iron pipes for drainage and sewage" NF label. Within this context, inspections are carried out regularly by CSTB.

The Epams system's specific elements, such as the roof inlets, are made in the Bayard-sur-Marne (Haute-Marne) factory. They comply with the criteria set out in standard NF EN 1253.

The production site mentioned above, like all the company's working locations, runs an ISO 9001-certified quality assurance system.

7. Identifying labelling elements

The pipes, unions and gaskets of the SMU® S or SMU® Plus product lines are identified in compliance with the provisions of the NF Label application Regulations " Cast iron pipes for drainage and sewage ", which takes Standard NF EN 877 into account.

The inlets, assemblies and accessories are marked as set out in standard NF EN 877. They include at the least the manufacturing mark of Saint-Gobain PAM, a Company from the Saint-Gobain group, or its name, and more particularly on the roof inlet anti-vortex device.

For the roof inlets, the outside diameter of the roof inlet's connecting pipe makes it possible to identify the DN and to determine the potential effective flow (see *table* 2).

The network installer is responsible for affixing, at least once per pipe, an "EPAMS" adhesive label (see *figure* 61) to identify the Epams siphonic network. Furthermore, whenever the network is not visible, the labels shall be affixed jointly on the pipes and on the elements that mask them.

Figure 61 – Example of label

Finally, any work on the Epams network, in particular a modification, shall be covered by a study and a written prior agreement from Saint-Gobain PAM.

8. Complementary information

Organisation of the company and assistance:

SAINT-GOBAIN PAM
(SAINT-GOBAIN group)
Head office in Nancy (54)

SAINT-GOBAIN PAM - Construction Activity France

Bayard plant (52)	*Sales Department Paris*	
Marketing, Logistics, Sales Administration, Nancy (54)	*Technical and development, Sales Engineering, After-sales, Maidières-les-Pont-à-Mousson (54)*	*Sales sectors: Lille (59), Lyon (69), Marseille (13), Nancy (54), Bordeaux (33), Nantes (44), Paris (92), Strasbourg (67) and Toulouse (31)*

B. Test results

The Epams roof inlets have been put through a test campaign led in compliance with standard EN 1253, by LGA Bautechnik engineering lab in Würzburg, Germany; see test report No. BMW 0402234-02 dated 5 May 2004, reports No. 7391265-01, -02, -03, -04 of 20, 21, and 22 July 2009.

C. References

C1. Environmental data ([1])

The Epams process is not subject to an Environmental Statement (ES). Therefore, no particular environmental performance may be claimed.

Data issued from the ES are notably intended to be used to calculate the environmental impacts of structures in which the products (or processes) concerned are likely to be integrated.

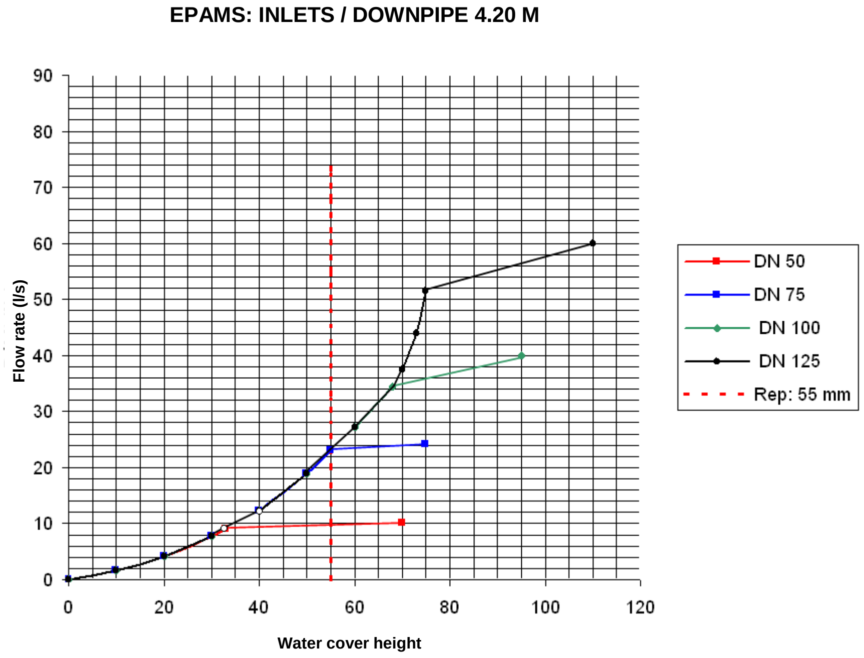
C2. Other references

The Epams system has been successfully implemented in a huge number of worksites across France and abroad. A listing inventorying over one million seven hundred thousand m^2 of Epams-equipped roof space in France was filed in as part of the request for a revision of the Technical Assessment.

(1) Non examined by the Specialised Groups within this ASSESSMENT.

Appendix 1

Flow rate calculated as per standard NF EN 1253



Conventional flow

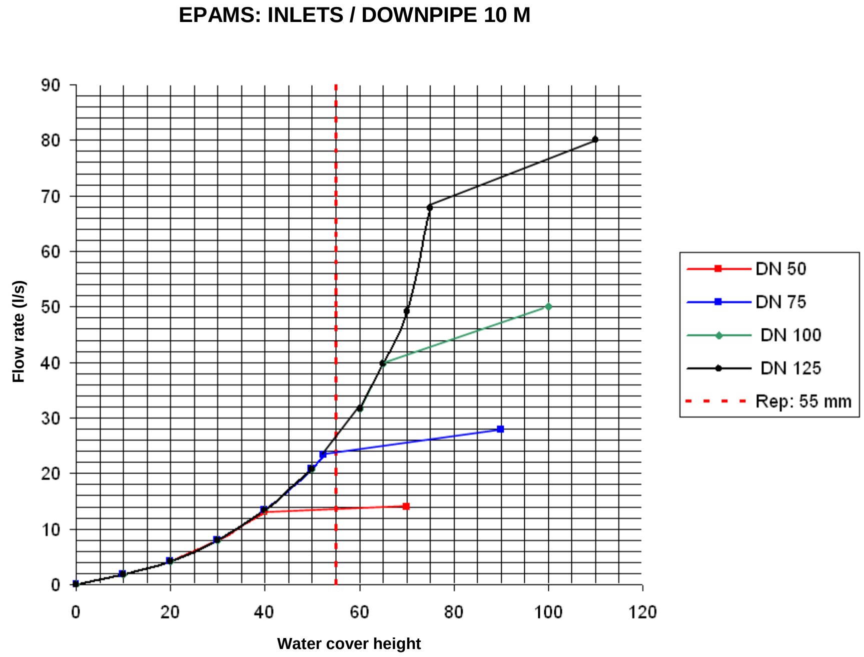


Figure 62 – Curves plotting Epams roof inlet flow rates

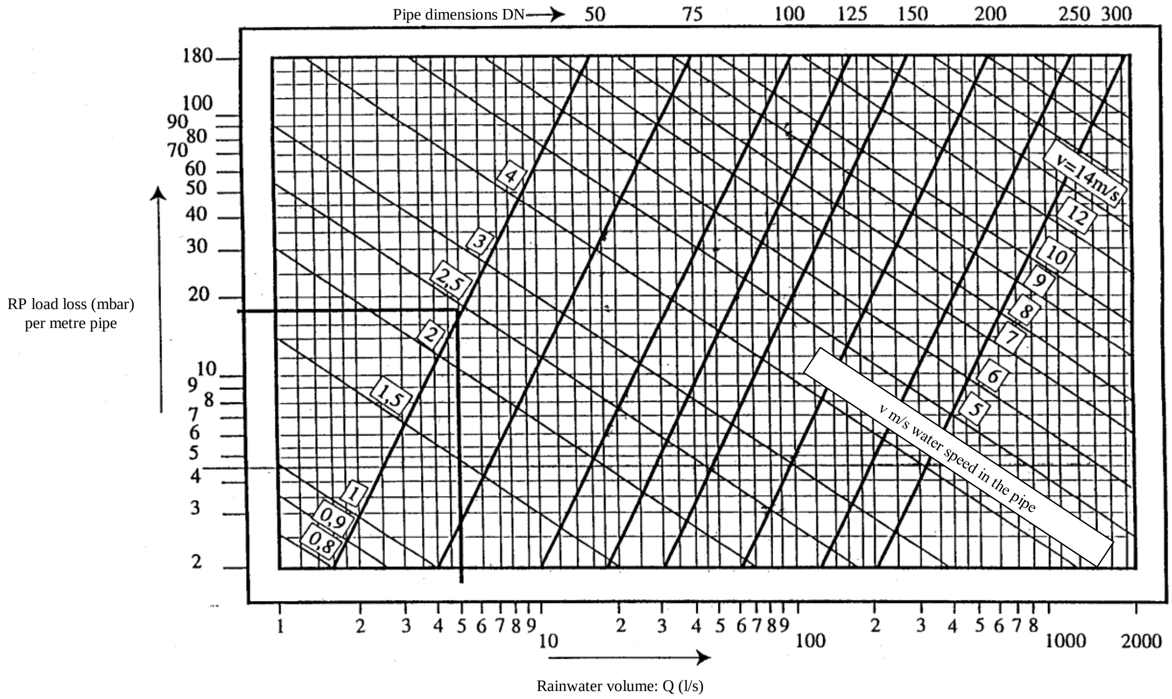


Figure 63 – Ready reckoner for pipework sizing

Appendix 2

Maintenance handbook

1. Foreword

The Epams system is subject to a Technical Assessment. This document is available free of charge on the www.pambatiment.fr web site.

2. Cleaning roofing and drainage systems

Correct operation of the Epams system hinges on keeping the roof inlets clean of obstructions.

Any elements like plant matter (leaves and twigs) from the surrounding environment that can end up on the roof must be regularly cleared away to prevent obstructions in the networks or blockages in the roof inlet rainwater entries.

The frequency of these maintenance cleaning operations will depend on the building's environment. A building surrounded by trees and garden plants will require more frequent maintenance servicing and inspections than a building sited in an open-space area.

2.1. French standardization

French standardisation together with the DTU standards require the building owner or operator to clean both the roofs and the rainwater drainage systems at least once a year, preferably in late autumn.

Siphonic drainage systems require more frequent cleaning of the rainwater entries.

The Book of Minimal Common Technical Specifications (CPT) for design and implementation of the installations has a specific chapter on "Siphonic rainwater drainage systems" that specifies, under section 7. Servicing and operation:

" ...The drainage devices (sewage, gutters, eave valleys and roof inlets) shall be inspected and cleaned at least twice each year: in autumn and spring. In the event there is a risk particles may become detached from the roof's protection, the system is to be cleaned every three months during the first year..."

2.2. Worksite project hand-over

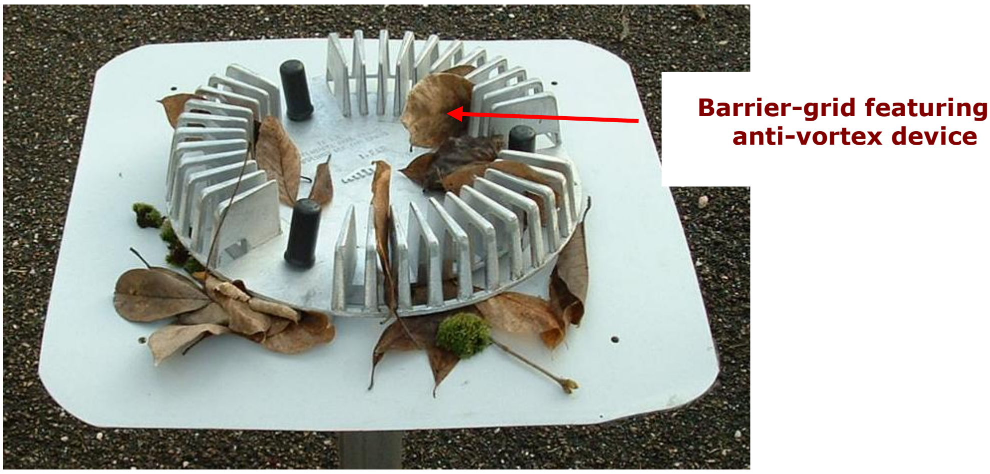
For worksite project hand-over, the roofs and the rainwater drainage systems, especially the roof inlets and any overflows installed, must be visited and cleaned of any and all debris and rubbish (plastics, wood, pieces of insulation material, etc.) to guard against obstruction to the rainwater drainage systems.

2.3. EPAMS roof inlets

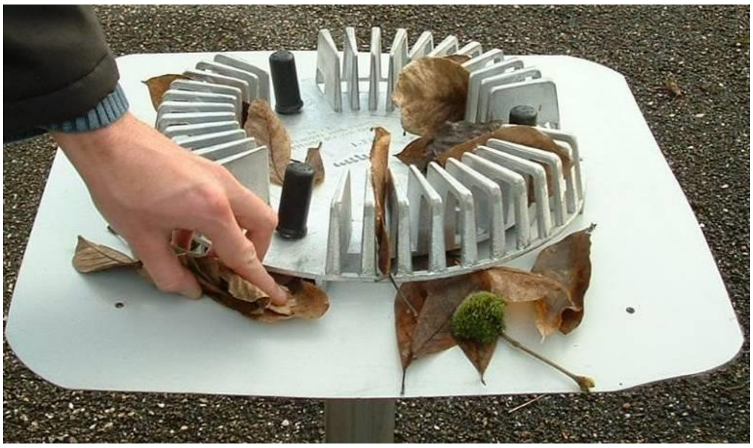
2.3.1 All roof inlet types

Check the barrier-grid is fitted.

To clean the roof inlet, proceed as follows:

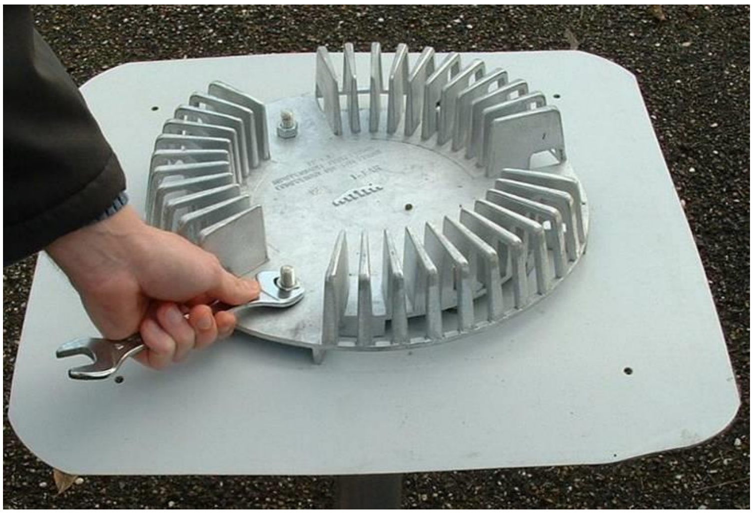


- Clean the barrier-grid.



- Remove the nut caps.

- Unscrew the nuts.



- Uninstall the barrier-grid.

- Clean the inside of the roof inlet bowl.

Make sure during cleaning operations that debris is not allowed to get into the EPAMS networks

- Refit the anti-vortex device and barrier-grid.

2.3.2 Welded roof inlets

Visually inspect the weld. Rework if necessary.

2.3.3 Waterproofing membrane-mounted roof inlets

Examine the connection/bond of the waterproofing covering between the roof inlet and the sheet (or membrane). Rework if necessary.

2.3.4 Roof inlet with elevating kit

- Free the roof inlet of its structural protection and gravel aggregate.

- Remove the top section of the elevating kit.

- Uninstall the elevating kit.

- Remove the anti-vortex barrier grid (Dispositif Anti-Vortex-Garde-Grève or DAV-GG in French).

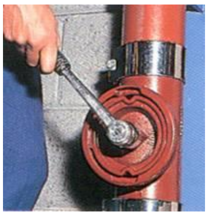
- Clean and repeat the same procedure in reverse order to re-fit the elevating kit and roof inlet.

2.4. Inspection tee

The inspection tee will usually be fitted at the gutter outlets or near the decompression zone.

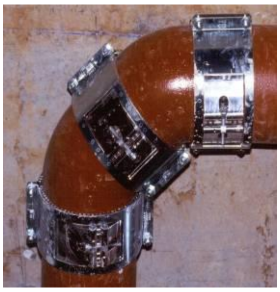
It is strictly forbidden to make any attempt to open an inspection tee during heavy bursts of rainfall.

It is essential to check the network is not under load before attempting to open the inspection tee. Run this check by lodging a screwdriver in the cover slot and putting pressure on the elastomer gasket to create an outflow (see *figure*, at left). Once the outflow has stopped, the cover can be unscrewed and removed so as to inspect the network. To re-close the inspection tee, replace the elastomer, allowing the requisite water flow, and place the cover back in its housing by positioning the two flap-mounts in their slots and screwing the cover back in.

2.5. SMU couplings, grip collars and thrust blocks

The SMU couplings are built dismountable, which facilitates interventions on the Epams network. Be sure to clearly identify all the elements and their positions before beginning any operation so as to avoid errors when refitting. Care must be taken to refit all grip collars back on their couplings (see *figures* below), plus the mechanical thrust blocks and any other accessories fitted.



3. Interventions on the network

Proper operation of the Epams system, which has been designed to evacuate rainwater, hinges on strictly complying with the required network sizing (calculate diameter that is specific to each lengthwise member of the network).

It is therefore formally forbidden to connect other drainage networks to an EPAMS network.

If interventions have to be performed, any modification to the network must be indicated in advance, and must receive the written authorisation of Saint-Gobain PAM (Buildings Business Unit - Sales Engineering department).

If any parts are replaced like-for-like, check that an Epams network identifier label remains visible. If not, affix a new identifier label on the newly-replaced parts.

If brackets need to be replaced, make sure the replacement collars have a shock-absorbing device built-in.

4. Extreme weather conditions

If roofing elements have been subjected to extreme weather conditions (violent winds, hailstorms, etc.), it is advisable to carry out an inspection of the roof inlets to check presence of all the devices elements, and clear away any packed ice that may have built up.

5. Servicing schedule timetable

Year	Period	Date set for cleaning	Observations	Sign.
1st	Build project completed			
1st	Spring			
1st	Summer			
1st	Autumn			
1st	Winter			
2nd	Spring			
2nd	Autumn			
3nd	Spring			
3nd	Autumn			
4nd	Spring			
5nd	Autumn			