


vacurain

Vacurain Flex

Technical Documentation



DYKA



Vacurain Flex

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1. General information

1.1 Introduction

Since 1996, Vacurain Flex, a DYKA rainwater drainage system, has proven to be a reliable alternative for the drainage of rainwater.

Vacurain Flex is a powerful system that proves itself to the architect, the architectural engineer and the installer.

The architect: The small pipe diameters make the system look nice and also make it easy to keep the drainage pipes out of view.

The architectural engineer: The roof is subjected to a smaller load.

The installer: Quick and easy installation.

The customer: Fewer pipes take up less space and smaller pipes mean lower installation costs for large buildings.

1.2 Short description

Vacurain Flex is a rainwater drainage system that drains the water according to the UV principle. The system of pipes is made from glueable, impact-resistant, modified PVC pipes and accessories, which are connected to fixed roof funnels with the aid of flexible hoses. A Vacurain Flex system cannot be used in combination with a traditional rainwater drainage system.

1.3 Vacurain construction

A Vacurain Flex system is constructed from impact-resistant, modified PVC pipes and accessories. The funnels are made from weather-resistant plastics and an aluminium housing and are installed in previously determined locations in the roof construction. The funnels and the Vacurain Flex pipes are connected by means of a specially constructed funnel connecting hose with a click connection.

1.4 Dimensions and classification

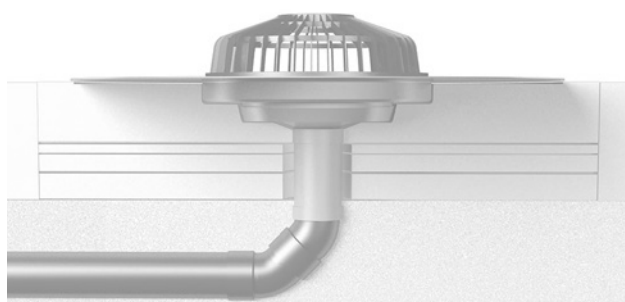
The pipes are available in diameters of 40 mm, 50 mm, 63 mm, 75 mm, 90 mm, 110 mm, 125 mm, 160 mm, 200 mm and 250mm, including the necessary adaptors, clips, funnels, connections and other accessories. Since Vacurain is only intended for siphonic rainwater drainage, the dimensions have been adapted to meet this purpose.

1.5 Appearance

Surface structure:	Smooth.
Colour of the pipes and accessories:	Dark green RAL 6007.
Gloss:	Semi matt to gloss.

1.6 Fire behaviour and fire resistance

- Vacurain Flex is flame retardant.
- PVC falls under fire class 2: it does not contribute to the spread of fire.
- PVC does not smoulder.
- Unlike PE, PVC does not drip in the event of a fire. Its fire resistance can be increased by:
 - Protecting wall feed-throughs with a fire sleeve.
 - Placing the pipes in a protective sleeve.



1.7 Thermal properties

The thermal coefficient of expansion is 0.06 mm/m° C.

The coefficient of thermal conductivity is 0.16 W/m° C.

1.8 Uses

Vacurain Flex can be used in utility buildings and residential homes. Vacurain is ideal for use in warehouses and storage buildings, office buildings, apartment buildings, hospitals and other buildings.

The maximum downpipe height is 50 metres. The drainage of rainwater from roofs situated at a greater height is only possible on request from DYKA.

1.9 A watertight system

DYKA developed the Vacurain Flex rainwater drainage system to drain rainwater from large roofs quickly, efficiently and inexpensively with a system that is unobtrusively included in the construction of the building.

It is a practical, cost-efficient, aesthetic, high-quality solution which is particularly suitable for draining rainwater from utility buildings which have special architectural or constructional requirements.

Vacurain Flex is an improvement of the UV system using PVC. UV stands for the Finnish "Umpi Virtaus", which means "closed flow". This closed rainwater drainage system uses pipes with small diameters which ensure the fast drainage of rainwater. This Finnish invention had been improved until the nineteen nineties. Vacurain Flex offers important advantages compared to alternative systems: a low coefficient of expansion, an inexpensive connection and attachment method and low material costs. Furthermore, Vacurain is easy to install and fire resistant.

The favourable secondary conditions also make Vacurain an easy choice. The system is guaranteed for a period of 10 years and is made according to a patented technique. The Vacurain system has the following quality marks:

- The Netherlands: KOMO for the system, pipes and accessories.
- Belgium: ATG (Algemeen Technische Goedkeuring) for the Vacurain system, pipes and accessories.
- Germany: Übereinstimmungsnachweis Vacurain system
- France: Avis Technique Vacurain system.
- Poland: Aprobata Technicza Vacurain system, pipes and accessories.
- Russia: Technical approval of the Vacurain system, pipes and accessories/hygiene certificate for plastic products.

In other words, Vacurain Flex is a system that fully meets the present-day requirements. This technical documentation explains the operation, design, calculation and installation of the system, as well as the warranty conditions.

1.10 Operation

The most important principles for the operation of the Vacurain system are:

Fullness of the system:	100%.
Sufficient (minimum) water level on the roof:	30 mm.
Sufficient (minimum) drop height:	3 m.
Free discharge of the water:	100%.

A UV system like Vacurain Flex is particularly useful when there is a sufficient supply of water. The Vacurain system, therefore, works the best during heavy rainfall. A condition for its use is that a special funnel is used. A Vacurain funnel has a dish which ensures that air is not drawn into the system when there is a sufficient (minimum) volume of water on the roof at the funnel. A minimum water level of 30 mm is required for optimal operation if a standard 50 mm Vacurain funnel is used. A minimum water level of 50 mm is required if a 75 mm funnel is used. A 75 mm funnel is used in situations where there is an extreme supply of water.

The system's self-priming action is produced by the downpipe. The downpipe is regarded as the system's "engine". The system will not work without a downpipe or a height difference. The minimum height of a downpipe is 3 metres. Falling water in a downpipe which is 100% filled with water produces a vacuum. This vacuum is the greatest at the top of the downpipe. As a result of the vacuum that is created, a system that is 100% filled with water will literally suck the roof empty as long as no air gets into the system. The specially developed funnel dish prevents air from getting into the system as long as there is a sufficient supply of water. Air will only get into the system if the water supply reduces, which will stop the vacuum and cause the system to work as a traditional rainwater drainage system.

When working at its maximum capacity, a Vacurain Flex system will act as a siphon so the roof is literally sucked empty.

If goes without saying that the water must also be able to flow away freely after it has been drained from the building. The water should be able to flow via a relief drain to a free-fall pipe with a large enough diameter which leads to the external sewer, into an underground infiltration system or into open water.

Provided there is a sufficient supply of water, there will not be a flow of air in the opposite direction in the Vacurain system, as is always the case for a traditional rainwater drainage system.

Clever dimensioning of the pipe system - calculated by a computer program (see page 13) - creates a situation where the pipe is 100% filled with water when there is a sufficient supply of water. The force of gravity in the vertical section of the pipe system (the downpipe) creates a vacuum in the system. The largest vacuum pressure occurs in the highest part of the downpipe. This vacuum quickly produces a (siphonic) flow of water. The vacuum pressure depends on the length of the downpipe (the height of the building) and the diameter of the pipe. It is important to limit the quantity of "false" air which enters the system with the rainwater. The ingenious Vacurain funnel takes care of this. As a comparison: a traditional system with a pipe diameter of 125 mm which is 50% full of water is comparable to a Vacurain system with a pipe diameter of 40 mm at a capacity of 3 litres of rainwater per second.

Graph 1.1 clearly shows the operation of a Vacurain Flex system. If there is a small supply of water, the system functions like a traditional system (A). As the supply of water increases, the system fluctuates between working like a traditional system and a siphonic system (UV system) (B). If the supply of water increases even further, the system will work continuously as a UV system for as long as there is a sufficient supply of water (C).

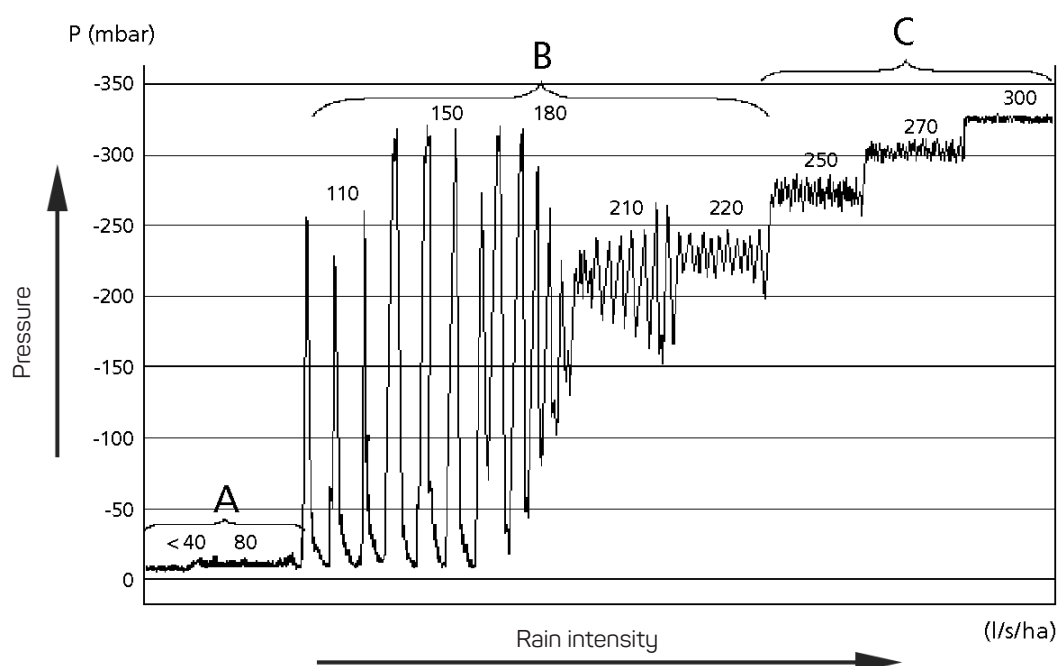
Rain intensity

The basic value for the calculation is the rain intensity. The rain intensity is decisive for the dimensioning of the system. In the Netherlands, a rain intensity of 300 litres per second per hectare (300 l/s.ha – 0.03 l/s.m²) is assumed. Statistically, this rain intensity occurs once every two years. The rain intensity can vary per country and also within a country.

1.11 The importance of the Vacurain funnel

The ingenious construction of the Vacurain funnel acts to combat the influx of air with the water that flows into the system for a certain drainage rate, which results in a high level of drainage.

DYKA has successfully developed a funnel which produces a maximum drainage rate for a minimum water level without extra noise production or excessive vibrations.



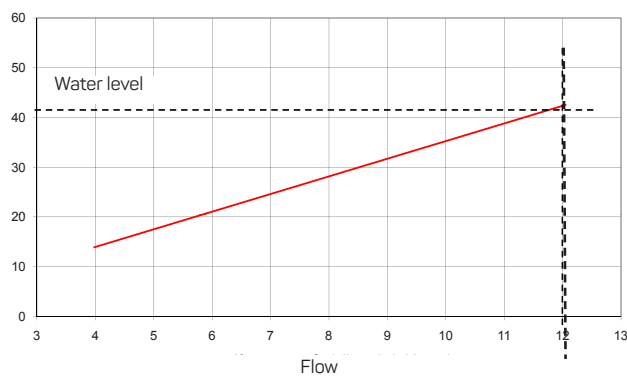
Graph 1.1: Graphical representation of a UV system for an increasing rain intensity

A minimum water level is required for full flow. The higher the water level on the roof, the greater the volume of water than can be drained.

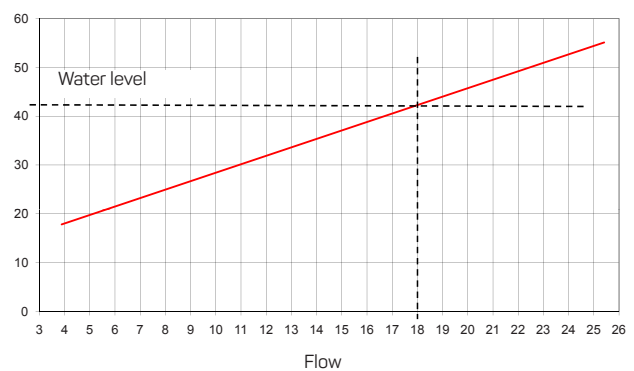
For a water level of 30 mm on the roof, a standard Vacurain funnel with an outlet diameter of 50 mm has a capacity of 8.5 l/s. One standard Vacurain funnel is, therefore, sufficient to drain the rainwater from a flat roof (in the Netherlands) with a surface area greater than 375 m².

For very large roofs, there is the option to use a Vacurain funnel with an outlet diameter of 75 mm.

The relationship between the required water level (in mm) above the funnel and the drainage capacity (in l/s) of Vacurain funnels with an outlet diameter of 50 mm and 75 mm measured in a laboratory situation is shown in the graphs below.



Graph 1.2: For a water level of 43 mm, a 50 mm funnel has a drainage capacity of 12 l/s.



Graph 1.3: For a water level of 43 mm, a 75 mm funnel has a drainage capacity of 18 l/s.

The graphs show that a certain level of water is always required for the system to work correctly.



The following information is required for the design and calculation of a Vacurain system:

- When determining the path of the pipes, it is recommended to take the building's future use into consideration. Vacurain Flex is a water drainage system and it is, therefore, not recommended to install the Vacurain Flex pipes above areas which contain crucial equipment (such as computer servers, operation theatres, etc.). If this cannot be avoided, then it is recommended to take additional measures.

It is not possible for the Vacurain system to be designed correctly without the above information.

1. The roof surface and the rain intensity determine the volume of water that must be drained (flow).
2. The presence of gravel or sedum on a roof hinders the drainage of rainwater. Such roofs with a pitch of up to 3 degrees lead to an extra reduction of the drainage capacity.
3. The direction of the pitch also plays a role in determining the location of the Vacurain funnels.
4. The pitch also has an influence on the flow: a flat roof will have to drain less water.

The height of the roof with regard to the ground also determines the height of the downpipe, the system's "engine". The higher the building, the greater the energy the falling water in the downpipe can generate. The height of the building also partly determines the diameter of the pipes in the Vacurain Flex system.

5. The location of the downpipe plays an important role in determining the layout of the Vacurain system and also in determining the diameter of the pipes.

- ### Note

DYKA supplies Vacurain Flex as a complete system, including calculations and diagrams. The results of the calculations are binding and cannot be altered without consultation.

If, for example, the design and/or the path of the pipes are altered, then DYKA will have to make new calculations.

Figure 2.1 gives an example of a detailed calculation for a Vacurain system. The volume of rainwater is a fixed value, which is equivalent to a heavy downpour. For the Netherlands, a rain intensity of 300 litres per second per hectare is assumed, which is in accordance with NEN 3215.

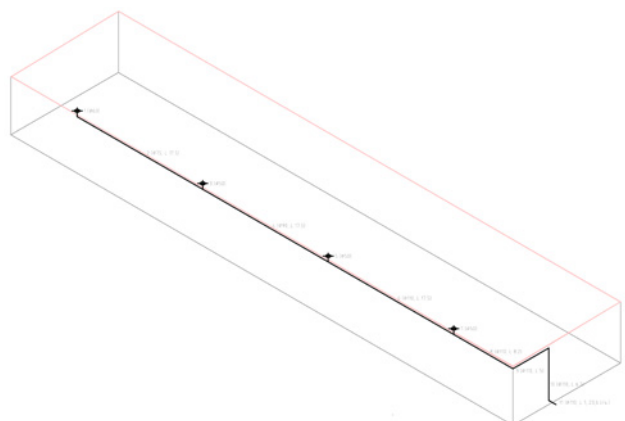


Figure 2.1 An example calculation for a Vacurain system

2.2 Vacurain Flex as an emergency spillway system

Extreme (but infrequent) downpours make it necessary to have a larger drainage capacity. Emergency overflows and/or emergency spillway systems are, therefore, necessary. The rain intensity that must be used for emergency spillway systems in the Netherlands is 500 litres per second per hectare. According to the Dutch Building Decree, NEN 3215, NEN 6702 and NPR 6703, emergency spillway systems are the responsibility of the building's constructor.

The constructor determines the following regarding the emergency spillway system:

- The location of the emergency overflows.
- The capacity of the emergency overflows.
- The maximum permissible water level at the emergency overflows.

DYKA can make the pipe calculations once these three issues have been determined by the constructor.

It is important to be aware that if a UV system is used as an emergency spillway system, only one Vacurain funnel may be installed for each system. For further information, see "Emergency measures", pages 38, 39 and 40.

In some cases, using a Vacurain system as an emergency spillway system results in a number of collection pipes being installed parallel to each other. An example is shown in figure 2.2.

Note

The constructor is always responsible for every type of emergency system.

2.3 Emergency overflows

The building's roof construction must be calculated in accordance with the applicable standards and regulations. Emergency overflows of a sufficient capacity must be installed (in accordance with NEN 6702). It is the constructor's responsibility to determine the location and the number of emergency overflows. If no emergency overflow system is used, water may accumulate as a result of blocked funnels or an overloaded sewer. This, in turn, can result in the roof construction being overloaded to the point that there is a risk of collapse.

For roofs where the pitch is such that the rainwater runs to the edge of the roof, the emergency measures can be the installation of overflows.

The constructor determines:

- The location of the overflows.
- The required capacity of the overflows.
- The dimensions of the overflows.

Figure 2.3 shows an example of an overflow.

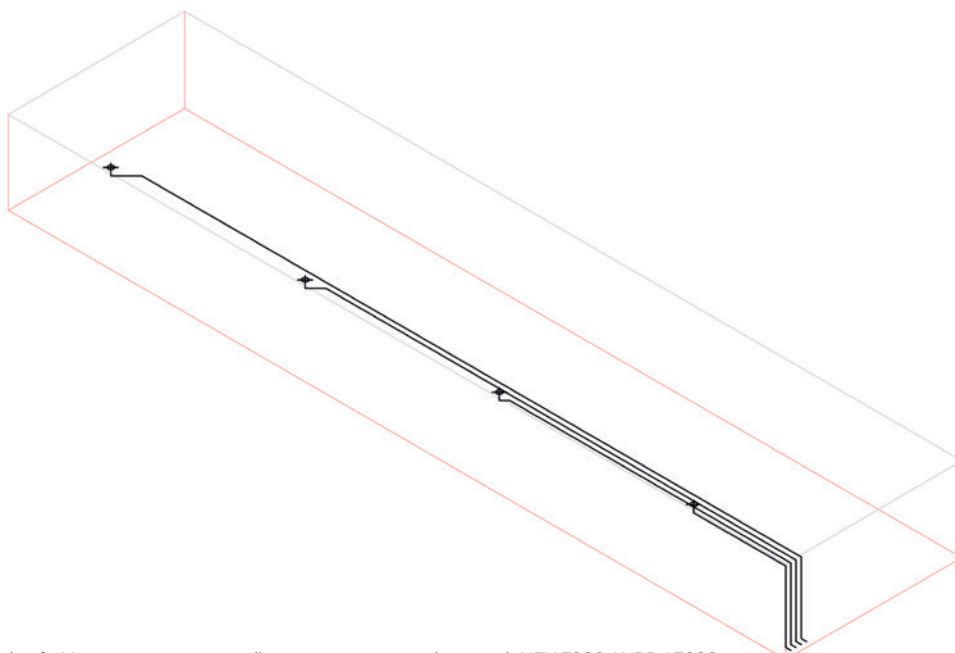


Figure 2.2: An example of a Vacurain emergency spillway system in accordance with NEN 7202 / NPR / 7203

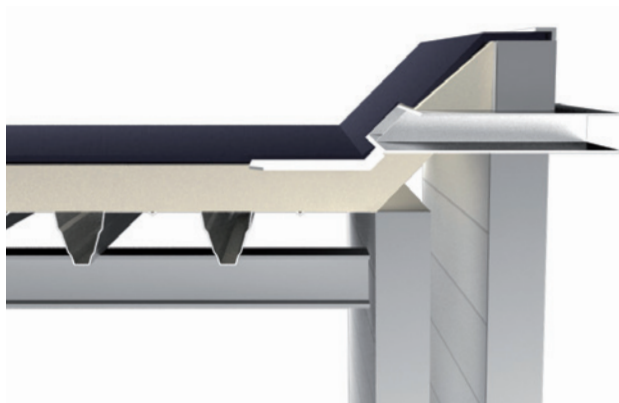


Figure 2.3: Cross-section of an emergency overflow

2.4 The location of Vacurain funnels in the roof

The Vacurain funnels are usually installed in a flat roof. Flat roofs must also have a pitch. A pitch of 16 mm/m is considered sufficient.*

* Source: BDA Roof Consultancy

The architect and/or the constructor determines the pitch. Attention must be given to the following:

- The weight of the roof.
- The variable load.
- The minimum pitch when in use for water drainage purposes.

The possibility of water accumulating on the roof must also be taken into consideration.

Funnels are always fitted at the lowest part of the roof. When located at the edge of a roof, they must, in principle, be approximately 50 cm from the edge of the roof. It is also possible to install a funnel in a gutter if the gutter is at least 65 cm wide or if a special gutter funnel is used.

If desired, every funnel can have its own downpipe.

2.5 Connecting to ground pipes - relief drain

The rainwater drainage system can be connected to the exterior sewer pipes (free-flow) in any location.

The rainwater must be drained from the roof unhindered, regardless of the exterior sewer system's drainage capacity. The system must be connected to the exterior sewer by means of a relief drain in accordance with NEN 3215 and/or the Dutch Building Decree.

With an eye on the latest developments with regard to this, DYKA has developed a series of relief drains which must be used in the transfer zone from the UV system to the free-flow system. These relief drains will overflow on to the ground in the event of extreme rainfall.

NEN 3215 places further requirements on the relief drain. The relief drain must:

- Act as an overflow.
- Be installed outside of the facade in the rainwater drainage pipe.
- Be easily accessible.
- If connected to a combined system, have a stretch trap with a water trap of at least 100 mm.
- Have the possibility to connect a horizontal pipe.
- Be easy to clean.
- Be installed in such a way that the top of the grille is at ground level.
- Be of a sufficient capacity to be able to drain the rainwater load.

The capacity of the free-flow pipe connected to the relief drain must be brought into agreement with the Vacurain system's calculated capacity.

Vacurain pipes and accessories can be easily connected to DYKA's external sewer range.

An example of a relief drain is an adapted road gulley which has two connections as standard (see figure 2.4).

The incoming pipe has a maximum diameter of 110 mm. The outgoing pipe with a stretch trap has a diameter of 125 mm. The flow capacity of the standard DYKA relief drain shown in the figure is 12 l/s. This is equivalent to a flat roof

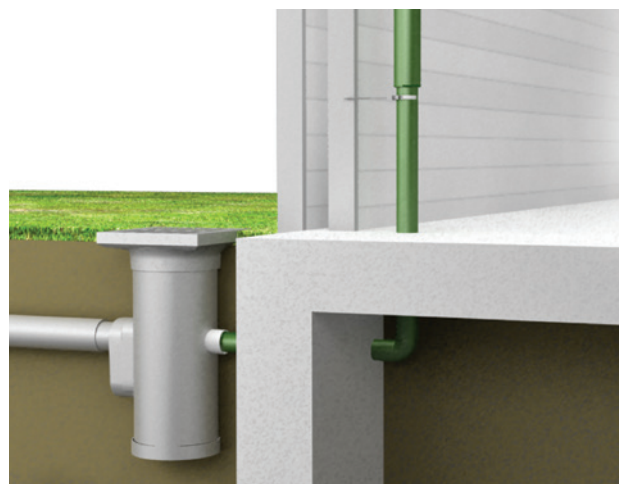


Figure 2.4: Example of a relief drain for a Vacurain Flex pipe with a diameter up to 90 mm

with a surface area of approximately 500 m². If a Vacurain downpipe drains more rainwater (up to 24 l/s), two relief drains can be connected, which is equivalent to a connected flat roof with a surface area of approximately 1,000 m².

If the Vacurain downpipe's drainage capacity is greater than 24 l/s, a larger relief drain will be necessary. A customized solution can be delivered through consultation with DYKA.

2.6 Thermal insulation

Air always contains a certain quantity of moisture. When the air cools on a cold pipe, condensation may form on the outside of the pipe. Whether condensation is formed depends on a combination of the temperature of the outside of the pipe and the relative humidity and temperature of the ambient air. Relative humidity is the relationship between the quantity of moisture in air of a certain temperature and the maximum possible quantity of moisture at that temperature.

Therefore, in certain situations, it is desirable to use thermal insulation. It is recommended to use Dykasol thermal insulation if the combination of the interior temperature and a high relative humidity results in the formation of condensation. A Vacurain pipe system above a lowered system ceiling in, for example, a shop or office will usually have to have thermal insulation.

The thermal property of Dykasol insulation of 0.05 W/m² C is sufficient to prevent condensation in most cases. Table 2.1 gives an overview of the relationship between room temperature, the air's relative humidity (RL) and the dew point temperature (DP).

Assuming a rainwater temperature ($\approx$ the pipe temperature) of 6° C, the pipe will have to be insulated in the areas marked in blue, because there, the temperature where condensation is formed is higher than the temperature of the pipe.

It can be said that, in general, a Vacurain system requires thermal insulation in areas where people are present, such as offices, showrooms, shops, etc.

Room temperature	Pipe temperature = 6°C	
	DP RL = 50%	DP RL = 60%
10°C	0.0°C	2.6°C
11°C	1.0°C	3.5°C
12°C	1.9°C	4.5°C
13°C	2.8°C	5.4°C
14°C	3.7°C	6.4°C
15°C	4.7°C	7.3°C
16°C	5.6°C	8.2°C
17°C	6.5°C	9.2°C
18°C	7.4°C	10.1°C
19°C	8.3°C	11.1°C
20°C	9.3°C	12.0°C
21°C	10.2°C	12.9°C
22°C	11.1°C	13.9°C

Insulate

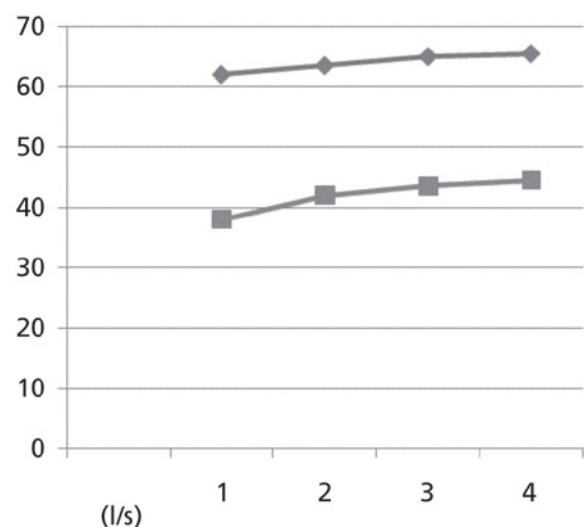
Do not insulate

Table 2.1: The relationship between room temperature, the temperature of the pipe and the relative humidity (RL) and the dew point temperature (DP).

2.7 Acoustic insulation

If the noise level must be reduced, it is possible to insulate Vacurain with Dykasol acoustic insulation. This product has high sound damping properties and achieves a noise reduction of approximately 20 dB(A) (see graph 2.1).

The thermal properties of Dykasol acoustic insulation are the same as the thermal properties of Dykasol thermal insulation (see the previous section).



Graph 2.1: Acoustic properties of Dykasol with a 110 mm downpipe

◆ Noise level without insulation in dB(A)

■ Noise level with Dykasol in dB(A)

3. Calculation

3.1 Rain intensity

In most countries, rainwater drainage systems are calculated according to established standards and the use of regional-specific rain intensities. For example, it rains more heavily to the north of the Alps than on the coast.

The Netherlands is considered as one region. The rain intensity that is assumed for the Netherlands is 300 litres per second per hectare: 300 l/s.ha. This is equivalent to 0.03 l/s.m², which means that 1 litre of water falls in an area of one square metre in approximately 33 seconds. This volume of water falls during cloudbursts.

A UV system only works to its full potential if the pipes have the correct dimensions. This means that for a rain intensity of 0.03 l/s.m² (= 300 l/s.ha), all the pipes are full, whilst the pipes have the smallest possible diameters.

Rainwater that falls on or against a neighbouring facade increases the supply of water and this must be taken into consideration in the calculation.

The calculation for the rainwater drainage system must be made in accordance with the following standards:

NEN 3215 (NNI)
NTR 3216 (ISSO)

An overview of the requirements and the basic calculation values used in NEN 3215 are given below.

3.2 Roof surface area calculation

The roof surface area (F) must be determined as the product of the effective width (b) and length (l) of the surface concerned (F):

$$F = b \times l \text{ (m}^2\text{)}.$$

3.3 Reduction factor for the effective width (β)

NEN 3215 assumes that rain falls at an angle due to the effect of the wind. Therefore, the calculation for the drainage of rainwater does not assume a horizontal projection of the roof surface area, but the actual roof surface area. Since rain does not fall exactly vertically, walls also play a role in the drainage of rainwater. An imaginary roof surface must be considered for roofs adjacent to a facade or roofs which are constructed from a number of roof surfaces with different pitches (see figure 3.1).

For a roof made up of different roof surfaces, the width of the imaginary surface is the effective roof width. For a roof consisting of a single roof surface, the effective roof width must be measured parallel to the roof surface (no horizontal projection!).

A reduction factor (β) can be applied to the effective roof width depending on the angle the (imaginary) roof surface makes with the horizontal surface (see table 3.1).

Source: NTR 3216

3.4 Reduction for delay (α)

For flat roofs, the drainage of rainwater is delayed. This delay depends on a number of factors, including the type of roof covering. When designing the rainwater drainage system, the rain intensity of 0.03 (l/s)/m² can, therefore, be multiplied by a factor α (see table 3.1). Source: NTR 3216

Rain intensity i = 0,03 l/s.m ²	Roof area (and/or imaginary roof surface for a number of roof sections) with pitch φ				Flat roof	Flat roof with gravel	Green roof with pitch φ and thickness of the soil layer s (cm)		
Reduction factor	φ > 3° φ ≤ 45°	φ > 45° φ ≤ 60°	φ > 60° φ ≤ 85°	φ > 85°	φ ≤ 3°	φ ≤ 3°	φ ≤ 3° s ≤ 25	φ ≤ 3° s > 25	φ > 3° s ≤ 45
α	1	1	1	1	0.75	0.6	0.6	0.3	0.75
β	1	0.8	0.6	0.3	1	1	1	1	1

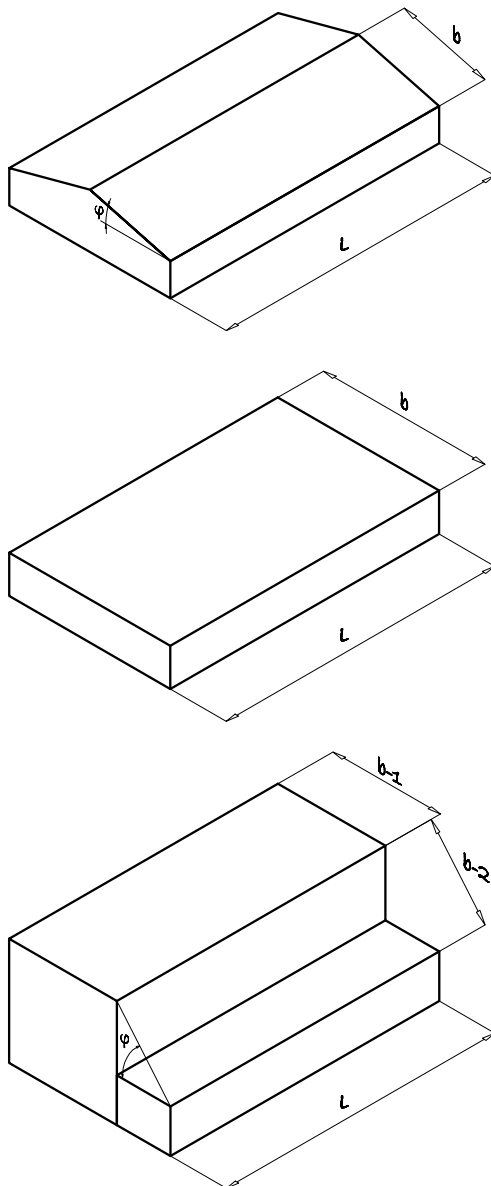
Table 3.1: Reduction factors α and β

3.5 Surface area F of the roof

The surface area F of the roof is the product of the effective width of the roof (b) and the length of the roof (l) (see figure 3.1). For a roof consisting of a single roof section, the effective width of the roof must be measured parallel to the roof surface (no horizontal projection).

For a roof consisting of a number of roof sections, the effective width of the roof must be measured parallel to the imaginary surface for the composite roof surface (see b-2 in figure 3.1).

Figure 3.1: Example of roofs and composite roofs



3.6 Load placed on the pipe

The load placed on a pipe or system of pipes is equal to:

$$Q_h = \alpha \cdot i \cdot \beta \cdot F$$

Where:

Q_h = The rainwater load in l/sec

α = The reduction factor for the rain intensity

i = The rain intensity in l/sec/m² = 0.03 (l/s)/m²

β = The reduction factor for the width of the roof

F = The roof surface area in m²

3.7 Calculation

To obtain the optimal system, DYKA uses a computer program which calculates the best possible combinations of diameters. The calculations for a Vacurain system are based on the requirements in NEN 3215. If DYKA has been given the correct information, then DYKA can make a calculation for you.

The most important information is:

- The length of the building.
- The width of the building.
- The height of the building.
- The direction of the pitch of the roof.
- The pitch of the roof.
- The desired location(s) for the downpipe(s).
- The location of the ground pipes.

An example calculation as can be made by DYKA is given on the following pages.

Note:

DYKA supplies Vacurain Flex as a complete system, including calculations and diagrams. The results of the calculations are binding any may not be altered without recalculation. If they are altered, then a new calculation will have to be made by DYKA.

3.8 Example calculation of a system

Calculation results

In this example, a building with the following dimensions is used:

- Width 30 m
- Length 35 m
- Height 7 m
- Flat roof, pitch 15 mm/m from the top to the long side of the building
- Pitch: 15 mm/m = 1.5%

The result of the computer calculation consists of two parts:

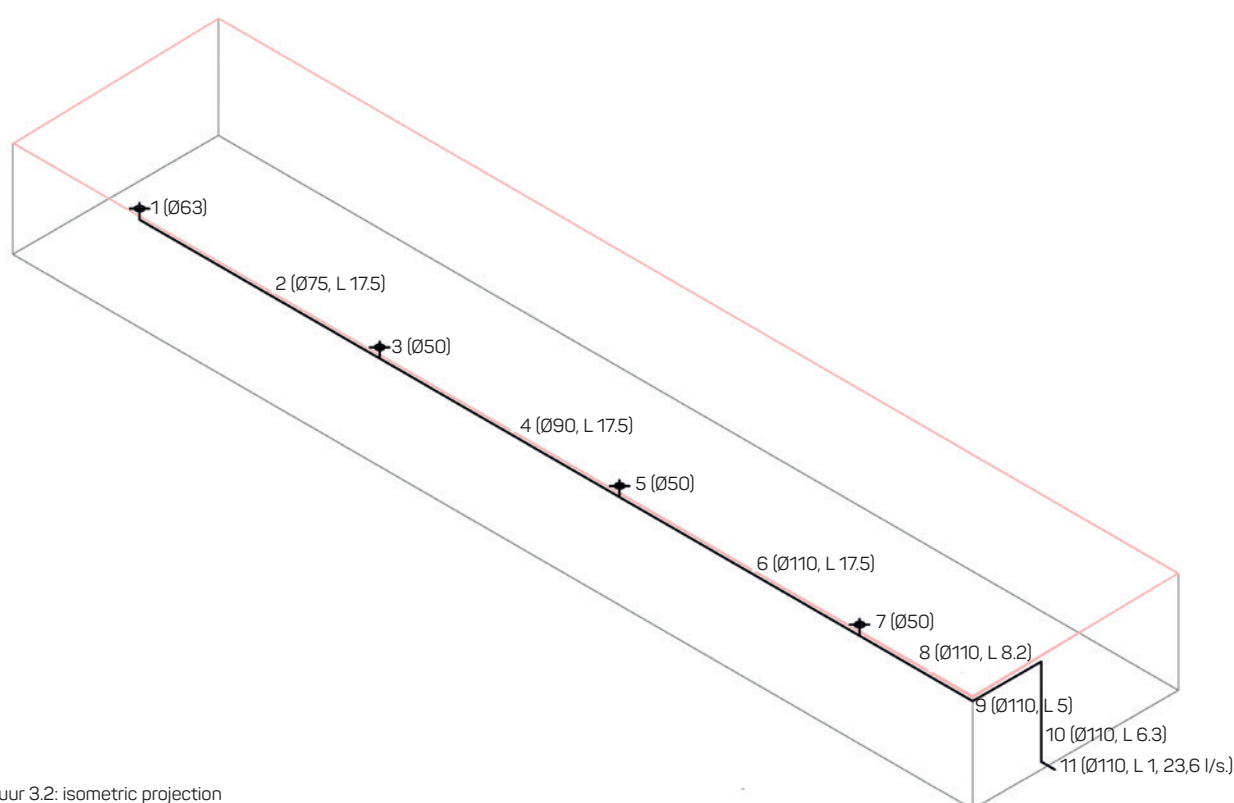
- An isometric projection (see figure 3.2).
- Calculation results (see table 3.2).

3.9 Isometric projection

The isometric projection gives the pipes and the building contours in perspective (see figure 3.2).

The isometric projection must be seen as a diagram. See pages 46 to 54 for the connection method used to connect the funnels to the (main) collection pipe by means of flexible Vacurain hoses. The position numbers in the diagram correspond to the numbers stated in the "Pos. no." columns (see table 3.2).

The diameters (in mm) and lengths (in m) of the pipes are also given.



Figuur 3.2: isometric projection

3.10 Calculation results

An example of the calculation results is given below.

Table 3.2: Calculation results

Funnel hoses										
Pos. no.	Diam. (mm)	Height (mm)	Flow (l/s)	Flow %	B45	B90	T-piece	L eq (mm)	Speed (m/s)	Resistance (kPa)
1	63	700	4.94	84	2	-	-	5757	1.81	4.51
3	50	700	5.26	89	1	-	1	3033	3.16	9.81
5	50	700	7.25	123	1	-	1	3033	4.36	18.48
7	50	700	8.84	150	1	-	1	3033	5.32	27.39

Legend: (funnel hoses)

Pos. no.	= Position number	B90	= Number of 90 degree bends between the funnel and the collection pipe
Diam. (mm)	= Funnel hose diameter	T-piece	= Number of T-pieces between the funnel and the collection pipe
Height (mm)	= Height difference between the roof surface and the collection pipe	L eq	= Equivalent length: an accessory (bend, T-piece) produces a local increase in resistance. This resistance is equal to a certain length of pipe
Flow (l/s)	= Actual volume of rainwater to be drained (litres per second)	Velocity (m/s)	= Speed of the flowing water
Flow (%)	= Difference compared to 100% of the initial flow	Resistance (kPa)	= The calculated funnel resistance for each position number
B45	= Number of 45 degree bends between the funnel and the collection pipe		

Pipes											
Pos. no.	Type	Diam. (mm)	Length (mm)	Flow (l/s)	B45	B90	T-in	T-dg	L eq (mm)	Speed (m/s)	Resistance (kPa)
2	L	75	17500	4.94	-	-	-	-	17500	1.25	5.26
4	L	90	17500	10.20	-	-	-	1	18500	1.77	8.66
6	L	110	17500	17.44	-	-	-	1	18800	2.03	8.91
8	L	110	8250	26.28	-	-	-	1	9550	3.06	10.12
9	L	110	5000	26.28	-	-	-	-	10578	3.06	11.20
10	S	110	6323	26.28	-	2	-	-	6323	3.06	6.70
11	G	110	1000	26.28	-	1	-	-	8337	3.06	8.83

Difference between the sum for the initial flow and actual flow is 7%

Legend (pipes)

Pos. no.	= Position number	B90	= Number of 90 degree bends in that section of pipe
Type	= L: Collection pipe S: Downpipe G: Ground pipe	T-in	= Pipe flow to a T-piece
Diam. (mm)	= Pipe diameter	L eq	= Equivalent length: the resistance of the accessory is equal to the resistance of a certain length of pipe. The total equivalent length is calculated, including the real length of pipe plus the equivalent length of a connected accessory.
Length (mm)	= Length of the section of pipe at that position number	Velocity (m/s)	= Speed of the flowing water
Flow (l/s)	= Actual volume of rainwater to be drained (litres per second) at that position number	Resistance (kPa)	= Calculated resistance for the section of pipe with that position number
B45	= Number of 45 degree bends in that section of pipe		

Pressures			
Pos. no.	Pressure (kPa)	Pressure loss (kPa)	Critical pressure (kPa)
1	68.90	64.20	-46.48
3	68.90	64.23	-46.52
5	68.90	64.24	-46.52
7	68.90	64.24	-46.52
Sum	-	0.00	-

Initial downpipe flow 7.5 l/s - minimum standpipe flow 4.8 l/s. The standpipe meets the start requirement.

3.11 Explanation of the calculation results

The table includes information about the funnel hoses and pipe sections for each system. The position numbers of the funnel hoses and pipes are given in the columns. These numbers correspond to the numbers given on the isometric projection.

Extra information regarding the diameter of the funnel hose, the velocity in the funnel hose, the funnel flow, the deviation with regard to the initial flow and the use of accessories is given for each position number (by row) in the **"Funnel hose"** table. The initial flow is the arithmetic value that is obtained by uniformly dividing the roof surface into equal areas. The equal areas generate an equal value for the flow to be drained.

A UV system, like the Vacurain system, drains unequal flows of water. These flows must not deviate too much from the original value which was calculated.

The flow from each funnel is not the same, because each funnel has a different position in the system of pipes. As a result, a connected system of pipes has a different resistance. This resistance is due to the diameters and lengths of the pipes, the extra resistance that is caused by the flow into T-pieces, the resistance as a result of the flow round bends and the resistance caused when flowing out of the system.

The (hydraulic) resistance that is generated by the components combined is calculated based on the geometry of the components (funnel, hose, bends and possibly T-pieces) and the flow.

Additional information about the rest of the Vacurain system is given in the **"Pipes"** table.

In the "Type" column, a distinction is made between the (horizontal) collection pipes (L), the downpipe (S) and the ground pipe (G). This table also gives information about the diameters, the length of the pipe sections and the presence of bends and T-pieces.

There is also information about the flow, the velocity and the hydraulic resistance.

Information about the total flow's deviation from the initial flow is given below the table.

The bottom table **"Pressures"** shows that the (vacuum) pressure differences between the funnels is minimal. This is necessary to keep the system balanced. If the system was unbalanced, this would result in a large difference in the flows. The difference is given in the first table ("Funnel hoses") in the "Flow %" column.

A material list is produced after the hydraulic calculations have been assessed. This material list acts as a basis for a quotation which may be produced for a calculated project.



4. Installation

4.1 Installation regulations

General information

On account of the Vacurain Flex warranty conditions, only items from the Vacurain range and items that meet the quality requirements given below may be used.

The Vacurain warranty will only remain valid if Vacurain pipes and accessories are used.

Note

Unless specified by DYKA, connections with rubber sleeves may not be used, nor expansion pieces in the horizontal pipes.

Constructional conditions

For a fixed point construction, it is important that the construction is firmly anchored (see figure 4.1).

Rail constructions can be used for attaching the studs. Attachment to roof panels, purlins, rafters, columns, walls, beams and/or other constructional components are to be made in accordance with the instructions provided by the supplier and/or the constructor. DYKA only gives the path of the pipes in its written advice as far as it has been informed of this in the diagrams and specifications which have been made available.

Any change in the course of the pipes has consequences for the calculation.

Note

DYKA supplies Vacurain Flex as a complete system, including calculations and diagrams.

The results of the calculations are binding. Any alterations to the path of the pipes lead to recalculations.

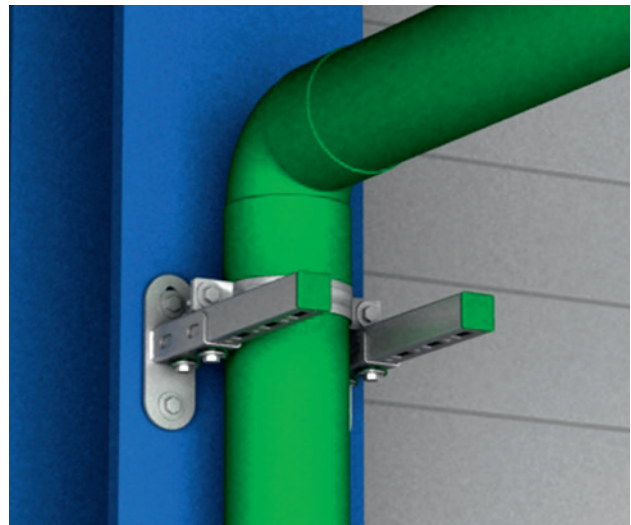


Figure 4.1: Example of a fixed point construction

4.2 The layout of a Vacurain Flex system

A Vacurain system is understood to be a system of pipes with one or more funnels connected to it.

4.3 The layout of the pipe system

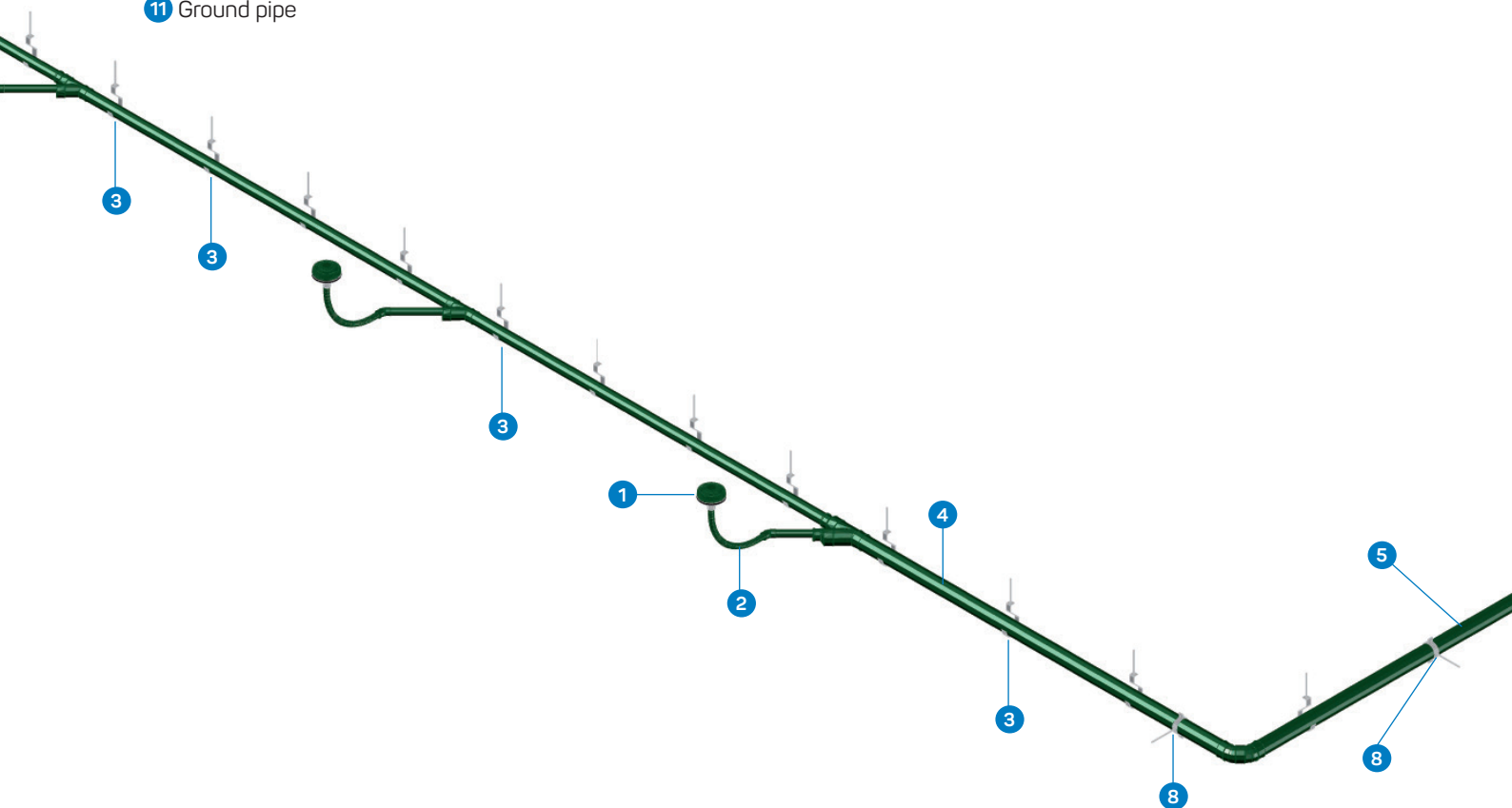
The pipe system consists of the following:

- 1 Funnels
- 2 Funnel hoses
- 3 Suspension brackets
- 4 Collection pipe
- 5 Transport pipe
- 6 Downpipe
- 7 Universal brackets
- 8 Fixed points for
 - Connection pipe
 - Collection pipe
 - Transport pipe
 - Downpipe
- 9 Expansion piece at the bottom of the downpipe
- 10 Fixed point below the expansion piece
- 11 Ground pipe

4.4 Brackets for the collection pipe

Extra fixed points may have to be included, depending on the length of the system and any changes in direction of the collection and transport pipes. The purpose of these fixed points is to absorb the forces that would otherwise be exerted on the bends in the system.

The funnels and the funnel hoses must be connected to the collection pipe according to the relevant examples on pages 46 to 54.



Figuur 4.3: benaming onderdelen van het Vacurain-systeem

4.5 Ease of installation

DYKA has given attention to the ease of installation and reliability. Various types of funnel, which can be used with every type of roof covering, guarantee simplicity and reliability. In order to be able to install the system systematically and independently from the work carried out by the roofers, DYKA supplies insulation varying in thickness from 7 cm to 13 cm which can be combined (see figure 4.4). The rainwater drains must be installed at the lowest points and be sunk using insulation over an area of 1 m² which is at least 10 mm thinner than the roof insulation. Source: BDA.

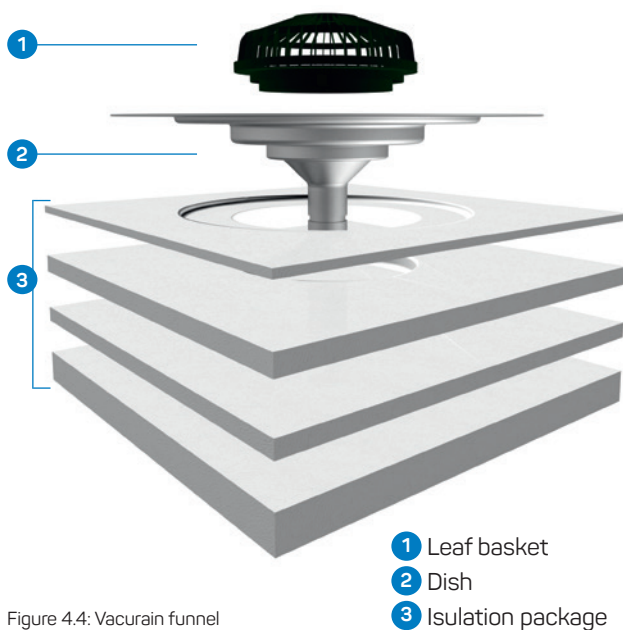


Figure 4.4: Vacurain funnel

4.6 Steps in the installation process

Vacurain Flex can be installed simply and easily.

The following steps are important in the installation process:

1. Determining the location of the funnels in the roof.
2. Installing the funnels in the roof.
3. Determining the location of the horizontal collection pipe.
4. If required, determining the location of the fixed points for the collection pipe.
5. Determining the length of the studs for the suspension.
6. Determining the length of the sections of pipe between the funnels.
7. Attaching the studs to the construction and aligning them.
8. Attaching the brackets to the studs.
9. Aligning the brackets.
10. Clicking the flexible funnel connecting hoses (of the right diameter) on to the funnels.
11. Fitting the collection pipe components in the brackets.
12. Gluing the pipe sections and accompanying accessories.
13. Installing adapters and bends between the funnel connecting hose and the collection pipe T-piece.
14. Clicking the funnel connecting hoses to the connection pipe.

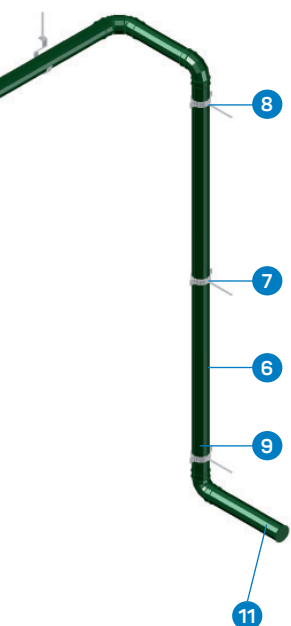
4.7 Installation tips

The pipes can be produced on the shop floor in practical lengths after which they can be placed in the brackets from mobile scaffolding. Only a few of the pipe sections are glued on the scaffolding. In general, it is not necessary to use the exact dimensions: a difference of 10 - 30 cm does not cause a problem. Dimension differences can easily be corrected using the funnel connections by, for example, slightly increasing or decreasing the branch-off accessories (perpendicular or parallel to the collection pipe).

Expansion and shrinkage

A Vacurain system will want to expand and shrink during use as a result of changes in temperature. Although the coefficient of expansion for PVC is small (0.06 mm/m° C), this can mean that extra measures are needed for long systems, such as fixed points or fixed point brackets.

The maximum permissible shrinkage and expansion for a collection pipe is 200 mm.



Determining the linear expansion

Pipe systems will expand or shrink as a result of temperature changes. How much they expand or shrink depends on the temperature difference.

An important factor for this is the length of the pipe section concerned and the temperature during installation. The expected maximum and minimum temperatures are also important.

The following examples show that the way in which the pipes are connected can also play a role.

Figure 4.5 acts as a guide for all the other examples.



Figure 4.5

The change in length as a result of temperature changes can be calculated using the following formula:

$$\Delta L = \alpha \times L \times \Delta T$$

Where:

ΔL	=	Change in length as a result of a temperature difference	mm
α	=	Linear coefficient of expansion	mm/m °C
L	=	Pipe length	m
ΔT	=	Temperature difference Tmax - Tmin	°C

Furthermore:

F	=	Fixed Point	
α (PVC)	=	0.06	mm/m°C

4.8 The collection pipe

One of the advantages of the Vacurain system is its flexibility. Expansion and shrinkage of the Vacurain system is absorbed by using flexible Vacurain hoses. As a result, a system can become up to 200 mm longer or shorter without the tension becoming too great. However, it is important to follow a certain installation method.

The collection pipes are installed in half-open brackets. The Vacurain pipes which are fitted in the brackets can be levelled.

A collection pipe will always have a number of different diameters. By using excentric adapter pieces of a different diameter, the top of the two pipe pieces will be at the same height at the transfer to the larger diameter.

This way, the collection pipe will always be level.

The fact that the pipes need to be level was taken into consideration when designing the brackets: when installing the brackets so that the top of the brackets are level, the top of the pipe will also be level, even for different diameters. The figure shows the use of brackets of different diameters (see figure 4.7).

The brackets can be attached with M8 studs. These studs must be attached to the roof or the roof construction.

The attachment to the roof or the roof construction is not part of the Vacurain package.

The system must be attached to the roof or the roof construction in a way that a reliable suspension is guaranteed.

It must be avoided that the attachment of the stud to the roof or the roof construction acts as a hinge.

A rigid attachment of the stud to the roof or the construction is recommended. This will prevent the collection pipe from resonating during use.

Rail constructions may be used to attach the studs.

The values given in table 4.1 must be used for the distance between the brackets.

Pipe diameter (mm)	Max. centre-to-centre distance between brackets (cm)	Weight of 100% full pipe per m (kg)	Weight of 100% full pipe per bracket (kg)
40	100	1.38	1.38
50	100	2.12	2.12
63	100	3.32	3.32
75	100	4.66	4.66
90	100	6.70	6.70
110	110	9.98	10.98
125	125	12.91	16.14
160	160	21.08	33.73
200	160	32.90	52.64
250	160	49.10	78.56

Table 4.1: Centre-to-centre distance between the Vacurain brackets and the weight of a full pipe per metre and per bracket

Note

Vacurain Flex brackets must always be fitted at least 20 cm from an accessory.

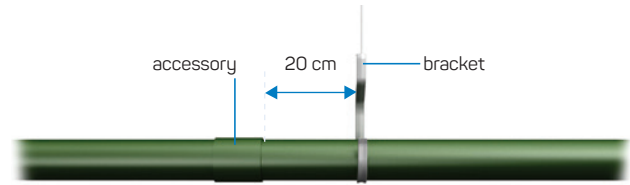


Figure 4.6: The minimum distance from a bracket to an accessory is 20 cm

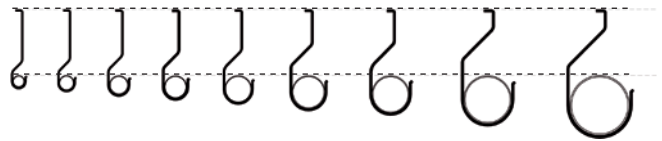


Figure 4.7: Overview of Vacurain brackets with diameters ranging from 40 mm to 250 mm

4.9 Fixed points in the collection pipe

In a number of cases, it is necessary to create fixed points in the (horizontal) collection pipe.

Examples of such situations include:

- **For collection pipes longer than 80 metres**, a fixed point will have to be included in the path before the downpipe.
- **For collection pipes that have a change of direction**, or when a number of collection pipes come together in the horizontal plane, a fixed point is also necessary.

The reason for including a fixed point is to absorb the reaction forces which are produced as a result of a change in direction.

Undesirable forces exerted on T-pieces and bends are absorbed by the fixed point construction.

The location of a fixed point for a single system longer than 80 m is just before the bend to the downpipe.

This point is shown in example A (see figure 4.8).

Example B shows a collection pipe which changes direction in the horizontal plane at the end. A fixed point bracket will have to be installed here at the end of the main pipe before the 90° bend in the main collection pipe.

Another situation which may occur is shown in example C. The fixed point bracket will have to be installed approximately 2 m before the 90° bend in the main collection pipe at the location shown in the figure.

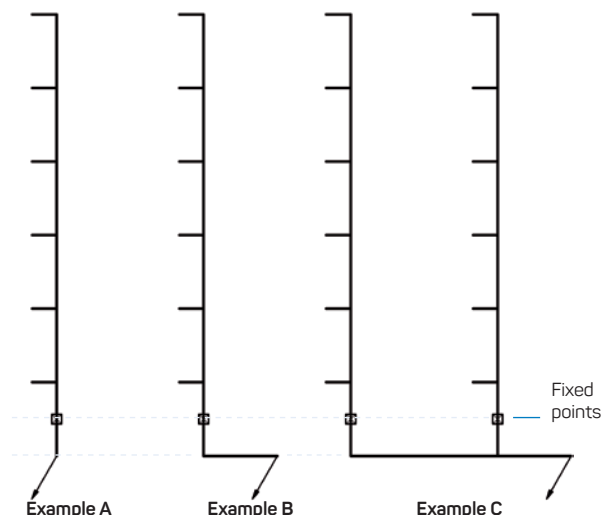


Figure 4.8: Location of fixed points in collection pipes

A number of calculations are given in the following examples. These calculations show the changes in length of the pipe sections as a result of temperature differences. The formula used is: $\Delta L = \alpha \times L \times \Delta T$, also see page 20.

Example 1

Length	L	=	80 m
Installation temperature	T instal	=	20°C
Expected maximum temperature	T max	=	40°C
Expected minimum temperature	T min	=	0°C

$$\Delta L = +96 \text{ mm}$$

$$\Delta L = -96 \text{ mm}$$

This example shows that an 80 m collection pipe experiences a change in length of +96 mm and -96 mm for a temperature difference of 20° C (between the installation temperature and the expected maximum or minimum temperature). According to this example, an 80 m Vacurain collection pipe can be installed according to any of the connection methods (see pages 46 to 54).

Example 2

Length	L	=	80 m
Installation temperature	T instal	=	5°C
Expected maximum temperature	T max	=	40°C
Expected minimum temperature	T min	=	0°C

$$\Delta L = +168 \text{ mm}$$

$$\Delta L = -24 \text{ mm}$$

This example shows that an 80 m collection pipe experiences a change in length of 168 mm for a temperature difference of 35° C (difference between the installation temperature and the expected maximum temperature). The reduction in length as a result of the expected minimum temperature is 24 mm. Since the change in length is more than 100 mm and less than 200 mm, the Vacurain Flex system must be installed according to connection method 1.

Connection methods 2, 3 and 4 are derived from connection method 1 and can, therefore, also be used.



Example 3

Length	L	=	101 m
Installation temperature	T_{instal}	=	5°C
Expected maximum temperature	T_{max}	=	38°C
Expected minimum temperature	T_{min}	=	0°C
	ΔL	=	+ 200 mm
	ΔL	=	- 24 mm

This example shows that a 101 m collection pipe experiences a change in length of 200 mm for a temperature difference of 33° C (difference between the installation temperature and the expected maximum temperature). The reduction in length as a result of the expected minimum temperature is 24 mm. Connection method 1 or a method derived from it (methods 2, 3 and 4) can be used in this case.

This example also shows that this length of collection pipe can be used in combination with a maximum temperature difference of 33° C. If the change in length was greater than 200 mm, then this could result in tension problems in the Vacurain accessories, the Vacurain funnels and the Vacurain hoses.

4.10 The use of brackets with the collection pipe

The values given in table 4.2 must be used for the distance between the brackets.

Pipe diameter mm	Max. centre-to-centre distance for the brackets (cm)	Weight of 100% full pipe per m ¹ (kg)	Weight of 100% full pipe per bracket (kg)
40	100	1.38	1.38
50	100	2.12	2.12
63	100	3.32	3.32
75	100	4.66	4.66
90	100	6.70	6.70
110	110	9.98	10.98
125	125	12.91	16.14
160	160	21.08	33.73
200	160	32.90	52.64
250	160	49.10	78.56

Table 4.2: Centre-to-centre distance between Vacurain Flex brackets and the weight of a full pipe per m1 and per bracket

Important

In certain cases, it will be necessary to give more attention to the expansion of the (horizontal) collection pipe. A combination of fixed points and "expansion legs" may be necessary to prevent the pipe sections from being placed under too much tension.

Note

A fixed point can replace a Vacurain Flex bracket. The standard Vacurain Flex brackets must be used between fixed points and bends at the indicated centre-to-centre distances.

Figure 4.9 shows examples of "flexible legs".

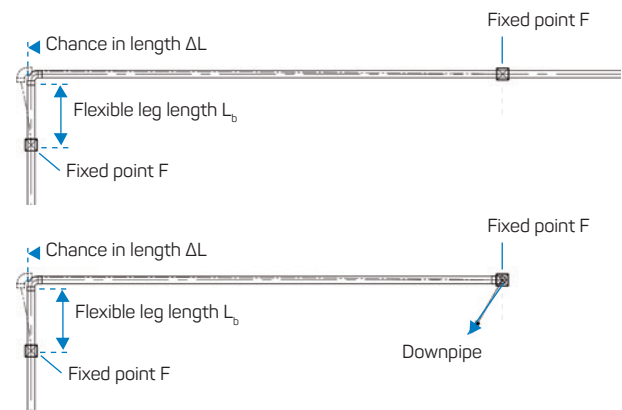


Figure 4.9: Location of fixed points, length of flexible leg

Legend:

L_b	= Length of flexible leg
F	= Fixed point
ΔL	= Change in length
F	= Fixed point symbol

Example

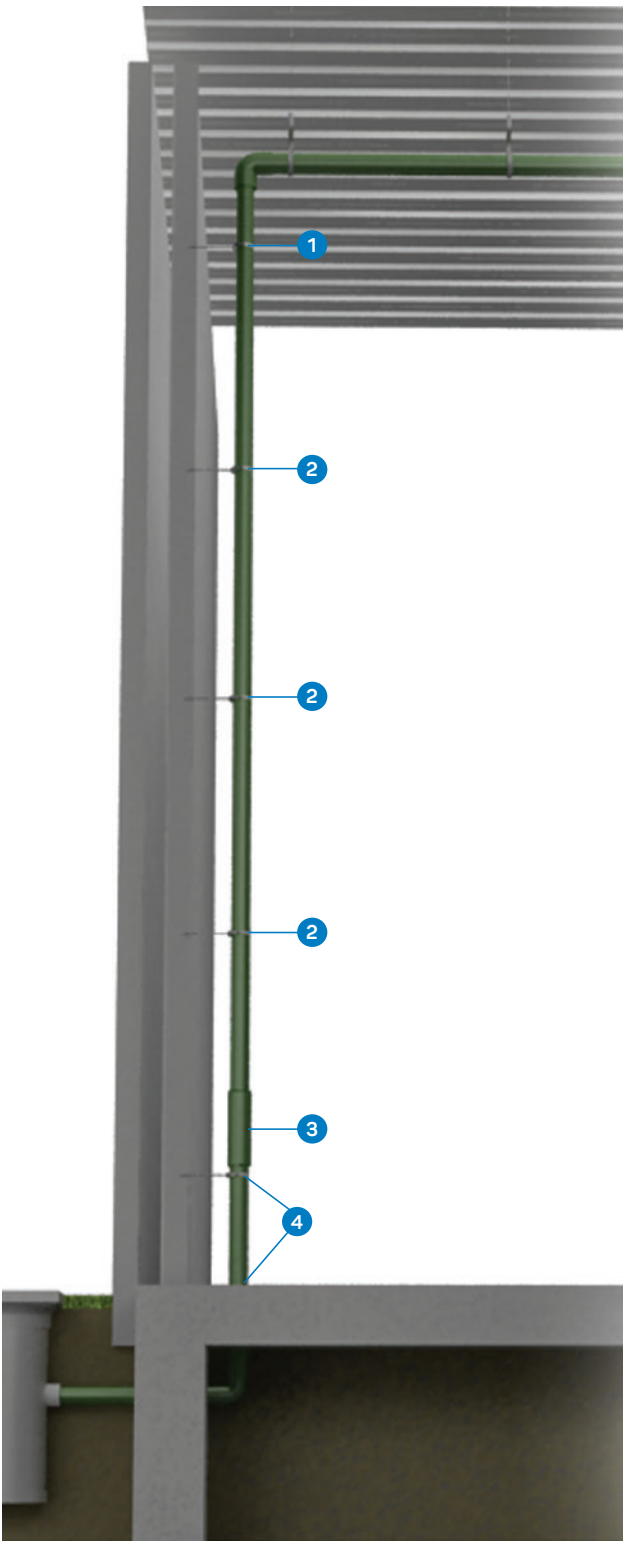
The formula to be used for calculating the length of a flexible leg is:

$$L_b = 20 \cdot \sqrt{(d \cdot \Delta L)}$$

The table below shows a number of lengths (in mm) of flexible legs which have been calculated using this formula in combination with a change in length (ΔL) of 25 mm, 50 mm, 75 mm and 100 mm.

Diameter d (mm)	L_b (mm) $\Delta L = 25$ mm	L_b (mm) $\Delta L = 50$ mm	L_b (mm) $\Delta L = 75$ mm	L_b (mm) $\Delta L = 100$ mm
40	632	894	1095	1265
50	707	1000	1225	1414
63	794	1122	1375	1587
75	866	1225	1500	1732
90	949	1342	1643	1897
110	1049	1483	1817	2098
125	1118	1581	1936	2236
160	1265	1789	2191	2530
200	1414	2000	2449	2828
250	1581	2236	2739	3162

Table 4.3: Length of the expansion legs (in mm)



Figuur 4.10: Downpipe, fixed points and expansion piece

- 1 Fixed point
- 2 Guide bracket
- 3 Expansion piece
- 4 Fixed point or laid in the concrete floor

4.11 The use of brackets with the downpipe

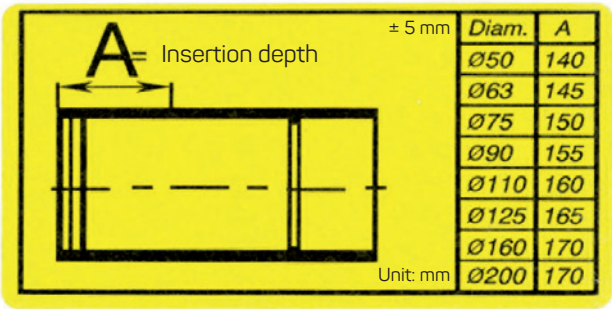
The downpipe is attached using universal, galvanized steel brackets in accordance with NEN 2672. One fixed point must be created directly below the 90° bend at the top of the downpipe (see figure 4.10).

This ensures that the expansion is aligned and absorbed by the expansion piece.

The downpipe is installed in the Vacurain Flex expansion piece directly above the floor.

The vertical pipe section below the expansion piece must also be fixed in position. This can be achieved, for example, by using a fixed point bracket or by laying it in the concrete floor when the floor is laid.

DYKA lubricant must be used when fitting the downpipe in the expansion piece. The expansion piece has a maximum expansion (see the sticker on the expansion piece).



When fitting the downpipe in the brackets, the same centre-to-centre distance must be used as for the horizontal pipes (see table 4.4).

Pipe diameter mm	Maximum centre-to-centre distance between the brackets (cm)
40	100
50	100
63	100
75	100
90	100
110	110
125	125
160	160
200	160
250	160

Table 4.4: Bracket distance for downpipes

5. Making connections

5.1 General information

Vacurain pipes and accessories are made from impact-resistant PVC. An adhesive connection is used to join pipes and accessories together. This chapter explains how to produce a good PVC adhesive bond.

5.2 Preparations

- Shorten the pipe perpendicularly using a pipe cutter or a fine-toothed saw and mitre box.
- Remove any burrs or irregularities with a knife, sandpaper or a file.
- Bevel the pipe to an angle of 10 - 15 degrees along at least 20% of the wall thickness.
- The surfaces to be connected must be clean and dry.
- Check the fit of the pipe in the accessory.
- Measure the insertion depth and mark it on the pipe; preferably use adhesive tape, so that any excess adhesive can be easily removed.

Type of adhesive:	Label:	Packaging:
PVC adhesive	Red pipe system	Pot: 0,125 litre 0,25 litre 1 litre Tin: 5 litre 10 litre 25 litre
PVC cleaner	Grey pipe system	Pot: 0,25 litre 1 litre

Table 5.1: Recognizing the PVC adhesive and PVC cleaner packaging

5.3 Connections

PVC adhesive consists of binding agents dissolved in a solvent or a mixture of solvents. One of the binding agents is PVC.

It requires accuracy and expert knowledge to produce a good bond. Knowledge of and experience in gluing PVC is particularly important for the quality of the adhesive bond in the case of larger diameters. Knowledge can be gained by reading these instructions carefully and by getting help from people with experience the first few times. For more information and training, please contact DYKA.

What is gluing?

PVC adhesive consists of fillers, including PVC, which have been dissolved in a solvent or a mixture of solvents. The adhesive penetrates the surface of the PVC components to be bonded and creates a cold-weld bond once the bond has been made. The adhesive and the PVC components form a single component if the correct type of adhesive is used with the correct technique.



What you should know about gluing before starting

In order to produce a good adhesive connection, it is important to have some knowledge of gluing. The following points are the basic principles which should always be observed when gluing PVC:

- The DYKA cleaning agent does more than just clean and remove grease. It penetrates the PVC and causes the PVC to swell up. As a result, the surfaces to be glued become soft and weak (mouldable), so that a good adhesive bond can be formed.
- The adhesive also penetrates the surface of the parts to be bonded. The adhesive penetrates the surface better when it remains in the liquid state for longer and it penetrates the surface more quickly if the parts are treated with a cleaner beforehand. The penetration time is longer in cold weather than in warm weather.
- Use the correct type of adhesive (see table 5.1) and the correct size brush (see the 'Materials and tools' list). Only use the brush provided with some tins for the uses specified on the tin.
- Use a sufficient amount of adhesive. Rub the adhesive in and keep it in the liquid state. If it is known in advance that there is a gap between both parts, then a number of layers of adhesive must be applied. Each new layer should be applied before the previous layer has dried. Therefore, never allow a layer of adhesive to dry completely before applying the next layer.
- The pipe and the fitting must be slid together in one movement whilst the adhesive is still wet and the PVC surface is still somewhat mouldable. This will ensure that both parts melt together to form a single piece.
- The solvent properties of the adhesive may result in damage to the join if too much adhesive is used or if there is any adhesive residue. Remove any excess adhesive immediately.
- The bond will start to form as the adhesive starts to dry and harden. For a tight fit between both parts, the surfaces will become mixed together. For a loose fit, the adhesive will produce the bond and seal the join. For a tight fit, the bond will be able to withstand a mechanical load before the adhesive has fully hardened. For a loose fit, it is necessary to wait longer before subjecting the bond to a load.

Note

If an accessory is to be glued on two sides, the side that is glued first must be allowed to fully dry before the other side is glued. This is necessary to prevent the first side from rotating whilst drying when the second side is glued.

5.4 Materials and tools

You require the following tools to make adhesive bonds with PVC:

- Pipe cutter (available from DYKA) or a fine-toothed saw and a bevelling tool (or a rough file).
- Clean, lint-free cloth or plain white crepe paper.
- DYKA cleaner.
- Scraper and pencil.
- DYKA adhesive (see table 5.1 for the choice of the correct type of adhesive).
- Brushes (see table 5.2).

Use hob bristle brushes (plastic bristles dissolve in the adhesive and will quickly become unusable).

The type of brush (round or flat) and the size depend on the diameters involved. An overview of the adhesive brush to be used is given below.

Pipe diameter	Type of brush	Brush dimensions
Up to 40 mm	Round	9 mm
50 mm to 75 mm	Flat	1 "
90 mm to 250 mm	Flat	1,5 "

Table 5.2: Relationship between the pipe diameter and the adhesive brush

5.5 Treating the adhesive

DYKA adhesive is delivered ready for use. The adhesive must be stirred well before use. Check the viscosity of the adhesive. Adhesive with a good viscosity runs off the brush without lumps. When the adhesive no longer drips freely off the brush or when the adhesive is lumpy or stringy, it no longer has the correct viscosity. Adhesive which has thickened or become lumpy may not be used. Do not dilute the adhesive! Keep the brush in the adhesive between creating each bond.

Keep the adhesive out of direct sunlight with the lid firmly in place when the adhesive is not used.

Store PVC adhesive in a dry location at a temperature between 5° C and 25° C. The adhesive can be kept for 18 months if it is stored correctly with the lid firmly closed. Do not use adhesive if it has aged. Do not use adhesive if

the viscosity is clearly different from the original viscosity.

Once a screw top tin has been opened, it may no longer be regarded as a hermetically sealed container.

5.6 Preparations

Shorten the pipe perpendicularly using a pipe cutter or a fine-toothed saw and mitre box. Remove any burrs or irregularities with a knife, sandpaper or a file to prevent the adhesive from being scraped away during fitting, which will result in a poor adhesive bond.

When gluing a pipe, the pipe must be bevelled along at least 10% of the wall thickness at an angle of between 10° and 15° as shown in figure 5.1. Remove the sharp edges using, for example, sandpaper or a scraper.

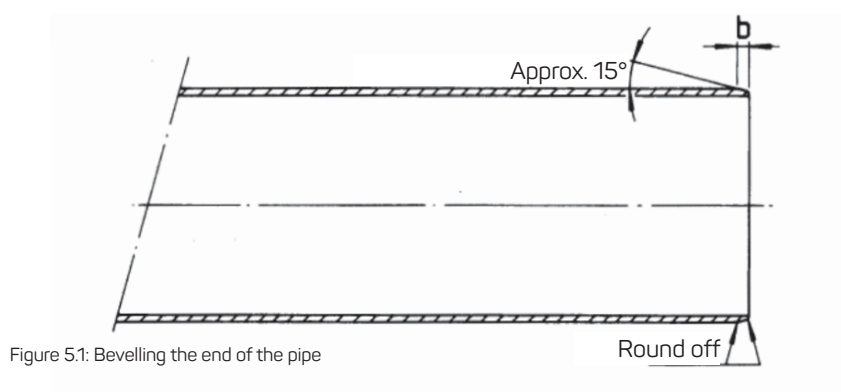


Figure 5.1: Beveling the end of the pipe

The surfaces to be bonded must be clean and dry. Check whether the pipe fits in the accessory correctly (size of the gap). Measure and mark the insertion depth and the direction of the fitting on the outside of the pipe. Do not use a sharp object to do this. If the pipe is going to be installed in view, you can mark the insertion depth with adhesive tape so that you can remove any excess adhesive together with the adhesive tape.

Cleaning

Thoroughly clean the end of the pipe and the inside of the fitting with a clean cloth or crepe paper and DYKA cleaner. Wait until the cleaner evaporates and the parts are dry. Remove any condensation which may have formed.



1 Cut the pipe perpendicularly



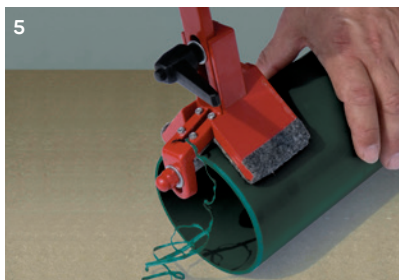
2 Mark the insertion depth



3 Remove the sharp edges on the outside



4 Remove the sharp edges on the inside



5 Beveling



6 Clean the end of the pipe with DYKA cleaner



7 Clean the inside of the fitting

5.7 Gluing

Particularly for pipes with a diameter larger than 90 mm, it is recommended to pretreat the surfaces to be connected again with a clean cloth and cleaner after they have been cleaned in order for the adhesive to penetrate better. Make sure that this is done all around the pipe and that the surfaces are dry before the adhesive is applied.

1. Apply the correct type of adhesive using a brush of the correct size. The different sizes of the brushes are such that the adhesive can be applied at the required speed and also has sufficient time to penetrate the PVC.
2. Evenly apply adhesive to the inside of the fitting and the outside of the end of the pipe or the end of the spigot. Use more adhesive than is required for the end of the spigot and rub it in.
3. First, apply the adhesive transversely and then brush the adhesive in the lengthways direction.
4. If there is a loose fit between the pipe and the accessory (large gap), then it is important to apply a second layer of adhesive (and possibly a third layer). When doing so, the previous layer of adhesive may not be dry before the next layer is applied. Keep the adhesive in the liquid state and brush it with the brush.
5. Apply a thin layer of adhesive to the inside of the fitting. Excess adhesive on the inside of the fitting cannot be removed later, because you will not be able to reach it.
6. The excess adhesive will accumulate after the bond has been made and cause damage to the pipe system.

To avoid an accumulation of adhesive on the inside of the pipe, only a thin layer of adhesive may be applied to the inside of the socket coupling when gluing.

Whilst the adhesive is still in the liquid state, insert the two parts together in a careful, even movement without stopping. Make sure the bond is in the correct position within 20 seconds. If there is an indication that the adhesive is starting to dry on the surface, you must quickly apply a second layer, making sure too much adhesive cannot get into the pipe system. Remove any excess adhesive immediately.

PVC adhesive dries quickly. It is, therefore, necessary to work quickly. This means that it is recommended that the gluing is done by two people when working with diameters larger than 110 mm. When working in a high relative humidity, it is very important to work fast, because the moisture in the air (condensation) can precipitate on the surface to be bonded.





When gluing in the sun, the pipe temperature must not exceed 45° C. There are tools to make the gluing easier for pipe diameters of 160 mm or more.
Never tap the two parts together!

A good bond will normally have a glue edge around the entire circumference. If there is a gap after the parts have been glued together, this may mean that the bond has not been made properly or that the wrong type of adhesive has been used.

Close the adhesive tin after use to prevent the solvent from evaporating. It is recommended to leave the brush in the adhesive between gluing each bond and to close the tin with, for example, a PE lid in which a hole has been made for the brush. If the brush is not going to be used for a longer time, then clean it so that it does not become hard. If the brush has become hard, then it will usually become soft again if it is placed in some cleaner or adhesive. A brush which has been soaked in cleaner may not be used for gluing.

When a brush is reused, first shake it, squeeze it and dry it thoroughly with crepe paper.

Since adhesive and cleaner dissolve and harm PVC, the pipes and fittings may not come into contact with adhesive residue for longer than is necessary.

Pay attention to the environment. Treat adhesive as chemical waste. Make sure empty adhesive tins, used cloths and paper are not left lying around, but are immediately placed in the chemical waste container.

Note:

the instructions given above for bonding PVC are applicable under normal conditions, i.e. at a temperature between 5° C and 25° C. Extra care must be taken outside of this temperature range. Do not glue at a temperature below 0° C. Contact DYKA if you must glue at a temperature below 0° C.

5.8 Drying time

Treat new bonds with care. The drying times are dependent on the diameter, the size of the gap and the ambient temperature.

An indication:

- 15° C to 40° C minimum drying time 1/2 hour
- 5° C to 15° C minimum drying time 1 hour
- 0° C to 5° C minimum drying time 2 hours

You must wait for the drying time to elapse before installing the pipe in the system. Furthermore, it is important that the inside of the pipe system is sufficiently ventilated. The time required depends on the type of adhesive used, the diameter of the pipe and the ambient temperature.

You must take a relatively long drying time into consideration at low temperatures, a high humidity and a large diameter.

5.9 Working safely with adhesive and cleaner

Note!

PVC adhesive and cleaner contain volatile solvents. To work safely with these substances, please observe the following:

- Read the label.
- Do not let the adhesive come into contact with your skin or eyes. Do not eat when working with adhesive.
- Make sure there is good ventilation or extraction facilities when you are working in a confined space.
- Do not use adhesive near a naked flame and do not smoke. Adhesive and cleaner with a methyl ethyl ketone (MEK) and tetrahydrofuran (THF) base are inflammable.
- Keep the lids on the containers when the adhesive and cleaner are not in use.
- Do not leave used, wet cloths with cleaner near the work area. Throw them away outside in a waste container.

6. Installing horizontal pipes

6.1 Horizontal pipes

- The horizontal collection pipe is usually fitted parallel to the edge of the roof.
- Connection method 1 is recommended as the first choice (see figures 6.5 and 6.6 on page 35). The position of the horizontal collection pipe is, projected in the horizontal plane, approximately 1,000 mm from the line on which the funnels are positioned. This distance can be smaller if connection method 4 is used.
- Connect the Vacurain Flex hoses to the funnels first using the bayonet connection and insulate the aluminium outlet.
- Next, determine distance A so that the funnel connecting hose does not sag below the collection pipe. Also make sure there is sufficient assembly space (see figure 6.1).
- Attach the threaded rods which have been made the correct length to the roof construction.
- Hang the Vacurain Flex brackets for the horizontal pipes on the already aligned M8 studs. Avoid the studs from being attached to the roof construction in a way that they act like hinges.
- Align the Vacurain Flex brackets horizontally by placing the nuts at the same height.
- Place the (prefabricated) length of pipe in the brackets.

Pipe diameter mm	Maximum centre-to-centre distance for the brackets (cm)	Weight of 100% full pipe per m (kg)	Weight of 100% full pipe per bracket (kg)
40	100	1.38	1.38
50	100	2.12	2.12
63	100	3.32	3.32
75	100	4.66	4.66
90	100	6.70	6.70
110	110	9.98	10.98
125	125	12.91	16.14
160	160	21.08	33.73
200	160	32.90	52.64
250	160	49.10	78.56

Table 6.1: Overview of bracket distances, weight per metre and weights per Vacurain Flex suspension bracket

It is not necessary to support the pipes with a half shell.

The funnel is connected to the collection pipe using the click connection at the Vacurain hose which is connected to the funnel's outlet. This connection is secured by the locking collar which is integrated in the Vacurain hose and which acts as a bayonet connection.

A spigot coupling can then be fitted from the collection pipe or the collection pipe's T-piece (and adapter) with the aid of a pipe, a 45° bend, a pipe and a double socket coupling. One side of the spigot coupling is glued into the double socket coupling and the other side is connected to the flexible funnel hose which has already been installed using a click connection (see figure 6.1).

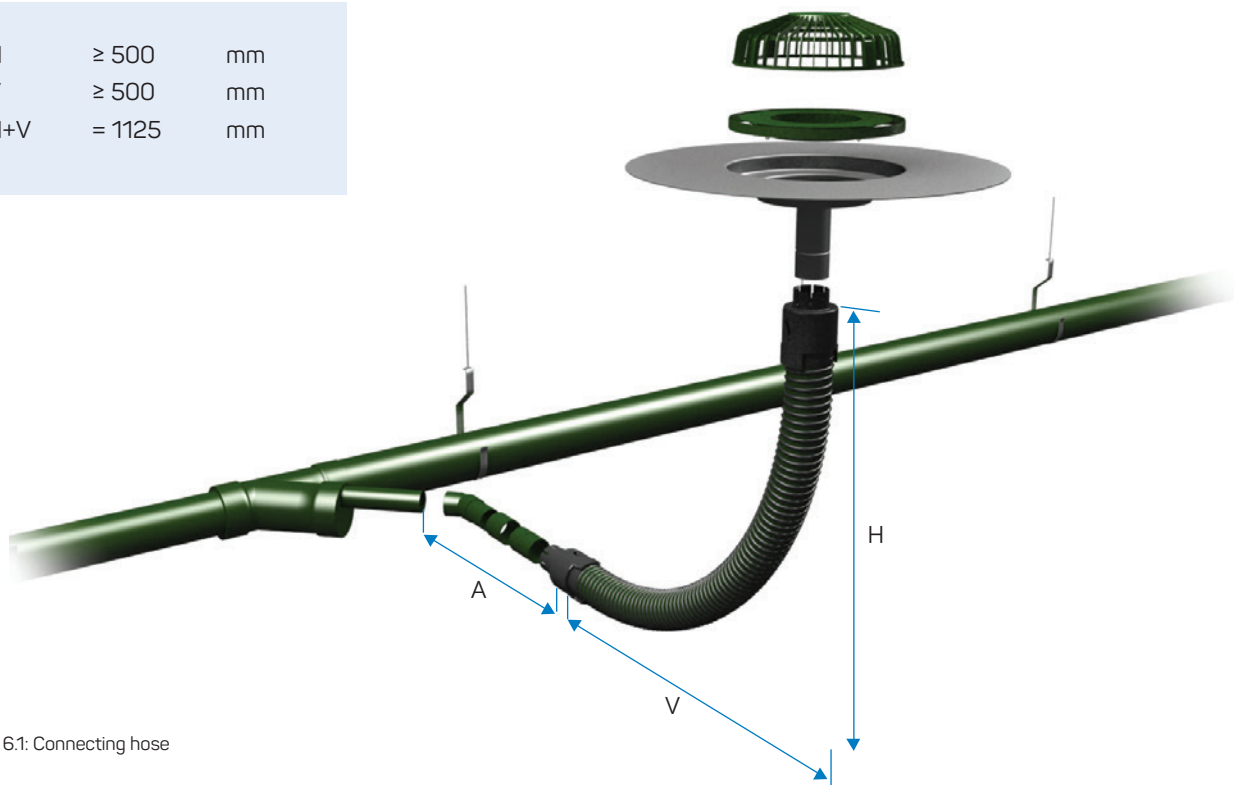
The most common practice, where the funnel hose is connected at right angles to the collection pipe via a 45 degree T-piece, is shown in figures 6.5 and 6.6 on page 35.

The positioning of the horizontal brackets with regard to the funnels is essential. If the distance is too small, then the flexible hose will be too long and will sag (see figure 6.2). If the distance is too great, then the flexible hose will not fit and will be unnecessarily stretched (see figure 6.3).

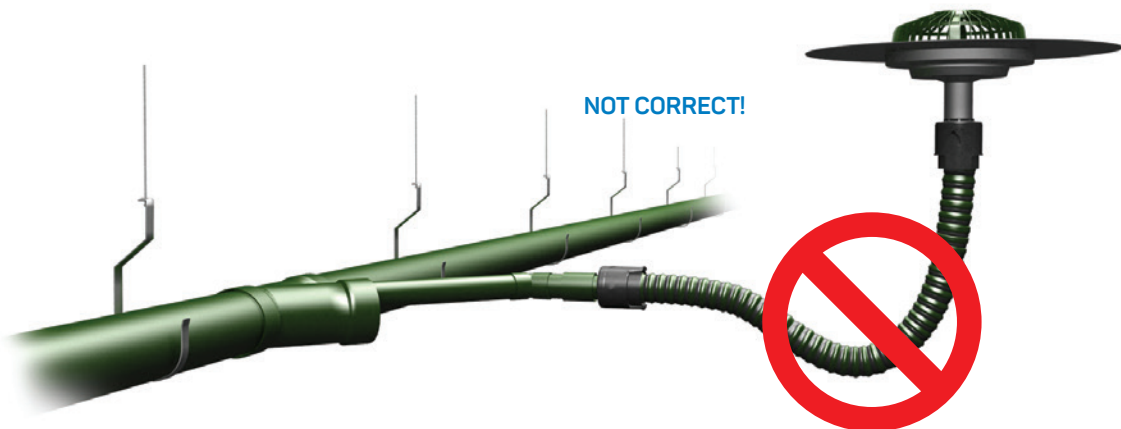
When fitting the funnel hose to the collection pipe, the length of the adapter A must be chosen carefully. If the adapter is too long, then the Vacurain funnel hose will want to sag below the collection pipe (see figure 6.2). As a result, there will be undesirable tension in the connections. This is not permitted.

If the adapter is too short, then the Vacurain funnel hose will be too tight (see figure 6.3). As a result, there will be undesirable tension in the connections. This is also not permitted.

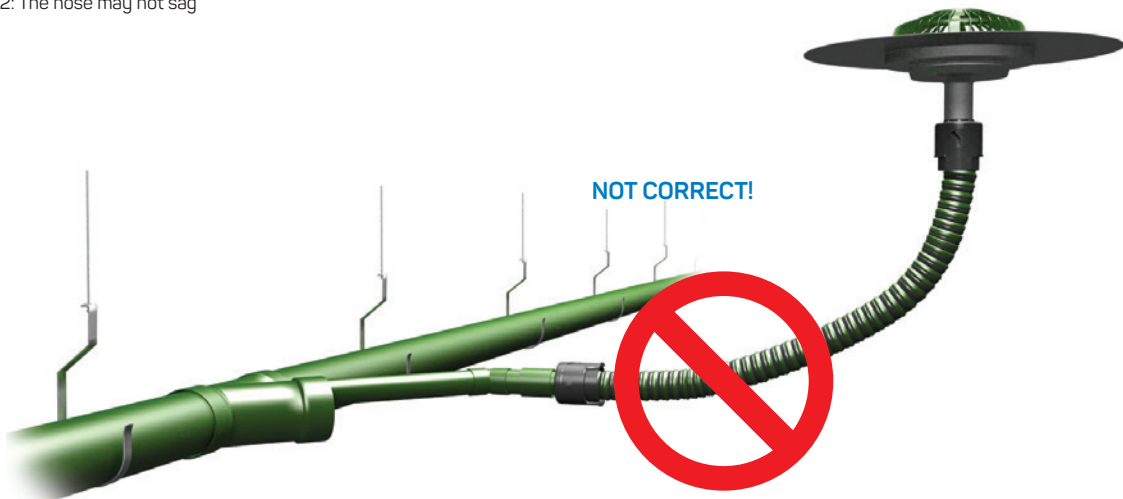
H	≥ 500	mm
V	≥ 500	mm
H+V	= 1125	mm



Figuur 6.1: Connecting hose



Figuur 6.2: The hose may not sag



Figuur 6.3: Do not fit the hose under tension

6.2 Funnel connections

Four different sizes of funnel connecting hose, which have two quick-release connections, are used.

Connection 1	Connection 2	
50 mm	40 mm	40 mm funnel hose
50 mm	50 mm	50 mm funnel hose
50 mm	63 mm	63 mm funnel hose
75 mm	75 mm	75 mm funnel hose

The 75 mm x 75 mm funnel hose may only be used in combination with the 75 mm Vacurain funnel.

This is a funnel with a high drainage capacity which is used in situations where larger drainage rates than normal are expected, which is particularly the case for large buildings like distribution centres.

They can also be used for emergency spillway systems after the required information has been provided by the constructor.

The size of the funnel connecting hose to be used, as well as the other diameters to be used, depend on the project's calculation results.

6.3 Connection methods

General information

Pipes expand or shrink as a result of temperature changes. The extent to which this happens depends on the material the pipes are made from. The coefficient of expansion (α) for PVC is 0.06 mm/m° C. The change in length of the collection pipe has a large influence on the Vacurain Flex hoses which are connected to it. DYKA has defined eight different connection methods for Vacurain Flex hoses, which take into consideration different expected changes in length of the collection pipe. These eight connection methods are described from page 46 onwards. Collection pipes must not change in length by more than 200 mm. In cases where the Vacurain Flex collection pipe changes in length by no more than 100 mm, any of the connection methods may be used. In cases where the change in length of the collection pipe is greater than 100 mm but no more than 200 mm, connection methods 1, 2 and 3 must be used (see pages 46, 47, 48 and 49).



Figure 6.4: Funnel hose

Connection method 1 (the standard method) - Installation height approx. 500 mm

The standard connection method for an installation height (H) of approximately 500 mm is given in the example below.

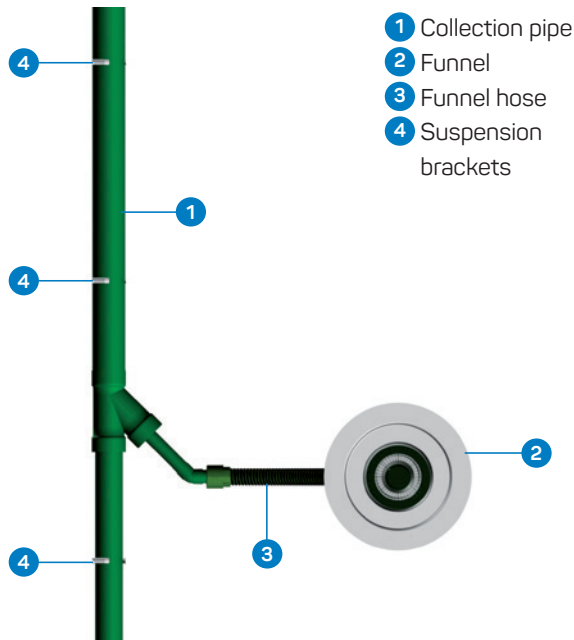


Figure 6.5: Top view of connection method 1

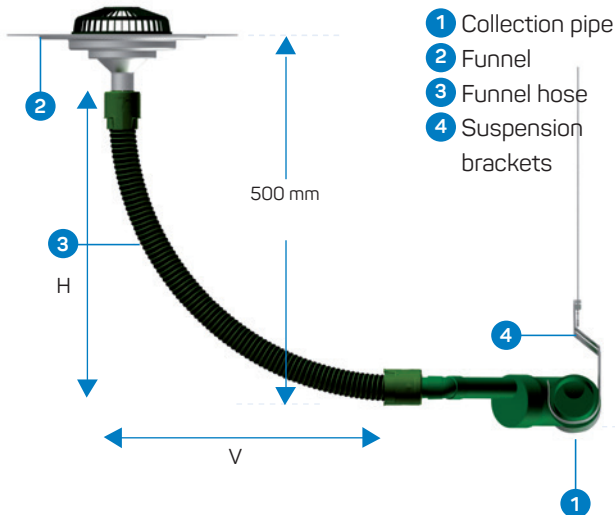


Figure 6.6: Side view of connection method 1

The funnels are connected to the collection pipe using 45° T-pieces. The T-pieces are the same size as the diameter of the pipe in the direction of flow. The T-pieces have the same diameter on three sides. Eccentric adapters must be used if there is a change in diameter. These adapters can be used both for the funnel connecting pipe and for connecting the collection pipe which gets smaller in the opposite direction to the flow (see figures 6.5 and 6.6). The water always flows into the collection pipe from the side. The funnel and the funnel hose with which a collection pipe begins is always connected to a 45° bend.

Stretches of pipe of a convenient length can be made in advance. Lengths of pipe with a T-piece and possibly an adapter glued in it can be placed in the bracket straight away. The branch-off pipe is then connected to the collection pipe using a 45° bend. It is recommended to use adapters (made out of pieces of pipe).

If the pipes are laid in a concrete roof, the funnel can be connected according to connection method 8 (see page 54). The pipe is to be placed between the top and bottom reinforcement. The following must be done at the connection at the end of a pipe or for a branch-off point: create the vertical connection using two 50 mm 45° socket/spigot Vacurain glue bends and a 50 mm double socket coupling. If an adapter is used, then place it between the bend and the horizontal pipe. The funnel's outlet must be shortened by 45 mm with a hacksaw or grinding disc and the burrs must be removed. The funnel can be inserted in the socket coupling after the insulation has been fitted. A Vacurain Flex hose is not used in this situation.

Note:

Vacurain Flex systems whose pipes are laid in a concrete roof cannot work correctly hydraulically in all cases because of the build-up flow. The correct operation is partly dependent on the flow to be drained and the total length of the pipe. Calculations must show this.

6.4 Fixed points and fixed point constructions

In many cases, an additional construction is necessary for making the fixed point. In that case, a composition of parts may be used.

If there is a fixed point in a downpipe which is too far from a fixed component in the building's construction, then special fixed point constructions can be used which can be installed with various components (see figures 6.8 and 6.9). Vastpuntconstructie zoals in figuur 6.9 beschreven bestaat uit de volgende onderdelen:

No.	Description	Quantity	Comment
1	Wall plate	2	
2	Rail		Length dependent on the distance to be bridged
3	Sliding nut	2	
4	End cap	2	
5	Hexagon bolt	2	
6	Washer	2	
7	Vacurain fixed point bracket	1	

The fixed point construction shown in figure 6.9 consists of the following components:

No.	Description	Quantity	Comment
1	Wall plate	2	
2	Rail		Length dependent on the distance to be bridged
3	Sliding nut	2	
4	End cap	2	
5	Hexagon bolt	4	
6	Washer	4	
7	Vacurain fixed point bracket	1	

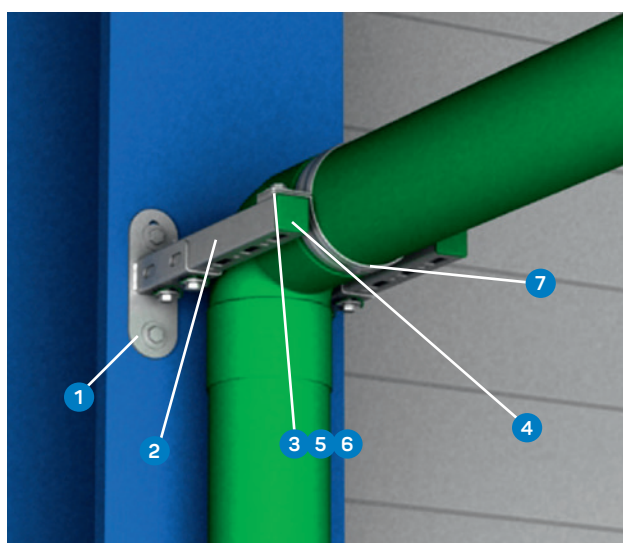


Figure 6.8: Example of a fixed point in the collection pipe immediately before the 90° bend

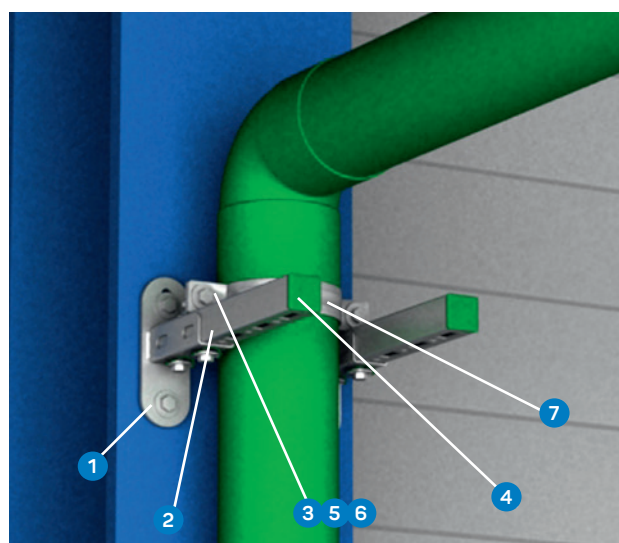


Figure 6.9: Example of a fixed point construction immediately below the 90° bend

A fixed point construction can be made in a number of different ways with the aid of rails, corner consoles and wall plates. A number of methods to create fixed point constructions are given below.

6.5 Fixed points below the funnel

In the case that the collection pipe must be installed more than 500 mm below the level of the roof, extra attention must be given to the vertical part under the funnel. The funnel's outlet will have to be increased in length using a separate click socket, a 50 mm piece of pipe, a double socket coupling and a spigot pipe. The Vacurain funnel hose can then be connected to this (see figure 6.10).

Note

A locking collar must also be used when using a separate click socket.

As a result of the flexibility of the Vacurain system, it will be necessary in these cases to absorb any undesirable forces exerted at the connection between the pipe and the funnel's outlet.

A possibility is, for example, to attach a bracket which is fitted on the extended part of the funnel to the nearest beam or column.

6.6 Fixed points where long pipes come together

If two horizontal collection pipes are connected to one downpipe, then one pipe must always join the downpipe via a Vacurain T-piece fitted in the downpipe. Extra strengthening with fixed point brackets is necessary for pipes longer than 80 m. See the example given in figure 6.11.

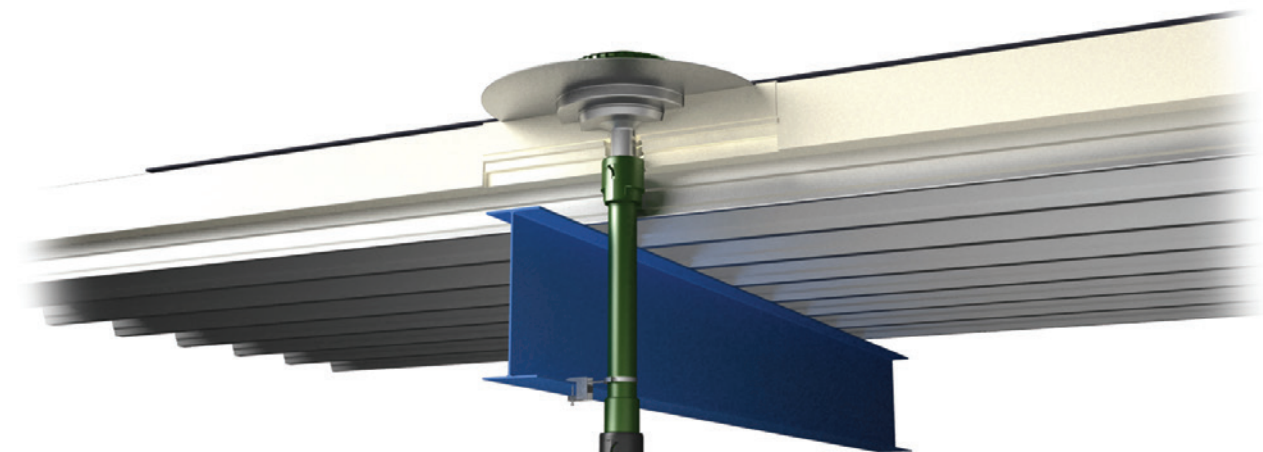


Figure 6.10: Example of a fixed point construction for an extended funnel

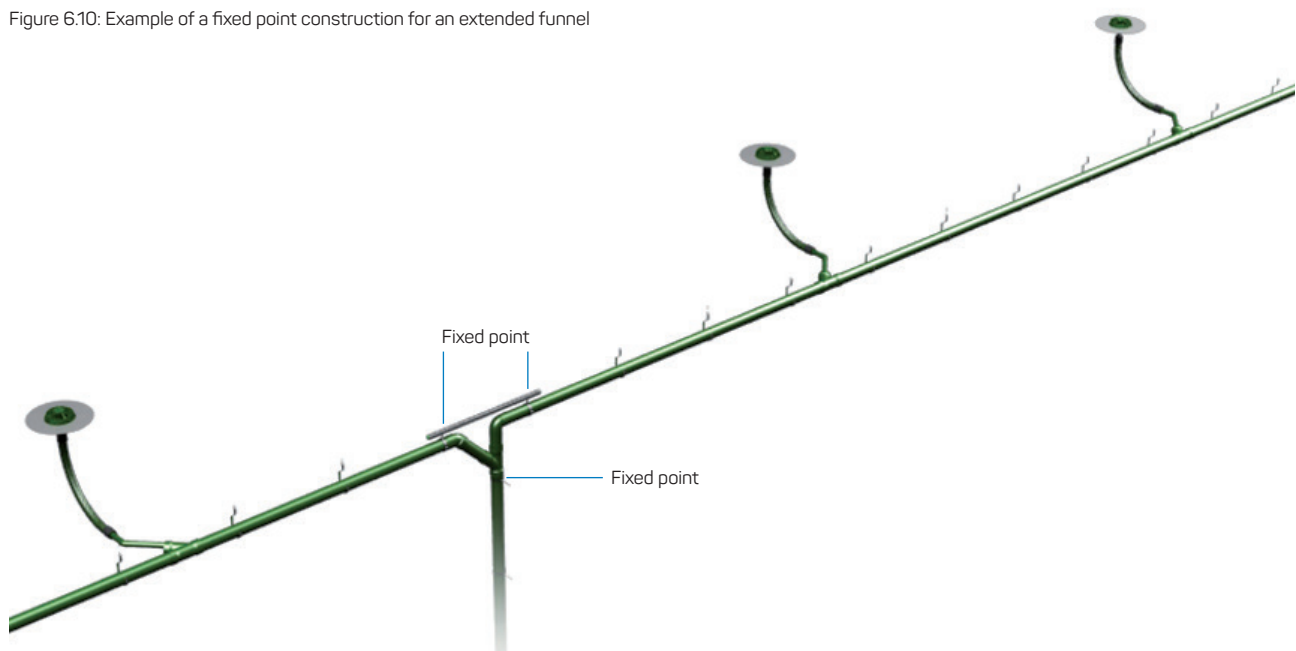


Figure 6.11: Example of a fixed point construction where several pipes come together

6.7 Ground pipes

The Vacurain Flex ground pipe goes as far as specified in the calculation, after which a connection must be made via a relief drain (also see page 10) to the external PVC sewer pipe.

In principle, a Vacurain Flex project is calculated so that - after the downpipe - the last part of the Vacurain system's ground pipe has a length of approximately 1 metre. This concerns a situation where the downpipe is located close to the building's outside wall. After this, the Vacurain system must be connected to the exterior sewer under free fall which has the correct diameter. The diameter depends on the required capacity and the available fall (decline).

Table 6.2 can be used to determine the correct diameter of the exterior pipe.

Pitch in mm/m	10	5	4	3	2	1
Diameter						
110	6	5	4	3	3	2
125	9	6	5	5	4	3
160	17	12	11	9	7	5
200	30	22	19	17	14	10
250	55	39	35	30	25	17
315	101	72	64	55	45	32
400	191	135	121	104	85	60
500	343	242	217	188	153	109
630	629	444	397	344	281	198

Table 6.2 Capacity in l/s for a pressureless sewer connection

6.8 Emergency facilities

Extreme (but infrequent) downpours make it necessary to have a larger drainage capacity. Emergency overflows and/or emergency spillway systems are, therefore, necessary. The rain intensity that must be used for emergency spillway systems in the Netherlands is 500 l/s.ha. According to the Dutch Building Decree, NEN 3215, NEN 6702 and NPR 6703, emergency spillway systems are the responsibility of the building's constructor.

The constructor determines the following regarding the emergency spillway system:

- The location of the emergency overflows.
- The capacity of the emergency overflows.
- The maximum permissible water level at the emergency overflows.

Vacurain Flex as an emergency system

If the three issues mentioned above have been determined by the constructor, then a Vacurain system can then be installed as an emergency system. Pipe calculations can be made by DYKA. It is important to know that if a Vacurain Flex system is used as an emergency system, only one Vacurain funnel may be used for each system.

An emergency system will be required in building designs where roof surfaces have such a pitch that the water cannot be drained via the edge of the roof.

Vacurain funnels that are used for this purpose must be installed at least 30 mm higher (see figure 6.12).

Also, if Vacurain is used as an emergency system, an extra contamination basket must be installed (see figure 6.12).

The pipe system for an emergency system also requires a downpipe which ends through the wall construction approximately 0.5 m above ground level and discharges rainwater onto the ground (see figure 6.14).

The downpipe must be located in a logical and responsible position.

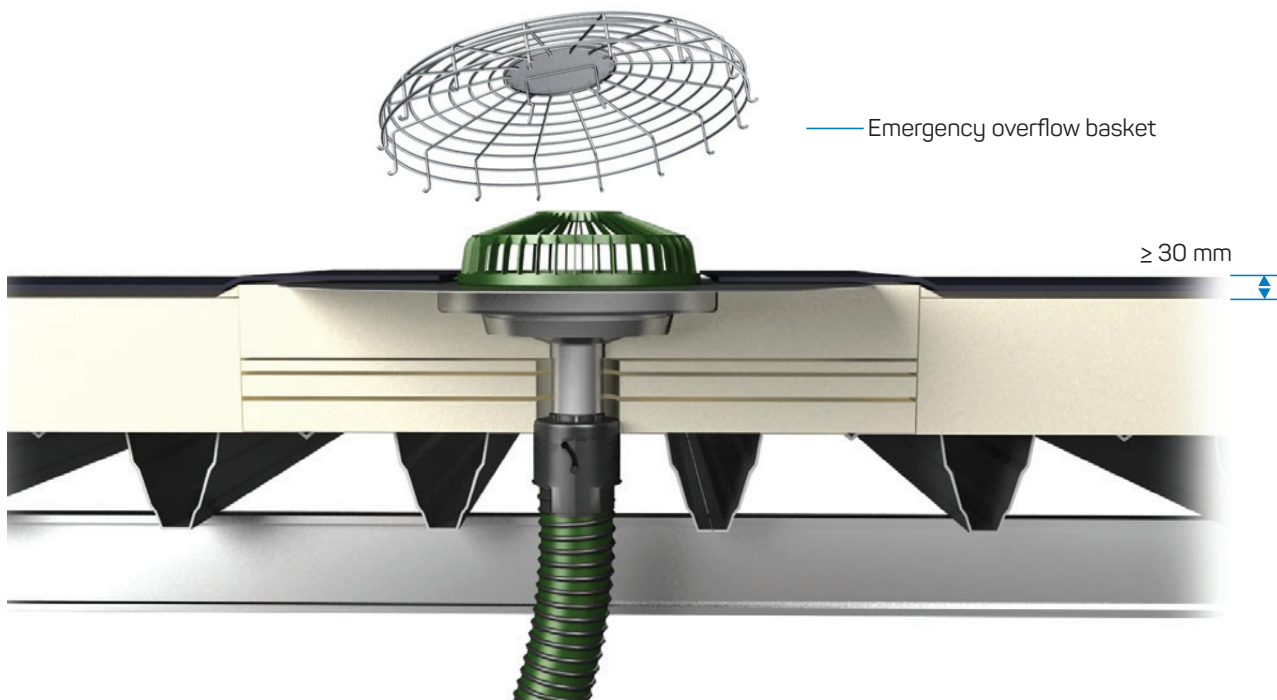
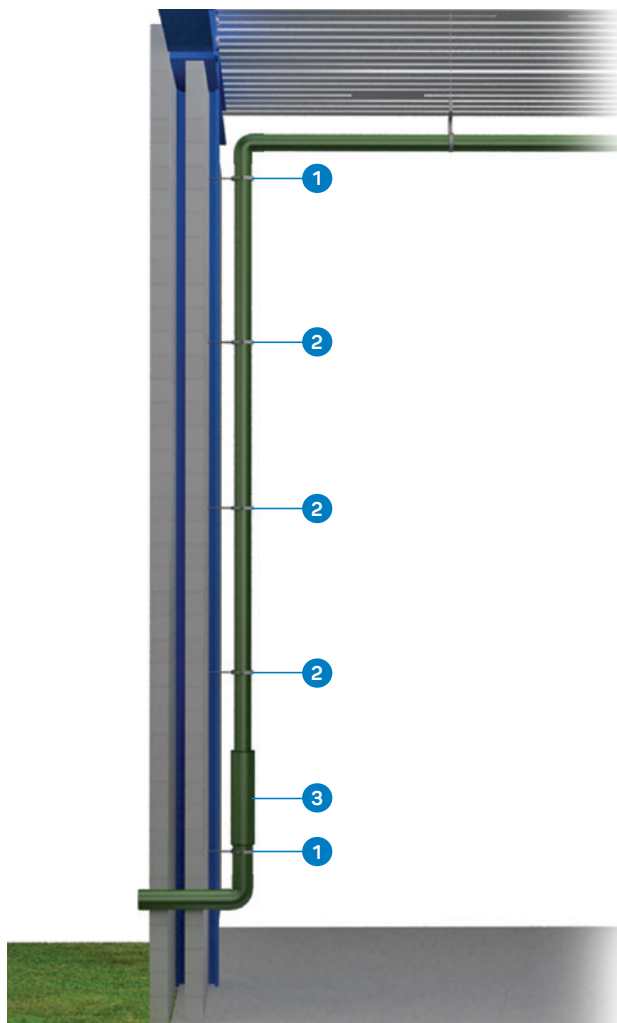


Figure 6.12: Emergency system: install 30 mm higher than the roof surface with an emergency overflow basket



An example of a downpipe for an emergency system is given opposite.

If a 50 mm Vacurain funnel is used as an emergency system, the roof construction must be able to support a minimum water level of 60 mm (30 mm for the increase in height + 30 mm for the correct operation of the system).

If a 75 mm Vacurain funnel is used as an emergency system, the roof must be able to support a minimum water level of 85 mm (30 mm for the increase in height + 55 mm for the correct operation of the system).

This information must be recognized and incorporated by the constructor.

- 1 Fixed point
- 2 Guide bracket
- 3 Expansion piece

Figure 6.14: Downpipe for an emergency system

An example of an emergency system with a number of pipe systems parallel to one another is shown in figure 6.15.

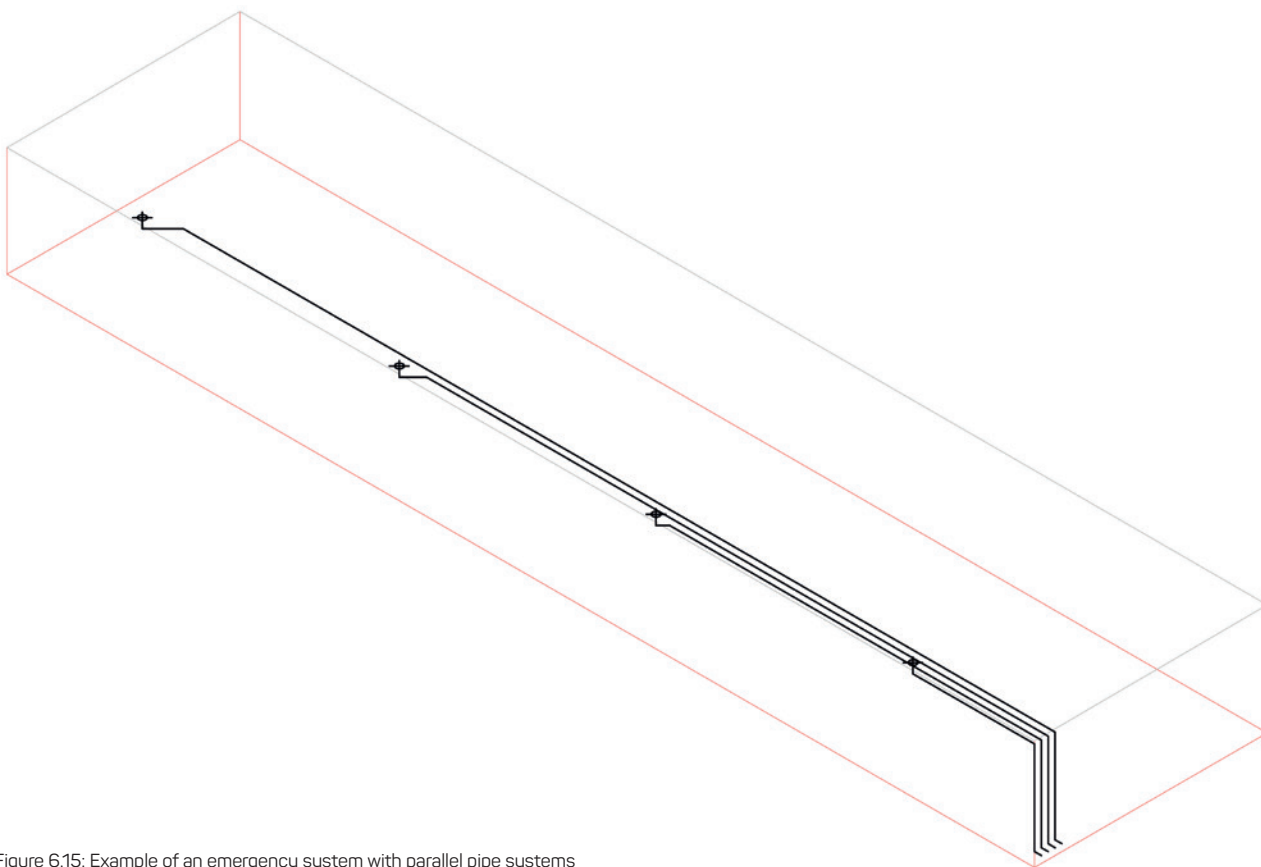


Figure 6.15: Example of an emergency system with parallel pipe systems

Emergency overflows

If the roof pitch is such that water collects at the edges, then emergency overflows can be chosen as the emergency system (see figure 6.16). The water level on the roof is decisive for the drainage capacity of the emergency overflows. This water level is limited to a maximum. This maximum must be determined by the constructor.

An emergency overflow elevation of 30 mm must be taken into consideration. When determining the capacity of the emergency overflows, it is, therefore, necessary to determine the maximum permitted water level on the roof.

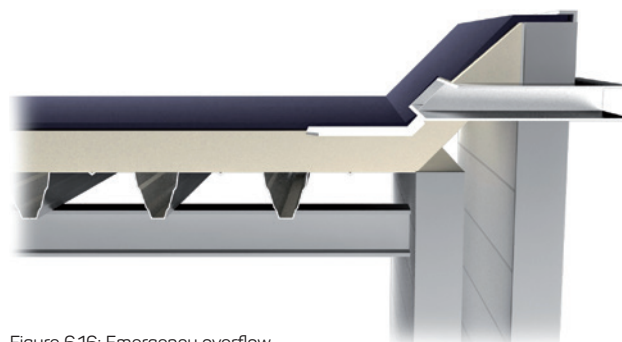
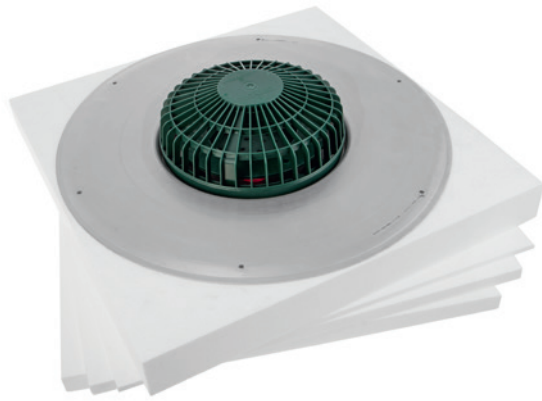


Figure 6.16: Emergency overflow

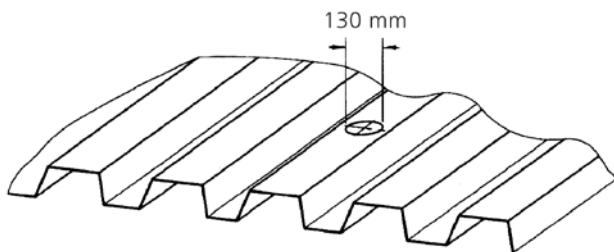
Note

The constructor is always responsible for determining the emergency facilities. The constructor determines the location, the number of outlets and the maximum permitted water level at the location of the emergency overflow.



6.9 For bitumen roof covering

1. Make a hole in the roof which has a diameter of 130 mm.

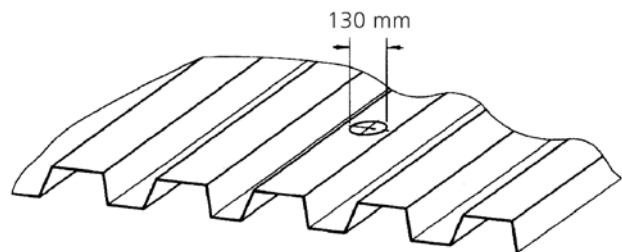


2. Determine the thickness of the layer of insulation.
With the insulation provided (560 mm x 560 mm), it is possible to vary the thickness of the insulation from 70 mm to a maximum of 130 mm in steps of 10 mm.
3. Place the aluminium funnel on the insulation with the spigot through the hole in the roof.
4. Attach the aluminium funnel onto the roof in at least four places using Parker screws.
5. Place the dish in the funnel. This is clicked into place in four places.
6. Place the leaf basket on the dish. This is clicked into place in four places.

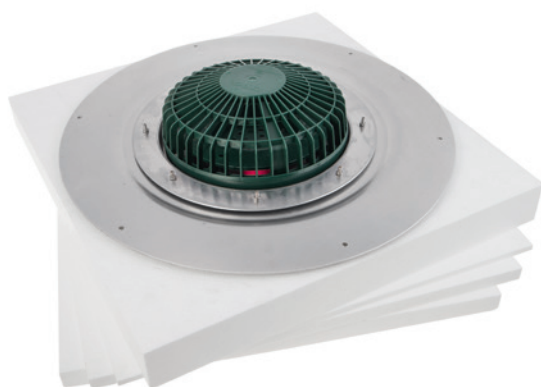


6.10 For PVC roof covering

1. Make a hole in the roof which has a diameter of 130 mm.

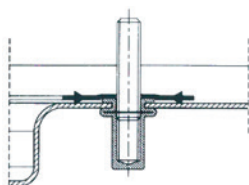


2. Determine the thickness of the layer of insulation.
With the insulation provided (560 mm x 560 mm), it is possible to vary the thickness of the insulation from 70 mm to a maximum of 130 mm in steps of 10 mm.
3. Place the aluminium funnel on the insulation with the spigot through the hole in the roof
4. Attach the aluminium funnel onto the roof in at least four places using Parker screws.
5. Verlijm of fohn de PVC dakbedekking over de trechter.
6. The funnel must then be incorporated in the roofing sheets in accordance with the instructions provided by the roofing sheet supplier.
7. Place the dish in the funnel. This is clicked into place in four places..
8. Place the leaf basket on the dish. This is clicked into place in four places.

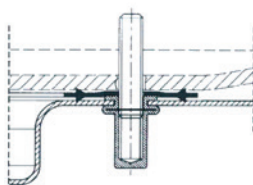


6.11 For plastic foil roof covering (clamp version)

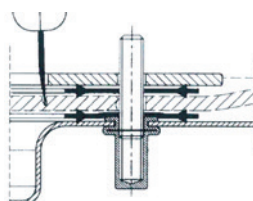
1. Follow the steps 1 to 4 uit de vorige paragraaf 6.1.1
2. Fit a funnel rubber. Make sure the rubber surfaces and the surrounding area are completely clean.



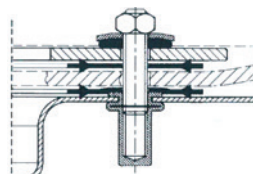
3. Roll the plastic roof covering over the funnel. Mark the hole to be made (for the studs). Punch the eight holes for the studs. Place the second funnel rubber over the studs. Make sure the rubber surfaces and the surrounding area are completely dry.



4. Fit the aluminium compression ring (with the text side facing upwards). Use a sharp knife to cut through the plastic roof covering on the inside of the compression ring. Use the inside of the compression ring as a cutting template.



5. Fit the eight washers with the rubber side down. (Therefore, with the steel side facing upwards.) Evenly tighten the eight nuts. The torque which is applied must never be so great that the studs start to rotate together with the rivet nut.



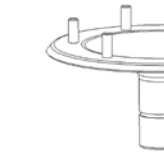
i It is recommended to prepare steps A to D in the workshop.

6. Fit the plastic dish in the funnel. This is clicked into place in four places.
7. Fit the leaf basket on the dish. When clicking the basket into place, pay attention to the recesses in the bottom edge of the leaf basket.

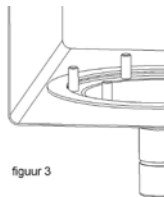
6.12 Installation instructions for gutter funnel

Vacurain flange funnel

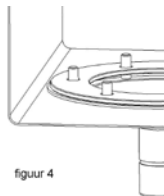
1. Define the place where the funnel must be mounted.
2. Make a hole (dia. 225 mm) in the metal gutter.
3. Place one rubber sealing on top of the funnel base around the stub ends. Make sure funnel, rubbers and gutter are cleaned before applying.
4. Place funnel underneath the gutter (figure 2).
5. Place second rubber sealing ring on top of the gutter (figure 3) around the stub ends.
6. Then place the steel ring over the stub ends (figure 4).
7. Place the washers (figure 5).
8. Screw the nuts evenly on to the stub ends. Use a torque of 40Nm (figure 6).
9. Place the dish in to the steel ring. It clicks on to 4 points. Be sure the spokes of the dish are not placed on to the nuts (figure 7).
10. Place the leaf baskets on to the dish. It clicks on 4 point (figure 8). Also see the drawings on the package (exploded view).



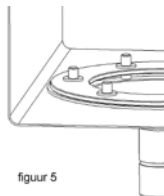
figuur 2



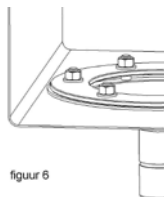
figuur 3



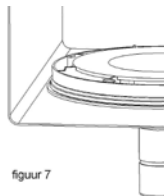
figuur 4



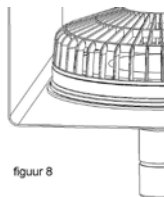
figuur 5



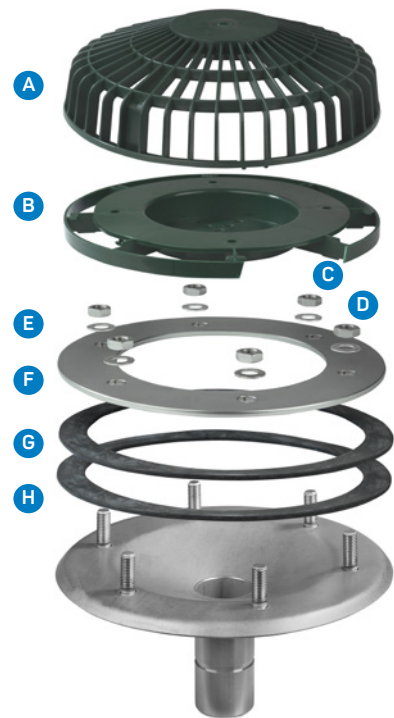
figuur 6



figuur 7



figuur 8



- A Leaf basket
- B Dish
- C Nut
- D Ring
- E Stainless Steel Compression ring
- F Rubber sealing ring
- G Rubber sealing ring
- H Stainless Steel Funnel base

6.13 Funnel heating element

To prevent meltwater from freezing to the outlet of the gully when extreme frost periods occur, DYKA supplies funnel heating elements.

6.14 Vacurain funnel protector shaft for green roofs

DYKA also supplies a perforated funnel protector shaft for use in green roofs. The shaft is placed over the Vacurain funnel. When installed on a green or gravel roof, the first 50 cm around the shaft must be filled with pebbles of at least 16/32 mm. This funnel protection is not suitable for traffic load.



7. Maintenance

It is recommended to visually inspect the pipes every two years. It is recommended to keep the pipes accessible if they are hidden from view.

Blockages caused by dirty funnels must be avoided so as to prevent rainwater from being discharged via the emergency overflows. Depending on the building's location, regular inspection of the funnels is necessary at least once a year. Funnels, dishes and leaf baskets must be checked and cleaned at least once a year.

The objective of the inspection is to trace contamination which originates from outside of the system, such as the accumulation of leaves.

Contamination reduces the funnels' capacity, so that the system will not drain sufficiently during extreme rainfall.

Since pipes made from modified PVC do not have any bonding properties, there will not be any local pipe constrictions. Furthermore, the high speed of the water in the Vacurain system means that it is self-cleaning: any dirt residue is washed away.

Damage to the pipes can be easily repaired. The damaged section is cut away and replaced by a new part with the same diameter. Connections are made with glue sockets. Repairs may only be carried out by a qualified fitter.

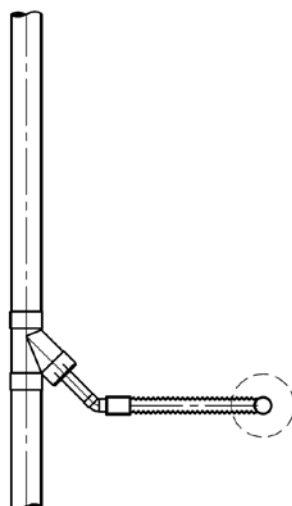
The leaf basket prevents larger foreign objects from getting into the system, which, in turn, prevents the system from becoming blocked. Periodic cleaning of the leaf baskets and the roof are essential for the system to work correctly.

8. Connection methods

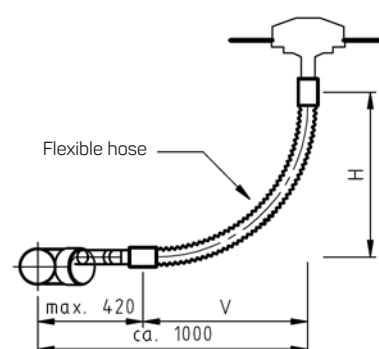
The diagrams below show the options for connecting funnels and hoses according to the connection methods specified by DYKA. The solutions shown are suitable for use with the given situation.

Connection method 1 (standard method)

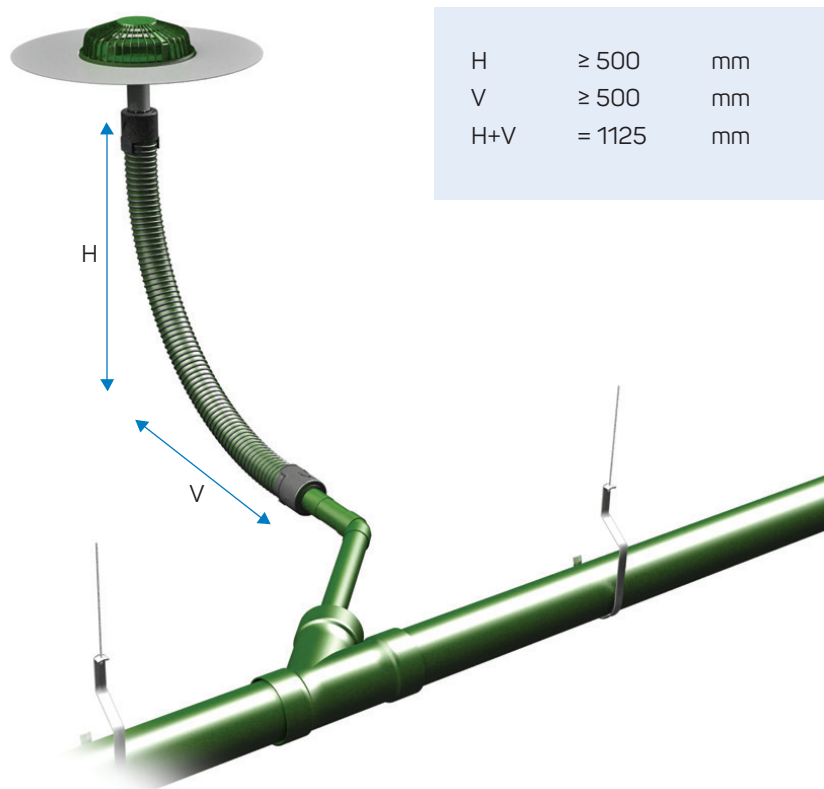
For the standard connection method, method 1, the funnel is located approximately 1 metre from the collection pipe. If this connection method is used, then a maximum change in length of approximately +/- 200 mm is permitted. This depends on the length of the collection pipe and the expected change in temperature.



Top view of the pipe and hose



Front view of the pipe, hose and funnel

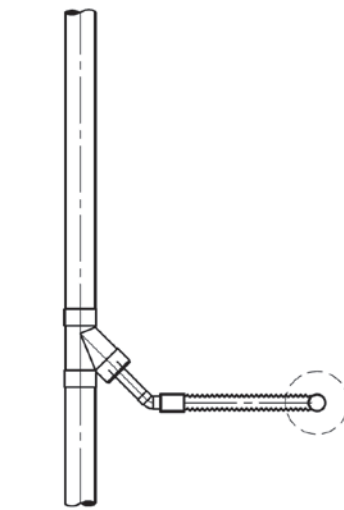


H	≥ 500	mm
V	≥ 500	mm
H+V	= 1125	mm

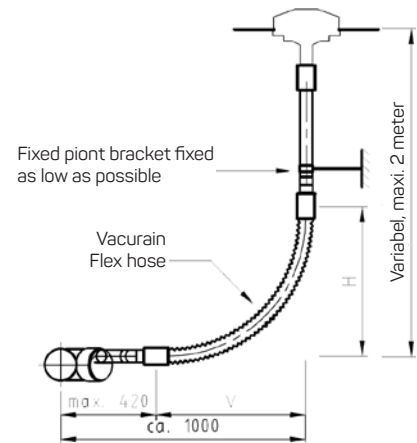
Connection Method 1a

For connection method 1a, the collection pipe is fitted in a lowered position and the funnel is located approximately 1 meter from the collection pipe. If this connection method is used, then a maximum change in length of approximately +/- 200 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature

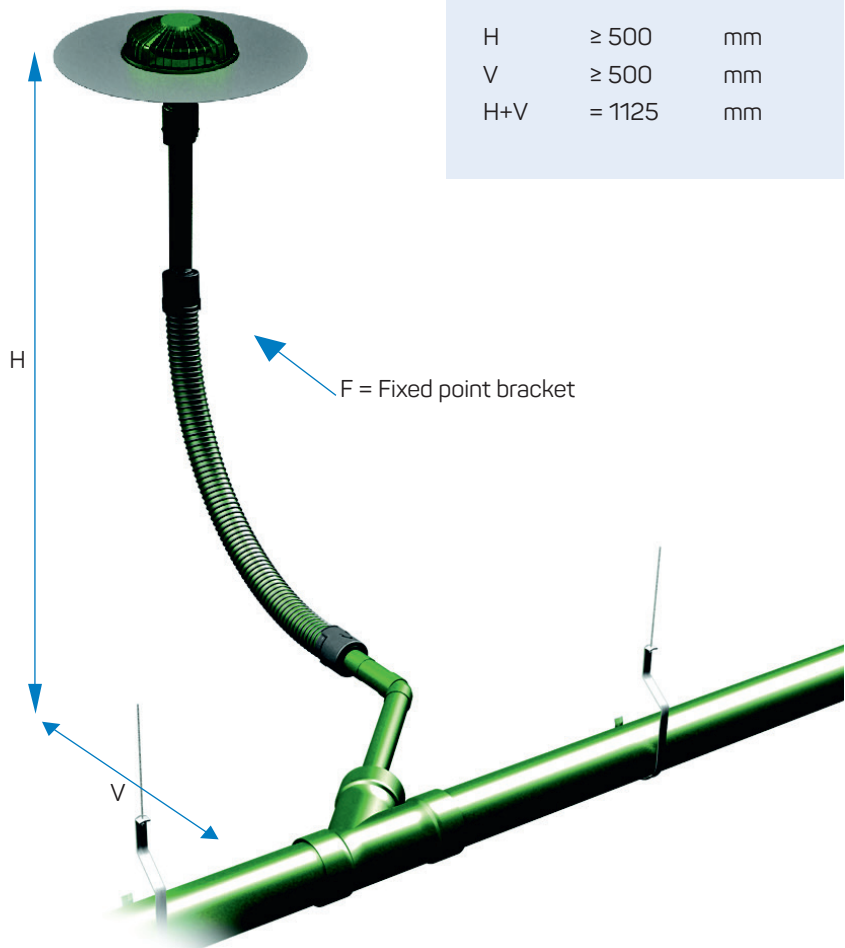
The maximum height of the extended section under the funnel is 2 metres from the funnel to the collection pipe, including the height of the hose



Top view of the pipe and hose



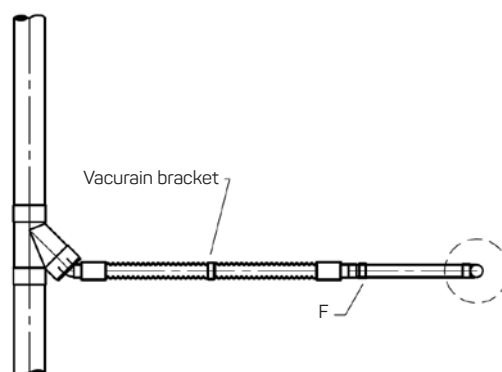
Front view of the pipe, hose and funnel



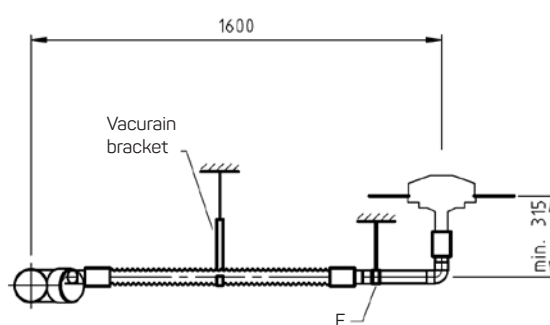
Connection method 2

For connection method 2, the collection pipe is fitted in a raised position and the funnel is located approximately 1.6 metres from the collection pipe. If this connection method is used, then a maximum change in length of approximately ± 200 mm is permitted. This depends on the length of the collection pipe and the expected change in temperature.

The length of the short section under the funnel must be at least 31.5 cm.

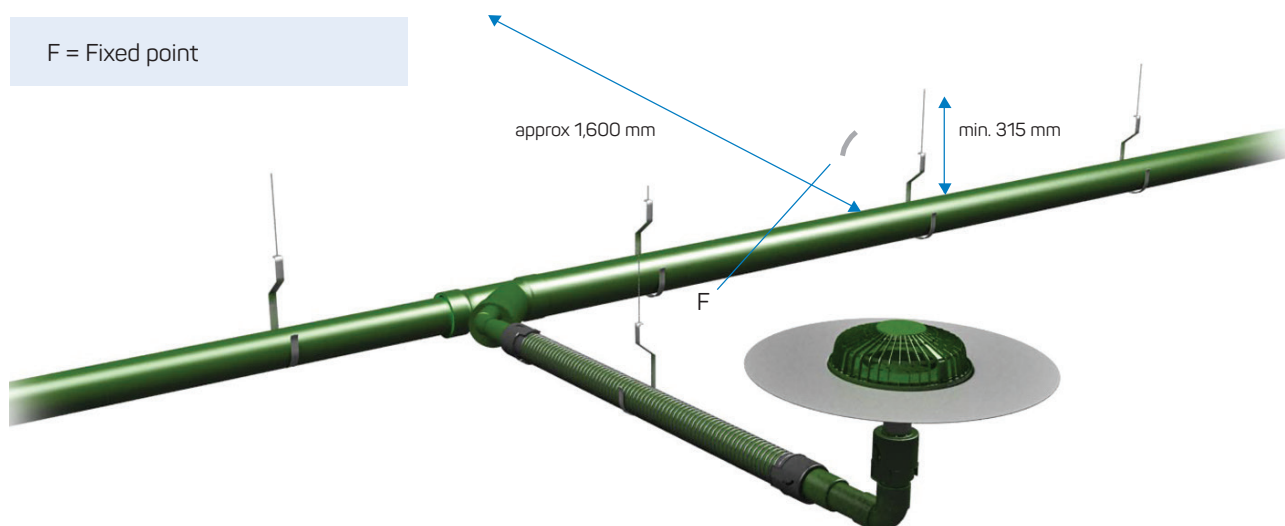


Top view of the pipe and hose



Front view of the pipe, hose and funnel

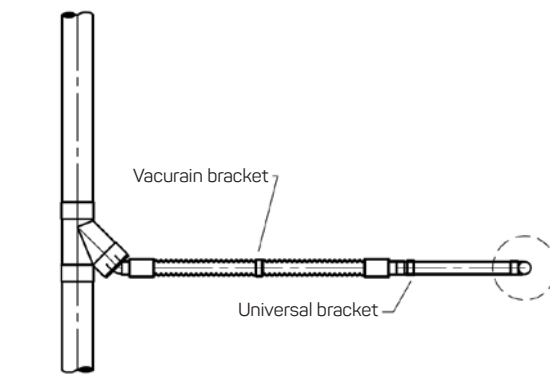
F = Fixed point



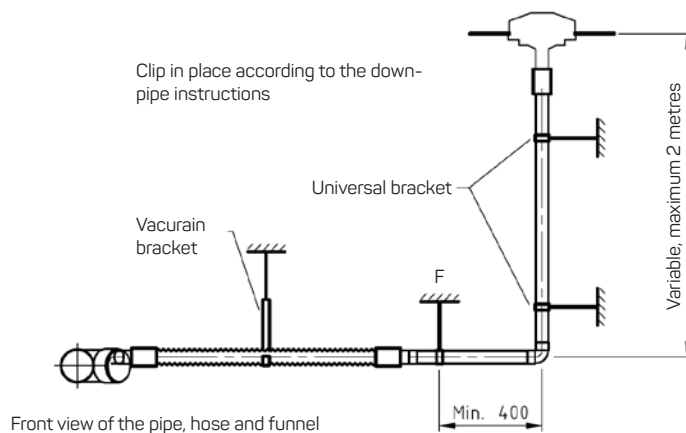
Connection method 3

For connection method 3, the collection pipe is fitted in a lowered position and the funnel is located approximately 1.6 metres from the collection pipe. If this connection method is used, then a maximum change in length of approximately ± 200 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature.

The maximum height of the extended section under the funnel is 2 metres from the funnel to the collection pipe, including the height of the hose.

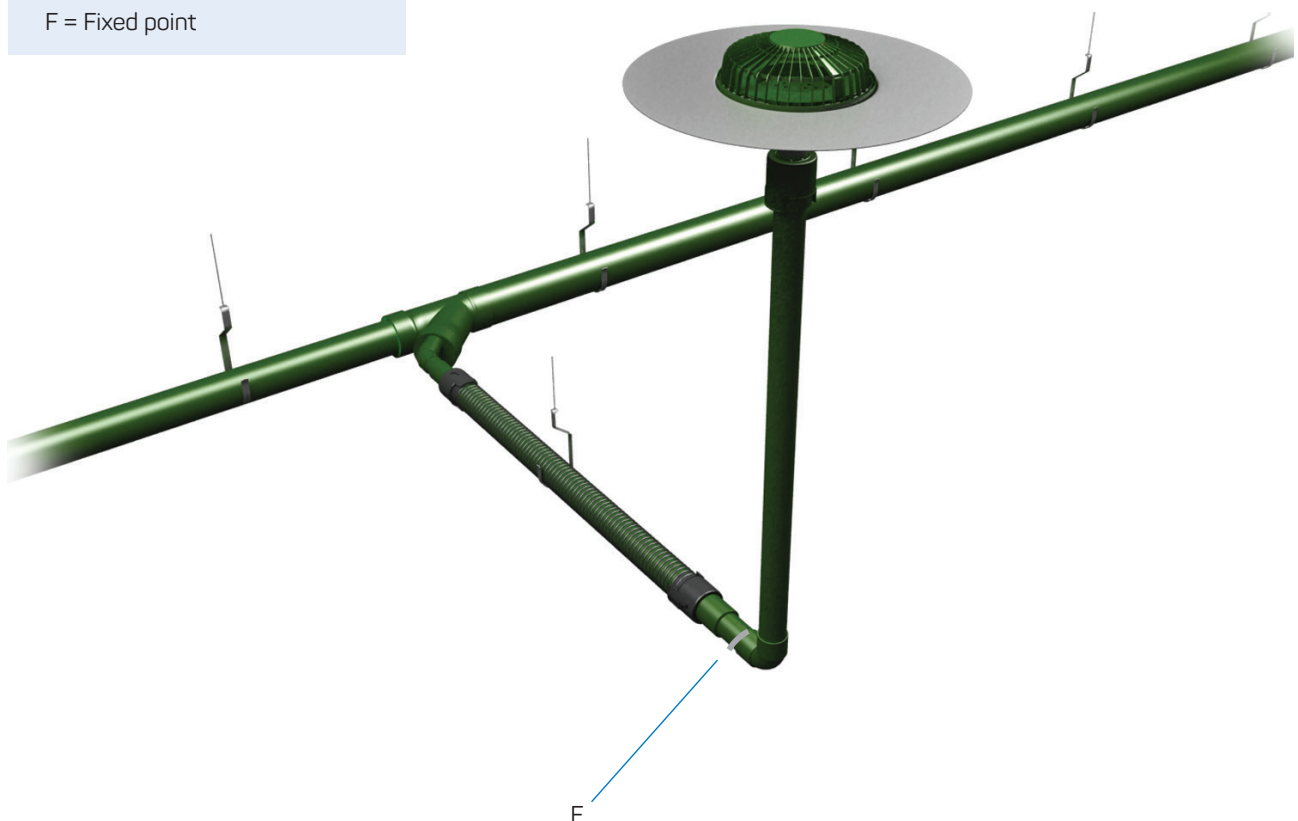


Top view of the pipe and hose



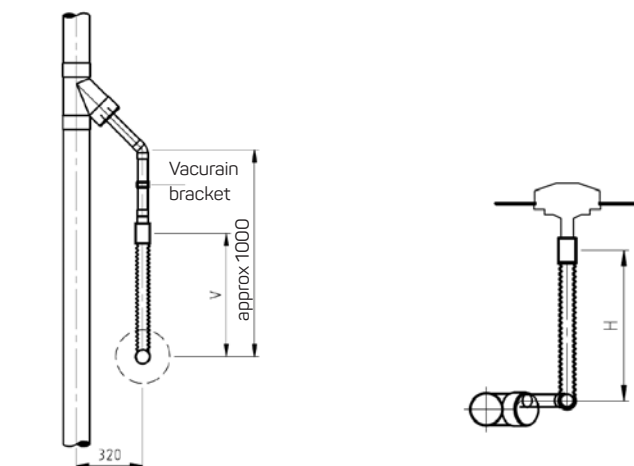
Front view of the pipe, hose and funnel

F = Fixed point



Connection method 4

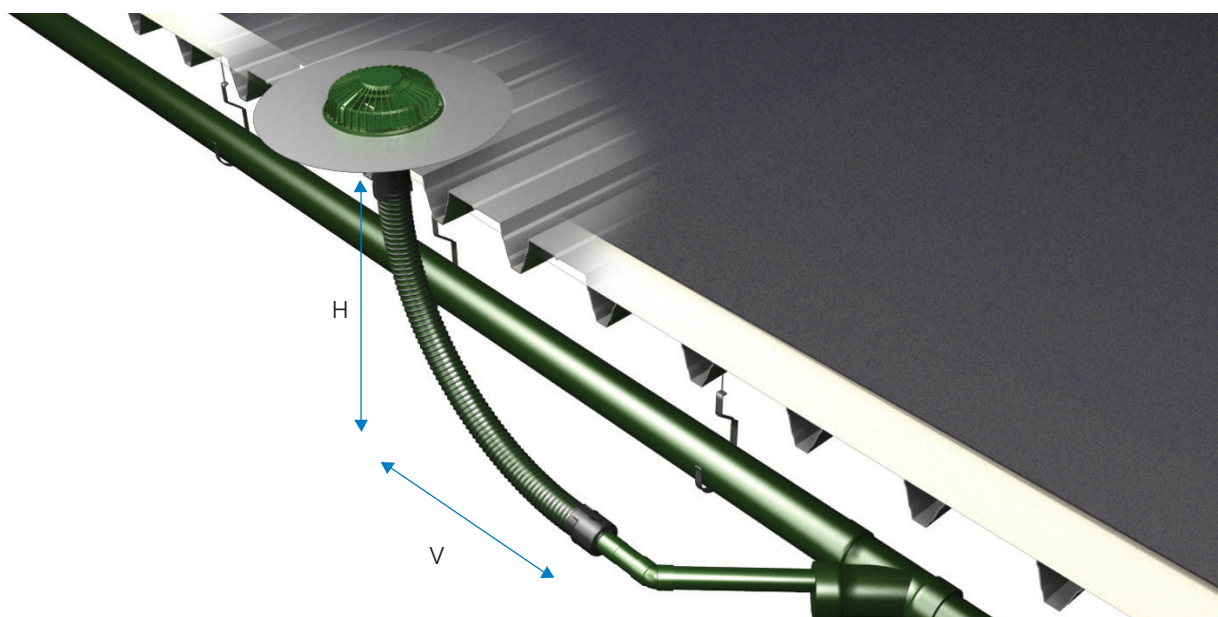
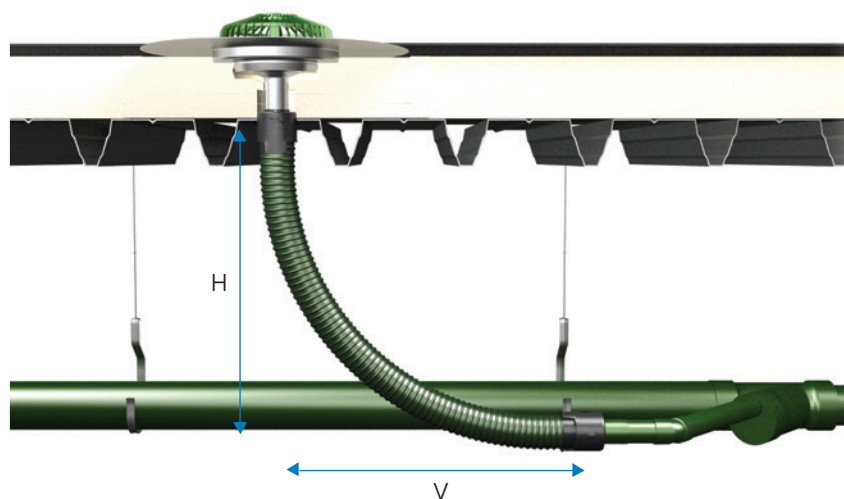
For connection method 4, the funnel is located approximately 0.3 metres from the collection pipe. If this connection method is used, then a maximum change in length of approximately +/- 100 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature.



Top view of the pipe and hose

Front view

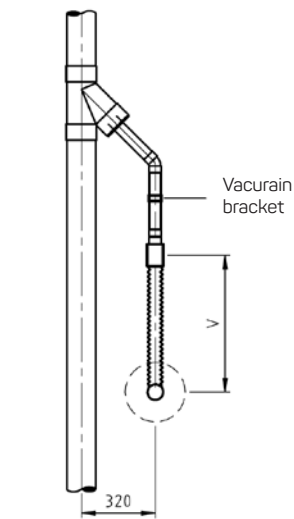
H	≥ 500	mm
V	≥ 500	mm
H+V	= 1125	mm



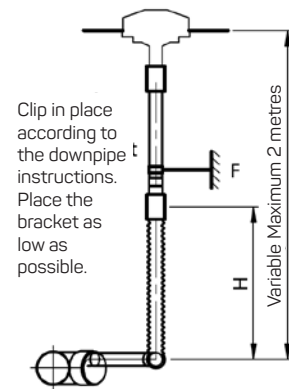
Connection method 5

For connection method 5, the collection pipe is fitted in a lowered position and the funnel is located approximately 0.3 metres from the collection pipe. If this connection method is used, then a maximum change in length of approximately +/- 100 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature.

The maximum height of the extended section under the funnel is 2 metres from the funnel to the collection pipe, including the height of the hose.



Top view of the pipe and hose

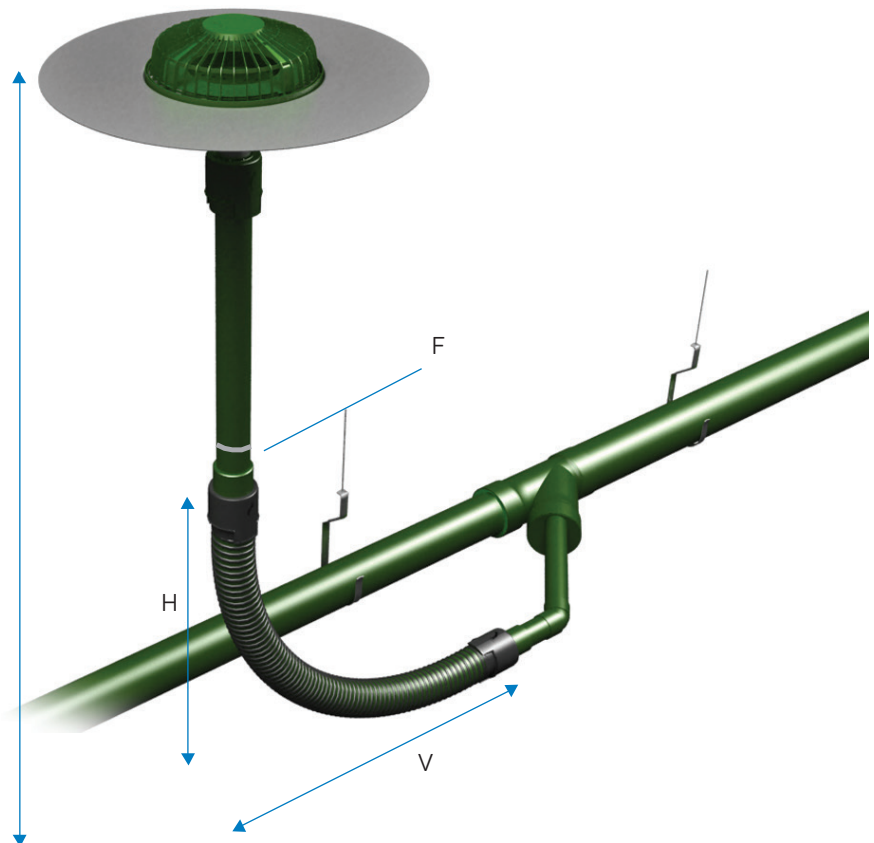


Front view

H	≥ 500	mm
V	≥ 500	mm
H+V	= 1125	mm

F = Fixed point

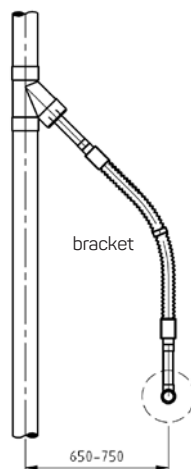
Variable: max. 2 metres



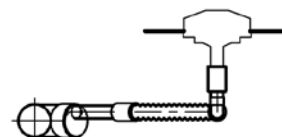
Connection method 6

Connection method 6 is intended for situations where the assembly height of the connection pipe is close to the underside of the roof. The maximum length of the short section under the funnel is 315 mm. If this connection method is used, then a maximum change in length of approximately ± 100 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature.

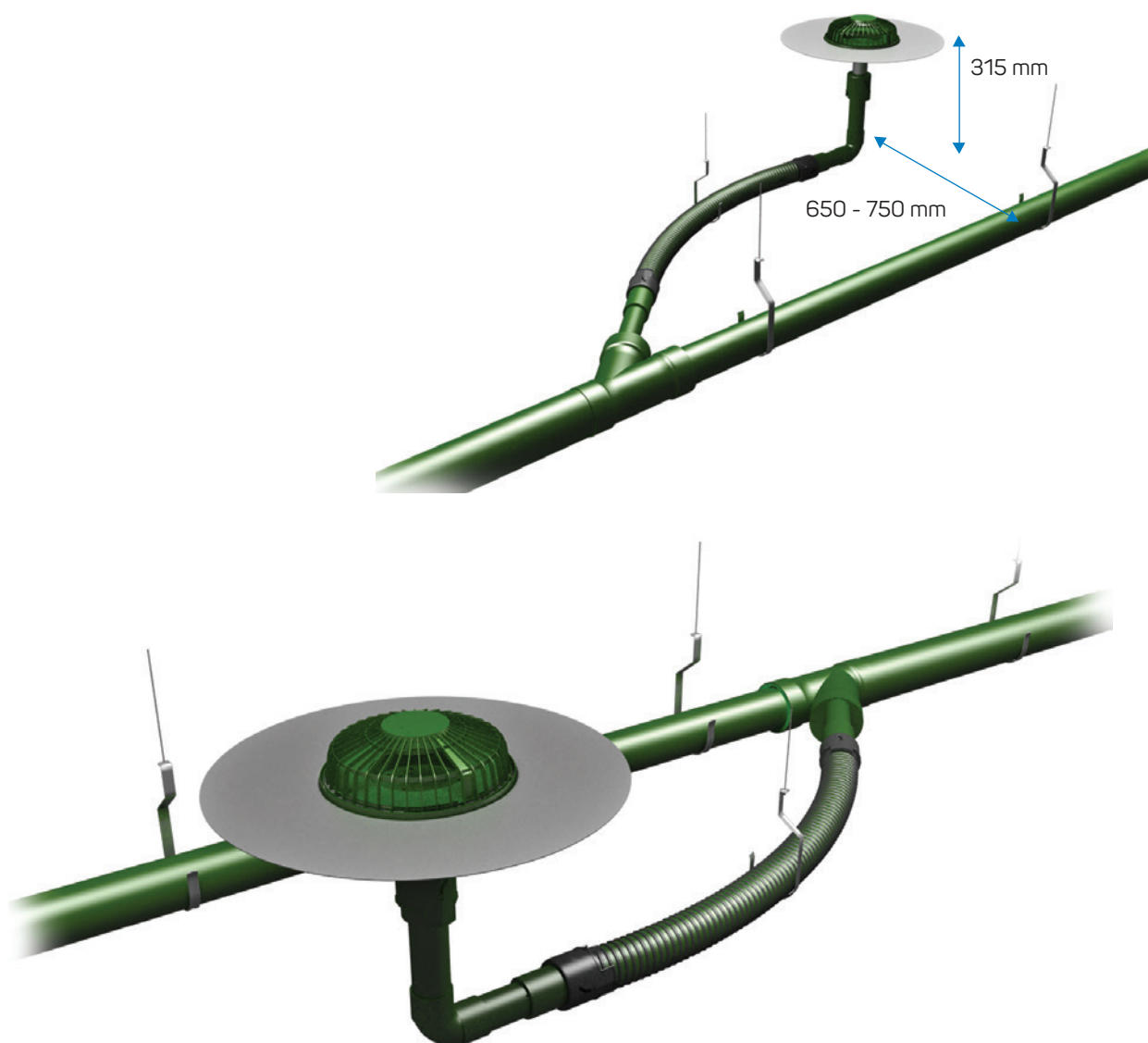
The funnel is located approximately 0.7 m from the collection pipe.
The maximum diameter of the funnel hose is 50 mm.



Top view of the pipe and hose

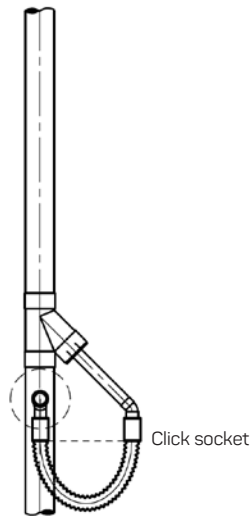


Front view

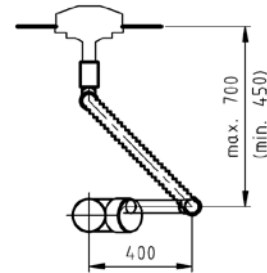


Connection method 7

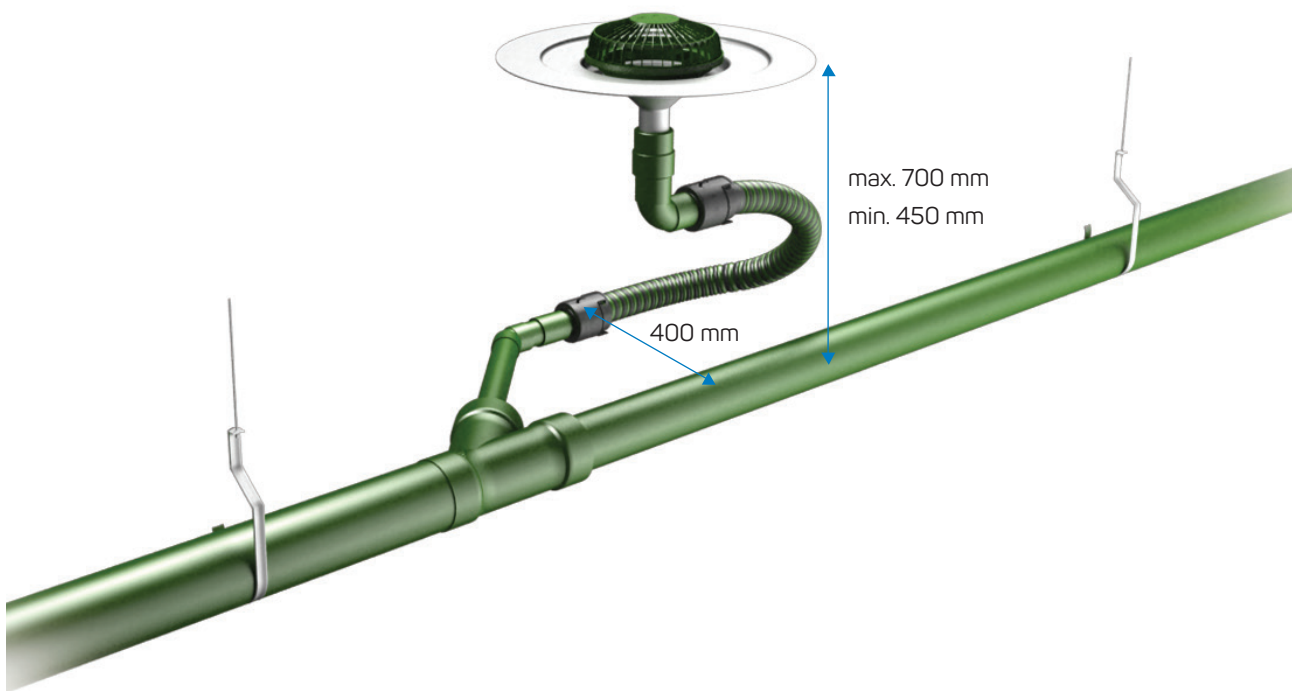
For connection method 7, the funnel is located directly above the collection pipe. The collection pipe must be more than 450 mm but no more than 700 mm below the roof level. The distance between the click socket connection at the transfer from the hose to the connecting pipe is 400 mm. If this connection method is used, then a maximum change in length of approximately +/- 200 mm is permitted. This depends on the length of the (horizontal) collection pipe and the expected change in temperature.



Top view of the pipe and hose



Front view



Connection method 8

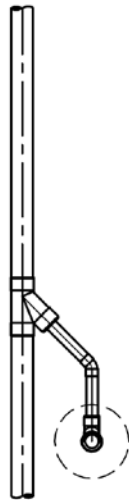
Connection method 8 is used when the funnels and the collection pipe are laid in a concrete roof floor.

The small assembly height can be achieved by shortening the funnel's bottom outlet by 45 mm. This is above the click ridge in the funnel's outlet. This prevents the 50 mm socket coupling's rubber seal from sealing the click ridge.

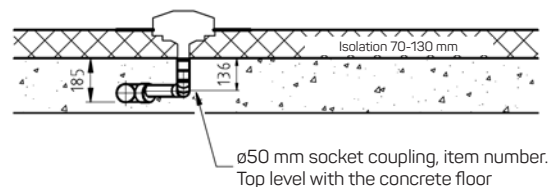
Connect the connecting pipe using two 45 degree 50 mm bends and a 50 mm socket coupling. The outlet of the aluminium funnel can be shortened using a metal saw. Connect it water-tight by using a rubber ring seal socket 50mm.

Only use this method for 50 mm funnels. Vacurain hoses will not be needed.

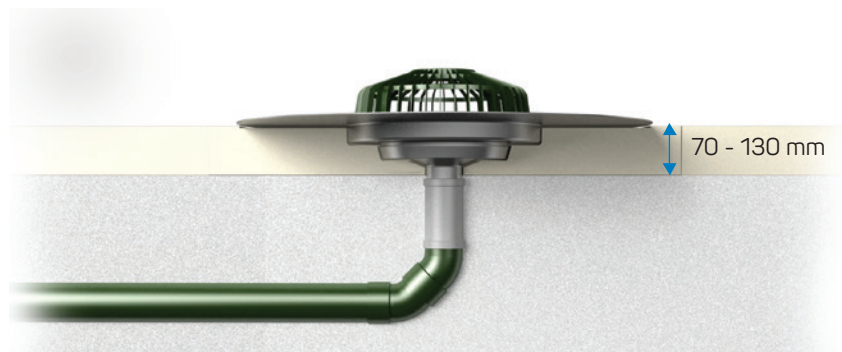
Take into consideration the minimum coverage of the collection pipe with regard to the underside of the concrete roof floor in accordance with the constructor's requirements.



Top view of the pipe and hose



Front view



9. Stabu specifications

50.11.10-a RAINWATER DRAINAGE

0. Rainwater drainage system

Design:

- In accordance with NEN 3215-2014.
- In accordance with NTR 3216-2012.
- In accordance with additional instructions issued by DYKA.

.01 Rainwater drainage system for flat roofs

50.12.10-a DIAGRAMS

0. Diagram

Roof gutters/Rainwater drains

The diagram(s) provided by the constructor must indicate:

- The location of the Vacurain funnels.

.01 Rainwater drainage system for flat roofs

50.12.20-a INSTALLATION CALCULATION

0. Roof gutters and rainwater drains

Calculations to be made by the constructor:

- For the Vacurain system's funnels.
- For the required overflow.

Calculation method according to NEN 3215-2014 and NTR 3216-2012 with additional instructions from DYKA.

.01 Rainwater drainage system for flat roofs

50.50.10-h ROOF DRAIN

0. Roof drain, Bottom outlet

- Manufacturer: - DYKA BV
- Type: - Vacurain funnel for a bitumen roof cover.
- Material: - Impact-resistant PVC.
- Accessories: - Vacurain hose connection.
- Additional items: - Insulation package.
- Covering plate.

.01 Rainwater drainage system for flat roofs

50.50.10-i ROOF DRAIN

0. Roof drain, Bottom outlet

- Manufacturer: - DYKA BV
- Type: - Vacurain funnel for a plastic roof cover.
- Material: - Impact-resistant PVC

- Accessories: - Vacurain hose connection.
- Additional items: - Insulation package.
- Covering plate.

.01 Rainwater drainage system for flat roofs.

50.50.10-j ROOF DRAIN

0. Roof drain, Bottom outlet

- Manufacturer: - DYKA BV
- Type: - Vacurain flange funnel.
- Material: - Impact-resistant PVC.
- Accessories: - Vacurain hose connection.

.01 Rainwater drainage system for flat roofs.

51.32.10-g INSTALLATION OF PLASTIC PIPES, PLASTIC PIPES

0. Installing Plastic

Rainwater drainage pipe

Method of installation

- Remove contamination, sharp edges and burrs before installing pipes and accessories.
- In accordance with NEN 3215-2014 and NTR 3216-2012 with additional instructions from the manufacturer of the Vacurain system.

Connecting method: - Adhesive bond.

Attachment method: - With brackets.

- Bracket distance: 10 times the pipe diameter with a minimum distance of 1 metre.

1. Plastic pipe, Impact-resistant PVC (Brl 5210-99)

- Manufacturer: - DYKA BV
- Type: - Vacurain Flex pipe.
- Outer middle line (mm): According to the diagram.
- Colour (RAL): - 6007
- Additional items: - Vertical pipes: DYKA thermally galvanized universal bracket.
- Horizontal pipes: DYKA electrolytically galvanized Vacurain bracket.

Plastic pipes are delivered under the KOMO product certificate.

.01 Rainwater drainage system for flat roofs.



10. Warranty

DYKA guarantees the Vacurain Flex system in writing for a period of 10 years.

This warranty only concerns improper operation due to material or manufacture errors.

A claim cannot be made against the warranty if:

- The materials are used incorrectly.
- The installation instructions were not followed.
- The calculations were not made by DYKA.
- The design provided by DYKA has been deviated from.

Repair work can only take place after approval has been given by DYKA.

Notes

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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