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Watertight corrugated PVC manholes

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Mechanical calculations



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SANECOR *calculation*

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1. Introduction

In urban sewerage networks and, in general, in pipelines above a certain diameter that transport water by gravity, there are a series of manholes spaced apart at intervals of no more than 50 m.

The purpose of these elements is to provide access to the pipeline for inspections, maintenance, repairs, etc.

Traditionally, these manholes have been manufactured ***in situ*** with cheap materials such as reinforced concrete or brick masonry, although for several years now it has also been very common to build them with prefabricated components, either made of concrete or plastic materials.

In sewage and drainage networks, plastic materials offer significant advantages due to their excellent performance against chemical damage from effluents and the gases they release, and their high resistance to abrasion caused by the flow of water, which in the case of wastewater laden with solids can have a very destructive effect on traditional materials.

From a hydraulic perspective, the smooth surface of plastic materials optimises water velocity, significantly increasing the flow rate at an equal cross-section.

Additionally, plastic materials often have watertight couplings at their joints with pipes. On the one hand, this watertightness prevents pollution of the environment and, on the other hand, it prevents infiltration of groundwater into the sewer network.

If these infiltrations are substantial, they often lead to high additional costs for wastewater transport and treatment and, depending on the amount and type of infiltrated water, they can also undermine or even impede the purification process.

Finally, it should be noted that manholes made of plastic materials are very light, which makes them much easier to handle and assemble, as well as offering greater occupational safety during installation in the trenches where they are buried.

However, prefabricated manholes made of plastic materials have two drawbacks:

- **Price**: these materials are much more expensive than traditional ones, although the difference in cost is greatly reduced when comparing the number of installed manholes. This is due to the low weight and high installation efficiency when using plastic materials.

- **They lack the versatility required to accommodate changes in the location of connections made** *in situ*: as they are usually prefabricated components, the joints with the pipes are made by welding pipe sections onto the manhole body. Any variation in the angles or elevations of the pipes when they are installed requires them





Traditional solutions

to be connected to the manhole using unforeseen components (special parts) or, worse still, by applying force to the welds, with the risk that the manhole outlets may be damaged or even break, thus losing their watertightness.

It should also be noted that, depending on the thickness of the manhole wall and the material used, its mechanical strength may not be adequate to withstand external loads from the existing ground and traffic. In such an event, the manhole must be lined with concrete after installation.

On this point, it is worth noting that the pipes in an urban sewage network are usually located under existing roads, as they collect water from the connection points from buildings.





Watertight solutions

2. SANECOR® watertight manhole system

At **Molecor** we have extensive experience in manufacturing manholes with different materials. Over the years, we have seen first-hand the advantages and disadvantages of both prefabricated manholes made of rigid materials (fibre cement and concrete) and plastic materials (FRP, HDPE and PVC).

Molecor's product strategy has always focused on developing high-quality, cost-competitive solutions with the main aim of adapting to the needs of the sectors in which it operates. This has led to the company adopting a policy based on innovation and continuously improving our products and services. In this particular case, this policy has allowed us to design and develop a wide range of manholes which not only takes advantage of the beneficial properties of plastic materials, it also resolves the problems described above that these materials can have.

This design makes the solution much cheaper than other plastic manholes and, more importantly, ensures excellent watertightness in the network.

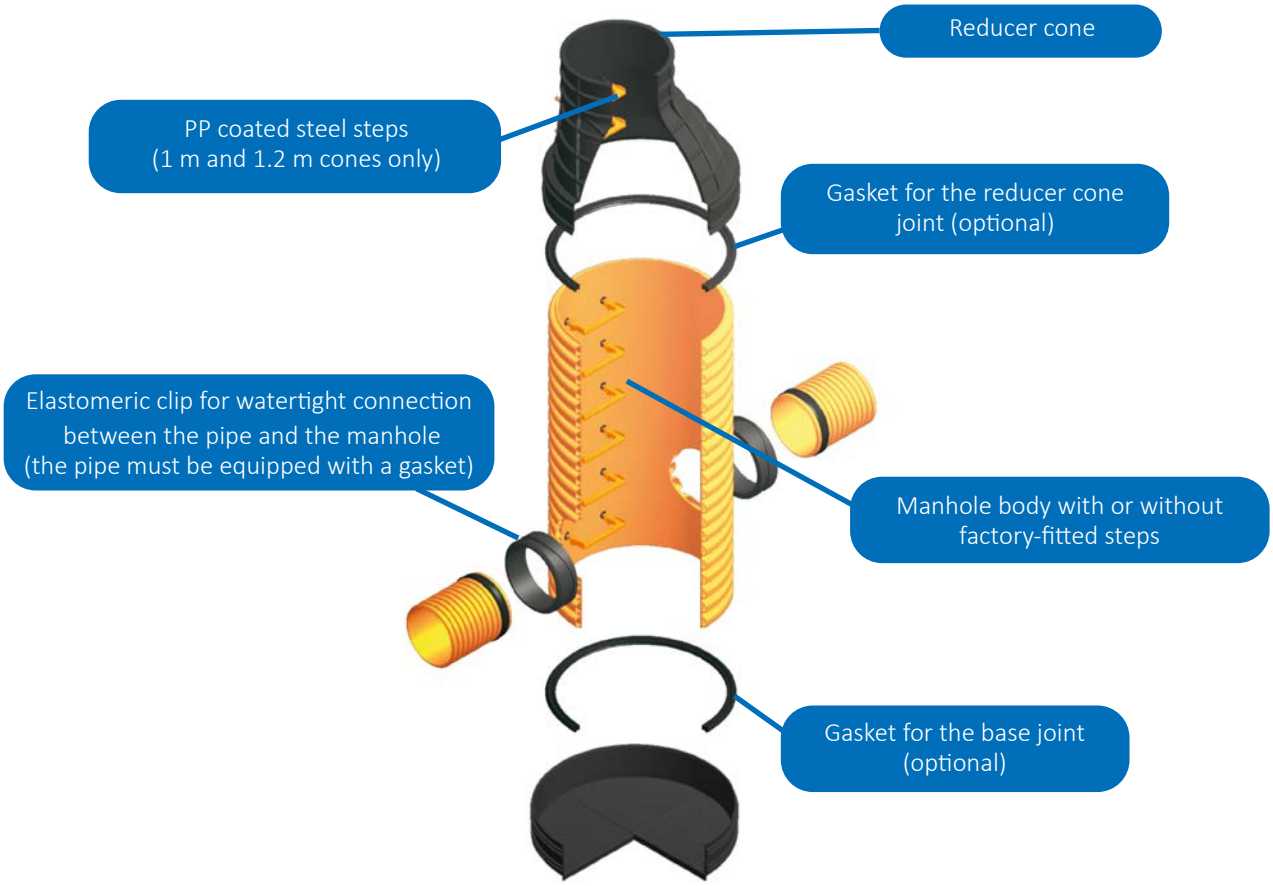
SANECOR® manholes have been in use for over 20 years, with thousands of references distributed across Spain.





3. Components of the standard SANECOR® manhole solution

Details of the components of a standard **SANECOR®** manhole (pipes up to DN630):



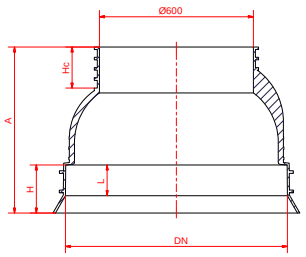
Outline of other **SANECOR®** manhole solutions

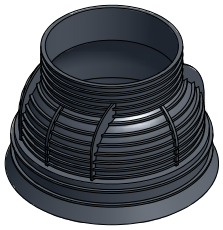


3.1. Entrance cone

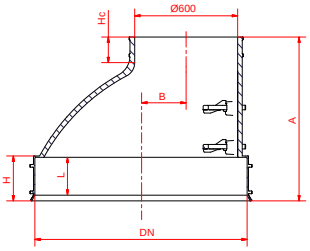
The manhole entrance reducer cone is made of high-quality HDPE, using a system that allows a large volume of plastic parts to be produced at a competitive price. This cone, which has a 600 mm opening, is asymmetrical and features two steps in the 1000 and 1200 mm manholes, while it is symmetrical and has no steps in the 800 mm manhole. It features a ribbed design to ensure high rigidity.

The cone fits into the upper end of the body, making it very easy to install. Optionally, a gasket can be installed between the reducer cone and the manhole body to ensure watertightness in the event of high groundwater levels.





Reducer cone for manhole with 800 mm diameter

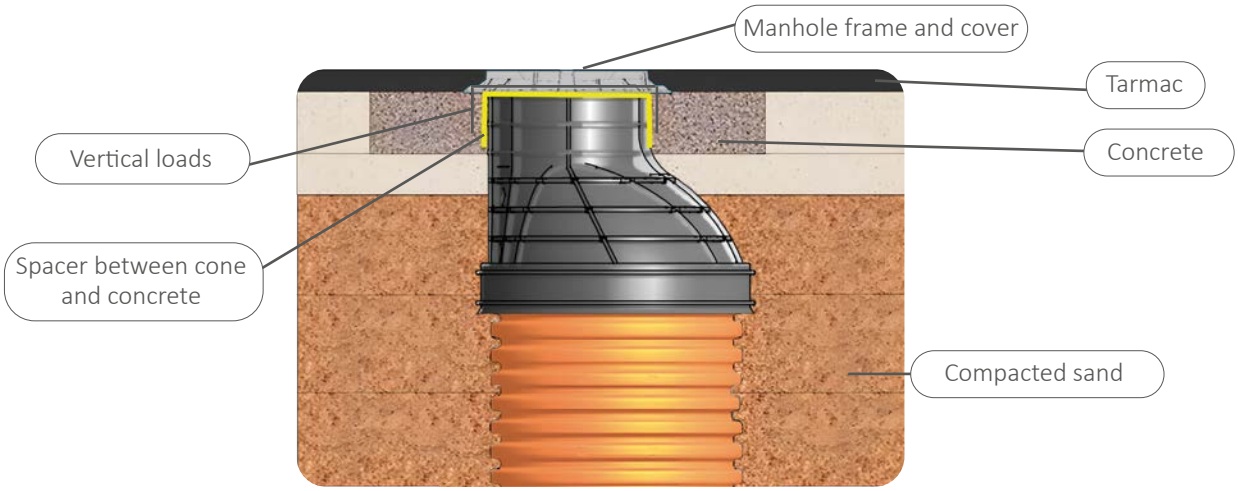




Reducer cone for manhole
with 1000 and 1200 mm diameters

When installing this element, the installation recommendations- which are the same for our whole range of manholes- must be followed. As a general rule, a concrete slab should be laid to support the upper frame and cover, ensuring that this slab is separated from the plastic cone using polystyrene, a geotextile, etc. This will protect the manhole from impacts to the cover caused by the presence of traffic and will avoid small deformations of the manhole that could damage the wearing course.

Manhole DN (mm)	Thickness (cm)	Slab section (m)	
		With traffic	Without traffic
630	20	1.20x1.20	1.00x1.00
800	20	1.40x1.40	1.20x1.20
1000	20	1.70x1.70	1.50x1.50
1200	20	2.00x2.00	1.80x1.80



Finish at the top of the manhole

3.2. Manhole body

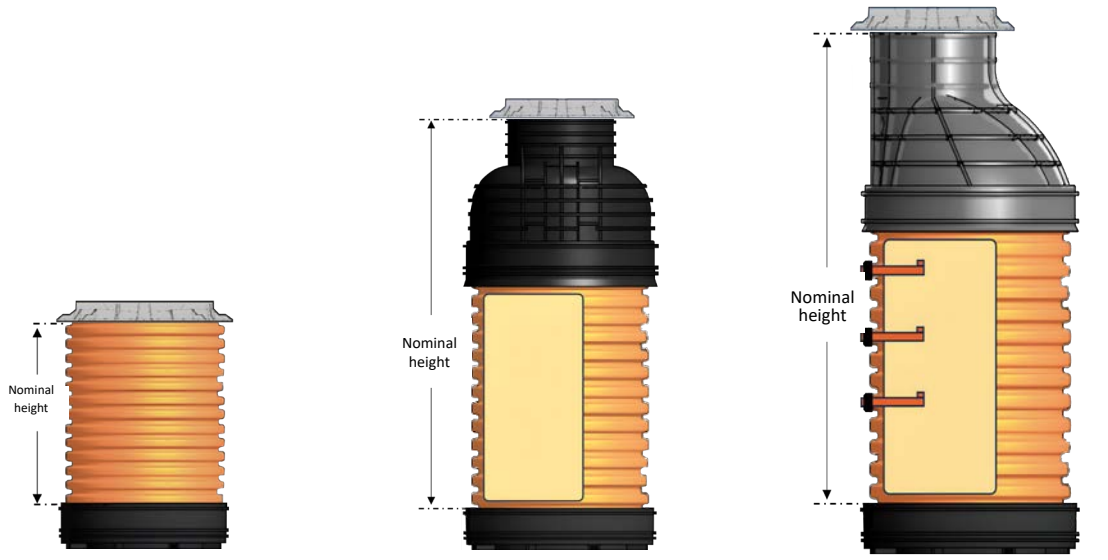
This is made from **SANECOR®** corrugated PVC pipe material with SN8 nominal stiffness, which ensures very high resistance to external loads throughout the life of the manhole. This material means that the manholes do not have to be reinforced with concrete to strengthen their rigidity. On the contrary, having a flexible material can be very beneficial in the event of ground settlement. **SANECOR®** manholes come in various diameters, ranging from 630 to 1200 mm.





The SANECOR® manhole body is manufactured with the same material as SANECOR® SN8 pipes

For shallow manholes, 630 mm diameter inspection chambers (without a cone or steps) can be used, which are very suitable for heights of less than 1.5 m, or 800 mm diameter manholes can be used for greater heights, with the option of adding steps. For the most common manholes with diameters of 1000 mm and 1200 mm, which, unless otherwise requested, are always fitted with steps, the height ranges from 1.5 m to 6 m.



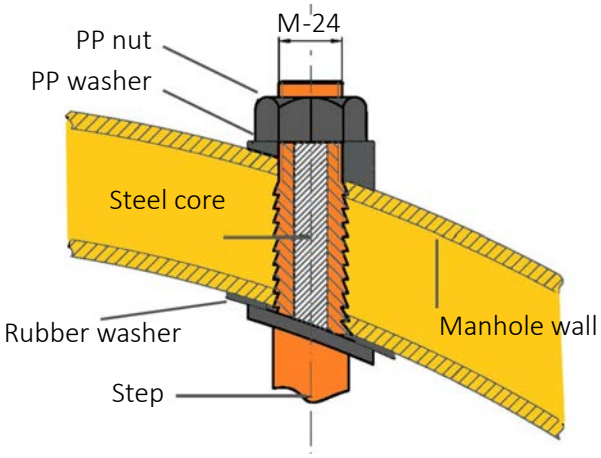
DN630 mm manhole | DN800 mm manhole | DN1000 and 1200 mm manhole

Standard range of SANECOR® bodies

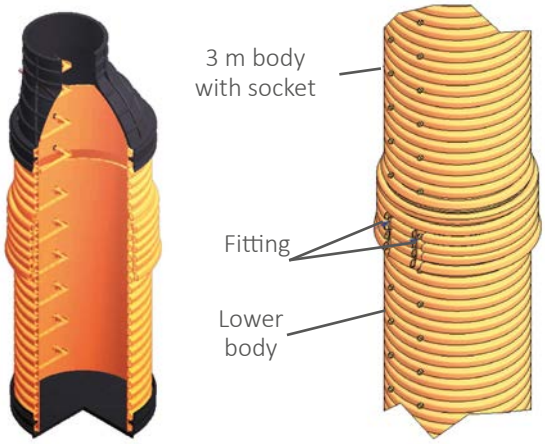
The steps installed in the manhole body are made of steel and are coated with polypropylene to prevent corrosion.

They are fitted with special washers to ensure watertightness against water ingress from the water table.

They are installed at the top of corrugations, evenly spaced at no more than 30 cm intervals.



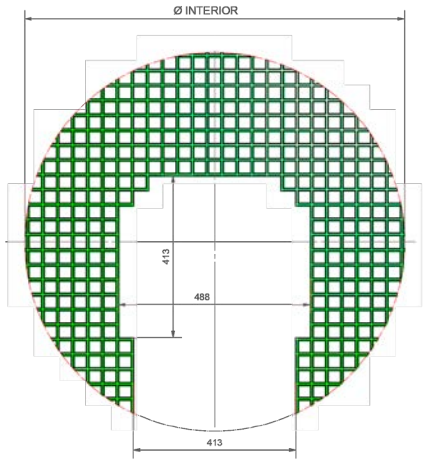
Details of the step attachment



Deep manholes using two units

The height of the bodies is customised according to the depths present on the site (bodies are manufactured in length increments of 0.5 m), up to a maximum of 5.5 m, for 6 m manholes. For deeper manholes, a second unit is used with a socket end to allow it to be joined to the previous unit.

Manholes of a certain depth must be equipped with grating or safety platforms which, as well as protecting against accidents, allow users to stop safely as they climb down. It is advisable to install these elements every 2.5 or 3 m of depth. **SANECOR®** manholes are equipped with custom-made grating, made of reinforced polyester to prevent electrochemical corrosion.





Polyester grating in SANECOR® manholes

3.3. Elastomeric clip

Elastomeric clips are used to ensure watertightness at pipe joints or at any downstream connections to the manhole body. Elastomeric clips are installed after drilling the corresponding holes *in situ*, which makes the system highly versatile as these connections can be made in the precise location required for the project, so the manhole can be adapted to meet the requirements of each site and any unforeseen circumstances that may arise. The extremely thick corrugated bodies make it possible to install clips of sufficient length to ensure total watertightness, even when there is some angular deflection. For this purpose, these parts are custom-designed according to the dimensions of the corrugated body.

To ensure that the manhole is watertight, you should always use specific elastomeric clips for each **SANECOR®**manhole, which are custom-designed for the thickness and curvature of the manhole and fit the borehole wall on both the inside and the outside. There are universal elastomeric clips on the market that do not guarantee watertightness.

The method for carrying out the connections is very simple and does not require specially trained personnel. The clip is supplied with an adhesive template which, when fixed to the manhole body in the trench, allows holes to be drilled quickly and accurately. The following sequence shows the different steps in the installation of an elastomeric clip, with drilling being performed using a jigsaw.



Elastomeric clip installation sequence





Elastomeric clip installation sequence

For small diameters (250 mm), drilling can be carried out with a crown drill bit installed on a hand tool.



Making a connection point with a crown drill bit

This system makes it possible to connect the pipes to the manhole body *in situ* and at the exact point where they need to be connected, with no need to make adaptations, as is required with prefabricated elements.

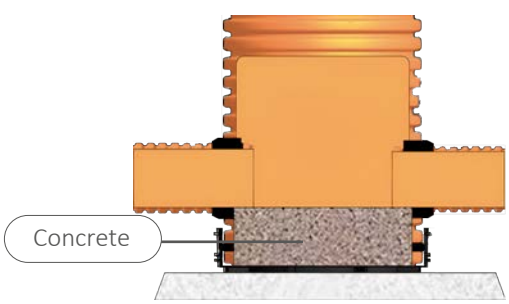




Connection points installed *in situ*

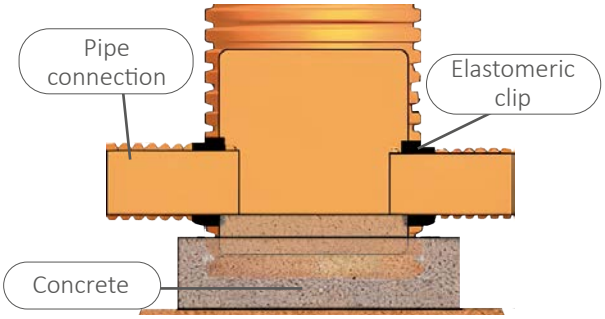
3.4. Watertight base

The bottom of the manhole is sealed with an HDPE plastic base, which features a gasket to prevent the ingress of groundwater through the bottom. Although this base is optional, it is recommended whenever the water table is at the same level as the manhole. Otherwise, the manhole can be installed without the base by filling the bottom of the manhole with concrete directly.





Manhole bottom finished with watertight base (necessary with groundwater)





Manhole bottom with a concrete finish (only recommended when there is no groundwater)

In both cases, the interior of the manhole must be finished with concrete, with the pipeline being formed with a reel of pipe passing through the manhole, with the top half of the pipe cut off, in order to minimise head losses.

***Note 1**: for manholes where the connections are made with elastomeric clips, the nominal height of the manhole is approximately the total height of the manhole minus the height of the base (for manholes with bases), or the total height of the manhole minus the concrete slab (for manholes without bases). In the latter case, the concrete slab must cover the bottom two corrugations, except in the case of short manholes measuring 630 mm, where it must cover the bottom three corrugations. In any event, in this type of manhole, the nominal height is not the same as the water flow depth, as this will depend on where the pipe connections are located. This depth will always be lower than the manhole's nominal height.*



Interior finish of a manhole at 180°

Installation instructions Manholes with watertight solid bases (for pipes up to DN630)

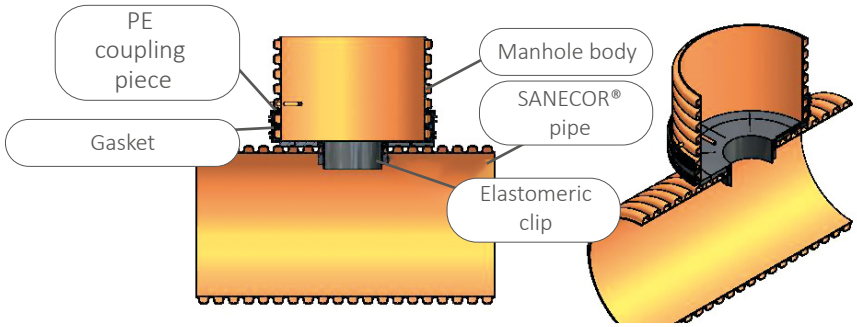
4. Other solutions from the SANECOR® manhole range

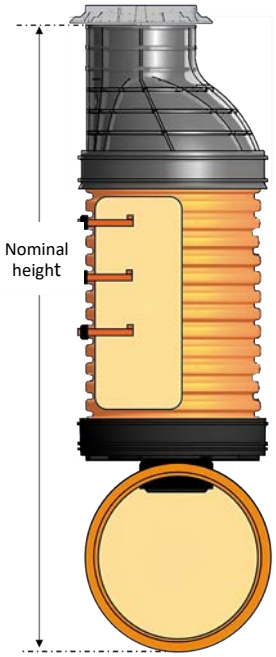
4.1. SANECOR® manholes for large-diameter pipes

The **SANECOR®** range of manholes is not only available for pipe diameters up to 630 mm with an elastomeric clip, **Molecor** has also expanded the range to provide an efficient, lasting solution for installations that require the use of large-diameter pipes (up to 1200 mm). This type of manhole also comes in versions with or without steps, to meet the technical safety requirements and facilitate inspections.

4.1.1. SANECOR® manholes with inspection bases

This type of solution allows the manhole to be connected to the pipe via a base with an inspection chamber at the bottom. The lower end of the body is sealed with a base and gasket and has an opening in the middle, thus providing a concentric access point to inspect the pipe from its uppermost point. This opening ends in a vertical collar where the pipe can be connected via an elastomeric clip to ensure complete watertightness of the assembly.





***Note**: for manholes with inspection bases, the nominal height of the manhole is approximately the sum of the height of the manhole above the pipe plus the diameter of the pipe up to a maximum nominal height of 5 metres.*

This type of manhole does not require interior finishing as the continuity of the pipe is maintained at all times. Manholes with inspection bases are accessible down to the base at the bottom, where maintenance, cleaning and any other necessary work can be performed. Workers should never enter pipes via a manhole when the network is being installed/in operation. The dimensions of the manholes and pipes available in this range are shown below:





Installation of the body with inspection base

Dimensions of manholes and connections	
Manhole DN	**For pipe**
1000	800, 1000 and 1200 mm
1200	800, 1000 and 1200 mm

Installation instructions Manholes with inspection bases (for DN800, 1000 and 1200 pipes)

4.1.2. SANECOR® prefabricated welded manholes with solid bases

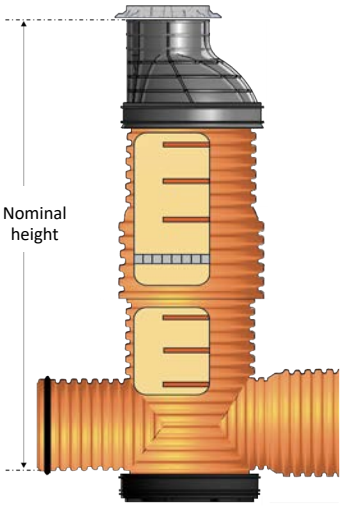
As technology has evolved and our knowledge and experience of working with PVC-U pipes has increased, we have developed a whole range of manholes by using chemical welding to join pipe segments together, thus providing a solution for large-diameter pipes.

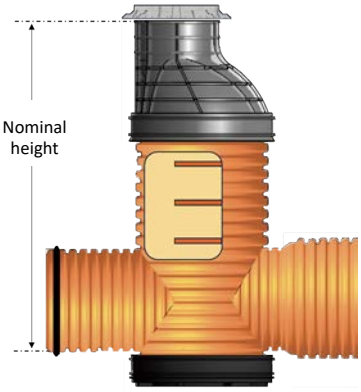
This solution is based on a **SANECOR®** manhole with a 1000 or 1200 mm solid base to which an inlet and/or outlet of the corrugated PVC pipe is welded at 180° so that it can be connected directly to the pipeline during the installation phase.

For connections at angles other than 180°, contact our technical office.

Each joint is welded on both the inside and outside to guarantee the watertightness and mechanical strength of the system.

This type of solution with a welded inlet and outlet is possible when the diameter of the manhole is larger than the diameter of the pipe.





Welded manhole with solid base (manhole DN > pipe DN)	
Manhole DN	**For pipe**
1000	800 mm
1200	1000 and 1200 mm

Generally speaking, the manholes in this type range have a single body for all nominal heights except for 1200 mm manholes with a 1000 mm pipe, which are higher than 3 m. These are composed of two bodies joined together using the flare end/male system and an elastic joint.

In solutions that have steps, when the manhole is composed of two bodies, grating will be installed in the area where the bodies are connected together.

The male outlet will be fitted with a rubber gasket so it can be connected to the **SANECOR®** pipe on site.



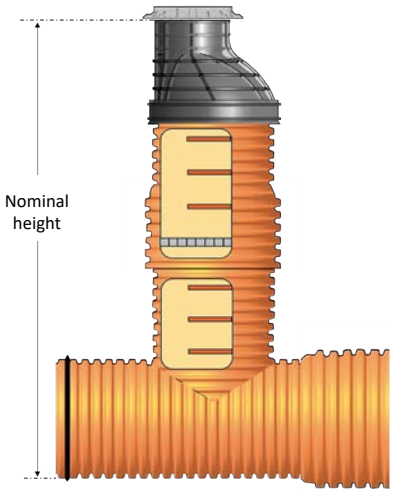
Installation of prefabricated welded manhole with solid base

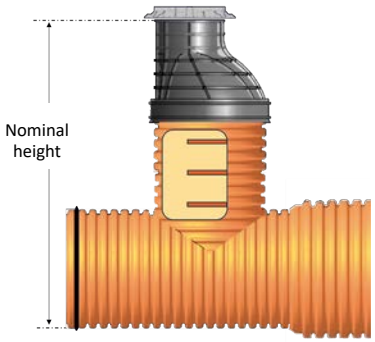
Once installed, in order to finish the inside of the manhole, a layer of concrete will be laid to make it flush with the water level in the pipe, in the same way as for conventional manholes, as detailed on page 10 of this document.

The following table summarises the nominal heights of the welded manholes in this range and their codes.

Installation instructions Prefabricated welded manholes with inspection bases (for DN800, 1000 and 1200 pipes)

1000 manhole to 800 pipe		1200 manhole to 1000 pipe		1200 manhole to 800 pipe	
Code	Nominal height	Code	Nominal height	Code	Nominal height
PSA100020	2	PSB120022	2.2	PSA120020	2
PSA100023	2.3	PSB120025	2.5	PSA120023	2.3
PSA100026	2.6	PSB120028	2.8	PSA120025	2.5
PSA100029	2.9	PSB120031	3.1	PSA120028	2.8
PSA100032	3.2	PSB120033	3.3	PSA120031	3.1
PSA100035	3.5	PSB120036	3.6	PSA120033	3.3
PSA100038	3.8	PSB120039	3.9	PSA120036	3.6
PSA100041	4.1	PSB120042	4.2	PSA120039	3.9
PSA100044	4.4	PSB120044	4.4	PSA120042	4.2
PSA100047	4.7	PSB120047	4.7	PSA120044	4.4
PSA100050	5	PSB120050	5	PSA120047	4.7
PSA100053	5.3	PSB120052	5.2	PSA120050	5
PSA100056	5.6	PSB120055	5.5	PSA120052	5.2
				PSA120055	5.5





4.1.3. SANECOR® prefabricated welded manholes with built-in junction

This second type of welded manhole has allowed us to simplify the manhole's design with a single weld, enabling us to create a new range that makes on-site installation even easier. It consists of a 1000 or 1200 mm pipe section welded directly to the manhole body. The end result is a T-assembly that can be installed directly on the pipe using a **SANECOR®** male-female joint. This solution can be manufactured when the diameter of the manhole is equal to or smaller than the diameter of the pipe.

T-welded manhole (manhole DN ≤ pipe DN)	
Manhole DN	For pipe
1000	1000, 1200 mm
1200	1200 mm

Generally, this range of manholes will only have a lower T-assembly for heights below 3 metres. For heights above 3 metres a **SANECOR®** pipe section with a socket will be fitted to reach the desired height.

In solutions that have steps, two-body manholes will be equipped with grating in the area where the bodies are connected together. The male outlet will be fitted with a rubber gasket so it can be connected to the **SANECOR®** pipe on site.

Once the manhole is installed, no internal finishing will be necessary as its geometry ensures an extremely level

Installation instructions Prefabricated welded manholes in T-assembly (for DN1000 and 1200 pipes)

flow of water and outstanding continuity in the pipeline. The following table summarises the nominal heights of the welded manholes in this range and their codes.

1000 manhole to 1000 pipe		1000 manhole to 1200 pipe		1200 manhole to 1200 pipe	
Code	Nominal height	Code	Nominal height	Code	Nominal height
PSB100023	2.3	PSC100023	2.3	PSC120024	2.4
PSB100026	2.6	PSC100026	2.6	PSC120027	2.7
PSB100029	2.9	PSC100029	2.9	PSC120030	3
PSB100033	3.3	PSC100033	3.3	PSC120033	3.3
PSB100036	3.6	PSC100036	3.6	PSC120035	3.5
PSB100039	3.9	PSC100039	3.9	PSC120038	3.8
PSB100042	4.2	PSC100043	4.3	PSC120041	4.1
PSB100045	4.5	PSC100046	4.6	PSC120043	4.3
PSB100048	4.8	PSC100049	4.9	PSC120046	4.6
PSB100051	5.1	PSC100052	5.2	PSC120049	4.9
PSB100054	5.4	PSC100055	5.5	PSC120051	5.1
PSB100057	5.7	PSC100058	5.8	PSC120054	5.4
PSB100061	6.1	PSC100061	6.1	PSC120057	5.7
				PSC120060	6



Inside view of prefabricated welded manhole in T-assembly

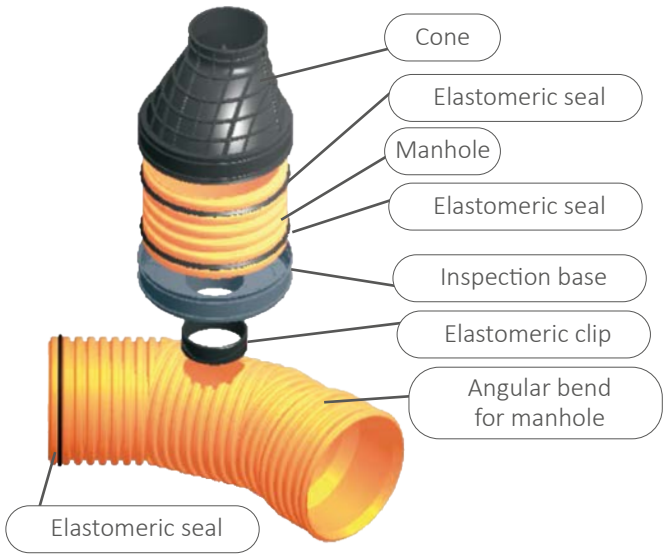
4.1.4. Manholes in pipes with direction change

Where there are changes in the direction of the pipe network, a manhole is usually installed at the point where the direction changes.

When the diameter of the pipe allows it to be connected directly to the manhole body these manholes feature an installation system that makes it possible to connect them at the required angle.

When the manhole is installed with an inspection base, the **SANECOR®** system is able to accommodate large-diameter bends for placement of the manhole at the point where the direction changes.

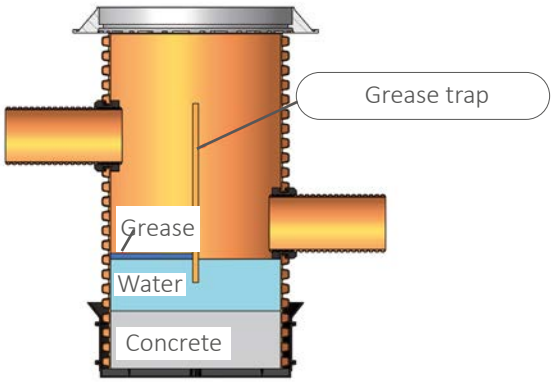




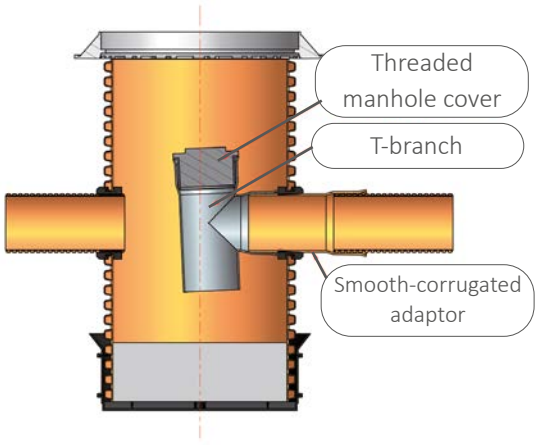
Manhole installation for pipes with direction change

4.2. Special inspection chambers and manholes

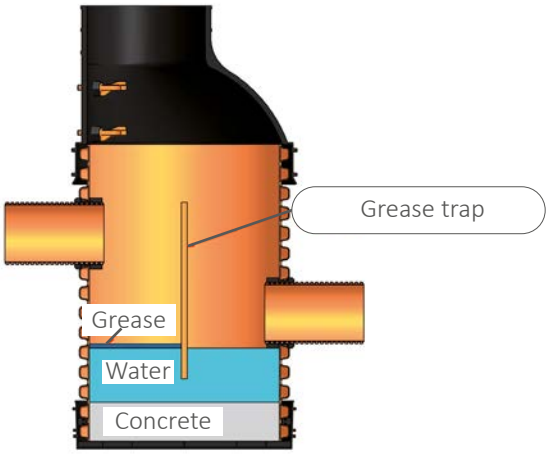
With the **SANECOR®** system a wide range of inspection chamber and manhole solutions can be installed for a variety of applications. The following figures show some examples, which are self-explanatory.

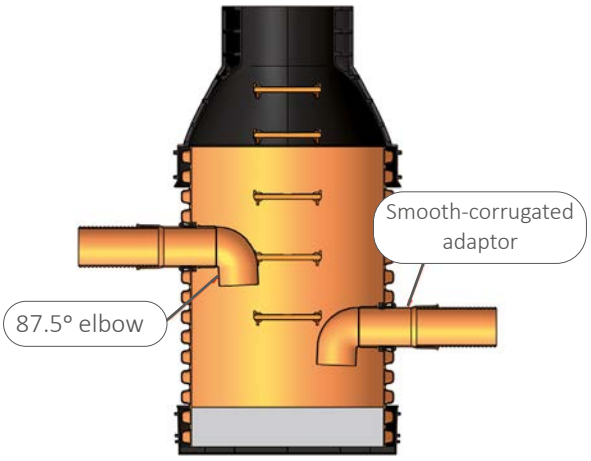


Grease trap chamber

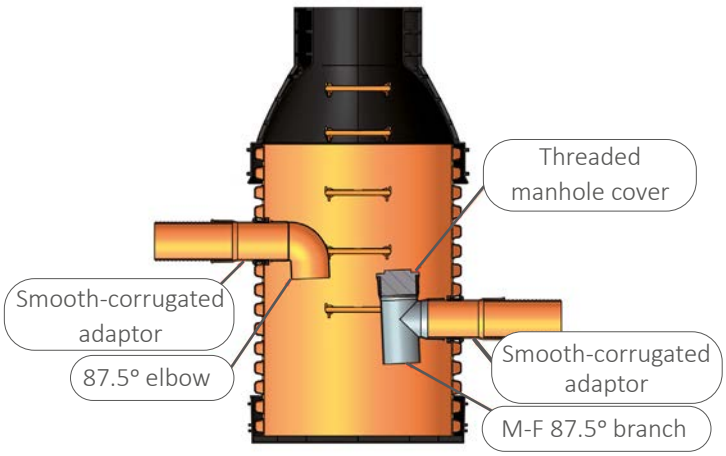


Siphon chamber

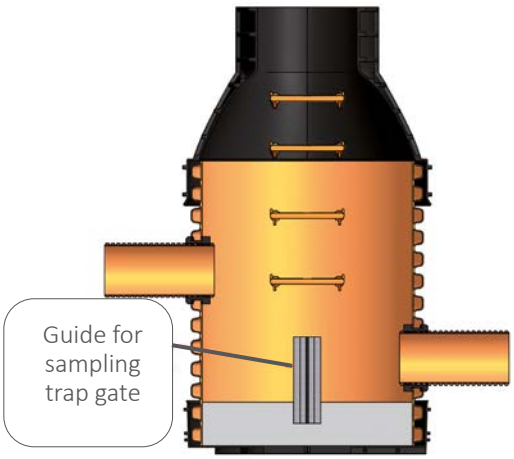




Grease trap manholes



Siphon manhole with grease trap



Sampling manhole

4.2.1. Drop manholes

Watertight drop manholes can also be installed in the **SANECOR® manhole system**. These elements are used when the pipeline follows a very steep slope. As the slope of a pipeline should not generally exceed 3°, drop manholes are used to reduce such slopes.

The following figures highlight the flexibility of the **SANECOR®** system. In a drop manhole, which is used when the difference in elevation between the inlet and outlet of the pipeline is greater than 1 m, the water flowing into the manhole is diverted towards the base to prevent the water from dropping vertically.

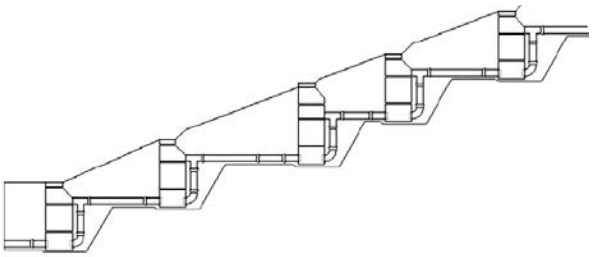
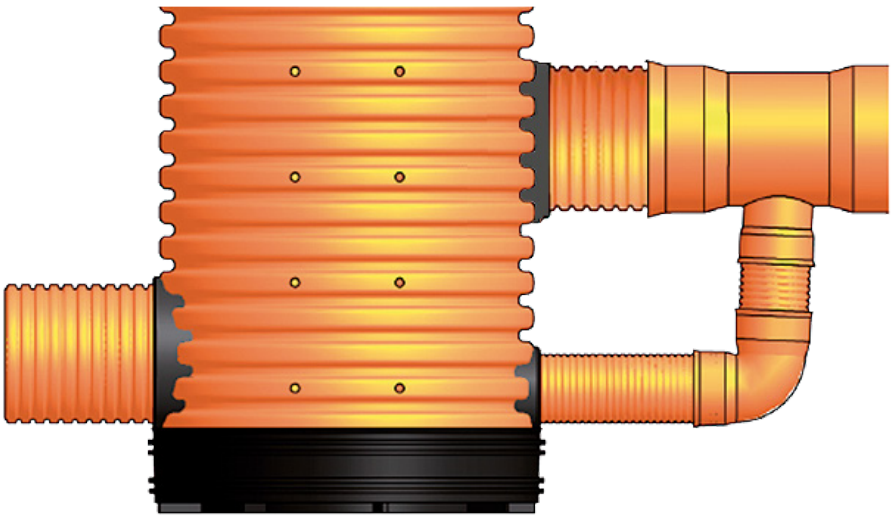


Diagram of a drop manhole arrangement





Drop manhole with SANECOR® manhole system



SANECOR® drop manhole

5. Choosing the right manhole

There is a wide range of **SANECOR®** manholes to meet all the possible requirements that may arise on a site. When choosing a **SANECOR®** manhole, the following points should be taken into account:

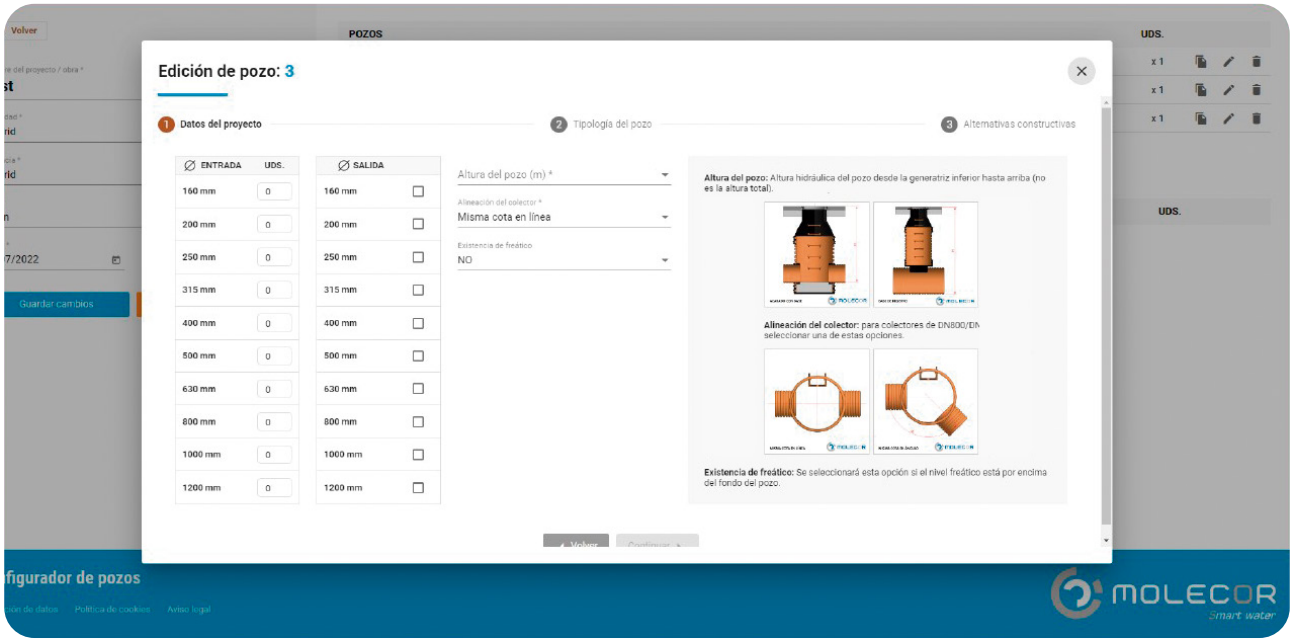
1. Project details

- Height of the manhole.
- Diameter of inlet and outlet pipes and connection points.
- Alignment of pipes (aligned, at an angle or at different elevations).
- Presence of water table.

2. Manhole types

- Nominal diameter of the manhole.
- With or without steps.
- Accessible or non-accessible.

Based on these parameters, you can select the manhole that best suits your needs. To make this task easier, **Molecor** provides users of its website with the "**SANECOR® manhole configurator**" tool at **www.sanecorconfigurator.com** where, once registered, users can access the program and, by entering the variables listed above, identify the watertight manhole that best suits their project and obtain all the technical information needed to design, assess or install **SANECOR®** manholes (breakdown of materials, drawings, work units, assembly instructions, etc.).



The relationship between the nominal diameter of the manhole and the nominal diameter of the pipe is a crucial factor when choosing the right manhole for each project. Pipes with diameters ranging from 800 mm to 1200 mm require special solutions to make the connection between the pipe and the manhole. The following table shows the different manhole types that are suitable for different pipe diameters.

Manhole type	Pipes					Connection type
	DN160 - DN315	DN400	DN500-DN630	DN800-DN1000	DN1000-DN1200	
Inspection chambers						
 DN630						
Manholes for small and medium sized pipes						
 DN800						
 DN1000 DN1200						
Manholes for large pipes						
 Inspection base						
 Prefabricated welded manholes with solid bases						
 Prefabricated T-welded manholes						

Inspection chambers with a nominal diameter of 630 mm are small in height and do not have steps and, if there is no groundwater in the trench, they can be supplied without a base.

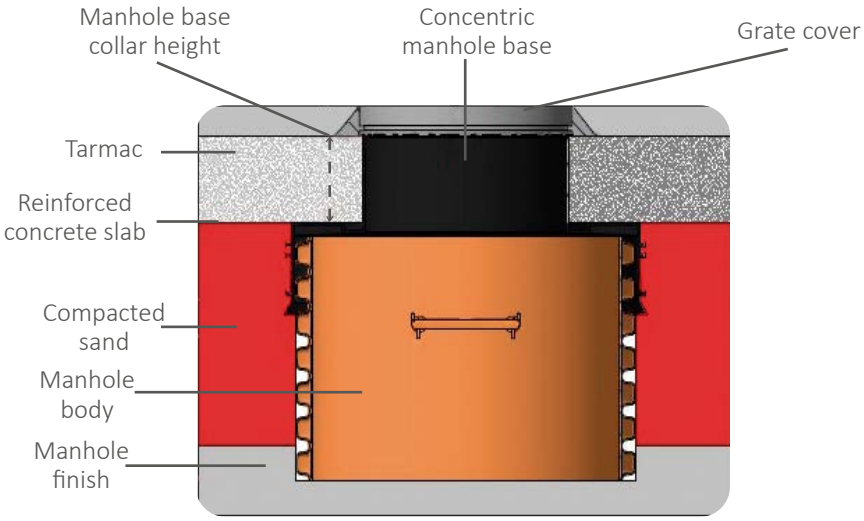
Manholes for small- and medium-diameter pipes of less than 800 mm have nominal diameters of 800 (only for pipes up to 400 mm), 1000 or 1200 mm, and heights of up to 6 m. They are normally supplied with steps installed, although they can be supplied without steps and, as above, they can also be supplied without a base as long as there is no water table present.

Moreover, there is a minimum height requirement for each manhole, which is determined by the diameter of the pipes to which it is connected. The following table shows the minimum heights for all possible pipe diameters and each manhole diameter. These heights can be reduced by up to 20 cm by cutting the collar of the reducer cone.

Manhole diameter	Pipe diameter						
	DN160	DN200	DN250	DN315	DN400	DN500	DN630
DN800 manhole	0.81	0.88	0.95	0.95	1.08	x	x
DN1000 manhole	1.15	1.15	1.25	1.25	1.35	1.46	1.66
DN1200 manhole	1.19	1.19	1.19	1.33	1.46	1.46	1.60

Minimum height of manholes including cone

If you require a lower height than that shown in the table above, instead of installing the standard cone, an inverted manhole base can be used as a reducer cone, making it possible to install low-height manholes with the following arrangement and minimum heights:



Manhole diameter	Pipe diameter						
	DN160	DN200	DN250	DN315	DN400	DN500	DN630
DN1000 manhole	0.68	0.68	0.78	0.78	0.88	0.98	1.18
DN1200 manhole	0.72	0.72	0.72	0.85	0.99	0.99	1.12

Minimum manhole height with inverted base

The minimum manhole heights shown are estimates and will depend on on-site adjustments made during installation.

6. Benefits of the SANECOR® system

Compared to traditional solutions, **SANECOR®** manholes offer the market significant advantages: watertightness, speed of installation (lower installation and social costs), on-site safety and versatility of the solution.

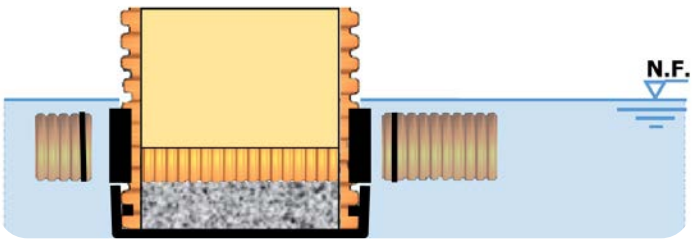
Watertightness: watertightness is important not only for preventing the contamination of soils and aquifers due to leakages of effluent, but also for preventing the infiltration of groundwater into the sewage network, which increase pumping and treatment costs, resulting in less sustainable sewage networks. Furthermore, the dilution of wastewater with groundwater can hinder proper treatment and cause costly technical problems.



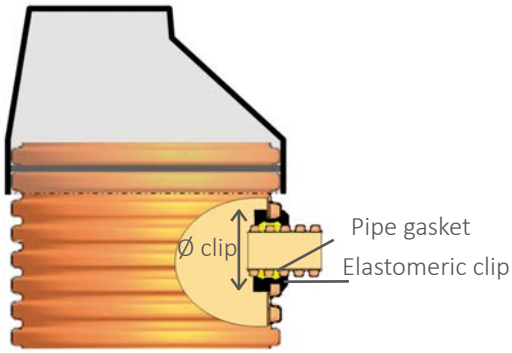


The key feature of **SANECOR®** manholes is their complete **watertightness**, which is ensured at the two critical points usually found in a conventional manhole:

- The intersection between the pipe and the manhole: the use of elastomeric clips to connect the pipe, in addition to an elastic joint, ensures complete watertightness at this point.
- The bottom of the manhole: with the plastic base and the gasket installed in the lower part of the manhole body, watertightness is also assured in this area.



- Optionally, a gasket can be fitted to the reducer cone in the event of a high water table to ensure that it is watertight.



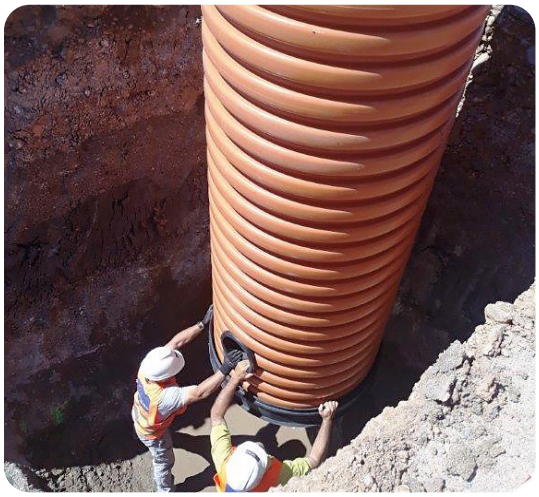
Quick installation: as you are working with lighter materials than with traditional solutions and can reach the top level in a single operation (as the manhole body is supplied in a single piece), installation times are reduced significantly. This leads to financial savings on the project and a reduction in social costs, as the disruption caused by road closures is very significant.





On-site safety: the manhole area is a critical part of the site. There are often gaps in the shoring and areas where there is a risk of landslides.

By reducing the time workers are at the bottom of the trench, with the **SANECOR®** manhole system the likelihood of an accident is significantly reduced.





Versatility: as the pipe joints and connection points are installed *in situ*, it is much easier for **SANECOR®** manholes to be adapted to any unforeseen events on the construction site, rather than the site having to be adapted to suit the configuration of the manholes. For example, this versatility makes it possible to install drop manholes and other special types of manholes.





Other benefits

The high stiffness of the **SANECOR®** pipes (over 8 kN/m²) that are used to manufacture **SANECOR®** manhole bodies ensures the high mechanical strength of the assembly. It is never necessary to concrete the body of the manholes, as happens in manholes made of other plastic materials.

Compared to traditional solutions (mainly made of concrete), **SANECOR®** manholes offer all the same overall benefits of plastic materials:

- No corrosion.
- High chemical resistance.
- Very high abrasion resistance.
- Very low head losses.
- Minimal energy consumption during the product life cycle.

7. Technical specifications

Manhole body	
Physical and chemical characteristics	
Density:	1,350 ÷ 1,520 kg/m³
Coefficient of linear expansion:	8 x 10^{-5} m/m °C
Thermal conductivity:	0.13 kcal/mh °C
Specific heat:	0.2 ÷ 0.3 cal/g°C
Vicat softening temperature:	≥ 79 °C, according to UNE-EN ISO 2507-1
pH limits:	Between 3 and 9, at 20 °C
Average B-onset processing temperature:	≥185 °C, according to ISO 18373-1 (DSC)
Thermal performance:	According to standard ISO 12091
Mechanical characteristics	
Ring stiffness (also known as SCS = specific circumferential stiffness)	SCS ≥ 8 kN/m², according to UNE-EN ISO 9969. The actual value is almost always higher than 10 kN/m².
Creep coefficient at 2 years:	≤ 2.5, UNE-EN ISO 9967 The actual value is below 1.9
Reference standard:	UNE-EN 13476
Impact resistance:	According to UNE-EN ISO 3127 (round-the-clock method)
Ring flexibility:	30% deformation in DN160 to D315, and 20% in DN400 to DN1200, according to UNE-EN ISO 13968

Dimensions of manholes and connections

Manhole DN	Inner diameter (mm)	Outer diameter (mm)	Diameter of connection points (mm)
630	590.00	649.2	160, 200, 250 and 315
800	775.00	855.7	160, 200, 250, 315 and 400
1000	970.00	1,072.3	160, 200, 250, 315, 400, 500 and 630
1200	1,102.90	1,220.0	160, 200, 250, 315, 400, 500 and 630

DN630 manholes have no cones

Steps	
Characteristics	
Coating material:	Polypropylene copolymer
Core material:	F1 calibrated steel. Tensile strength 65 kg/mm²
Reference standard:	EN-13101

Cone and watertight base	
Characteristics of polyethylene	
Density:	0.936- 0.989 g/cm
Material:	High-density polyethylene
Flexural modulus:	650 MPa
Impact resistance:	21 J/mm
Elongation:	>700% at break
Manufacturing process:	Rotational moulding

Elastomeric clip	
Characteristics	
Material:	Natural rubber and EPDM
Hardness (° SHORE A)- H:	50 ± 5
Elongation at break (%)- (23 °C at 72 h.):	21 J/mm
Tensile strength (MPa)- A:	≥ 9
Manufacturing process:	Injection moulding
Reference standard:	UNE-EN-681-1

Functional characteristics		
Technical characteristics	**Reference standard**	**Verified by**
Watertightness requirements	UNE-EN ISO 13259	CEIS
Durability requirements	UNE-EN 13598-2	NYS Ingeniería
Ability to withstand traffic loads	UNE-EN ISO 13268	NYS Ingeniería

8. References

Project name	Province	Year	Public/private developer	No. of manholes
Fernán Caballero sewage network (Ciudad Real)	Ciudad Real	2010	Private	40
Sewage on C/ Jose Mª Pemán, Maestro Vallejo & Calvario (Marmolejo)	Jaén	2010	Sociedad Mixta del Agua-Jaén, S.A	23
Sewage in Carracedelo (Ponferrada)	León	2010	Somacyl	60
Río Madre sewage (Colindres)	Cantabria	2011	Northern River Basin Authority	30
North Ponferrada access road (Ciuden)	León	2011	Ponferrada City Council	30
Gullón biscuit factory development (Aguilar de Campoo)	Palencia	2011	Private	60
Sewage and supply in San Miguel de Langre	Palencia	2011	Government of Castilla and Leon	32
Construction of a vehicle inspection station (MOT) in the municipality of Priego de Córdoba	Córdoba	2013	Andalusian Regional Government	23
Avenida Escuela Pías (Daroca)	Zaragoza	2013	Daroca City Council	18
Lapuebla de Labarca sewage	Álava	2014	Provincial Council of Álava	50
Villamuriel industrial estate	Palencia	2014	Villamuriel Town Council	60
Langosteira Port (A Coruña)	A Coruña	2015	A Coruña Port Authority	20
Hospital Línea de la Concepción (La Línea)	Cádiz	2015	Andalusian Regional Government	18
Grupo Giro factory (Teruel)	Teruel	2015	Private	24
Manhole renovation in the southern expansion of Huelva	Zaragoza	2015	Private	20
"Los Alisios" Shopping Centre (Las Palmas)	Las Palmas	2016	Private	300
La Marazuela Development (Las Rozas)	Madrid	2016	Ikasa	30
Improvements to Río Breiro in Boiro	A Coruña	2017	Aguas de Galicia	20
Logistics centre in Badajoz	Badajoz	2017	Extremadura Regional Ministry of Development	152

Project name	Province	Year	Public/private developer	No. of manholes
Construction works on Avenida Capitán Claudio Vázquez (Ceuta)	Ceuta	2017	Regional Ministry of Development and the Environment	40
Renovation of pipe networks on Avenida Juan Carlos I (Tomelloso)	Ciudad Real	2017	Tomelloso City Council	45
La Caleta Port (Vélez Malaga)	Malaga	2017	Andalusian Port Authority	33
Sewage in Puente de Sanabria	Zamora	2017	Government of Castilla and Leon	50
South-western European logistics centre	Badajoz	2018	Regional Government of Extremadura	100
Adaptation and renovation of the MOT station facilities in Algeciras	Cádiz	2018	Andalusian Regional Government	57
Parque Morales sewage (Santander)	Cantabria	2018	Santander City Council	20
Maella WWTP	Zaragoza	2018	Aragonés Water Institute	27
Development of Avenida General Mayandia (Zaragoza)	Zaragoza	2018	Private	17
Wastewater collection and joint WWTP project in Nerva-Riotinto (Huelva)	Huelva	2019	Andalusian Environment and Water Agency	150
Construction of water treatment plants in Esguevillas de Esgueva, Valoria La Buena and Quintanilla de Onésimo	Valladolid	2019	Duero River Basin Authority	50
Sewage works in the area surrounding the Arroyo de la Encomienda sports centre	Valladolid	2019	Arroyo de la Encomienda Town Council	20
Elevated sewage pipeline in Níjar Villa	Almería	2020	Andalusian Regional Government	130
Pipeline renovation in Sitges	Barcelona	2020	Sitges Town Council	25
Water drainage and treatment in the Hervás region (Cáceres)	Cáceres	2020	Tajo River Basin Authority	120
4-star hotel and shopping centre on Playa Blanca (Lanzarote)	Las Palmas	2020	Private (Yudada, S.L.)	492
Caleido Tower (5th Madrid Tower)	Madrid	2020	Private	51
Naropa building (Las Rozas)	Madrid	2020	Private	34
Los Cortijos Phase II development (Sevilla la Nueva)	Madrid	2020	Isabel II Canal	18
Estepona sewage network	Malaga	2020	Acosol	25
Pato development (Malaga)	Malaga	2020	Private	23
Chemical and refining integrated Singapore project	Singapore	2020	Private (Exxon Mobile)	150
Development on Playa de Gandía	Valencia	2020	Gandía City Council	120
Pipeline on Avenida Benidorm (Finestrat)	Alicante	2021	Finestrat Town Council	24
Bajo Cabezuela rail connection	Cádiz	2021	ADIF	174
Parque de la Vaca sewage network (Santander)	Cantabria	2021	Aqualia	24
Wastewater collection, Rus, Canena and La Yedra WWTP	Jaén	2021	Andalusian Regional Government	210
Los Monteros development sewage (Marbella)	Malaga	2021	Acosol	17
Sewage network on various streets in Malaga	Malaga	2021	Emasa	20

Project name	Province	Year	Public/private developer	No. of manholes
Central drainage Astexol II CSP plant	Badajoz	2022	Dioxipe Solar	12
Surface water drainage of Extresol II & III CSP plant	Badajoz	2022	Private	35
Central drainage Astexol II CSP plant	Badajoz	2022	Dioxipe Solar	12
Overall renovation of pipeline Girona WWTP	Girona	2022	Girona City Council	10
Peri San Antonio development	Huelva	2022	Aguas de Huelva	18
San Lucas development sewage network	Malaga	2022	Private	62
Sanchez Blanca development	Malaga	2022	Private	401
Wastewater collection, Villaverde del Rio WWTP	Seville	2022	Andalusian Regional Government	40
Sevilla promenade sewage network	Seville	2022	Las Cigarreras Garden	14
Sewage and water treatment in Cumbre	Cáceres	2023	Ministry of Ecological Transition	70
Hotel Hilton refurbishment Cala Blanca	Ibiza	2023	Private	25
WWTP and pipes in Arriate	Malaga	2023	ACUAES	47
Pizarrillo development	Malaga	2023	Private	49
Dev. industrial estate in former airfield in Calamocha	Teruel	2023	Calamocha Town Council	48
Ana María Navales State School	Zaragoza	2023	Aragón Regional Ministry of Education	32
Playa Ares pipeline repair	A Coruña	2024	Aguas de Galicia	12
Improvement of road access to historic quarter (Finestrat)	Alicante	2024	Finestrat Town Council	14
Sewage on promenade in La Línea Concepción	Cádiz	2024	ARGISA	24
Sewage network in Burela	Lugo	2024	Petrolam	30
Cortijo Merino development	Malaga	2024	Private	215
Las Lomas de Torreblanca development	Malaga	2024	Private	63
El Tomillar development	Malaga	2024	Private	161
Laguna Grande sewage network in Villafranca de los Caballeros	Toledo	2024	TRAGSA	142
Volkswagen battery gigafactory in Sagunto	Valencia	2024	Private	120
Sewage at Langosteira outer port	A Coruña	2025	Port Authority	51
Sewage in Martín (Fene)	A Coruña	2025	Navantia	15
Sewage in El Príncipe district and Coronel Gautier	Ceuta	2025	Acemsa	285
Motril Port sewage	Granada	2025	Motril Port	35
Montizon WWTP	Jaén	2025	Andalusian Regional Government	49
Combined drainage network 66 properties on C/ Mesena	Madrid	2025	Private	22
Sewage lot 3 CYII Plan Sanea.	Madrid	2025	Isabel II Canal	9
Coto de Canedo Park	Ourense	2025	Ourense City Council	12
Sewage in Ponteareas & Rivadetea	Pontevedra	2025	Aguas de Galicia	112
Vila-seca development	Tarragona	2025	Vila-seca Town Council	15
Horta Nord pipeline in El Puig	Valencia	2025	EPSAR	13
TOTAL NO. MANHOLES: 5,550				



Drainage network at Anoeta football stadium
(San Sebastian)



Logistics centre in Badajoz



Hospital La Línea de la Concepción (Cádiz)



Caleido Tower (5th Madrid Tower)



Sewage network in Lapuebla de Labarca (Álava)



Maella WWTP (Zaragoza)



Carlos V Gardens- Alhambra (Granada)



Sewage network in Tobatí- Cordillera (Paraguay)

Notes

Notes

SANECOR

The optimal sustainable solution for sewage networks

AENOR GESTIÓN DE LA CALIDAD ISO 9001 ER-1644/2008 ER-0440/1996

AENOR GESTIÓN AMBIENTAL ISO 14001 GA-2014/0250 GA-2001/0255

IQNET RECOGNIZED CERTIFICATION

AENOR TUBOS PLÁSTICOS 001/007322 UNE-EN 13476-1 UNE-EN 13476-3

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