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PRO MANHOLES

PRO injection molded polypropylene manholes

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CONTENTS

1 INTRODUCTION

1.1 Why should we choose plastic manholes and rain gully

Plastic manholes are the modern, environment friendly and cheap in terms of operation alternative to the heavier, bigger and difficult to maintain concrete structures. Their guaranteed water-tightness, strength and low weight makes them suitable for integration in a complete sewer system of long and trouble-free service life.
The use of such plastic materials, both pipes and manholes, offers a number of practical and economic advantages.
It is worth noting, most of all, their low weight, which implies easier transportation and installation, excellent corrosion- and abrasion-proof properties, high resistance to wear and tear, in addition to durable impermeability. All that in aggregation results in low maintenance cost throughout their operation.

1.2 Why polypropylene (PP) has been chosen for PRO manholes and rain gully

Polypropylene (PP) is the latest generation of thermoplastic materials used for the production of thermoplastic manholes. This material combines the hardness of polyvinyl chloride (PVC) and the elasticity of polyethylene (PE) to become the most suitable and best balanced material capable of satisfying the complex requirements of BDS EN 13598-2.

1.3 Why the colour of the PRO manholes and rain gully must be different from black

The practice of manufacturing thermoplastic manholes by mould casting showed that the most common reason for adding black dye for the end products is the fact that using recycled materials (scrap) turns the production process impossible to manufacture a product of homogenous color other than black.
This is the main reason why Pipelife is manufacturing its products in a color other than black - to prove once again indisputably that Pipelife uses only and exclusively primary raw materials.

1.4 Why are PRO type manholes injection moulded?

For the making of PRO manholes Pipelife has chosen the method of injection moulded components. This method allows the achievement of high density and ribbed external surface. Each and every component has been designed and manufactured in consideration of its functions in the manhole operation and services its structural integrity as a finished end product meeting all standard requirements.

- the double ribbed bottom is capable of withstanding a 5 m long water column, which guarantees the intactness of sewer shape and its hydraulic conductivity;
- the barrels are cast with step attachments, which guarantees their strength and ease for inspection. The ribbed external surface ensures better cohesion between the manhole and the backfill against floating;
- the cone is ribbed and tested for heavy traffic areas up to 40 t.
- they can be laid up to 6.5 m depth in heavy traffic areas and up to 2 m depth from the manhole bottom.

Disadvantages of the rotation cast manholes:

- the rotation cast components have smooth walls, in the best case it may be corrugated but it cannot be thicker than 12 mm, which precludes the making of any thicker zones in the bottom or ribbing of the barrels in order to achieve the minimum ring hardness required by the applicable standard > SN2;
- the installation of rotation cast manholes deeper than 2 m is risky and the manhole should be supported additionally;
- a significant disadvantage of rotation casting is that inlets and the outlet cannot be made as hard as needed in the area of coupling the socket with the inlet pipe. There is a high risk of loss of water-tightness;
- difficult calibration of the socket and smooth part of the coupling, which in combination with the shrinkage of material leads to insecure joints and leakages from and to the system;
- the steps are cast in oval shape, which makes them uncomfortable for inspections;
- the base is the final cast component and the lack of a ribbed bottom makes the base not hard enough, which results in deflection if the level of underground water is high.

1.5 Long-lasting performance

To demonstrate the long-lasting performance of polyolefin (polyethylene and polypropylene) pipes, a study was conducted by Teppfa's European Association of Plastic Pipe and Fittings Manufacturers in collaboration with the Borealis and LyondellBasell raw material producers. The purpose of the study is to provide sufficient validated data in order to declare the expected duration of at least 100 years of operation of pipes manufactured according to the standards. In the course of the study, their thermal-oxidative decay, maximum allowable stress, long-term behavior at constant tension and temperature influence were investigated. For the study, new tubes and those in use for over 40 years have been used. All of these methods are implemented in accordance with valid international standards (ISO) and the accumulated knowledge of polymer materials science. The results have shown that the lifetime of polyolefin piping systems is at least 100 years if the materials, products and installation practices meet the relevant requirements.

2 APPLICATION

PRO type manholes are used for:

- Revision and inspection of gravity sewer networks;
- Connection between sewer networks at different levels;
- Changing the sewer network way in both horizontal and vertical direction;
- Changing the gradient and cross section of the sewer network;
- A draw tank for PROFOS type sewer pumping plant;
- Rainwater harvesting;
- Water meter boxes, type PRO-WM;
- For specific industrial needs;
- Revision and inspection of telecommunication and electric power distribution networks.

3 ADVANTAGES

- Resistance to abrasion;
- Resistance to chemicals(from pH=2 to pH=12)
- Resistance to high temperatures (60°C for continuous flow, and 95°C to 100°C for intermittent flow);
- Resistance to shocks – conforming to the requirements of BDS EN 1411 and BDS EN 1206;
- Guaranteed hardness SN ≥ 2 kN/m^2 throughout the manhole height – conforming to the requirements of BDS 13598-2:2009 and ISO 9969;
- Reinforced ribbed bottom to resist high underground water level;
- Modular system – easy to transport and allowing fast and easy installation on the spot;
- Mould cast elastomer sealing rings EPDM 45 ± 5. BDS EN 681-1;
- Option for joining at different angles and different heights - more than 3000 combinations are possible;
- All PRO type manholes can be equipped with telescopic covers;
- High hydraulic conductivity thanks to the smooth-surface invert;
- Guaranteed water-tightness of the system ranging from -0.3 bar to +0.5 bar in accordance with the requirements of BDS EN 1277;
- Light weight;
- Long service life;
- Compatible combination with smooth-walled PVC pipes, KG type, and profiled pipes, types Pragma and Pragnum, using unique system of fittings and adaptors;
- All inlets and outlets are equipped with sockets and rubber sealing for fast and easy installation;
- Integrated unit in a complete sewer system of pipes, fittings and facilities;
- Ease of inspection thanks to the steps meeting the requirements of EN 13101 and EN 14396
- Resistance to floating thanks to the ribbed external surface;
- All components of the PRO type system are manufactured under continuous production control of raw materials and end products.

3.1 Comparative table of costs for laying of classic reinforce concrete manhole and Pipelife's PRO manhole

	Manhole, DN1000, made of concrete components up to 3 m high, without cover, BGN	Manhole, DN1000, PRO type, up to 3 m high, straight, DN315, without cover, BGN
I. Labor:	36,42	20.03
II. Machines and equipment	113,22	0,00
III. Extra cost	81,71	20.03
Manhole price	1100.00	2013,00
Unit price, including 10% profit	1354,49	2214.3

Number of manholes that could be installed per work day:

- Concrete: 2-3
- PRO: 8-10

4 STANDARDS

4.1 Why are standards necessary?

The standards are a combination of rules and norms based on practical and theoretical observations and studies of the technical parameters which the products should meet. They define minimal requirements for quality of the specific product. At the same time they guarantee compatibility of products made by different manufacturers.

All this make the standard extremely important because it guarantees to all parties: designers, engineers, architects, builders, clients, control authorities that the product which they use meets the specific application and possesses all the qualities for unhindered, flawless and long-term exploitation.

4.2 Which standards and norms meet the PRO manholes and PRO-RG rain gullies meet?

The PRO manholes are manufactured and meet the requirements of the standard EN 13598-2:2009 Plastics piping systems for nonpressure underground drainage and sewerage - Unplasticized poly (vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE).
Part 2: Specifications for manholes and inspection chambers in traffic areas and deep underground installations.

4.3 What do the standards require?

The standard EN 13598-2:2009 defines minimal requirements for manholes and inspection chambers in traffic zones and deep underground installations with regard to the following characteristics:

- Definition of the manhole types according to EN 13598-2:2009

Inspection chambers (without man access) with a diameter of the base DN/ID - 200, 250,315,400 и 600.
Manholes (with man access) with a diameter of the base > DN/ID800.

- Ring stiffness - SN>2 kN/m^2 according to ISO 9969.

It is tested according to EN ISO 13268:2023 and concerns the components of the manhole: base, riser rings and cone.

- Water-tightness. It is tested according to EN ISO 13259.

This method tests the system ability to hold the liquids from and out of the system (filtration/infiltration). The test confirms the watertightness between the elements of the manhole and the connection with the sewer system. This tightness of the system concerns the ecological aspect for protection of soil and waters.

The standard requires water-tightness: from - 0,3 bar negative pressure to +0,5 bar positive pressure

- Shock-resistance – it is tested according to EN 12061.

The tests with a weight which falls from the height of 2,5 m weighing 1 kg and cone radius 50 mm are performed close to the injection points of the shell at 23°C. The zone close to the injection point is accepted as the weakest spot. The standard does not allow cracks and substantial deformations.

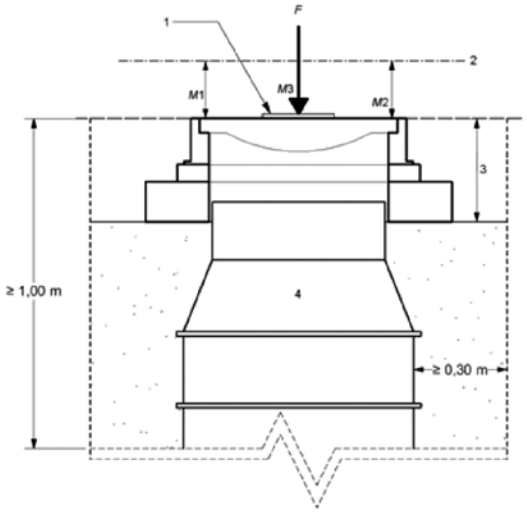
- Mechanical strength of the connections. It is tested according to EN ISO 13264.

The standard defines the mechanical strength of the connections as it requires when specific force is applied at a specific distance from the connection, the displacement to remain within 170 mm without breaking the connection integrity at the critical spot (see Figure 1).

Figure 1

- Cones mechanical strength. It is tested according to EN ISO 13266:2023.

The test is performed in lab conditions, as it is shown on Figure 2.



Legend:
1 – plate for applying of weight, the plate size is defined according to EN 124
2 – reference line, basic
3 – cover + ring
4 – cone
M1, M2 и M3 – distances defining the displacement
F – force of test load

Figure 2

In Table 1 are shown the parameters of testing from which it is evident that the max lab load of 100 kN is equivalent to exploitation load of traffic of Class D (40 tons according to EN 124).

Manholes classification - a	Maximal load - b kN	Soil type around the manhole - c	Soil sealing around the manhole %
Class A	5	3	≤ 95
Class B	50	2	> 95 and ≤ 98
Class D	100	1	> 98
Class E	150	1	> 98

a) The classification is according to EN 124.
b) The maximal load does not meet the test load for covers according to EN 124.
c) Classification of soils, according ENV 1046.

Table 1 – Test parameters

- Requirements for the manholes ladder. According to EN 13101 and EN 14396.

The standard does not allow in case of vertical load of 2 kN the deflection to be >10 mm. After removing the load the remaining deformation must be not > 5 mm.

In case of horizontal load of extraction of 1 kN the ladder must retain their position and integrity.

- Requirements for manholes integrity and maximal depth of subterranean waters. It is tested according to EN 14830.

- The structural integrity of the manholes is tested with simulation of 50 years exploitation:
a) vertical load, when the deformation must not exceed 5%
b) horizontal load, when the deformation must not exceed 10%

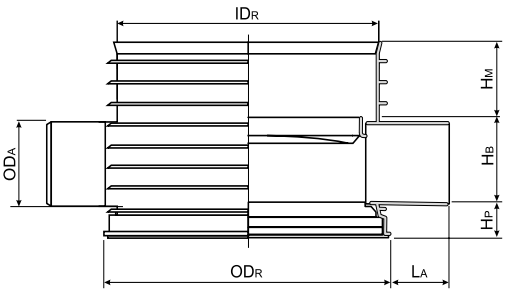
The standard requires manhole water-tightness in case of availability of subterranean waters. The minimal requirement is the system water-tightness to be kept in case of subterranean water of minimum 2 m (from bottom of manhole to the highest level of groundwater).

The standard does not comment on the danger of manhole emerging in case of high subterranean waters, but definitely makes the manufacturer to announce the maximal acceptable height of subterranean waters (from the manhole elevation) when the manhole keeps its integrity.

5 PRODUCT RANGE

5.1 PRO +ID600 manholes

5.1.1 Base ID600

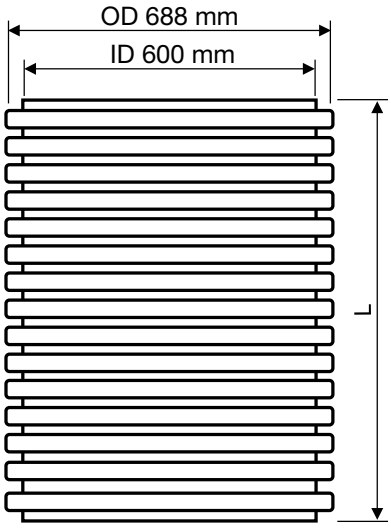


Bottom type	Effective height	Possible DN				
Base 1	HB	160	200	-	-	-
Base 1,5		-	-	250	315	-

**all sizes are in mm*
Note: H_M – depth of putting the riser

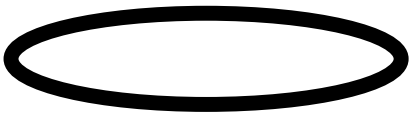
Base DN	Outlet	Inlet 1	Inlet 2	Inlet 3
ID600	160, 200, 250, 315	160, 200, 250, 315	160, 200, 250, 315	160, 200, 250, 315

5.1.2 Riser



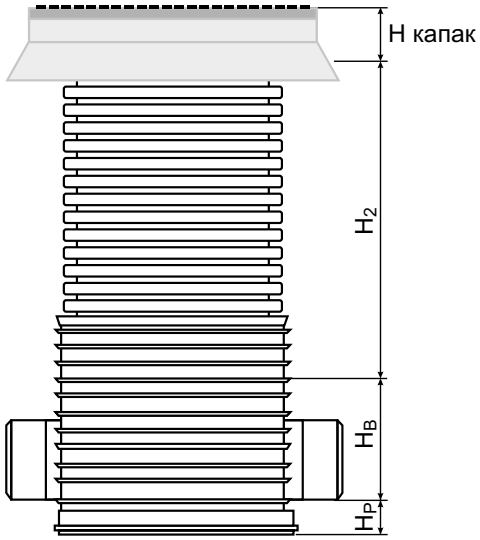
Product code	ID/OD (mm)	Calculated length from the project L (mm)	Effective height H_2 (mm)
ECO Corr_DW/WO/ID600/400kg/m2/6m	600/688	500	500

5.1.3 Sealing ring for manhole's riser

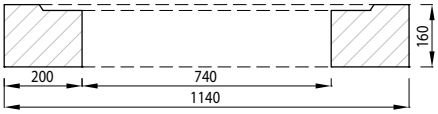


Product code	OD	ID
PRKID600	920	688

5.1.4 Manhole ending without telescope



5.1.5 Concrete ring

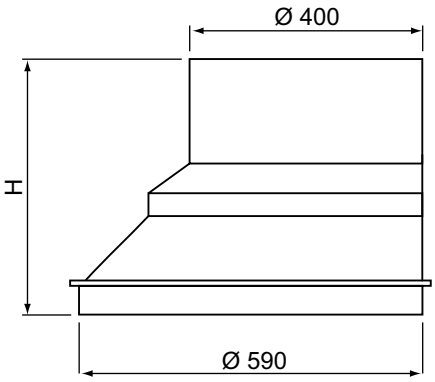


The purpose of concrete ring is to distribute the dynamic load caused by traffic to the soil.

Product code	Dimension	H
PRO-Frame630	1140/700	160

Dimensions are shown in mm

5.1.6 Manhole's ending with cone 630/400



Product code	Dimension	H	Effective height
PRO-Con630/400	590/400	461	400

Dimensions are shown in mm

*** Cone 630/400 can be completed with a telescopic cover 315/400 (see catalogue PRAKTO)**

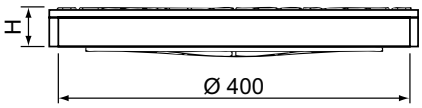
5.1.7 Cover types

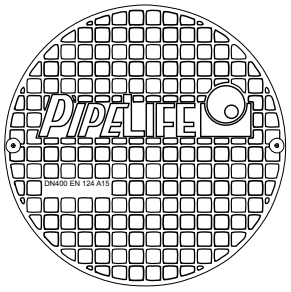
All PRO manholes can be equipped with covers of the following types:

- A15 = 1.5 tons load, PE
- B125 = 12.5 tons load, polymer
- C250 = 25 tons load, polymer
- D400 = 40 tons load, cast iron

according to BDS EN 124.

PP plastic cover – DN400, A15 for cone 630/400





Product code	Dimension	H
KGDOV400-A15	400	80

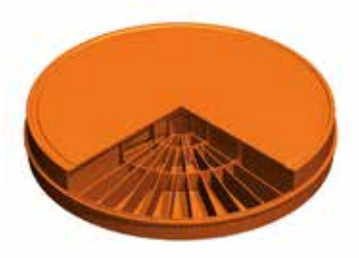
Dimensions are shown in mm

Pipelife's PRO manholes can be furnished with all types of covers DN600 available on the market with different load class according to EN 124.

5.2 PRO manholes DN800 and DN1000

5.2.1 Base components

Reinforced double bottom



Double bottom consists of two butt welded single bottoms.

With shell

Riser ring with guaranteed watertightness of the connections

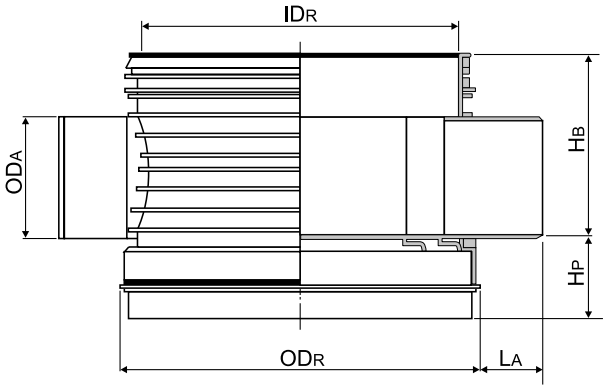
Flow channel with guaranteed hydraulic conductivity

Reinforced double bottom

Manholes PRO1000 and PRO800 with height up to 3.5 and without groundwater are produced with single bottom!

Manholes PRO1000 and PRO800 with height above 3.5 m or existnce of groundwater are produced only with double bottom!

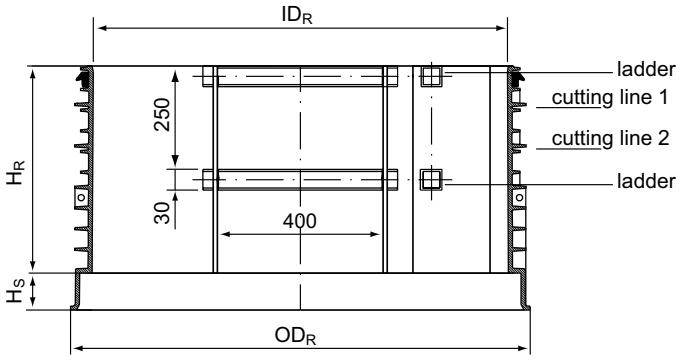
5.2.2 Base



Base DN	Outlet	Inlet 1	Inlet 2	Inlet 3
DN800	160, 200, 250, 315, 400, 500	160, 200, 250, 315,400, 500	160, 200, 250, 315,400, 500	160, 200, 250, 315, 400
DN1000	160, 200, 250, 315, 400, 500, 600	160, 200, 250, 315,400, 500, 600	160, 200, 250, 315,400, 500, 600	160, 200, 250, 315, 400, 500

For inlets/outlets bigger than DN800 we can offer side manholes PRO PRAGNUM with diameter of the revision DN1000 and cone 1000/600.
https://www.pipelife.bg/bg/media/Files/06_Katalozi_Broshuri/01_Katalozi/02_Kanalizacia/Pragnum_katalog.pdf?m=1541778416&

5.2.3 Riser ring with/without ladder ribs



Possible reduction of the risers' height.

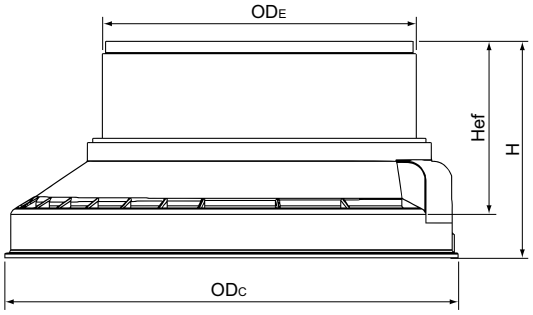
Riser	Cutting line 1	Cutting line 2	Total
DN800	100	100	200
DN1000	100	150	250

Dimensions are shown in mm

Name	Product code	ID$_R$	Ladder
Riser with ladder ribs 800	PRO-RISER800-L	800	yes
Riser without ladder ribs 800	PRO-RISER800-WO-L	800	no
Riser with ladder ribs 1000	PRO-RISER1000-L	1000	yes
Riser without ladder ribs 1000	PRO-RISER1000-WO-L	1000	no

Note: When using a riser without ladder ribs, an aluminium ladder is used /see 5.2.4 Aluminium ladder/

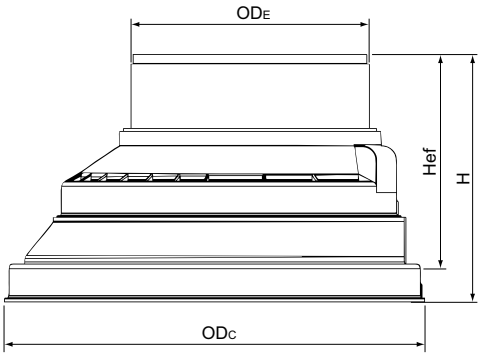
5.2.4 Cone for manhole with fixed entrance DN800/630



Product code	OD$_E$	H	H$_{ef}$	OD$_C$
PRO-Con800/630-Fix	630	430	340	910

Note: It is possible a maximal reduction/extension of the height H$_E$ of 10 см

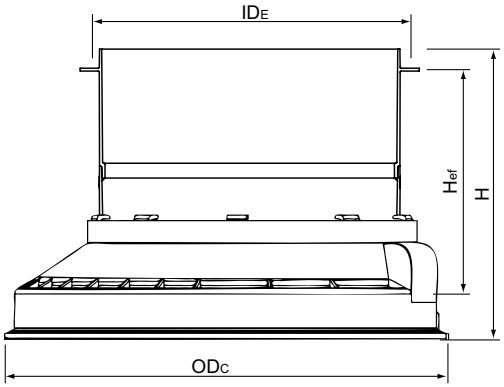
5.2.5 Cone for manhole with fixed entrance DN1000/630



Product code	OD_E	H	H_{ef}	OD_C	Weight (kg)
PRO-Con1000/630-Fix	630	650	560	1110	19,8

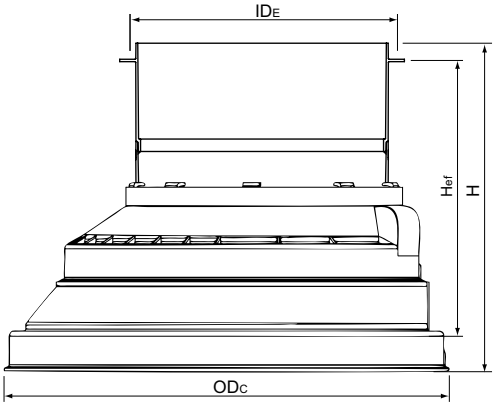
Note: It is possible a maximal reduction/extension of the height H_E of 10 см

5.2.6 Cone for manhole with telescopic entrance and rubber sealing DN800/630



Product code	ID_E	OD_C	H_{ef}	H	Weight (kg)
PRO-Con800/630-Tel	637	910	340	480	7,9

5.2.7 Cone for manhole with telescopic entrance and rubber sealing DN1000/630



Product code	ID_E	OD_C	H_{ef}	H	Weight (kg)
PRO-Con1000/630-Tel	637	1110	560	700	17

Note: The images may differ from actual products.

5.2.8 Assembly of inspection entrance of PRO DN800 and DN1000 manhole

Telescopic inlet

Cone with telescopic inlet, consisting of two parts – a cone 1000/630 and 800/630 and a telescope, the telescope is connected to the cone by means of a rubber seal. The telescope has the following functions and advantages:

- can be easily adjusted to the desired height
- will not transmit dynamic load to the manhole
- capable of evenly fitting the cover in case of inefficient sealing

Fixed inlet

Cone with fixed inlet, consisting of two parts – a cone 1000/630 and 800/630 and an extendable pipe welded to the cone. The fixed inlet has the following functions and advantages:

- can be easily adjusted to the desired height by being cut out as needed
- ready for fast and easy installation

Cover with two-piece adaptable concrete rings to align the slope of the cover with the slope of the pavement.

Cover with concrete ring for pavement without inclination.

We recommend the use of telescopic covers (see points 5.2.7 and 5.2.8) because they offer the following advantages:

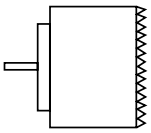
- easy levelling to the surrounding surface;
- the telescope transmits the traffic-generated dynamic load to the sealing ring and not to the manhole walls;
- it is possible to adjust the height in case a new layer of asphalt is laid;
- it settles down together with the road covering (it “breaths” along with the road pavement);
- it has a double adapting ring, providing the exclusive capability of changing the degree of inclination by rotating the two parts axially, the lower part remaining in horizontal position in order to distribute the load vertically to the soil, and the upper part following the road gradient.

5.3 Additional elements for connection of PRO chamber with the sewerage

Additional inlets with a big diameter to the risers can be made with insitu connection, and the nominal diameter of the inlet must be from DN160 to DN315. In order the connection to be made a cutter is chosen with the desired diameter. After making the opening in the pipe or in the riser ring of the manhole, the rubber adapter is mounted. A smooth wall pipe is inserted directly in it. If the inlet is made with a Pragma corrugated pipe, it is necessary to mount a passage from the PP pipe to the PVC pipe.

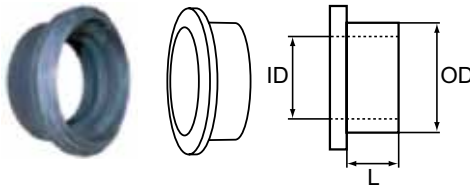
5.3.1 „InSitu" cutter

Ø	Product code
177	PRFREZ160
225	PRFREZ200
274	PRFREZ250
345	PRFREZ315



5.3.2 Rubber adapter for „InSitu" connection

For inlet	Product code	OD	ID	L
		(mm)		
160	PRMAN160	177	160	65
200	PRMAN200	220	200	65
250	PRMAN250	274	250	65
315	PRMAN315	345	315	65



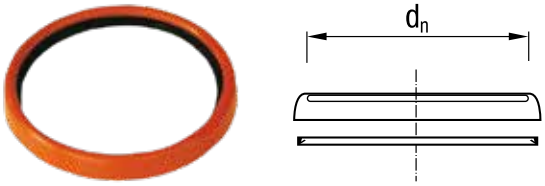
5.3.3 Pragma PVC socket adapter for PVC-KG with smooth walls

DN	Product code
160	PRP160
200	PRP200
250	PRP250
315	PRP315

For connecting of PVC-KG socket with Pragma OD pipe end without a socket

5.3.4 Assembly ring with sealing for connection of Pragma end without socket with PVC end with socket

dn	Product code
160	PRS 160
200	PRS 200
250	PRS 250
315	PRS 315
400	PRS 400
500	PRS 500



For connecting of Pragma OD socket with PVC-KG pipe end without a socket

5.3.5 Necessary elements for „InSitu" connection according to the inlet pipe

DN	APPLICATIONS	PVC	PP-Master	PP-Pragma
160	pipes			
200	manholes			
250				
315	for inlet			

6. DESIGN REQUIREMENTS

6.1 Requirements for design of PRO

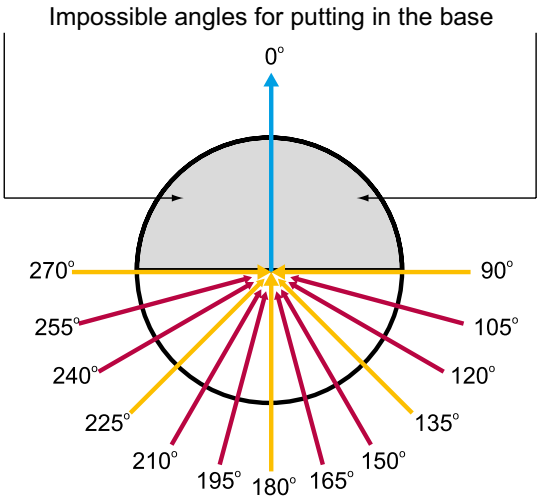


Figure 3

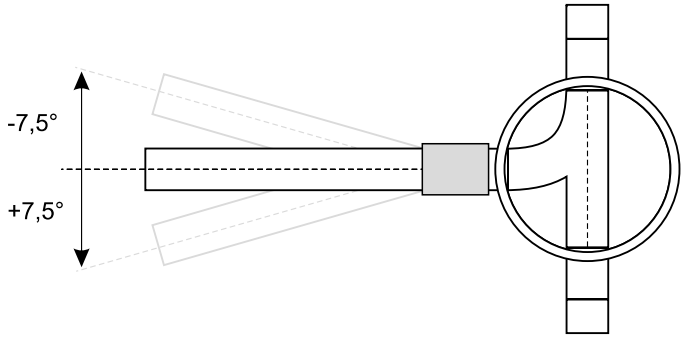


Figure 2

6.1.1. Possible inlet angles

What is unique about the PRO manholes is that they allow huge variety of connecting to the base and to the riser rings (see Figure 3). In practice, using PRO, the designer can design with concrete manholes, i.e. without regarding standard configurations of inlet angles.

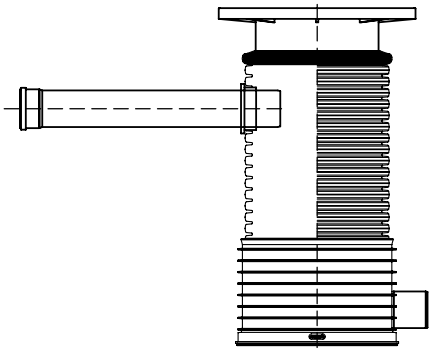
In addition Pipelife offers elastic sockets which allow correction of ± 7.5° of inlet angle (see Figure 2). These elastic sockets are very successful for small change of sewerage route. Inlet angles <90° and >270° in the PRO base are not recommended. Such inlet angles can be made above the base in the riser rings.

6.1.2 Cascade manholes

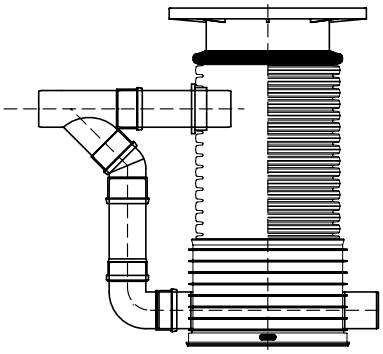
PRO manholes are offered as cascade manholes for pipelines with a nominal diameter DN<600. When the dropping height is from 0,5 m to 6 m they are designed according to the inlet type / with a socket or without a socket/ bypass connections from KG PVC pipes with smooth walls or Pragma profile pipes with 45° branch, 45° and 90°elbows, and connecting pipes with the specific diameter.

These are cascade manholes of manhole type (with incoming pipe, ending with vertical section, leading to the manhole bottom) without stilling basin.

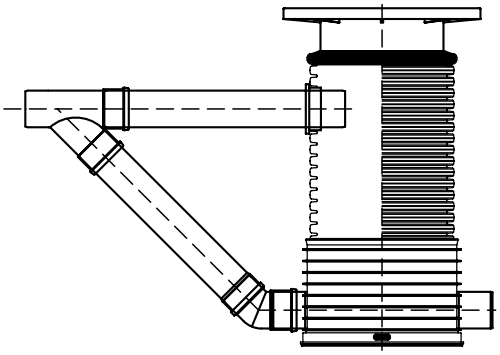
а) DN ≤200



б) DN ≥250



в) DN ≥250



6.1.3 Types of inlets according to the type of the inlet pipe

Scheme of the connection between smooth pipe and PRO Manhole (PP Mono, PP Master, PVC KG)

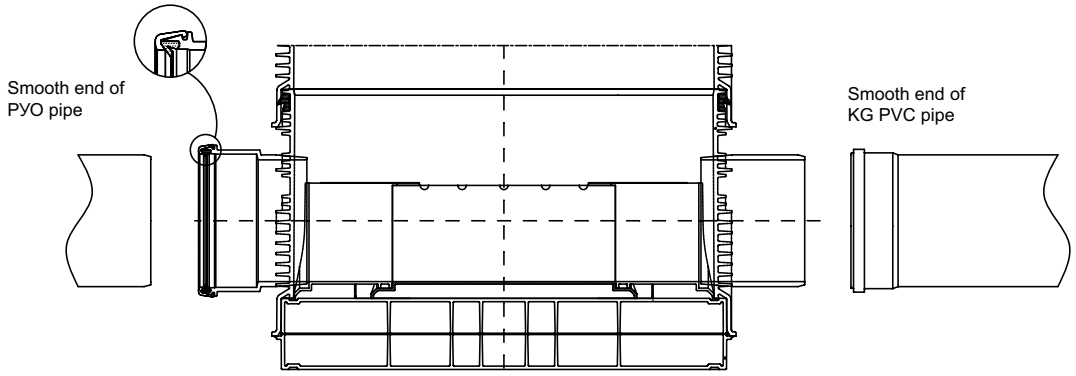
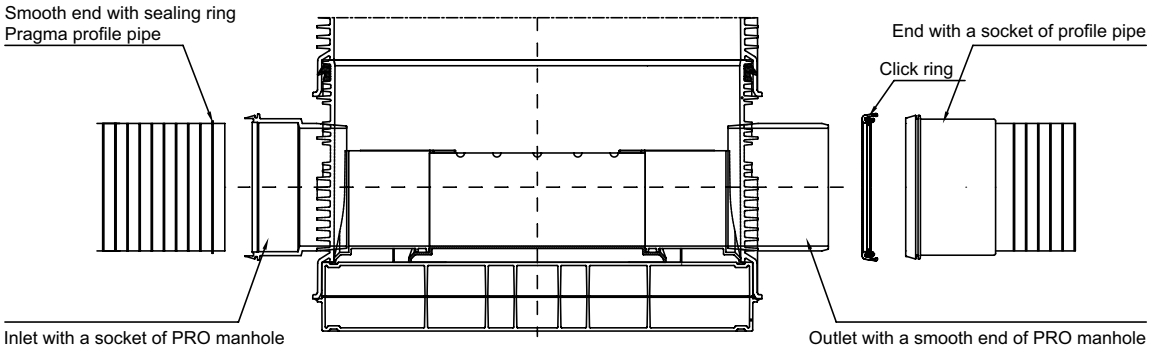


Diagram of connecting PRO manholes with Pragma pipes

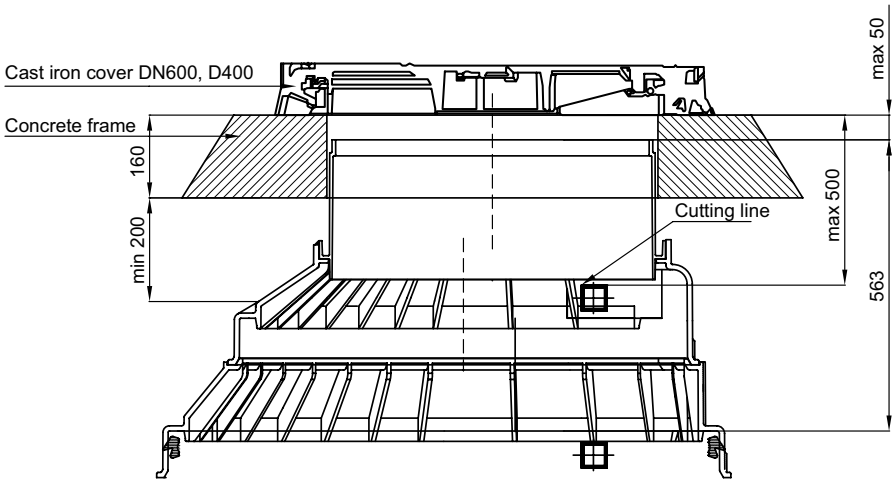


6.1.4 Concrete rings

- Regular concrete ring
- Adaptive concrete ring - Pipelife recommended to be used in case of road with inclination and the cover will be with the same incline as the road

Principle of operation - the two parts are joined to one another via a channel and upon rotation remain joined and tightly. The lower part of the concrete ring is always horizontal and perpendicular to the axis of the manhole. Upper Roll creates an inclined surface that follows the slope of the road. In the upper ring has a bed in which lies the lid and thus have full contact between all elements.

6.1.5 Minimal elongations of the concrete ring and the cover of the PRO manhole cover



6.1.6 ProCalc - software for detailed specification anddrawing of manholes „PRO“

Pipelife has its own software to help you with the following:

1. Specify the elements of each individual manhole from your project.
Example:

Str. 87, MH 125

Terrain level - 125.78

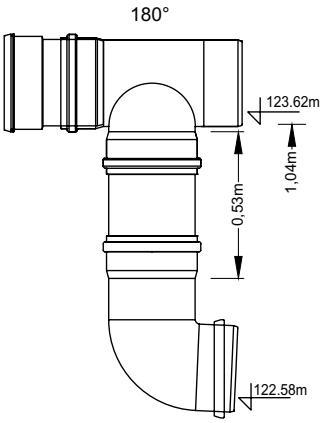
Outlet bottom level - 122.58
Outlet DN315 - Pragma

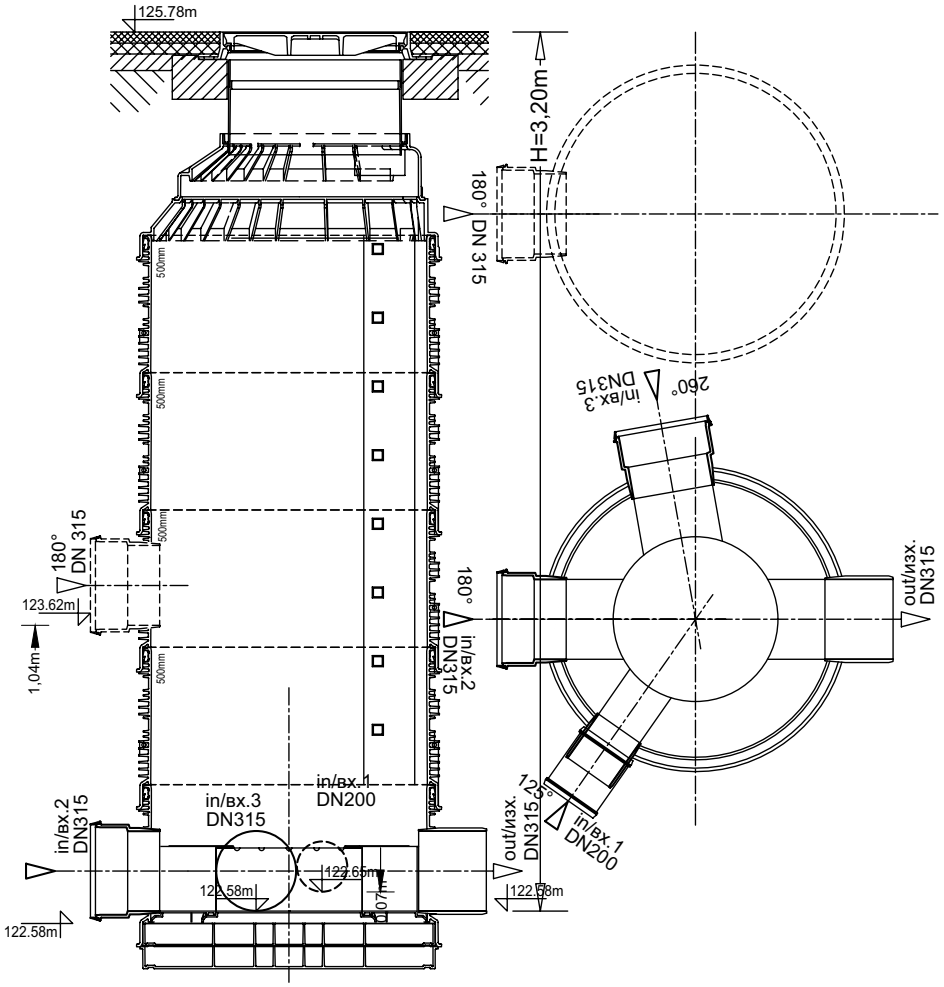
Inlet 1 122.65, DN200 PVC, 125 degree

Inlet 2 123.62, DN315 Pragma, 180 degree, cascade

Inlet 3 122.58, DN315 Pragma, 260 degree

2. Drawing of each manhole from your project.





3. Offer

SAP code	№	Code	Description	Unit	Quantity	Price	Sum price
	Str. 87 - MH 125		PRO1000 DN315 Pragma 0°/125°/180°/260° - 3.2 h.				2899,39
4196102986	Str. 87 - MH 125	KGSG1000/315/3-SB	PRO1000 Base, 3 inlet/outlet 315 Pragma 0°/125°/180°/260° - single bottom	pcs.	1	702,88	702,88
4196100183	Str. 87 - MH 125	PRO-RISER1000-L	Riser ring DN1000/0.5m with steps	pcs.	4	266,07	1064,28
4195005449	Str. 87 - MH 125	PRO-TFE B	Riser for cone fix entrance DN630, h=250mm	pcs.	1	35,57	35,57
4195005447	Str. 87 - MH 125	PRO-Seal1000	Sealing ring DN1000	pcs.	5	26,62	133,1
4196102297	Str. 87 - MH 125	PRO-Con1000/630-Fix	Cone DN1000/630 with fixed entrance	pcs.	1	227,45	227,45
4195005189	Str. 87 - MH 125	PRO-Frame630	Concrete ring DN630	pcs.	1	89,98	89,98
4195001582	Str. 87 - MH 125	PRO-Cover630-D400	Cover DN600, D400 - cast iron	pcs.	1	164,99	164,99
4196103080	Str. 87 - MH 125	PRO-Casc315/0.8-3	PRO-Casc315/0.8-2 (180°)	m	1	324,28	324,28
4196103106	Гл.Кл. I - РШ125	PRO-TSO-315	DN/OD315 socket Pragma (180°)	pcs.	1	29,85	29,85
4195005350	Str. 87 - MH 125	Base bottom plug 1000 single Ribs	Single bottom 1000 with ribs	pcs.	1	127,01	127,01
						Total price	2899,39

4. Calculation of statics if there is high groundwater level - HGL

Description	Calculation parameter	Value	Unit
Str. 87 - MH 125 / PRO1000 DN315 Pragma 0°/125°/180°/260° - 3.2 h.			
The manhole installation is	OK		
The construction damage is	OK		
The shape stability is	OK		
The position stability (buoyancy force) is	OK		
The short term deformation limit is	OK		
1) Structure failure - short-term - res. 1			
Horizontal tension from passive earth pressure	Sxk=	8,73	kPa
2) Structure failure - long-term - res. 1			
Voltage on the walls of the shaft to the bottom	Sxs,d=	1,62	kPa
3) Structure failure - extremely high groundwater - res. 1			
Tension on the MPP shaft walls	Sxs,d=	1,37	MPa
4) Form deformation - short term - res. 2			
Critical short-term load on the shaft walls	SsKr=	41,19	kPa
5) Form deformation - long-term - res. 2			
Critical horizontal tension in the shaft walls	SsKr=	42,35	kPa
6) Form Deformation - Extreme - RVS - Res. 2			
Critical horizontal tension in the shaft walls	SsKr=	50,82	kPa
7) Change of position - long-term - res. 3			
Dynamic ground pressure under water	Kat=	0,36	kPa
8) Position Change - Extreme - NWR - Res. 3			
Water upsurge - extreme	Wk=	10,52	kN
9) Short-term deformation (admissible - 6%) - res. 4			
Permissible deformation:	Dx,lim=	0,06	m

To take advantage of this complimentary service, you need to submit the information about the project's manholes in our application form, which you will find under this link:
https://www.pipelife.bg/en/dimensioning-tools/application-forms-for-offers.html

Depending on the number of pits, you will receive the above documents within a few days.

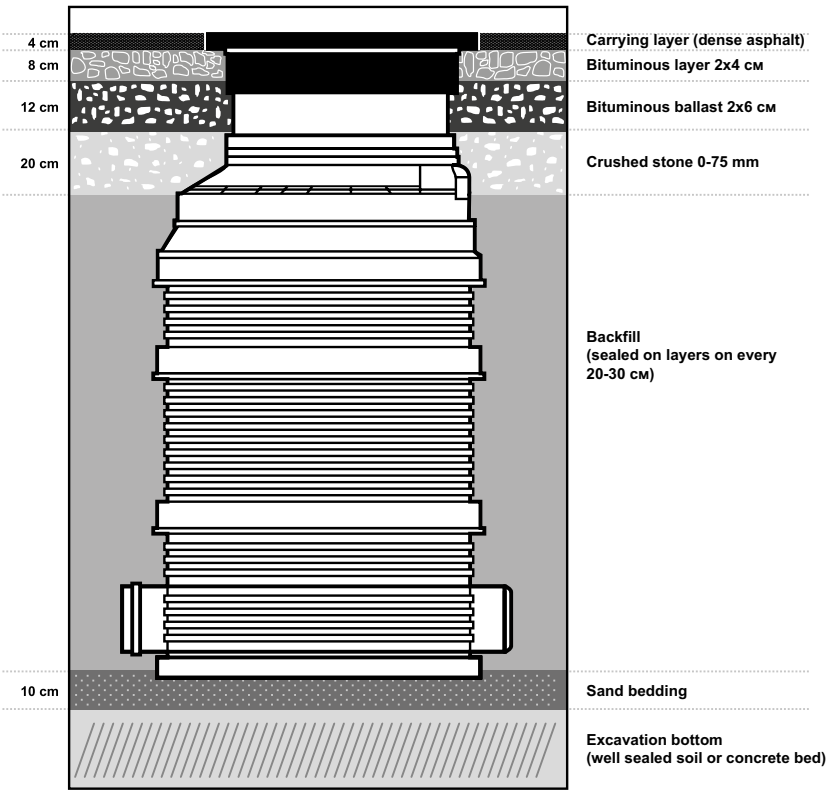
Example - 100 shafts are prepared within maximum 2 working days.

7 REQUIREMENTS FOR LAYING

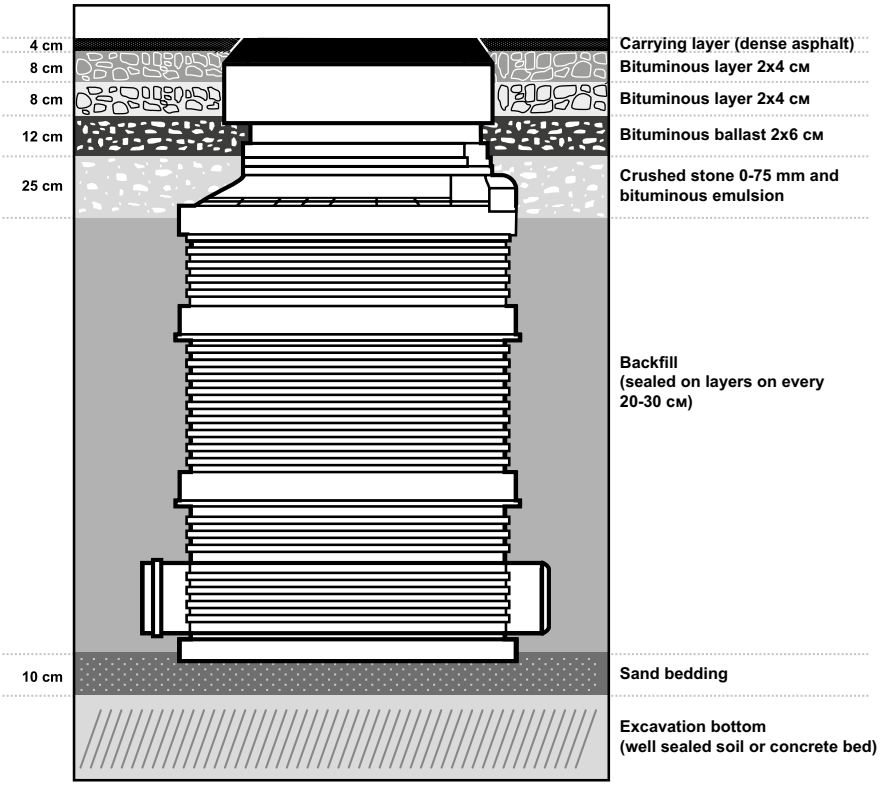
7.1 Diagrams of PRO manhole laying

The diagrams below show laying of PRO manholes with telescopic and fixed entrance in traffic zones (SLW30 and SLW60). The road surface shown is conditional and for the specific case must be taken into account part “Road infrastructure”.

manhole PRO-DN800/DN1000 with telescopic entrance, SLW 30, LKW 12



manhole PRO-DN800/DN1000 with fixed entrance SLW 60

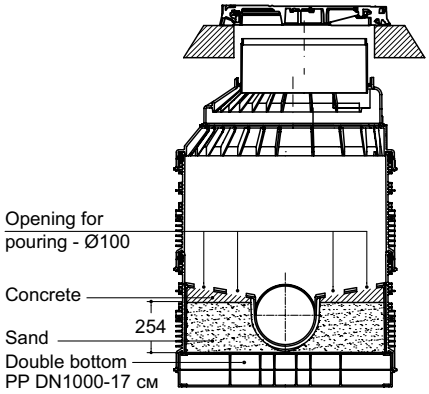


7.2 Laying of PRO manholes in case of high underground waters

The PRO manholes can be laid without any danger of emerging in case of underground waters up to 2 m from the manhole bottom elevation, but for safety reasons we recommend checking with our software (see 11 from the Catalogue).

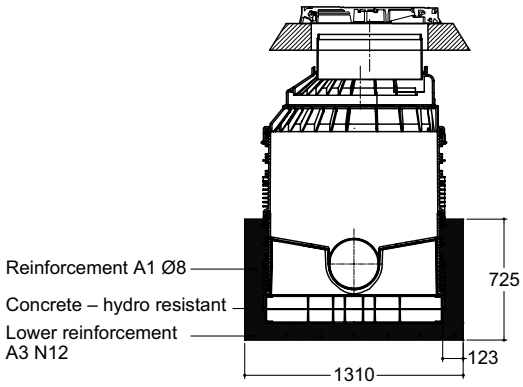
In case of underground waters higher than 2 m or when our software shows that there is a risk of emerging, Pipelife recommends the following options which eliminate the possibility of "emerging" of breaking the manhole integrity.

7.2.1 Filling the space between the shell, the base walls and the bottom of the manhole with low-slump concrete



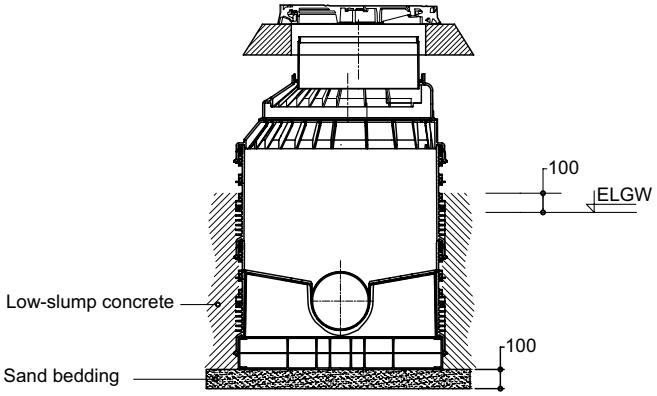
7.2.2 External concrete of the base with the inlets and the outlet of the manhole

The stabilization of the PRO is made with watertight concrete (min. class B25) with plasticizers. The concrete must enter between manhole ribs and must be vibrated.



7.2.3 External concrete of the base with the inlets and the outlet of manhole with low-slump concrete above the underground waters

The concrete must enter between the manhole ribs and must be vibrated.



8 DIRECTIONS FOR LAYING AND ASSEMBLY

8.1 Directions for laying and assembly of PRO-DN630, DN800 and DN1000

8.1.1 Preparation of the bedding layer and building of the manhole bottom

The ballast material and the place for laying of the manhole bottom are in accordance with the regulations of EN 1610. The bedding layer must be flat and resistant to load. For this purpose a preparatory layer must be laid and compacted. Its thickness must be around 10 cm.

The ring sealing for multiple use must be put in the highest sealing canal. Check the sealing element for defects and if it is properly placed. Spread uniformly the ring-shaped sealing for multiple use with Pipelife lubricant.

Building and levelling the manhole bottom with preliminary mounted ringshape sealing for multiple uses in accordance with the pipe connections and the project instructions.

8.1.2 Pipe connection assembly for inlet/outlet of the manhole bottom

For flexible bending of the pipe at direction up to 7,5° we recommend putting of flexible Pipelife double socket +/-7,5° (see the Table). Before the pipe connection you must check the connection sealings for their proper place and cleanness. Put Pipelife grease on the ends. Put flexible double socket on the ends of the specific pipe connection until it hits the bottom. Insert the pipe to the end in the double socket.

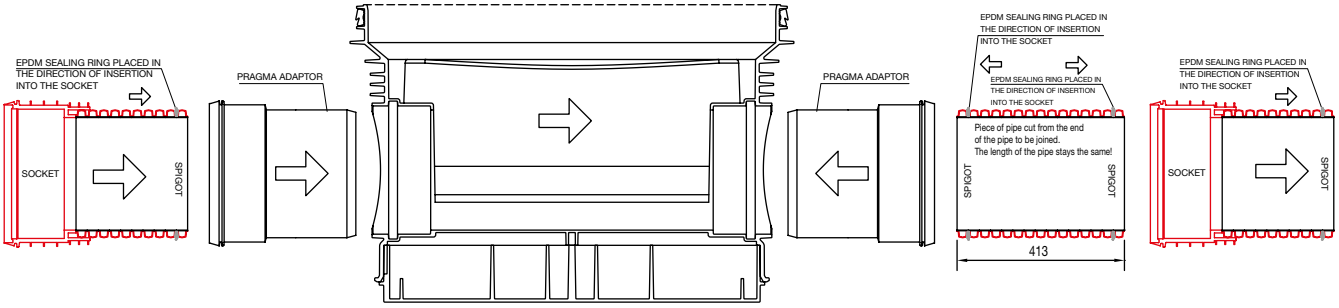
8.1.3 Connecting Pragma pipe with OSB manhole

For this purpose, we need:
Two adapters to connect Pragma with a smooth pipe.Two additional sealing rings for Pragma.Piece Pragma pipe with a length of 40 cm.

Steps:
First mount the adapters into the outlet and into the inlets of the OSB manhole.After first step the manhole is ready for connection with Pragma pipe with a rubber seal mounted at the end of the pipe.To connect to the outlet, cut the length of 40 cm from the pipe to be connected on the outlet.Mount two sealing rings on the bought ends of the pipe, taking care to follow the direction of connection.

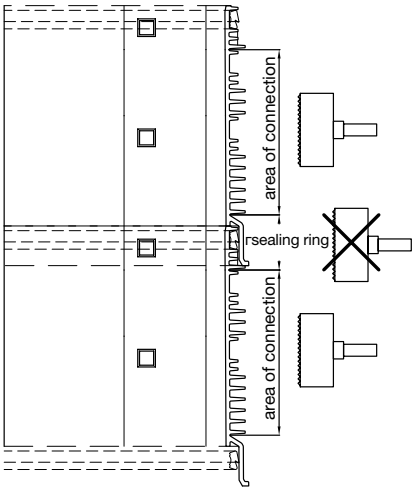
Note:
The length of the pipe from which we cut a piece and put it in front is the same. The purpose of this action is to mimic a tube with two smooth ends.It is also possible to cut out the pipe socket, in this case only one additional seal, but lose 10 cm of the length of the pipe.

Connection of Pragma pipe to a factory injection molded base type OSB



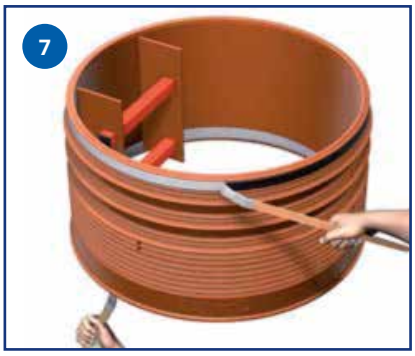
8.1.4 Possible zones for adding additional inlets to the riser rings

Additional inlets of the construction site can be performed in the areas provided in the scheme where there is no sealing ring. The hole should be done with the borer.



Note:
If the entrance is in the area of the sealing ring, it should be done in factory conditions!

8.1.5 Manhole rings mounting



Grease uniformly the ring-shaped sealing for multiple uses on the manhole ring. Put Pipelife grease uniformly also on the ring socket of the manhole.

Put the manhole ring tightly to the bottom of the manhole. To assure correct leveling of the ladder for climbing you must be careful the outer alongside ribs to be in line. Analogically to the mounting actions 7 and 8 put the other manhole rings.

Filling the hole of the manhole with filling material G1 and G2 with maximal size of the pieces 32 mm (for material with round shape) and maximal 16 mm (for material in pieces), and beating of layers with thickness of 20 to 40 cm according to EN 1610, ATV-DVWK- A 139. For street section the degree of sealing must be at least DPr = 95 %.

8.1.6 Manhole cone mounting

Put Pipelife grease uniformly on the manhole cone.

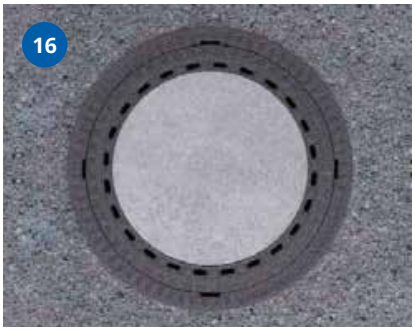
Put the manhole cone until it hits the ring. To assure correct leveling of the ladder for climbing, you must be careful the outer alongside ribs to be in line. Put a protective cover to avoid contamination inside.

The Pipelife canal manhole is mounted and can be filled and sealed analogically to the **mounting action of Figure 9**.

8.1.7 Shortening the manhole cone

The manhole cone ends with riser with smooth walls 200 mm which can be cut maximum with 100 mm from the opening with an electric saw. The cut surface must be made flat. When the height is not enough to reach 15 cm, an additional riser with smooth walls can be added.
It is not recommended the superstructure with smooth walls to exceed 30 cm.

8.1.8 Mounting the support concrete ring



Put the fulcrum ring of concrete in the center. The fulcrum ring transmits the weight of the transport vehicles towards the lower layers of the roadway. The direct load between the cover and the manhole entrance must be avoided in order not to be transmitted to the manhole. The upper end with smooth walls of the entrance of the cone enters up to the half of the fulcrum ring and a distance of 4 cm must be left between the cover and the cone which assures the weight not to be transmitted directly to the manhole system.

Fill and seal up to the upper end of the terrain analogically to the mounting action of Figure 9, meeting EN 1610 (see the example for mounting on p. 29). Before laying the road flooring take away the protective cover and put the corresponding cover on the fulcrum ring. The correct fitting close to the upper road flooring can be achieved by correcting the height of the concrete ring which moves around the cone entrance with smooth ends.

8.1.9 Example of PRO manhole building

Asphalt covering

Carrying layer about 3 см

Bituminous carrying layer about 20 см

Protective layer about 10 см

Layer against freezing about 20 см

Gravel about 25-30 см

Soil

Sand

1. Manhole cover from cast concrete
2. Concrete fulcrum ring
3. Pipelife-system sewerage manhole PRO
4. Pipelife-elastic socket ±(7,5°)
5. Pipelife- Pragma pipe

8.1.10 Important directions for safety during assembly

The personnel for mounting, maintenance and repair must prove the necessary qualification for the manhole mounting.
The degree of responsibility, competency and the control of the personnel must be regulated by the company which executes the project.

Norms/Directives	Title
DIN 4124	Excavations and trenches - Slopes, planking and strutting, breadths of working spaces
BDS EN 1610	Construction and testing of drains and sewers
BGV C22	Construction (Personal protective equipment against falls)
BGR 117	Directives for work in tanks, silos and small spaces

9 TRANSPORTATION - LOADING, UNLOADING AND STORAGE

9.1 Transport, delivery and storage

The modular Pipelife sewerage manholes are delivered as a set. Each part of the manhole is designated with a number in accordance with its assembly sequence. The different parts are assembled in accordance with sequence designation.
The sealings are placed inside the manhole bottom.

10 HYDRAULIC CAPACITY OF PRO MANHOLES

The factors that determine the hydraulic conductivity of sewer manholes are the following:
The invert channel – it has to be designed so as to ensure trouble-free conduction of the sewer flow, without leaving any "dead zones" to prevent deposit buildups. They are made of polypropylene with low roughness coefficient and are inclined to the manhole outlet.
Inlets/outlets – depending on the difference of inlet and outlet diameters they are produced crown to crown to avoid rises of the water level in the manhole area due to narrowing.

Design suggestions:

When determining the dimensions of sewer network, designers should make provisions for such a specific energy of the wastewater flow that will prevent the deposition of suspended substances along its length. For that purpose they should take into account the manhole local resistance depending on the particular type of factory made manholes. Failure to do that coupled with the presence of insufficient inclination may result in clogging of the sewer network.

Losses of about 0.04 m were recorded for invert channels in manholes DN1000 with two inlets DN315 and outlet DN315 and accordingly 90° angle of the first inlet, 180° angle of the second inlet, 0° angle of the outlet, as a result of joining the two flows and increasing the energy of the outlet flow when the inclination is < 1%. If the inclination is higher, reliable results cannot be recorded due to the formation of a turbulent flow but anyway there is no risk of deposition of suspended substances.

Losses of about 0.03 m were recorded for invert channels in manholes DN1000 mm with three inlet pipes DN315 and one outlet pipe and accordingly 90° angle of the first inlet, 180° angle of the second inlet, 270° of the third inlet, 0° angle of the outlet, as a result of joining the three flows and increasing the energy of the outlet flow when the inclination is < 1%. If the inclination is higher, reliable results cannot be recorded due to the formation of a turbulent flow but anyway there is no risk of deposition of suspended substances.

The inclination of the bottom of invert channel does not in fact have any practical influence on head losses as compared to the head losses in invert channel whose bottom is not inclined. In such cases the changed water flow regimen should be taken into consideration in addition to the importance of ensuring sufficient specific energy for the flow that will enable it to transport the suspended substances it carries. If the feeding and the discharging pipes are of the same diameter and are used in collection chambers with two or three inlets the pipes, the pipes inside the manhole should not be connected crown to crown but the levels of feeding pipes should be adjusted to the outlet level instead.

EXPERIMENTAL SETTING AND MEASURING TOOLS AND DEVICES

This experimental setting was designed with the purpose to test the factory made manholes of Pipelife, and the main materials, pipes, manholes, sealing, etc. were provided by the Client.
The experimental setting should be satisfying the following requirements:

- to recreate a realistic reproduction of the most common hydraulic cases occurring in practice;
- to enable direct visual monitoring of the flow in different sections of the pipes and the manhole;
- to allow the conduction of experiments that could cover a comparatively wide range of changes in the main hydraulic parameters such as water amount, pipe inclination, and depth of the flow in the different sections;

Fig.9 shows the layout of experimental setting, and Fig.10 shows a picture of the ready test setting including the installed test manhole with three inlets and one outlet.

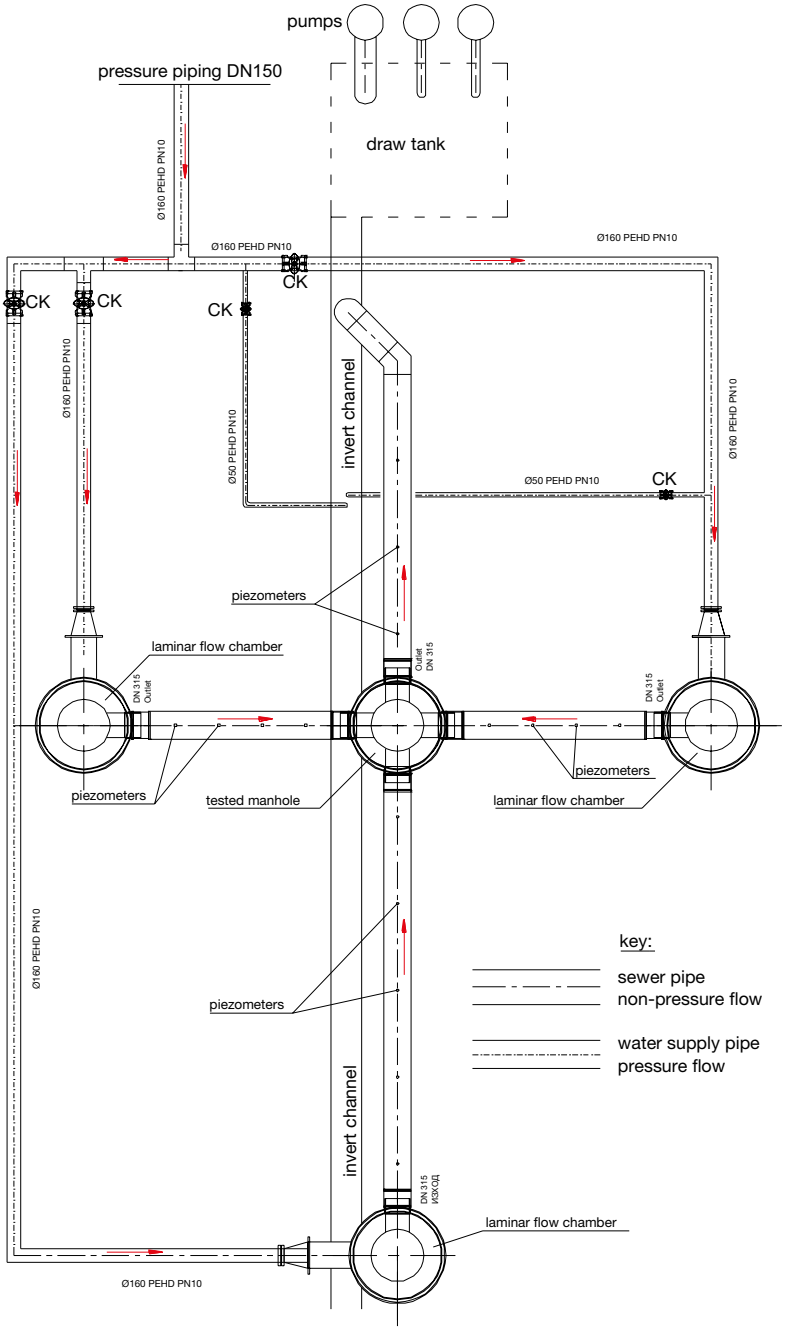


Fig. 9

Fig. 10

UNIVERSITY
OF ARCHITECTURE
CIVIL ENGINEERING
AND GEODESY

1 Hristo Smirnenski Blvd, Sofia 1046,
Republic of Bulgaria
Telephone: (02) 963-52-45; Fax: (02) 865 68 63

TEST REPORT

On the hydraulic test study of polypropylene manholes manufactured by Pipelife Bulgaria.

ORDERING ORGANIZATION: PIPELIFE BULGARIA EOOD, Company ID Code 115944768, 3 Industrialna Street, Botevgrad Town

PERFORMED BY: UNIVERSITY OF ARCHITECTURE, CIVIL ENGINEERING AND GEODESY – CENTER OF RESEARCH STUDIES AND DESIGNS /UACEG-CRSD/ in Sofia, 1 Hristo Smirnenski Blvd.

Team of Researchers:

Project Manager: ……..
Assoc. Prof. Engineer Dimitar Alichkov

1. …….
   Chief Prof. Assistant Engineer Tanya Igneva-Danova

2. …….
   Chief Prof. Assistant Engineer Emil Tsanov

3. …….
   Prof. Assistant Engineer Borislav Indzhov

April 2016
Sofia

11 STATIC CALCULATION OF PRO MANHOLES

Basic requirements according to EN 13598-2 where manholes PRO responding to - to withstand laying in traffic areas in dept up to 6m and high water level 2m from the bottom. For that reason Pipelife can provide static calculation for the next conditions:

- In case of dynamic load D400 they preserve their construction integrity.
- In case of static load from the soil they keep their shape.
- In case of high underground waters the bottom does not deform and due to its ribs the manholes do not emerge and keep
- their position.

For security design Pipelife recommends to contact the technical department in cases when the manholes have to be installed in conditions that are not described in the standard. Pipelife will calculated static calculations for additional fortification of the manhole.

Inquiry Form

Project data	Project			
	Customer			
	Designer			
	Дата			
Manhole configuration	Type - DN200,DN300, DN400, DN630, DN800, DN1000			
	Hw – Ground water level (normal), [m]			
	Hwe – Ground water level (extreme case), [m]			
	Safety factor - 1, 1,5 (default), 2			
Soil configuration (backfill and sidewalls)	Backfill soil type			
	G1 - non cohesive (loose gravel and sands)			
	G2 - slightli cohesive (the little clayey gravel and sands)			
	G3 - mixed cohesive (the clayey or little muddy gravel and sands)			
	G4 - cohesive (the clays and the grounds with mixture of organic components (ref. ATV 127)			
	Backfill compaction, [kN/m^3] - Compaction by Proctor			
Traffic data	Traffic (select one of the following options)		Location	
			terrain	Road/location HLC 30
	PKW 2 – 2 tons, 2 axles			
	LKW 12 – 12 tons, 2 axles			
	SLW 30 – 30 tons, 2 axles			
	SLW 40 – 39 tons, 2 axles			
	SLW 60 – 60 tons, 2 axles			

11.1 Types of soils according to ENV 1046

Soil type	Soil group					Filling
	Soil groups as per ATV127	Typical name	Symbol	Distinctive feature	Examples	
Gravelly	G1	Poorly-graded gravel	(GE) [GU]	Steep granulometric curve, predominantly poorly-graded	Crushed stone, river and coastal gravel, moraines, cinder, volcanic ash	YES
		Well-graded gravels, gravel/sand mixtures	[GW]	Uninter. granulometric curve, several granulometric groups		
		Poorly-graded gravels, gravel/sand mixtures	(GI) [GP]	Steep granulometric curve, missing one or several granulometric groups		
		Poorly-graded sands	(SE) [SU]	Steep granulometric curve, predominantly one	Dune sands and sediments, river sand	YES
		Well-graded sands, gravel/sand mixtures	[SW]	Uninter. granulometric curve, several granulometric groups	Morainal sand, coastal sand, beach sand	
		Poorly-graded sands, gravel/sand mixtures	(SI) [SP]	Steep granulometric curve, missing one or several granulometric groups		
	G2 and G3	Silty gravels, poorly-graded gravel/ silt/sand mixtures	(GU) [GM]	Wide / interrupted granulometric curve with fine silty grains	Crushed gravel, sharp debris, loamy gravel	YES
		Loamy gravels, poorly-graded gravel / sand / clay mixtures	(GT) [GC]	Wide / interrupted granulometric curve with fine silty grains		
		Silty sands, poorly-graded silt/sand mixtures	(SU) [SM]	Wide / interrupted granulometric curve with fine silty grains	Quicksand, soil, sandy loess	
		Loamy sands, poorly-graded sand / clay mixtures	(ST) [SC]	Wide / interrupted granulometric curve with fine silty grains	Sandy soil, alluvial clay, alluvial marl	
Cohesive		Inorganic silts and very fine sands, rock flour, silty or clay-like fine sands	(UL) [ML]	Low stability, short reaction, zero to weak plasticity	Loess, clay	YES
	G4	Inorganic clays, distinctly pastic clay	(TA)(TL) (TM) [CL]	Medium to high stability, slow reaction, low to medium plasticity	Alluvial clay, clay	
Organic		Soils of mixed grain size with humus and talc inclusions	[OK]	Vegetational and non-vegetational inclusions, rots, lightweight, high porosity	Upper layers, hard sand	NO
		Organic silt and organic silty clays	[OL](OU)	Moderately stable, slow to very fast reaction, low to medium plasticity	Marine chalk, upper soil layer	
		Organic clay, clay with organic inclusions	[OH](OT)	High stability, zero reaction, medium to high plasticity	Mud, soil	
Organic		Peat, other highly organic soils	(HN)(H2) [Pt]	Non-composite peat, fibrous, colored in brown to back	Peat	NO
		Slime	[F]	Slimes in silt deposits, often mixed with sand / clay / talc, very soft	Slime	

11.2 Compaction of the material for backfill

The table below shows the different methods of compaction to achieve the required Proctor ratio:

The requirements for the degree of compaction depend on the general load and must be defined in the project documentation. The compaction must be done by different types of compacting. Depending on the equipment, the layers' thickness and the soil susceptibility to compaction, different degrees of compaction can be achieved. In Table 3.2 are given different data which refer to gravel, clay and alluvium soils.

Table 3 Compaction methods

COMPACTION METHODS							
Equipment	**Weight [kg]**	**Maximal thickness of the layer before compaction [m]**		**Minimal thickness of the initial backfill above the pipe [m]***	**Number of repetitions for achieving the compaction**		
		gravel, sand	**clay, alluvium**		**85% according to Proctor modified test**	**90% according to Proctor modified test**	**95% according to Proctor modified test**
Fine stuffing	-	0.10	-	-	1	3	6
Manual compaction	min. 15	0.15	0.10	0.30	1	3	6
Vibration compaction	50-100	0.30	0.20-0.25	0.50	1	3	6
Distributed mechanized compaction**	50-100	0,20	-	0.50	1	4	7
Mechanized compaction	50-100 100-200 400-600		- - 0.20	0.50 0.40 0.80	1 1 1	4 4 4	7 7 7

* Before using compaction tools

** Compaction on both pipe sides

12 QUALITY MARK BY THE BULGARIAN WATER ASSOCIATION

The Bulgarian Water Association launched the initiative entitled "Bulgarian Water Association Quality Mark" to reassure the confidence in every manufacturer pretending to be supplying products that meet the standard requirements.

The presence of "Bulgarian Water Association Quality Mark" on manufactured products guarantees that the raw materials used for their production are of proven high quality and meet the manufacturing standards. The control of materials is exercised by random inspections and the sample taken are tested in accredited laboratories. The inspections are carried out in strictly defined order and the exercise of full control throughout the test.

Manholes and inspection chambers according to BDS EN 13598-2:2016			
№	*Name of indicator*	*Number and size of tested samples*	*Frequency of testing procedures*
1.	**Appearance, color** **Dimensions** (geometry), p.6.1; p.6.2. - diameter and length of socketed/smooth tip - wall thickness of the body, of socketed/smooth tip - of the base (bottom), p.6.3. - external/internal diameter of the body and the individual sections (modules) - internal dimensions - of socketed/smooth tips of the inlet and the outlet	1 pc. of fully equipped manhole with modules	twice a year
2.	**Physical properties – of the body and/or the individual sections (modules) of the manholes, p.8, Table 5 and Schedule A, B**		twice a year
	Melt flow index by weight (MFR)		
	Density		
	Polymer type identification		
3.	**Mechanical properties, p.7, Table 3.4**		twice a year
	Shock resistance/strength at (23±1)°C of the base, Table 3		
	Ring hardness of the individual sections (modules), Table 4	3 pc. of tested samples, L=(300÷1000) mm from sections (modules)	twice a year
	Resistance/strength to vertical loading on stairs, Table 4	1 pc. of step of the stairs	twice a year
5.	**Requirements for system operation, p.9, Table 6**		
	Water-tightness (water impermeability) of the system at (23±5)°C	1 manhole system (base, 1 module, cover and frame) and 2 socketed pipes, L=1.0 m, for connecting the base inlet and outlet	twice a year
	Water-tightness of the system with elastomer sealing rings (diametrical or angular deflection) of the pipe connecting fittings	1 system of flexible pipes and fittings for horizontal connection by sockets to the manhole base and cover	twice a year

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