

PLASTIC MANHOLES: UNIFORM REQUIREMENTS FOR DIFFERENT TECHNOLOGIES

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Currently in Russia, there are a great number of domestically-produced and imported plastic manholes in the plastic pipeline water disposal system market. Most of the main production technologies are represented. Each technology has its advantages and disadvantages, but they all fall under this unified rule – the greater the investment in technology and production it gets, the more reliable the manhole will be.

Plastic manholes for water disposal systems are installed at significant depth. They are often subjected to static and dynamic loads in the presence of a high level of ground waters. The basic requirements were stipulated in the EN13598-2 standard, and followed by GOST 32972-2014, which aims to ensure the reliable and safe operation of plastic manholes.

This overview considers how manholes produced using different technologies comply with the above requirements.

Major players and their products

PIPELIFE

- DN 900/1000, DN 900/800, DN 630 module manholes – connection diameters DN/OD 160–315 mm with limited choice of design (constructed from parts made by low pressure moulding).

- DN 1000, DN 800 module manholes – connection diameters DN/OD 160–630 mm with unlimited design (welding parts made by low pressure moulding).

- DN 630 module inspection chambers – connection diameters DN/OD 160–315 mm with unlimited design (the base of the manholes is made by welding parts made by low and high pressure moulding; the manhole shaft is completed with a two-layer corrugated pipe made using the extrusion method).

- DN 400 module inspection chambers – connection diameters DN/OD 160–315 mm with limited design (the base of the manholes is made by welding parts made by high pressure moulding; the manhole shaft is completed with a two-layer corrugated pipe made using the extrusion method).

WAVIN

- DN 1000 module manholes – connection diameters DN/OD 160–315 mm with limited design (parts are made by low and high pressure moulding).

- DN 600 module inspection chambers – connection diameters DN/OD 160–315 mm with limited design (the base of the manholes is made by high pressure moulding; the manhole shaft is completed with a one-layer corrugated pipe made using the extrusion method);

- DN 315, DN 425 module inspection chambers – connection diameters DN/OD 160–200 mm with limited design (the base of

the manhole is made by high pressure moulding; the manhole shaft is completed with a one-layer corrugated pipe made using the extrusion method).

IKAPLAST

- DN 1000 module manholes – connection diameters DN/OD 160–315 mm with limited design (made of parts produced using rotational moulding; connections into the base of the manhole are made by tapping with a sealing ring or using manual extruder welding of the pipe pieces).

- DN 1000 welded manholes – connection diameters DN/OD 160–630 mm with unlimited design (the shaft/base of the manhole is made from two-layer corrugated pipe by manual extruder welding the pipe pieces, and the bottom is made of plastic sheet).

- DN 400, DN 600 welded inspection chambers – connection diameters DN/OD 160–630 mm with unlimited design (the shaft / base of the chamber is made of two-layer corrugated pipe by manual extruder welding the pipe pieces, and the bottom is made of plastic sheet).

NAWELL

- DN 1000, DN 1500 module manholes made of PE and PP – connection diameters DN/OD 110–600 mm with limited design (the assembled parts are made by rotational moulding; connections are tapped in using sealing rings or pipe pieces welded using a hand extruder).

- DN 400 module inspection chambers – connection diameters DN/OD 160–250 mm with limited design (the base of the chamber is produced by rotational moulding; connections are tapped in using pipe pieces, and the shaft of the chamber is made of a two-layer corrugated extruded pipe).

PK NIS

- DN 1000, DN 1500 welded manholes – connection diameters DN/OD 110–600 mm with unlimited design (the shaft/base is made of spiral wound pipe; the connections are welded using a manual extruder, and the bottom is made of plastic sheet).

POLYPLASTIC GROUP

- DN 1000, DN 1500 module manholes – connection diameters DN/OD 110–800 mm with unlimited design (the base of the manhole is welded of parts made by injection moulding, rotational moulding and extrusion. The shaft of the manhole is

complete with a two-layer corrugated pipe made by extrusion; the cone of the manhole is produced by rotational moulding).

– DN 1200, DN 1600 welded manholes – connection diameters DN/OD 110–800 mm with unlimited design (the shaft/base of the manhole is welded of parts made by injection moulding, rotational moulding and extrusion).

– DN 600 module inspection chambers – connection diameters DN/OD 110–315 mm with unlimited design (the base of the chamber is welded together with parts made by injection moulding, rotational moulding and extrusion. The shaft of the chamber is completed with a two-layer corrugated pipe made by extrusion).

– DN 400 inspection chamber – connection diameters DN/OD 110–200 mm with limited design (the base of the chamber is made by injection moulding, the shaft is completed with an extruded two-layer corrugated pipe).

Compliance with the main articles of GOST 32972-2014

The standard compliance, GOST 32972-2014 “Plastic manholes for sewerage and drainage systems. Specifications” is based on research into the properties of thermoplastic material products, and the results of tests on samples of different products sold in Russia.

CONNECTION TO THE BASE OF THE MANHOLES

The GOST 32972-2014 clause 4.2.2 states: “Sizes and design of the manhole’s sockets and spigots must comply with regulatory and technical documentation for the pipes and fittings the manholes are used for”.

The manholes manufactured by PipeLife, Wavin, POLYPLASTIC are in full compliance with GOST 32972-2014.

Some GOST 32972-2014 compliance problems may occur with an in-situ connection using a sealing ring (IKAPLAST, Nawell). This kind of connection does not comply with the requirements for corrugated pipe connections. In particular, it does not ensure the necessary tightness under deformation of the pipe. Strictly speaking, manholes that are equipped with pipe connections made of smooth PE pipe (IKAPLAST, Nawell, PK NIS) do not comply with GOST 32972-2014; smooth pipes are incompatible with the regulatory and technical documentation for sewer pipes made of PVC and PP. For example, the tolerances of the outer diameter of GOST 18599-2001 pipes do not comply with the inner diameter of GOST R 54475-2011 couplers and sockets.

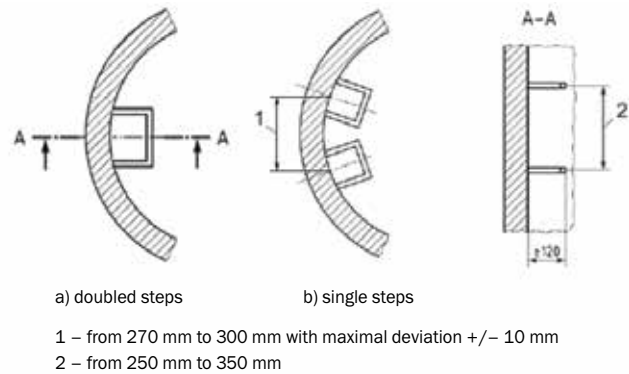
LADDER

The GOST 32972-2014 clause 4.2.3 states: “If the manhole has a ladder (climbing frames), they must be put at the distance shown on pic.1. The distance from the shaft wall should be no less than 120 mm. Note – doubled step is designed for two legs and has a width no less than 250 mm. Single step is designed for one leg and has a width no less than 145 mm. Single steps are set in a checkerboard order”.

The following manholes are in full compliance with GOST 32972-2014:

– PipeLife, Wavin, POLYPLASTIC.

The following products may have some compliance problems with GOST 32972-2014:



Pic 1.

– Nawell, IKAPLAST – the single step ladder in the shaft, made by rotational moulding, does not comply with GOST as the “ladder steps /step frames” suggest the possibility of step holding according to pic. 1.

OUTER APPEARANCE OF THE SURFACE

GOST 32972-2014 clause 5.1.1: “Bulging, dents, cracks and other foreign inclusions on the surface of the manhole components made of plastic that are visible without magnification tools are prohibited.

Recommended colour for the manhole components made of PE is black, components made of unplasticised PVC and components made of PP – orange-brown.

Surface layers of manhole components with multi-layer design must have even and uniform colour”.

There are possible GOST 32972 compliance problems with products made using the low pressure moulding method (PipeLife). As a result of the technology used, the surface of the products often have whitish spots and pores.

HOOP STRENGTH OF THE MANHOLE SHAFT

GOST 32972-2014 clause 5.1.4: “Hoop strength of the manhole shaft and telescopic extension must be no less that 2 kN/m².

Notes: Greater hoop strength may be required for the heavy grounds and over 4 metres depth”.

PipeLife, Wavin, POLYPLASTIC, PK NIS manholes strictly comply with GOST 32972-2014.

There may be some GOST 32972-2014 compliance problems with the products made by rotational moulding (Nawell, IKAPLAST), as the hoop strength of the shaft directly depends on the thickness of the wall or the height of the profile. But rotational moulding does not facilitate construction with high ribbing and limits the thickness of the homogeneous wall 12–15 mm, which is not enough for a required hoop strength of no less than 2 kN/m².

TIGHTNESS

GOST 32972–2014 clause 5.1.6: “Manhole components assembled together must comply with the parameters set in table 2.”

GOST 32972-2014 clause 8.11: “Leak tightness of base and shaft connection with sealing ring is checked on the sample of the fully assembled base with a section of the shaft no shorter

Table 2.

Indicator	Value	Testing method
1 Shaft connections tightness at the pressure of 0,1N, bar ^{1), 2)}	no leaks	8.9
2 Tightness of telescopic extension connection assembly ³⁾	no leaks	8.10
3 Tightness of cone connection assembly	no leaks	8.10
4 Tightness of base and shaft assembly : - at air pressure of 0,3 bar ²⁾ ; - at water pressure of 0,05 bar ²⁾ ; - at water pressure of 0,5 bar ²⁾	pressure increase $\leq 0,03$ bar within 15 minutes no leaks within 15 minutes no leaks within 15 minutes	8.11

¹⁾ N – maximal level of ground waters above the bottom of the base in metres, but no less than 2 meters.

²⁾ 1 bar = 0.1 MPa = 105 Pa.

³⁾ For the telescopic extension located below 0.5 m from the ground level.

than 1 metre. The section of the shaft and other connections must be sealed in order to create inner pressure. Design of end caps must ensure leak tightness and eliminate transfer of axial load onto the connection caused by inner pressure. Pipe caps must have a port to connect to the pressure source.

The leak tightness is checked sequentially in the following modes:

- The sample is subjected to reduced air pressure at $-30 \text{ kPa} \pm 5\%$, which is held for 5 minutes and then disconnected from the pressure source. The test is carried out at the ambient temperature of $23 \pm 5 \text{ }^\circ\text{C}$. The temperature deviation during the test must not be more than 2°C . The pressure mark for the sample in 15 minutes must be no more than $-27 \text{ kPa} \pm 5\%$.

- The sample is filled up with water of $19 \pm 9^\circ\text{C}$, the air is removed, and held for at least 15 minutes. The pressure is gradually increased to $5 \pm 0.5 \text{ kPa}$ over a period of no less than 5 minutes and held for no less than 15 minutes. If the sample does not have visible leaks then the test continues...

- The inner water pressure is gradually increased over a period of no less than 5 minutes to $50 \pm 5 \text{ kPa}$ and held for 15 min. The sample must not have any visible leaks."

PipeLife, Wavin and POLYPLASTIC manholes strictly comply with GOST 32972-2014.

There are possible GOST 32972-2014 compatibility issues with the following products:

- Nawell, IKAPLAST. The tightness of the base and shaft joint and the connections to the manhole base should be achieved by using precision-sized connecting components and superior quality sealing rings. Rotational moulding technology cannot guarantee the dimensional tolerance stability of the connecting components. This disadvantage can be eliminated by post-production calibration – although this is a little-used, labour-intensive process.

- PK NIS. Human skill plays an important role in achieving the desired tightness of the seams in a welded manhole,

using superior quality materials. Unfortunately, the number of reclamations for welded manholes is significantly higher than for module analogues.

TRAY DEFORMATION

GOST 32972-2014 clause 5.1.10: "Projected deformation of the flow cross section of the base canals for 50 years' service life must be:

- Vertical – no more than 5% of outer pipe diameter;
- Horizontal – no more than 10% of outer pipe diameter."

GOST 32972-2014, Annex B "Determination of design durability of the manhole base".

PipeLife, Wavin, POLYPLASTIC manholes strictly comply with GOST 32972-2014.

The durability of DN 1000, DN 1500 manhole bases to deformation at reduced inner pressure ($-30 \text{ kPa} \pm 5\%$) is only possible with a spherical bottom and big wall thickness ($>15 \text{ mm}$) or a high profile with reinforcing ribs. However, rotational moulding technology does not facilitate the manufacture of products with these parameters; therefore GOST 32972-2014 compatibility problems can be associated with Nawell and IKAPLAST products.

The bottom of PK NIS manholes is made of sheets with reinforcing ribs. To ensure its compatibility with the required standards, it must be supported by the appropriate calculations, and also depends on the quality of the welding.

IMPACT RESISTANCE

GOST 32972-2014 clause 5.1.3 states: "Manhole base must be impact resistant at free fall from the height of 500 mm at the temperature of 10°C .

Prior to fall, the sample of the base is placed with the weakest place, e.g. pipe end pointing down".

Table 3.

Load class	Test load, kN
Class A	5
Class B	50
Class D	100
Class E	150

Wavin, POLYPLASTIC, PipeLife DN 900/1000 and DN 900/800, Nawell (PE), IKAPLAST manholes strictly comply with GOST 32972-2014.

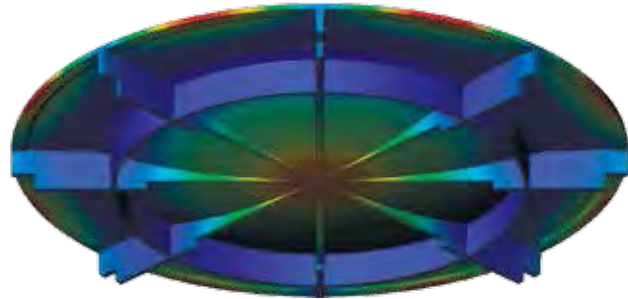
There are possible GOST 32972-2014 compliance problems with the following manholes:

- PipeLife DN 1000 and DN 800. Welding the connecting pipes to the base with a structural wall (produced by low pressure moulding and adding nitrogen) causes risks of seam cracking on impact.
- Nawell (PP). The use of PP in rotational moulding leads to material destruction that can badly affect the product's impact resistance.

TRANSPORT LOAD ONTO THE MANHOLE CONE

GOST 32972-2014 clause 5.1.7 states: "Cones and pre-surface components of the manhole must be resistant to the load, relevant

Pic. 1. Deformation of base and shaft of the manhole made using rotational moulding method.



Pic. 2. Design pressure of ground waters on the bottom of the manholes

to the allowed load class on transport according to the Table 3".

Wavin, POLYPLASTIC, PipeLife, Nawell (PE), IKAPLAST manholes strictly comply with GOST 32972-2014.

There are possible GOST 32972-2014 compliance problems with the following manholes:

- Nawell (PP) – The use of PP for rotational moulding leads to the destruction of the material structure which influences stability at cone deformation.
- PK NIS – Manhole cone replacement using the welded design, made of horizontal sheet and a PE passage neck, directs all the vertical load onto the sheet and the manhole shaft, which leads to significant deformation and the destruction of the installation at class D loads – 100 kN and greater.

WEIGHT OF ROTATIONAL MOULDING MANHOLES

GOST 32972-2014 clause 5.1.8: "Weight of components made by rotational moulding must be within the following limits relating to the weight set in the manufacturer's technical documentation:

- for the components with weight less than 10 kg – over 96%;
- for the components with weight from 10 to 50 kg – over 97%;
- for the components with weight over 50 kg – over 98%".

Manufacturers' desire to save material can result in lower weight rotationally moulded manholes that could be different to the weight required by the technical specifications. In such cases, manhole deformation resistance will not comply with the regulations' requirements. Therefore, rotationally moulded manholes (Nawell, IKAPLAST) might require closer attention at the acceptance stage, especially if they are intended to be used in difficult conditions.

Conclusion

Wavin, POLYPLASTIC and PipeLife manholes (except for DN 1000 and DN 800 manholes) fully comply with GOST 32972-2014. IKAPLAST, Nawell and PK NIS manholes may not comply with some of them, due to their design features, and because of the production processes employed.

What does it mean for the actual use of manholes? These manholes may not display any problems in idyllic conditions (e.g. small depth, no ground waters, top quality installation with backfill etc.). But, in reality, as we know, the ideal conditions are quite rare; only full compliance with all the requirements can guarantee the reliable, long-term operation of plastic manholes.