SYSTEM OF SEWAGE PIPES

K2-Kan XXL

of structural type, made of polyethylene (PE) and polypropylene (PP)

ecological solutions

ISO 14001

ISO 9001

Kaczmarek

System of sewage pipes and fittings K2-Kan XXL

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Intended use

The subject of these instructions are pipes with and without socket as well as fittings of trade name K2-Kan XXL, made of polyethylene (PE) or polypropylene (PP), intended for:

- laying down gravity systems (of sewage, rainwater, combined, and industrial effluent types),
- constructing bleeding, leaching and drainage systems,
- protection lines and culverts under embankments,
- building of sewer manholes, tanks and pump pits,
- pipelines in waste water treatment stations,
- underwater pipelines (sewer traps, dump sewers),
- no-dig rehabilitation of pipelines,
- individual use in objects

Standards, approvals, attestations

EN 13476-3+A1:2009 Plastics piping systems for non-pressure underground drainage and sewerage. Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Part 3: Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B
DIN 16917-2 Rohre und Formstücke aus thermoplastischen Kunststoffen mit profilierter Wandung und glatter Rohrinnenfläche — Großrohre über DN 1200 für den Erdeinbau — Teil 2: Anforderungen an Rohre und Formstücke

EN 476:2012 General requirements for components used in drains and sewers
EN 681-1:2002 Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Part 1: Rubber
EN 1610:2002 Construction and testing of drains and sewers
EN-ENV 1046:2007 Plastics piping systems. Systems outside building structures for transporting water or wastewaters. Under- and aboveground installation practice

Technical Approval **AT/2014-02**, developed by the Road and Bridge Research Institute in Warsaw, regarding the product: Sewage pipes and fittings K2-Kan XXL of structural wall made of polyethylene (PE) or polypropylene (PP).
Technical Approval **AT-15/2014**, developed by the Building Research Institute in Warsaw, regarding the product: Sewage pipes and fittings K2-Kan XXL of structural walls made of polyethylene (PE) or polypropylene (PP) for non-pressure dewatering, drainage and sewage.

Technical Information

To manufacture K2-Kan XXL pipes a high density polyethylene or polypropylene (PP) is used. This is a material that perfectly works in many piping applications. It is distinguished by high strength to impact loads that can be present at the stage of laying out the pipes, as well as a wide range of working temperatures, which allows to conduct the construction works at every season of the year.
Polyethylene and polypropylene are extremely chemically resistant to the most of chemical compounds. Further details can be found in tables of chemical resistance of polyethylene and polypropylene. Please do not hesitate to contact us in case of any questions.

		PE 80	PE 100	PP
Density	ISO 1183	950 kg/m^3	960 kg/m^3	910 kg/m^3
Modulus of elasticity (momentary value)	ISO 527-2	1000 MPa	1100 MPa	1200 MPa
Tensile strength at yield	ISO 527-2	25 MPa	25 MPa	30 MPa
Elongation at break	ISO 527-2	> 600 %	> 600 %	> 350 %
Oxidative-induction time OIT (200 °C)	EN 728	> 20 min	> 20 min	> 8 min
Melt flow index (PE 190 C/5kg; PP 230 C/2.16kg)	ISO 13479	> 1,6	> 1,6	> 1,5
Mean linear expansion coefficient	[10 -4 K -1]	1,7	1,7	1,4

Method of manufacture

K2-Kan XXL pipes are manufactured by co-extrusion consisting in the fact that two independent single-worm systems plasticize a PE granulate (of two different colours, but of similar features) that is fed to a tubing die forming a definite profile and then through spiral winding on a drum of a definite diameter extruded profiles mutually joined while manufacturing process which form a structural construction of the pipe wall with a smooth inner surface and a spirally profiled outer surface. The smooth inner pipe wall is of light grey colour, whereas the outer wavy pipe wall is of black colour.
A main advantage of that type structural pipes is that with a small use of the material, i.e. with their light weight, you can manufacture the pipes of good strength that enable to bear high loads.
A pipe with a structural wall is lighter by 65% with reference to the pipe with a monolithic wall. K2-Kan XXL pipes can be adapted precisely to specific requirements of any projects.
The pipes of type K2-Kan XXL made of PE or PE, are manufactured with ring stiffness from SN 1to SN 32 kN/m^2 acc. to PN-EN ISO 9969 (whereas acc. to DIN 16961, this stiffness is 4 - 128 kN/m^2).

As the material to manufacture K2-Kan XXL pipes, polyethylene (PE) or polypropylene (PP) is used, the plastics that are classified to a group of polyalkenes manufactured from semi-products generated by oil refining.
An inner diameter of K2-Kan XXL pipes is from DN/ID 1200 mm to 2400 mm. A nominal diameter (DN) of the pipe is the same as the inner diameter (ID), a thickness of pipe wall may be larger or smaller, however, the inner diameter stays always the same. It ensures keeping the planned capacity of the system. A standard length of K2-Kan XXL pipes is 6 metres, which makes them easier handling, storage and transport. Besides, it is possible to manufacture pipes of any length from 1 to 6 metres.

Advantages of K2-Kan XXL pipe system

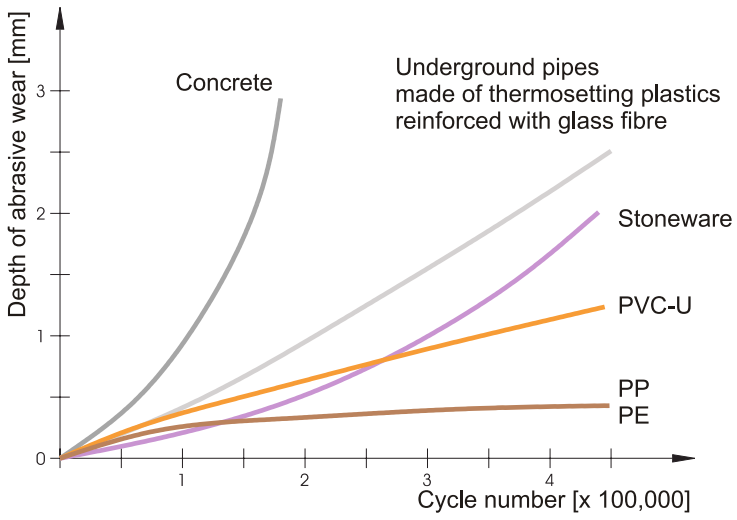
Low weight of pipes

Performing networks of sewage pipelines laid down under the ground is simplified considerably owing to their low weight. K2-Kan XXL pipes are very light in comparison with the pipes of monolithic walls with similar static properties; the use of pipes with structural walls allows to lower the weight of a pipeline even by up to 65% and they are 15-20 times lighter than stoneware or concrete pipes. K2-Kan XXL pipes can be easily handled between between trench struts of formworks. Making push fit joints with elastomer seals is also very simple even using pipes of larger diameters.

It is estimated that due to a small weight of pipes and easy joints to be made in most cases with no need to apply any special techniques to mount them, the assembly of pipelines should bring savings resulted from labour intensity by approx. 20-30%.

High abrasion resistance

Abrasion resistance is one of the most important features that distinguish PE pipes amongst different types of material used to produce pipelines. K2-Kan XXL pipes, thanks to their properties, are used to transport sewages originated from rain waters that contain considerable amounts of sharp sand and other highly abrasive media. Testing (with the use of a method developed in Building Institute in Darmstadt) made acc. to DIN 19534 for different materials showed that the lowest abrasibility have pipes made of polyethylene and polypropylene; this abrasibility is lower than the abrasibility of the pipes made of: PVC-U and stoneware, and thermosetting plastics reinforced with glass fibre as well. It is even several times lower with reference to the pipes made of concrete.



High elasticity

PE and PP pipes have a considerable advantage over the pipes made of concrete, steel, cast iron and other materials. Thanks to their elasticity, K2-Kan XXL pipes are highly resistant. It means that they are more fast to a load and deformation. K2-Kan XXL may deform themselves under the effect of ground movement and do not crack, providing in this way a further continuity of pipeline undisturbed operation. When these processes are stopped the pipe returns to its original shape.
Another advantage is high elasticity of the pipes. As opposed to the pipes made of other materials, the pipes of type K2-Kan XXL stay practically free of damage even in regions of earthquakes. Despite of high elasticity, the pipes are able to stand much higher loads, therefore, they are also used in road building section.

Advantages of K2-Kan XXL pipe system

High impact strength and point thrust resistance

K2-XXL pipes are extremely resistant to the impacts at low temperatures; it also guarantees the impact resistance during their transportation, storage and installation under tough ground conditions and further use.

Perfect hydraulic properties

High hydraulic smoothness of pipe inner surfaces and low flow resistances, which is related with: no formation of deposits on inner wall surfaces of the pipes, the use of minimum slopes, no clogging of the pipelines, the reduced flow resistances of wastewaters,

High chemical and corrosion resistance

Chemical resistance in a wide range of pH to the corrosion caused by the reaction of media in a form of municipal wastewaters, stormwaters, surface waters and groundwater; this feature enables transport of chemically aggressive effluents and the installation of pipes in chemically aggressive environments;
Total resistance of pipe surfaces against corrosion, i.e. a destructive effect of groundwater, there fore, the pipes do not require the use of protective coverings;

High durability of system (more than 100 years)

According to the developed method of artificial weathering under laboratory conditions and by comparison of testing results with reference to the changes in natural conditions, it can be already predicted that the operational life of PE and PP sewage pipelines laid down in the ground should be at least 100 years. This indicates that while designing a sewage system made of K2-XXL pipes, you should plan a uniform network without any "weak points" made of conventional materials that would be damaged sooner or would not meet the requirements.

Physiologically neutral, the pipes have no effect on live organisms, able to be recycled

Wastes produced while manufacturing K2-XXL pipes are recycled in 100% by technological recovery. PE and PP pipes and fittings laid down in ground are biologically and chemically inert to the effect of groundwater, aggressive wastewater and also make watertight systems that do not allow to permeate the wastewater into the ground, which would be recognised as the contamination of natural environment. Both polyethylene and polypropylene are recyclable in 100%; possible wastes are not predictable to be combusted or stored in waste dumps; however, in the case of (incidental) combustion, there are no gases noxious for health or natural environment.

Quality requirements for K2-XXL pipes

Tests in the Factory Laboratory are conducted at all stages of the manufacturing processes, starting from:
pre-production inspection: checks of granulate acc. to its quality certificate,
production inspection during the entire course of manufacturing
post production inspection of final product.
We monitor the conditions of storage, we also offer out own transport of pipes and fittings to out warehouses or directly to construction sites.

A strict quality supervision of our products is provided by the quality management system implemented in Kaczmarek Company that is based on the standard EN ISO 9001, certified by TÜV-Rheinland and Building Research Institute. In our production plants, we observe rigorous standards of environmental protection EN ISO 14001. All wastes originated while manufacturing PE and PP pipes are recycled by technological recovery.

According to PN-EN 13476-3+A1:2009; K2-Kan XXL pipes and fittings should meet the requirements as follows:
- Testing the effect of heating in temperature of 150°C during 30-60 min. on the appearing of K2-XXL pipes and fittings - there are no bubbles and delaminations;
- Determination of ring stiffness with pipe inner diameter distortion by 3%;
- Checking dimensions and appearance acc. to the documents of manufacturer;
- Checking ring stiffness. In normal temperature, a pipe deformed by 30 of its outer diameter should not crack and there should not be seen any cracks or wall delaminations.
- Checking for tightness of hub-and-spigot joints with elastomer sealing ring - this test is conducted in normal temperature of water under low pressure (0.05 bar), elevated pressure (0.5 bar) and suction pressure (vacuum) of air (-0.3 bar) for hub-and-spigot joints with no angular deviation or with angular deviation up to 2°.

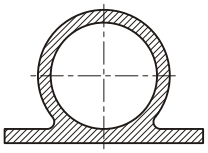
Types of profiles, ring stiffness

Ring stiffness is calculated precisely for each profile basing on a value of elasticity module (Young's modulus) for polyethylene, moment of inertia and diameter of the pipe. By applying a pipe with structural wall, you can reduce its weight in comparison to common pipes of the same ring stiffness. K2-XXL pipes with structural wall can be used for high static loads.

Profile type: PR

A main feature of PR profile is both a smooth inner surface and a structural outer surface. The most important features of this profile include its low weight and high ring stiffness.
The scope of application of this profile type: sewage systems, stormwater drainage systems and ventilation systems.

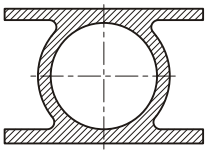
PR



Profile type: CPR

A main feature of CPR profile is a smooth inner and outer surface of its pipe wall. The most important features of this profile include its low weight and high ring stiffness. The scope of application of this profile type: sewage systems, stormwater drainage systems and ventilation systems.

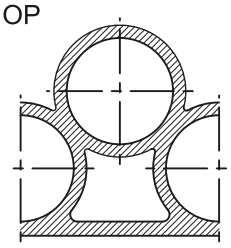
CPR



Profile type: OP

The profile has a smooth inner surface and a structural outer surface of the so called "Olympic mark". Besides, the most important feature of this profile is its low weight and high stiffness.

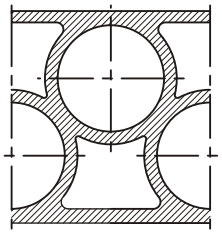
OP



Profile type: COP

This profile is of smooth inner and outer surface, at the same time, the inner profile is composed of one or more layers. The profile is characterised of a very high long-term stiffness, hence it is suitable for very hard loads and for large diameter pipelines.

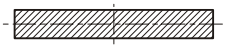
COP



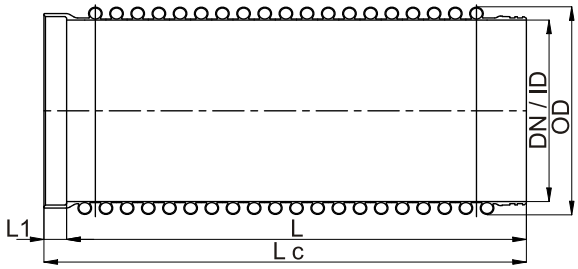
Profile type: VW

VW profile is a type of monolithic pipe with smooth inner and outer pipe wall surface. These pipes can be used under the conditions of positive internal operating pressure. Minimum thickness of pipe wall is 5 mm, whereas the maximum one is 80 mm.

VW



K2-Kan XXL pipes with socket
with seal



DN/ID	SN [kN/m2]	OD [mm]	h [mm]	a [mm]	t [mm]	L1 [mm]	L [mm]	Index -
600	8	712	56	140	160	150	6000	0975549600
600	16	720	60	140	160	150	6000	0975579600
800	8	912	56	140	160	150	6000	0975749600
800	16	920	60	140	160	150	6000	0975779600
1000	8	1116	58	140	160	150	6000	0975949600
1000	16	1124	62	140	160	150	6000	0975979600
1200	6	1366	83	140	160	150	6000	0976139600
1200	8	1370	85	140	160	150	6000	0976149600
1200	16	1452	126	140	160	150	6000	0976179600
1400	4	1566	83	140	160	150	6000	0976329600
1400	6	1574	87	140	160	150	6000	0976339600
1400	8	1654	127	140	160	150	6000	0976349600
1400	16	1680	140	120	160	150	6000	0976379600
1600	2	1766	83	140	160	150	6000	0976519600
1600	4	1770	85	140	160	150	6000	0976529600
1600	6	1852	126	140	160	150	6000	0976539600
1600	8	1860	130	140	160	150	6000	0976549600
1600	16	1896	148	120	160	150	6000	0976579600
1800	2	1966	83	140	160	150	6000	0976719600
1800	4	2052	126	140	160	150	6000	0976729600
1800	6	2060	130	140	160	150	6000	0976739600
1800	8	2080	140	120	160	150	6000	0976749600
1800	16	2126	163	120	160	150	6000	0976779600
2000	2	2170	85	140	160	150	6000	0976919600
2000	4	2272	136	120	160	150	6000	0976929600
2000	6	2280	140	120	160	150	6000	0976939600
2000	8	2292	146	120	160	150	6000	0976949600
2000	16	2340	170	100	160	150	6000	0976979600
2200	2	2372	86	120	160	150	6000	0977119600
2200	4	2480	140	120	160	150	6000	0977129600
2200	6	2496	148	120	160	150	6000	0977139600
2200	8	2508	154	120	160	150	6000	0977149600
2200	16	2550	175	120	160	150	6000	0977179600
2400	2	2652	126	140	160	150	6000	0977319600
2400	4	2690	145	120	160	150	6000	0977329600
2400	6	2708	154	120	160	150	6000	0977339600
2400	8	2726	163	120	160	150	6000	0977349600
2600	2	2852	126	140	160	150	6000	0977519600
2600	4	2890	145	120	160	150	6000	0977529600
2600	6	2908	154	120	160	150	6000	0977539600
2600	8	2926	163	120	160	150	6000	0977549600

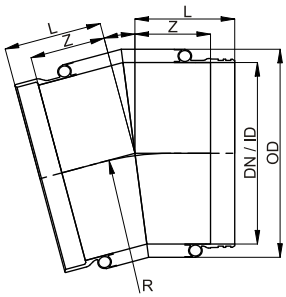
Pipe fittings

Except the pipes of different diameters and stiffness, Kaczmarek Company is also a supplier of pipe fittings, inspection manholes and other elements. Pipe fittings are mainly manufactured of pipes of type VW or SQ. Generally, pipe fittings are manufactured according to the requirements concerning stiffness and including the conditions of their welding. All pipe fittings are suitable to all types of pipes and can be joined with an existing pipeline using any joining method.

Bends

Pipe bends can be manufactured and segmented under a different angle; separately you can choose a ratio of bend radius to pipe diameter. Table presents angles of standard pipe bends acc. to DIN 16961. Other solutions are available on the request of customer.

K2-Kan XXL bends with socket
with seal
15°

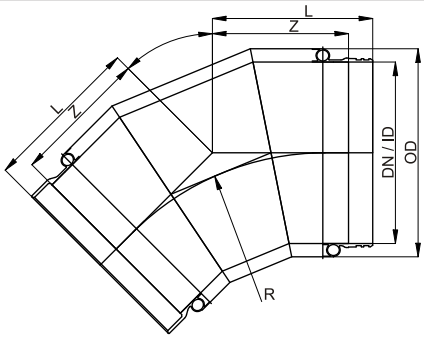


DN/ID	SN [kN/m2]	OD [mm]	Z [mm]	L [mm]	R=1,5 DN [mm]	Index -
600	8	720	300	450	900	1061554150
800	8	920	400	550	1200	1061574150
1000	8	1126	400	550	1500	1061594150
1200	8	1370	500	650	1800	1061614150
1400	8	1598	600	750	2100	1061634150
1600	8	1810	600	750	2400	1061654150
1800	8	2022	700	850	2700	1061674150
2000	8	2344	700	850	3000	1061694150
2200	8	2562	800	950	3300	1061714150
2400	8	2779	900	1050	3600	1061734150
2600	8	2983	1000	1150	3900	1061754150

K2-Kan XXL bends with socket
with seal
30°

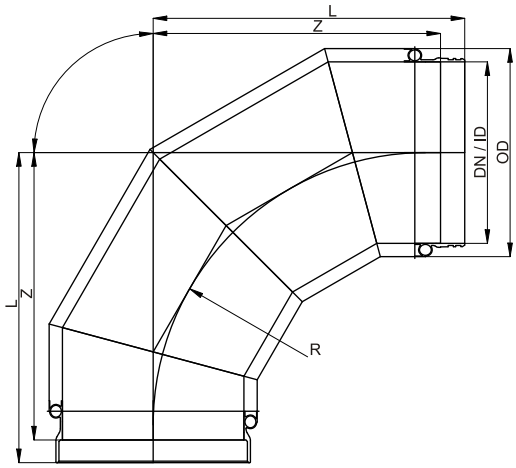
DN/ID	SN [kN/m2]	OD [mm]	Z [mm]	L [mm]	R=1,5 DN [mm]	Index -
600	8	720	400	550	900	1061554300
800	8	920	400	550	1200	1061574300
1000	8	1126	500	650	1500	1061594300
1200	8	1370	600	750	1800	1061614300
1400	8	1598	700	850	2100	1061634300
1600	8	1810	800	950	2400	1061654300
1800	8	2022	900	1050	2700	1061674300
2000	8	2344	1000	1150	3000	1061694300
2200	8	2562	1100	1250	3300	1061714300
2400	8	2779	1200	1350	3600	1061734300
2600	8	2983	1300	1450	3900	1061754300

K2-Kan XXL bends with socket
with seal
45°



DN/ID	SN [kN/m2]	OD [mm]	Z [mm]	L [mm]	R=1,5 DN [mm]	Index -
600	8	720	500	650	900	1061554450
800	8	920	700	850	1200	1061574450
1000	8	1126	800	950	1500	1061594450
1200	8	1370	1000	1150	1800	1061614450
1400	8	1598	1100	1250	2100	1061634450
1600	8	1810	1200	1350	2400	1061654450
1800	8	2022	1400	1550	2700	1061674450
2000	8	2344	1500	1650	3000	1061694450
2200	8	2562	1600	1750	3300	1061714450
2400	8	2779	1700	1850	3600	1061734450
2600	8	2983	1800	1950	3900	1061754450

K2-Kan XXL bends with socket
with seal
90°



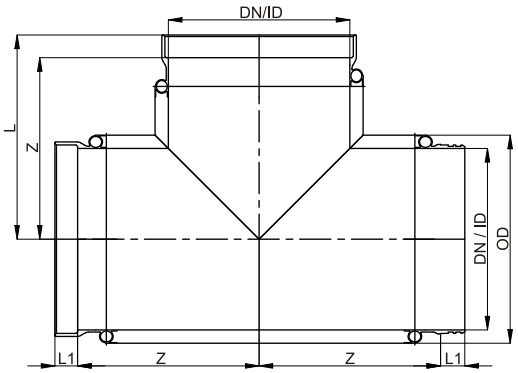
DN/ID	SN [kN/m2]	OD [mm]	Z [mm]	L [mm]	R=1,5 DN [mm]	Index -
600	8	720	1000	1150	900	1061554900
800	8	920	1300	1450	1200	1061574900
1000	8	1126	1600	1750	1500	1061594900
1200	8	1370	1900	2050	1800	1061614900
1400	8	1598	2200	2350	2100	1061634900
1600	8	1810	2500	2650	2400	1061654900
1800	8	2022	2900	3050	2700	1061674900
2000	8	2344	3200	3350	3000	1061694900
2200	8	2562	3500	3650	3300	1061714900
2400	8	2779	3800	3950	3600	1061734900
2600	8	2983	4100	4250	3900	1061754900

Tees

Tees are manufactured in any shapes. Fork junction angle is from 15° to 90° including ends and lengths of suitable segments.

K2-Kan XXL tees with socket

with seal
15° - 90°



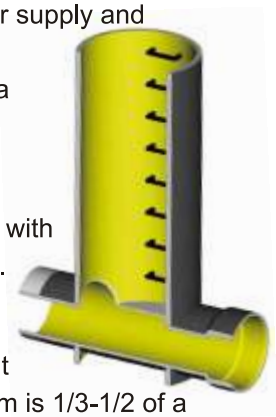
DN/ID	SN [kN/m2]	OD [mm]	Z [mm]	L [mm]	Index -
600	8	720	600	750	1062554900
800	8	920	800	950	1062574900
1000	8	1126	1000	1150	1062594900
1200	8	1370	1200	1350	1062614900
1400	8	1598	1400	1550	1062634900
1600	8	1810	1600	1750	1062654900
1800	8	2022	1800	1950	1062674900
2000	8	2344	2000	2150	1062694900
2200	8	2562	2200	2350	1062714900
2400	8	2779	2400	2550	1062734900
2600	8	2983	2600	2750	1062754900

Reductions

It is possible to manufacture both centric and eccentric reductions that provide the compliance with specifications. For standard reductions, a maximum difference of diameters is 200 mm, other - acc. to the order.

Inspection manholes

In order to make possible a regular service of pipelines, the Kaczmarek pipe system K2-Kan XXL has integrated inspection manholes in their product range. They are mostly installed in the locations of tees, reducers or branchings. The inspection manholes are manufactured using the same raw materials, of which the pipes are manufactures and they are joined in the same way.
Kaczmarek Company manufactures inspection manholes in compliance with conditions defined by a designer. The manholes are made of polyethylene and meet requirements of all international standards and norms. The material applied is durable and environmentally friendly, therefore, the most appropriate for manufacture pipelines, inspection manholes and tanks. The offer of Kaczmarek includes a wide scope of inspection manholes for water supply and sewage systems that are installed on request with cast iron hatchways or the ones made of plastics.
The hatchways may be joined with the inspection manhole in a rigid way or in a movable way using a telescopic pipe. We offer hatchways with a grid or cast cover.



Rainwater and drainage wells

These types of wells are intended for discharging stormwater. Generally, the wells are manufactured with a flat bottom. Similarly are made the catch basins to discharge rain water from car parks to pipelines.

Sewage manholes

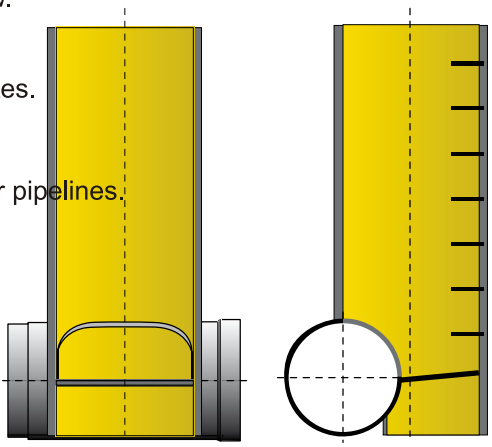
They serve to inspect and maintain sewage systems. The manholes are manufactured with a straight through bottom to provide a fluent flow of effluents. Recommended size of the straight-through bottom is 1/3-1/2 of a diameter of main pipeline. It means that within the scope of at least one third invert of pipe diameter, in the bottom of manhole there is located a straight-through to provide better wastewater outflow.

Valve manholes

Their purpose is to open and to close sections of water supply and sewage routes.

Water meter manholes

They serve to meter a volume of water that flows through water and wastewater pipelines.



Sampling wells

With the use of this type of well, it is possible to collect samples for quality control of waters flowing through water and wastewater pipelines.

Overflow chambers

They are used in sewage and stormwater pipelines to reduce a flow rate.

Culverts

Owing to a high ring stiffness, a low temperature resistance and a structure of pipe outer wall that provides an optimal liaison with soil, K2=Kan XXL pipes are suitable to make pipe culverts under roads.

Tanks

Tanks

Joining K2-Kan XXL pipes

Reliability of a pipe system depends on a failure rate of the weakest element that is a pipe contact. Therefore, it is crucial to select a suitable and safe method to join pipes. The dimensional system of K2-Kan XXL pipes and fittings has been developed in such a way that joints with seals present leaktightness with overpressure of at least 0.5 bar or underpressure of 0.3 bar. Practically, there are no cases of exfiltration of wastewater into soil of infiltration of groundwater into the inside of pipelines.

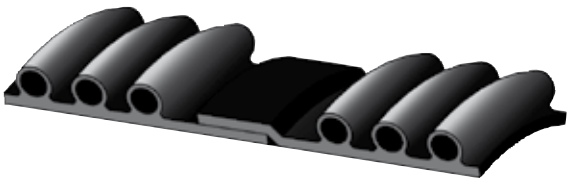
Joining K2-Kan XXL pipes using rubber seal

- Two rubber seals are used for one joint
- Install the seals according to the drawing below (in order to make the pipe assembly easier, make the layer backfill for one of joined pipes, which will provide a suitable support in the process of pipe joining and will help to avoid pipeline waving)
- Using a waterproof marker, mark the length of a part of the pipe that inserts into a muff (at least 125 mm).
- Cover a muff abundantly the with a grease (a lubricant).
- The muff and a bare end of pipe must be free of contamination while greasing and joining the pipes.
- To make pope joints, some additional mechanical tools are necessary. If the pipe is joined by pushing, a suitable stress distributor (e.g. a wooden panel) should be used to avoid a damage of the muff.
- Avoid pulling pipe ends in soil.
- K2-Kan XXL pipes with a joint with a rubber seal are used while assembling the pipelines on straight sections of their routes. In the case when the design provides pipeline bends, use pipe bends.

Joining K2-Kan XXL pipes using electrofusion

Welding pipes and fittings of small diameters using a heating coil has found a wide use recently. Based in standard DVS 2207-1, the use of this technology has been developed for large diameter pipes. The heating coil is built in the pipe muff. When joined pipe ends has been linked, the heating is heated with a special appliance and both pipe ends (the muff and the bare end) are welded. Such method allows to install the pipes in a very short time.

Joining K2-Kan XXL pipes with a method of welding using an extruder from the inside and outside of pipeline



Joining K2-Kan XXL pipes with a method of welding using the extruder

Joining K2-Kan XXL pipes with butt welding

Sewage systems

Under the notion of outer sewage pipelines made of sewage pipes is considered a system of gravity pipelines from a place of which the wastewaters are discharged outside the building from its inner sewerage system or possibly from the places of the reception of rainwaters to a wastewater treatment plant or another wastewater receiver, where their disposal is performed. Rainwater pipelines or sewage pipelines under buildings may be classified to the outer sewage system, if they are not a part of inner installation of the building.

General design requirements

Those requirements that concern elastic pipes are defined in standards: PN-EN 752, PN-EN 1295-1 and PN-EN 1610. The pipeline laid in soil shall be planned to take into account inner and outer loads that will be present during the erection and operation works without any risks of excessive deformation or tightness loss, and not create any hazards for the environment by not fulfilling their functions.
Respecting outer static and dynamic loads, soil conditions, thoroughness and supervision while laying out of them, the on-pressure (gravity) sewage pipelines shall be of suitably selected nominal ring stiffness guaranteeing respecting permissible momentary and long lasting deformations.
Low- and high-pressure pipelines shall have determined nominal operational pressure assumed by the designer, taking into account the ability to occur overloads.
With loads of outer pipelines made of plastics, a nominal ring stiffness of the pipeline shall be included together with an elasticity of the co-operating soil as well as the effect of trench construction and groundwater as a function of the action time. Thrusts on the pipeline through focused surface loads from the vehicle wheels shall be calculated according to Boussinesq's method and the effect of this load shall be taken into account.
Limit states shall be defines at which the pipeline is able to behave inappropriately (e.g. leakages, deformations of pipe cross-section may be occurred). The project shall ensure that such cases are not able to occur.
The depth of covering the pipelines (the vertical distance from the top of pipe up to the soil surface) is dependent on the freeze depth of the ground (hz) for a given zone of country (PN-B-03020) and for sewage pipelines it is h z + 0.2 m.

Earthworks

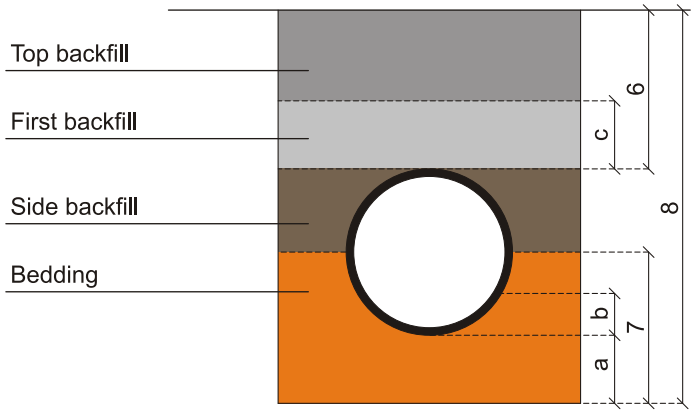
The earthworks shall be conducted in accordance with technical guidelines of implementing and the acceptance of building and assembly works and health and safety rules. The most commonly used are continuous narrow-spaced trenches of vertical walls with expanded boarding. If the area is not densely developed and there is enough place, it is also possible to use trenches of slope trench walls, however, not deeper than to a zone of the laid pipeline, i.e. 30 cm above the pipe top.
A zone of the pipeline should be made as the narrow-spaced trench with a tight formwork.
It is not permissible to apply wide-spaced excavation in the pipeline zone, because then it is not practically possible to achieve a well soil compaction in the pipeline zone.
Selection of the excavation type and a necessity to protect its walls depend on the excavation depth, an occurrence and a level of groundwater table, a cohesion and a type of soil and a local road traffic.

Laying out K2-Kan XXL pipes in trenches

1. Trench wall
2. Top backfill
3. First backfill
4. Side backfill
5. Bedding
6. Backfill depth
7. Depth of bedding layer
8. Trench depth

a - depth of the bottom layer of bedding
b - thickness of the top layer of bedding
c - thickness of the original backfill
b = k x OD (see Section "Backfill and supports")
where:
k - dimensionless coefficient, a correlation of thickness of the top b to OD
OD - outer diameter of the pipe in milimetres

Pipeline profile



Note 1
Minimum values a and c, see Section "Backfill and supports"
Note 2
In some international standard k x OD is replaced by the definition of bedding layer angle. The bedding layer angle does not cover with the definition used in the designs: the reaction angle of bedding layer.
The trenches shall be made in such a way to guarantee a possible and safe assembly of sewage pipelines.
In the case, when during the implementing the underground work, including the trenches, from the outer side of the excavation an erection approach is needed, leave a belt of width at least 0.5 m for the operational zone between the edge of trench and a food of stockpiling area.
If two or more number of pipelines are to be places in one trench or at the same height, it is recommended to keep a horizontal distance between the pipes. Unless indicated otherwise, for pipes up to DN 700 this distance is 0.35 m, but for pipes of more DN 700: 0.50 m..

Trench width

A maximum value of trench width cannot exceed maximum allowable width provided in the design. If the adaptation of this value is impossible, ask the pipeline designer about this problem.

Nominal diameter of pipe	Minimum width of trench (OD+x)		
	boarded trench	trench without boarding	
		B>60	B<60
DN [mm]	[m.]	[m.]	[m.]
DN < 1200	OD + 0,85	OD + 0,85	OD + 0,40
DN > 1200	OD + 1,00	OD + 1,00	OD + 0,40

Minimum width of trench

Table 1 and 2 present minimum widths of trenches as a function of pipe diameter and trench depth, with the exception of cases described below.
The minimum width of trench basing on the data in Table 1 and 2 can be exceeded only in the cases as follows:
- When workers shall never enter into the trench;
- When workers shall never be present between the pipeline and the trench wall
- in unjustifiable cases.

In all cases mentioned above, special operational requirements specified in the design shall be applied.

Dewatering

In the bottom of a trench and in the side backfill, water shall not be present in time when the earthwork is carried out. Methods of trench dewatering should not have any effect on the backfill and pipeline. When trench dewatering is finished, the drainage system shall be excluded from the operation.

Backfill and supports

Materials, backfill thickness, trench boarding and backfill shall meet the requirements specified in the design. During the selection of backfill the following aspects shall be taken into account:
- pipe size;
- pipe material and pipe wall thickness;
- layer characteristics.

The width of bedding layer should be the same as the trench width, unless otherwise specified. The layer width of the pipeline installed to the underground objects shall be four times larger than OD, unless otherwise specified.
A minimum thickness of the fop layer (see Fig. 1) shall be 150 mm above the cylindrical part of the pipe and 100 mm above the joint location.

Backfill

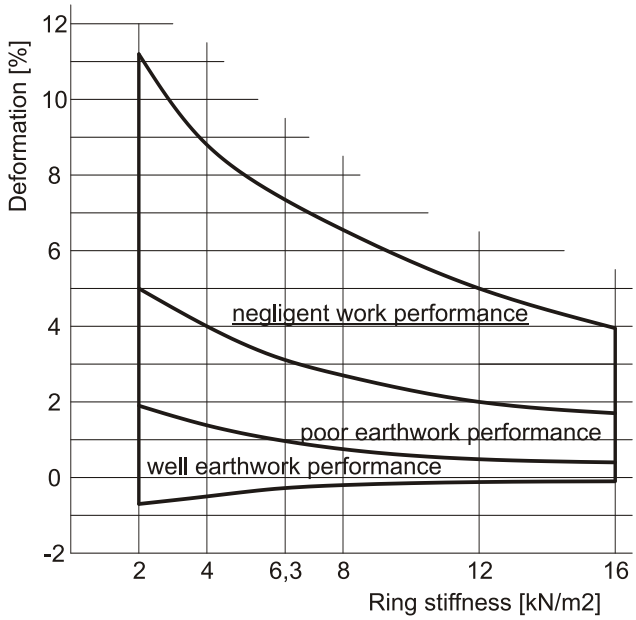
The performance of haunching and backfill can be started only when the places of pipe joints and the layer of bedding resist suitable loads.
The backfill, including the removal of the elements of trench reinforcement and the soil compaction shall be made in such way that secures the capability of bearing pipe in compliance of the design guidelines. The backfill is made in such way to avoid bedding settlement or outwashing fine material while lowering of groundwater table.
In justified cases, to avoid bedding migration inside the ground, the necessity to lay down a geotextile or wellpoints shall be assumed.
Moreover, take the means to prevent the outwashing of fine material while lowering
the groundwater table.
When pipeline sections are anchored, the bolt anchoring shall be done before backfilling.

Compacting

While laying out K2-Kan XXL pipes between the bottom of trench and the side of pipe a foundation angle of minimum 90° shall be maintained basing on Proctor's module.
If needed, spread the backfill above the pipe manually. Mechanical compaction of the trench directly above the pipe can be done only when the backfill layer above the pipe is at least 300 mm. Different compaction ratio can be achieved by using different machines. Strength properties of the pipe backfill zone are essentially dependent on a type of soil material used to implement it and on the achieved compaction ratio.

Final assessment

Soil material in a zone of laid pipeline an Contractor's qualifications are of great significance for laying out sewage pipelines. In the project practice, the pipeline deflection should be provided not higher than 5%. Pipe distortions will be practically dependent on quality of completing the earthwork and of the selection of ring stiffness of used pipes. Figure shows in a form of diagram (acc. to the standard mentioned above) pipe distortions in relation to the quality of completing the earthwork and the ring stiffness of the used pipes. However, the deformation to 15%, e.g. induced by the motion of soil, shall not have any effect on a correct functioning of the system of pipelines.



Technical acceptance

Technical acceptances of sewage pipelines shall be carried out in compliance with the technical design in coordination with the Investor and Factory who will operate them.
Valid regulations (standard PN-EN 1610: Erection and testing sewage pipelines) contain testing procedures including:
Visual control regarding checking the pipeline route and the depth of laid out pipeline.
Testing tightness if pipelines including wells and manhole chambers;
The control of the correctness of the performance of pipeline laying zone - the soil compaction and the selection of soils.
Checking soil compaction under the pipeline;
Measurement of pipe deformations.

Leaktightness testing

Pursuant to the requirements, all systems of pipelines are submitted to tests for leaktightness of hermetic system. There are different methods of carrying out the tests.
One of these methods is testing for leaktightness of a part of the pipeline (a section) between two manholes/wells. On the segment tested pipeline special plugs are installed of the diameter suitable for the diameter of pipe collector. Sealing of pipe plugs is made with the use of pneumatic rubber hoes. To the tested pipeline section water is pumped under the specified pressure. The pressure drop is calculated for a definite time and the information is obtained on the leaktightness within the scope of the tested pipeline segment.
As the alternative of sectional testing, a pressure test can be done directly in a place of joining the pipes (it concerns generally the pipes of diameter more than 600 mm); for this case, it is assumed that the pipe is leaktight along its entire length. The testing appliance is used similarly as during sectional tests, the difference consists only in a place of conducting the test.

Shipping and storage

Thanks to its low weight, the transport of K2-Kan-XXL pipes is very simple. The pipes for transport shall be laid down on a stable platform and the movement of pipes during transport is inadmissible. In the individual cases, when pipes are delivered in their original packing, they shall be stored as long as it is possible, in compliance with the transport conditions.
Pipes and fittings shall be stored on even surface. Not allowable is the contact with sharp objects and surfaces. While laying the layer of pipes, arrange them alternately: the parts of muffs (hubs) of the upper row should not touch the muffs of lower pipe row. Actually, this means that each layer of pipes should have a possibility to be rotated by 180 degrees. The pipe hubs (muffs) should extended in such a way that pipe ends of higher pipe layer do not rest on the ends of pipes of lower pipe layer.

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