KONTI HIDROPLAST®

PRODUCTION OF POLYETHYLENE AND POLYPROPYLENE PIPES

KONTI KAN PE SPIRAL SEWAGE PIPES

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CONTENTS

KONTI HIDROPLAST®

WELCOME TO OUR WORLD

Konti Hidroplast is part of the world's largest manufacturer and supplier of high performance plastic pipes and offers the best and the most cost effective pipe systems for its customers.

Konti Hidroplast specialises in polyethylene pipe systems for gas and water transportation in the utilities and industrial markets.

MARKET ORIENTED

Konti Hidroplast products find a broad range of applications in the industrial and utilities market on a worldwide scale.

The water and gas distribution enterprises are important sectors for high integrity products where the maintenance of water quality and the safe transport of gaseous fuels are of paramount importance.

Industrial applications include alternative energy installations in landfill gas systems to effluent transportation and mineral slurry.

Products are widely used in pipeline installation, repair and maintenance.

Many of the brands in the Konti Hidroplast portfolio have a long record of innovation in meeting the needs of the water and gas utilities.

Being one of the foremost pioneers in polyethylene pipe systems, Konti Hidroplast is continually improving and updating its offer to meet the ever growing needs of the distribution engineer, ensuring they stay at the forefront of world gas and water distribution/treatment systems.


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CUSTOMER FOCUS

The key to our success lies in the commitment to provide the highest quality service and support. We are a team of highly motivated and experienced individuals.

We place the utmost importance on meeting the needs of our customers, constantly evolving our extensive product portfolio to meet the ever changing demands of the water and gas utilities, industrial and foreign markets.

QUALITY

Konti Hidroplast is a result-driven busines – its people, products and service. Designed, manufactured and supplied under EN ISO 9001:2000 accredited Quality Management Systems, Konti Hidroplast products comply with relevant national, European and international product standards to ensure complete reliability for our customers.

Besides the ISO certificates for Quality Management Systems and ecology, the gas pipes are also certified by DVGW CERT GmbH.

THE ENVIRONMENT

Committed to sustainable manufacture and systems, Konti Hidroplast operates and maintains an environmental policy fully accredited by ISO 14001.

GENERAL

KONTI KAN SPIRAL PIPE gravity system, is structured-wall (high-density polyethylene (PE-HD) pipe with nominal diameter DN/ID 1300-2000 mm. KK Spiral pipes are made of hollow PE-HD sections helically wound with a specific diameter.

KONTI KAN SPIRAL PIPE provides all technical advantages of an equivalent polyethylene solid wall pipe with substantial saving in weight, combining greater ease of installation with increased cost effectiveness. Its unique structure can offer a range of pipe sizes and ring stiffness, depending on customer requirements.

REFERENCE STANDARDS

DESIGNATION	DESCRIPTION
EN 13476-1:2007	PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE – STRUCTURED-WALL PIPING SYSTEMS OF UNPLASTICIZED POLYVINYL CHLORIDE (PVC-U) AND POLYETHYLENE (PE) – PART 1: GENERAL REQUIREMENTS AND PERFORMANCE CHARACTERISTICS
EN 13476-2:2007	PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE – STRUCTURED-WALL PIPING SYSTEMS OF UNPLASTICIZED POLYVINYL CHLORIDE (PVC-U) AND POLYETHYLENE (PE) – PART 2: SPECIFICATIONS FOR PIPES AND FITTINGS WITH SMOOTH INSIDE AND OUTSIDE SURFACE, TYPE A
EN 476:2001	GENERAL REQUIREMENTS FOR COMPONENTS USED IN DISCHARGE PIPES, DRAINS AND SEWERS FOR GRAVITY SYSTEMS
EN 1610:2002	CONSTRUCTION AND TESTING OF DRAINS AND SEWERS
EN 1852-1:1999	PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE – PART 1: SPECIFICATIONS FOR PIPES, FITTINGS AND THE SYSTEM
ENV 1046:2002(U)	PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWERAGE – PART 1: SPECIFICATIONS FOR PIPES, FITTINGS AND THE SYSTEM
SFS 5906:2004	PLASTIC PIPES. STRUCTURED-WALL PE PIPES AND FITTINGS FOR NON-PRESSURE UNDERGROUND SEWAGE AND DRAINAGE SYSTEMS. NOMINAL SIZES LARGER THAN 1200 mm

PROPERTY		PE
DENSITY	kg/m^3	≥ 930
MFR (PE 190˚C/5kg; PP 230˚C/2.16kg)	g/10min	≤ 1.6
OXIDATION INDUCTION TIME (OIT) (200˚C)	min	≥ 20
E MODULES	MPa	1200
TENSILE STRENGTH AT YIELD	MPa	28
ELONGATION TO BREAK POINT PE	%	≥ 350
THERMAL LINEAR EXPANSION COEFFICIENT	10^{-4} K^{-1}	1.5 - 2.0

APPLICATIONS OF GRAVITY SYSTEMS

- Sewage system – waste water and combined sewage system
- Highway engineering
- Surface water drainage and building draining systems
- Industrial and process pipelines
- Underwater pipelines
- Renovations

ADVANTAGES OF PE MATERIAL

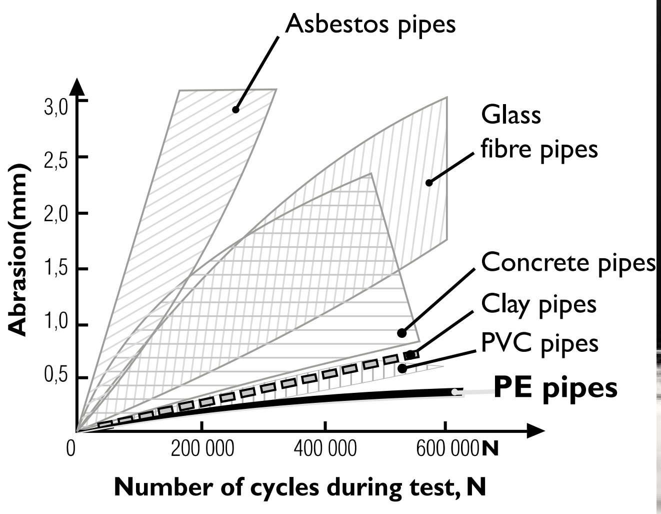
Favourable properties of the PE material have had a decisive effect on the general use of polyethylen pipes and fittings in water supply and sewage systems.

The most crucial advantages include:

- High abrasion resistance
- Corrosion resistance (chemical compounds)
- Very good fluid-flow properties
- Non toxic material
- 100% tight joints
- Flexibility
- Light weight
- Reliability

High abrasion resistance belongs to the most distinctive features of PE pipes among other materials used in pipeline construction. Owing to this advantage, PE pipes are used for transport of sludge, sand and other highly abrasive media.

Pipes made of commonly used materials were tested using the Darmstadt method. Pipe samples were filled with water and sand mixture and subjected to cyclic swinging motion. The amount of the rubbed off pipe wall material was regularly measured. Test results demonstrate high abrasion resistance of polyethylene pipes. For example, a 0.3 mm loss of PE pipe surface was measured after 400,000 cycles while the loss measured for glass fibre pipes (GRP) was 6-8 times greater.



CORROSION RESISTANCE

PE pipes are resistant to many chemical compounds – unlike pipes made of conventional materials that easily corrode and age when exposed to most of acids (excluding nitric acid), bases, salts, aliphatic solvents (pH 0 – 14). Polyethylen pipes are low-resistant to oxidants and aromatic solvents.

Resistance of PE pipes to chemical compounds depends on their temperature, concentration and working pressure. Detailed information on chemical resistance of PE and other thermoplastics may be found in the ISO / TR 10358 Standard.

PROPERTIES OF PE AND PIPELINES

FLUID-FLOW PROPERTIES

PE pipes retain low and constant roughness grade k = 0.01 mm.

Lack of corrosion and resistance to clogging of PE pipes belong to the most important functional qualities of PE systems.

100% TIGHT JOINTS

PE gravity pipes can be welded together using polyethylene wire (extrusion method) or connected by means of socket joints, or screw joints.

FLEXIBILITY

With natural bend radius of R = 50 outside diameters, PE pipes may be laid according to variations of the pipeline route and in many cases use of expensive fittings can be avoided. Flexibility is the distinctive feature of PE pipes among other conventional materials.

LOW PIPE WEIGHT

Low pipe weight permits reduction of the costs and shorten the installation time. Owing to their light weight, PE pipes do not require heavy equipment for laying a pipeline as well as for unloading the pipes at the construction site.

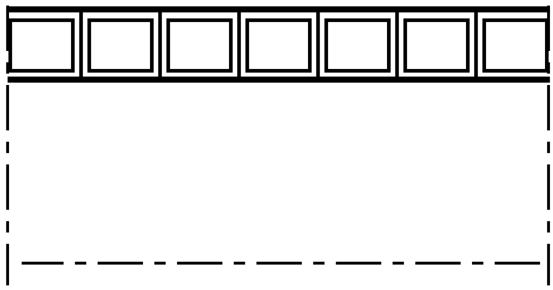
RELIABILITY

Failure frequency of PE pipes is much lower than that of rigid pipes (concrete, clay, GRP). PE pipes are resistant to changing atmospheric conditions. They may be installed and transported both in low (below freezing point) and high ambient temperatures (tropical conditions). Therefore, PE pipes are used worldwide, regardless of climatic conditions.

STRUCTURE OF GRAVITY PIPES

CONSTRUCTION OF STRUCTURAL PIPES

KONTI KAN SPIRAL pipes (PE)
Diameters from ID 1300 to 2000 mm



HYDRAULIC CALCULATIONS FOR GRAVITY FLOWS

A FLOW THROUGH THE FULLY FILLED CONDUIT

The hydraulic analysis of gravity flow conduits is based on correct relations between variables of a flow and flow resistance resulting in velocity and potential energy losses. Hydraulic resistance is expressed as a loss of pressure head along the pipe length and as local losses resulting from disturbances of the stream. These relations are defined by the following Darcy-Weisbach formula:

1

$$i = \frac{\lambda \cdot v^2}{d_w \cdot 2 \cdot g} \cdot \left(1 + \frac{\kappa}{100\%}\right)$$

i – unit pressure drop (–) lub (‰)

g – acceleration of gravity (m^2/sec)

λ – hydraulic resistance coefficient (–)

d_w – conduit inside diameter (m)

v – mean velocity of flow (m/sec)

κ – proportional allowance for local losses as part of losses over conduit length (%)

2

$$v = \frac{4 \cdot Q}{\pi \cdot d_w^2}$$

Q – mean flow rate (m^3/sec)

Turbulent flow occurs in transient range between hydraulically smooth and totally rough conduits (the so called B zone) in pipelines with free surface of liquid.

For such flow conditions, hydraulic resistance coefficient representing resistance generated at the point of contact between liquid and the conduit wall, can be determined using the Colebrooke-White formula (3):

3

$$\frac{1}{\sqrt{\lambda}} = -2 \cdot \log \left(\frac{2.51}{R_e \cdot \sqrt{\lambda}} + \frac{k}{3.71 \cdot d_w} \right)$$

k – absolute roughness of conduit wall surface (m)

R_e – Reynolds number calculated from the formula (4):

4

$$R_e = \frac{v \cdot d_w}{\nu}$$

v – mean velocity of flow (m/sec)

ν – coefficient of kinematic viscosity (m^2/sec)

Values of the coefficient of kinematic viscosity ν (m^2/sec) depending on temperature and concentration of the matter suspended in liquid wastes:

TEMPERATURE °C	WATER	LIQUID WASTES WITH CONCENTRATION OF SUSPENDED MATTER		
		100 mg/l	300 mg/l	500 mg/l
2	1.67×10^{-6}	2.17×10^{-6}	3.17×10^{-6}	4.17×10^{-6}
5	1.52×10^{-6}	1.60×10^{-6}	1.76×10^{-6}	1.92×10^{-6}
10	1.31×10^{-6}	1.33×10^{-6}	1.37×10^{-6}	1.41×10^{-6}
20	1.01×10^{-6}	1.02×10^{-6}	1.02×10^{-6}	1.04×10^{-6}
25	0.90×10^{-6}	0.90×10^{-6}	0.91×10^{-6}	0.92×10^{-6}

In the existing design practice, a fixed value of the coefficient of kinematic viscosity both for water and liquid wastes is usually assumed:

$\boldsymbol{\nu = 1{,}31 \times 10^{-6}\ m^2/sec}$ for water (liquid wastes) temperature of 10° C

The conduit wall relative roughness depends on the conduit material and pipe inside wall surface wear.

Regarding PE pipes, the standard value for k is 0.01 mm. By assuming respective roughness the type of transported liquid may be modelled. For pipelines carrying liquids containing considerable amount of deposits bigger roughness should be assumed – according to their content and up to a value between 0.05 and 0.4 mm. If the above formulas are combined in one and standard liquid temperature is assumed at 10 degrees Celsius, the mean flow rate can be calculated using the following formula:

5

$$Q = -6.598 \cdot \log\left(\frac{0.741}{10^6 \cdot d_w \cdot \sqrt{d_w \cdot i}} + \frac{k}{3.71 \cdot d_w}\right) \cdot d_w \cdot \sqrt{d_w \cdot i}$$

This formula is a basis for preparing flow nomograms. It combines three quantities essential in hydraulic dimensioning – rate of flow, pipe bottom falling gradient (pressure drop) and pipe diameter.

Based on the flow nomograms it is possible to determine one of the three values mentioned above if two values are known.

6

$$i_{min} = \frac{\tau_{min}}{\gamma \cdot Rh}$$

Rh – Hydraulic radius (m)

τ min – minimum tangential stress on the pipe-liquid border (N/m^2)

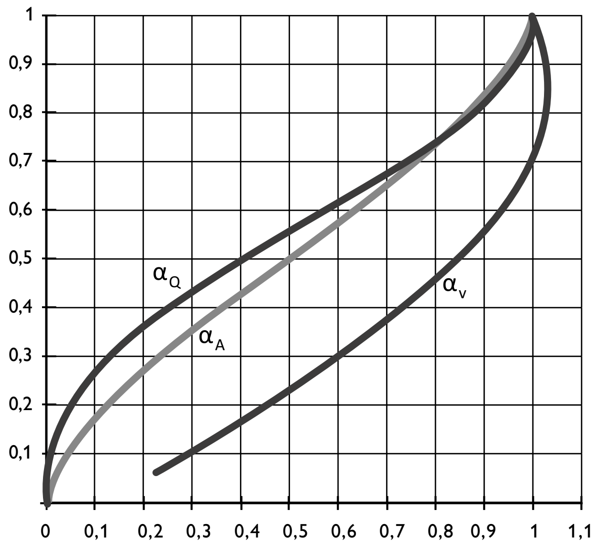
The value of the radius used in the above formula should correspond to the type of liquid flowing through a pipe. In case of industrial and municipal waste water systems - hydraulic radius corresponding to filling ratio of 60% is assumed, while in case of rain-water disposal systems they are considered as fully filled with water.

Minimum tangential stresses are assumed 2.20 N/m^2 and 1.47 N/m^2 respectively.

FLOW THROUGH PARTIALLY FILLED CONDUITS

When designing gravity flow conduits, their partial filling is often assumed. Consequently, the formulas applying to fully filled conduits are corrected accordingly by introducing a coefficient depending on the h/dw ratio (see the diagram next to this text).

- **αQ** – flow rate for partially filled conduit to flow rate for fully filled conduit ratio (–)
- **αv** – flow velocity for partially filled conduit to flow velocity for fully filled conduit ratio (–)
- **αA** – fluid stream cross section for partially filled conduit to conduit cross section ratio (–)



MATERIAL		ABSOLUTE ROUGHNESS	FLOW RATE	FLOW CAPACITY REDUCTION AS COMPARED WITH PE AND PP PIPES
		K (mm)	Q (l/sec)	%
PE		0.001	235	0
STEEL	NEW	0.1	220	6.4
	OLD	3.0	153	34.9
PVC	NEW	0.05	227	3.4
	OLD	0.07	224	4.7
REINFORCED CONCRETE	NEW	0.5	193	17.9
	OLD	3.0	153	28.1

DESIGN PARAMETERS OF PE GRAVITY PIPES

RING STIFFNESS

Pipe section stiffness is characterized by the so called ring stiffness. Ring stiffness depends on the geometry of a pipe (diameter and wall thickness) as well as on the strength of the structural material.

Regarding pipes made of the most popular plastic – PE and PP – their ring stiffness marked with SN should be determined according to the Standard EN ISO 9969/1995 "Thermoplastics pipes. Determination of ring stiffness".

Ring stiffness – as per Standard ISO 9969 – is determined experimentally following the described procedures consisting in measurement of the force causing 3% pipe deflection within 3 minutes.
This force varies with time during the test and is acting on the pipe with constant speed.

$$SN = ER \times I / D^3 \ (kN/m^2)$$

Where:

ER – modulus of elasticity of the structural material

I – unit moment of inertia of the pipe wall

D – mean (neutral) pipe diameter

Another method for determination of ring stiffness is based on the DIN 16961 standard. In this method constant pressure is applied to the pipe and pipe deflexion is measured after 1, 6 and 24 hours. 24-hour deflexion under defined load should be 3% (the so called Constant Load Method). Pipe stiffness according to the DIN method can be calculated from the following formula:

$$SR\ (ATV) = ER \times I/rm^3 \ (kN/m^2)$$

Where:

ER – modulus of elasticity of the structural material

I – unit moment of inertia of the pipe wall

rm – mean pipe radius

In case of solid wall pipes their ring stiffness may be determined using the above mentioned methods.

Table: Ring stiffness SN according to different methods

SN (kN/m^2) ACC. TO ISO9969	SN (kN/m^2) ACC. TO DIN16961
2	16
4	32
6	48
8	64
10	80
16	128

where: **SN** – ring stiffness of a pipe (kN/m^2)

Table: Ring stiffness (acc. to ISO9969) of structural pipes and ring stiffness values of solid wall (pressure) pipes.

GRAVITY PIPELINES RING STIFFNESS SN* (kN/m^2)			
PIPE	TYPE	MEDIUM	HEAVY
KK SPIRAL	kN/m^2	2 4	8

	PIPE	KK SPIRAL
GRAVITY PIPELINES RING STIFFNESS SN* (kN/m^2)	SDR (-)	kN/m^2
	33	2.5
	27.6	
	26	5
	22	
	21	10
	17.6	
	17	19
	13.6	38
	11	75
	9	150

STATIC CALCULATIONS FOR PE AND PP PIPELINES

PIPE DEFLECTION

Theoretical deflection of a pipe under the load of soil and vehicular traffic is:

(3) $$\left(\frac{\delta}{D}\right)_q = \frac{q(C\cdot b_1 - 0{,}083\cdot K_0)}{8\cdot S_R = 0{,}061\cdot E_S}$$

C – coefficient of load concentration C=1

b_1 – coefficient of load distribution for pipe bearing angle α =180° b_1 = 0.083

K_0 – coefficient of static earth pressure K_0 = 0.5

E_S – ground compression modulus

Ring stiffness of S_R pipe (according to ISO)

$$S_R = \frac{E\cdot I_1}{D_R^3}$$

I – moment of inertia of pipe cross section (m^4/m)

E – modulus of elasticity of pipe material (kN/m^2) assumed for PE:
momentary value E = 800 000 kPa
sustained value El = 200 000 kPa

DR – neutral axis diameter (m)

VERTICAL LOAD

Vertical load q caused by earth weight, hydrostatic thrust and vehicular traffic is:

(4) $$q = q_s + q_w + q_{tr}$$

Where:

q_s – earth weight

$q_s = \gamma_{gs}(H-h) + \gamma_{gm}(h-D+s)$ (kN/m^2)

q_w – hydrostatic thrust of underground water

$q_w = \gamma_w(h-(D/2)+s)$ (kN/m^2)

q_{tr} – load caused by vehicular traffic (kN/m^2)

γ_{gs} – specific gravity of dry ground; here γ_{gs} = 19 kN/m^3

γ_{gm} – specific gravity of watered ground; here γ_{gm} = 11 kN/m^3

γ_w - specific gravity of water; here γ_w = 10 kN/m^3

D – outside pipe diameter (m)

s – pipe wall thickness

Table: Values of specific gravity of dry ground **γ_{gs}**

TYPE OF GROUND	SPECIFIC GRAVITY kN/m^3
SAND	17 - 19
SANDY CLAY	17 - 19
THICK CLAY	18 - 22
SANDY AND DUSTY LOAMS	17 - 22
LOAMS	17 - 22

Traffic generated load q_{tr} according to German Standards (ATV A127, EN 124.EN 1610).

The guidelines of the German Standard ATV A127 single out three types of standard loads in evaluation of load carrying capacity of pipelines exposed to traffic loads. These are:

- SLW60 – standard vehicle with gross vehicle weight of 600 kN and wheel load of 100 kN
- SLW30 – standard vehicle with gross vehicle weight of 300 kN and wheel load of 50 kN
- LKW12 – standard vehicle with gross vehicle weight of 120 kN and front wheel load of 20 kN and rear wheel load of 40 kN.

Load acting on the top of the pipe and caused by particular type of standard vehicle can be calculated using the following formulas:

(5) $$pv = \phi \, . \, aF \, . \, pF$$

Where: ϕ – dynamic coefficient

(6) $$p_F = \frac{F_A}{r_a^2 \cdot \pi} \cdot \left(1 - \left(\frac{1}{1+\left(\frac{r_A}{H_p}\right)^2}\right)^{\frac{3}{2}}\right) + \frac{3 \cdot F_E}{2 \cdot \pi \cdot H_p^2} \cdot \left(\left(\frac{1}{1+\left(\frac{r_E}{H_p}\right)^2}\right)^{\frac{5}{2}}\right)$$

(7) $$a_F = 1 - \frac{0.9}{0.9 + \frac{4 \cdot H_p^2 + H_p^6}{1.1 \cdot D_m^{2/3}}}$$

$$d_m = \frac{d_w + d_z}{2}$$

Table: Coefficients used in calculations of traffic generated load $\mathbf{q_{tr}}$

TYPE OF LOAD	F_A (kN)	F_E (kN)	r_A (m)	r_E (m)
SLW60	100	500	0.25	1.82
SLW30	50	250	0.18	1.82
LKW12	40	80	0.18	2.26

TYPE OF LOAD	ϕ
SLW60	1.2
SLW30	1.4
LKW12	1.5

COMPRESSION MODULUS E'S OF THE PIPE SURROUNDING GROUND

Soil compression modulus E's depends not only on the degree of compaction but also on the type of soil and thickness of cover Hp. The diagram shows the minimum values of ground compression modulus E's for underground water level below pipe and specific gravity of the backfill of 19 kN/m3 and compaction degree according to modified Proctor for such grounds as loam, sand and gravel.

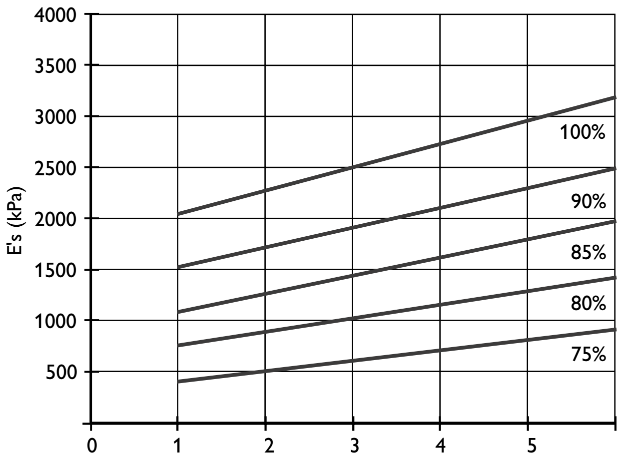
For covers Hp exceeding 6 m constant value of E's, corresponding to Hp=6m were assumed.

The diagram shows minimum values of E's for underground water level above pipe and compaction degree according to modified Proctor for such grounds as loam, sand and gravel.

For covers Hp exceeding 6m constant value of E's, corresponding to Hp=6m were assumed.

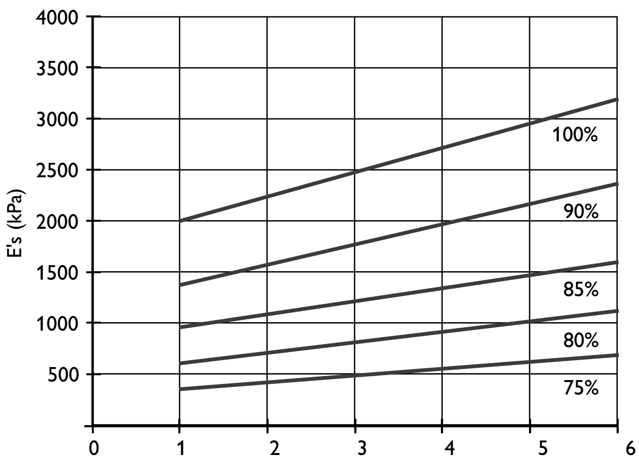
THICKNESS OF COVER ABOVE THE PIPE TOP HP (m)

The diagram shows the compression modulus E's depending on the modified Proctor density of soil and Hp for underground water level below pipe.



THICKNESS OF COVER ABOVE THE PIPE TOP HP (m)

The diagram shows the compression modulus E's depending on the modified Proctor density of soil and Hp for underground water level above pipe.



MODIFIED PROCTOR DENSITY VERSUS STANDARD PROCTOR DENSITY

One of the parameters defining foundation conditions that may be selected in the program is Modified Proctor Density (MPD). Its value is slightly smaller in comparison with Standard Proctor Density (SPD), however, no direct and clear quantitative relation exists between these two numbers.

This relation is closely connected with the type of soil. In common practice, for non-cohesive soil used for pipeline foundations, Modified Proctor Density constitutes reliable parameter to define mechanical properties of soil.

In order to obtain proper value of Modified Proctor Density for pipe backfilling, with particular consideration given to the sub-base zone, it is necessary to choose appropriate type of soil, thickness of compacted layers and suitable compacter equipment. Methods for ground compaction are shown in the table below.

Table: Values of Standard Proctor Density and relevant values of Modified Proctor Density

STANDARD PROCTOR DENSITY	MODIFIED PROCTOR DENSITY
88	85
93	90

TYPE OF EQUIPMENT	WEIGHT (kg)	MAX. LAYER THICKNESS		NUMBER OF CYCLES	
		GRAVEL SAND	LOAM, CLAY, SILT	85 % OF MODIFIED PROCTOR DENSITY	90 % OF MODIFIED PROCTOR DENSITY
MANUAL TAMPER	15 Min.	0.15	0.10	1	3
VIBRATORY COMPACTOR	50 - 100	0.30	0.20 - 0.25	1	3
DUST VIBRATOR	50 - 100 100 - 200 400 - 600	0.15 0.20 0.40	- - 0.20	1	4

BUCKLING

External pressure (generated by soil and underground water) that generates circumferential compressive stress in the pipe wall may lead to buckling damages of pipe. Buckling risk depends on external pressure (Hp and h), possible negative pressure inside the pipe, pipe ring stiffness and type of soil. Regarding pipes laid in grounds with relatively high and uniform compaction, the risk of buckling is small.

The permissible (critical) load can be calculated using the following formula:

(8) $$q_{dop} = \frac{5{,}63}{F} \cdot \left(1 - 3 \cdot \frac{\delta}{D_m}\right) \cdot \sqrt{S_{RI} \cdot E'_t}$$

Where:

F – factor of safety, here F = 2

E'_t – ground deformation modulus, here E'_t = 2E's

δ/D_m – total relative pipe deflection

Long-term pipe ring stiffness SRI = 0,25 S_R was assumed in this formula.

For pipes with low ring stiffness, laid down in shallow trenches (Hp < 1.5 m) and subjected to vehicular traffic loads, the following formula is additionally used:

(9) $$q_{dop} = \frac{64 \cdot S_R}{\left(1 + 3{,}5 \cdot \frac{\delta}{D_m}\right)^3}$$

Short-term pipe ring stiffness should be used here.

Dimensioning criteria are: short-term relative deflection and critical pressure causing buckling.

MAXIMUM SHORT-TERM DEFLECTION

The recommended maximum short-term deflection is 6%. This value includes considerable margin for unpredictable effects resulting from operating conditions rather than from strength of pipe material.
Excessive pipe deflection and self-consolidation of the backfill soil may lead to surface damages. When tube jointing sleeves are used, excessive pipe deflection may result in unsealed joints.
Verification of permissible load is based on the formulas:

- for Hp ≤1,5m – formula (8) assuming long-term pipe ring stiffness SRI = 0,25SR and formula (9) when short-term pipe ring stiffness SRI is assumed.

Smaller permissible load of the two values calculated according to the above scheme is considered reliable value.

- for Hp > 1,5 m – formula (8) assuming long-term pipe ring stiffness SRI = 0,25SR

For thermoplastic pipes laid down in ground, buckling will rarely have decisive effect on load carrying capacity.

LAYING GRAVITY PIPELINES IN THE GROUND

SOIL CLASSIFICATION

Table: Classification of soil used for pipe-laying according to Standard ENV 1046:2001.

SOIL GROUP	TYPE OF SOILS		
	NO	NAME	EXAMPLE
GRANULAR SOIL	1	SINGLE SIZE GRAVEL, HIGHLY SCREENED GRAVEL, MIX OF GRAVEL AND SAND, MIX OF POORLY SCREENED GRAVEL AND SAND.	CRUSHED ROCK, RIVER GRAVEL, MORAINIC GRAVEL, VOLCANIC ASHES
	2	SINGLE SIZE GRAVEL, MIX OF SAND AND GRAVEL, MIX OF POORLY SCREENED GRAVEL AND SAND.	DUNE SAND AND ALLUVIAL DEPOSITS, MORAINIC GRAVEL, COAST SAND
GRANULAR SOIL	3	GRAVEL WITH SILT, GRAVEL WITH CLAY, SAND WITH SILT, SAND WITH CLAY, POORLY SCREENED MIX OF GRAVEL, SILT AND SAND.	GRAVEL WITH CLAY, SAND WITH SOIL, ALLUVIAL CLAY
COHESIVE SOIL	4	INORGANIC SILT, FINE SAND WITH SILT AND CLAY, INORGANIC CLAY.	SOIL, ALLUVIAL MARL, CLAY
ORGANIC SOIL	5	ORGANIC SILT, CLAYISH ORGANIC SILT, ORGANIC CLAY, CLAY WITH ORGANIC MIX	SUPERFICIAL LAYER, TUFA SAND, SEA LIMESTONE, MUD, SOIL
ORGANIC SOIL	6	PEAT, OTHER HIGHLY ORGANIC SOILS, SLUDGE	PEAT, SLUDGE

Classification of mineral soils.

NAME OF SOIL	SYMBOL	SUB-TYPE	FRACTION (mm)
LOAM	I		<0.002
CLAY	G	DUSTY CLAY CLAY SANDY CLAY	0.002 - 0.006 0.006 - 0.02 0.02 - 0.06
SAND	P	FINE SAND MEDIUM SAND COARSE SAND	0.06 - 0.2 0.2 - 0.6 0.5 - 2.0
GRAVEL	Z	FINE GRAVEL MEDIUM GRAVEL COARSE GRAVEL	2.0 - 6.0 6.0 - 20.0 20.0 - 60.0

TRENCH CONSTRUCTION

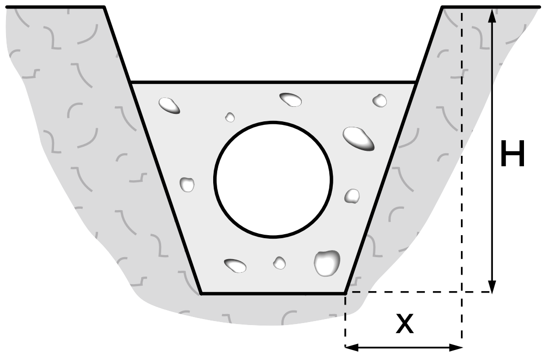
OPEN TRENCH WITHOUT BOARDING

- Open trench, sloping walls without boards. In case of trenches up to 4.0 m deep with no underground water and without landslides, with no load on surcharge within reach of soil wedge, the following safe sloping is allowed:

Table: Slopes in open trench without boarding.

PERMISSIBLE SLOPE IN OPEN TRENCH WITHOUT BOARDING	
TYPE OF SOIL	MAX. SLOPE H:X
HIGHLY COHESIVE	2:1
ROCKY	1:1
OTHER COHESIVE SOILS	1:1.25
NON-COHESIVE	1:1.5

For other cases sloping should be indicated in the engineering design.

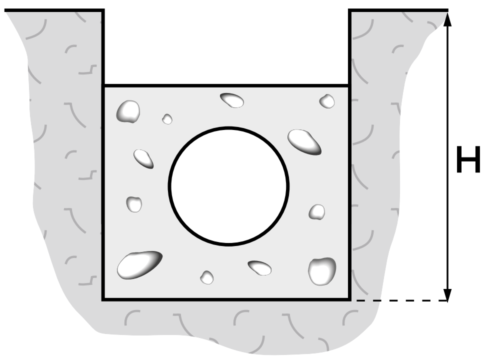


sectional view of open trench without boarding

- Open trench with vertical walls without boarding. Such trench is allowed in a dry soil only provided the ground is not under the load of a bank or construction equipment located near trench edges at a distance less than one trench depth. The excavated material should be stored at least 0.5 m away from trench edges while the damp must not present any risk to stability of the trench walls.

Table: Slopes in open trench without boarding.

PERMISSIBLE DEPTH OF VERTICAL WALL TRENCH	
WITHOUT BOARDING	MAX. TRENCH DEPTH
SOLID ROCKY GROUND WITHOUT CRACKS	4.0 m
COHESIVE SOILS	1.5 m
OTHER SOILS	1. 0 m



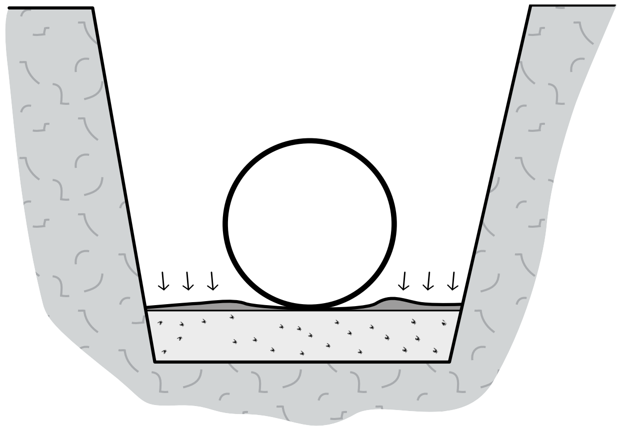
sectional view of vertical wall trench without boarding

METHOD FOR INSTALLATION OF PIPELINES IN THE GROUND

Determination of soil conditions is crucial for engineering design that precedes earth work and laying a pipeline in the ground.

(1) Subgrade: soil compacted to approx. 90 – 95% SPD

Layer of approx. 100-150 mm, gravel, sand, well graded aggregate, loam, clay (group 1-4 in the table), manual compaction. Pipes should be laid down on the trench bottom so that they evenly rest on the subgrade along their entire length. The strength of the subgrade may not be less than assumed in the engineering design (static calculations of pipeline). Moreover, hydraulic gradient should be ensured.

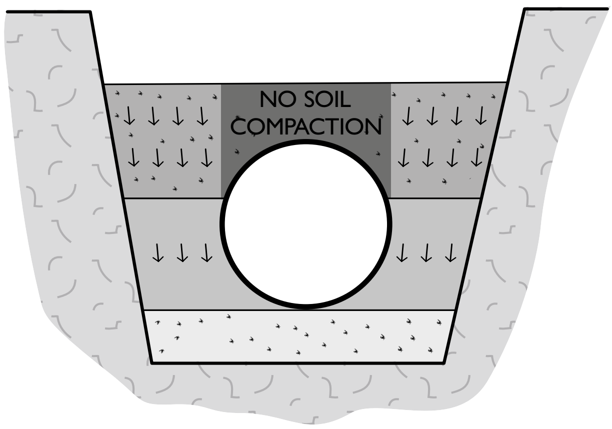


preparation of subgrade

Main backfill (2) and upper backfill

(3): Soil compacted to approx. 90 – 95% SPD

Backfill should be symmetrical at both sides of pipe in layers not exceeding 0.2 m, paying particular attention to careful compaction of the soil in the pipe support zone. It is necessary to ensure that the pipe would not go up during compacting operation. Use of light vibratory equipment (weight up to 100kg) is recommended. Use of the compactor directly above the pipeline is not allowed. This may be used only when the cover is at least 0.3 m thick. For the first layer – up to 0.3 m thick – material belonging to group 1-4 with granularity specified in the table should be used.



main and upper backfills

Virgin soil may be used for backfilling in the pipe foundation zone provided it satisfies all the criteria given below:

- does not contain particles larger than allowed for the given pipe diameter as per table;
- does not contain lumps larger than double size of the particles for the specific application as shown in the table;
- the material is not frozen;
- does not contain foreign matter (such as asphalt, bottles, cans, pieces of wood)
- if compaction using flexible material is required.

If no detailed information about the original material is available, density factor of 91 to 97% according to Standard Proctor Density (SPD) is assumed.

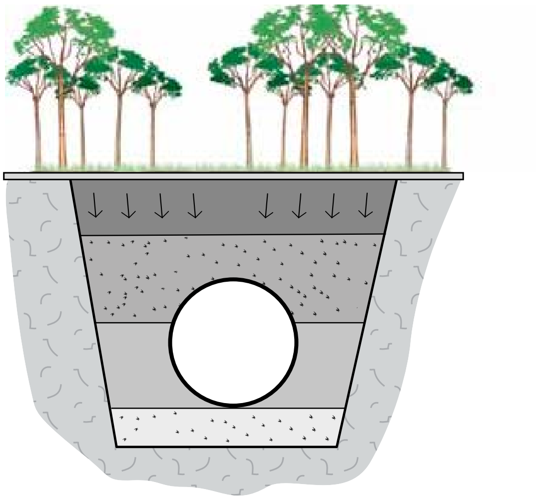
TABLE: REQUIRED GRANULATION OF SOIL

SYSTEM	NOMINAL DIAMETER OF PIPE	MAX. PARTICLE SIZE
KK SPIRAL (MANHOLES, TANKS, FITTINGS)	1300 < DN ≤ 2000	50

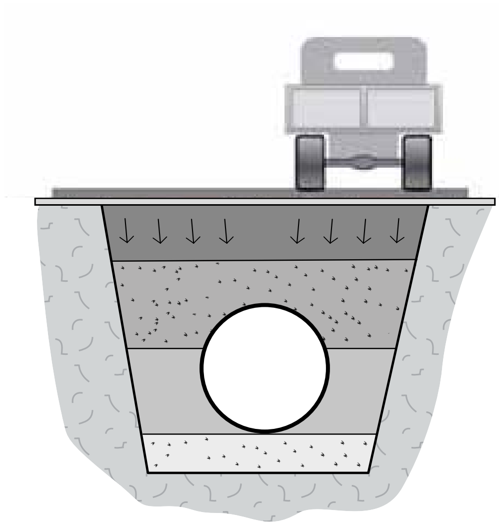
BACKFILL

The green belt: If a pipeline is laid down in a green belt area, virgin soil (from excavation) can be used since it belongs to group 1-4. In this case it should be compacted to approx. 88% SPD.

Excavations under streets: Virgin soil may be used for backfilling. Vibratory equipment with weight of up to 200 kg may be used also. Density according to SPD should satisfy the requirements for road construction. For pipelines laid under streets, frost heave soils may not be used as upper layer of backfill (thickness depending on the frost penetration conditions).



sectional view of a trench made in the green belt area



sectional view of a trench made under street

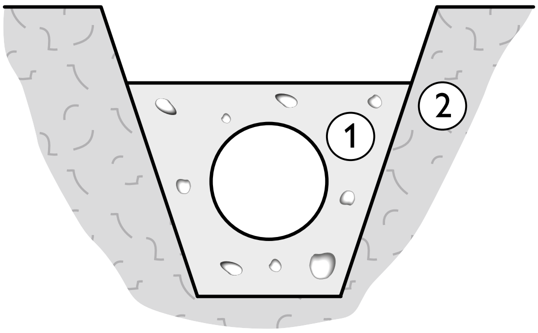
EXCAVATION WATER DRAINAGE

The lowering of water level in a trench should be done if excavation work or laying the pipelines is hindered by underground water. Lowering of the water level should be done without disturbing subgrade soil structure or subgrade soil of neighbouring buildings. Underground the water level should be lowered by minimum 0.5 m below the trench bottom. Due to harmful effect of the water level variations on the trench bottom soil structure, lowering of the underground the water level should include 24-hour periods. Moreover, excavated trench should be protected against inflow of rain water. Structures protecting trench walls should stand out at least 0.15 m above the adjacent ground, while ground surface should be suitably sloped for easier water removal.

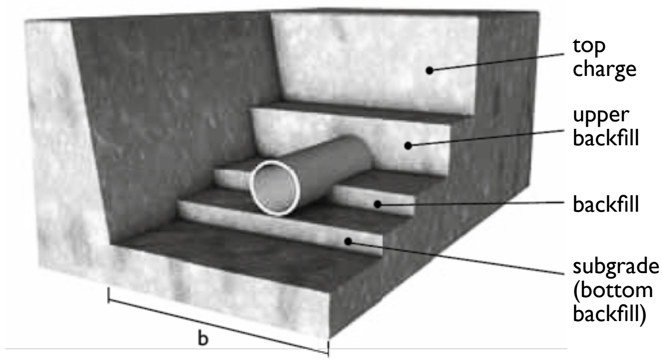
Any loose ground (dewatered for the time of construction) without grains exceeding 20 mm (not more than 16 mm in case of crushed stone) or cohesive soil satisfying the requirements for grounds with symbols ms, ss, can be used as subgrade for the pipeline. Strength parameters of subgrade may not be worse than assumed in the design documentation (static calculations for the pipeline). If cohesive soil occurs at the trench bottom, a layer of loose ground backfill not less than 0.15 m thick and not less than 0.25 pipe diameter should be made before the pipeline is laid down. This backfill should be compacted up to 95% SPD. Pumping of underground water may be stopped only when the pipeline is completely backfilled. Civil engineering design must describe detailed method for trench dewatering.

SELECTION OF PIPE STIFFNESS FOR THE TYPE OF GROUND

Type of ground and the degree of its compaction are crucial factors in construction of gravity pipelines.



division of trench into zones of virgin soil (2) and the ground around pipeline (1)



layers of soil with different density

RECOMMENDED METHODS FOR SOIL COMPACTION

The structural properties of the pipe zone backfill material are primarily dependent upon the type of material and the degree of compaction achieved. The degree of compaction can be varied by using different types of equipment and by varying the number of layers. The table represents groups of material classified in conformance with Annex A – the degree of compaction expressed in Standard Proctor Density (SPD) for the three classes of compaction used in this prestandard, i.e "W", "M" or "N".

NOTE: Proctor Density determined in accordance with DIN 18127

CLASS OF COMPACTION	EMBANKMENT GROUP			
	4	3	2	1
N (NOT)	75-80%	79-85%	84-89%	90-94%
M (MODERATE)	81-89%	86-92%	90-95%	95-97%
W (WELL)	90-9 %	93-96%	96-100%	98-100%

Selected pipe stiffness should be verified by static calculations (e.g. according to Scandinavian Method). In general, it is assumed that the trench is dewatered prior to installation. If underground water is present, allowance for additional pipe load should be made in pipeline calculations.

In general, selection of pipe stiffness depends on the type of virgin soil, top charge material and its density, thickness of cover above pipe, water table, size and geometry of load as well as the boundary values for a given pipe.

Matching pipeline stiffness with installation conditions should be agreed with the designer. The tables below show general values of ring stiffness relative to given ground properties.

RECOMMENDED MINIMUM STIFFNESS FOR PIPES LAID IN GROUND NOT EXPOSED TO TRAFFIC GENERATED LOADS

BACKFILL MATERIAL (GROUP)	CLASS OF DENSITY	PIPE STIFFNESS (kN/m²)					
		1 m < THICKNESS OF COVER < 3 m					
		VIRGIN SOIL GROUP					
		1	2	3	4	5	6
1	W M	4 4	4 4	4 4	4 4	4 8	8 8
2	W M		4 4	4 4	4 8	8 8	8 8
3	W M			4 8	8 8	8 8	8 **
4	W M				8 **	8 **	8 **
		3 m < THICKNESS OF COVER < 6 m					
1	W M	4 4	4 4	4 8	4 8	8 8	8 8
2	W M		4 8	4 8	8 8	8 8	8 **
3	W M			8 **	8 **	8 **	** **
4	W M				** **	** **	** **

* In grounds with low carrying capacity, pipe foundation should be reinforced e.g. with geotextiles.
** Static calculations are necessary for determination of geometry of trench and pipe stiffness.

BACKFILL MATERIAL (GROUP)	CLASS OF DENSITY	PIPE STIFFNESS (kN/m²)					
		1 m < THICKNESS OF COVER < 3 m					
		VIRGIN SOIL GROUP					
		1	2	3	4	5*	6*
1	W	4	4	8	8	8	**
2	W		8	8	8	**	**
3	W			8	**	**	**
4	W				**	**	**
		3 m < THICKNESS OF COVER < 6 m					
1	W	4	4	4	8	8	8
2	W		4	4	8	8	8
3	W			8	8	8	**
4	W				**	**	**

* In grounds with low carrying capacity pipe foundation should be reinforced e.g. with geotextiles.
** Static calculations are necessary for determination of the geometry of the trench and pipe stiffness
In addition, when the pipeline is laid under the unsurfaced road (particularly if the depth is small) the pipeline may be covered with reinforced slabs for greater safety.

RECOMMENDED COMPACTION METHODS

The table gives the recommended maximum layer thicknesses and the number of presses required to achieve the compaction classes for the various types of equipment and pipe zone backfill materials.
The recommended minimum cover thicknesses required above the pipe before the relevant piece of equipment can be used over the pipe are also included.

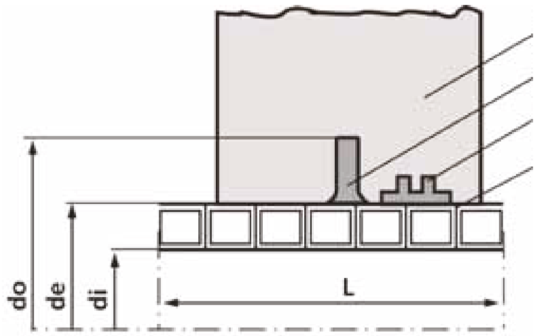
EQUIPMENT	NUMBER OF PRESSES FOR COMPACTION CLASS		MAXIMUM LAYER THICKNESS, IN METRES, AFTER COMPACTION FOR SOIL GROUP (SEE SOIL GROUP TABLE)				MINIMUM THICKNESS OVER PIPE CROWN BEFORE COMPACTION
	WELL	MODERATE	1	2	3	4	m
FOOT OR HAND TEMPER MIN. 15kg	3	1	0.15	0.10	0.10	0.10	0.20
VIBRATING TAMPER MIN. 70kg	3	1	0.30	0.25	0.20	0.15	0.30
PLATE VIBRATOR							
MIN. 50 kg	4	1	0.10	-	-	-	0.15
MIN. 100 kg	4	1	0.15	0.10	-	-	0.15
MIN. 200 kg	4	1	0.20	0.15	0.10	-	0.20
MIN. 400 kg	4	1	0.30	0.25	0.15	0.10	0.30
MIN. 600 kg	4	1	0.40	0.30	0.20	0.15	0.50
VIBRATING ROLLER							
MIN. 15 kN/m	6	2	0.35	0.25	0.20	-	0.60
MIN. 30 kN/m	6	2	0.60	0.50	0.30	-	1.20
MIN. 45 kN/m	6	2	1.00	0.75	0.40	-	1.80
MIN. 65 kN/m	6	2	1.50	1.10	0.60	-	2.40
TWIN VIBRATING							
MIN. 5 kN/m	6	2	0.15	0.10	-	-	0.20
MIN. 10 kN/m	6	2	0.25	0.20	0.15	-	0.45
MIN. 20 kN/m	6	2	0.35	0.30	0.20	-	0.60
MIN. 30 kN/m	6	2	0.50	0.40	0.30	-	0.85
TRIPLE HEAVY ROLLER (NO VIBRATION) MIN. 50kN/m	6	2	0.25	0.20	0.20	-	1.00

REPLACEMENT OF SOIL

If rocks, stones or hard soil are found, it is necessary to exchange soil at the trench bottom. Running sand, organic soils and soils with tendency to change volume when damp may appear. In such instances the project engineer has to make decision on the extent of soil exchange under the pipe and how to found the pipe on the new soil. Each case must be considered individually based on professional experience. If soil is to be replaced involving unplanned additional deepening of the trench, the same material should be used for subgrade and the backfill and it should be compacted with density of class "W".

GRAVITY PIPE WALL PASSES

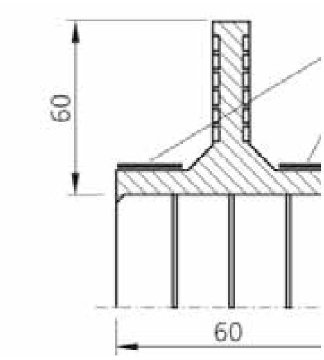
KONTI KAN SPIRAL pipe through concrete wall.
This anchor wall pass remains tight up to 3 m column of water, provided rubber sleeves are used.
In addition, the wall must be made of watertight concrete.



1. Partition – watertight concrete
2. PE anchor flange
3. Rubber sleeve
4. KK SPIRAL pipe

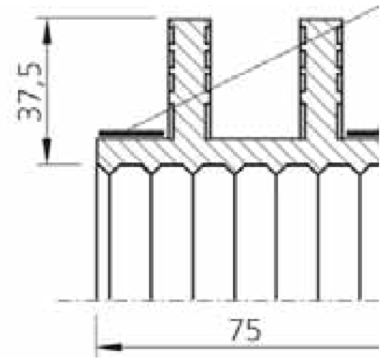
FRANK TYPE RUBBER SEALING SLEEVES

Sleeves may be installed on KK SPIRAL pipe in any location. Depending on the design specification the length L may differ. Additional tightness may be obtained using sealing sleeves (profile A or B) – depending on conduit diameter.



Rubber sleeve
Profile A

dn=90-315 mm



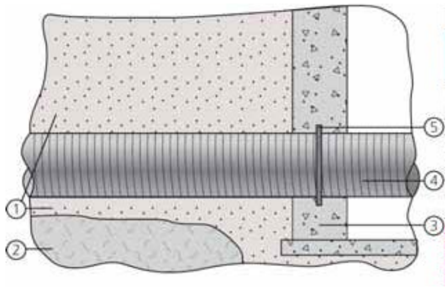
Rubber sleeve
Profile B

dn=355-1200 mm

The technical drawings are made and owned by Frank Gmbh Germany

CONNECTIONS WITH RIGID STRUCTURES

When a pipeline is passed through buildings, drains or retaining walls, an allowance for differences in settlement should be made while designing the connections.



Legend:

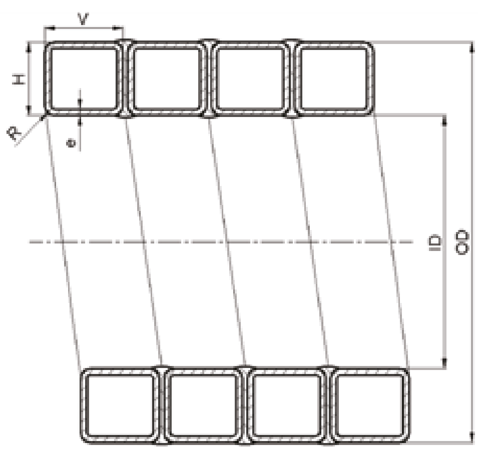
1. Backfilling material – well compacted (class W)
2. Virgin soil
3. Pipe
4. Fitting – wall pass

Such materials as polyethylene / polypropylene are flexible enough to take existing displacements and may be connected as shown in the picture, projecting from rigid structures should be effectively supported by the subgrade to minimize stresses caused by shearing forces and bending moments.

DIMENSIONS

The dimensions and weights in the table are indicative and they apply to a class which responds to the required product. The indicated values are medial values for manufacture. The table shows the guaranteed manufacturing values provided for by the EN 13476 and SFS 5906:2004 standards.

DN	OD	ID	HEIGHT OF PROFILE (H)	THICKNESS OF PROFILE (E)		
				SN 4	SN 8	SN 10
mm	mm	mm	mm	mm	mm	mm
1300	1422	1302	60	5	5.5	6.05
1400	1524	1404	60	5.2	5.7	6.3
1500	1645	1505	70	5.9	6.5	7.15
1600	1745	1605	70	6.3	6.93	7.16
1700	1855	1705	75	7	7.7	8.7
1800	1965	1805	80	7	7.7	8.5
2000	2175	2005	85	8.2	9	10

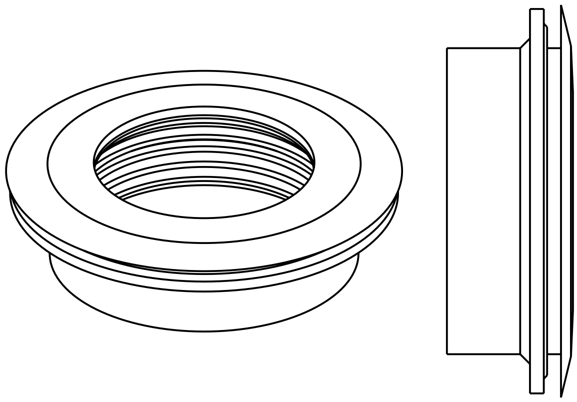


GRAVITY PIPE CONNECTIONS

IN-SITU CONNECTIONS WITH EXISTING COLLECTOR / MANHOLE

Dimensions of In-Situ connections

OD / ID	DIAMETAR OF KNIFE (mm)
OD 110	114
ID 110	125
OD 160	166
ID 160	193
OD 200	208
ID 200	240
OD 250	262
ID 250	295
OD 315	337
ID 300	355



IN-SITU CONNECTOR SHOULD BE USED FOR MAKING CONNECTION WITH COLLECTOR OR MANHOLE.

Proceed as follows:

1. Define connection diameter

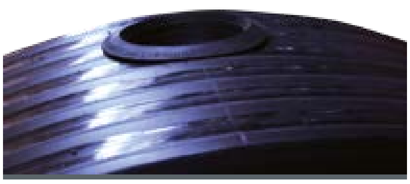
2. Cut suitable hole in the manhole wall

3. Place In-Situ connector in the hole

4. Insert connection pipe in the rubber In-Situ connector

1

2



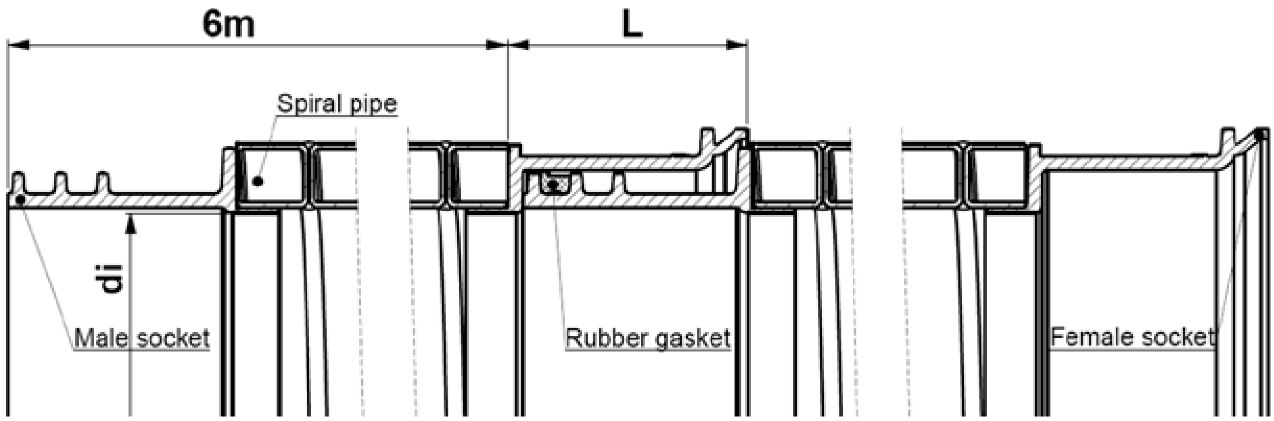
3

4

SNAP-JOINT CONNECTION

Before connection, pipes should be aligned coaxially and then one pipe end should be pushed into another with the use of excavator. Force F required to make this connection varies depending on the pipe diameter. Snap on terminal is factory fitted on the pipe end.

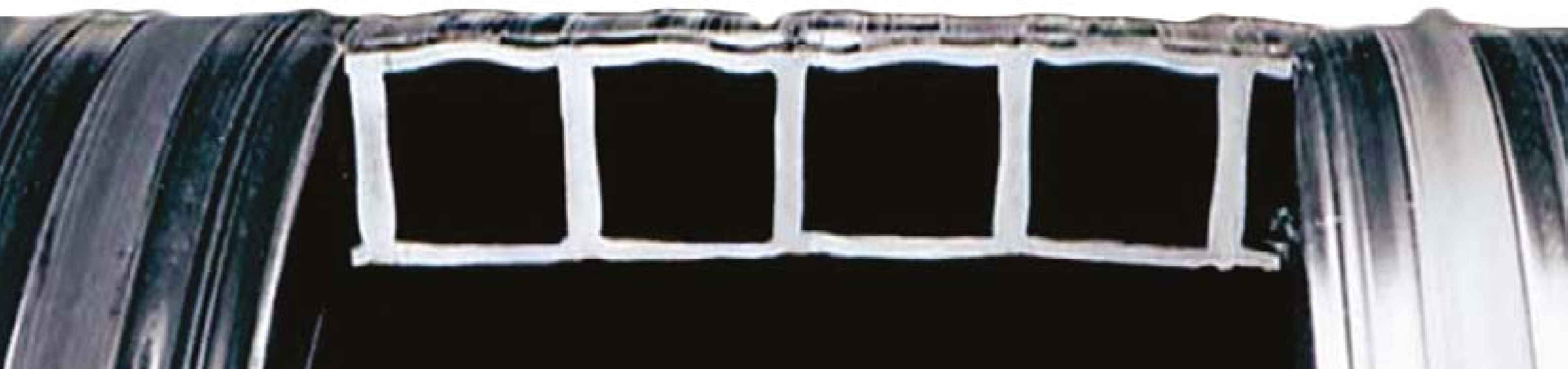
SNAP-JOINT CONNECTION IS A PERMANENT JOINT.



D	L
mm	mm
1300	219
1400	219
1500	267
1600	267
1700	267
1800	314
2000	314

EXTRUSION WELDING CONNECTION

Extrusion welding is a connection of KK SPIRAL pipe using a hand extruder and a rod made of the same PE material.



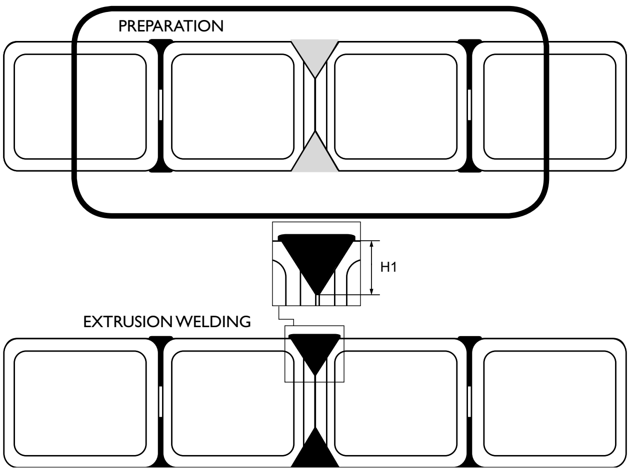
General guidelines for extrusion welding:

- Connection has to be made in dry conditions. Even minimum quantity of water may result in leaky connection.
- Joint has to be protected against wind (particularly in winter season and during rain).
- Prior to the joining operation the pipe ends should be cleaned and suitably prepared: the pipe ends should be bevelled as shown in the picture above. The pipe surface adjacent to the chamfer should be ground gently so that the extrusion material is applied to fresh pipe surface.
- Since polyethylene can oxidize easily, bevelling and grinding operations should be done immediately before joining.
- In case of secondary soiling, the dirty spot should be cleaned and ground again.
- The temperature of the PE rod should be 220 to 225°C.
- The extruder nozzle outlet air temperature should be in the range from 230 to 260°C, depending on the ambient air temperature. During cold season the blower air temperature should be higher than during the summer.

Required tools:

- Extruder (extruder type according to specific requirement)
- Electric saw with vertical blade app. 30 cm long
- Drill
- Power source 4kW, 220 VAC

CROSS SECTION OF EXTRUSION WELDED CONNECTION



Depending on the installation conditions (dimensions of the trench) KK SPIRAL pipes may be welded:

From the inside – in narrow trenches

From the inside and the outside – in wide trenches

From the outside – pipe diameters up to 1300 mm

The time needed to make the connection depends on the pipeline diameter. Any welding method requires electric power and compressed air available at the construction site.

The group responsible for making joints as well as supervision of work should ensure correct installation of pipelines. The members of the Service Group are highly qualified Konti Hidroplast employees equipped with suitable tools: extruders and welding machines.

The Service Group is also authorized to train personnel in installation of PE pipelines and making joints directly at the construction site, as well as to issue certificates confirming participation in a training course. Such certificate is often required during bidding to confirm qualifications of contractor's personnel.

LEAK PROOF TESTS FOR GRAVITY PIPELINES

LEAK PROOF TEST FOR GRAVITY PIPELINES (WITH FLOW CAUSED BY GRAVITY)

GENERAL

The following components are subjected to water-pressure test at the construction site:

- Gravity thermoplastic pipelines, in sections of limited length (e.g. between manholes);
- Pipelines composed of KK SPIRAL pipes of 1000 m maximum length;
- Manholes.

The tested pipeline is filled with clean water and pressurized with definite hydrostatic pressure. Leak tightness is assessed by measuring the amount of water necessary to fill in for retaining required pressure or water level in the pipeline.

REQUIRED MINIMUM TEST PRESSURE:

P01 = 10 kPa = 0,1 bar = 1,0 m column of water, and maximum 50kPa, on top of the pipe
If underground water is present, test pressure depends on the difference of levels between pipeline axis and underwater water level.
P02 = P01 + 1,1 x a (m column of water) (2)

Where:

P01 = 1,0 m column of water, min or 5.0 m max
a = pressure exerted by underground water (m column of water)

Test pressure values relative to pipeline level and underground water level.

DIFFERENCE IN HEIGHT BETWEEN PIPELINE AXIS AND UNDERGROUND WATER LEVEL	TEST PRESSURE P_{01}	
a (m)	kPa	mm H_2O
a < 0	10.0	1000
0 < a < 0.5	15.5	1550
0.5 < a < 1.0	21.0	2100
1.0 < a < 1.5	26.5	2650
1.5 < a < 2.0	32.0	3200
2.0 <a < 2.5	37.5	3750
2.5 < a < 3.0	43.0	4300
3.0 < a < 3.5	48.5	4850
3.5 < a < 4.0	54.0	5400
4.0 < a < 4.5	59.5	5950
4.5 < a < 5.0	65.0	6500

NOTE:

100 kPa = 1 bar = 1 atm = 10 m column of water.

Temperature of water inside pipeline during test:

T_{mean} = 20°C +ΔT; ΔT<10°C
(for gravity flow pipes)

Temperature of leakage make-up water:

$Ta = T_{mean} \pm 3°C$

Hydraulic test procedure according to EN 1610

Phase I:	Test pressure or water level increased to: **P_{e1} = 1,0 + 1,1 a** (column of water) Prior to starting Phase II maintain pressure P_{e1} for at least 10 minutes
Phase II:	Test pressure P_{e1} = 1,0 + 1,1 a (m column of water) is maintained for half an hour by adding water to the pipeline (if necessary). Amount of make-up water is measured 3 times, always for 6 minutes, in litres (Q_1,Q_2,Q_3).
Phase III:	Conclusion of the test. Average value of Q1, Q2, Q3 is calculated: **Qa = 1/3 x (Q_1 + Q_2 + Q_3)** (3) Next, Qa is transformed into Qap, expressed in litres/m x hour: **k1 = 60 / 6 = 10 (1/hour) k2 = 1/L (L = lenght of section under test)** **Q_{ap} = Q_a x k1 x k2** (4) Test result is satisfactory if Qap value remains in the shaded area.

Explanation of the symbols used:

L – length of the pipeline section under test

a – underground water level measured from pipe axis in the middle of the tested section (1/2 L)

Di – Pipeline inside diameter

P_{e1} - test pressure

Test pressure may be calculated using the formula:

P_{e1} = P10 + 1,1 a (m column of water) (2)

Where:

P10 = 1,0 m column of water (= 1,0 x 10-2 kPa)

DIAGRAM EVALUATION OF WATER-PRESSURE TEST RESULTS BASED ON AMOUNT OF ADDED-UP WATER (GRAVITY PIPELINES)

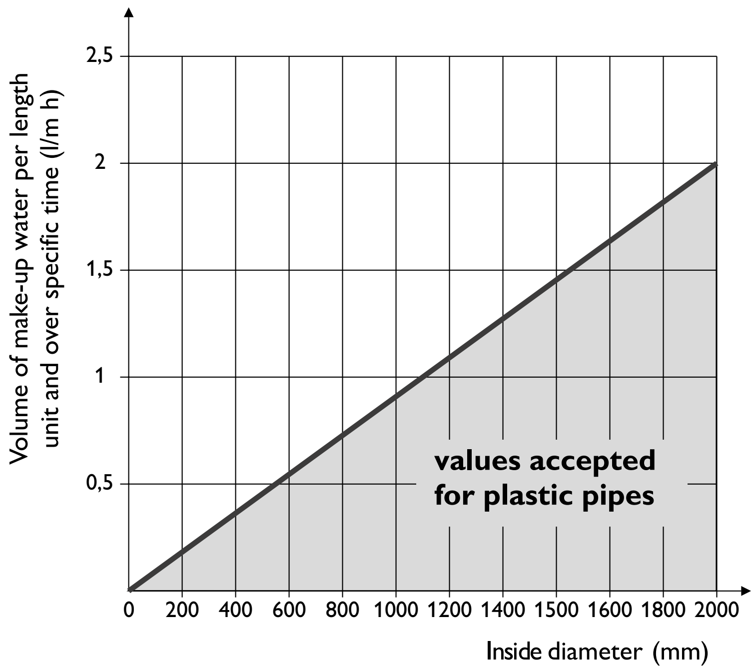
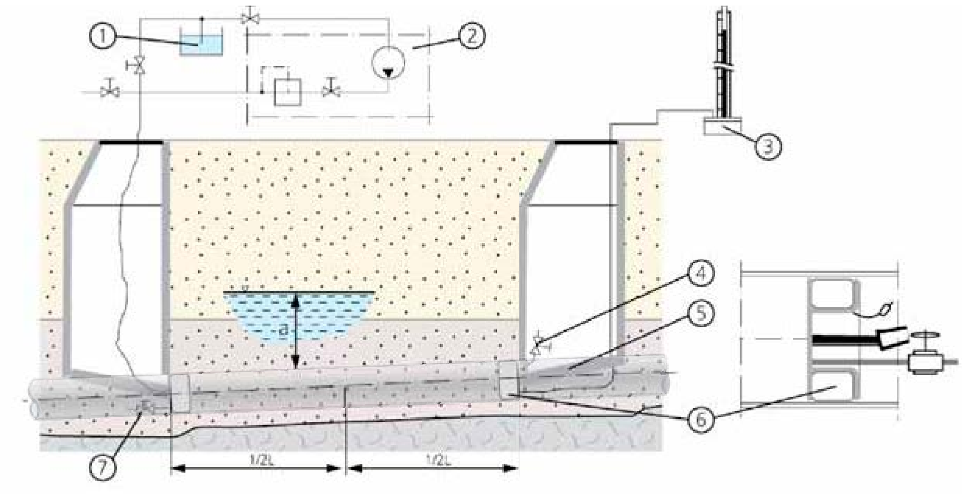
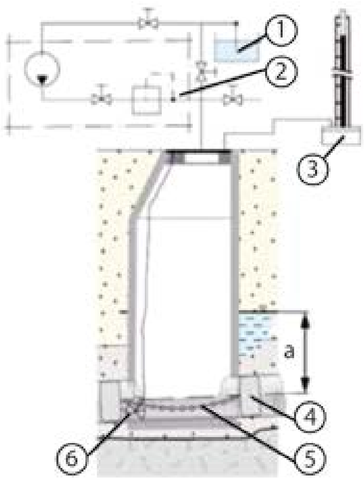


DIAGRAM SHOWING THE PROCEDURE FOR PRESSURE TESTING OF GRAVITY PIPELINE BETWEEN MANHOLES



1. Additional water tank
2. Pressure equalizing equipment (when necessary)
3. Pressure gauge
4. Valve
5. Plug support
6. Plug
7. Valve

DIAGRAM SHOWING THE PROCEDURE FOR PRESSURE TESTING OF SEWAGE SYSTEM INSPECTION CHAMBERS



1. Additional water tank
2. Pressure equalizing equipment (when necessary)
3. Pressure gauge
4. Plug
5. Chain
6. Valve

Legend:

l – height of inspection chamber

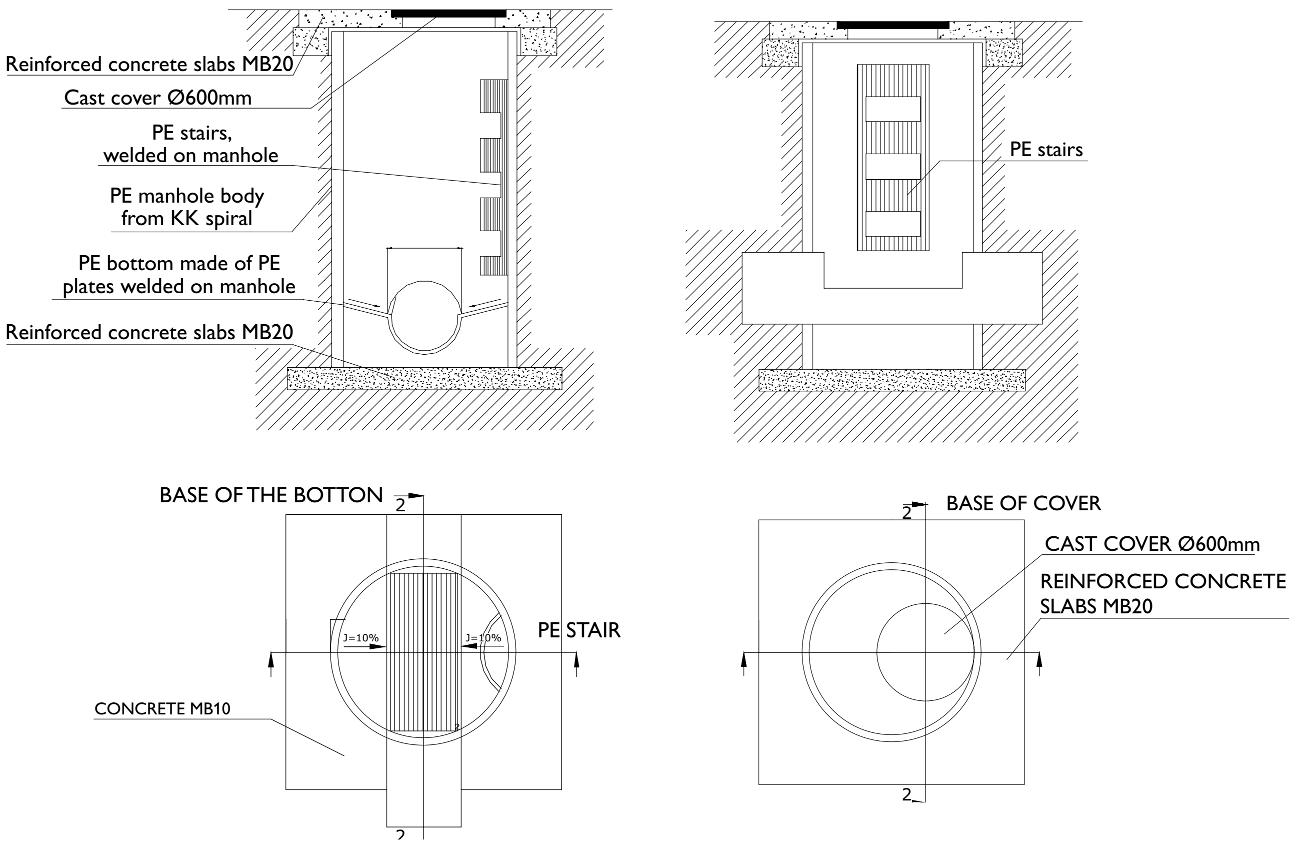
a – underground water table up to the pipeline axis

Di – inspection chamber inside diameter

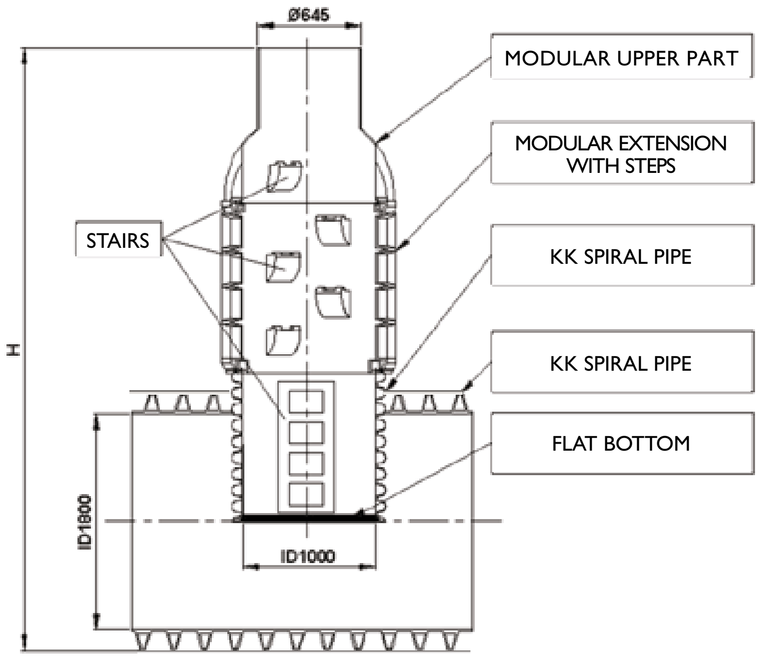
Test pressure: as indicated in the table above or according to formula (2)

Water-pressure test procedure is identical with that used for pipelines (Phases I to III). Test result is satisfactory if Qap value remains in the shaded area – see Diagram.

TYPE OF KK SPIRAL MANHOLES



Manholes can be made as a combination of KK spiral pipe and rotomolded parts.



TANGENTIAL MANHOLE

This type of manhole is tangentially positioned related to the vertical pipe, which means it is moved from the middle. The tangential part of the manhole is made in diameters from ID1300 to ID 2000mm, and the vertical part is ID1000mm. The manholes are made from polyethylene, and the only difference is that the tangential pipe – the horizontal one is made of polyethylene/polypropylene – KK SPIRAL pipe.

The vertical part (the body) can be made in hights according to the requests of the buyer (10-12 m), and it can be made from spiral pipe or rotomolded parts.

On the inside, it has built in stairs. The upper part – the cover of the manhole is conically shaped eccentric opening.

The major advantage is a stable, flexible, low weight, easily accessible, self-cleaning and permanent construction.

COVER OF MANHOLE

Usually, the manholes are installed in a way so that the upper part of the manhole – the cover – is positioned on the upper edge of the field on top of which comes the concrete plate, which evens the load. The advantage of these manholes is that the outside load is not directly transferred to the manhole but it is transferred through the concrete ring in the surrounding soil.

The manhole cover is also made of polyethylene, conically shaped with eccentric hole and there are two different hights of it avalible.

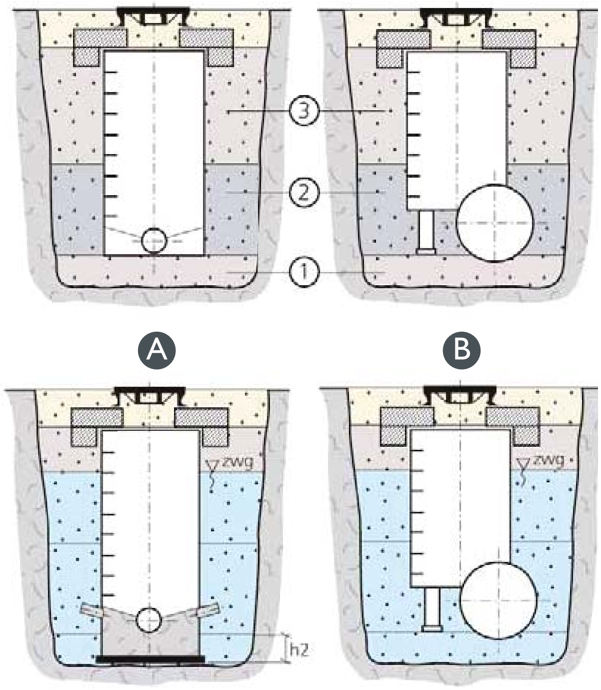
INSTALLATION OF PE MANHOLES

PE manholes installed in earth behave similarly as PE pipe. The manholes, pipes and connection parts are a single construction where stability and function safety are based on mutual functions of all integrated parts, bedding and filling. The site work, like bedding, connection of manhole with pipes, side backfilling and main backfilling, make a compact system which insures a proper function of the whole manhole system according to the standards' requirements.

INSTALLATION OF KK SPIRAL MANHOLES

Soils belonging to group 1-3 may be used for subgrade, backfill and top charge. Soils of the group 4-6 (cohesive and organic soils) are not recommended. In tank backfill zone soil should be replaced with that belonging to group 1-3.

Depending on the underground water level, the manhole may be provided with a heavy bottom. The standard height of heavy bottom chamber is h2=30cm. Eccentric or T-connection manholes do not need anchoring with special heavy slabs. Buoyancy is compensated by a collecting pipe.



INSTALLATION IN DRY SOIL

Installation in watered soil – Konti Hidroplast manhole buoyant force may be calculated with the use of Konti Hidroplast computer program.

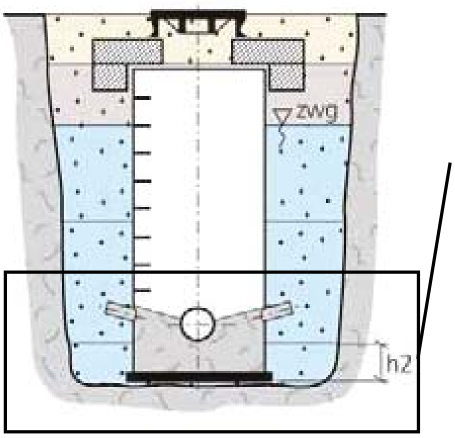
(A) Manhole with heavy bottom filled with lean concrete

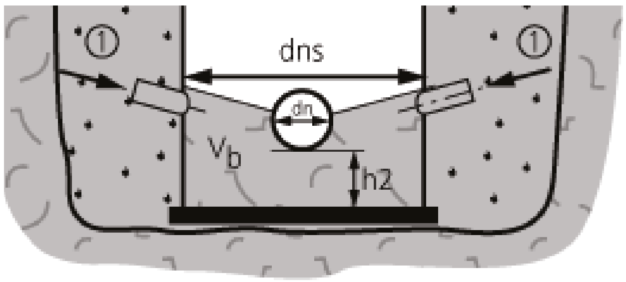
(B) T-connection or eccentric manhole

TYPES OF SOIL COMPACTION DENSITIES

TYPE OF SOIL	GROUP	EXAMPLE OF SOIL	COMPACTION IN SPD%
LOOSE	1	GRAVEL – GAP GRAINED, VALLEY AND BEACH GRAVEL	98 ÷ 100
LOOSE	2	SAND – GAP GRAINED, DUNE SANDS, DEPOSITED SANDS, VALLEY SANDS	96 ÷ 100
LOOSE	3	CLAY SAND, SAND-CLAY MIX – GAP RAINED, WATERED SAND	93 ÷ 96
COHESIVE	4	INORGANIC LOAM, FINE SAND, STONE DUST, HIGHLY PLASTIC CLAY	---
ORGANIC	5	MULTI-FRACTIONAL LOOSE SOIL WITH HUMUS	---
ORGANIC	6	PEAT AND OTHER HIGHLY ORGANIC SOILS	---

ANCHORING OF MANHOLE IN WET SOIL





① - concrete inlet

Depending on the underground water level, a manhole may be provided with a heavy bottom. The standard height of the heavy bottom chamber is h2=30cm. The heavy bottom chamber should be filled with lean concrete. For this reason, the lower part of the bottom is provided with two opposite filler pipes for pouring the concrete in. After the concrete is poured in, the fillers should be closed using a PE plug.

CHECKING HYDROSTATIC STABILITY OF SEWAGE MANHOLES

In order to check the hydrostatic stability of a sewage manhole we should compare the design value of the hydrostatic lift exerted on the manhole with the sum of values of the bearing forces (tare weight and friction of the soil against the external lateral surface of the manhole).

The calculation diagram is shown in the figure. Checking of hydrostatic stability refers to such design cases, where the ratio between the nominal diameter of the collector and diameter of manhole chamber does not exceed 0.7 and the nominal diameter of manhole is at least 800 mm. In other cases, especially when the collector diameter is larger than the diameter of the manhole chamber, the calculation of the additional load can be neglected. If the condition for manhole hydrostatic stability is not met, the manhole must be equipped with a loading chamber filled with concrete, placed in the bottom part of the manhole.

Calculation of forces exerted on the manhole:
The value of hydrostatic lift:

$$W = \frac{\pi \times D_z^2}{4} \times h \times \gamma_w$$

The value of friction force of the soil against the lateral surface of a manhole in homogenous backfill:

$$T = tg\varphi \times \pi \times D_z \times \left[\frac{\gamma \times H^2}{2} \times tg^2\left(\frac{\pi}{2} - \frac{\varphi}{4}\right) - 2 \times c \times H \times tg\left(\frac{\pi}{4} - \frac{\varphi}{2}\right) + \frac{2 \times c^2}{\gamma}\right]$$

Calculation of the value of friction force of the soil against the lateral surface of a manhole in complex ground and water conditions is shown below. In accordance with the requirements of the limit state method, for the first limit state (load capacity), the value of unbalance forces should be multiplied by an appropriate increasing coefficient while bearing forces – by a decreasing coefficient. Adopting the most economical values of the correcting factors (provided they are admissible by the standard) (1,1 and 0,9), the necessary anchoring force is as follows:

$$F_k = 1.1 \times W - 0.9 \times (G_w + T)$$

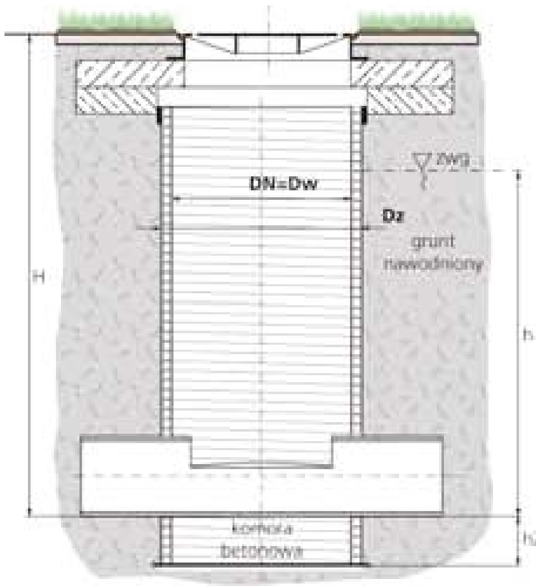
Where:

Gw – tare weight of manhole.

If the calculated value of the anchoring force is greater than zero, the bearing force should be increased by means of a loading chamber filled with concrete whose depth can be calculated as follows:

$$h_2 = \frac{4 \times F_k}{\pi \times D_w^{\,2} \times \gamma'_b}$$

Manhole with a loading chamber.



H – depth of the channel bed (m)

h – ground water level above the channel bed (m)

h2 – height of the loading chamber (m)

D_z – outer diameter of the chamber (m)

Dw – inner diameter of the chamber (m)

γw – volume weight of water (kN/m^3)

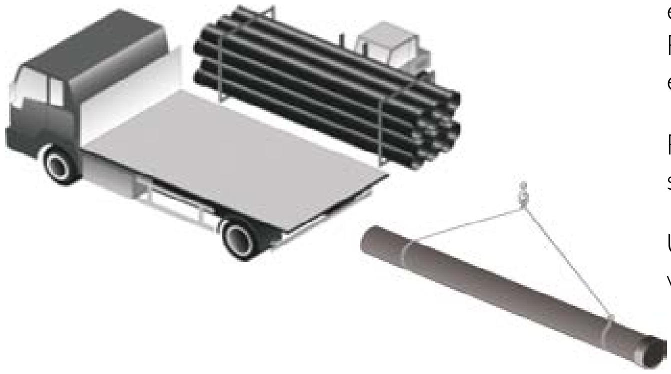
γ'b – effective volume weight of concrete

(γ'b =γb – γw) (kN/m^3)

γ – volume weight of the ground (kN/m^3)

Φ – angle of internal friction of the soil (rad)

TRANSPORT AND STORAGE OF PE PIPES



Loading and unloading of pipes on pallets should be effected with the use of fork lifts with smooth forks. Pallets must not be damaged and should be strong enough not to present risk to personnel.

Pipes loaded individually must be suspended on soft slings such as polyester belts of suitable strength.

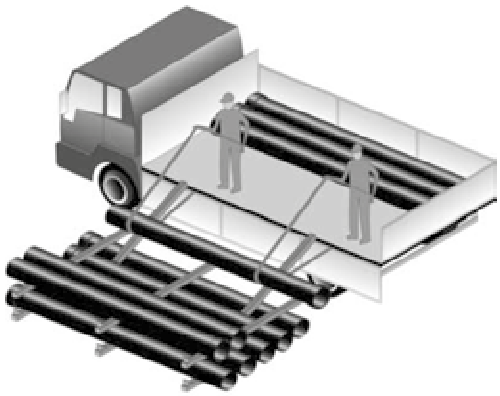
Use of rods, hooks or metal chains may lead to damages when pipes are incorrectly handled.

Trucks with flat loading platform or special vehicles for transport of pipes should be used. No nails or other elements should protrude from the platform.

Side boards should be flat and without sharp edges. Pipes with biggest diameters should be loaded directly on the platform. Individually loaded pipes should be separated with wooden slats so the slings may be threaded between pipe layers for unloading. In case of socket pipes, sockets should not touch one another.

Pipes should be bound together tightly so they would not move during transport. During transport pipes should not hang down more than five times nominal diameter and not more than 2 metres (smaller value applies).

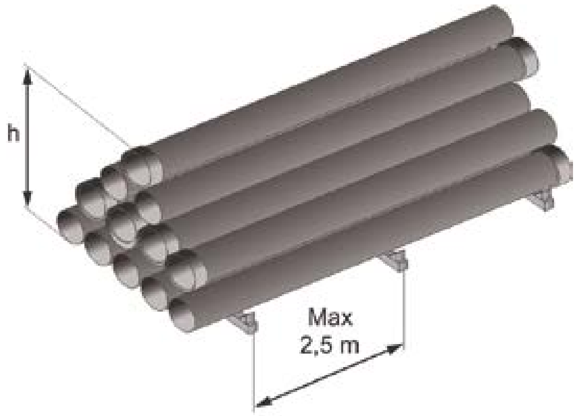
During unloading pipes must not be dropped in an uncontrolled manner. Otherwise, mechanical damage may occur. Pipes should be transported to a storage yard. Strength of plastic pipes decreases when temperature drops. Therefore, particular caution is needed when unloading plastic pipes in low ambient temperatures.



For manual unloading polyester slings should be used. Unloaded pipes must not produce any hazard to personnel. Lifting equipment and proper slings should be used when unloading heavy pipes. Nobody is allowed to stay under the suspended load or within reach of the crane.

Pipe storage yard should be accessible to personnel, e.g. quality control staff. Easy access should be also provided for further transport. Pipes must not be stored near open fire, sources of heat or dangerous substances: fuel, solvents, oils, paints, etc.

Wooden separators should be used during storage of pipes – in the same way as in transport. Wooden slats should be flat and wide to avoid deformation of pipes. The biggest diameter pipes should be placed at the bottom. In case of socket pipes, deformation of sockets should be avoided (alternating arrangement).



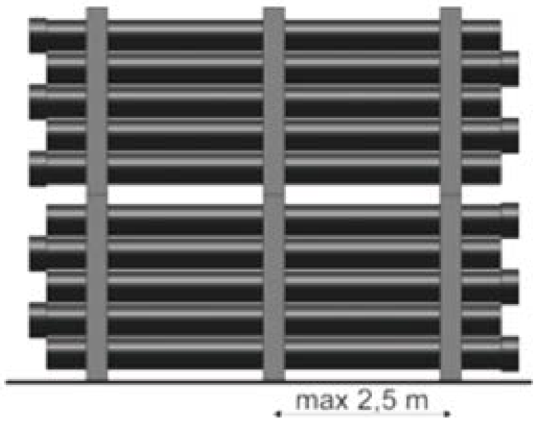
Pipes should not rest directly on the floor.

It is necessary to use supports – similar to wooden slats placed between pipes.

The distance between supports should not exceed 2.5 m. The floor should be flat and without sharp elements. The stacking height should not exceed 3-4 m.

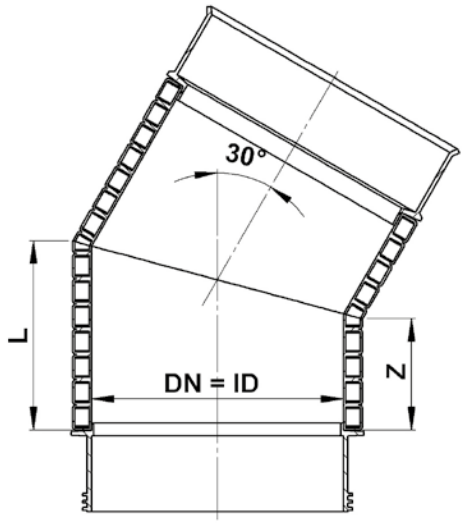
Pipe stacking height

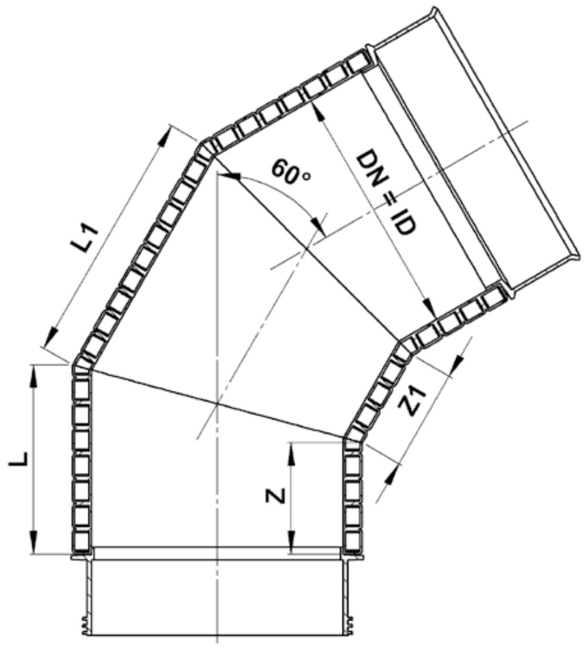
SYSTEM	MAXIMUM APPROXIMATE STACKING HEIGHT h (m)
KK SPIRAL	3,0 - 4,0 m

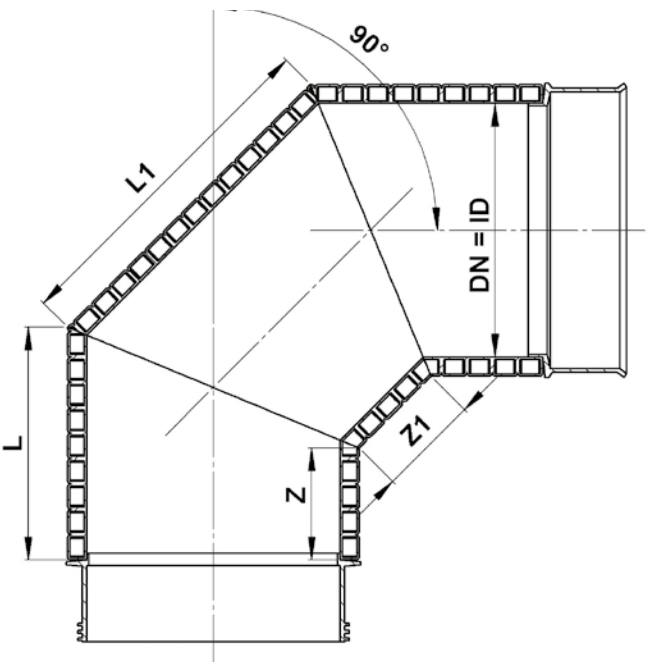


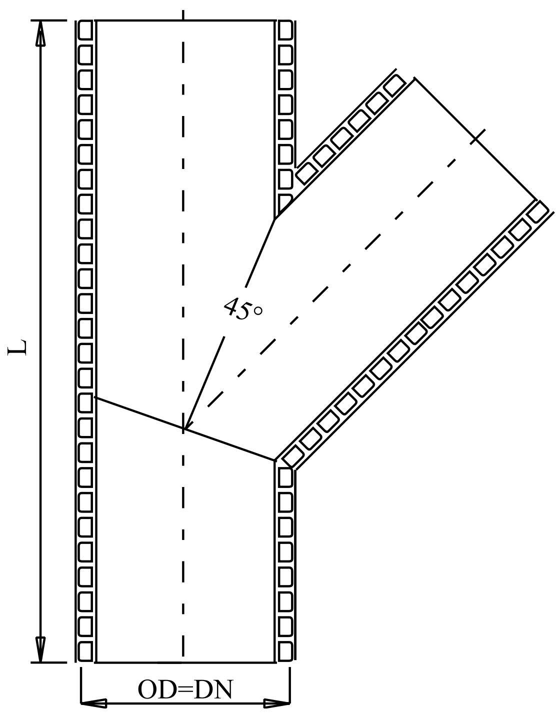
FITTINGS

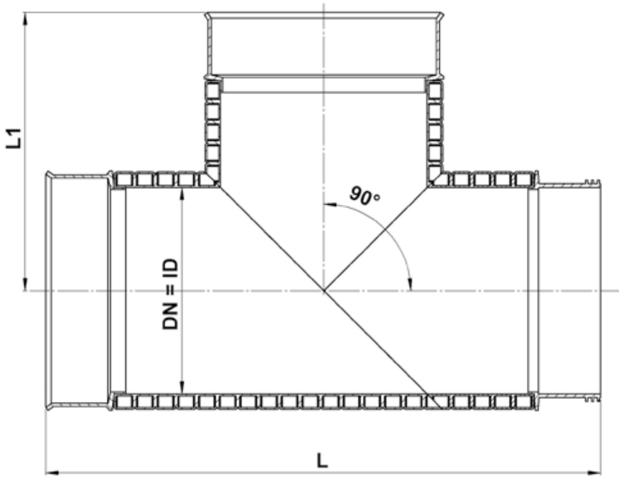
Manholes can be very easily connected to pipes by a wide range of different fittings fabricated in KONTI KAN Pipes.

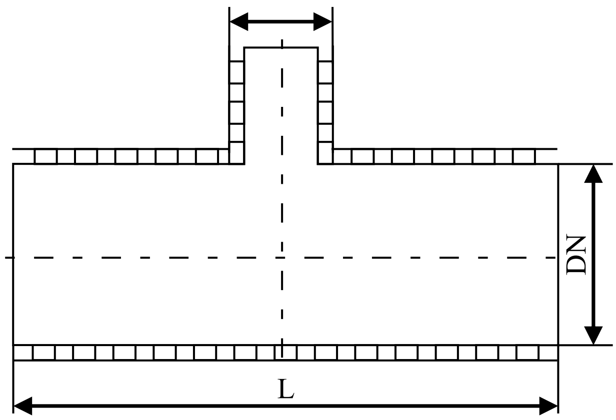


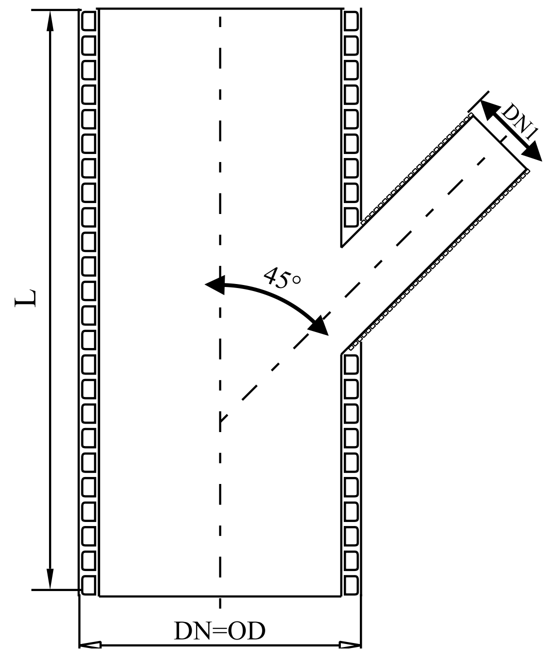


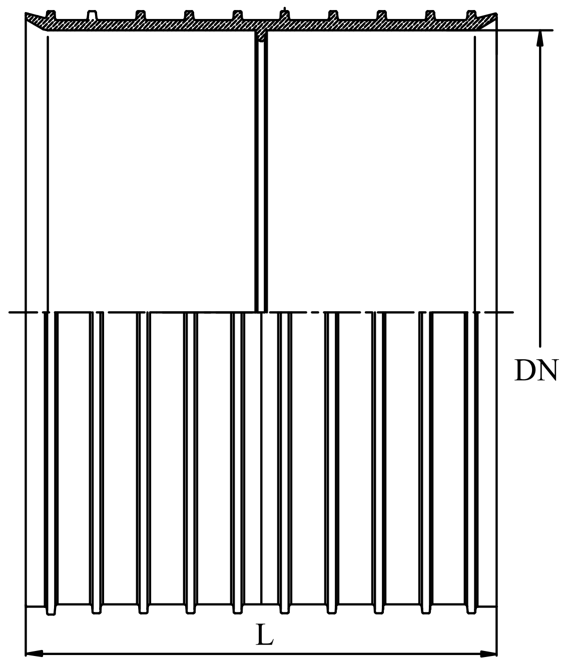





L1
90°
DN = ID
L


DN
L


DN1
45°
L
DN=OD


DN
L

CERTIFICATES


IQNet
CERTIFICATE
ENVIRONMENTAL MANAGEMENT SYSTEM
ISO 14001:2004


IQNet
CERTIFICATE
OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM
BS OHSAS 18001:2007


IQNet
CERTIFICATE
QUALITY MANAGEMENT SYSTEM
ISO 9001:2008


CERTIFICATE


CERTIFICATE


CERTIFICATE


IGH


IGH


СЕРТИФИКАТ

LABORATORY TESTING

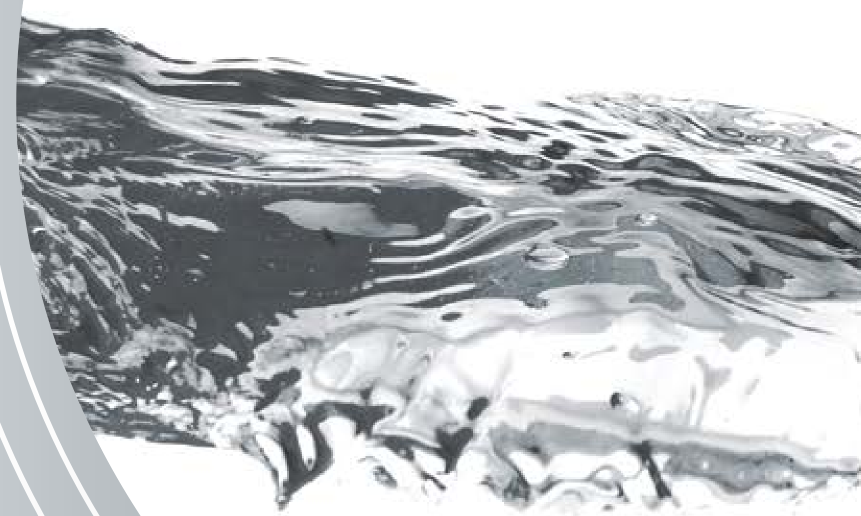
MELT MASS-FLOW RATE

LONGITUDINAL REVERSION

DENSITY

TENSILE STRENGHT OF SEAM

RING STIFFNESS / RING FLEXIBILITY



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MAY, 2019