Gamrat

PIPING SYSTEMS

GAMRAT NEW TECHNOLOGIES - MORE POSSIBILITIES

TECHNICAL CATALOGUE

ACCREDITED

TESTING LABORATORY GAMRAT S.A.

Since 1999, the testing laboratory of the Quality Centre has had a management system implemented in accordance with the requirements of PN-EN ISO/IEC 17025:2005 (Certificate of Accreditation No. AB 237). Accreditation is an objective confirmation of ensuring a high level of services related to the conducted tests.

The Polish Accreditation Centre is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA), therefore the results of the tests covered by the accreditation are recognised in all countries that are signatories to ILAC MRA multilateral agreements.

The laboratory conducts tests of:

PVC, PE, PP pipes and fittings
(including tests of resistance to internal pressure of thermoplastic pipes with diameters up to 800 mm)

WPC composite products,

Soffit and gutter systems
(gutters, fittings, downpipes)

Fittings of water supply and sewage systems
(sewage gratings, storm and aeration valves, traps and others),

Raw materials for the production of plastics such as PE, PP, PVC.

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Basic concepts

PVC-U	unplasticized polyvinyl chloride
PE	polyethylene
PE-LD	low density polyethylene
PE-MD	medium density polyethylene
PE-HD	high density polyethylene

D	PVC-U or PE pipe nominal diameter equal to its outside diameter, given in mm
g	pipe nominal wall thickness, given in mm
SDR	standard dimension ratio, the ratio of a pipe's nominal outside diameter to its nominal wall thickness, dimensionless nul.m.er
SDR = D / g	
S	pipe series (serial), dimensionless nul.m.er, associated with SDR with the following relationship: S = (SDR-1) / 2
SN	ring stiffness (wall stiffness) of a pipe, expresses the ability of pipes for withstanding external loads originating from the surrounding ground or road traffic, it depends on the pipe structure and wall thickness, given in kPa
MRS	minimum required strength minimum expected strength of a pipe after 50 years of its use at 20°C, given in MPa
MRS	for PVC-U 25 MPa for PE-100 10 MPa
C	safety factor, dimensionless nul.m.er for PVC-U pressure pipes of is 2.0 and 2.5 for PE pressure pipes, for water, is 1.25 for PE pressure pipes, for gas, is a minimum of 2.0
σ	allowable hoop stress in the pipe wall, expressed in MPa
σ = MRS / C	
PVC-U:	σ = 25 / 2,0 = 12,5 MPa for diameters greater than 90 mm
	σ = 25 / 2,5 = 10,0 MPa for diameters up to and including 90 mm
PE100	σ = 10 / 1,25 = 8,0 MPa
PN	nominal pressure, maximum working pressure at the temperature of the medium to be conveyed of 20°C, given in bar
PN = 20 σ g / (D - g)	
where:	g – wall thickness [mm]
	D – pipe outside diameter of [mm]

The pressure can be given in different units. Below are the conversion rates of the most common units. Conversion factors are approximations used in practice for the comparison of individual pressure values.

1 bar ↔ **10m H_20** ↔ **1 atm** ↔ **0,1 MPa**

MFI	melt flow index
MFI 190/5	amount (in grams) of polyethylene plasticized at 190°C, which is pressed through a plastometer die (Ø 2.095 mm) by a force of 5 kg in 10 minutes.

Melt flow index group, MFI 005 – 0,2 g do 0,7 g /10 minutes
Melt flow index group, MFI 010 – 0,7 g do 1,4 g /10 minutes

When making hydraulic calculations, when substituting values to flow formulas or using nomograms, it is necessary to use different flow units. To facilitate it, please find below conversion factors for the most common units.

1 l/s ↔ **60 l/min** ↔ **3,6 m^3/h** ↔ **0,001 m^3/s**

TWINGAM PE100RC PIPES
FOR TRENCH-FREE METHODS
ACCORDING TO PAS 1075

New types of raw materials and new designs of PE pipes satisfy current needs of the market and contribute to emergence of more cost-effective pipe laying technologies. The response is a PE pipe made of PE100RC (Resistant to Crack) material designed for alternative pipe laying (installation) techniques.

What is PAS 1075:2009-4

Polyethylene (PE100RC) pipes for alternative pipe laying methods. Technical requirements and test (PAS – Publicly Available Specification). It is a collection of requirements, recommendations and tests that confirm their resistance to scratches and point loads which may occur when the piping system is installed directly on the background without any bedding and filling and for construction and renovation projects based on traditional and trench-free methods.

Situations causing propagation of cracks in polyethylene pipes

1. Scratches or cuts of the outer surface of a pipe that occurred before installation (due to incorrect storage or transportation) or during the assel.m.ly (the common rule: a pipe with its outer surface damaged to a depth higher than 10% of the wall thickness should not be installed for safety reasons).

2. "Point loads" – direct contact of the outer surface of the pipe to a hard (sharp) object (e.g. a stone) is the cause of additional stress occurring in the pipe. As time goes by a crack may emerge on the opposite side of the pipe as a result of simultaneous stresses caused by internal pressure, external pressure and the contacting object. This crack, once initiated, will then expand.
The PE100RC TWINGAM pipes are more resistant to crack propagation than classic PE100 pipes.

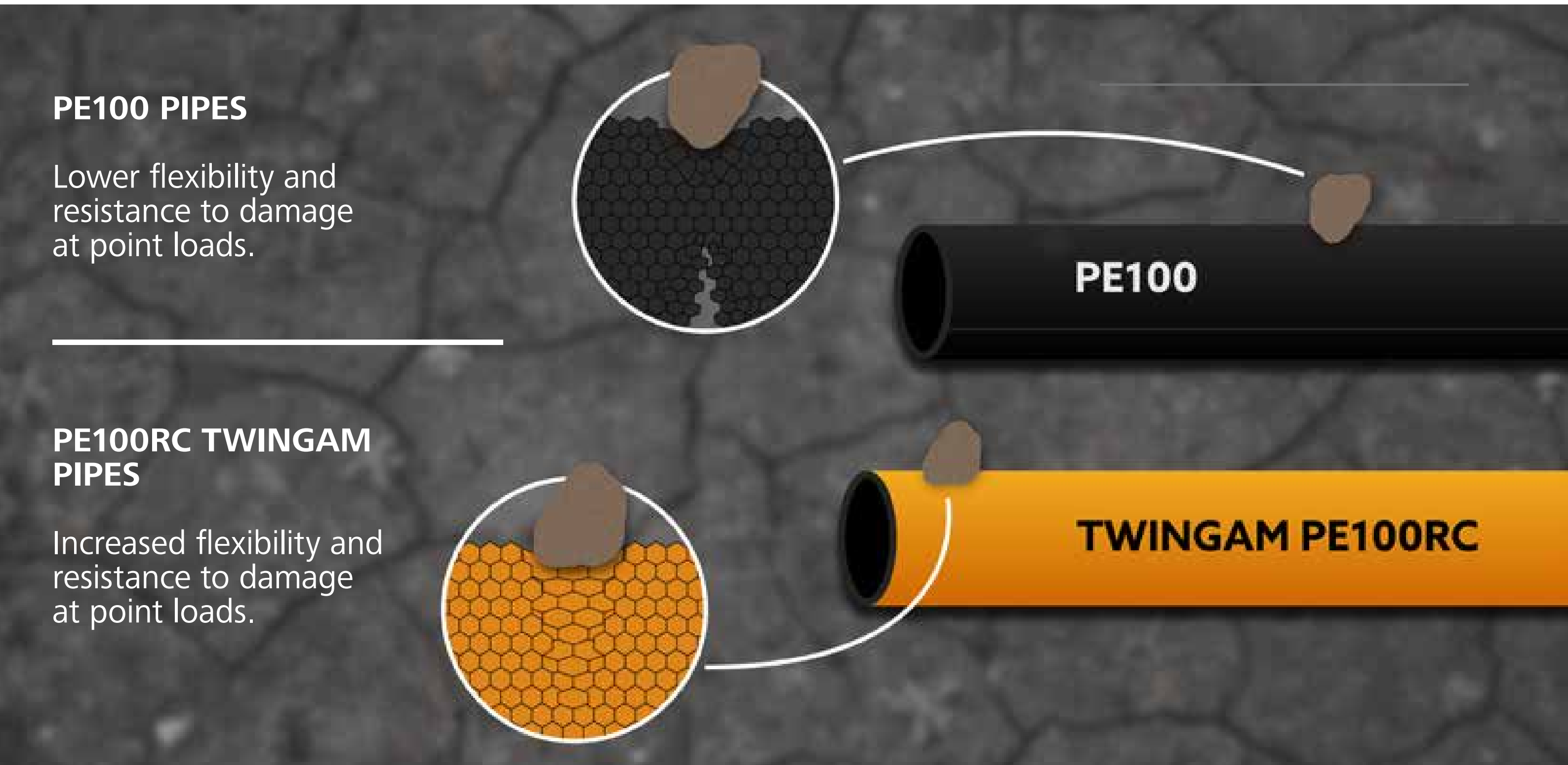
Features of PE100RC TWINGAM pipes

The results of tests run in Hessel Ingenieurtechnik Gl.m.H and INiG Cracow confirmed their unique resistance to consequences of scratches and point loads that may occur during trench-free pipe laying or assel.m.ly works.

The tests made according to the requirements of PAS (Publicly Available Specification) 1075:2009-04 by Hessel Ingenieurtechnik Gl.m.H were then confirmed by a set of Certificated issued by DIN CERTO Institute, depending on the pipe type, diameter range and intended use (water, gas or sewage).

Advantages of PE100RC TWINGAM pipes and their application in trench and trench--free methods:

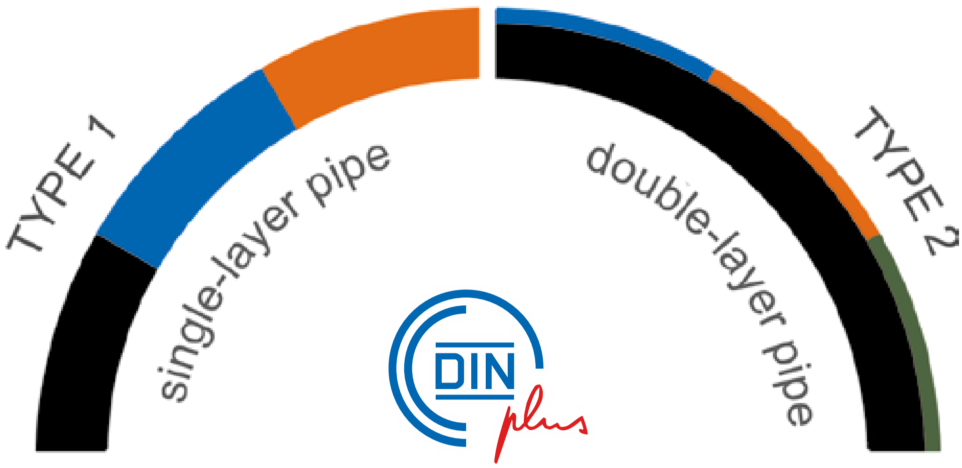
- cost-effective pipe laying without sand bedding in the trench technology,
- much higher resistance to point loads, scratches and indentations and, as a result, to propagation of cracks,
- applicable to trench-free technologies without a risk of pipe damage,
- ensures considerable savings in the investment costs if compared to traditional trench--based methods,
- causes no road traffic difficulties and minimizes problem for vehicles,
- lower impact on environment,
- lower costs caused by elimination of some operations such as: digging trenches, filling, replacement of the ground, packing,
- shorter time needed for assel.m.ly and installation works,
- the excavation area reduced to minimum,
- lowest level of interference into the existing infrastructure,
- increased safety of work,
- lower risk of damage to existing underground systems located in the vicinity of the pipeline,
- drainage necessary only at the starting and end excavation, not for the whole pipeline,
- increased durability,



Structure of PE100RC TWINGAM pipes

A polyethylene TWINGAM pipe may be provided as a single-layer pipe, which walls are fully made of PE100RC (Type 1), or as a double-layer pipe where the layers of plastic are joined at the molecular level (Type 2). TWINGAM pipes are made of PE100RC with enhanced durability. It is a best-quality material that is highly resistant to crack propagation and point loads. The material and the pipe are subject to special testing according to PAS 1075 such as:

Hessel's point loading test (PLT)
FNCT (Full Notch Creep Test) / ACT
Resistance to slow propagation of cracks (Notch Test)



Intended use, pressure class, types, colours and applications of PE100RC "TWINGAM" class pipes according to PAS 1075 certificate.

Production range:

Gas networks:

For the construction of gas networks, "TWINGAM" pipes are manufactured as Type 1 single-layer orange pipes, with diameters ranging from 20 to 63 mm, and as Type 2 double-layer pipes, where the inner layer of the pipe is black and the outer layer is orange (with marking) with diameters ranging from 25 to 630 mm for the construction of low and medium pressure networks up to 0.5 MPa, and for the construction of increased medium-pressure gas networks up to 1 MPa for traditional and alternative pipeline construction technologies, excluding the pipe bursting method.

Water supply:

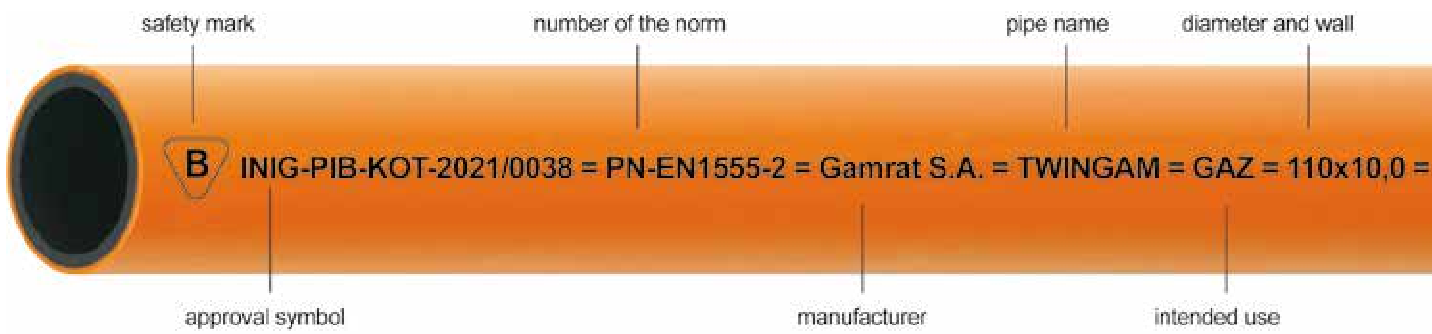
"TWINGAM" pipes are designed for the construction of water supply systems and networks. They are produced as Type 1 single-layer pipes in navy blue with diameters ranging from 20 to 63 mm as, and as Type 2 two-layer pipes, where the inner layer of the pipe is black and the outer layer is navy blue (with marking) with diameters ranging from 32 to 800 mm, for nominal pressures PN 16 (SDR 11) and PN 10 (SDR 17).

Drainage and sewage:

For the construction of pressure, vacuum and gravity sewer networks and facilities, PE 100RC "TWINGAM" pipes are produced as Type 1 pipes in black with diameters ranging from 32 to 800 mm or as Type 2 two-layer pipes, where the inner layer of the pipe is made in black and the outer layer in green. Two-layered pipes are produced with diameters ranging from 75 to 630 mm in series SDR 11 and 17. They can also be used as casing pipes.

Marking and packaging

Polyethylene PE 100RC pipes for the construction of water supply, drainage and sewage, or gas networks are produced with diameters ranging from 90 to 800 mm in standard straight sections with a length of 12 m and are packed in bundles, and pipes with diameters ranging



GAS NETWORKS

CERTIFICATE PAS 1075 TYPE 2 - G
BASE EN 1555-2

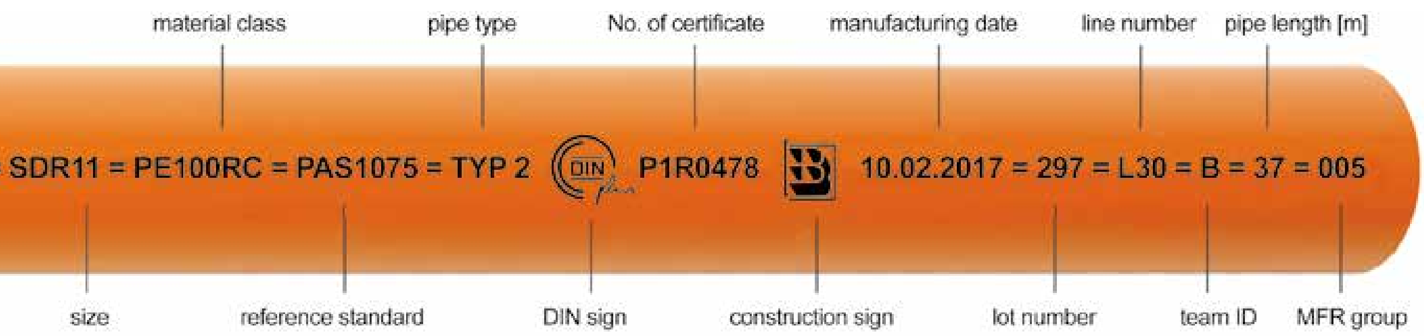
WATER SUPPLY

CERTIFICATE PAS 1075 TYPE 2 - TW
BASE EN 12201-2

DRAINAGE AND SEWAGE

CERTIFICATE PAS 1075 TYPE 2 - AW
BASE EN 12201-2

from 20 to 110 mm are coiled in lengths from 60 to 200 m depending on the pipe diameter. Marking (marking of pipes) is carried out in accordance with reference documents with the specification of valid parameters according to the template:



“TWINGAM” pipe and fitting joining technologies are the same as for typical PE100 pipes. They do not require the removal of the molecularly bonded marking layer. The diameters of “TWINGAM” pipes are compatible with other PE pipes. Pipes are manufactured on the basis of PN EN 12201-2 (water supply, drainage and sewage) and PN EN 1555-2 (gas networks) standards.

Approvals and certificates:

- Certificates of Conformity with the requirements of PAS 1075 issued by DIN CERTCO on the basis of test results from the Institute of Hessel Ingenieurtechnik Gl.m.H, depending on the intended use, range and diameters.

- National Technical Assessment of the Oil and Gas Institute for PE100RC “TWINGAM” pipes for excavation and trenchless technologies and increasing the working pressure to 1 MPa in gas networks.

- Technical recommendation of the Oil and Gas Institute for PE100RC “TWINGAM” pipes for excavation and trenchless technologies and increasing the working pressure to 1 MPa in gas networks.

- Opinion of the Central Mining Institute of Katowice approving the use of pipes in mining damage areas.

- PZH (National Institute of Hygiene) Certificate for the TWINGAM pipes for the conveyance of drinking water.

- National Technical Assessment of the Road and Bridge Research Institute approving “TWINGAM” pipes for the construction of networks in road engineering.

- National Technical Assessment issued by the Instytut Techniki Budowlanej (Building Research Institute) for the use of “TWINGAM” pipes in trenchless technologies.

PE100RC TWINGAM POLYETHYLENE PIPES **FOR CONSTRUCTION OF GAS NETWORKS**

Assortment		diameter x wall thickness	unit	index	kg/l.m.	Quantity in package	
						l.m.	pcs
single-layer pipe PE100 RC TYPE 1 Orange SDR11		20 x 3,0 coil	lm	811110102	0,16	100	-
		25 x 3,0 coil	l.m.	811110103	0,21	100	-
		32 x 3,0 coil	l.m.	811110104	0,28	100	-
		40 x 3,7 coil	l.m.	811110105	0,43	100	-
		50 x 4,6 coil	l.m.	811110106	0,66	150	-
		63 x 5,8 coil	l.m.	811110107	1,05	100	-
double-layer pipe PE100RC / PE100RC TYPE 2 orange-black SDR11		25 x 3,0 coil	l.m.	841140103	0,21	100	-
		32 x 3,0 coil	l.m.	841140104	0,28	100	-
		40 x 3,7 coil	l.m.	841140105	0,43	100	-
		50 x 4,6 coil	l.m.	841140106	0,66	150	-
		63 x 5,8 coil	l.m.	841140107	1,05	100	-
		75 x 6,8 coil	l.m.	841140108	1,45	100	-
		90 x 8,2 coil	l.m.	841140109	2,10	60/100	-
		110 x 10,0 coil	l.m.	841140111	3,11	60/100	-
		90 x 8,2	l.m.	841140309	2,10	384	32
		110 x 10,0	l.m.	841140311	3,11	312	26
		125 x 11,4	l.m.	841140312	4,04	312	26
		140 x 12,7	l.m.	841140313	5,03	276	23
		160 x 14,6	l.m.	841140314	6,61	156	13
		180 x 16,4	l.m.	841140315	8,35	132	11
		200 x 18,2	l.m.	841140316	10,30	132	11
		225 x 20,5	l.m.	841140317	13,04	108	9
		250 x 22,7	l.m.	841140318	16,04	84	7
		280 x 25,4	l.m.	841140319	20,11	84	7
		315 x 28,6	l.m.	841140320	25,47	60/84	5/7
		355 x 32,2	l.m.	841140326	32,32	60	5
		400 x 36,3	l.m.	841140321	41,04	36	3
		450 x 40,9	l.m.	841140322	51,99	24	2
		500 x 45,4	l.m.	841140323	64,14	24	2
		560 x 50,8	l.m.	841140327	80,36	24	2
		630 x 57,2	l.m.	841140324	101,81	24	2
double-layer pipe PE100RC / PE100RC TYPE 2 orange-black SDR17		75 x 4,5 coil	l.m.	841340108	1,00	100	-
		90 x 5,4 coil	l.m.	841340109	1,43	60/100	-
		110 x 6,6 coil	l.m.	841340111	2,13	60/100	-
		90 x 5,4	l.m.	841340309	1,43	384	32
		110 x 6,6	l.m.	841340311	2,13	312	26
		125 x 7,4	l.m.	841340312	2,72	312	26
		140 x 8,3	l.m.	841340313	3,42	276	23
		160 x 9,5	l.m.	841340314	4,47	156	13
		180 x 10,7	l.m.	841340315	5,65	132	11
		200 x 11,9	l.m.	841340316	6,98	132	11
		225 x 13,4	l.m.	841340317	8,85	108	9
		250 x 14,8	l.m.	841340318	10,85	84	7
		280 x 16,6	l.m.	841340319	13,63	84	7
		315 x 18,7	l.m.	841340320	17,26	60/84	5/7
		355 x 21,1	l.m.	841340326	21,96	60	5
		400 x 23,7	l.m.	841340321	27,77	36	3
		450 x 26,7	l.m.	841340322	35,18	24	2
		500 x 29,7	l.m.	841340323	43,47	24	2
		560 x 33,2	l.m.	841340327	54,45	24	2
		630 x 37,4	l.m.	841340324	68,98	24	2

PE100RC TWINGAM POLYETHYLENE PIPES **FOR CONSTRUCTION OF GAS NETWORKS**

Assortment		diameter x wall thickness	unit	index	kg/l.m.	Quantity in package	
						l.m.	pcs
double-layer pipe PE100RC / PE100RC TYPE 2 orange-black SDR17,6		75 x 4,3 coil	l.m.	841440108	0,96	100	-
		90 x 5,2 coil	l.m.	841440109	1,39	60/100	-
		110 x 6,3 coil	l.m.	841440111	2,05	60/100	-
		90 x 5,2	l.m.	841440309	1,39	384	32
		110 x 6,3	l.m.	841440311	2,05	312	26
		125 x 7,1	l.m.	841440312	2,62	312	26
		140 x 8,0	l.m.	841440313	3,30	276	23
		160 x 9,1	l.m.	841440314	4,30	156	13
		180 x 10,3	l.m.	841440315	5,46	132	11
		200 x 11,4	l.m.	841440316	6,71	132	11
		225 x 12,8	l.m.	841440317	8,47	108	9
		250 x 14,2	l.m.	841440318	10,45	84	7
		280 x 15,9	l.m.	841440319	13,08	84	7
		315 x 17,9	l.m.	841440320	16,56	60/84	5/7
		355 x 20,2	l.m.	841440326	21,08	60	5
		400 x 22,8	l.m.	841440321	26,78	36	3
		450 x 25,6	l.m.	841440322	33,83	24	2
		500 x 28,4	l.m.	841440323	41,71	24	2
		560 x 31,9	l.m.	841440327	52,42	24	2
		630 x 35,8	l.m.	841440324	66,19	24	2

Documents:

- "B" safety mark certificate
- PN-EN1555 Plastic piping systems for the transmission of gaseous fuels. Polyethylene (PE)
- PAS1075 certificate
- GiG's technical opinion on the possibility of using pipes in mining areas
- INiG National Technical Assessment
- INiG Technical recommendation

TWINGAM POLYETHYLENE PIPES **FOR CONSTRUCTION OF WATER PIPE NETWORKS**

Assortment		diameter x wall thickness	unit	index	kg/l.m.	Quantity in package l.m.	Quantity in package pcs
double-layer pipe PE100 RC / PE100 RC TYPE2 navy blue - black SDR 11 PN16		32 x 3,0 coil	l.m.	851150104	0,28	100	-
		40 x 3,7 coil	l.m.	851150105	0,43	100	-
		50 x 4,6 coil	l.m.	851150106	0,66	150	-
		63 x 5,8 coil	l.m.	851150107	1,05	100	-
		75 x 6,8 coil	l.m.	851150108	1,45	100	-
		90 x 8,2 coil	l.m.	851150109	2,10	60/100	-
		110 x 10,0 coil	l.m.	851150111	3,11	60/100	-
		90 x 8,2	l.m.	851150309	2,10	384	32
		110 x 10,0	l.m.	851150311	3,11	312	26
		125 x 11,4	l.m.	851150312	4,04	312	26
		140 x 12,7	l.m.	851150313	5,03	276	23
		160 x 14,6	l.m.	851150314	6,61	156	13
		180 x 16,4	l.m.	851150315	8,35	132	11
		200 x 18,2	l.m.	851150316	10,30	132	11
		225 x 20,5	l.m.	851150317	13,04	108	9
		250 x 22,7	l.m.	851150318	16,04	84	7
		280 x 25,4	l.m.	851150319	20,11	84	7
		315 x 28,6	l.m.	851150320	25,47	60/84	5/7
		355 x 32,2	l.m.	851150326	32,32	60	5
		400 x 36,3	l.m.	851150321	41,04	36	3
		450 x 40,9	l.m.	851150322	51,99	24	2
		500 x 45,4	l.m.	851150323	64,14	24	2
		560 x 50,8	l.m.	851150327	80,36	24	2
		630 x 57,2	l.m.	851150324	101,81	24	2
		710 x 64,5	l.m.	851150333	129,34	12	1
double-layer pipe PE100 RC / PE100 RC TYPE2 navy blue-black SDR17 PN10		50 x 3,0 coil	l.m.	851350106	0,45	150	-
		63 x 3,8 coil	l.m.	851350107	0,72	100	-
		75 x 4,5 coil	l.m.	851350108	1,00	100	-
		90 x 5,4 coil	l.m.	851350109	1,43	60/100	-
		110 x 6,6 coil	l.m.	851350111	2,13	60/100	-
		90 x 5,4	l.m.	851350309	1,43	384	32
		110 x 6,6	l.m.	851350311	2,13	312	26
		125 x 7,4	l.m.	851350312	2,72	312	26
		140 x 8,3	l.m.	851350313	3,42	276	23
		160 x 9,5	l.m.	851350314	4,47	156	13
		180 x 10,7	l.m.	851350315	5,65	132	11
		200 x 11,9	l.m.	851350316	6,98	132	11
		225 x 13,4	l.m.	851350317	8,85	108	9
		250 x 14,8	l.m.	851350318	10,85	84	7
		280 x 16,6	l.m.	851350319	13,63	84	7
		315 x 18,7	l.m.	851350320	17,26	60/84	5/7
		355 x 21,1	l.m.	851350326	21,96	60	5
		400 x 23,7	l.m.	851350321	27,77	36	3
		450 x 26,7	l.m.	851350322	35,18	24	2
		500 x 29,7	l.m.	851350323	43,47	24	2
		560 x 33,2	l.m.	851350327	54,45	24	2
		630 x 37,4	l.m.	851350324	68,98	24	2
		710 x 42,1	l.m.	851350333	87,52	12	1
		800 x 47,4	l.m.	851350325	111,00	12	1

Documents:

- National Technical Assessment ITB
- National Technical Assessment IBDiM
- PN-EN 12201 - Plastic piping systems for water transmission. Polyethylene (PE)
- Hygienic certificate of the Polish Hygiene Association
- PAS1075 certificate
- GiG's technical opinion on the possibility of using pipes in mining areas

TWINGAM POLYETHYLENE PIPES **FOR THE CONSTRUCTION OF SEWAGE NETWORKS**

Assortment		diameter x wall thickness	unit	index	kg/l.m.	Quantity in package l.m.	pcs
single-layer pipe PE100 RC TYPE1 black SDR11 PN16		32 x 3,0 coil	l.m.	831130104	0,28	100	-
		40 x 3,7 coil	l.m.	831130105	0,43	100	-
		50 x 4,6 coil	l.m.	831130106	0,66	150	-
		63 x 5,8 coil	l.m.	831130107	1,05	100	-
		75 x 6,8 coil	l.m.	831130108	1,45	100	-
		90 x 8,2 coil	l.m.	831130109	2,10	60/100	-
		110 x 10,0 coil	l.m.	831130111	3,11	60/100	-
		90 x 8,2	l.m.	831130309	2,10	384	32
		110 x 10,0	l.m.	831130311	3,11	312	26
		125 x 11,4	l.m.	831130312	4,04	312	26
		140 x 12,7	l.m.	831130313	5,03	276	23
		160 x 14,6	l.m.	831130314	6,61	156	13
		180 x 16,4	l.m.	831130315	8,35	132	11
		200 x 18,2	l.m.	831130316	10,30	132	11
		225 x 20,5	l.m.	831130317	13,04	108	9
		250 x 22,7	l.m.	831130318	16,04	84	7
		280 x 25,4	l.m.	831130319	20,11	84	7
		315 x 28,6	l.m.	831130320	25,47	60/84	5/7
		355 x 32,2	l.m.	831130326	32,32	60	5
		400 x 36,3	l.m.	831130321	41,04	36	3
		450 x 40,9	l.m.	831130322	51,99	24	2
		500 x 45,4	l.m.	831130323	64,14	24	2
		560 x 50,8	l.m.	831130327	80,36	24	2
		630 x 57,2	l.m.	831130324	101,81	24	2
		710 x 64,5	l.m.	831130333	129,34	12	1
single-layer pipe PE100 RC TYPE1 black SDR17 PN10		32 x 2,0 coil	l.m.	831330104	0,19	100	-
		40 x 2,4 coil	l.m.	831330105	0,29	100	-
		50 x 3,0 coil	l.m.	831330106	0,45	150	-
		63 x 3,8 coil	l.m.	831330107	0,72	100	-
		75 x 4,5 coil	l.m.	831330108	1,00	100	-
		90 x 5,4 coil	l.m.	831330109	1,43	60/100	-
		110 x 6,6 coil	l.m.	831330111	2,13	60/100	-
		90 x 5,4	l.m.	831330309	1,43	384	32
		110 x 6,6	l.m.	831330311	2,13	312	26
		125 x 7,4	l.m.	831330312	2,72	312	26
		140 x 8,3	l.m.	831330313	3,42	276	23
		160 x 9,5	l.m.	831330314	4,47	156	13
		180 x 10,7	l.m.	831330315	5,65	132	11
		200 x 11,9	l.m.	831330316	6,98	132	11
		225 x 13,4	l.m.	831330317	8,85	108	9
		250 x 14,8	l.m.	831330318	10,85	84	7
		280 x 16,6	l.m.	831330319	13,63	84	7
		315 x 18,7	l.m.	831330320	17,26	60/84	5/7
		355 x 21,1	l.m.	831330326	21,96	60	5
		400 x 23,7	l.m.	831330321	27,77	36	3
		450 x 26,7	l.m.	831330322	35,18	24	2
		500 x 29,7	l.m.	831330323	43,47	24	2
		560 x 33,2	l.m.	831330327	54,45	24	2
		630 x 37,4	l.m.	831330324	68,98	24	2
		710 x 42,1	l.m.	831330333	87,52	12	1
		800 x 47,4	l.m.	831330325	111,00	12	1

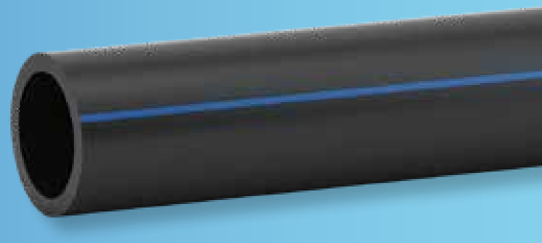
TWINGAM POLYETHYLENE PIPES **FOR THE CONSTRUCTION OF SEWER NETWORKS**

Assortment		diameter x wall thickness	unit	index	kg/l.m.	Quantity in package l.m.	pcs
double-layer pipe PE100 RC / PE100 RC TYPE2 green-black SDR11 PN16		75 x 6,8 coil	l.m.	861170108	1,45	100	-
		90 x 8,2 coil	l.m.	861170109	2,10	60/100	-
		110 x 10,0 coil	l.m.	861170111	3,11	60/100	-
		90 x 8,2	l.m.	861170309	2,10	384	32
		110 x 10,0	l.m.	861170311	3,11	312	26
		125 x 11,4	l.m.	861170312	4,04	312	26
		140 x 12,7	l.m.	861170313	5,03	276	23
		160 x 14,6	l.m.	861170314	6,61	156	13
		180 x 16,4	l.m.	861170315	8,35	132	11
		200 x 18,2	l.m.	861170316	10,30	132	11
		225 x 20,5	l.m.	861170317	13,04	108	9
		250 x 22,7	l.m.	861170318	16,04	84	7
		280 x 25,4	l.m.	861170319	20,11	84	7
		315 x 28,6	l.m.	861170320	25,47	60/84	5/7
		355 x 32,2	l.m.	861170326	32,32	60	5
		400 x 36,3	l.m.	861170321	41,04	36	3
		450 x 40,9	l.m.	861170322	51,99	24	2
		500 x 45,4	l.m.	861170323	64,14	24	2
		560 x 50,8	l.m.	861170327	80,36	24	2
		630 x 57,2	l.m.	861170324	101,81	24	2
double-layer pipe PE100 RC / PE100 RC TYP2 green-black SDR17 PN10		75 x 4,5 coil	l.m.	861370108	1,00	100	-
		90 x 5,4 coil	l.m.	861370109	1,43	60/100	-
		110 x 6,6 coil	l.m.	861370111	2,13	60/100	-
		90 x 5,4	l.m.	861370309	1,43	384	32
		110 x 6,6	l.m.	861370311	2,13	312	26
		125 x 7,4	l.m.	861370312	2,72	312	26
		140 x 8,3	l.m.	861370313	3,42	276	23
		160 x 9,5	l.m.	861370314	4,47	156	13
		180 x 10,7	l.m.	861370315	5,65	132	11
		200 x 11,9	l.m.	861370316	6,98	132	11
		225 x 13,4	l.m.	861370317	8,85	108	9
		250 x 14,8	l.m.	861370318	10,85	84	7
		280 x 16,6	l.m.	861370319	13,63	84	7
		315 x 18,7	l.m.	861370320	17,26	60/84	5/7
		355 x 21,1	l.m.	861370326	21,96	60	5
		400 x 23,7	l.m.	861370321	27,77	36	3
		450 x 26,7	l.m.	861370322	35,18	24	2
		500 x 29,7	l.m.	861370323	43,47	24	2
		560 x 33,2	l.m.	861370327	54,45	24	2
		630 x 37,4	l.m.	861370324	68,98	24	2

Documents:

- National Technical Assessment ITB
- National Technical Assessment IBDiM
- PAS1075 certificate
- GiG's technical opinion on the possibility of using pipes in mining areas
- PN-EN 12201 - Plastic piping systems for water transmission. Polyethylene (PE)

PE100 POLYETHYLENE PIPES
FOR WATER SUPPLY AND SEWAGE



GAMRAT PE pipes are manufactured by extrusion of polyethylene of a density higher than 930 kg/m3 with the addition of antioxidants, stabilizers and pigments necessary for the production of pipes of specific mechanical properties and weldability. The base resin is HDPE of PE100 grade. The quality of polyethylene is confirmed by suppliers' certificates. High quality raw materials and our production technology on a global level, and the ability to make inspection and analytical testing enable us to manufacture pipes of the highest quality, in accordance with the requirements of international standards.

GAMRAT polyethylene pipes PE are designed for the distribution of drinking water, technological liquids, and sewage as well as protective pipes. This variety of applications of polyethylene pipes results from their excellent physical and mechanical properties and their resistance to aggressive media. At the same time, polyethylene pipes are physiologically neutral and harmless to the environment.

Advantages of PE pipes

GAMRAT Polyethylene pipes, along with the entire range of fittings for permanent and detachable joints, create a uniform and universal system that ensures more than 50 years of service life.

This system is characterized by:
- excellent mechanical strength;
- high impact resistance (PE pipes do not break upon impact even at low temperatures down to -80°C);
- very good flexibility;
- possibility of squeezing pipes off and stopping the flow of media for renovations;
- smooth inner surface decreasing flow resistance;
- low weight;
- pipe joints made easily and quickly;
- resistance to corrosive factors contained in the soil;
- resistance to stray electrical currents;
- physiologically neutral – plastic material not releasing any contaminants to the environment.

Physical and mechanical properties

Density of pipe material	0,930–0,960 g / cm^3
Melt flow index	0,2–1,4 g / 10 min / 5 kg / 190°C
Ultimate elongation at rupture	not less than 350%
Thermal stability, at. 200°C	not less than 20 min
Linear thermal expansion	0,2 mm / m / °C
Elasticity coefficient	600–800 N / mm^2

Bending radius of polyethylene pipes:

Temperature	Dimension ratio SDR [-]				
	11	13,6	17	21	26
> 20°C	20 × D	20 × D	20 × D	25 × D	30 × D
> 10°C	35 × D	35 × D	35 × D	45 × D	55 × D
> 0°C	50 × D	50 × D	50 × D	60 × D	70 × D

Optimal operating temperature of Gamrat PE pipes is 20°C. When a PE piping system is to be operated at other temperatures, a pressure reduction coefficient as given in Annex A to PN EN 12201-1 standard.

Temperature of conveyed medium °C	Reduction coefficient
20	1
30	0,87
40	0,74

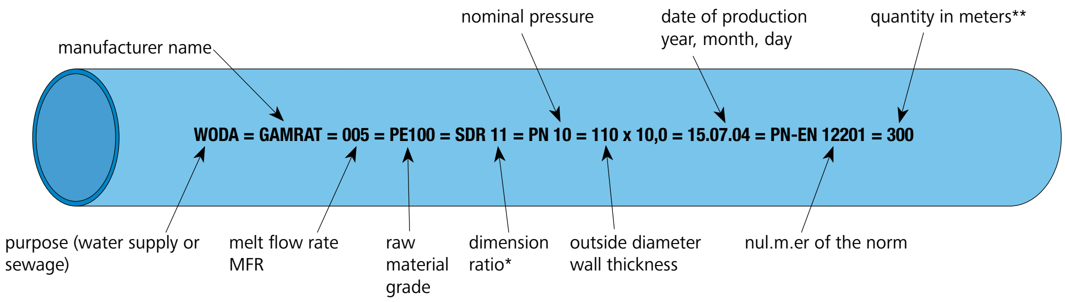
PE100 polyethylene pipes for water supply and sewage

				SDR 11			SDR 17			SDR 26		
				Nominal pressure PN, w bar								
PE100				PN 16			PN 10			PN 6		
Nominal size DN/OD	Mean outside diameter d_{min}	Mean outside diameter d_{max}	Ovality	Wall thickness e_{min}	Wall thickness e_{max}	Weight per meter (kg)	Wall thickness e_{min}	Wall thickness e_{max}	Weight per meter (kg)	Wall thickness e_{min}	Wall thickness e_{max}	Weight per meter (kg)
25	25,0	25,3	1,2	2,3	2,7	0,17	-	-		-	-	-
32	32,0	32,3	1,3	3,0	3,4	0,27	2,0	2,3	0,19	-	-	-
40	40,0	40,4	1,4	3,7	4,2	0,42	2,4	2,8	0,29	-	-	-
50	50,0	50,4	1,4	4,6	5,2	0,65	3,0	3,4	0,44	2,0	2,3	0,30
63	63,0	63,4	1,5	5,8	6,5	1,04	3,8	4,3	0,71	2,5	2,9	0,47
75	75,0	75,5	1,6	6,8	7,6	1,45	4,5	5,1	1,00	2,9	3,3	0,65
90	90,0	90,6	1,8	8,2	9,2	2,10	5,4	6,1	1,46	3,5	4	0,94
110	110,0	110,7	2,2	10,0	11,1	3,11	6,6	7,4	2,13	4,2	4,8	1,40
125	125,0	125,8	2,5	11,4	12,7	4,04	7,4	8,3	2,72	4,8	5,4	1,81
140	140,0	140,9	2,8	12,7	14,1	5,03	8,3	9,3	3,42	5,4	6,1	2,28
160	160,0	161,0	3,2	14,6	16,2	6,61	9,5	10,6	4,47	6,2	7,0	2,99
180	180,0	181,1	3,6	16,4	18,2	8,35	10,7	11,9	5,65	6,9	7,7	3,66
200	200,0	201,2	4,0	18,2	20,2	10,30	11,9	13,2	6,98	7,7	8,6	4,63
225	225,0	226,4	4,5	20,5	22,7	13,04	13,4	14,9	8,85	8,6	9,6	5,82
250	250,0	251,5	5,0	22,7	25,1	16,04	14,8	16,4	10,85	9,6	10,7	7,21
280	280,0	281,7	9,8	25,4	28,1	20,11	16,6	18,4	13,63	10,7	11,9	9,00
315	315,0	316,9	11,1	28,6	31,6	25,47	18,7	20,7	17,26	12,1	13,5	11,46
355	355,0	357,2	12,5	32,2	35,6	32,32	21,1	23,4	21,96	13,6	15,1	14,49
400	400,0	402,4	14	36,3	40,1	41,04	23,7	26,2	27,77	15,3	17,0	18,37
450	450,0	452,7	15.6	40,9	45,1	51,99	26,7	29,5	35,18	17,2	19,1	23,23
500	500,0	503,0	17,5	45,4	50,1	64,14	29,7	32,8	43,47	19,1	21,2	28,66
560	560,0	563,4	19,6	50,8	56,0	80,36	33,2	36,7	54,45	21,4	23,7	35,94
630	630,0	633,8	22,1	57,2	63,1	101,81	37,4	41,3	68,98	24,1	26,7	45,53
710	710,0	716,4	-	-	-	-	42,1	46,5	87,52	27,2	30,1	57,89
800	800,0	807,2	-	-	-	-	47,4	52,3	111,00	30,6	33,8	73,34

Weight per meter is given for orientation purposes

The pipes are manufactured in blue or black. In case of black pipes it is possible to make four or six colour stripes.

Marking



** SDR = d/e ratio of the nominal outside diameter, "d", and nominal wall thickness, „e".*
*** Markings used only on coiled pipes.*

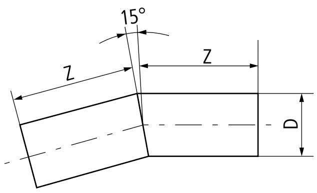
SEGMENTED FITTINGS

PE100 AND TWINGAM PE100RC FOR WATER SUPPLY AND SEWAGE

Segmented fittings are produced in stationary conditions by butt welding of PE100 polyethylene pipe segments and PE100RC polyethylene pipe segments.

They are used for construction and repair of water supply and sewage systems. The offer includes SDR 11 and SDR 17 fittings of the following types:

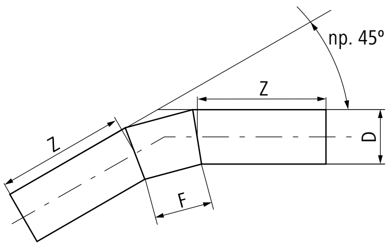
- bends with angles 15°, 30°, 45°, 60°, 75°, 90° with diameters ranging from 90-500 mm
- equal tees of the inlet angle of 90° with diameters ranging from 90-400 mm
- reducing tees of the inlet angle of 90 ° with diameters ranging from 90-160 mm
- reduction couplings available with diameters ranging from 90-160 mm



Dimensions of 2-segment bends in mm	D	Z*
		15° and 30°
	90	145
	110	155
	125	165
	140	175
	160	185
	180	190
	200	210
	225	240
	250	260
	280	270
	315	280
	355	290
	400	300
	450	345
	500	375

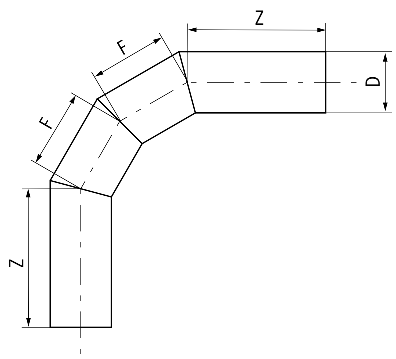
** Other values allowed*

Dimensions of 3-segment bends in mm	D	F*	Z*
			45° and 60°
	90	130	145
	110	135	155
	125	140	165
	140	145	175
	160	150	185
	180	170	190
	200	190	210
	225	210	240
	250	230	260
	280	240	270
	315	250	270
	355	260	290
	400	270	300
	450	290	345
	500	370	375



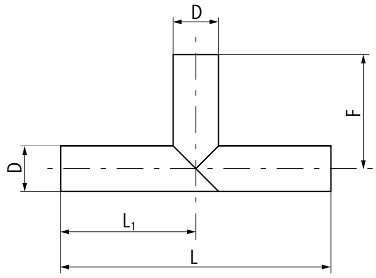
** Other values allowed*

Dimensions of 4-segment bends in mm	D	F*	Z*
			75° and 90°
	90	130	145
	110	135	155
	125	140	165
	140	145	175
	160	150	185
	180	170	190
	200	190	210
	225	210	240
	250	230	260
	280	240	270
	315	250	270
	355	260	290
	400	270	300
	450	290	345
	500	370	375



** Other values allowed*

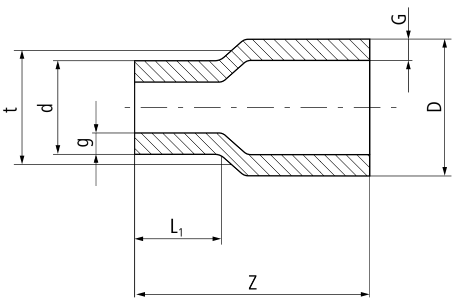
Dimensions of equal tees in mm



D	F*	L_1*	L*
90	190		380
110	200		400
125	210		420
140	220		440
160	235		470
180	290		580
200	310		620
225	340		680
250	370		740
280	430		860
315	490		980
355	630		1260
400	630		1260
500	850		1700

** Other values allowed*

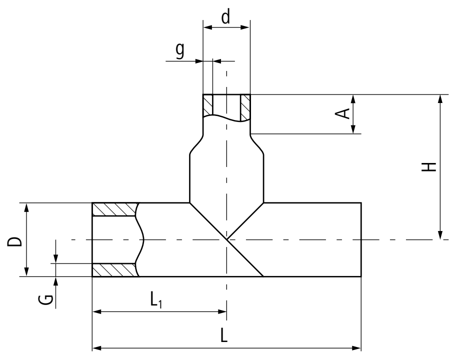
Dimensions of reducing couplings in mm



D	d	L_1*	Z*	t
90	63	110	203	
90	75	115	209	
110	75	115	210	
110	90	135	238	
125	90	138	250	
125	110	138	254	t_{max}=d+0,05d
140	110	138	267	
140	125	138	275	
160	110	138	285	
160	125	140	279	
160	140	140	285	

** Other values allowed*

Dimensions of reducing tees in mm



D	d	L*	L_1*	H*	A*
90	63	380	190	237	210
90	75	380	190	239	115
110	75	400	200	253	115
110	90	400	200	281	135
125	90	420	210	305	138
125	110	420	210	308	138
140	110	440	220	325	138
140	125	440	220	332	138
160	110	470	235	339	138
160	125	470	235	333	140
160	140	470	235	337	140

** Other values allowed*

The recommendations of manufacturers of raw materials for the welding of polyethylene pipes

Welding temperature: 210°C ±10°C
Melt flow rate range, MFR (190°C / 5 kg): 0,2–1,4 g/10 min

Specific recommendations for electrofusion welding:
The outer surface of a pipe subjected to welding should be suitably prepared within the welding area, i.e., scrapped (machined for TWINGAM pipes) and treated with a degreasing agent. Pipe segments placed in the electrofusion fitting should be clamped for the period of welding and cooling.

Detailed information concerning electrofusion welding are contained in the recommendations of manufacturers of electrofusion fittings and welding machines.

Dimensions of weld beads

The width of weld beads for butt welding of segments should be in accordance with the table.

Minimum pipe wall thickness, mm	Bead width B, mm	Minimum pipe wall thickness, mm	Bead width B, mm
2	3 ÷ 5	19	12 ÷ 18
3	4 ÷ 6	22	13 ÷ 18
4	4 ÷ 7	24	14 ÷ 19
5	5 ÷ 8	27	15 ÷ 20
6	6 ÷ 9	30	16 ÷ 21
8	7 ÷ 10	34	17 ÷ 22
9	8 ÷ 11	40	18 ÷ 23
11	9 ÷ 12	45	20 ÷ 25
13	10 ÷ 14	50	22 ÷ 27
16	11 ÷ 15	55	24 ÷ 30
18	12 ÷ 16	60	26 ÷ 32

The deviation of the bead width, B from its average value B_m shall not exceed ± 10%.

The average width of the bead, Bm is calculated as follows:

$$\mathbf{B_m = (B_{min} + B_{max}) / 2} \qquad B_{min} \geq 0{,}9\ B_m \qquad B_{max} \leq 1{,}1\ B_m$$

The joint shall also meet the following conditions:

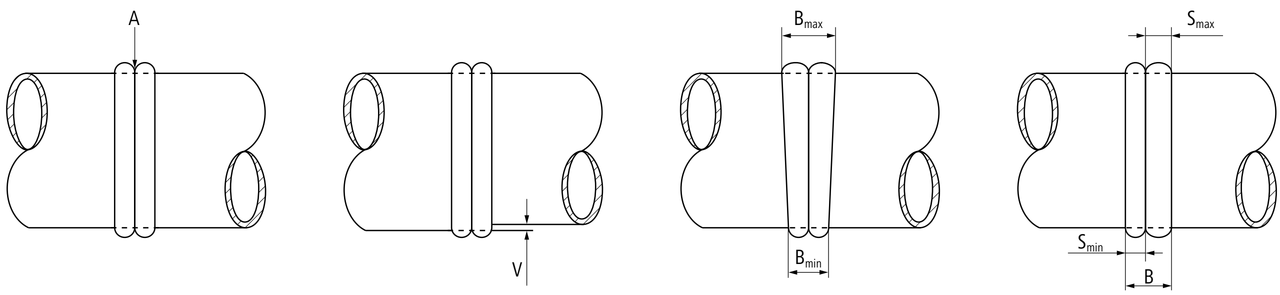
- a cavity at the joint of beads (A) shall not be below the outer diameter of jointed elements,
- the offset of external surfaces (V) shall not exceed 10% of the wall thickness of jointed elements.

The difference in the width of beads, D_s, for one joint, shall not exceed X% of the width of a double bead. The values D_s and X are calculated as follows:

$$\mathbf{D_s = S_{max} - B_{min}} \qquad X \geq (D_s / B_m) \times 100\%$$

The X value, depending on the type of joint, shall be as given in the table.

Type of joint	Value of X
pipe / pipe	≤ 10%
pipe / fitting	≤ 20%
fitting / fitting	≤ 20%

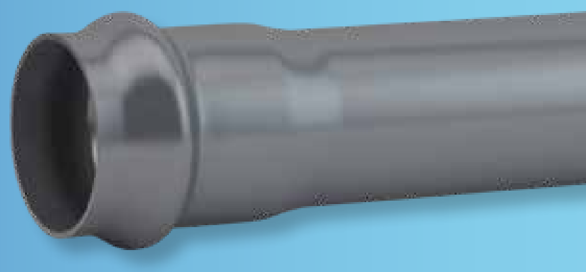


Weld beads of polyethylene pipes and fittings.

Reference documents for PE100 and PE100RC pipes and fittings

- PN EN 12201-2 standard
- ITB National Technical Assessment
- National Technical Assessment IBDiM – TWINGAM pipes.
- Hygienic certificate of PZH – TWINGAM polyethylene structured pipes.
- Opinion of the Central Mining Institute regarding the fulfillment of the conditions of use of PE100 single layer pipes and TWINGAM dual-layer pipes in mining areas.

PVC-U PRESSURE PIPES
AND FITTINGS



GAMRAT SA produces PVC-U pipes for the three operating pressure ranges: 0.6; 1.0 and 1.6 MPa. The pressure pipes are manufactured by extrusion of PVC with the addition of stabilizers, dyes, and lubricants. They are light grey colour with smooth inside and outside surfaces.

Pipes, with a diameter of 63 mm, have a socket at one end with a groove for rubber seal. The profiled seal is made of special rubber. It is a joining and sealing element, which is placed in the pipe socket groove. This type of joint is detachable one and it enables mutual movement of pipeline parts and expansion compensation. PVC-U pipes can also be joined using traditional fittings (cast iron, steel).

PN 6 (SDR 41)

D (mm)	g (mm)	Weight per meter (kg)
$90^{+0,3}$ *	$2,8^{+0,5}$	1,18
$110^{+0,4}$	$2,7^{+0,5}$	1,41
$125^{+0,4}$	$3,1^{+0,6}$	1,85
$140^{+0,5}$	$3,5^{+0,6}$	2,31
$160^{+0,5}$	$4,0^{+0,6}$	3,00
$200^{+0,6}$	$4,9^{+0,7}$	4,58
$225^{+0,7}$	$5,5^{+0,8}$	5,80
$250^{+0,8}$	$6,2^{+0,9}$	7,28
$280^{+0,9}$	$6,9^{+0,9}$	9,03
$315^{+1,0}$	$7,7^{+1,0}$	11,36
$400^{+1,2}$	$9,8^{+1,2}$	18,36
$450^{+1,0}$	$11,0^{+1,3}$	23,20
$500^{+1,0}$	$12,3^{+1,5}$	28,93
$630^{+1,0}$	$15,4^{+1,8}$	45,79

* SDR 33 (typ 100)

PN 10 (SDR 26)

D (mm)	g (mm)	Weight per meter (kg)
$63^{+0,3}$ *	$3,0^{+0,5}$	0,85
$90^{+0,3}$ *	$4,3^{+0,7}$	1,77
$110^{+0,4}$	$4,2^{+0,7}$	2,14
$125^{+0,4}$	$4,8^{+0,7}$	2,76
$140^{+0,5}$	$5,4^{+0,8}$	3,49
$160^{+0,5}$	$6,2^{+0,9}$	4,57
$200^{+0,6}$	$7,7^{+1,0}$	7,06
$225^{+0,7}$	$8,6^{+1,1}$	8,88
$250^{+0,8}$	$9,6^{+1,2}$	11,01
$280^{+0,9}$	$10,7^{+1,3}$	13,87
$315^{+1,0}$	$12,1^{+1,5}$	17,54
$400^{+1,2}$	$15,3^{+1,8}$	28,18
$450^{+1,0}$	$17,2^{+2,0}$	35,71
$500^{+1,0}$	$19,1^{+2,1}$	44,03
$630^{+1,0}$	$24,1^{+2,7}$	70,46

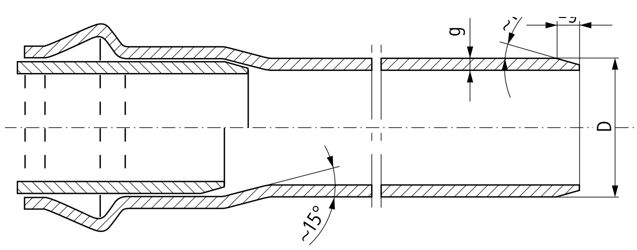
* SDR 21 (type 100)

PN 12,5 (SDR 21)

D (mm)	g (mm)	Weight per meter (kg)
$90^{+0,3}$	$5,4^{+0,8}$	2,18
$110^{+0,4}$	$5,3^{+0,8}$	2,65
$125^{+0,4}$	$6,0^{+0,9}$	3,39
$140^{+0,5}$	$6,7^{+0,9}$	4,25
$160^{+0,5}$	$7,7^{+1,0}$	5,57
$225^{+0,7}$	$10,8^{+1,3}$	10,98
$250^{+0,8}$	$11,9^{+1,4}$	13,46
$280^{+0,9}$	$13,4^{+1,6}$	17,02
$315^{+1,0}$	$15,0^{+1,8}$	21,42
$400^{+1,2}$	$19,1^{+2,2}$	34,77
$450^{+1,0}$	$21,5^{+2,4}$	44,07
$500^{+1,0}$	$23,9^{+2,6}$	54,49
$630^{+1,0}$	$30,0^{+3},^{3}$	86,59

PN 16 (SDR 17)

D (mm)	g (mm)	Weight per meter (kg)
$90^{+0,3}$	$6,7^{+0,9}$	2,64
$110^{+0,4}$	$6,6^{+0,9}$	3,24
$125^{+0,4}$	$7,4^{+1,0}$	4,13
$140^{+0,5}$	$8,3^{+1,1}$	5,19
$160^{+0,5}$	$9,5^{+1,2}$	6,78
$200^{+0,6}$	$11,9^{+1,4}$	10,60
$225^{+0,7}$	$13,4^{+1,6}$	13,52
$280^{+0,9}$	$16,6^{+1,9}$	20,78
$315^{+1,0}$	$18,7^{+2,1}$	26,34
$400^{+1,2}$	$23,7^{+2,6}$	42,49



Maximum operating temperature of pipes is 45°C.
Allowable working pressure decreases with temperature incre-

ase, for which a pipeline is designed.
The values of conversion factors for the calculation of the working pressure from the nominal pressure for different ranges of the working temperature are given in the table.

Temperature (°C)	Conversion factor „k”
20	1,0
25	1,0
30	0,9
35	0,8
40	0,7
45	0,63

The fragility of pipes increases below the temperature of 0°C. Pipes are certified by the National Institute of Hygiene (PZH certificate) allowing them to be used for the conveyance of drinking water.

Rubber seal joints
After cleaning the pipe socket, place the seal into a dry socket groove with the thicker part backwards. To facilitate this, make the seal to have the shape of the figure eight. Then, clean the outer surface of the spigot pipe end. To increase the slip, apply a lubricant agent to this pipe end and join pipes by pressing the spigot pipe into the socket to a proper depth. The seals in the pipes and fittings are fitted at the factory.

PVC-U pressure pipes, type “WK” (extended socket)

GAMRAT SA is manufacturer of piping systems made of PVC-U, type “WK”, used for the construction of underground pipelines and pipe networks in areas under the influence of mining activities. Modifying the depth of the socket allows the use of PVC-U pipes and fittings, type “WK”, in areas under the influence of continuous deformation of the intensity corresponding to the fourth category of land.
PVC-U pressure pipes, type “WK”, are used to build pipe networks for drinking water and for other liquids at the operating pressures of 0.6, 1.0 and 1.6 MPa at the temperature of 20°C. In addition to general advantages, which distinguish plastic pipes from pipes made of other materials, the PVC-U pipes, type “WK”, do not require additional compensation elements, which are necessary in mining areas in the case of other engineering solutions.

Gamrat PVC-U pressure pipes, type “WK”
PN 10 (SDR 26)

D (mm)	g (mm)	Weight per meter (kg)
$63^{+0,3}$ *	$3,0^{+0,5}$	0,88
$90^{+0,3}$ *	$4,3^{+0,7}$	1,80
$110^{+0,4}$	$4,2^{+0,7}$	2,18
$160^{+0,5}$	$6,2^{+0,9}$	4,65
$225^{+0,7}$	$8,6^{+1,1}$	9,03
$280^{+0,9}$	$10,7^{+1,3}$	14,11
$315^{+1,0}$	$12,1^{+1,5}$	17,85
$400^{+1,2}$	$15,3^{+1,8}$	28,68
$450^{+1,0}$	$17,2^{+2,0}$	38,27
$500^{+1,0}$	$19,1^{+2,1}$	45,63
$630^{+1,0}$	$24,1^{+2,7}$	71,69

* SDR 21 (type 100)

Gamrat PVC-U pressure pipes, type “WK”

PN 16 (SDR 17)

D (mm)	g (mm)	Weight per meter (kg)
$110^{+0,4}$	$6,6^{+0,9}$	3,27
$160^{+0,5}$	$9,5^{+1,2}$	6,84
$225^{+0,7}$	$13,4^{+1,6}$	13,69

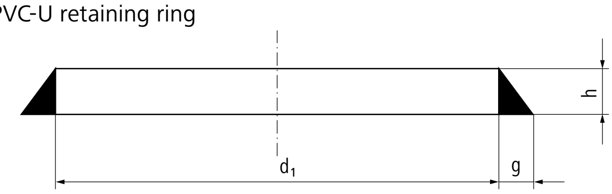
Standard pipe laying length for all ranges of working pressures, L = 6 m + 0,02 m.
Nominal pressure corresponds to the maximum working pressure at the temperature of 20°C.
The depth of the socket of type “WK” pipes is increased by 110 mm compared to a typical pipe socket.

Sealing components of the joint for type “WK” pipes

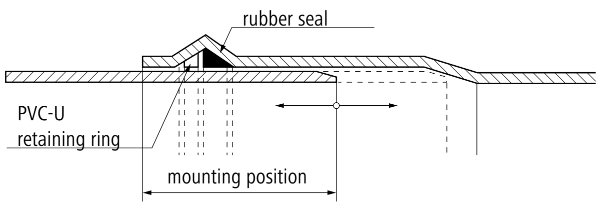
For diameters ranging from 63 to 450 mm, an EPDM elastomer seal is used.

Note: When installing a type “WK” pipeline of diameters of 160-450 mm, the direction of seal mounting is reversed. For diameters of 63-110 mm, the seal is mounted traditionally.

PVC-U retaining ring



D	Size	160	225	280	315	450
d	mm	161	226	281	316	451
g	mm	6,2	86	10,7	12,1	17,2
h	mm	17	19	20	24	34



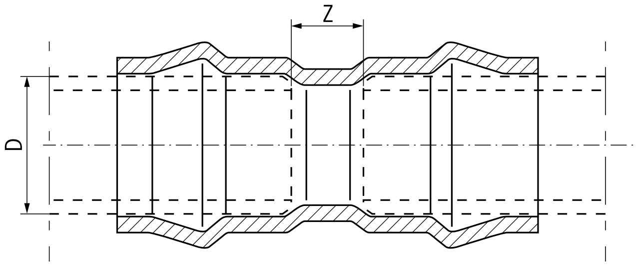
Note: For pipe diameters of 500 and 630 mm, there is used a seal with an internal split retaining ring, factory mounted
The installation of joints in pipelines Ø 160 - 450 mm, laid in areas under the influence of mining activities, differs from the installation of traditional pipelines with the following: the seal is placed in the socket groove in the opposite direction, i.e. the convergence towards the inside, and then, the PVC-U retaining ring is mounted in the groove.

PVC-U pressure fittings

Pressure fittings for PVC-U pipes are manufactured for the standard working pressure of 1 MPa. The dimensions of a fitting socket are the same as for a pipe socket.

On special request, it is possible to manufacture these fittings for a working pressure of 0.6 MPa, 1.25 MPa and 1.6 MPa and for pipes with an extended socket, type “WK”.

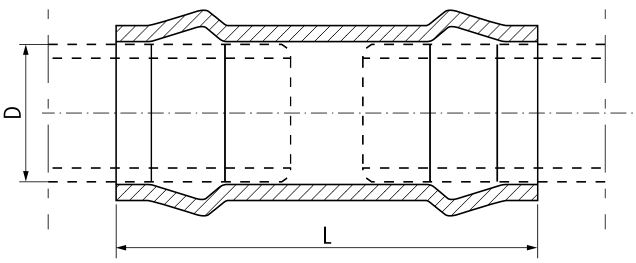
Double-socket coupling PN 10



D	Z	Weight per piece (kg)
63	2	0,26
90	3	0,63
110	4	0,75
125	4	1,03
140	5	1,52
160	5	2,31
200	6	3,51
225	7	5,14
250	8	6,42
280	8	8,08
315	8	11,22
450	8	25,17

D - outside diameter
Z - laying length

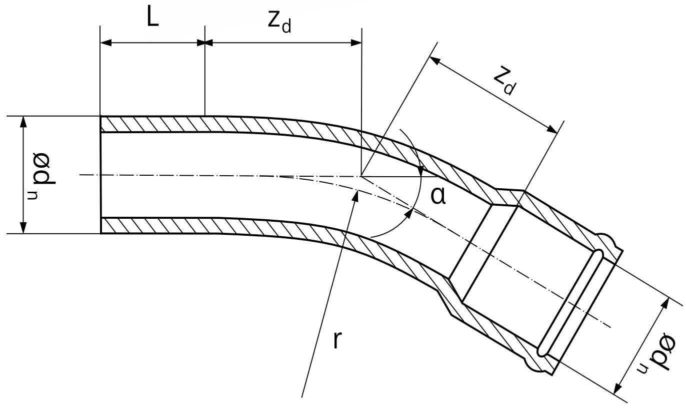
Socket sleeve coupling PN 10



D	L	Weight per piece (kg)
63	245	0,25
90	262	0,59
110	285	0,73
125	287	0,94
140	385	1,37
160	335	1,82
200	369	3,14
225	400	4,09
250	450	5,77
280	455	7,30
315	490	10,10
400	560	17,97
450	610	24,22
500	650	32,60
630	740	59,28

L - laying length

Single-socket bend PN 10

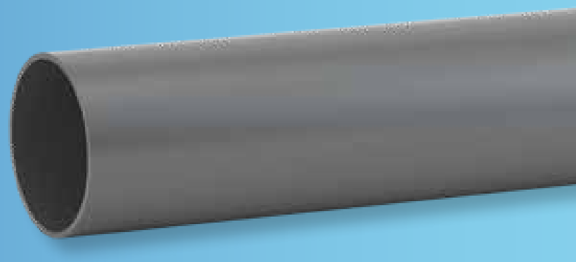


Nominal diameter	Minimum bend radius	Minimum design length $Z_{d,min.}$									
$\phi\ d_n$	$r_{min.}$	α 11°	Weight per piece (kg)	α 22°	Weight per piece (kg)	α 30°	Weight per piece (kg)	α 45°	Weight per piece (kg)	α 90°	Weight per piece (kg)
63	221	46	0,45	68	0,49	84	0,53	117	0,59	246	0,87
90	315	66	1,05	97	1,18	120	1,28	166	1,47	351	2,26
110	385	81	1,42	119	1,63	147	1,78	203	2,05	429	3,27
125	438	92	1,86	135	2,23	167	2,46	231	2,83	488	4,62
140	490	103	2,44	151	2,91	187	3,37	259	3,89	546	6,44
160	560	118	3,36	173	4,40	214	5,01	296	5,70	624	9,33
200	700	147	6,42	216	7,83	268	8,77	370	10,38	780	17,62
225	788	166	9,03	243	10,73	301	11,90	416	14,42	878	24,41
250	875	184	13,13	270	14,25	334	15,88	462	18,93	975	32,62
280	980	206	16,11	302	19,82	375	22,11	518	26,95	1092	44,68
315	1103	232	22,80	340	27,56	421	30,84	583	37,77	1229	65,55
400	1400	295	43,43	432	52,63	535	59,36	740	71,96	-	-
450	1575	332	59,25	486	72,75	602	81,93	832	101,55	-	-

Standards, certificates, documents related to PVC-U pressure pipes and fittings

- PN-EN ISO 1452 - piping systems from plasticized poly(vinyl chloride) (PVC-U) for water supply
- Technical opinion concerning the applicability of PVC-U pressure pipes manufactured by GAMRAT SA in areas covered by the influence of mining activities
- Certificate of PZH Warsaw

PVC-U PIPES
FOR TECHNICAL SYSTEMS AND SWIMMING POOLS



This system of products is designed for building swimming pool systems, as well as for various technical systems used for water boosting stations, greenhouses, laboratories, agriculture and industrial plants. The nominal pressure of the system (maximum working pressure) is 1.0 MPa (10 bar) at operating temperatures up to 25°C. At higher operating temperatures, factors shall be applied to reduce the nominal pressure. The maximum permissible operating temperature is 45°C.

Temperature (°C)	Reduction factor
25	1,00
30	0,90
35	0,80
40	0,70
45	0,63

A wide range of commercially available PVC-U fittings for adhesive bonding and adaptor fittings (with diameters ranging from 16 to 225 mm) allows you to perform a complete system using adhesive bonded, threaded and flanged joints. The system is supplemented by pipe brackets and PVC-U valves.

Methods of joining

Adhesive bonding is the primary method of joining pipes and fittings. Use only an aggressive adhesive for PVC – we recommend TANGIT or EFFAST-TITE adhesive. Detailed bonding instructions may be obtained from our company. In the case of threaded adaptor fittings, use Teflon tape to seal the threaded connections.

Advantages of the system

Easy and quick to install, attractive appearance, not requiring special equipment, maintenance free, resistant to corrosion and limescale buildup, cheaper than steel and copper products, characterized by very low hydraulic resistance and high chemical resistance, high durability – at least 50 years , physiologically neutral – safe for humans health.

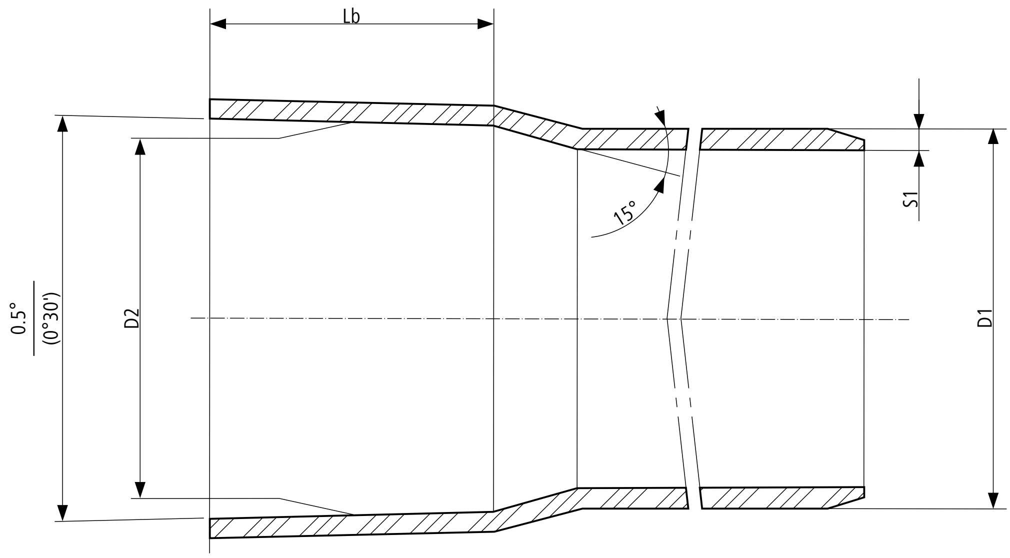
PN 10			
Outside diameter (mm)	Permissible deviation in diameter (mm)	Wall thickness (mm)	Weight per meter (kg)
16	+0,2	1,5	0,11
20	+0,2	1,5	0,14
25	+0,2	1,5	0,18
32	+0,2	1,6	0,24
40	+0,2	1,9	0,35
50	+0,2	2,4	0,55
63	+0,3	3,0	0,85
75	+0,3	3,6	1,21
90	+0,3	4,3	1,74
110	+0,4	4,2	2,10
125	+0,4	4,8	2,70
140	+0,5	5,4	3,41
160	+0,5	6,2	4,47
200	+0,6	7,7	6,89
225	+0,7	8,6	8,65
250	+0,8	9,6	10,71
280	+0,9	10,8	13,35
315	+1,0	12,1	17,00

** On request, we manufacture pipes with a diameter of up to 315 mm inclusive and the nominal pressure of 1,6 MPa (16 bar).*

PVC-U SOCKETED PIPES FOR TECHNICAL SYSTEMS AND SWIMMING POOLS

D1	S1			D2	Lb
	PN 10	PN 12,5	PN 16		
25		1,5 $^{+0,4}$	1,9 $^{+0,4}$	25,1 $^{+0,2}$	32
32	1,6 $^{+0,4}$	1,9 $^{+0,4}$	2,4 $^{+0,5}$	32,1 $^{+0,2}$	32
40	1,9 $^{+0,4}$	2,4 $^{+0,5}$	3,0 $^{+0,5}$	40,1 $^{+0,2}$	35
50	2,4 $^{+0,5}$	3,0 $^{+0,5}$	3,7 $^{+0,6}$	50,1 $^{+0,2}$	45
63	3,0 $^{+0,5}$	3,8 $^{+0,6}$	4,7 $^{+0,7}$	63,1 $^{+0,2}$	55

Standard fitting length 4 m.
Possibility to offer socketed pipes with a diameter of up to 315 mm.



GAMRAT WELLGAM
WATER WELL SYSTEM

WellGam well systems

WellGam is a set of components for the construction of drilled wells, dug wells and well water connections for individual consumers, collective water supply and industrial plants. Many times, the construction of a drilled well is the only way to provide water to a household or a production plant. The unavailability of the water supply network or the unprofitability of connecting an investment object to the water supply network at a given moment are increasingly influencing both private and commercial users to build their own wells so that they do not have to worry about supply shortages or rising water prices.

Drilled wells are used, among others:

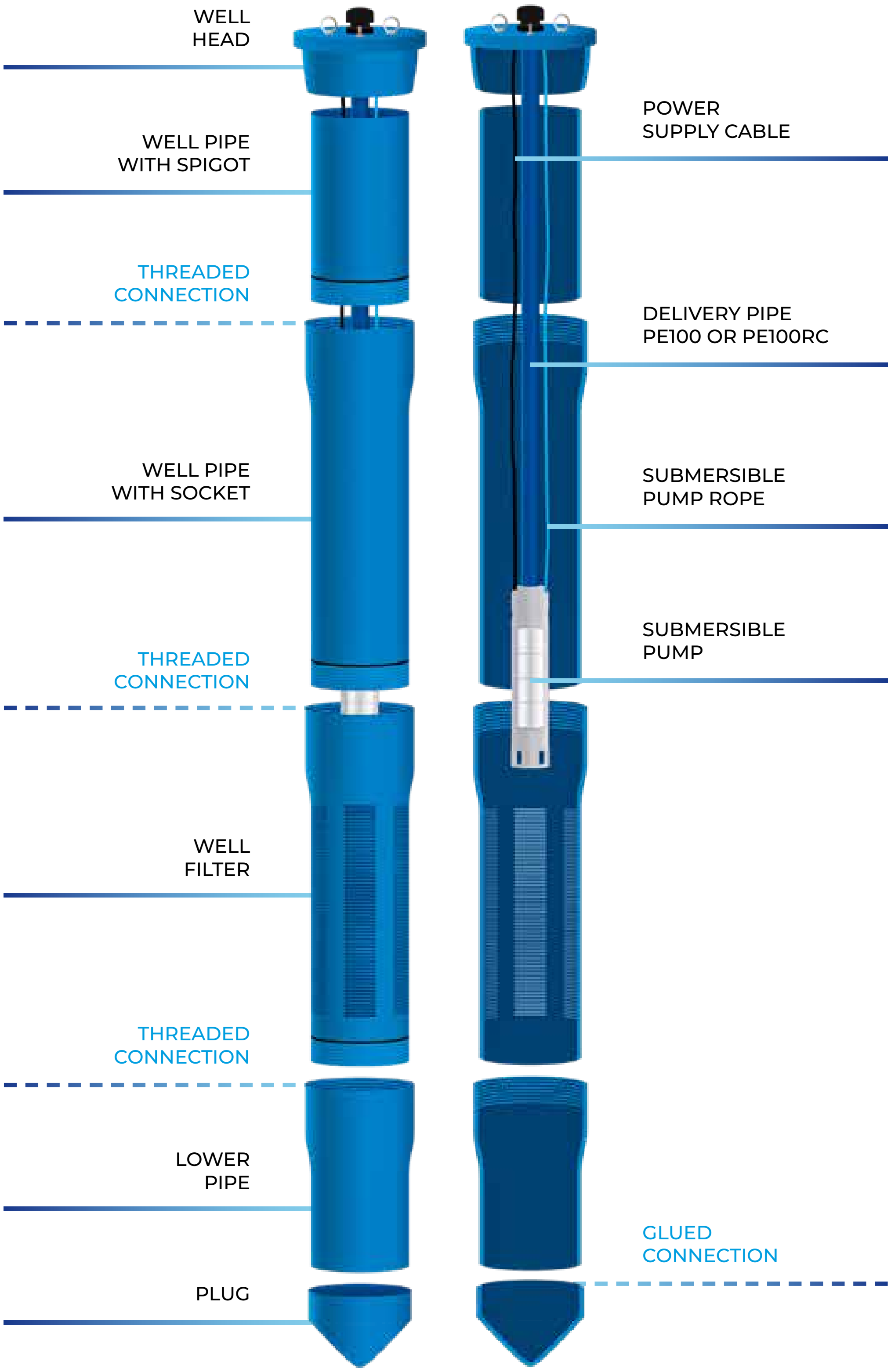
- **for households – for food and domestic purposes;**
- **for large farms and plantations – for irrigation (e.g. automatic irrigation systems) or plant and animal production;**
- **as water intakes for industrial plants – provide process water needed for the production process;**
- **as drinking water intakes for small towns or villages – where other sources of drinking water are not available.**

Drilled wells

The offer includes PVC-U well pipes, slotted and sieve filters, manhole shafts, thermal insulation housings, drilled well casings, well heads and plugs, and also submersible pumps.

It is possible to manufacture non-standard pipes and well filters at the customer's request.

The diagram below shows the most common variant of drilled well design.



Well pipes

WellGam well pipes, made of PVC-U, are approved for use in drinking water systems and the process of pipe production is controlled at regular intervals. Pipes are manufactured according to PN-G-02323 standard and have a Polish hygienic certificate issued by the National Institute of Hygiene in Warsaw.

WellGam well pipes, are offered in PN 10, PN 12.5, PN 16 ranges, with standard pipe laying lengths of 1, 2, 3, 4 and 6 m in threaded versions, in the diameter range DN 110 - DN 450.

WELLGAM WELL PIPES						
	PN 10		PN 12,5		PN 16	
nominal outside diameter DN/OD [mm]	wall thickness [mm]	external pressure resistance [bar]	wall thickness [mm]	external pressure resistance [bar]	wall thickness [mm]	external pressure resistance [bar]
110	-	-	5,3	9,0	6,6	18,9
125	4,8	4,3	6,0	8,9	7,4	18,0
140	5,4	4,3	6,7	8,8	8,3	18,1
160	6,2	4,4	7,7	9,0	9,5	18,2
200	7,7	4,3	9,6	8,9	11,9	18,3
225	8,6	4,3	10,8	8,9	13,4	18,3
280	10,7	4,2	13,4	8,8	16,6	18,1
315	12,1	4,3	15,0	8,7	18,7	18,2
400	15,3	4,0	19,1	9,0	23,7	18,0
450	17,2	4,0	21,5	9,0	26,7	18,0

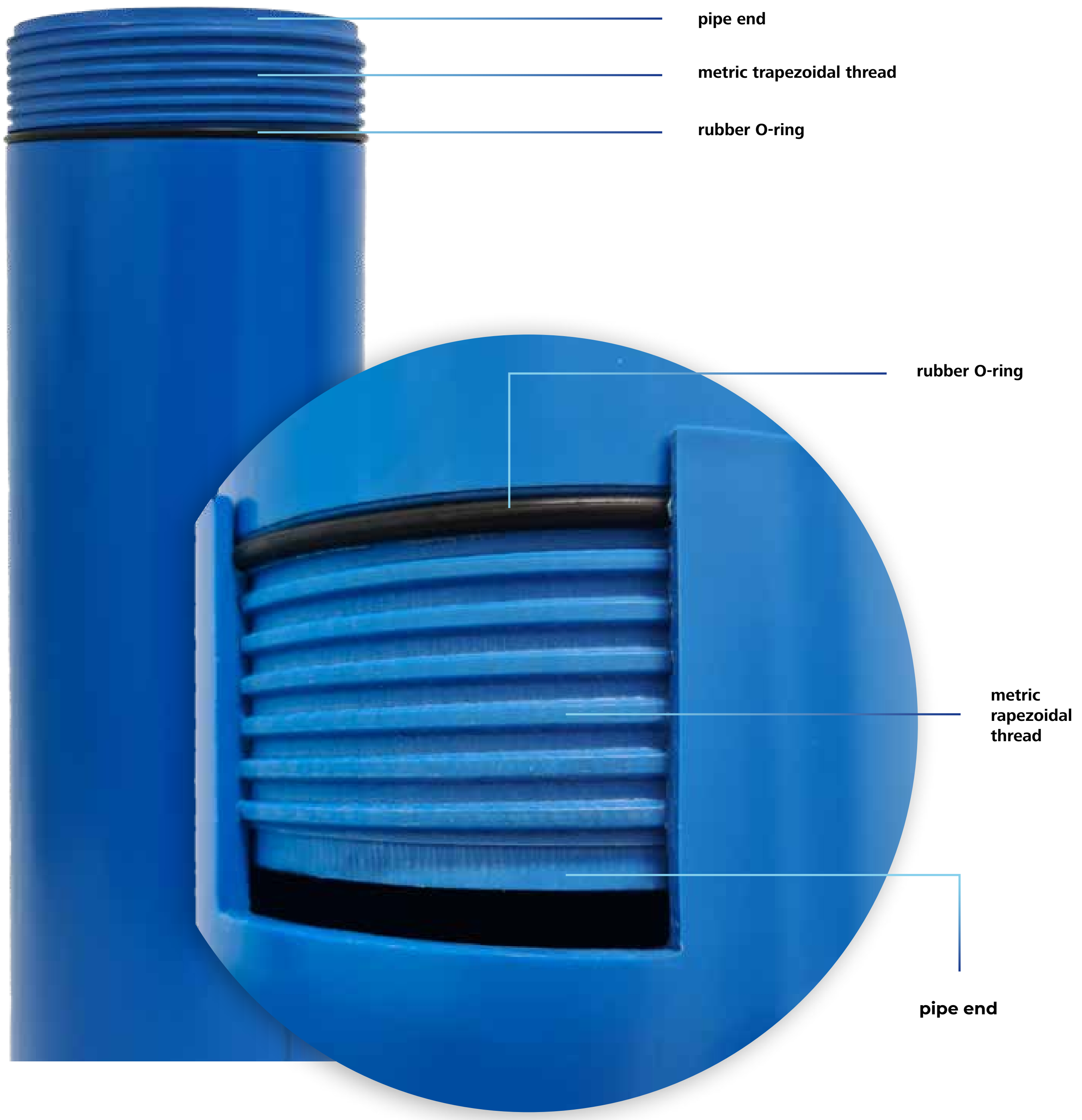
On request, it is possible to manufacture pipes with non-standard wall thicknesses.

Gamrat SA also offers KOT-compliant PVC-U well pipes (adhesive bonded socket) in diameters DN 90 - DN 450 and GEO-HYDRO pipes (threaded socket) in diameters DN 90 - DN 450. For more information, please contact our Customer Service.

Threads in well pipes

WellGam well pipes offered by Gamrat SA have threads according to PN-G-02323 standard with a 6 mm pitch metric trapezoidal thread for diameters DN 110 - DN 225 and with a 12 mm pitch metric trapezoidal thread for diameters DN 280 - DN 450. Each threaded joint is fitted with a rubber O-ring, which ensures its tightness. The rubber O-rings used in WellGam manhole pipes have a Hygienic Certificate issued the National Institute of Hygiene in Warsaw.

The pipes we offer meet the highest quality criteria, which is guaranteed by the ISO 9001:2015 quality management system certificate



Well filters

A well filter allows the inflow of drawn water from the aquifer into the well, assuming the lowest possible hydraulic resistance and the best possible retention of sand and rock particles from the aquifer. The length of the filter should be adapted to the thickness of the aquifer, taking into account the slope of the water table. An inadequately chosen filter obstructs the flow of water into the well and thus significantly reduces the well's capacity or causes the well to become clogged.

WellGam slotted filters

These slotted filters are manufactured from WellGam well pipes. The filters are approved for use in drinking water systems and their manufacturing process is inspected at regular intervals. They are easy to install, produce low hydraulic resistance, are corrosion-resistant and have a high resistance to external forces.

We offer slotted filters in PN 10, PN 12.5 and PN 16 pressure ratings in threaded versions (DN 110 - DN 450) with standard installation lengths of 2, 3 and 4 m. WellGam slotted filters comply with the PN-G-02323 standard.

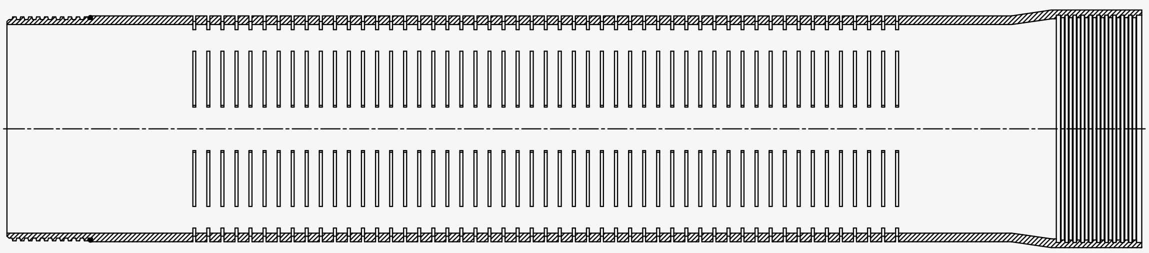
WELLGAM SLOTTED FILTERS, PN 10								
nominal outside diameter DN/OD [mm]	wall thickness [mm]	slot width [mm]						
		0,5	0,75	1,0	1,5	2,0	2,5	3,0
		filter flow capacity factor [%]						
125	4,8	5,2	7,6	9,7	8,6	10,9	11,7	13,5
140	5,4	4,9	7,1	9,1	8,1	10,3	11,0	12,7
160	6,2	5,1	7,4	9,5	8,4	10,7	11,4	13,2
200	7,7	-	7,0	9,0	8,0	10,1	10,8	12,5
225	8,6	-	7,2	9,2	8,2	10,4	11,1	12,8
280	10,7	-	6,7	8,5	7,6	9,6	10,3	11,9
315	12,1	-	7,0	8,9	7,9	10,1	10,7	12,4
400	15,3	-	-	8,6	7,6	9,7	10,4	12,0
450	17,2	-	-	8,5	7,5	9,6	10,2	11,8

WELLGAM SLOTTED FILTERS, PN 12,5								
nominal outside diameter DN/OD [mm]	wall thickness [mm]	slot width [mm]						
		0,5	0,75	1	1,5	2	2,5	3
		filter flow capacity factor [%]						
110	5,3	5,8	8,3	10,6	9,4	12,0	-	-
125	6,0	5,4	7,7	9,9	8,8	11,2	11,9	13,8
140	6,7	5,0	7,2	9,3	8,2	10,5	11,2	12,9
160	7,7	5,2	7,5	9,7	8,6	10,9	11,6	13,5
200	9,6	-	7,1	9,2	8,1	10,4	11,0	12,8
225	10,8	-	7,3	9,4	8,3	10,6	11,3	13,1
280	13,4	-	6,8	8,7	7,7	9,8	10,5	12,1
315	15,0	-	7,1	9,1	8,1	10,3	11,0	12,7
400	19,1	-	-	8,8	7,8	10,0	10,6	12,3
450	21,1	-	-	8,7	7,7	9,8	10,4	12,1

WELLGAM SLOTTED FILTERS, PN 16								
nominal outside diameter DN/OD [mm]	wall thickness [mm]	slot width [mm]						
		0,5	0,75	1	1,5	2	2,5	3
		filter flow capacity factor [%]						
110	6,6	5,9	8,5	10,9	9,7	12,4	-	-
125	7,4	5,5	7,9	10,1	9,0	11,5	12,2	14,1
140	8,3	5,2	7,4	9,5	8,4	10,8	11,5	13,3
160	9,5	5,4	7,7	9,9	8,8	11,2	11,9	13,8
200	11,9	-	7,3	9,4	8,3	10,6	11,3	13,1
225	13,4	-	7,5	9,6	8,5	10,9	11,6	13,4
280	16,6	-	7,1	9,1	8,1	10,3	11,0	12,7
315	18,7	-	7,3	9,4	8,3	10,6	11,3	13,0
400	23,7	-	-	9,0	8,0	10,2	10,9	12,6
450	26,7	-	-	8,9	7,9	10,1	10,7	12,4

The tables show the minimum flow capacity values for slotted filters.

At the customer's request, it is possible to manufacture slotted filters in the version with a socket for gluing in the diameter range DN 90 - DN 450. For more information, please contact Customer Service - Pipes.



longitudinal section of the slotted filter

Components for drilled wells

The offer includes PVC-U well pipes, slotted and sieve filters, manhole shafts, thermal insulation housings, drilled well casings, well heads and plugs, and also submersible pumps.

Type I well head

- Available diameters: DN 125, DN 160
- Pump delivery pipe connection: **DN 32, DN 40, DN 50***
- Sealing type: rubber O-ring
- Made of PVC-U

*only available with DN 160 head

Type II well head

- Manufactured in either a straight-through or threaded version
- Available diameters: **DN 110*, DN 140, DN 200, DN 225**
- Pump delivery pipe connection: straight-through: **DN 32, DN 40, DN 50****; **with threaded connector pipe**: 1.5", 2", 2.5", 3"**
- Sealing type: lip seal
- Made of PE

*only with straight-through connection DN 32 | *only available from DN 160 head

Type III well head

- Manufactured in either a straight-through or threaded version
- Available diameters: **DN 110, DN 125, DN 160, DN 200**
- Pump delivery line connection: **straight-through: DN 32, DN 40, DN 50, DN 63, DN 75, DN 90; with threaded connector pipe: 1", 11/4", 11/2", 2", 3"**
- Sealing type: rubber O-ring
- Made of galvanised steel

The diameter of the delivery pipe connection of the pump depends on the diameter of the head.

Well plug

The well plug is the closure of the lower pipe.

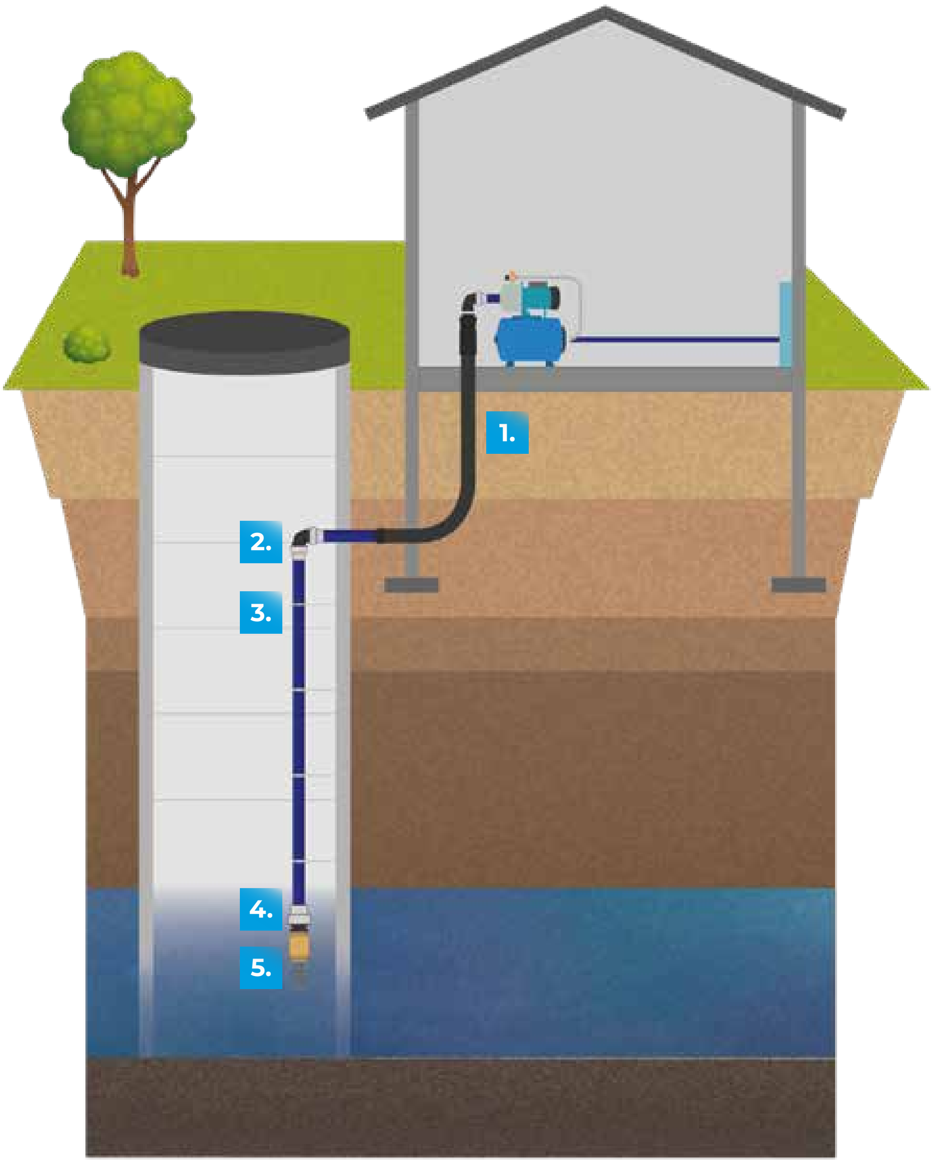
- Available diameters: **DN 110, DN 125, DN 140, DN 160, DN 225**
- Connection with the lower pipe: glued
- Made of PVC-U
- Hygienic approval issued by PZH in Warsaw

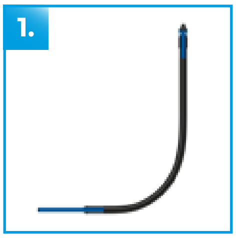
Dug wells

The WellGam well system is not only a complete set of components for the construction of drilled wells, but also a set of components for the construction of a new and the modernisation of an existing water intake system of a dug well.

The water intake system from the dug well can be made using PE* pipe, fitted with a PE pipe compression elbow and a PE pipe threaded compression fitting ended with a suction basket and check valve. The system comes with a connection passage. In the case of upgrading an existing water intake system made of steel pipes, it is possible to connect PE pipes to steel pipes by means of compression fittings with a thread for PE pipes.

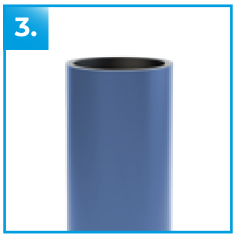
*it is possible to make a dug well system using PVC-U pipes





connection line

compression elbow for PE pipes



PE pipe

PE pipe threaded compression fitting

suction basket with check valve

Polyethylene pipes manufactured by Gamrat SA, are designed for the distribution of drinking water, liquid process media, sewage, and also as casing pipes. Such a wide range of applications of PE pipes results from their excellent physical and mechanical properties and resistance to various aggressive media. PE pipes are completely safe for health and not harmful to the environment.

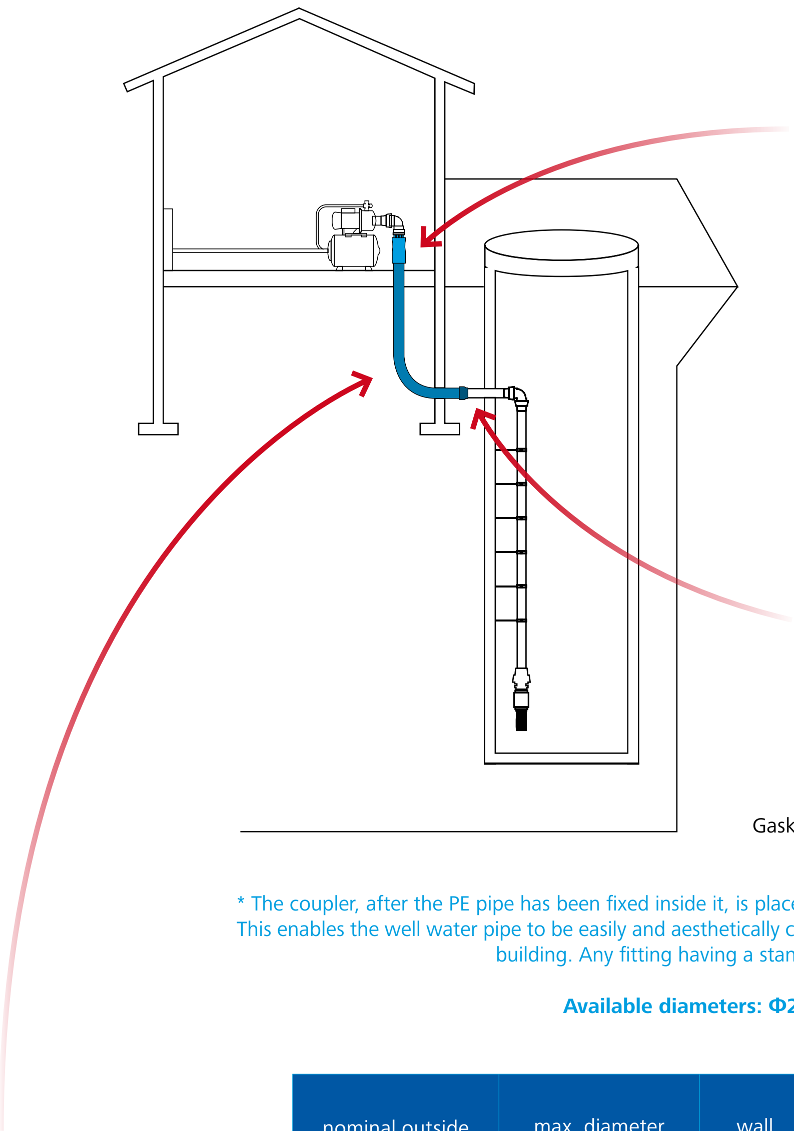
Connection line

To meet the needs of modern installers, Gamrat SA offers connection lines made of PVC-U as an alternative solution to traditional casing pipes. Its unquestionable advantage is the ease with which the water supply pipe can be routed to a building and, in case of failure, the possibility of a simple and quick replacement.

It is possible to extend the connection line, using PVC-U pipe for swimming pool and technical installations in a version with a glued coupler. The connection of the water supply pipe from the well to the internal drinking water installation in the building, can be done in 2 ways:

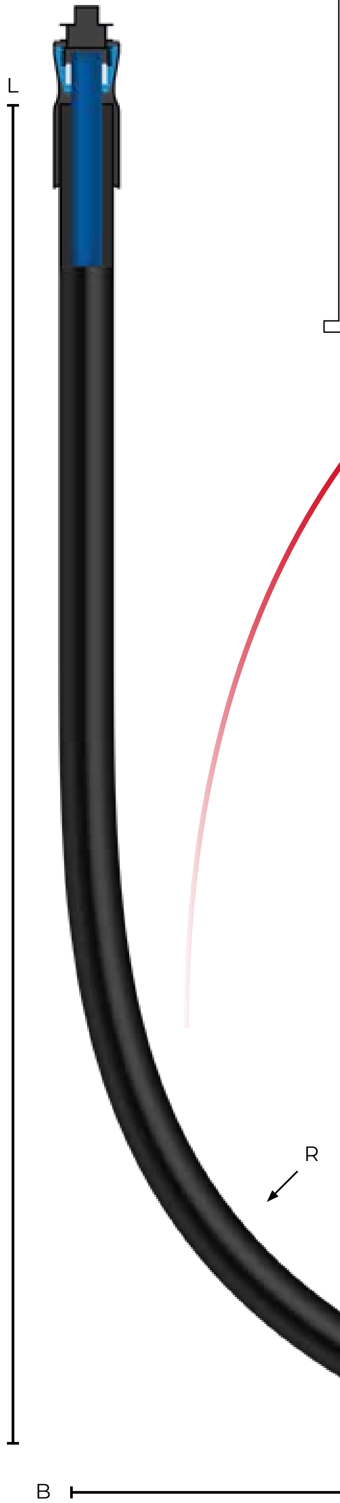
I. Using a compression fitting ended with a coupler for PE pipes.

II. In the traditional manner, using electrofusion or compression fittings directly on the pipe supplying water to the building.



Compression fitting ended with a coupler* with external thread

Gasket to close and seal the space between pipes

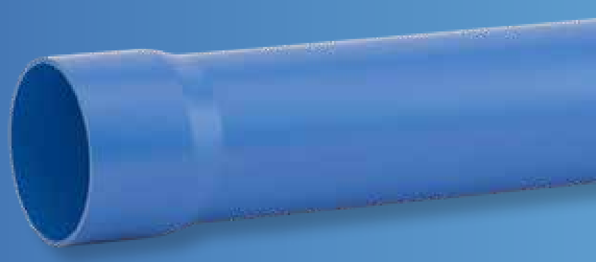


* The coupler, after the PE pipe has been fixed inside it, is placed on the connection line inside the building. This enables the well water pipe to be easily and aesthetically connected to the drinking water system in the building. Any fitting having a standard pipe thread can be fitted to the coupler

Available diameters: Φ25 - Φ63 with threads 3/4 inch - 2.5 inch.

nominal outside diameter DN/OD [mm]	max. diameter of connection line [mm]	wall thickness [mm]	R [mm]	L [mm]	B [mm]
63	25	3,0	700	1700	900
75	32	3,6	930	1800	1100
90	40	4,3	1050	1750	1200
110	63	4,2	1470	2000	1630

PVC-U PRESSURE SOLID PIPES
(GEO-HYDRO) FOR DRILLED WELLS



PVC-U pipes for wells

The PVC-U material combines a number of features and benefits that are particularly desirable in the construction of deep wells for drinking water.

Advantages of PVC-U

- resistant to corrosion,
- low specific gravity, so that the PVC-U pipes are easy to transport and install,
- easy to work with,
- PVC-U pipes and filters have smooth surfaces, which is hydraulically beneficial and prevents buildups,
- attractively priced when compared to pipes made of other materials.

GEO-HYDRO pipes are approved for use in drinking water systems and the process of pipe production is controlled at regular intervals. The colour of the pipes is blue.

GEO-HYDRO pipes for drilled wells are manufactured according to PN-G-02323 standard and have a Polish hygienic certificate issued by the National Institute of Hygiene.
Our products meet the highest quality criteria guaranteed by a certified system of quality control, production and management, **ISO 9001:2008.**

PVC-U pressure pipes, type GEO-HYDRO

We offer the following pipe versions for nominal pressures PN 10, PN 12,5, PN 16:
- without a socket,
- socketed.

Advantages of using PVC-U well pipes:

- quick and easy installation;
- high resistance of PVC to external forces.

Pipe laying lengths are as follows:

• 1,0 • 2,0 • 3,0 • 4,0 • 5,0 • 6,0 lm.

Certificates and standards:

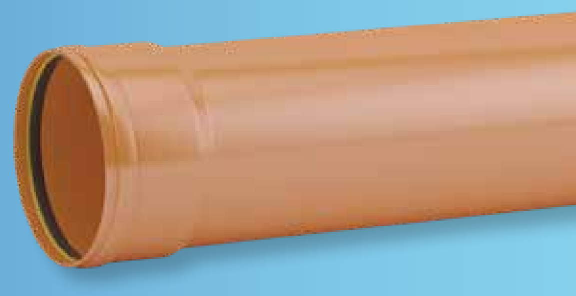
- PN-G-02323 – Drilled wells. PVC-U solid pipes and filter pipes for wells. Requirements.
- Hygienic certificate issued by the National Institute of Hygiene in Warsaw.

	PN 10		PN 12,5		PN 16	
Nominal dimension DN/OD	Wall thickness	Weight per meter (kg)	Wall thickness	Weight per meter (kg)	Wall thickness	Weight per meter (kg)
90	-	-	5,4	2,14	-	-
110	-	-	5,3	2,60	6,6	3,18
* **125**	4,8	2,70	6,0	3,32	7,4	4,05
* **140**	5,4	3,41	6,7	4,16	8,3	5,08
* **160**	6,2	4,47	7,7	5,45	9,5	6,63
200	7,7	6,89	9,6	8,48	11,9	10,34
225	8,6	8,65	10,8	10,71	13,4	13,11
280	10,7	13,35	13,4	16,53	16,6	20,17
315	12,1	17,00	15,0	20,76	18,7	25,53
400	15,3	27,22	19,1	33,59	23,7	41,05
450	17,2	34,41	21,5	42,47	26,7	52,00

*** On special order we also manufacture pipes in the following dimensions**

125x3.0 | 125x4.3 | 125x5.0 | 125x6.3
140x4.0 | 140x4.2 | 140x5.0
160x4.0 | 160x4.2

Other non-standard wall thicknesses can also be manufactured.



PVC-U SEWAGE PIPES
AND FITTINGS

Advantages of PVC-U sewage pipes

- high resistance to many chemicals;
- total resistance of external surfaces to corrosive and destructive effects of groundwater (protective coats are not required);
- smooth internal surface, which involves resistance to depositing of internal sediments, clogging and also reducing the flow resistance of the liquid;
- easily laying and installing due to their length, low weight and type of joints;
- long service life of pipes;
- tightness of joints with respect to the exfiltration of wastewater into the ground, what ensures the protection of environment, as well as with respect to the infiltration of groundwater into the inside of a sewage, which is connected with the economics of the construction and operation of sewage treatment plants;
- low weight of pipes, more than ten times smaller than that of substitutes (concrete, stoneware, cast iron);
- high resistance to abrasion.

Physical and mechanical properties

Property	Unit	Value
Density	g / cm^3	1,38–1,40
Tensile strength - (short-term test) up to 3 minutes - design	 MPa MPa	 48–50 10
Elongation at break	%	10
Coefficient of linear expansion	1 / OC	80 × 10^{-6}
Modulus of elasticity (Young's modulus) - short-term, 1 minute - long-term, 50 years	 MPa MPa	 3000–3200 1000
Product forming temperature	°C	120–130
Vicat softening point, Vicat Test B	°C	≥80
Thermal conductivity	W/M h OC	0,16–0,21
Impact resistance - at temperature of 0°C - at temperature of 20°C	 % %	 5 10
Surface electrical resistance	Ω	>10^{12}
Resistance to water freezing in the conduit	-	not resistant - freezing destroys pipe
Flammability	-	self-extinguishing material
Hot water absorption	g / cm^3	40

Application

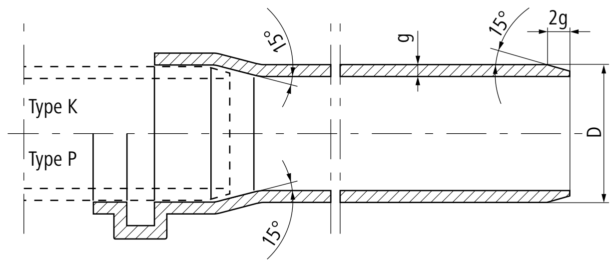
Construction of sanitary, col.m.ined and rainwater sewage networks, for non-pressurized transporting of sewage.

Joining method

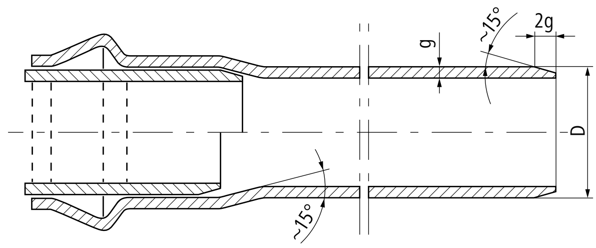
- standard push-fit socket joint (P,W)

Depending on the construction of a socket, there are distinguished two types of PVC-U sewage pipes

P – pipe with a rectangular socket groove for the range of outside diameters from 110 to 500 mm.



W – pipe with an oval socket groove with the outside diameter of 630 mm.



PVC-U sewage pipes for the construction of external sewage networks are manufactured as the homogeneous-wall pipes according to DIN EN 1401-1.

GAMRAT PVC-U Sewage Pipe Light-weight series „L" (SDR 51) – SN 2 according to PN EN 1401

D (mm)	g (mm)	Weight per meter (kg) *
$160^{+0,4}$	$3,2^{+0,5}$	2,56
$200^{+0,5}$	$3,9^{+0,5}$	3,86
$250^{+0,5}$	$4,9^{+0,7}$	6,06
$315^{+0,6}$	$6,2^{+0,9}$	9,71
$400^{+0,7}$	$7,9^{+0,5}$	15,70
$500^{+0,9}$	$9,8^{+1,2}$	24,50
$630^{+1,1}$	$12,3^{+1,5}$	39,11

** The weight of 1 meter pipe is given for a pipe length of 6 meter*

GAMRAT PVC-U Sewage Pipe Superheavy-weight series „L" (SDR 29) – SN 12 according to ITB-KOT-2019/1130

D (mm)	g (mm)	Weight per meter (kg) *
$160^{+0,4}$	$5,5^{+0,8}$	4,24
$200^{+0,5}$	$6,9^{+0,9}$	6,64
$250^{+0,5}$	$8,6^{+1,1}$	10,39
$315^{+0,6}$	$10,8^{+1,3}$	16,46
$400^{+0,7}$	$13,7^{+1,6}$	26,69
$500^{+0,9}$	$17,1^{+2,0}$	41,97
$630^{+1,1}$	$21,6^{+2,4}$	67,25

** The weight of 1 meter pipe is given for a pipe length of 6 meter*

GAMRAT PVC-U Sewage Pipe Medium-weight series „N" (SDR 41) – SN 4 according to PN EN 1401

D (mm)	g (mm)	Weight per meter (kg) *
$160^{+0,4}$	$4,0^{+0,6}$	3,13
$200^{+0,5}$	$4,9^{+0,7}$	4,80
$250^{+0,5}$	$6,2^{+0,9}$	7,63
$315^{+0,6}$	$7,7^{+1,0}$	11,92
$400^{+0,7}$	$9,8^{+1,2}$	19,35
$500^{+0,9}$	$12,3^{+1,5}$	30,58
$630^{+1,1}$	$15,4^{+1,8}$	48,60

** The weight of 1 meter pipe is given for a pipe length of 6 meter*

GAMRAT PVC-U Sewage Pipe Superheavy-weight series „L" (SDR 26) – SN 16 according to ITB-KOT-2019/1130

D (mm)	g (mm)	Weight per meter (kg) *
$160^{+0,4}$	$6,2^{+0,9}$	4,77
$200^{+0,5}$	$7,7^{+1,0}$	7,38
$250^{+0,5}$	$9,6^{+1,2}$	11,53
$315^{+0,6}$	$12,1^{+1,5}$	18,39
$400^{+0,7}$	$15,3^{+1,8}$	29,68
$500^{+0,9}$	$19,1^{+2,2}$	46,64
$630^{+1,1}$	$24,1^{+2,7}$	74,74

** The weight of 1 meter pipe is given for a pipe length of 6 meter*

GAMRAT PVC-U Sewage Pipe Heavy-weight series „S" (SDR 34) – SN 8 according to PN EN 1401

D (mm)	g (mm)	Weight per meter (kg) *
$110^{+0,3}$	$3,2^{+0,6}$	1,73
$160^{+0,4}$	$4,7^{+0,7}$	3,59
$200^{+0,5}$	$5,9^{+0,9}$	5,61
$250^{+0,5}$	$7,3^{+1,0}$	8,90
$315^{+0,6}$	$9,2^{+1,2}$	13,89
$400^{+0,7}$	$11,7^{+1,4}$	22,95
$500^{+0,9}$	$14,6^{+1,7}$	36,03
$630^{+1,1}$	$18,4^{+2,1}$	57,69

** The weight of 1 meter pipe is given for a pipe length of 6 meter*

Moreover, for the areas of mining damages, there are used medium-weight "N", heavy-weight "S", and superheavy-weight series pipes with an extended socket (the depth of the pipe socket is increased by 110 mm).

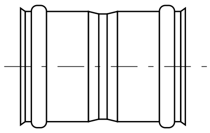
Sealing ring joints

After cleaning the pipe or fitting socket, place the seal into a dry socket groove. To facilitate this, make the seal to have the shape of the figure eight. Then, clean the outer surface of the spigot pipe end. To increase the slip, apply talcum or "SILPASTA R" to this pipe end and join pipes by pressing the spigot pipe into the socket to a proper depth. Detailed information on joining and laying the pipes is given below.

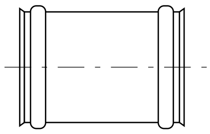
Solvent cement joints

For adhesive bonding of PVC-U pipes, you shall use only an aggressive adhesive. Degrease the pipe surfaces to be bonded with methyl chloride. Before applying an adhesive, make sure that the surface is dry and clean. Apply the adhesive with a brush, starting from the innermost end of the socket. The adhesive should be applied evenly. The whole operation shall not last longer than one minute. Once the adhesive is applied, press home the connected elements. Immediately after joining, remove the excess adhesive squeezed out. During 5 minutes after joining, you shall not move the joined elements.

Sewage fittings of SN 8 class

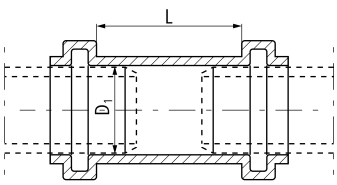


Double-socket coupling	Diameter
	110
	160
	200
	250
	315
	400

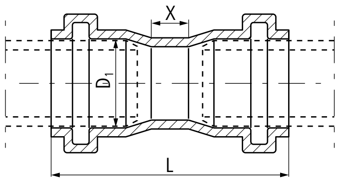


Socket sleeve coupling	Diameter
	110
	160
	200
	250
	315
	400
	500
	630

Sewage fittings (stiffness class SN 12)



Socket sleeve coupling SN 12	D	D_1 Socket inside diameter	L_{min}
	110	110,4 + 0,5	64
	160	160,5 + 0,5	84
	200	200,6 + 0,5	100
	250	250,6 + 1,2	110
	315	315,7 + 1,3	124
	400	400,8 + 1,6	140
	500	501,0 +2,0	160
	630	631,9 + 2,0	186



Double-socket coupling SN 12	D	D_1 Socket inside diameter	L_{min} Coupling design length	X_{min}
	110	110,4 + 0,5	93	35
	160	160,5 + 0,5	112	38
	200	200,6 + 0,5	140	50
	250	250,6 + 1,2	190	65
	315	315,7 + 1,3	212	80
	400	400,8 + 1,6	235	85
	500	501,0 +2,0	255	95
	630	631,9 + 2,0	288	100

Certificates, standards, reference documents for PVC-U sewage pipes and fittings

- EN 1401-1 – Plastic piping systems for non-pressure underground drainage and sewage - PVC-U.
- ITB National Technical Assessment
- Opinion of the Central Mining Institute regarding the application of PVC-U sewage pipes in mining damage areas.

DATA FOR DESIGNING

Allowable pressure, temperature, ring stiffness

The nominal pressure, PN, given by GAMRAT SA for pipes, is the maximum operating pressure for water of the temperature of 20°C. The operating temperature of PVC-U and PE pressure pipes is maximum of 40°C. Permissible operating pressure for water, P_{op} is calculated by the following formula:

$$P_{op} = PN \times k$$

Temperature [°C]	Coefficient „k”	
	PVC-U	PE
20	1,0	1,00
25	1,0	0,90
30	0,9	0,87
35	0,8	0,70
40	0,7	0,74

Values of the coefficient "k" for different temperatures and pipe materials are given in the table. When designing pressurized water and industrial networks, for determining the working pressure, one shall take into account the temperature and type of medium to be conveyed according to the table.

Scope of application	Type of conveyed liquid or gas	Operating temperature °C	Maximum operating pressure [MPa]		
1	Liquids and gases safe for the environment, not affecting significantly the properties of PVC-U and PE	20 40	0,6 0,4	1,0 0,6	1,6 1,0
2	Liquids and gases hazardous to the environment, not affecting significantly the properties of PVC U and PE	20 40	0,4 0,1	0,6 0,25	1,0 0,4
3	Liquids and gases deteriorating the properties of PVC-U and PE	20 40	0,25 -	0,4 0,1	1,0 0,4

Ring stiffness of PVC-U, PE pipes depending on the pressure, material and SDR

For PE pipes

SDR	41	33	26	21	17,6	17	13,6	11	9
PN (bar) for PE100	4	5	6	8	9,5	10	12,5	16	20
Minimum ring stiffness (kPa) SN	1	2	4	8	14	16	32	64	128

For PVC-U pressure pipes

SDR	41	34,4	33	26	21	17
PN (bar) for PVC 125	6	7,5	8	10	12,5	16
Minimum ring stiffness (kPa) SN	4	7	8	16	32	64

For PVC-U sewage pipes

SDR	51	41	34	29
Typ	Light	Medium	Heavy	Super-heavy
Minimum ring stiffness (kPa) SN	2	4	8	12

The tables show a summary of chemical resistances of PVC-U and PE, not subjected to mechanical stresses, at the temperatures of 20°C and 45°C.

Table of chemical resistance of PVC-U pipes

This list distinguishes three types of chemical resistance:
S – satisfactory resistance
L – limited resistance
N – unsatisfactory resistance

Details of the chemical resistance of plastics are given in ISO/TR 10358.

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Acetone	100%	N	N
Ethyl acrylate	100%	N	N
Crotonaldehyde	100%	N	N
Formaldehyde	up to 10%	S	L
Formaldehyde	40%	S	S
Acetaldehyde	40%	N	-
Acetaldehyde	100%	N	-
Allyl alcohol	96%	L	N
Amyl alcohol	100%	S	L
Ethyl alcohol	95%	S	L
Furfuryl alcohol	100%	N	N
Methanol	100%	S	L
Liquid ammonia	100%	L	N
Ammonia dry gas	100%	S	S
Ammonia water	up to 10%	S	L
Ammonium nitrate	saturated solution	S	S
Ammonium chloride	saturated solution	S	S
Ammonium fluoride	20%	S	L
Ammonium sulphate	saturated solution	S	S
Aniline	100%	N	N
Aniline	saturated solution	N	N
Aniline hydrochloride	saturated solution	N	N
Antimony chloride	90%	S	S
Benzaldehyde	0,10%	N	N
Benzene	100%	N	N
Gasoline (aliphatic hydrocarbons)	-	S	S
Gasoline (aliphatic hydrocarbons / benzene)	80/20	N	N
Acetic anhydride	100%	N	N

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Borax	saturated solution	S	L
Bromine liquid	100%	N	N
Butadiene	100%	S	S
Butane gas	100%	S	-
Buthanols	up to 100%	S	L
Butylphenol	100%	N	N
Chlorine dry gas	100%	L	N
Chlorine aqueous solution	saturated solution	L	N
Stannous chloride	saturated solution	S	S
Zinc chloride	saturated solution	S	S
Sugar	saturated solution	S	S
Cyclohexanol	100%	N	N
Cyclohexanone	100%	N	N
Dextrin	saturated solution	S	L
Yeast	up to 10%	S	L
Dichloroethane	100%	N	N
Dichloromethane	100%	N	N
Dimethylamine	30%	S	-
Ethyl ether	100%	N	-
Phenol	90%	N	N
Phenylhydrazine	100%	N	N
Phenylhydrazine hydrochloride	97%	N	N
Phosphorus trichloride	100%	N	-
Phosphine	100%	S	S
Glycerine	100%	S	S
Ethylene glycol	saturated solution	S	S
Glucose	saturated solution	S	L
Aluminum potassium alum	saturated solution	S	S
Aluminum chloride	saturated solution	S	S
Aluminum sulphate	saturated solution	S	S

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Hexadecanol	100%	S	S
Cresols	saturated solution	-	N
Xylene	100%	N	N
Adipic acid	saturated solution	S	L
Anthraquinone sulfonic acid	10%	S	L
Nitric acid	up to 45%	S	L
Nitric acid	from 50% to 98%	N	N
Benzoic acid	saturated solution	L	N
Boric acid	up to 10%	S	L
Hydrobromic	10%	S	L
Hydrobromic	50%	S	L
Bromo acid	10%	S	-
Chloroacetic acid	10%	S	L
Chlorosulfonic acid	100%	L	N
Chromic acid	from 1% to 50%	S	L
Citric acid	saturated solution	S	S
Diglycolic acid	18%	S	L
Hydrofluoric acid	40%	L	N
Hydrofluoric acid	60%	L	N
Hydrofluoric acid gas	100%	L	N
Tannic acid (tannin)	up to 10%	S	S
Glycolic acid	up to 30%	S	S
Maleic acid	saturated solution	S	L
Butyric acid	20%	S	L
Butyric acid	98%	N	N
Methylbenzoic acid	saturated solution	-	N
Lactic acid	10%	S	L
Lactic acid	from 10% to 90%	L	N
Formic acid	from 1% to 50%	S	L
Perchloric acid	10%	S	L
Perchloric acid	70%	L	N
Nicotinic acid	working solution	S	S
Acetic acid	25%	S	L
Acetic acid	60%	S	L
Acetic acid	glacial	N	N
Oleic acid	100%	S	S
Orthoarsenic acid	up to 10%	S	-
Orthoarsenic acid	saturated solution	S	L
Phosphoric acid	30%	S	L
Phosphoric acid	above 30%	S	S
Picric acid	saturated solution	S	S
Sulphurous acid	up to 10%	S	S
Sulphurous acid	from 40% to 90%	S	L
Sulphurous acid	96%	L	N
Fuming sulphuric acid (oleum)	10% SO_3	N	N
Hydrochloric acid	20%	S	L
Hydrochloric acid	above 30%	S	S

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Oxalic acid	up to 10%	S	L
Oxalic acid	saturated solution	S	S
Acid hexafluorosilicic	32%	S	S
Tartaric acid	up to 10%	S	S
Magnesium chloride	saturated solution	S	S
Magnesium sulphate	saturated solution	S	S
Molasses	working solution	S	L
Methyl methacrylate	100%	N	N
Copper chloride	saturated solution	S	S
Copper fluoride	2%	S	S
Copper sulphate	saturated solution	S	S
Milk	-	S	S
Urine	-	S	L
Urea	10%	S	L
Soap	up to 10%	S	L
Nickel sulphate	saturated solution	S	S
Vinegar	up to 80 g/l acetic acid	S	S
Amyl acetate	100%	N	N
Butyl acetate	100%	N	N
Ethyl acetate	100%	N	N
Vinyl acetate	100%	N	N
Oils and fats	-	S	S
Lead acetate	up to 10%	S	S
Lead acetate	saturated solution	S	S
Tetraethyl lead	100%	S	-
Ozone	100%	S	S
Pyridine	up to 100%	N	-
Beer	-	S	S
Potassium nitrate	saturated solution	S	S
Potassium bromide	saturated solution	S	S
Potassium chloride	saturated solution	S	S
Potassium chromate	40%	S	S
Potassium cyanide	above 10%, but not saturated solution	S	S
Potassium dichromate	40%	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	saturated solution	S	L
Potassium hydroxide	above 10%, but not saturated solution	S	S
Potassium ferricyanide	saturated solution	S	S
Potassium ferrocyanide	saturated solution	S	S
Liquid propane	100%	S	-
Liquid sulphur dioxide	100%	L	N
Sulfur dioxide, dry	100%	S	S

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Hydrogen sulphide gas	100%	S	S
Sodium benzoate	35%	S	L
Sodium chloride	saturated solution	S	S
Sodium chloride	saturated solution	S	S
Sodium hypochlorite (13% chlorine)	100%	S	L
Sodium sulphite	saturated solution	S	L
Sodium hydrosulphide	saturated solution	S	S
Sodium hydroxide	up to 10%	S	S
Sodium ferricyanide	saturated solution	S	S
Sodium ferrocyanide	saturated solution	S	S
Silver nitrate	saturated solution	S	L
Oxygen	100%	S	S
Toluene	100%	N	N
Trichloroethylene	100%	N	N

Chemical substance name	Concentration	Temperature	
		20°C	45°C
Tri-hydroxymethyl propane	up to 10%	S	L
Calcium nitrate	50%	S	S
Calcium chloride	saturated solution	S	S
Carbon tetrachloride	100%	N	N
Carbon disulphide	100%	N	N
Carbon dioxide	saturated solution	S	L
Wet gas carbon dioxide	-	S	S
Carbon dioxide dry gas	100%	S	S
Wine	-	S	S
Seawater	-	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	S
Photographic developers	saturated solution	S	S
Ferrous chloride	saturated solution	S	S

Chemical resistance of polyethylene pipes (details are given in ISO/TR 10358)

Chemical resistance of polyethylene pipes – used classification:

Resistance	Swelling	Weight loss	Elongation at breaking
S = sufficient	< 3%	< 3%	No change
L = low	3–8%	0,5–5%	Reduced by less than 50%
U = unsatisfactory	> 8%	> 5%	Reduced by more than 50%

Applicability:
Y – yes
N – no
R – with limitations

[1] – Change of colour at high temperature.
[2] – Hardening at 60°C
[3] – Hardening
[4] – Softening and deforming
[5] – Slightly softening

Item	20°C	40°C	Applicability
ALCOHOLS:			
aliphatic (+C6)	S	S	Y
allyl	S	L	R
ethyl 100%	S	S	Y
benzyl	S	S	Y
butyl	S	S	Y
ethanol 96%	S	S	Y
ethanol 100%	S	L	R
furfuryl	S	L	R
isoamyl	S	-	Y
Isopropyl 100%	S	S	Y
methyl	S	L	Y
propargyl	S	S	Y
n-propyl	S	S	Y
isopropyl 60%	S	-	Y
ACIDS:			

Item	20°C	40°C	Applicability
Acetylsalicylic acid	S	S	Y
Nitric acid			
· from 0 to 30%	S	L	R[1]
· from 30 to 50%	L	U	N
· from 95 to 98%	U	U	N
Vapours of nitric acid	S	S	Y
Benzene-sulfonic acid	S	S	Y
Benzoic acid - 100% aqueous solution saturated	S	S	Y
Boric acid (all concentrations)	S	S	Y
Succinic acid until the saturation	S	S	Y
Acid, chloroacetic:			
· mono 50%	S	S	Y
· 100%	S	L	R
· di- 50%	S	S	Y
· 100%	S	L	R[1]

Item	20°C	40°C	Applicability
· tri- 10 up to 50%	S	S	Y
Chlorosulfonic acid 100%	U	U	N
Hydrochloric acid (hydrochloric acid), all concentrations	S	S	Y
Hydrochloric acid (hydrogen chloride)	S	S	Y
Chromic acid:			
· 20%	S	S	Y
· 50%	S	S	Y
· 80%	S	U	R[1,2]
· concentrated 100%	L	U	N
Hydrocyanic acid	S	S	Y
Citric acid (all concentrations)	S	S	Y
Acid, ethylene-diamino-tetraacetic	S	S	Y
Fluoro-boronic acid	S	S	Y
Fluorosilicic acid			
· 32%	S	S	Y
· concentrated	S	S	Y
Hydrofluoric acid			
· 40%	S	L	R
· 60%	S	L	R
· 70%	S	L	R
Phosphoric acid			
· from 0 to 85%	S	S	Y
· from 85 to 90%	S	L	R
· 95%	S	U	R
Phosphoric acid 50%	S	S	Y
Gallic acid	S	S	Y
Tannic acid (tannin)			
· 1%	S	S	Y
· 10%	S	S	Y
Glycolic acid (hydroxyacetic acid)			
· 30%	S	S	Y
· 70%	S	S	Y
malic acid	S	S	Y
silicic acid	S	S	Y
maleic acid	S	S	Y
butyric acid	S	L	R
(sq. methyl-sulfonic acid)	S	S	Y
The lactic acid from 10 to 90%	S	S	Y
Formic acid	S	S	Y
Formic acid 85%	S	S	Y
Perchloric acid			
· 20%	S	L	R
· 50%	S	L	R
· 70%	S	U	N
Acetic acid			
· from 1 to 10%	S	S	Y

Item	20°C	40°C	Applicability
· from 10 to 60%	S	L	R
· from 80 to 100%	S	U	R
· Ice (100%)	S	L	R
oleic acid	S	L	R
Palmitic acid 10%	S	L	R
Picric acid (1% aqueous solution)	S	S	Y
propionic acid			
· 50%	S	L	R
· 100%	S	L	R
Salicylic acid	S	S	Y
	S	S	Y
Sulphurous acid	6%	S	L[R2]
Sulphurous acid			
· 10%	S	S	Y
· 50%	S	S	Y
· 70%	S	L	R[3]
· 80%	S	L	R[3]
· from 95 to 98%	L	U	N
Fuming sulphuric acid (oleum)	U	U	N
Mixture of sulphuric and chromic acid	L	U	N
Acid, sulphur-hydrogen	S	S	Y
Stearic acid	S	L	R
Oxalic acid	S	S	Y
Fatty acids (more than +C6)	S	S	Y
Carbonic acid	S	S	Y
Tartaric acid	S	S	Y
Aqua regia	U	U	N

OILS:

Peanut oil	S	S	Y
Corn oil	S	L	R
Corn germ oil	S	S	Y
Coconut oil	S	S	Y
Linseed oil	S	L	R
Peppermint oil	S	S	Y
Mineral oil	S	S	Y
Cottonseed oil	S	L	R
Grapeseed oil	L	U	R[3]
Olive oil	S	S	Y
Palm oil	S	S	Y
Paraffin oil	S	S	Y
Vegetable oil	S	S	Y
Castor oil	S	L	R
Engine oil	S	S	Y
Soybean oil	S	S	Y
transformer oil	S	L	R
Vaseline oil	S	S	Y
Cod liver oil	S	S	Y

Item	20°C	40°C	Applicability
PERFUMES AND COSMETICS			
Brilliantine (Hair)	S	-	Y
Hand cream	S	-	Y
Nail polish	S	-	Y
Tanning oil	S	-	Y
Aftershave	S	-	Y
Lipstick	S	-	Y
Shampoo (Hair)	S	-	Y
FOOD PRODUCTS			
Coca cola	S	S	Y
Horseradish	S	S	Y
Sugar (sucrose)	S	S	Y
Yeast	S	S	Y
Jam	S	S	Y
Glucose	S	S	Y
Glucose	S	S	Y
Tea	S	S	Y
Cocoa	S	S	Y
Coffee	S	S	Y
Ketchup (from tomatoes)	S	S	Y
beef tallow	S	S	Y
Mayonnaise	S	S	Y
Margarine	S	S	Y
Marmalade	S	S	Y
Butter	S	S	Y
cocoa butter	S	S	Y
Flour	S	S	Y
Honey	S	S	Y
Milk	S	S	Y
Mustard	S	S	Y
Vinegar	S	S	Y
Olives	S	S	Y
Beer	S	S	Y
Processed vegetables	S	S	Y
Fruit pulp	S	S	Y
Cheese	S	S	Y
Lard	S	S	Y
Beet juice	S	S	Y
Salt	S	S	Y
Wine	S	S	Y
Gelatine	S	S	Y
VARIOUS CHEMICAL COMPOUNDS:			
2-methyl-n-pentanol	S	L	R[1]
Acetophenone	S	S	Y
Acetone	S	L	Y[5]
Benzaldehyde	S	S	Y

Item	20°C	40°C	Applicability
Acetaldehyde	S	L	R
Aliphatic esters	S	from S to L	from Y to R
Alums (all types and at all concentrations)	S	S	Y
Formic acid amide	S	S	Y
Acetic acid amide	S	U	R
Aniline	S	S	Y
Asphalt	S	L	R
Benzene	L	U	R[4]
Anisole (methoxybenzene)	L	U	R[4]
Methyl benzoate and ethyl	S	S	Y
White spirit	L	L	N
Anhydrides:			
· phosphoric acid	S	S	Y
· acetic acid	S	L	R
· sulfurous acid	S	S	Y
· sulfuric acid	U	U	N
· carbonic acid	S	S	Y
Bitumen and tar	S	S	Y
Borax ($Na_2BaO_7 \times H_2O$)	S	S	Y
Methyl bromide (Bromoethane)	L	-	R
Bromo-chloromethane	U	U	N
Butane gas and liquid	S	S	Y
Butyl glycol	S	S	Y
Butyl glycolate	S	S	Y
Chlorine:			
· liquid	U	U	N
· gas	L	U	N
· wet	L	U	N
Antimony chloride ($SbCl_3$)	S	S	Y
Barium chloride	S	S	Y
Stannous chloride ($SnCl_2$)	S	S	Y
Phosphorus chloride (PCl_3)	S	L	R
Phosphoryl chloride (POCl)	S	L	R
Lead chloride (PbCl2)	S	S	Y
Sulfuryl chloride ($SoCl_2$)	U	U	N
Thionyl chloride ($SOCl_2$)	U	U	N
Chlorobenzene	L	U	N
Chloroethane	L	L	N
Chloroethanol	S	L	R[1]
Chloroform	U	U	N
Chloromethane	U	-	N
Chloropentan 100%	L	L	N
Brake fluid	S	S	Y
Naphthas	S	L	R
Cyclohexane	S	L	R
Cyclohexanol	S	L	R
Cyclohexanone	S	L	R
Tetra-bromo-ethane	U	U	N

Item	20°C	40°C	Applicability
Tetra-chloro-ethane	L	U	N
Tetra-ethyl lead	S	L	R
Tetrahydro-furan	L	U	N
Tetrahydro-naphthalen	L	U	N
Carbon tetrachloride	U	U	N
D-glucose and dextrin	S	S	Y
Decalin (dziesięciowodo ronafta-technical flax)	L	U	N
Di-chloroethane	L	L	N
Di-chloroethylenes	U	U	N
Dibutyl phthalate	S	L	R
Dichlorobenzene	L	U	N
Dichloromethane	U	U	N
Diheksylo phthalate	S	S	Y
Dimethylamine	L	U	N
Dimethyl-acetyl-aldehyde and Biphenyl-acetyl-aldehyde	S	S	Y
Dimethyl phthalate	S	-	Y
Dimethylformamide	S	L	Y
Dimethyl sulfoxide	S	S	Y
Dinonyl phthalate	S	S	Y
Dioctyl phthalate	S	S	Y
Dioxan	S	S	Y
carbon disulphide	L	U	N
Carbon dioxide	S	S	Y
Emulsifiers	S	L	R
Emulsions:			
· acrylic	S	S	Y
· photographic	S	S	Y
Epichlorohydrin-hydryna	S	S	Y
1.2 ethanediol (ethylene glycol) (for vehicle radiators)	S	S	Y
Bis-glycol ether (diethyl glycol, glycol)	S	S	Y
Petroleum ether	S	U	R
Ethers:			
· dibutyl	L	U	N
· diethyl	L	-	R
· isopropyl	L	U	N
Ethylene diamine	S	S	Y
Ethyl-monochloro	S	S	Y
Ethylbenzene	L	L	N
Phenol at 90%	S	S	Y
Fluorine	U	U	N
Formaldehyde 40%	S	S	Y
phosphorus butyl	S	L	R
tributyl phosphate	S	S	Y
phosphate trójkrezylowy	S	S	Y[1]
Phosphates (metal salts in aqueous solutions)	S	S	Y

Item	20°C	40°C	Applicability
freon	L	U	N
Fructose	S	S	Y
Furfural 100% (2-formylofural)	S	S	Y
petrol	S	from S to L	from Y to R
Glycerine	S	S	Y
Ethylene glycol	S	S	Y
propylene glycol	S	S	Y
Glucose	S	S	Y
Heptane	S	L	R
Hydrazine	S	S	Y
Hydroquinone	S	L	R
Camphor	L	U	N
Ketones	S	from S to L	from Y to R
Cresol	S	L	R[1]
Xylene	L	U	N
Cumene	L	L	R
Sodium bisulphite	S	-	Y
Latex	S	S	Y
Tallow	S	S	Y
Molasses	S	S	Y
Ethyl butyrate	S	L	R
Menthol (6-hydro-thymol)	S	L	R
Methoxybutanol	S	L	R
Methyl-dichloro-acetate	S	S	Y
Methyl glycol	S	S	Y
Methyl-monochloro	S	S	Y
Methyl-paracresol	S	S	Y
Methyl-salicylate	S	-	Y
Methylacetophenone	S	S	Y
Methylcyclohexane	L	U	N
Copper	S	S	Y
Urea (saturation)	S	S	Y
Sodium peroxide (Na202)	S	-	Y
Naphthalene	S	L	R
Nicotine	S	S	Y
Nitrobenzene	S	L	R
Nitroethane	S	L	R
Nitromethane	S	L	R
Acetic acid nitrile (acetonitrile)	S	S	Y
Ethyl acetate	L	U	N[4]
Ethyl acetate	S	L	R[5]
Tin	S	S	Y
Aluminium acetate	S	-	Y
Oil	S	S	Y
Ortonitrotoluen	S	L	R
Azote	L	U	N
Paraffin	S	S	Y
Perchloro-ethylene	L	U	N

Item	20°C	40°C	Applicability
Phosphorus pentoxide (P205)	S	S	Y
pyridine	S	L	R
Sodium hypochlorite	S	L	R
Sodium hydrosulphite (hydrosulfite)	S	S	Y
liquid propane	S	S	Y
Propergol	S	S	Y
Solutions for metallization			
Chromium, copper, cadmium			
Gold, nid, lead, nickel, rhodium,			
Silver, tin, zinc	S	S	Y
Sulphate chlorohydrin	U	U	N
Sulphates and sulphites (of all types in aqueous solution)	S	S	Y
Colloidal sulphur	S	S	Y
Hydrogen sulphide	S	S	Y
Starch	S	S	Y
Ammonium salts:			
• nitrate	S	S	Y
• chloride	S	S	Y
• fluoride, 20%	S	S	Y
• meta phosphate	S	S	Y
• persulfate	S	S	Y
• acetate	S	S	Y
• thiocyanate	S	S	Y
• sulphate and sulphite	S	S	Y
• carbonate	S	S	Y
Chromium and chromium salts in aqueous solutions	S	S	Y
Aluminium salts (in aqueous solution)	S	S	Y
Magnesium salts (in aqueous solution)	S	S	Y
Nickel salts (in solution)	S	S	Y
Mercurous salts and mercury	S	S	Y
Styrene	L	U	N
Rayon (viscose)	S	S	Y
Talc	S	S	Y
Turpentine	U	U	N
Tetralines (C10H12)	S	U	R
Thiophenes	L	L	N
Ammonium thiolacetate	S	S	Y
Carbon monoxide	S	S	Y
Toluene	U	U	N
Antimony trichloride	S	S	Y
Trichloro-benzene	L	U	N
Trichloroethylene	L	U	N
Petrolatum	S	S	Y
Bismuth carbonate	S	S	Y

Item	20°C	40°C	Applicability
Hydrocarbons:			
· aliphatic	S	L	R
· aromatic	S	L	R
Water	S	S	Y
Bromine water	U	U	N
Chlorine water	S	L	R
Seawater	S	S	Y
Hydrogen peroxide:			
· 30%	S	S	Y
· 100%	S	U	N
Hydrazine hydrate	S	S	Y
Bee wax	S	U	R
All ferrous salts	S	S	Y
All potassium salts (in aqueous solution)	S	S	Y
All silver salts (in solution)	S	S	Y
All salts of calcium (in sol.)	S	S	Y
Photographic developer	S	S	Y
Epoxy resins	S	S	Y

MAINTENANCE MEANS:

Item	20°C	40°C	Applicability
Denatured alcohol	S	L	R
Inks (inks)	S	L	R
Soaps	S	L	R
Rust remover	S	S	Y
Shoe polish	S	-	Y
Standard detergents (liquid and powder)	S	S	Y
Concentrated detergents	S	S	Y
Drainage measures	S	-	Y
Wetting means	S	S	Y
Aqueous solution of bleach	S	-	Y
Wax for polishing	S	L	R

PHARMACEUTICAL PRODUCTS:

Item	20°C	40°C	Applicability
Aspirin	S	-	Y
Methylene blue	S	-	Y
Eucalyptus	S	-	Y
Glycerine	S	-	Y
Magnesia (MgO or MgCO3)	S	-	Y
Tincture iodine	S	-	R[1]
Hydrogen peroxide	S	-	Y

ALCALIS:

Item	20°C	40°C	Applicability
Ammonia (all concentrations)	S	S	Y
Ammonia gas	S	S	Y
Barium oxide 30%	S	S	Y
Whitewash 30%	S	S	Y
Magnesium hydroxide (in solution)	S	S	Y
Potassium hydroxide 30%	S	S	Y

Coefficients: pressure networks

Rules of calculation pressure pipelines are given in necessary standards. The liquid flow in the pipeline causes pressure losses. They arise as a result of friction of the liquid along the pipe wall (pipeline losses) and flow disturbances on fittings (local losses). Relevant factors for pressure piping systems:

- viscosity of water at temp. 10°C – 1,306 × 10^{-6} m^2/s
- water density 1000 kg/m^3
- absolute roughness (k) shall be taken for pipe diameters:

	≤ 200 mm	> 200 mm
PVC-U	0,02 mm	0,05 mm
PE	0,01 mm	0,015 mm

The tables show the values of r and K for PVC-U and PE produced by GAMRAT SA. They were calculated for the water of the temperature of 10°C and the flow velocity of 1 m/s. Since the coefficient λ, which affects the values of the coefficients r and K varies a little, given coefficients can be applied for the water at 0-20°C and the velocity of 0.5 to 2 m/s

Pipeline hydraulic conductivity K [m^3/s] for PVC-U

D [mm]	SDR 41 (PN 6)	SDR 26 (PN 10)	SDR 17 (PN 16)
16	-	0,0004145	-
20	-	0,0007468	-
25	-	0,001473	-
32	-	0,002991	-
40	-	0,005453	-
50	-	0,009762	-
63	0,1962	0,01793	0,01526
90	0,5005	0,04553	0,03884
110	0,08766	0,08125	0,07160
160	0,2324	0,2153	0,1911
225	0,5527	0,5119	0,4525
250	0,7260	0,6730	0,5968
280	0,9762	0,9053	0,8015
315	1,328	1,229	1,089
400	2,473	2,291	2,030
450	3,360	3,113	2,756
500	4,415	4,094	3,624
630	8,057	7,463	6,578

Pipeline hydraulic conductivity K [m^3/s] for PE100 pipes

D [mm]	SDR 21	SDR 17	SDR 13,6	SDR 11
20	-	-	-	0,000585
25	-	-	0,001226	0,001226
32	-	0,002661	0,002611	0,002319
40	0,005212	0,005135	0,004688	0,004199
50	0,009888	0,009215	0,008467	0,007561
63	0,01815	0,01684	0,01545	0,01384
75	0,02856	0,02662	0,02436	0,02204
90	0,04605	0,04287	0,03929	0,03540
110	0,07757	0,07239	0,06668	0,05986
125	0,1084	0,1015	0,09310	0,08341
40	0,1458	0,1364	0,1251	0,1124

D [mm]	SDR 21	SDR 17	SDR 13,6	SDR 11
160	0,2061	0,1930	0,1770	0,1587
180	0,2807	0,2622	0,2404	0,2159
200	0,3670	0,3432	0,3155	0,2829
225	0,4988	0,4662	0,4281	0,3842
250	0,6576	0,6146	0,5637	0,5064
280	0,8818	0,8250	0,7572	0,6805
315	1,199	1,120	1,028	0,9241
355	1,637	1,528	1,404	1,262
400	2,230	2,085	1,915	1,720
450	3,027	2,830	2,599	2,334
500	3,979	3,719	3,416	3,070
560	5,343	4,995	4,585	4,122
630	7,255	6,777	6,228	5,593

Pipeline relevant hydraulic resistance [s^2/m^6] for PVC-U pipes

D [mm]	SDR 41 (PN 6)	SDR 26 (PN 10)	SDR 17 (PN 16)	SDR 11
16	-	5 820 000	-	0,000585
20	-	1 793 000	-	0,001226
25	-	461 000	-	0,002319
32	-	111 800	-	0,004199
40	-	33 630	-	0,007561
50	-	10 490	-	0,01384
63	2 598	3 112	4 295	0,02204
90	399,2	482,4	662,8	0,03540
110	130,1	151,5	195,1	0,05986
160	18,51	21,58	27,39	0,08341
225	3,274	3,817	4,885	0,1124
250	1,898	2,208	2,808	0,1587
280	1,049	1,220	1,557	0,2159
315	0,5669	0,6621	0,8434	0,2829
400	0,1635	0,1905	0,2428	0,3842
450	0,08857	0,1032	0,1316	0,5064
500	0,05129	0,05965	0,07616	0,6805
630	0,01541	0,01796	0,02311	0,9241
355	1,637	1,528	1,404	1,262
400	2,230	2,085	1,915	1,720
450	3,027	2,830	2,599	2,334
500	3,979	3,719	3,416	3,070
560	5,343	4,995	4,585	4,122
630	7,255	6,777	6,228	5,593

Pipeline relevant hydraulic resistance [s^2/m^6] for PE100 pipes

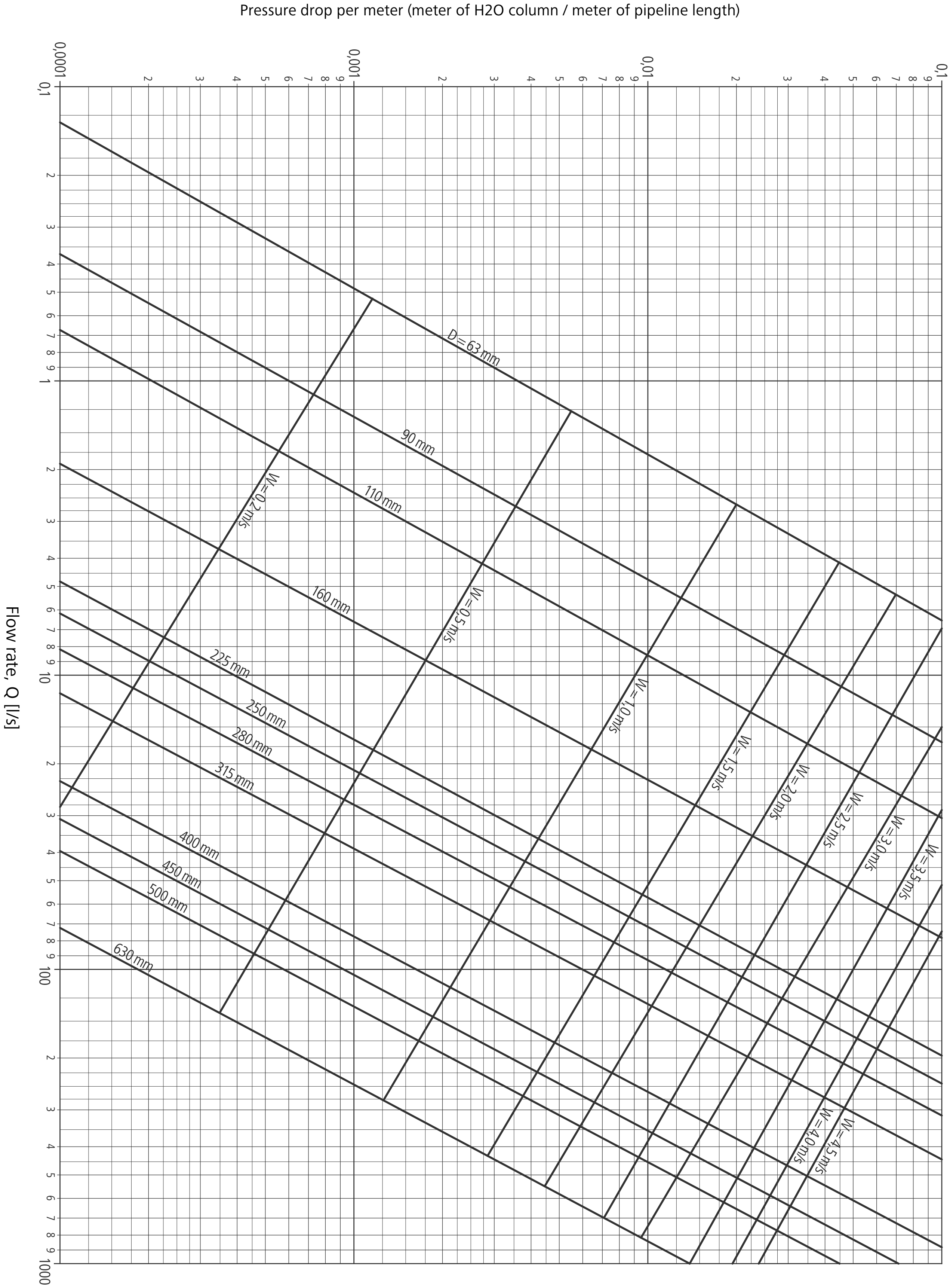
D [mm]	SDR 21	SDR 17	SDR 13,6	SDR 11
20	-	-	-	2 923 000
25	-	-	665 400	665 400
32	-	141 200	146 700	186 000
40	36 820	37 930	45 490	56 720

D [mm]	SDR 21	SDR 17	SDR 13,6	SDR 11
50	10 230	11 780	13 950	17 490
63	3 037	3 525	4 190	5218
75	1 226	1 411	1 685	2059
90	471,6	544,2	647,8	798,2
110	166,2	190,8	224,9	279,1
125	85,12	97,02	115,4	143,8
140	47,06	53,78	63,86	79,10
160	23,53	26,84	31,90	39,69
180	12,69	14,54	17,30	21,45
200	7,423	8,490	10,05	12,50
225	4,020	4,600	5,458	6,775
250	2,312	2,647	3,147	3,899
280	1,286	1,469	1,744	2,159
315	0,6951	0,7970	0,9460	1,171
355	0,3733	0,4285	0,5073	0,6282
400	0,2011	0,2299	0,2728	0,3380
450	0,1091	0,1248	0,1480	0,1836
500	0,06316	0,07228	0,08569	0,1061
560	0,03503	0,04008	0,04756	0,05885
630	0,01900	0,02177	0,02579	0,03197

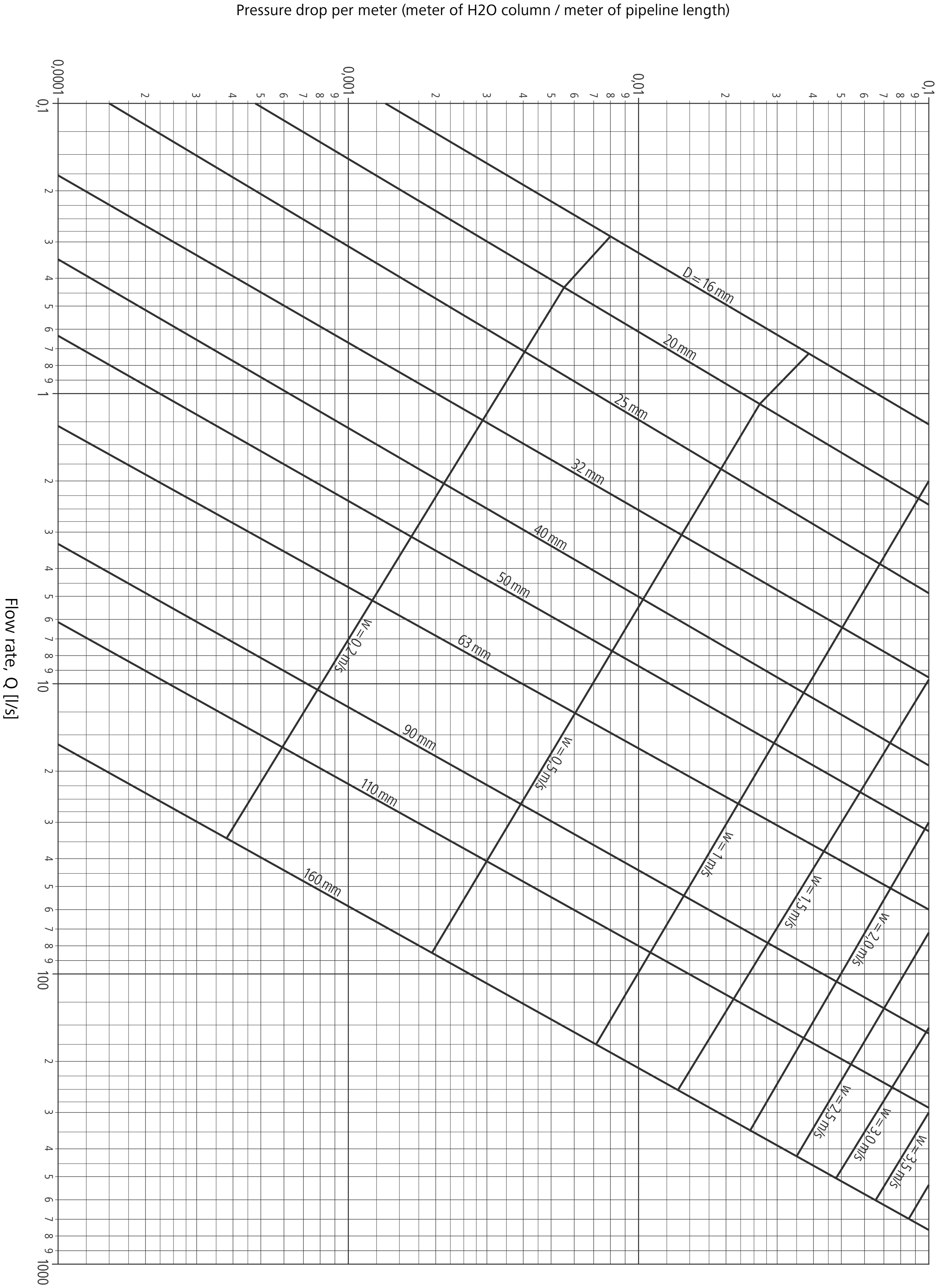
Nomograms allow you to solve tasks faster. They show the relationships between flow rate Q [l/s], pipe diameter D [mm], hydraulic gradient I [meter of H2O column / meter of pipeline length] and flow velocity [m/s]. Nomograms were calculated for water flows at 10°C. If the total loss is assumed to be hs when calculating the slope, then L should be increased by an appropriate percentage due to existing local losses.

Using the charts consists in finding, for two known parameters, a point in the nomogram field and reading the values of the other two parameters. For example, for a flow rate of 10 l/s in PE100 pipeline, PN 10, D = 110 mm, the hydraulic gradient is 0.018 and the velocity is about 1.35 m/s.

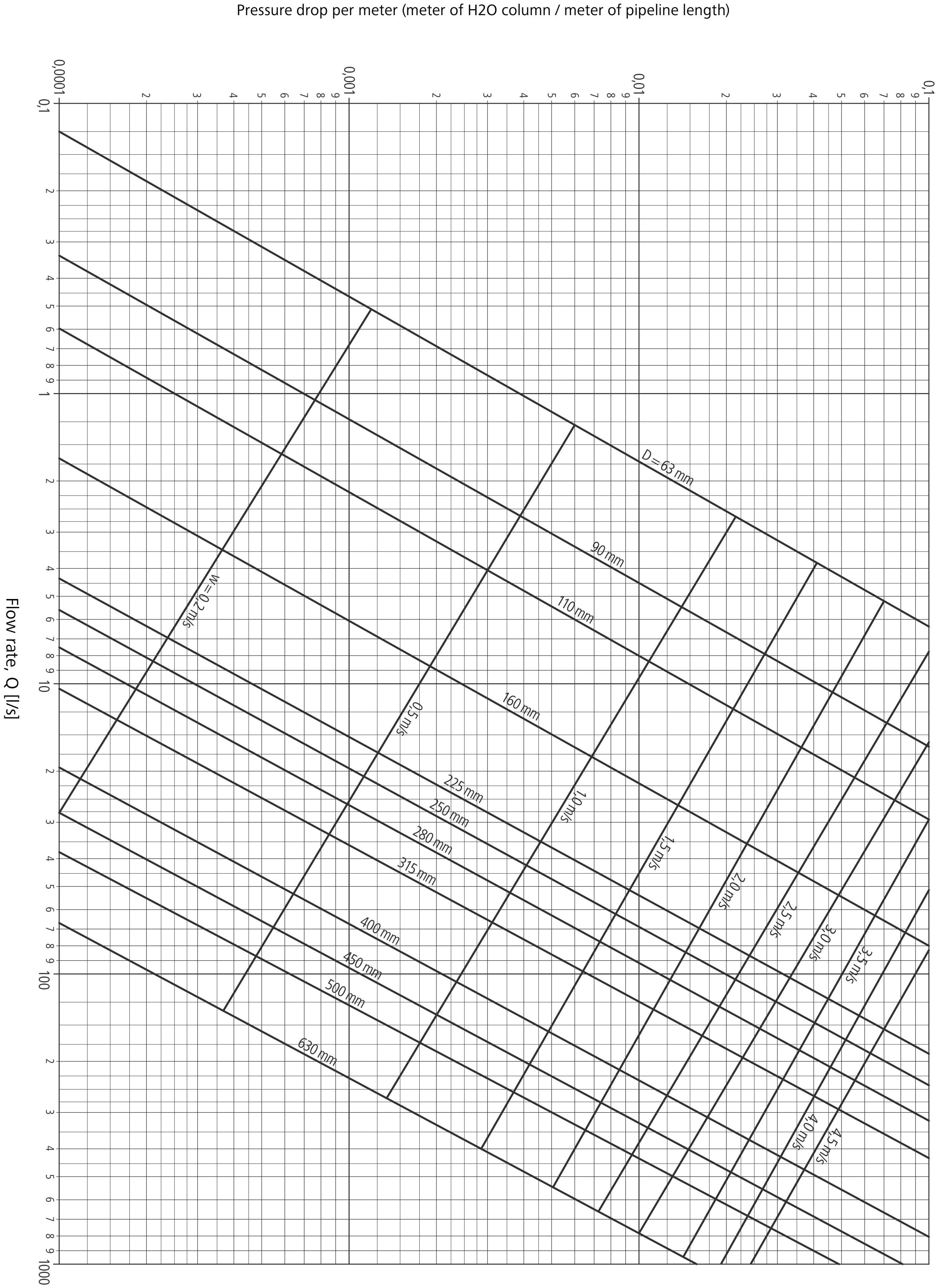
PVC socketed pipes PN 6,3



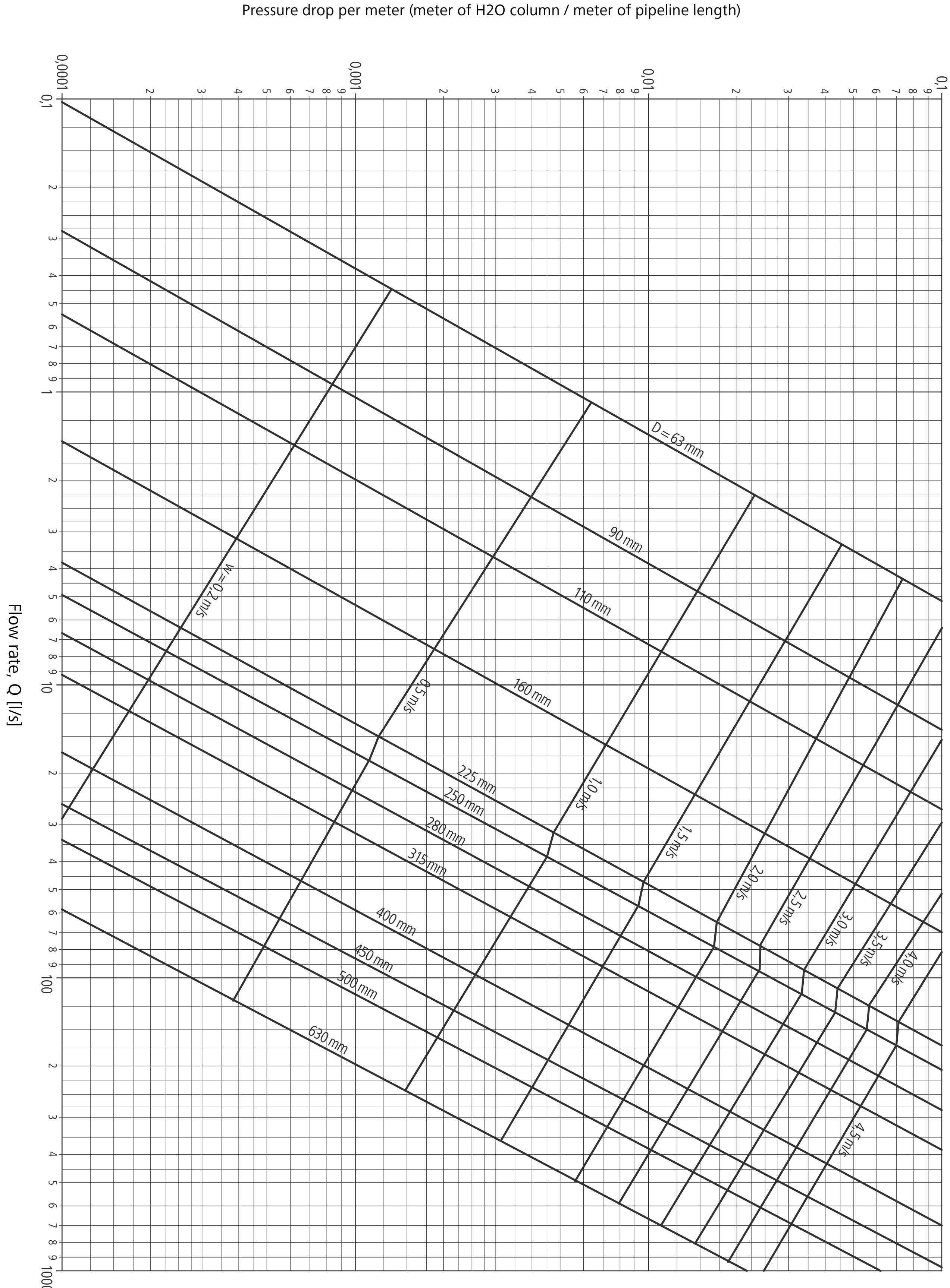
PVC plain-end pipes PN 10



PVC socketed pipes PN 10



PVC socketed pipes PN 16



Coefficients and nomograms: sewage systems

Recommended flow velocities, filling heights, slopes:

	Sanitary sewage	Col.m.ined sewage	Rainwater sewage
Min. velocity [m/s]	0.8	1.0	0.6
Max. velocity [m/s]	5.0	7.0	7.0

The given minimum velocities ensure the so-called "self-cleaning" of sewage pipes.

Filling:

Due to the ventilation of sanitary sewage pipes, the maximum filling height must not exceed:

- 60% for diameters of 160-315 mm
- 70% for diameters of 400-500 mm
- 80% for diameters equal to or greater than 630 mm

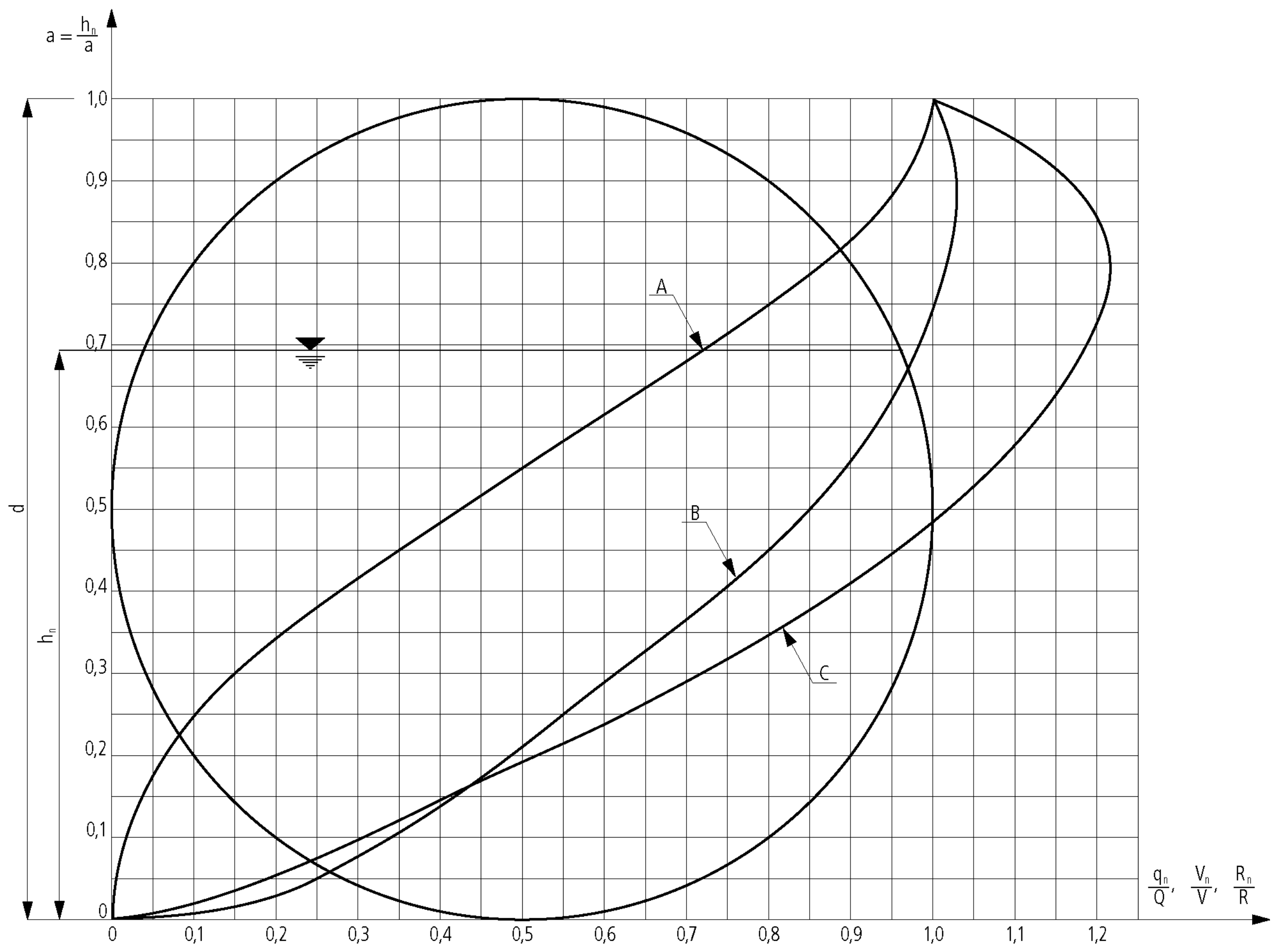
For rainwater sewage pipes, a maximum filling height of up to 100% may be assumed for all diameters.

Slopes:

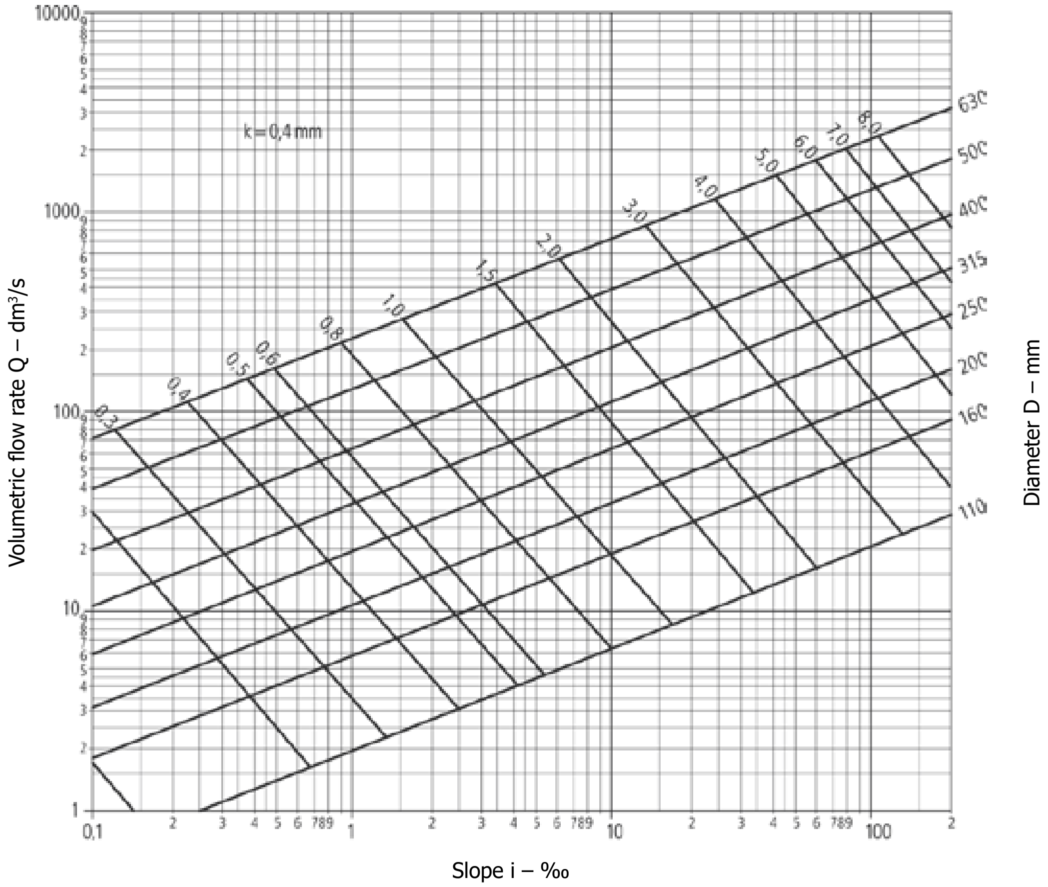
The minimum slopes should be the slopes calculated from the converse of the inner diameter of a sewage pipe. With the assumed slope and design flow rate, the calculated flow velocity and the sewage pipe filling height should not exceed the above mentioned limit values.

Friction coefficient "k":

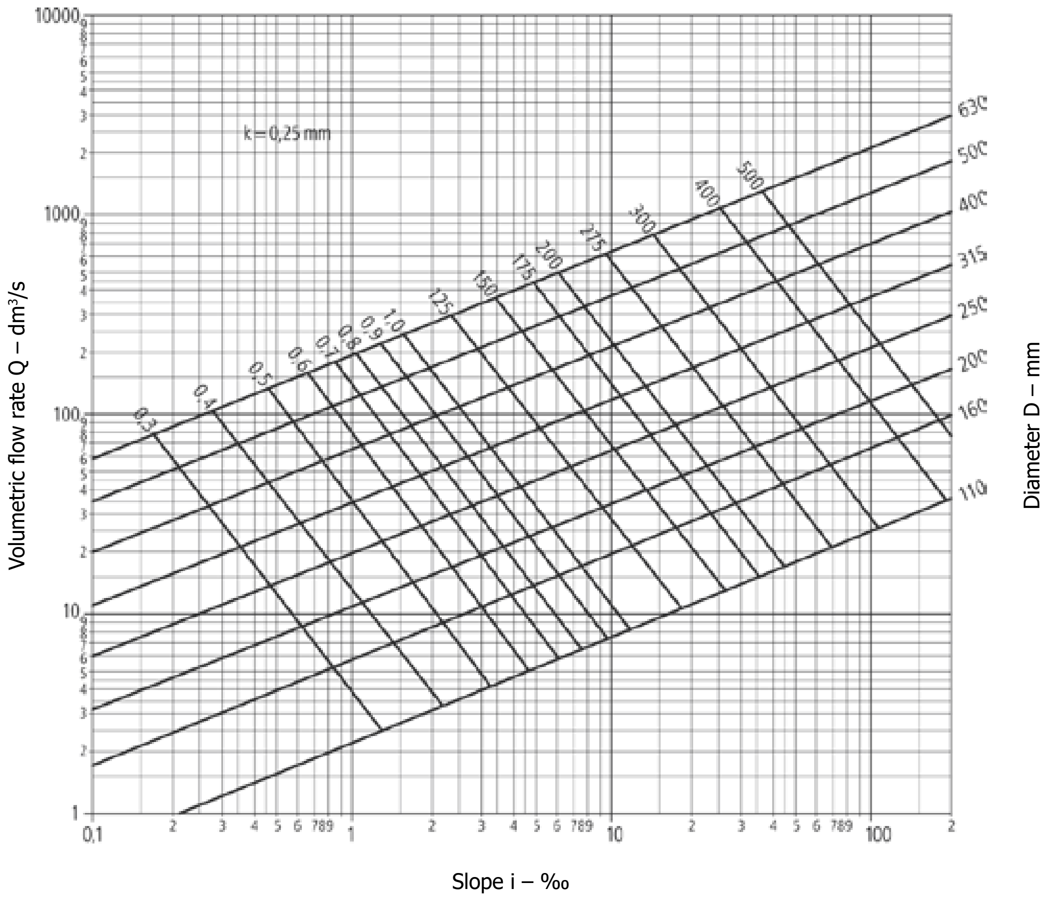
For the hydraulic calculation of the sewage lines for sewage pipes with side inlets, the coefficient "k" = 0.4 mm is recommended. For transit sewage pipes without side inlets, the coefficient "k" = 0.25 mm may be used.



Nomogram: dependence of flow rate, sewage velocity and hydraulic radius from sewage pipe filling level



Nomogram for calculating flow rates in PVC-U pipes with total filling
according to Prandtl-Colebrook's equation at k = 0.40 mm and temperature of 10°C

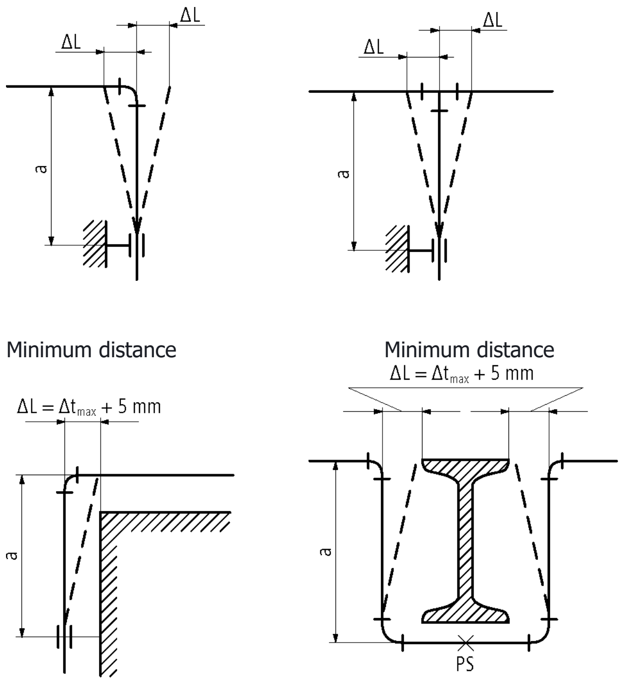


Nomogram for calculating flow rates in PVC-U pipes with total filling
according to Prandtl-Colebrook's equation at k = 0.25 mm and temperature of 10°C

Coefficients and nomograms: technical installations

Linear expansion of pipes
At fluctuating temperatures, PVC-U and PE pipelines, as well as those made of other materials, are increasing or decreasing in length. The coefficient of linear expansion of PVC-U pipes is a = 0.08 mm / m°C and that of PE pipes is a = 0.20 mm / m°C. In the case of PVC-U it is about seven times, and in the case of PE about twenty times the coefficient of linear expansion for steel pipes. The necessity to use compensation devices depends on the method of connecting pipes, their location, the material they are made of and the extent of temperature fluctuations.

Self-compensation application
The use of self-compensation in the form of a flexible arm is the simplest and cheapest way of taking into account the thermal expansion of PE and PVC-U pipes. The length of the flexible arm "a" is practically dependent on the diameter of the pipe and the amount of thermal elongation. For the design and construction purposes, the temperature of the pipe wall, as the third parameter influencing the behaviour of the "flexible arm", is not taken into account, assuming that the temperature of laying the pipes is within the range from +5°C to 25°C. The use of a flexible arm takes place when changing the direction of the pipeline, branching, as well as bypassing an obstacle, e.g. an Ibeam



Example of application of self-compensation – flexible arms in the installation.

Calculation of thermal expansion

The value of linear thermal expansion of PE and PVC-U pipes is determined by the formula:

$$\mathbf{\Delta L = L \times \Delta t \times a}$$

where:
ΔL = expansion value [mm]
L = length of pipe section [m]
Δt = temperature difference between the installation temperature of the pipeline and the maximum operating temperature or the minimum operating temperature [°C]
a = coefficient of linear expansion of pipes [mm / m °C]: PE – 0.20; PVC-U – 0.08

Note: If the operating temperature of the pipeline is higher than the installation temperature, the pipeline will be increasing in length, if the operating temperature is lower, the pipeline will be decreasing in length. Therefore, both the installation temperature and the minimum and maximum operating temperatures must be taken into account in the calculations.

Determination of the length of a flexible arm
For PE pipes any thermal expansion ΔL, the length of a flexible arm "a" may be determined from the following formula:

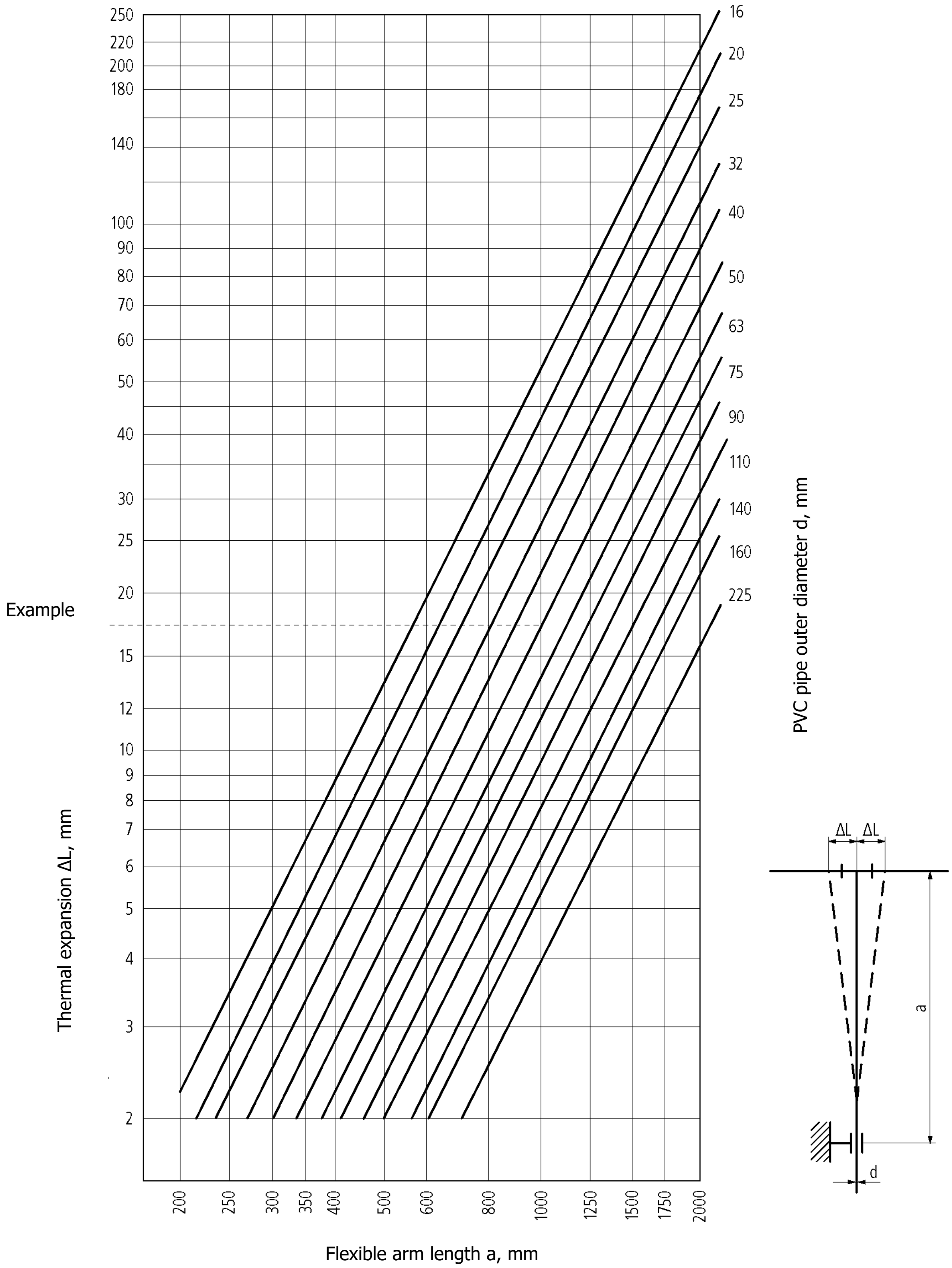
$$\mathbf{a = 26\sqrt{d \times \Delta L}}$$

and for PVC-U pipes, from the following formula (values a, d, ΔL in mm):

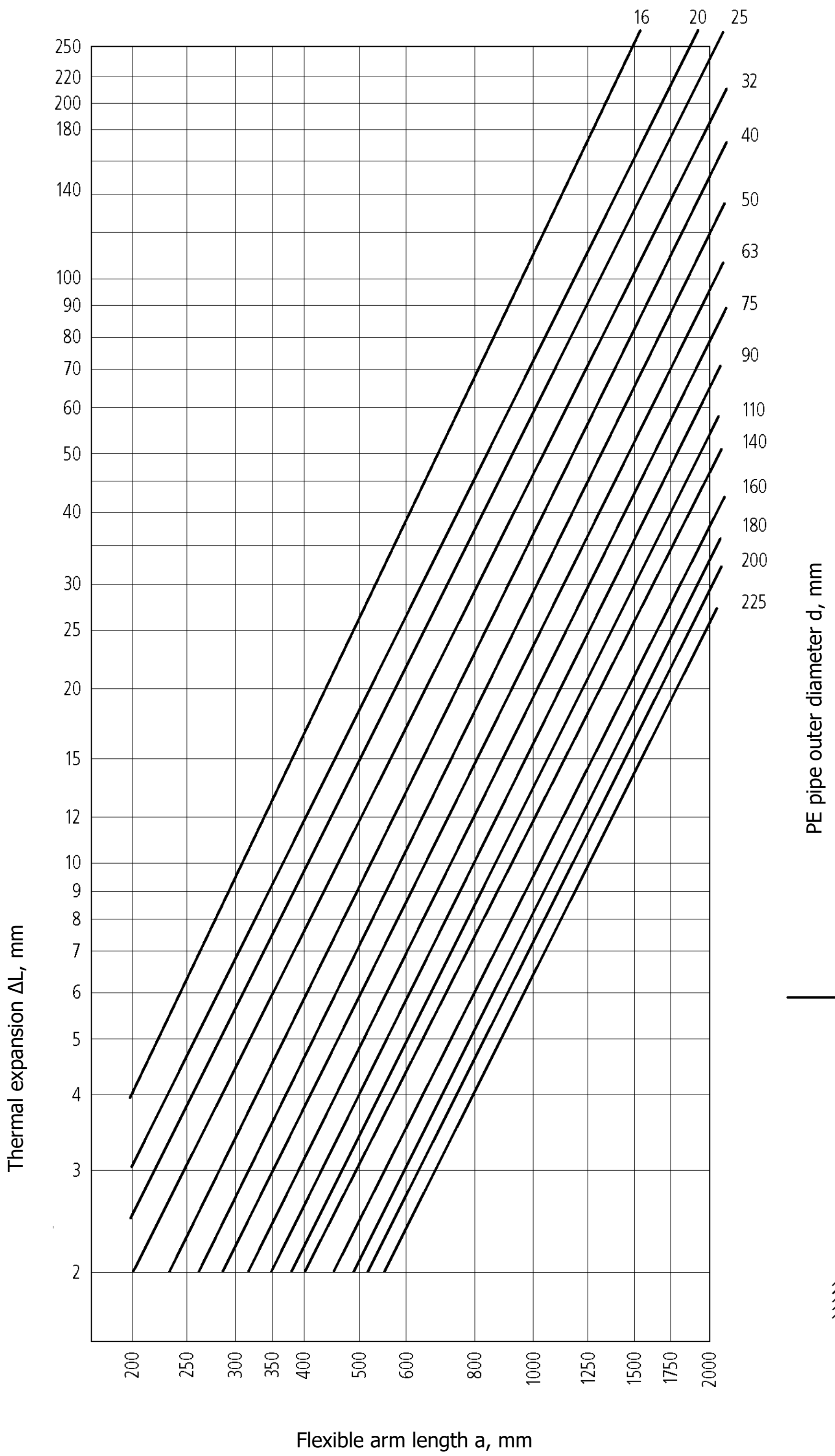
$$\mathbf{a = 35\sqrt{d \times \Delta L}}$$

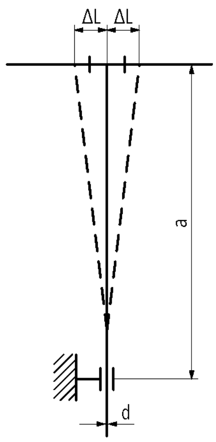
Alternatively, you may use attached nomograms.

Nomogram for determining the length "a" of a flexible arm depending on the value of thermal expansion ΔL for PVC-U pipes at +20°C.



Nomogram for determining the length "a" of a flexible arm depending on the value of thermal expansion ΔL for PE pipes at +20°C.





Example: In order to emphasize the problem of thermal expansion, we assumed a refrigerating system:

- pipeline length from the fixed point PS to the bend L = 8 m,
- pipe laying temperature: t_u = 15°C,
- operating temperature of refrigerating brine t_1 = −12°C,
- system defrosting temperature t_2 = +35°C,
- PVC-U pipeline.

Temperature differences:

$\Delta t_1 = t_u - t_1 = 27°C$

$\Delta t_2 = t_2 - t_u = 20°C$

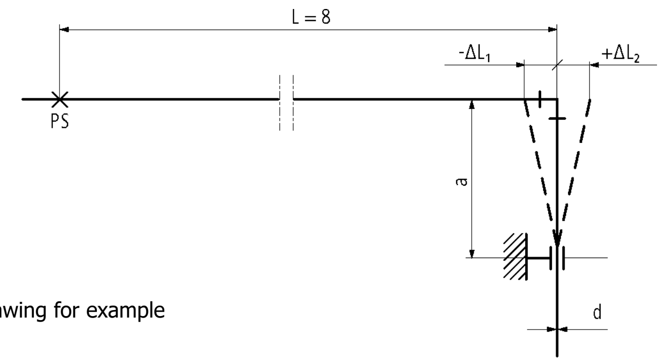
Pipeline decreasing in length at the operating temperature of the refrigerating brine:

$- \Delta L_1 = L \times \Delta t_1 \times a = 8 \times 27 \times 0.08 = 17.28$ mm

Pipeline increasing in length when defrosting:

$+ \Delta L_2 = L \times \Delta t_2 \times a = 8 \times 20 \times 0.08 = 12.08$ mm

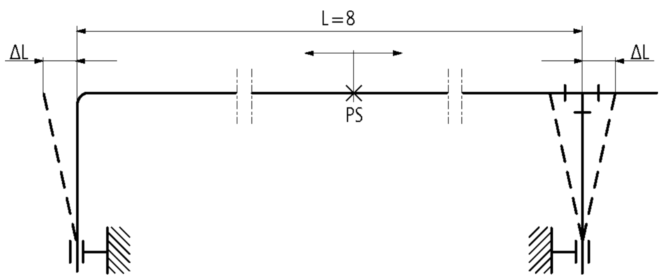
To determine the length of the flexible arm, a higher calculation value is assumed regardless of the sign "+" or "−".



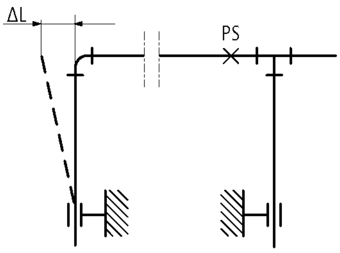
Drawing for example

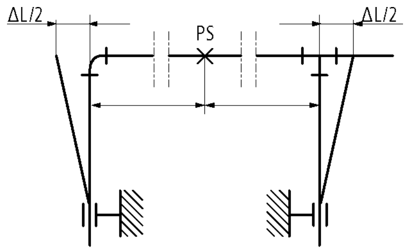
Guidelines for fixing pipeline at compensation points

The change in length and the direction of the movement of the section of pipeline subjected to thermal expansion must always be clearly determined by the use of fixtures – fixed brackets PS. With the correct location of the fixed brackets on the pipeline, a favourable division of the thermal expansion of the relevant pipeline section is obtained. For fixed brackets, it is not permitted to use structures in which a pipe is restrained by clamping around its perimeter. Fixed points shall be constructed using stops, which may be plastic fittings. If a flexible arm cannot be placed when changing direction or at a branch point, or if longer lengths are to be taken into account for straight pipeline sections, a U-shaped compensator may be used. In this case, the section in question must be divided into two parts by a fixed point PS. With reference to the example given, it follows that if the length change ΔL = 17.28 / 2 = 8.64 mm, the length of the bending (flexible) arm is a = 700 mm instead of 1000 mm.

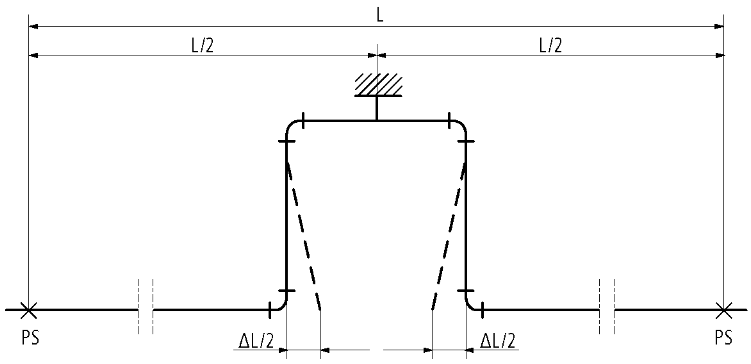


Example of application of fixed brackets PS





Example of application of fixed brackets PS



Application of a U-shaped compensator over a long distance of a pipeline

Laying of pipelines on supports

When laying pipes on trestle bridges, walls or in ducts, the following factors must be taken into account
- medium temperature
- al.m.ient temperature
- UV radiation
- thermal expansion

The following tables show maximum spacing of pipe supports for PVC-U and PE pipes.

Maximum spacing of pipe supports for PVC-U pipes

Outer diameter D	Pressure pipes PN 6 and type "N" and "S" sewage pipes		Pressure pipes PN 10 and PN 16	
[mm]	20°C	40°C	20°C	40°C
16	-	-	0.80	0.70
20	-	-	0.90	0.80
25	-	-	0.95	0.85
32	-	-	1.05	0.90
40	-	-	1.20	1.10
50	-	-	1.40	1.30
63	-	-	1.50	1.40
90	1.50	1.50	1.50	1.50
110	1.50	1.50	2.00	1.50
160	2.00	2.00	2.00	2.00
200	2.00	2.00	2.00	2.00
225	2.00	2.00	3.00	2.00
250	3.00	2.00	3.00	3.00
280	3.00	3.00	3.00	3.00
315	3.00	3.00	3.00	3.00
400	3.00	3.00	3.00	3.00

Outer diameter D	Pressure pipes PN 6 and type "N" and "S" sewage pipes		Pressure pipes PN 10 and PN 16	
[mm]	20°C	40°C	20°C	40°C
500	3.00	3.00	3.00	3.00
630	4.00	4.00	4.00	4.00

Maximum spacing of pipe supports for PE100 pipes

Outer diameter D	Pressure pipes PN 8 SDR 17		Pressure pipes PN 12.5 SDR 11	
[mm]	20°C	40°C	20°C	40°C
20	0.45	0.40	0.45	0.40
25	0.50	0.45	0.50	0.45
32	0.60	0.55	0.60	0.55
40	0.65	0.60	0.75	0.70
50	0.70	0.65	0.75	0.70
63	0.80	0.75	0.90	0.85
75	0.95	0.85	1.05	0.95
90	1.15	1.05	1.25	1.15
110	1.30	1.20	1.40	1.30
125	1.40	1.30	1.60	1.45
160	1.70	1.60	1.90	1.75
180	1.90	1.75	2.10	1.95
200	2.05	1.90	2.25	2.10
225	2.25	2.10	2.45	2.30
250	2.40	2.20	2.65	2.45
280	2.60	2.40	2.90	2.70
315	2.85	2.65	3.15	2.95
400	3.40	3.20	3.80	3.50

Basic recommendations for squeezing PE pipes manufactured by "GAMRAT" S.A. Jasło

Polyethylene pipes manufactured by GAMRAT S.A. Jasło enables the use of squeeze-off techniques for emergency stopping the gas flow during a failure, which is confirmed by product type tests. Important features of polymers (PEHD, PEMD) used in the production of pipes for the supply of gaseous fuels are their mechanical properties. Changes in these properties under the influence of deformation as a result of squeezing a pipe in order to close its bore have a significant impact on the strength of the gas pipeline, and thus on the safety of its operation.

All works on the gas network, including the process of squeezing PE pipes, should be carried out on the basis of instructions for gas-hazardous work obligatory in individual gas companies and on the basis of the Regulation of the Minister of Economy of 28 Decel.m.er 2009 on the Occupational safety and health while constructing and operating gas networks and commissioning natural gas systems, Official Journal of the Republic of Poland 2010. No. 2, item 6.

The process of squeezing polyethylene pipes follows the same procedures for pipes made of PE100 and PE100RC, while observing all regulations and conditions concerning both the activities performed and the equipment used for this purpose.

Rules of procedure for squeezing PE pipes

1. Pipe squeeze-off should only be used in case of emergency using original company equipment and in compliance with the following recommendations:
- pipe squeeze-offs must be fitted with:
• mechanical stops to prevent pipe damage by excessive compression;
• a safety mechanism to prevent accidental release of the squeeze-off bars;
• a mechanism for determining the compression rate and the release rate of the squeeze-off.
2. Before squeezing the a pipe, check the wall thickness of the pipe.
3. Adjust the size of the squeeze-off tool to the pipe. The squeeze-off tool must be equipped with properly set squeeze-off stops adjusted to the dimensions of the pipe to be squeezed.
4. The distance between the squeeze-off and a butt weld, electrofusion weld or installed fitting must not be less than 3 x D (where D - nominal diameter of pipe) or 300 mm, whichever is greater.
5. The pipe should be squeezed between two parallel bars of circular cross-section, where one is a fixed and the other is a movable bar.
6. The surfaces of the squeeze-off bars must not be damaged as they may cause additional damage to the pipe surface during squeezing.
7. Do not insert any additional elements (planks, rags) between the pipe and the squeeze-off working elements.
8. Both bars should have a circular cross-section and rigidity to ensure an even gap between and along the bars when squeezing. The diameters of both squeeze-off bars must be the same and must comply with the following table:

Table 1.
Squeezing levels:

Outer pipe diameter	Minimum bar diameter	Squeezing level, L
(mm)	(mm)	(%)
do 63	32,0	80
75 – 110	38,0	80
125 – 200	50,0	80
225 – 400	74,0	80 – 90
450 – 630	90,0	90

- the final distance eq in mm between the squeeze-off bars should be calculated using the equation:

$$e_q = 0{,}02\ L \times e_{min}$$

where:
e_{min} – minimum wall thickness of a given pipe
L – squeezing level in accordance to the table

The squeezing level **L** in **%** is the ratio of the distance between the squeeze-off bars in mm and the double minimum wall thickness of the e_{min} in mm

9. The pipe should be positioned between the squeeze-off bars so that a right angle is reached between the axis of the pipe and the axes of the bars.

1. Start squeezing the pipe by flattening the pipe between the working elements at the specified rates:

Table 2.

Al.m.ient temperature	Compression rate
°C	(mm/min)
< = 0°C	5
10	10
20	10
25	Max 15

- For pipes with a diameter greater than 63 mm, squeezing shall be stopped for one minute when the pipe is half flattened and for another one minute when the flattening of the pipe reaches 75 %. For pipes of all diameters, also a 1-minute hold in squeezing is to be made when the inner surfaces of the pipe wall have come into contact with each other. This time is needed to compensate for occurring stresses.
- After a 1-minute hold following the inner surfaces of the pipe coming into contact with each other, continue squeezing at a rate reduced to half the previous value until the working elements of the squeeze-off tool come into contact with the stops.
- If necessary or required, a pressure relief valve shall be used.

NOTE: As the squeeze-off may not stop the flow completely, a venting or drain valve may be required for 100% shut--off efficiency. In this case, two squeeze-offs must be used and the pipe section between them must be vented. The distance between the squeeze-offs must not be less than 6 x D or 600 mm, whichever is greater. All works must then be carried out behind the second squeeze-off.

2. When squeezing pipes, the corresponding rates of the squeeze-off bars must be used. As a general rule, the compression and release rates should be as low as possible. The release rate is a more important parameter. The pipe must have sufficient time to compensate for pipe wall stresses during squeezing. Therefore, the process of releasing the squeeze-off tool must be much longer and carried out in stages. This applies especially to pipes with walls of higher thickness. Releasing the squeeze-off bars must not be carried out at a rate greater than 1 cm/min.

- After completion of the work, the squeeze-off tool must be released according to the following criteria:

Table 3.

Al.m.ient temperature	Release rate
°C	(mm/min)
< = 0°C	5
10	10
20	10
25	10

- Squeeze-off releasing should be carried out in stages. The first 1-minute hold occurs at the point of contact between the inner surfaces of the pipe wall for diameters above 63 mm. Subsequent 1 minute hold should be made at ¼ open point (¾ close) and at ½ open point (½ close).

3. It is not recommended to conduct squeezing pipes at temperatures above 25°C, whereas at temperatures close to 0°C or lower, the compression rate should be decreased by half and holds increased twice. Low temperatures reduce the elasticity and plasticity of polyethylene. Additional heating of the pipe, e.g. by a heater, is not allowed, because with high thermal resistance of polyethylene, raising the temperature will prevent safe use of the squeeze-off
4. After the squeeze-off has been completely released, turn the squeeze-off on the pipe by 90° and restore its circular shape (similar to the circular one) very slowly.

- Achieve a circular pipe shape by partially closing the squeeze-off tool until the desired effect is obtained. The compression and release rates must not exceed the values in Tables 2 and 3.
- Prestoring a circular shape of pipe cross-section constitutes a partial closure of the pipe. **DO NOT CLOSE THE PIPE COMPLETELY!**

5. The total time between the installation of the squeeze-off tool on a pipe and its removal must not exceed 8 hours. Exceeding this time may cause damage to the pipe.

NOTE: ELECTROSTATIC CHARGES
When squeezing a pipe, through which gas flows, the gas flow velocity increases in place where the inner diameter is decreased. The solids contained in the gas, the gas dryness of the high flow velocity cause electrostatic charges to build up on the pipe surface. This can lead to an explosion. Therefore, before starting the squeeze-off procedure, the squeeze-off tool must be earthed and appropriate safety procedures for static electricity must be followed throughout the squeeze-off procedure.

NOTE:
The location of a pipe squeeze-off should be marked to prevent the pipe from being compressed again in the same location. Any new squeeze-off point may be located at least 6 x D but not less than 600 mm from this pipe squeeze-off. The squeeze-off location should be secured with an identification band (containing information, e.g. date, parameters) or a full repair clamp (around the pipe circumference). This clamp should also be used for squeezing at temperatures close to 0°C and below.

NOTE:
If damage is found or suspected during squeezing operations, the damaged pipeline length must be replaced.

This procedure has been developed based on the following publications:

- Standard PN EN 12106, edition July 2002 – "Polyethylene (PE) pipes – Test method for the resistance to internal pressure after application of squeeze-off".

- "Sieci gazowe polietylenowe" (Polyethylene gas networks), 2006, 2nd edition extended, edited by A. Barczyński and T. Podziemski

- Włodzimierz Baranowski, "Wybrane właściwości rur z PE HD po zamknięciu przekroju przez zaciskanie podczas konserwacji lub naprawy rurociągu" (Selected properties of HD PE pipes after cross section closure by application of squeeze-off during pipeline maintenance or repair) – "Przetwórstwo Tworzyw" No. 3/2009.

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