RADPOL
PIPES

RC MULTIsafe®
RC MAXIprotect® PP/PE
PE 100 Smart 2L®



2025

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Pressure pipes RC MULTIsafe®1L, RC MULTIsafe®2L, RC MULTIsafe®3L and RC MAXIprotect® PP/PE-d and PE 100 Smart 2L® for infrastructural networks - general information

During the last few years the actions of Investors on the infrastructural networks construction market leads to searching for solutions in range of reducing the investment costs with use of the newest technologies. It refers either to construction of new pipelines, and to renovation of existing ones. Moreover, the pressure exerted on the Town and Community Councils, connected with compensation for difficulties occurring during the construction works requires using of modern and inexpensive technologies. Therefore the trenchless methods of installation of pipes or installation without using the sand bed and sand pack are commonly used, which significantly reduces the investment realization time. The newest trend is use of plastic products PE100 RC with an additional jacket and detection tape. It allows for better preparation and realization of investment in case of pipeline location necessity and increases its construction and operation safety to the maximum.
In order to use such pipes installation methods the products of multiple times higher resistance to the external damages and point loads are required.
We have developed **RC MULTIsafe®** and **RC MAXIprotect® PP/PE-d** systems for such criteria.

The **RC MULTIsafe®**system is based up the technology of:

- **single layer (RC MULTIsafe®1L) pipes** made of new generation plastics of class PE100 RC, as solid - all in a colour suitable for transported medium (dark blue, orange, green, or black), or black with colour stripes,
- **double-layer (RC MULTIsafe®2L)** made of new generation plastics of class PE100 RC, with the external layer in distinguishing colour,
- **triple-layer (RC MULTIsafe®3L)** made of new generation plastics of class PE100 RC, with the extreme layers in distinguishing colour.
  In both types of layered pipes all layers made from PE100 RC materials are connected with each other in a molecular way during the coextrusion stage and cannot be separated in a mechanical way.
  The thickness of layers may be selected individually in range of thickness and material according to the customer's needs.

The second system of pipes of increased strength and operating parameters is **RC MAXIprotect® PP/PE**. It has been developed on the basis of **RC MULTIsafe®**, pipes, equipped with an additional external protective jacket from PE100, PE100 RC, or PP modified in a mineral way, and detection tape beneath it, made of an aluminium, stainless steel, or copper.
Such solution assures the product additionally protected from the results of damages occurring outside of pipe. An additional jacket made of PE or PP is not connected in a molecular way with the internal carrier pipe. The detection tape beneath it allows for locating the pipeline after its installation.

The third system are layered **PE 100 Smart 2L®**, pipes, allowing for visual inspection of damages and scratches during each construction stage, made from PE100, conforming to PN EN 12201, PN EN 1555 and PN EN 12007.
The pipes are being made of the visual inspection layer thickness designed to be a visual indicator of deep damages. The visual inspection layer thickness is 10% of the wall thickness, according to the standard (i.e. EN 12007), and is made of a material in the distinguishing colour, suitable for the product application (gas, water, sewage).).

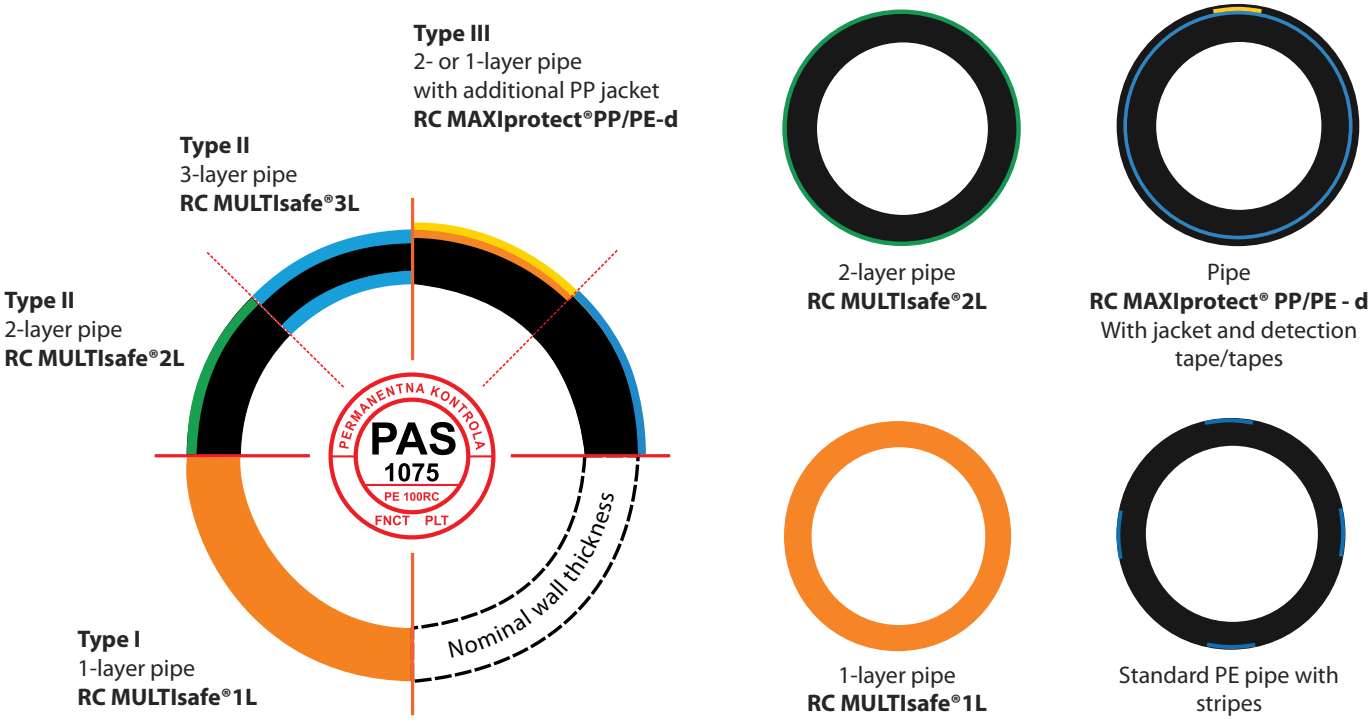


Fig. Types of PE100RC pipes available on the market - divided acc. to PAS 1075:2009-4.

Advantages of RC MULTIsafe® and RC MAXIprotect® PP/PE-d pipes

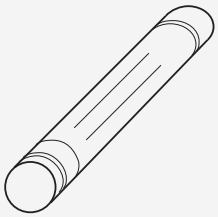
- the highest reliability thanks to use of materials of PE100 RC class and the newest plastics processing technology,
- resistance to point loads (dr. Hessel test),
- resistance to external damages ("notch test 8760 h" acc. to PN EN ISO 13479 - the standard requirement for pipes with protective layer),
- optimal for installation without sand bed and sand pack,
- suitable for trenchless installation,
- butt-welded, electrofusion, polyfusion-welded, and mechanically connected,
- compatible with standard PE100 pipes,
- detection tape allows for locating the pipeline route (**RC MAXIprotect®PP/PE-d**),
- additional pipe protection thanks to the external jacket made of PE or PP (**RC MAXIprotect®PP/PE-d**).

Characteristics of RC MULTIsafe® i RC MAXIprotect® PP/PE-d pipes

The results of **RC MULTIsafe®** pipes tests, realized in Hessel Ingenieurtechnik GmbH institute and in INiG in Kraków have confirmed their extraordinary resistance to the results of scratches or point loads, which may occur due to trenchless installation or assembly works.

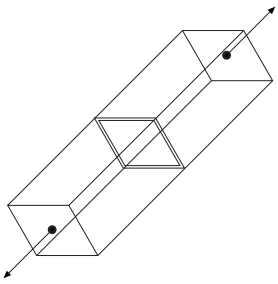
The characteristics of tests realized according to PAS requirements (Publicly Avaliable Specification) 1075:2009-04
- Polyethylene pipes (PE100-RC) for alternative installation methods.
Technical requirements and test - in order to conform the properties **RC MULTIsafe®** pipes.

Notch test
(Notch Test)



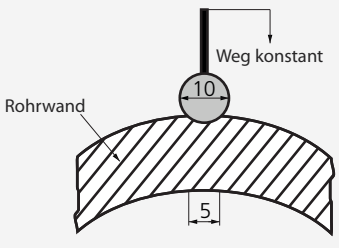
The notch test according to PN EN ISO 13479 is a pressure test, realized for the pipe sample notched on the surface, immersed in water of specified temperature, and subjected to specified hydrostatic pressure. The notch test allows for determining the pipe resistance to slow propagation of cracks.
The pipe should last 8760 hours without any damage
(**RC MULTIsafe®** >10 000 h).

Test FNCT
(Full Notch Creep Test)
+ **ACT test**



The FNCT test is realized for the sample in form of pipe sector or specially extruded board in order to show the resistance to environmental influence. The sample after notching is subjected to tensioning in Arkopal N-100. Arkopal solution in specified temperature.
For RC product the sample should last 3300 hours in such conditions without damage (acc. to ISO 1677).
(**RC MULTIsafe®** > 8760 h).

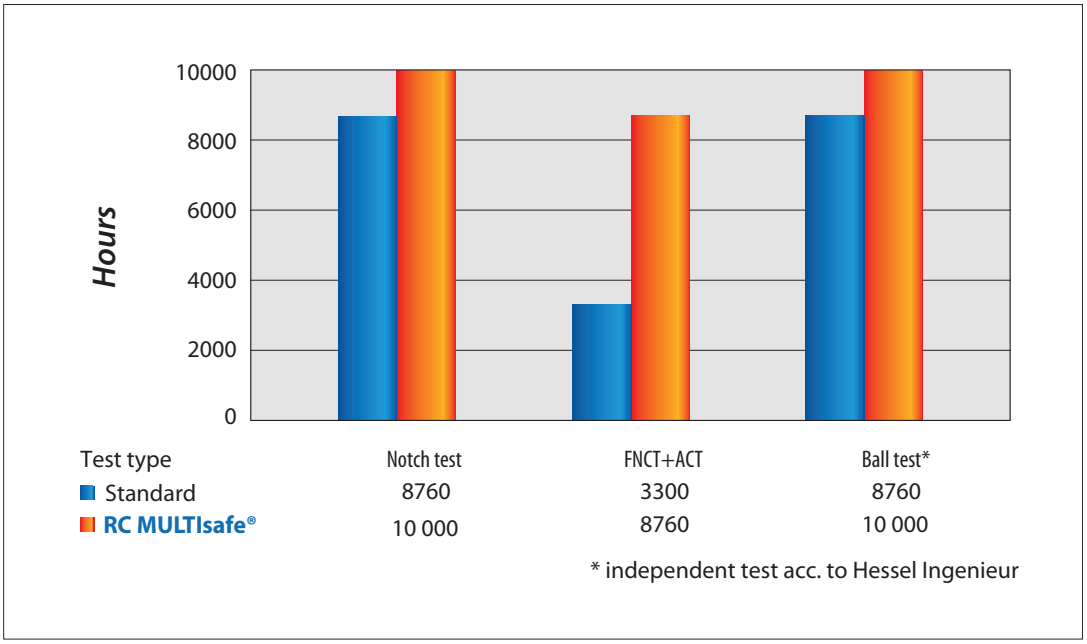
Ball test
(Point load test
according
to dr. Hessel)



Strecke senkrecht zum Rohrradius
Picture. Hessel Ingenieurtechnik

Ball test according to dr. Hessel, i.e. point load test, is used also for determining the material resistance to SCG (Slow Crack Grow).
The sample in form of pipe sector is subjected to the external point pressure in specified time and temperature.
The sample of RC material should last 8760 hours in such conditions without any damage.
(**RC MULTIsafe®** ≥ 10 000 h).

Test results according to PAS 1075:2009.04 specification, obtained for RC MULTIsafe® pipes



- Point load test (ball test) - required result obtained - test interrupted after 10000 hours.
- FNCT - required result obtained.
- Notch test - required result obtained - test interrupted after 10000 hours.

Properties	Method and parameters of test	Requirements acc. to PAS 1075	Result for RC MULTIsafe® and RC MAXIprotect® carrier pipes
Test FNCT (Full Notch Creep Test)	ISO 16770 parameters: 4 N/mm^2, 80°C, 2% Arkopal N-100	No damages (brittle cracking) during test time > 3300 h	time > 8760 h
Resistance to point loads	Dr. Hessel PLT test parameters: 4 N/mm^2, 80°C, 2% Arkopal N-100	No damages (brittle cracking) during test time > 8760 h	time > 10 000 h
Resistance to SCG (Slow Crack Growth) - Notch Test	PN-EN ISO 13479:2009 parameters: SDR 11, pressure 9.2 bar, temp. 80°C	no damages during test time > 8760 h	time > 10 000 h
Resistance to RCP (Rapid Crack Propagation)	ISO 13477:1997 critical pressure Pc ≥ 10 bar	propagation stop at Pc < 10 bar	propagation stop at Pc ≥ 12 ba

Tab. Basic parameters of tests for pipes of PE100 RC.

Approvals and certificates

RC MULTIsafe® have been successfully tested with use of notch test 10000 h - test of resistance to SCG according to PN-EN ISO 13479:2001, realized in **accredited** laboratory INIG in Kraków. The pipes have been successfully tested for SCG in accredited Hessel Ingenieurtechnik institute upon the basis of long-term tensile strength (FNCT+ACT) according to ISO 16770, lasting 8760 hours without any damage.
During the point load test (ball test) according to dr. Hessel the pipes lasted 10000 hours without any damage. The ACT and PLT tests (ball test) are realized in cycles according to PAS 1075:2009-4 requirements.
The pipes manufactured according to PAS1075 requirements and raw materials used for their production are subjected to continuous periodical tests, realized in accredited laboratories.
Those are expensive and time-consuming processes, but they assure continuous highest quality and possibility of documentation of manufacturing of products conforming to PAS1075.

For the drinking water and utility water (sewage) pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE-d** the documents of conformity with the Technical Approval / National Technical Assessment or European / Polish Standard are issued.

The National Institute of Hygiene has conformed with the hygienic certificate that pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE-d** fulfil all requirements for the drinking water transport pipes.

For gas pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE-d** the declaration of conformity with standard EN 1555:2012 is issued upon the basis of the national certificate of conformity, issued by ZBIA ZETOM in Katowice.

Gas pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE-d** are marked with the safety mark **„B"** upon the basis of certificate issued by ZBIA ZETOM in Katowice.
Other certificates of conformity for our range of products base on standards: EN12201, EN12007 and EN253 or other, for an individual request.

In the area of the mining damage the pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE** may be used according to the conditions included in the Technical Opinion of the Central Mining Institute.

Pipes **MULTIsafe®** and **MAXIprotect® PP/PE** for the drinking water and sewage transport have the technical approval / national technical assessment issued by the Building Research Institute.

Pipes **MULTIsafe®** and **MAXIprotect® PP/PE** for gas transport have the technical approval / national technical assessment issued by the Oil and Gas Institute.

Pipes **MAXIprotect® PP/PE** of diameters above 75 mm have the technical approval / national technical assessment, conforming their weldability without removing the PP jacket (under conditions specified in the approval document).

Pipes **MULTIsafe® RC** and **MAXIprotect® PP/PE** have approvals allowing for their use in the European Union, as well as in Russia, Belarus, Ukraine, Kazakhstan and Lithuania. The possibility of using in other countries and details of certificates are available in the company main office.

Current **certificates of conformity of pipes with PAS1075** and products covered with certification may be checked at: www.dincertco.tuv.com. The information of all certificates of manufacturers of pipes of such type is available.

The Hessel Ingenieurtechnik institute is an accredited laboratory, authorized to realize tests according to PAS 1075.
All types o **RC MULTIsafe®** pipes conform to requirements of specification PAS 1075:2009.04

All types of **RC MULTIsafe®** conform to requirements of PN, EN standards, which is confirmed by appropriate declaration of conformity:


DIN CERTCO
ZERTIFIKAT


DIN CERTCO
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СЕРТИФІКАТ ВІДПОВІДНОСТІ


ATEST HIGIENICZNY
HYGIENIC CERTIFICATE

Properties and applications of **RC MULTIsafe®** and **RC MAXIprotect®**

Due to their properties the polyethylene pipes of PE100RC are widely used in construction of underground networks for transport of gas fuels, water, and sewage.
In comparison with standard pipes of PE100, thanks to significantly higher resistance to scratches and point loads the pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE** allow for installation of pipelines in the virgin soil, without the sand bed and sand pack, and are indispensable in the trenchless technologies and renovation techniques.

The polyethylene pipes have the following advantages, comparing to the metal, concrete, or ceramic products:

- long operational life,
- high flexibility, allowing for using the in the areas of mining damage (Rurgaz has the positive opinion of the Central Mining Institute for the possibility of using the company products of PE100RC in the areas of mining damage of category I - IV),
- possibility of coiling pipes into longer lengths, leading to lower number of connections,
- resistance to most chemical compounds,
- resistance to corrosion,
- smooth internal surface, assuring insignificant flow resistance of transported liquids and preventing scale deposits (low roughness factor k = 0.01),
- resistance to low temperatures,
- low heat conductivity (no need of using the heat insulation),
- high durability and reliability of connections (welding),
- low weight,
- low installation, maintenance, and operation costs,
- environment-friendly during production and disposal.

Range of pipes manufactured by Rurgaz made of PE100 RC:

RC MULTIsafe® pipes:

- diameters from 25 mm to 630 mm for gas transport in orange colour, black colour with orange distinguishing layer, black colour with orange extreme layers, or black colour with orange stripes,
- diameters from 25 mm to 1000 mm for drinking water transport in dark blue colour, black colour with dark blue distinguishing layer, black colour with dark blue extreme layers, or black colour with dark blue stripes,
- diameters from 32 mm to 1000 mm for pressure and gravity sewage systems in green colour, black colour with green distinguishing layer, black colour with green extreme layers, or black colour with green stripes.

RC MAXIprotect® PP/PE pipes:
They consist in standard of the double- or triple-layer (sometimes single-layer) carrier pipe RC MULTIsafe® of parameters:

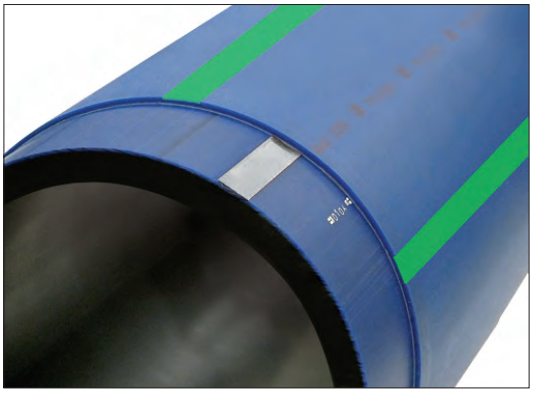
- diameters from 25 mm to 630 mm for gas transport in orange colour, black colour with orange distinguishing layer (2L), black colour with orange extreme layers (3L), or black colour with orange stripes,
- diameters from 25 mm to 630 mm for drinking water transport in dark blue colour, black colour with dark blue distinguishing layer (2L), black colour with dark blue extreme layers (3L), or black colour with dark blue stripes,
- diameters from 32 mm to 630 mm for pressure and gravity sewage systems in green colour, black colour with green distinguishing layer (2L), black colour with green extreme layers (3L), or black colour with green stripes..

The external jacket is made of minerally modified polypropylene PP, polyethylene PE100 or PE100 RC in colours depending on the application of pipes:

- (for gas) yellow with green stripes (PP), with white stripes (PE),
- (for drinking water) blue with green stripes (PP), with white stripes (PE),
- (for utility water/sewage) brown with green stripes (PP), with white stripes (PE), or
- black with yellow stripes (for gas) (PE),
- black with blue stripes (for drinking water) (PE),
- black with green stripes (for utility water/sewage) (PE).

The detection tape is available as an element of equipment of MAXIprotect PP/PE-d pipes and is made of:

- aluminium,
- (stainless) steel,
- copper (agreed individually with the manufacturer).



The pipe geometrical dimensions (wall thickness, pipe diameter) are connected with resistance to the internal pressure or external load. The ratio of external diameter to the pipe wall thickness is designated as SDR (Standard Dimension Ratio) as below:

$$SDR = dn/en$$

where: **dn** - nominal external diameter [mm] **en** - nominal wall thickness [mm]

SDR does not take the thickness of PP/PE protective jacket into consideration.

Application areas for the individual types of PE100 RC pipes

	Division acc. to PAS	Installation in native soil without sand bed and sand pack	Relining	Ploughing	Narrow-trench installation	Directional drill	Burstlining, cracking
RC MULTIsafe®1L	Typ I	●●●●●	●●●○○	●●●○○	●●●○○	●●●○○ (*)	●○○○○ (SDR 11)
RC MULTIsafe®2L	Typ II	●●●●●	●●●○○	●●●○○	●●●○○	●●●○○ (*)	●○○○○ (SDR 11)
RC MULTIsafe®3L	Typ II	●●●●●	●●●●○	●●●●○	●●●●○	●●●●○ (*)	●●○○○
RC MAXIprotect®PE	Typ III	●●●●●	●●●●○	●●●●○	●●●●○	●●●●○	●●●○○
RC MAXIprotect®PP	Typ III	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●

(*) - for diameters below 160 we recommend pipes from the series of types SDR 11
All pipe types listed above may be used for standard installation type.

Properties of RC MULTIsafe® and RC MAXIprotect® PP/PE-d pipes:

- tensile strength close to yield point, min. 22 MPa,
- ultimate elongation min. 350%,
- resistance to oxidation in OIT test above 30 minutes,
- resistance to SGP (Slow Crack Growth) - above 10000 hours,
- modulus of elasticity 1100 - 1200 MPa,
- hardness 58 - 62 Shore D,
- Vicat heat resistance (5 kg load) 65 - 74°C.

General remarks - design

The information below does not replace the designing guidelines and may be used as an auxiliary material only. All necessary information for the contractor must be included in the detailed design, prepared according to the valid regulations.

Parameters influencing the design and installation.

Allowable operating pressures PN (medium temperature up to 20°C).

- Water pipes PE100 and PE 100RC
  (**RC MULTIsafe®, RC MAXIprotect® PP/PE and PE 100 Smart 2L®**):
  - SDR 26 - 0,64 MPa
  - SDR 21 - 0,8 MPa
  - SDR 17 - 1,0 MPa
  - SDR 11 - 1,6 MPa
- Gas pipes PE100 and PE 100RC
  (RC MULTIsafe® i RC MAXIprotect® PP/PE and PE 100 Smart 2L®):
  - SDR 17 - 0,6 MPa
  - SDR 11 - 1,0 MPa

Instalation at low temperatures

In case of such necessity (e.g. pipeline failure) the welding station must be protected with use of tent. Take care of proper packing and compacting of the soil around the pipes, which is difficult in such conditions.

Special products for an individual design

It is possible to prepare the special produkct feauters different that shown in the catalogue. The use of other materials for an individual application of pipes is possible. Special UV protection layers, antistatic layers, antiabrasive layers, high temperaturę resistance pipes ara available uppon previous agreement.

Technological parameters of pipes made of PE100 RC

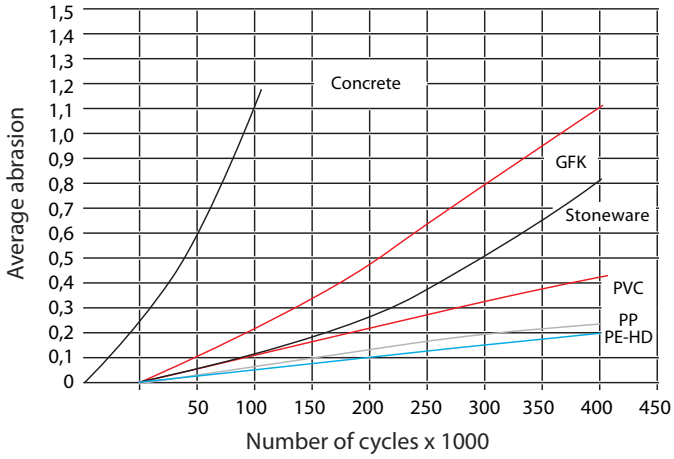
The relation between the operating pressure and the dimensional series SDR for transport of drinking water, utility water, and sewage is shown in the table below:

PE 100 and PE 100RC	
SDR	**PN** [bar]
41	4
33	5
26	(6,3)
21	8
17,6	9,6
17	10
13,6	12,5
11	16
9	20
7,4	25

Tab. Nominal operating pressure of pipes for drinking water, utility water, and sewage, depending on series of types and material class.

Due to chemical resistance of polyethylene and resistance to abrasion the pipes **RC MULTIsafe®** and **RC MAXIprotect®** may be widely used in renovation of old pipelines of pressure sewage systems and installation of new ones. PE pipes (PE 100 and PE 100RC) are resistant to water-induced corrosion. They are also very resistant to most chemical compounds in wide pH range (from 2 to 12), occurring in the municipal sewage of various origin, rain water, surface waters, and underground waters.

The detailed information of polyethylene chemical resistance are included in technical report (standard) ISO/TR 10358. The polyethylene pipes are extremely resistant to abrasion. Only polypropylene has better properties.
Both plastics significantly surpass other materials used for pressure and gravity sewage systems, which is shown in the chart:

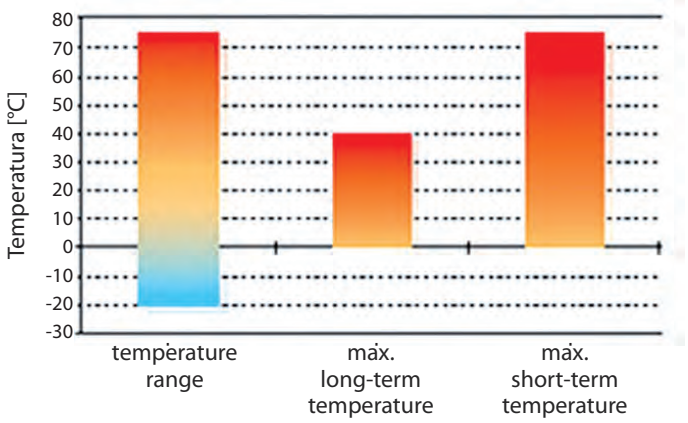


Average abrasion (abrasive wear) for various materials.
Abrasion chart acc. to Darmstadt

Value of k coefficient depending on temperature is shown in the table.

Temperature [°C]	**f_t coefficient** [abs.]
20	1,0
30	0,87
40	0,74
>40	ask RURGAZ for opinion

Allowable temperature range for PE-HD pipes



It is allowed to use the polyethylene pipes for operation in temperature above 20°C, max. 40°C.
Temperature is defined as a 12-month average temperature in PE pipe environment.
The allowable operating pressure in conditions of increased temperature is calculated as below:

$$Pr = PN \times k$$

where: **PN** - nominal pressure in bar f_t - coefficient depending on temperature

Keep in mind that above 40°C not only the pressure resistance but also the durability of pipes is reduced. The relation between durability and temperature is shown in the table below.

Extrapolated durability of PE pipes for constant temperature from od 20 to 80°C

Temperature	Time	Stress σ LCL	Stres σ LTHS
[°C]	[years]	[MPa]	[MPa]
20	109,7	10,9	11,2
40	109,7	8,41	8,69
60	10,9	6,68	6,92
80	2,19	5,17	5,37

The amount of linear thermal expansion of PE pipes is calculated as below: $\Delta L = L \times \Delta t \times \alpha$

where: **L** - length of segment subjected to expansion **Δt** - temperature difference

α - linear expansion coefficient, for HDPE 0,2 mm/m°C

PE 100RC pipes have high flexibility, but when the required curvature radius is lower than the allowable pipe bending radius, it is necessary to use the segment bends or injection-moulded bends. The bending radius depends on the pipe internal diameter and environment temperature during the pipeline installation

Ambient temperature	Minimum pipe bending radius (SDR<17)
[°C]	[m]
+ 20	20 x d_e
+ 10	35 x d_e
0	50 x d_e

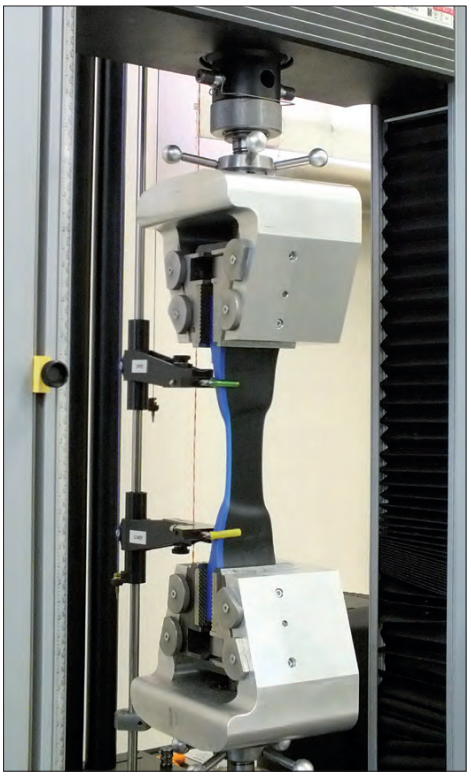
Gas engineering applications

The maximum operating pressure (MOP) for pipes and fittings used for construction of gas networks depends on the value of assumed safety coefficient (the minimum value is 2.0), provided that the minimum durability of pipes is 100 years and temperature is 20°C.

Gas networks are classified according to the following parameters:

- Low pressure networks (up to 0.1 bar, 10 kPa incl.)
- Medium pressure networks (up to 5.0 bar, 0.5 MPa incl.)
- Increased medium pressure networks (up to 16.0 bar, 1.6 MPa incl.)
- High pressure networks (above 16 bar, 1.6 MPa)

Use of PEHD pipes, including PEHD RC, is defined by standards EN 1555 and PAS1075, as well as guidelines for designing and construction, issued and updated by Polish Gas Company:
"Principles of designing of pipelines and construction, welding technology, and repairs of polyethylene gas networks" - PSG 21. XII. 2016.





Installation and assembly

Installation

Pipes **RC MULTIsafe®** and **RC MAXIprotect® PP/PE** are designed mainly for installation with use of alternative techniques, but the traditional installation is also possible.
The trenchless installations are becoming more and more important due to increasing costs of installation for the pressure pipes. Use of trenchless methods for PE100 RC and PE100 RC with additional protective jacket allows for significant investment savings. Due to high resistance to point loads (in particular the 3-layer pipes **RC MULTIsafe®3L**) are recommended) and effects of surface scratches those products may be installed in the ground without the sand bed and sand pack, which is the protective zone for them. Due to high costs of soil transport use of pipe **RC MULTIsafe®** and **RC MAXIprotect® PP/PE** allows for avoiding significant expenses connected with delivering the appropriate material for ground works to the construction site and removing the excess of remaining soil. Lack of sand pack allows for savings of 15-25% in comparison with traditional trench methods. Installation of pipes with use of open trench method, especially in heavily urbanized areas, is connected with high costs resulting, among other things, from the road occupation time or restoring the road pavement. In the trenchless technologies the natural flexibility of pipes and ability to change the direction of installed pipeline are used. As a result of many years of positive experience in range of operation of pressure PE pipes the replacement and renovation of pipes from the traditional materials, e.g. steel, cast iron, concrete, are becoming more and more common.

RC MULTIsafe® and **RC MAXIprotect® PP/PE** pipes may be installed with use of the following technologies:

1. **Trenchless**
   - cracking - installation in place of an old pipeline with its simultaneous crushing,
   - pneumatic ramming with use of ramming machine,
   - directional drills,
   - micro-tunnelling,
   - hydraulic ramming.
2. **Narrow trench**
   - ploughing,
   - milling, etc.
3. **Trench**
   - without sand bed and pack, with use of native soil and pack of stones up to 60 mm.
4. **Renovation of pipes**
   - sliplining,
   - close fit,
   - swagelining,
   - rolldown.



Advantages of trenchless methodes

Advantages of trenchless methodes are:

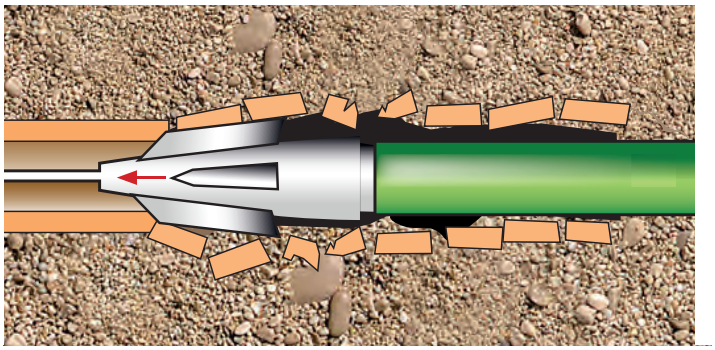
- assuring significant savings of investment in comparison to the traditional trench methods
- cost reduction through partial elimination of ground works, such as excavations, refilling, soil replacement, compacting, and surface works, e.g. reclamation,
- reduction of installation time,
- minimization of excavation area,
- the lowest level of infrastructural and environmental disruption,
- minimum or no traffic disturbances,
- possibility of using the existing pipe routes,
- lower possibility of damaging the existing underground infrastructure in the vicinity of constructed pipeline,
- minimization or elimination of ground settlement, and therefore probability of damaging the nearby buildings,
- dewatering is required only for entry and exit pit, not the whole route of new pipeline,
- increase of work safety,
- increase of structure durability.

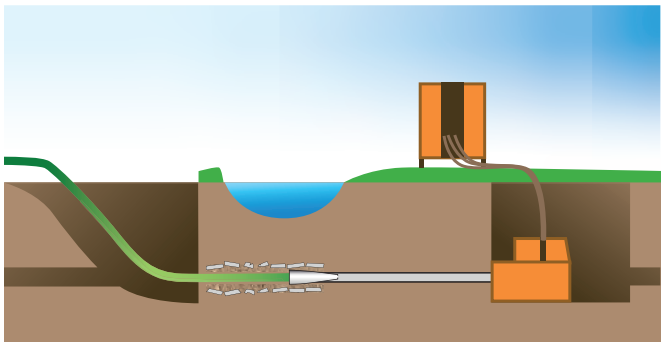


Brief characteristics of trenchless methods

Cracking (Burstlining)

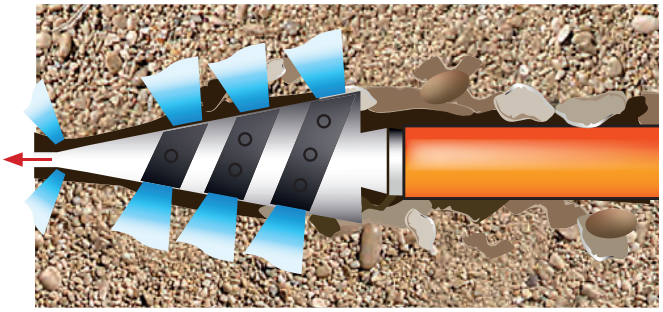
This method is used for replacement of existing pipes, having numerous and extensive damages, or requiring increase of their hydraulic output. Crushing of pipes is realized with use of special head, which increases diameter in order to insert the new pipe. Pieces of old pipe are pressed into the surrounding soil. New pipe of the same or higher diameter is pulled or pushed through the old pipeline. For that method the pipes **RC MAXIprotect® PP/PE**, are particularly recommended, i.e. carrier pipes from PE100 RC with protective layer made of minerally modified PP.

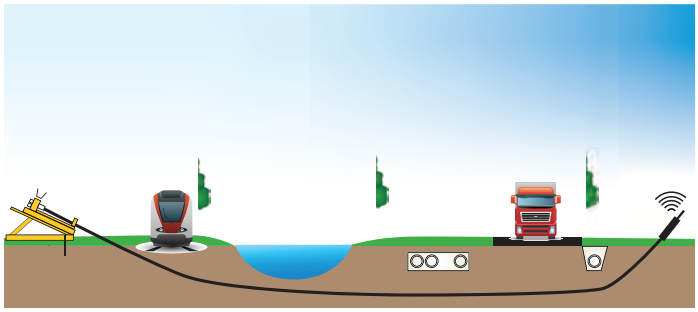




Directional drill

That method makes use of the polyethylene natural flexibility, perfect for passing the new pipelines under such obstacles as rivers, roads, railroads, etc.
Depending on soil type the pipes **RC MULTIsafe®**, andD **RC MAXIprotect® PP/PE** may be used.





Sliplining

This method is commonly used for renovation of pipelines with use of PE pipes for many years. It is used for steel and cast iron pressure pipes, heavily degraded due to corrosion, which leads to many failures.
In that method PE pipe is pulled into the old pipeline through the entry pit. The dimensions of the pit must allow for pulling the pipe with appropriate bending radius. While determining it keep in mind the relation between the allowable radius and temperature and the fact that with an ambient temperature below 20°C the minimum bending radius significantly increases.

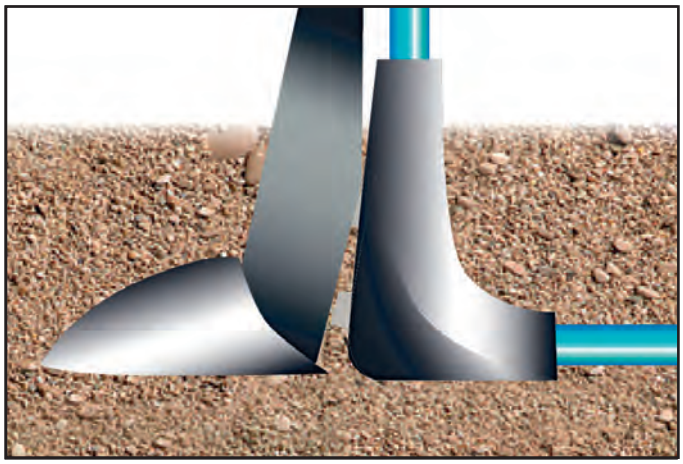




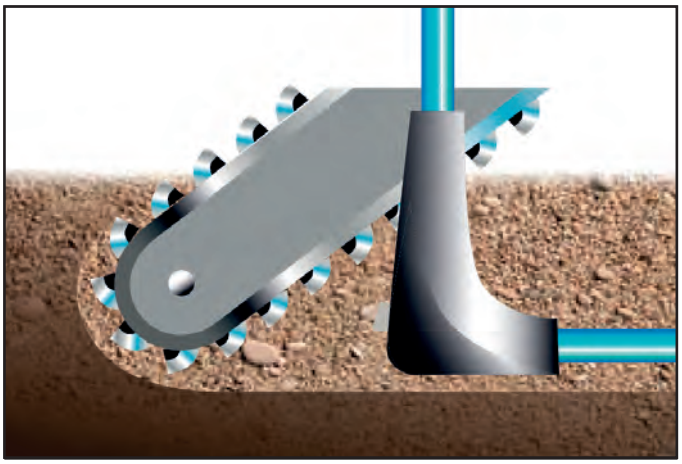




Brief characteristics of narrow-trench methods



Ploughing



Milling

Ploughing

Briefly, that method consists in lying of the pipe section on the bottom of the furrow made with use of the ploughing machine. In the beginning and end of each section the narrow excavations are made. After positioning the ploughing machine above the excavation the pipe and the warning tape, are pulled through the separated channels (tape at the specify high above the pipe) in the box connected with the plough share.
After lowering the plough share to required depth the beginning of pipe and tape is anchored in the ground. Therefore during the ploughing machine movement the successive metres of pipe and tape are pulled from the ground level into the entry of the box connected with the plough share and then exit in the bottom of the furrow, where they are covered with soil spread with the plough share.

That method allows for:

- pulling the pipes directly into the ground,
- installation on depth up to 2 m,
- high stability of pipe installation direction and depth thanks to plough height adjustment,
- simultaneous installation of pipe and warning tape above it,
- installation of pipes in the inclined areas, as well as in soils with high ground water level
- low costs and high speed of pipeline installation .

Milling

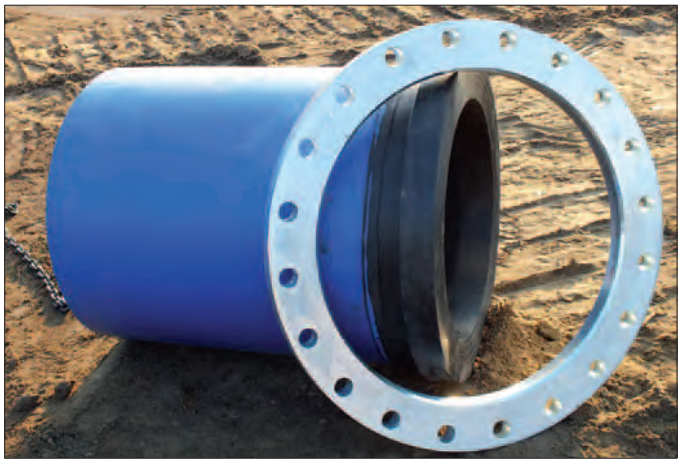
That method consists in making a trench of width slightly bigger than the diameter of installed pipe using the milling excavator. The individual pipe lengths are welded on the surface and lowered as a whole to the excavation directly after the milling element, just like after the plough share in the ploughing method. Then the pipeline is covered with disintegrated native soil.

Requirements for pipes installation in native soil without sand bed and pack:

- The native material from excavation of unspecified graining may be used again.
- The soil used for pipe pack should not cause hollow spaces or holes. The material from the excavation should assure obtaining the required standard of compaction (Proctor factor), depending on designed load.
- Pay attention that there are not stones in the soil used for filling which may cause pipeline damage (it is assumed that the maximum size is approx. 60 mm of diameter).
- The excavation bottom should assure uniform support on the whole length, allowing for correct installation and obtaining the appropriate inclination.
- Do not use waste material (e.g. rubble, scrap metal, etc.). In case of installing pipes made of PE100 RC during winter weather the pipeline should be covered with not frozen soil.

Assembly





Jointing technology for **RC MULTIsafe®** pipes

The pipes **RC MULTIsafe®** are installed and jointed just like the typical PE100 pipes. They do not require removing the distinguishing layer, connected in a molecular way. High resistance of **RC MULTIsafe®** pipes to SCG (Slow Crack Growth) allows for using cracked stones and gravel up to 60 mm diameter for bed and pack during the pipeline instalation.
Keep in mind that size of soil fragments must assure uniform support for the pipeline on its whole length, therefore in case of using larger stones or rock debris, especially in the mountain terrains, use also material of finer graining for covering the pipeline in order to fill the empty spaces between the bigger stones.

Jointing technology for **RC MAXIprotect® PP/PE-d** pipes

The pipes **RC MAXIprotect®PP/PE-d** are connected with use of butt or electrofusion welding after previous removal of some protective jacket from the pipe end. The mechanical connections are also possible after previous welding of a stub flange (stub end) with metal backing ring, or with use of mechanical couplings designed for use with PE pipes.
It is recommended to remove the protective jacket with the special tool available in our offer. The external jacket should be removed from the pipe end on length sufficient for making the butt welding or putting on the coupling.
Keep in mind that **RC MAXIprotect® PP/PE-d** pipes with an additional protective jacket have slightly larger external diameter than the standard PE pipes, therefore before the welding start it is required to obtain jaws suitable for their size.
After welding the pipes connect the detection tape and permanently protect the connection point from the external factors with use of heat-shrink sleeve available in our offer.

Installation of polyethylene pipelines on supports

The polyethylene pipelines are usually placed underground, but there are situations when their installation above the ground is necessary. In such case it is required to determine the span of supports, taking into consideration many factors influencing it, as correct support is very important for the pipeline trouble-free operation.

Those factors include:

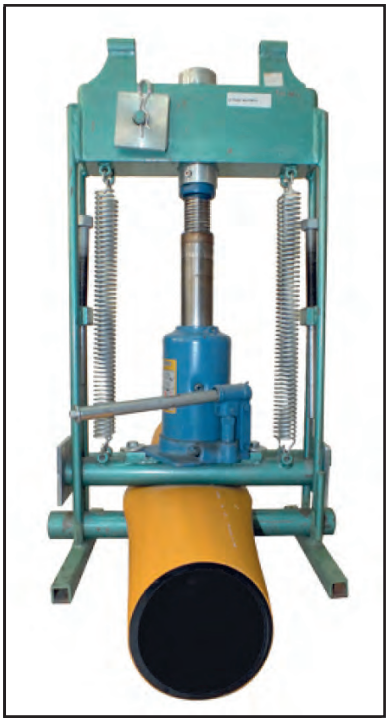
- ambient temperature,
- transported medium temperature,
- pipeline thermal expansion,
- resistance of pipe material to UV radiation,
- chemical resistance of pipes to transported medium, including its temperature.

The maximum span of supports for pipes made of PE100 - **RC MULTIsafe®(1L, 2L, 3L)**, **RC MAXIprotect® 2L PP/PE-d** and **PE 100 Smart 2L®.**

External diameter of pipe OD	Pressure pipes PN 6 (SDR 26)		Pressure pipes PN 10 (SDR 17)		Pressure pipes PN 16 (SDR 11)	
	20°C	40°C	20°C	40°C	20°C	40°C
[mm]	[m]	[m]	[m]	[m]	[m]	[m]
90	1,00	0,90	1,10	1,00	1,20	1,10
110	1,10	1,00	1,20	1,10	1,30	1,20
125	1,25	1,15	1,30	1,20	1,50	1,40
160	1,50	1,40	1,60	1,50	1,80	1,70
180	1,60	1,50	1,80	1,70	2,00	1,90
200	1,75	1,60	2,00	1,90	2,20	2,00
225	1,90	1,80	2,20	2,00	2,40	2,20
250	2,10	1,90	2,40	2,20	2,60	2,40
280	2,30	2,10	2,60	2,40	2,80	2,60
315	2,50	2,30	2,75	2,60	3,10	2,80
355	2,75	2,50	3,00	2,75	3,40	3,10
400	3,00	2,75	3,20	3,00	3,70	3,40

Squeeze-off of RC MULTIsafe® pipes

Squeezing of **RC MULTIsafe®** should be realized just like for PE100 pipes (including PE100 SMART 2L), according to principles listed below. The pipes RC MULTIsafe® for gas, water, and sewage have been tested for their squeezing ability in the Oil and Gas Institute in Kraków.
The pipes RC MULTIsafe have passed all required tests, which is confirmed by the Institute report from realized tests.



Squeeze-off tool

Squeeze-off tool for PE pipes should have:

- parallel squeeze bars of round shapes that do not damage the pipes,
- mechanical stops that limit the squeeze as to not over stress the pipe,
- safety mechanism protecting from accidental squeeze-off tool loosening.

Moreover the squeeze-off tool should have the mechanism allowing for determination of compression and release speed.
The squeeze bars may be formed as single or double bars of circular cross section, as well as flat bars with rounded edges. Other shapes of the squeeze bars may also be used, unless the radii of their edges are smaller than specified in the table below.

The damages occur on the wall internal surface or in its direct vicinity and are not visible from the outside. During cold days use lower compression and release speeds as low temperatures reduce flexibility and plasticity of polyethylene.

Caution! Direct heating of pipe (e.g. with the heater) in forbidden, as for high thermal resistance of polyethylene increasing the temperature on the wall internal surface, where stress is the highest (during use of squeeze-off tool) requires long heating time in properly high temperature, and it causes excessive plasticization of the pipe external surface and prevents safe use of a tool.
Equipping the squeeze-ott tool with a mechanical stops prevents the PE pipes damage in case of excessive compression. The stops prevent bringing the squeeze bars closer than 70% of double maximum pipe wall thickness.

Caution! Before squeeze-off it is required to check the pipe wall thickness (it is specified in the product designation).
In the typical squeeze-off tools for PE pipes the moving squeeze bars are displaced with use of screw or hydraulic jack. In each solution the system preventing the accidental release of a tool is an important element of its safety. During squeeze-off of the PE pipes use correct speed for the compression and release of the clamps. In general the compression and release speeds should be as low as possible, whereas the release speed is more important parameter.

PE pipe external diameter D DN [mm]	**Maximum radius of edges of clamping elements** [mm]
20 - 63	16
75 - 110	19
125 - 200	25
225 - 400	37
450 - 630	45

Practically the squeeze-off tool with cylindrical bars are usually used.
The minimum diameters of cylindrical elements:

PE pipe external diameter DN [mm]	**The minimum diameter of cylindrical bar** [mm]
20 - 63	32,0
75 - 110	38,0
125 - 200	50,0
225 - 400	74,0
450 - 630	90,0

The PE pipe must have properly long time for compensation of very high stress, occurring in the wall internal layer during squeeze-off. The tests results reveal that the highest risk of pipe damage takes place during too fast squeezing-off or tool release, especially in case of pipes of thicker walls.
The total time from the clamp installation on the pipe to its removal must not exceed 8 hours. Exceeding of that time may cause the pipe damage.
The clamping process should be realized according to the following principles:

1. Select the squeeze-off tool size appropriate for the pipe. The squeeze-off tool must be equipped with correctly set stops, appropriate for the dimensions of squeezed pipe (diameter and wall thickness or SDR).
2. Center the squeeze-off tool squarely on the pipe. The distance between the tool and the butt weld, electrofusion weld, or mechanical connection should be at least 3 x dn, but not less than 300 mm, depending which value is bigger. The surfaces of the squeezing bars must be smooth and clean to avoid damaging the pipe.

Caution! Electrostatic charges! During squeeze-off the PE pipe in which the gas flows the flow rate increases in the flattening point. High flow rate, dry gas, and fine solid particles may cause build-up of electrostatic charges on the pipe surface, and then their discharge to the ground. Before squeeze-off the tool should be grounded, it is also required to follow the safety procedures for static charges. This must be followed during the whole pipe squeez-off procedure

3. Pipe squeeze-off should be started by flattening it between the bars at specified speed.
   For pipes of diameter above 63 mm, when the pipe is flattened in half, make 1 minute break and then the same break, when the pipe is flattened in 3/4 (for pipes of diameter lower or equal to 63 mm the breaks during squeeze-off are not necessary). Moreover, for all diameters make 1 minute break, when the pipe wall internal surfaces touch each other.

Ambient temperature [°C]	**Release speed** [mm/min]
≤ 0	5 (always secure squeeze-off point with full circle band clamp)
10	10
20	10
> 25	max 15

After 1 minute from that touch continue compression at speed reduced to half of previous speed, until the squeeze bar reach the stops. When the ambient temperature is close to 0°C or lower, reduce the compression speed to a half and make breaks two times longer.

Caution! As the squeeze-off tool may not stop the gas flow completely, the venting may be required for 100% of cut-off efficiency. In such case use two (or set of) squeeze-off tools and vent the pipeline segment between them. The distance between the tools must not be lower than 6 x dn. All works must be realized after the second tool. Do not remove the stops, change them to other proper for the pipe wall thickness, or put anything between the pipe and the squeeze bar (rags, boards, etc.).

Ambient temperature [°C]	**Release speed** [mm/min]
≤ 0	5 (always secure squeeze-off point with full circle band clamp)
10	10
20	10
> 25	10

4. Perform required works on the pipeline between squeeze-off tools.
5. After work the squeeze-off tools should be released at speed not higher than used in point 3.
   Release speed must not be faster than 10 mm/min. Release operation must include 1 minute break, when the pipe wall internal surfaces touch each other, and for products of diameter above 63 mm 1 minute breaks for pipe opening in 1/4 (closing in 3/4) and in 1/2.
   When the ambient temperature is close to 0°C or lower, reduce the release speed to a half and make breaks two times longer.
6. After full loosening of clamp rotate it by 90° on the pipe and slowly restore the circular cross section of the pipe.
   Make the pipe round by partial closing of the tool Compression and release the desired effect is obtained. The cross section may require slight flattening in order to restore the circular section. Compression and release speeds must not exceed values specified in points 3 and
5. Restoring the pipe circular section is the procedure of partial compression.
   DO NOT squeeze-off the pipe completely.
7. After restoring the circular section remove the tool from the pipeline.
8. The squeeze-off point should be marked with the identification band or install full circle band clamp (covering the entire circumference of the pipe). The full circle band clamp should always be used when the squeeze-off is used in temperatures close to 0°C or lower and when there is even the minimum probability of pipe damage during squeezing

   Caution! Do not squeeze-off the pipe more than once in the same place as the probability of its damage significantly rises. New squeeze-off point must be located not closer than 6 x dn.

Squeezing of pipes in emergency situations

In the emergency situations it is necessary to squeeze the pipeline quickly to stop the gas outflow and following the above procedure is not justified. In such case it is probable that the pipe may become damaged during squeezing After stopping the gas outflow install the second set of squeeze-off tools on the pipeline according to the procedure (not closer than 6 x dn). While removing the damaged section of pipe it is also required to remove the section of the pipeline squeezed-off with the first tool.

* This procedure is based upon: Polyethylene gas networks - 2006, ed. II expanded - edited by Andrzej Barczyński and Tadeusz Podziemski.

Jointing methods for RC MULTIsafe® and RC MAXIprotect® PP/PE pipes

Pipes made of PE100 RC manufactured by RURGAZ may be jointed with use of various methods as below

- butt welding in range of diameters ≥ 75 mm,
- electrofusion welding mainly in range of diameters 25 - 110 mm,
- mechanical connections:
  - couplings for water pipelines,
  - PE/steel transition fittings for gas pipelines,
- flange connections (PE stub flange and metal backing ring).

The polyethylene pipeline contractor should use the jointing methods specified in the technical documentation, approved by the user of gas, water, or sewage network.



Butt welding

Butt welding of pipes **PE 100 Smart 2L** and **RC MULTIsafe®** follows the same principles as for pipes made of PE 100. In case of pipes **RC MAXIprotect® PP/PE-d with detection tape** the difference consists in removing the protective jacket from the welding zone and using the butt welding machine with appropriate set of clamps, taking into consideration increased pipe diameter (due to protective jacket).
The jacket removing procedure is described on page 22.

General principles

Butt welding consists in heating and melting of faces of jointed elements through their contact with the heater plate (called mirror) heated up to required temperature, and after removing the plate - connecting them to each other using appropriate pressure. Cooling of the joint should be realized in the natural way. It is forbidden to accelerate cooling by e.g. using water, ventilation, etc. The butt welding method is used to joint polyethylene pipes and fittings of the same diameter and wall thickness. The difference in MFR (Melt Flow Ratio) of jointed elements is less important. Keep in mind that products of the same geometry (SDR), made of polyethylene of different classes (PE100 PE80), have different resistance to the internal pressure. That method should not be used for connecting pipes of wall thickness below 5 mm and diameter below 75 mm, as the misalignment to jointed elements must not exceed 10% of the wall thickness. For such small values it is virtually impossible to determine the error amount.
Due to higher allowable ovality values for coiled pipes butt welding is used only for straight pipes.

Preparation of elements for welding

The welding place should be protected from negative environmental conditions, e.g. wind, too low temperature, dust, etc. In such situations take the appropriate preventive measures, e.g. use tent, increase the temperature with use of heater, etc. Butt welding should not be used in negative temperatures, but also during fog regardless the ambient temperature. After assuring proper conditions in the welder vicinity works may be realized in any weather. In order to avoid draughts in the pipes and excessive cooling of welded elements both distant ends should be plugged. Ends of element to be welded should be fixed coaxially in the welding machine, assuring the possibility of longitudinal movement of one element. Directly before welding the both ends of jointed elements should be trimmed with a trimming tool in order to remove the oxidized layer and make both pipe end faces completely planed (and parallel).

Butt welding of **RC MULTIsafe®** pipes is realized just like for traditional PE100 pipes, following the same parameters and welding procedures. In case of welding pipes **RC MAXIprotect® PP/PE-d with detection tape** it is first required to remove a piece of external jacket from the pipes ends, long enough for making a weld. Jacket removing should be realized with use of special tool designed for such purpose, available in RURGAZ offer. Maintain caution during that operation in order to avoid breaking the detection tape, located under the jacket. The tape ends with sufficient excess should be pulled from the pipes ends on both sides of the weld, and then connected by soldering or clamping and leave outside of the butt weld. The whole butt weld with tape placed on it should be secured with the heat-shrink sleeve put previously on the pipe in order to protect that place from the external conditions and mechanical damages.

Displacement of external surfaces of connected elements should not exceed 0.1 of wall thickness. Ends of elements to be connected must not be damaged and must be free from contamination. In order to assure correct quality of welds pay special attention to the cleanness of tools, in particular the hot plate. Use the cleaning liquid which dissolves grease, bonds moisture, and evaporates quickly, as well as fresh, clean, absorptive, and non-dusting paper.

After preparing the pipes for welding the gap between connected elements after pressing them to each other should not exceed:

0,3 mm for de < 225 mm
0,5 mm for < de < 400 mm
1,0 mm for de < 400 mm

Ends of connected elements should be also cleaned in the vicinity of welding zone for at least 10 cm so the contamination does not penetrate the contact surface during the technological activities. Faces of connected elements should be timed with a trimming tool just before welding. In case of contamination of faced surfaces it is sufficient to clean them with paper soaked in the cleaning liquid.

Equipment for butt welding

The exemplary set for butt welding includes:

- butt welding machine
- trimming tool
- heater plate (mirror) with temperature controller, protective container for the heater plate,
- saw or pipe cutter for pipe cutting,
- electric power generator,
- contact thermometer for controlling the heater plate temperature,
- roller supports for pipes,
- welding tent.







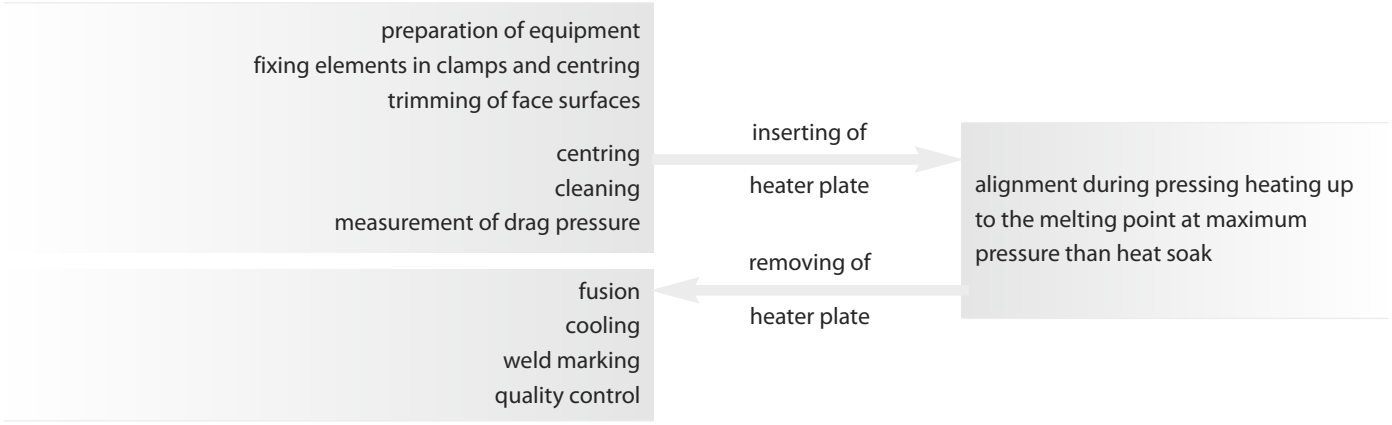
The heater plates in the welding devices must be electric. The butt welding machine should assure maintaining the required pressure on the surfaces of jointed elements and in case of error it should stop the process at any moment while indicating the error type. Before welding check condition of devices and tools.
Use only butt welding machine having valid calibration certificate. Movement of movable jaws of the device must be smooth. The heater plate should be clean, without any defects in the teflon coating. The general principles describe the conditions for the welding place and its direct vicinity, as well as preparation of jointed elements.
As pipes and fittings stored in the open warehouses or at the construction site may become dirty, one may use dry paper for the initial cleaning. The actual cleaning should be realized with use of clean paper and cleaning liquid, which removes grease and any moisture.
The butt welding procedure should be approved by the network user, taking into consideration the welding cycle, according to technology specified by the manufacturers of the polyethylene pipes and welding machine. After melting the ends of jointed elements the butt welding machine should allow for removing the heater plate and jointing the elements in proper time, without damaging the melted surfaces.

The automatic butt welding machine for jointing of polyethylene elements should assure control and recording of welding parameters for each joint, i.e.:

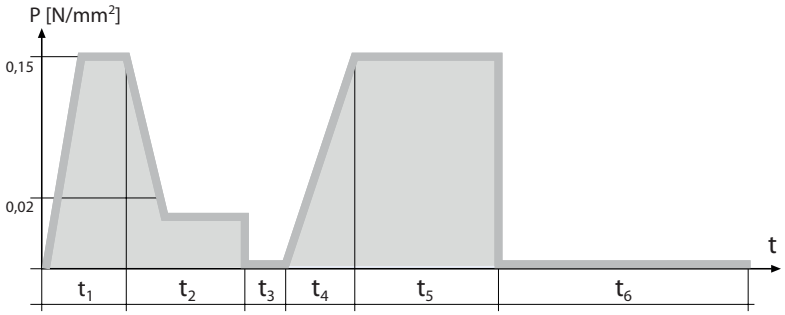
- times of the welding cycle individual stages,
- pressure on the surface of the individual elements,
- temperature of the heater plate,
- ambient temperature,
- drag pressure required for overcoming the resistance of the welding machine moving part with fixed element to be welded.

Making the so called "dummy weld" is a good practice. Upon the basis of shape of obtained bead it is possible to verify the correctness of process parameters. The test goal is also cleaning of the heating plate in the contact point between the jointed elements before the actual welding.
Tests should be realized before each change of diameter or wall thickness of jointed elements. Temperature of the heater plate depends mostly on the material type. For elements made of PE100 and PE100 RC the tool temperature is 220°C.

The activities realized in range of butt welding procedure are listed in the block diagram.



We recommend to realize welding according to the classic cycle. Change of pressure on the surfaces of jointed elements in the individual cycle phases is shown in the chart below.



Pressure on surfaces of jointed elements in phase t_1 and t_5 is 0,15 N/mm^2.

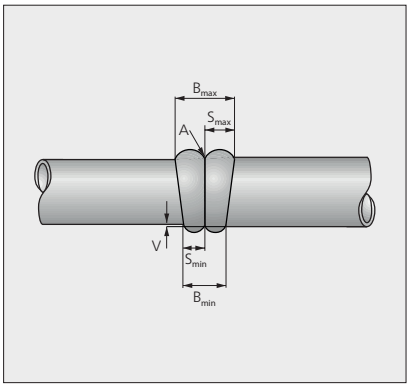
- t_1 - time of maintaining contact of elements with the heater plate until initial bead is obtained
- t_2 - heat soak time (t_2 = 10 x e) [s],
- t_3 - time for removing the heater plate and bring the melted surfaces toge [s],
- t_4 - time for built up required fusion pressure [s],
- t_5 - time of cooling under pressure [min],
- t_6 - time of cooling without pressure $t_6 \geq 1{,}5$ e [min].

Nomina thickness of pipe wall	Initial heating	Heat soak	Plate removal time (separating elements, removing heater plate, bring the melted surfaces together) t_3	Łączenie		
	Temperature of heater plate: - for PE 100 and PE 100RC - 220°C					
	Height of initial bead at the end of initial heating time p_1=0,15 N/mm²	Time of heat soaking = 10 × wall thickness $p_2 \leq 0{,}01$N/mm² t_2		Pressure built up time t_4	Time of cooling under p_3 (min. values) p_3=0,15 N/mm² t_5	Min. cooling time without pressure (t_6) – 1,5 min per 1 mm of wall thickness
[mm]	[mm]	[s]	[s]	[s]	[min]	[min]
do 4,5	0,5	do 45	5	5	6	7
4,5 ... 7,0	1,0	45 ... 70	5 ... 6	5 ... 6	6 ... 10	7 ... 11
7,0 ... 12,0	1,5	70 ... 120	6 ... 8	6 ... 8	10 ... 16	11 ... 18
12,0 ... 19,0	2,0	120 ... 190	8 ... 10	8 ... 11	16 ... 24	18 ... 29
19,0 ... 26,0	2,5	190 ... 260	10 ... 12	11 ... 14	24 ... 32	29 ... 39
26,0 ... 37,0	3,0	260 ... 370	12 ... 16	14 ... 19	32 ... 45	39 ... 56
37,0 ... 50,0	3,5	370 ... 500	16 ... 20	19 ... 25	45 ... 60	56 ... 75
50,0 ... 70,0	4,0	500 ... 700	20 ... 25	25 ... 35	60 ... 80	75 ... 105

Tab. Butt welding parameters acc. to DVS 2207-1/2007. Pipes PE 100 Smart 2L and MULTISafe 1L, 2L, 3L, as well as MAXIprotect PP/PE-d with removed PP jacket.

Kontrola jakości połączeń

Normy zalecają sprawdzanie każdego wykonanego połączenia. Kontrola jakości zgrzewu doczołowego opiera się na oględzinach zewnętrznej wypływki oraz pomiarze jej geometrii. Kształt i wielkość wypływki uzależnione są od właściwego wykonania poszczególnych etapów procesu zgrzewania. Jeżeli zaistnieje podejrzenie zanieczyszczenia łączonych powierzchni, bezwzględnie należy ściąć wypływki i dokładnie zaobserwować jej zachowanie przy zginaniu i skracaniu.
Ścięcie wypływki nie osłabia wytrzymałości wykonanego połączenia. Wypływki powinny mieć kształt w miarę równy na całym obwodzie i stykających się ze sobą wałeczków. Powinny być one gładkie i symetryczne na całym obwodzie rury.



Na co należy zwracać uwagę oceniając wygląd wypływki

Kryteria oceny zgrzewów podano poniżej:

- zagłębienie (A) pomiędzy wałeczkami wypływki powinno znajdować się powyżej zewnętrznych powierzchni łączonych elementów,
- przesunięcie ścianek łączonych elementów (V) nie powinno przekraczać 10% grubości ścianki (e) oraz więcej niż 2 mm,
- szerokość wypływki (B) powinna być zawarta w przedziale $5 + 03 \times e_n \leq B \leq 0{,}55 \times e_n$ [mm],
- minimalna i maksymalna szerokość wypływki powinna odpowiadać następującym wartościom:
  Bmin ≥ 0,8 Bśr.
  Bmax ≤ 1,2 Bśr.
  Bśr. = (Bmin + Bmax)/2
- różnica względnej szerokości wałeczków wypływki

$\Delta S = \left(\frac{Smax - Smin}{Smax + Smin}\right)$ nie powinna przekraczać: - 0,1 ΔS przy zgrzewaniu rury z rurą (tych samych klas PE lub PE 100 z PE 100RC),
- 0,2 ΔS przy zgrzewaniu rury z rurą (PE 100RC z PE 80),
- 0,2 ΔS przy zgrzewaniu rury z kształtką,
- 0,1 ΔS przy zgrzewaniu kształtki z kształtką.

Graniczne wartości szerokości wypływek w [mm] dla gazociągów z rur PE 100RC SDR11, SDR17 przedstawiono w tabeli poniżej:

Średnica rury d_n [mm]	SDR 17			SDR 11		
	e_n	B min	B max	e_n	B min	B max
90	5,4	6,6	9,0	8,2	7,5	10,5
110	6,6	7,0	9,6	10,0	8,0	11,5
125	7,4	7,2	10,1	11,4	8,4	12,3
140	8,3	7,5	10,6	12,7	8,8	13,0
160	9,5	7,9	11,2	14,6	9,4	14,0
180	10,7	8,2	11,9	16,4	9,9	15,0
200	11,9	8,6	12,5	18,2	10,5	16,0
225	13,4	9,0	13,4	20,5	11,2	17,3
250	14,8	9,4	14,1	22,7	11,8	18,5
280	16,6	10,0	15,1	25,4	12,6	20,0
315	18,7	10,6	16,3	28,6	13,6	21,7
355	21,1	11,3	17,6	32,2	14,7	23,7
400	23,7	12,1	19,0	36,3	15,9	26,0
450	26,7	13,0	20,7	40,9	17,3	28,5
500	29,7	13,9	22,3	45,4	18,6	31,0
560	33,2	15,0	24,3	50,8	20,2	33,9
630	37,4	16,2	26,6	57,2	22,2	37,5

Parametry wypływki mierzy się za pomocą suwmiarki lub innego przyrządu pomiarowego, pozwalającego na pomiar z dokładnością do 0,1 mm. W przypadku gdy połączenie zgrzewane nie odpowiada któremukolwiek z kryteriów oceny, należy je wykonać nowe. Powyższe zalecenia mają charakter zasad ogólnych. W praktyce do wykonywania połączeń zgrzewanych doczołowo, zaleca my stosowanie parametrów podanych przez producenta zgrzewarki (posiadającej do puszczenie do stosowania oraz aktualną kalibrację).

Electrofusion welding

Electrofusion welding of pipes **RC MULTIsafe®** follows the same principles as for pipes made of PE100.
For pipes **RC MAXIprotect®** the difference consists in necessity of removing the protective jacket from the welding zone.

General principles

Electrofusion welding consists in supplying the electric energy to the coil of resistance wire, placed at the internal surface of fitting, where it is transformed into heat, causing melting of surface of jointed elements (internal surface of fitting and external surface of pipe) and fusing them with each other. Electrofusion welding is realized while using the couplers and saddle fittings.

The welding place should be protected from negative environmental conditions, e.g. wind, too low temperature, dust, etc. In such situations take the appropriate preventive measures, e.g. use tent, increase the temperature with use of heater, etc.

Electrofusion welding should not be used in negative temperatures, but also during fog regardless the ambient temperature. After assuring proper conditions in the welder vicinity works may be realized in any weather.

Preparation of elements for welding

In order to obtain the required quality keep in mind that the surfaces of jointed elements must be properly prepared and cleaned. The pipes ends must be cut off perpendicularly.

Electrofusion welding of pipes **PE 100 Smart 2L®**, **RC MULTIsafe® 1L, 2L, 3L** is realized just like for traditional PE100 pipes, following the same parameters and welding procedures.
In case of welding pipes **RC MAXIprotect® PP/PE** it is first required to remove a piece of external jacket from the pipes ends, long enough for placing the electrofusion coupler. Jacket removing should be realized with use of special tool designed for such purpose, available in **RURGAZ** offer. Maintain caution during that operation in order to avoid breaking the detection tape, located under the external jacket. The tape ends with sufficient excess should be pulled from the pipes ends on both sides of the coupler, and then connected by soldering or clamping and leave outside of the coupler. The whole electrofusion joint with tape placed on it should be secured with the heat-shrink sleeve put previously on the pipe in order to protect that place from the external conditions and mechanical damages.
The internal edges must be free from burrs, and external edges rounded (curvature radius = 0.5e). The external surfaces of elements to be jointed with use of coupler should be cleaned from the oxidized layer with use of scraper, at least in the welding zone. Similar procedure should be followed while connecting the saddle fittings, where after removing the external jacket the surface of the polyethylene pipe, to which the heating element will adhere, should be cleaned.
Thickness of the oxidized layer to remove is 0.1 mm. Ovality of pipes should be removed with use of pipe clamps. They are also designed for immobilizing the ends of jointed elements so no force is exerted on the coupler during welding. The connected elements should be fixed in clamps either during welding and cooling. Before fixing the jointed elements it is required to clean their internal surfaces with use of the same materials as for butt welding.

Procedure of electrofusion welding

The parameters of electrofusion welding are entered into the electrofusion control unit depending on the device type.
There are the following possibilities of setting the welding parameters:

- automatically, upon the basis of fitting resistance measurement,
- by scanning the bar code visible on the fitting or reading the magnetic card attached to the fitting,
- manually, by entering parameters of voltage and welding time.

After preparing the elements and device the welding procedure consists of the following activities:

- determination of welding parameters according to the data given by the fitting manufacturer,
- in case of automatic welding realization of activities specified in the device operation manual,
- control of the welding process,
- leaving the jointed elements in clamps until the melted material cools down.

Joint cooling should be realized in the natural way.
It is forbidden to accelerate cooling by e.g. using water, ventilation, etc.
After cooling the joint the clamps may be removed.

Equipment for electrofusion welding

Equipment for electrofusion welding should have valid calibration and approval for use and must be adapted to the technical characteristics of fittings and system in which they operate.



The exemplary set for electrofusion welding includes:

- control device,
- clamps,
- set of scrapers for pipes,
- saw or pipe cutter for pipe cutting,
- electric power generator,
- saddle clamping tool (while welding the saddle fittings),
- welding tent,
- cleaning agents,
- RADPOL knifes.



Connections quality control

All connections welded with use of electrofusion method should be subjected to visual inspection. In case of couplers on both sides of the fitting there should be visible signs of removing the oxidized layer on the pipe (on the whole perimeter). Similarly, in case of saddle fittings there should be visible signs of removing the oxidized layer on the pipe - uniform on the whole saddle perimeter.

There should be no signs of leaks of melted polyethylene on the fitting ends. There should be no cracks, scratches, on the pipe near the saddle. When the fitting is equipped with indicators, their position after welding should conform to the manufacturer's requirements. The joint should not reveal the coaxiality defect of welded elements.

Removing of external jacket from RC MAXIprotect® PP/PE pipes

Tool for removing of external jacket from RC MAXIprotect® PP/PE pipes - operation manual

The universal rotary knifes **RADPOL T1** and **T2** allows for removing the external protective jacket in order to prepare the carrier pipe for butt or electofusion welding. For comfortabe work it is recommended to use **T2** for pipes up to diameter 180 mm and **T1** for pipes of diameter bigger than 160 mm.



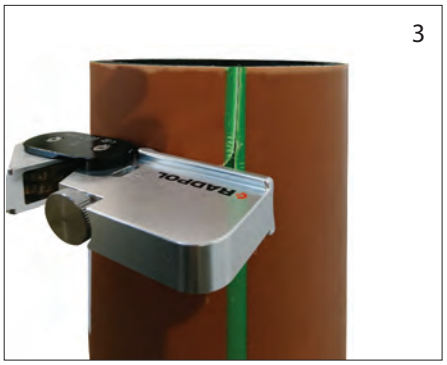


Tool operation procedure:

1. Set the cut depth with the knob (equal to the pipe jacket thickness - the depth range is 0 - 5 mm).
2. Press the cutting end under the external jacket - perpendicularly to the pipe face.
3. Press the cutting part (with RADPOL inscription) to the pipe, grab the handle with another hand, and press downwards to rotate the toothed roller and slide the whole tool along the pipe axis. In such way the jacket is cut.
3. After cutting the jacket on appropriate length stop the tool and without removing from under the jacket rotate it perpendicularly to the pipe axis.
4. Then continue cutting the jacket as before, but on the pipe perimeter, until the jacket piece is completely cut off. Continue that operation, cutting the jacket on length allowing for installation of clamps of butt welding machine or electrofusion fitting. (For the machines equipped with clapms fitted to the pipe outher diameter it is not necessarily to remove the jacket).
5. After removing the required jacket piece clean and degrease the surface in a standard way in order to make the electrofusion welding (muffs, couplers, saddle fittings, etc.) or butt welding.













Caution: Gas pipes **RC MAXIprotect® PP** obtained the Technical Approval no. AT/2015-03-02 w. I/2015, which allows for butt fusion welding of those pipes without removing the protective polypropylene jacket.

The minimum jacket thickness values are shown in the table below:
Thickness of protective jacket of pipes MAXIprotect PP/PE – d depending on carrier pipe diameter.

External nominal pipe diameter without protective jacket	Minimum thickness of protective jacket made of PE **RC MAXIprotect® PE**	Minimum thickness of protective jacket made of PE with metal tape **RC MAXIprotect® PE-d**	Minimum thickness of protective jacket made of PP **RC MAXIprotect® PP**	Minimum thickness of protective jacket made of PE with metal tape **RC MAXIprotect® PP**
25	0,8	1,0	0,8	1,0
32	1,0	1,3	1,0	1,3
40	1,0	1,3	1,0	1,3
50	1,0	1,3	1,0	1,3
63	1,1	1,4	1,1	1,4
75	1,2	1,5	1,2	1,5
90	1,2	1,5	1,2	1,5
110	1,4	1,7	1,4	1,7
125	1,4	1,7	1,4	1,7
140	1,5	1,8	1,5	1,8
160	1,8	2,1	1,8	2,1
180	2,7	3,0	2,7	3,0
200	2,7	3,0	2,7	3,0
225	2,7	3,0	2,7	3,0
250	2,7	3,0	2,7	3,0
280	3,5	3,5	3,5	3,5
315	3,5	3,5	3,5	3,5
355	3,5	3,5	3,5	3,5
400	3,5	3,5	3,5	3,5
450	3,5	3,5	3,5	3,5
500	3,5	3,5	3,5	3,5
560	3,5	3,5	3,5	3,5
630	3,5	3,5	3,5	3,5
710*	3,5	3,5	3,5	3,5
800*	3,5	3,5	3,5	3,5
900*	3,5	3,5	3,5	3,5
1000*	3,5	3,5	3,5	3,5

MAXIprotect® PE-d - added letter "d" is from "detection" - means that the pipe has built-in detection tape.
* CAUTION: diameters above 630 mm to be agreed.

Use of protective heat-shrink sleeves RADPOL for RC MAXIprotect® PP/PE-d pipes

It is recommended to protect joints of pipes **RC MAXIprotect® PP/PE-d** with detection tape (detection wire) with use of heat-shrink sleeve RADPOL PE-X with heat-melting glue, made of radiationally crosslinked material. (Detection wires in the pipe should be previously connected with use of connection tape). The heat-shrink sleeves RADPOL have shape memory and the following properties:

May be used in operating temperatures from -50 to +125°C.
Shrinking temperature +120 to +200°C.
Tensile strength 18 MPa.
Ultimate elongation approx. 350%.

The heat-shrink sleeves RADPOL assure connection protection from moisture and corrosion of detection tape. They are resistant to UV radiation and aggressive environment. The ends of sleeves are chamfered which protects them from peeling from the pipe during movement in the soil and prevents curling during shrinking. The products have certificate no. 489 1106 96A confirming their conformity to standard EN 489:2009, defining requirements for resistance to the soil loads. Tests have been realized in Fernwärme-Forschungsinstitut in Hannover.

Connecting of detection tapes (detection wires) in RC MAXIprotect® PP/PE-d pipes

Connecting of a detection tapes (detection wires) is realized with use of metal tapes with so-called "overlap".
Steel and aluminium detection tapes should be connected with an aluminium tape. The copper detection tapes should be connected with a copper tape.
Alternatively detection tapes may be soldered or clamped.
Caution: Be sure that surfaceces of tapes are clean, free from protective isolation cover. The abrasive of high grade may be used to achieve raw surface of metal. Raw surface before making any connection is required for proper electric conductivity.



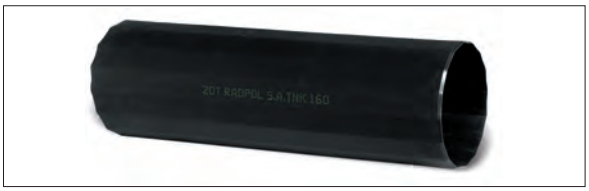
Aluminium and copper tapes for connecting detection wires in pipes RC MAXIprotect® PP/PE-d.

Installation of heat-shrink sleeves on connections of RC MAXIprotect® PP/PE-d pipes

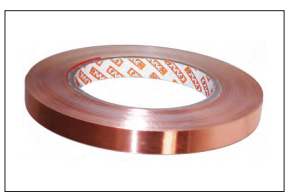
Required tools:
Shrinking of heat-shrink sleeves requires the propane-butane torch or got air blower, able to heat the sleeve above +120°C. Connection of detection tape may be realized by soldering or clamping.
During preparation of pipe to the butt welding it is necessary to measure and mark on both ends of pipes the required length, inserted into butt welding machine clamps. Then remove the external protective pipe layer to the marked line, using the special tool. (Rotary knife RADPOL T1/T2). The rotary knife blade should be set according to the protective layer thickness. Its design prevents damages of the main pipe. Do not use other cutting tools for that purpose as they may cut the surface of the carrier pipe.
Check length of exposed segments of jointed pipes and compare it with length of selected heat-shrink sleeve, which size should be longer by approx. 10 cm than a length of a exposed finally connected pipes.
Select appropriate sleeve for the pipe diameter and slide it on the pipe segment beyond the butt welding zone.
Prepare pipes ends for butt welding and make weld according to the procedure. Leave the pipe for cooling down. Connect segments of detection tape.

Installation of heat-shrink sleeve
Move the heat-shrink sleeve to the joint and tape connection area and place it in such way that it fully covers the pipes surfaces with removed protective layer. The sleeve ends must overlap the insulated pipe segment symmetrically on both sides by min. 5 cm.
Set the flame or blower temperature to +120°C. Start shrinking from the centre. Heat the sleeve around, trying to obtain the uniform shrinking. The central part must shrink and tightly adhere to the pipe surface. Heat the sleeve in a uniform way, moving the heat source all the time on the surface, trying to avoid local overheating. Continue shrinking, moving towards the sleeve edges.
After shrinking the glue should flow out from both sides of the sleeve. That glue protects the insulated connection from moisture and corrosion. Leave the insulated pipe for full cooling down.

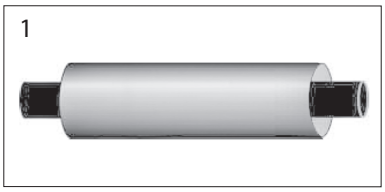
Heat-shrink sleeve

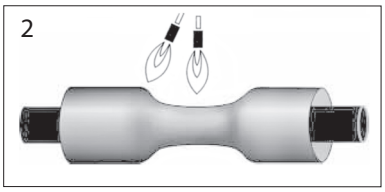


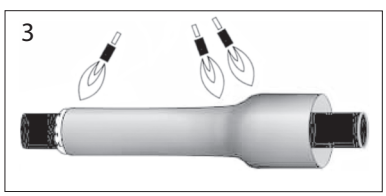


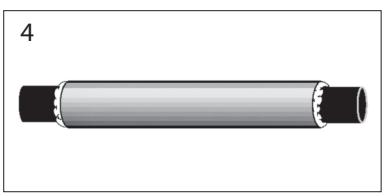


Installation of heat-shrink sleeve



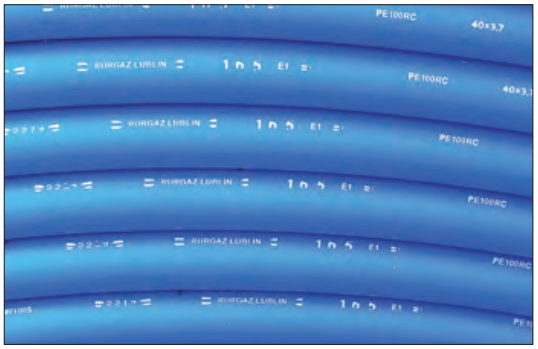






Anti-corrosion protection of pipes

PE pipes do not require any anti-corrosion protection. In case of connecting steel pipes with PE pipes pay special attention that the anti-corrosion protection of steel elements do not contact PE pipe in any way.





Electric conductivity of PE

The polyethylene pipes are dielectric and do not conduct the electric current.. Therefore they cannot be used for grounding purposes. PE pipes accumulate electrostatic charges on the surface, therefore in dangerous places (e.g. mines) it is required to follow the special precautions and use proper technology (e.g. antistatic polyethylene pipes).

Storage and transport

Pipe length

Pipes of diameters from 25 to 63 mm are manufactured in coils by 100 m, 200 m, and 300 m. Pipes of diameters from 75 to 110 mm are manufactured in straight bars of 12 m length or in coils. Coils of pipes of diameter 75 and 90 mm by 100 m, of diameter 110 mm by 50 m. Other pipes are cut into bars of length of 12 m and packed into bundles or stored loose (dimensions of pallets and coils are specified in tables on page 28).

While delivering pipes in coils the diameter of drum core on which the pipes are wound should not be smaller than 20 external diameters of pipe (min. 0.6 m).

Transport

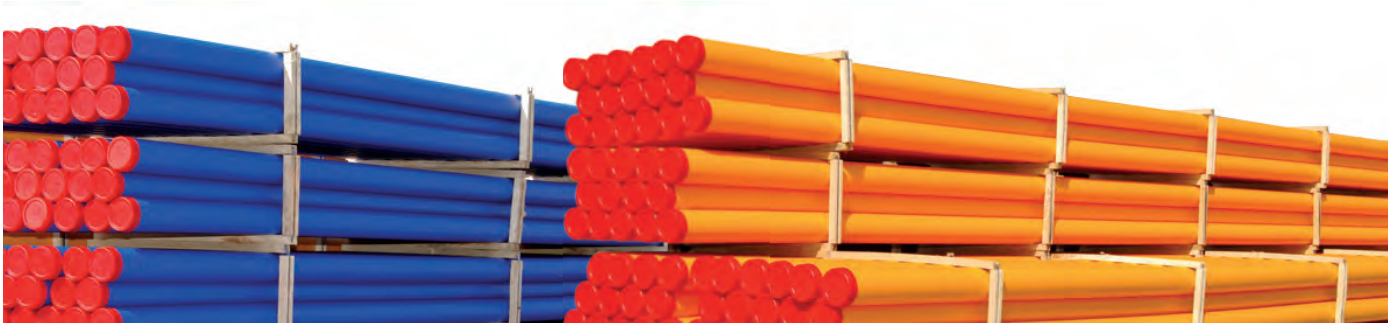
The pipes must be transported on trucks of sufficient length. Transport of pipes should be realized in a way allowing for avoiding the mechanical damages during loading, transport, and unloading. During loading and unloading use the fork-lift trucks with flat forks or crane with soft slinges (it is forbidden to use ropes and chains). The pipes transported loose may be unloaded manually according to the regulations for such works. Do not throw the pipes or slide them on the ground.

The load surfaces of vehicles used for transport of PE pipes should be even, without sharp edges and protruding objects. The individual coils or bundles of pipes should be put tightly next to each other and protected from moving.

Storage

The pipes should be stored horizontally on flat and even surface. The bundles packed in the factory may be stacked up to 2 m, placing the bundles with wooden frames on each other. The pipes stored loose should be placed on wooden beams of minimum width of 50 mm, placed every 2 m, and secured with side supports located in the same places as beams.
The storage height for loose pipes should not exceed 1 m, and pipes in coils should be stored horizontally, stacked up to 1.5 m. Pipes of different diameters and wall thicknesses should be stored separately. When it is not possible, the pipes of higher ring stiffness (lower SDR) should be placed in the bottom.

Stored pipes should be protected from harmful sunlight as well as from greases and oils. Temperature in the storage place must not exceed 30°C, and distance from the heaters and heating pipes must not be lower than 1 m. The storage time in open warehouses should not exceed 1 year.



Logistic parameters of pipes from PE100 RC (pipes in bars)

Pipe diameter DZ	No. of pipes in bundle	Metres of pipes in bundle	Width of pipes in bundle	Height of pipes in bundle	Metres of pipes on truck*	No. of pipes on truck
[mm]	[pcs.]	[m]	[mm]	[mm]	[m]	[pcs.]
90	32	384	990	330	4608	384
110	26	312	990	390	4368	364
125	23	276	1000	400	3312	276
140	20	240	980	500	2400	200
160	17	204	960	530	2040	170
180	6	72	1080	240	1440	120
200	6	72	1200	260	1296	108
225	5	60	1125	280	960	80
250	4	48	1000	315	864	72
280	4	48	1120	340	576	48
315	3	36	945	400	504	42
355	3	36	1065	420	432	36
400	3	36	1200	460	360	30
450	2	24	900	510	240	20
500	2	24	1000	560	192	16
560	2	24	1120	620	192	16
630	2	24	1260	700	108	9
710	1*	12	710	710	108	9
800	1*	12	800	800	108	9
900	1*	12	900	900	48	4
1000	1*	12	1000	1000	48	4

Tab. Basic dimensions of pallets and number of pipes for full-truck transport of pipes in 12 segments.
* loose pipes (without pallets) – loaded on the truck on wooden beams.

Logistic parameters of pipes from PE100 RC (pipes in coils)

Pipe diameter DZ	Metres in coil	Approx. coil height H	Coil external diameter F1	Approx. coil weight [kg]		Metres of pipes on truck
[mm]	[m]	[mm]	[mm]	SDR17	SDR11	[m]
25	**100**	**260**	**860**	**17**	**21**	**13200**
25	200	460	900	34	42	17600
25	300	460	1000	51	62	26400
32	**100**	**260**	**970**	**19**	**28**	**13200**
32	200	460	1050	39	56	17600
40	**100**	**260**	**1250**	**29**	**43**	**17100** (2 layers)
40	200	460	1250	59	86	19000 (2 layers)
50	**100**	**350**	**1350**	**45**	**67**	**5400**
63	**100**	**460**	**1900**	**72**	**112**	**3200**
75	**100**	**550**	**2000**	**102**	**148**	**2300**
90	50	550	2200	73	107	1150
90	**100**	**550**	**2400**	**147**	**214**	**2300**
110	**50**	**550**	**2200**	**109**	**159**	**1200**

Tab. Basic dimensions of coils are bolded.
Amount of pipes for uniform, full-truck transport of standard coils.

Caution:
In case of loading various dimensions into one transport the specified amount will differ from the tables. Coils of pipes MAXIprotect PP/PE-d of different dimensions are possible due to technology of winding pipes with the jacket.

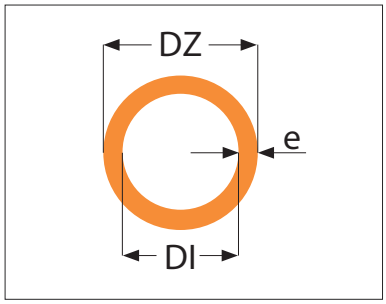
Gas pipes RC MULTIsafe®1L

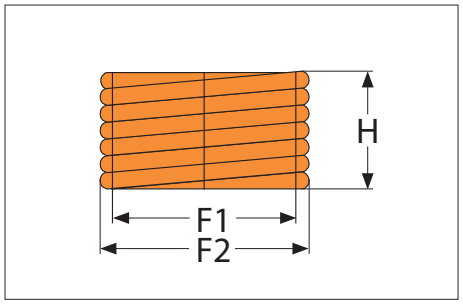
Pipes **RC MULTIsafe®1L** - solid, 1-layer (all orange - type 1 - acc. to PAS 1075:2009.04) for gas are manufactured in range of diameters 25 - 630 mm for an individual request.

Gas pipes RC MULTIsafe®1L - coils

Type 1
1-layer pi
RC MULTIsafe®1L





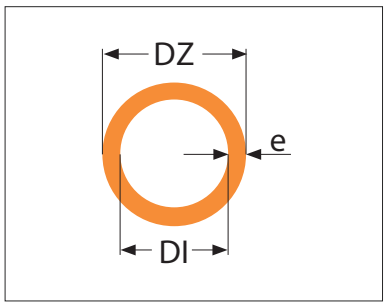


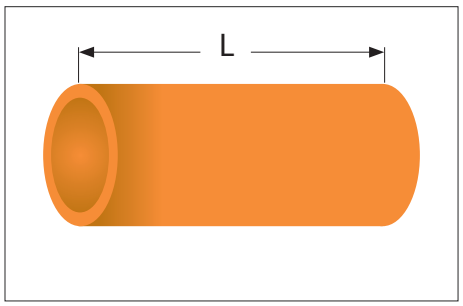
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Wall thickness SDR 17,6	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	**e** [mm]	[m]
25	2,3	2,3	2,3	100/200
32	3,0	2,3	2,3	100/200
40	3,7	2,4	2,3	100/200
50	4,6	3,0	2,9	100
63	5,8	3,8	3,6	100
75	6,8	4,5	4,3	100
90	8,2	5,4	5,2	100
110	10,0	6,6	6,3	50

Gas pipes RC MULTIsafe®1L - 12 m bars

Type 1
1-layer pi
RC MULTIsafe®1L







Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Wall thickness SDR 17,6	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5.4	5.2	384
110	10,0	6,6	6,3	312
125	11,4	7,4	7,1	276
140	12,7	8,3	8,0	240
160	14,6	9,5	9,1	204
180	16,4	10,7	10,3	72
200	18,2	11,9	11,4	72
225	20,5	13,4	12,8	60
250	22,7	14,8	14,2	48
280	25,4	16,6	15,9	48
315	28,6	18,7	17,9	36
355	32,3	21,1	20,2	36
400	36,4	23,7	22,8	36
450	41,0	26,7	25,6	24
500	45,5	29,7	28,4	24
560	50,9	33,2	31,9	24
630	57,3	37,4	35,8	24

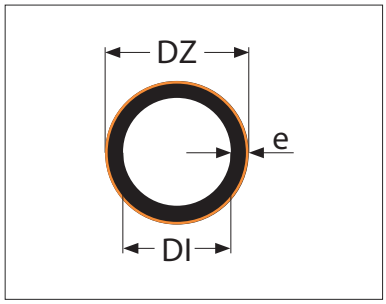
Gas pipes PE100 RC MULTIsafe®2L

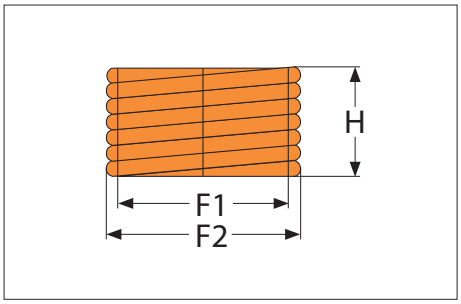
Pipes **RC MULTIsafe®2L** - 2-layer (black with distinguished orange external layer - type 2 - acc. to PAS 1075:2009.04) for gas are manufactured in range of diameters 25 - 630 mm.

Gas pipes **RC MULTIsafe®2L** - coils

Type 2
2-layer pipe
RC MULTIsafe®2L





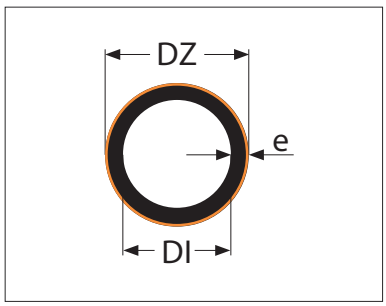


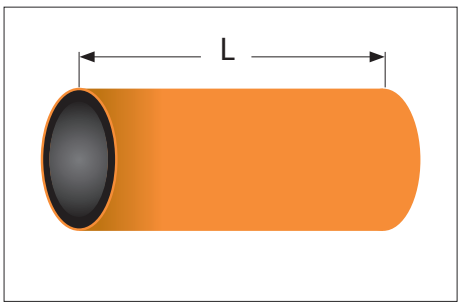
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Wall thickness SDR 17,6	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	**e** [mm]	[m]
25	2,3	2,3	2,3	100/200
32	3,0	2,3	2,3	100/200
40	3,7	2,4	2,3	100/200
50	4,6	3,0	2,9	100
63	5,8	3,8	3,6	100
75	6,8	4,5	4,3	100
90	8,2	5,4	5.2	100
110	10,0	6,6	6,3	50

Gas pipes **RC MULTIsafe®2L** - 12 m bars

Type 2
2-layer pipe
RC MULTIsafe®2L

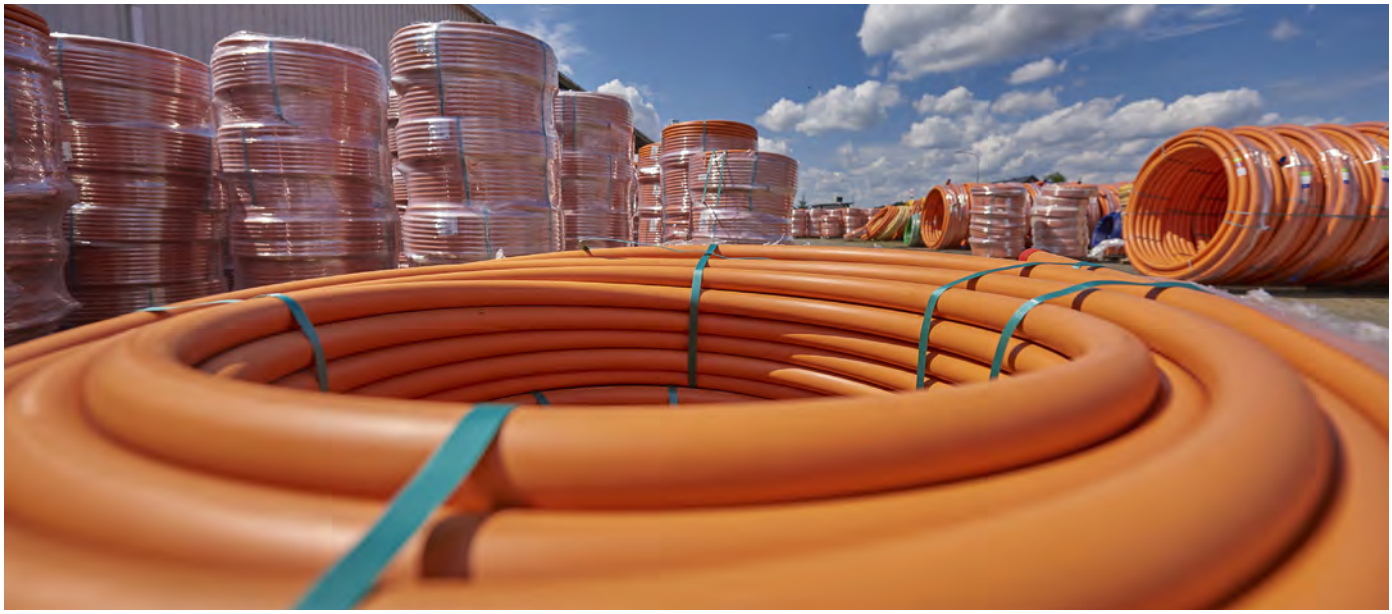






Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Wall thickness SDR 17,6	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5.4	5.2	384
110	10,0	6,6	6,3	312
125	11,4	7,4	7,1	276
140	12,7	8,3	8,0	240
160	14,6	9,5	9,1	204
180	16,4	10,7	10,3	72
200	18,2	11,9	11,4	72
225	20,5	13,4	12,8	60
250	22,7	14,8	14,2	48
280	25,4	16,6	15,9	48
315	28,6	18,7	17,9	36
355	32,3	21,1	20,2	36
400	36,4	23,7	22,8	36
450	41,0	26,7	25,6	24
500	45,5	29,7	28,4	24
560	50,9	33,2	31,9	24
630	57,3	37,4	35,8	24



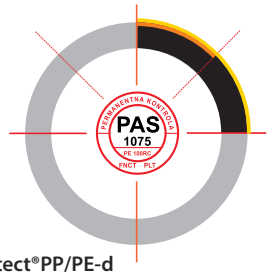



QUANTUM 360

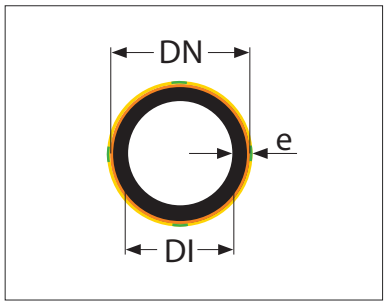
Gas pipes PE100 RC MAXIprotect®PP/PE-d 2-layer (or 1-layer) for gas with additional protective jacket made of PE or PP and optionally with detection tape (type 3 - acc. to PAS 1075:2009.04)

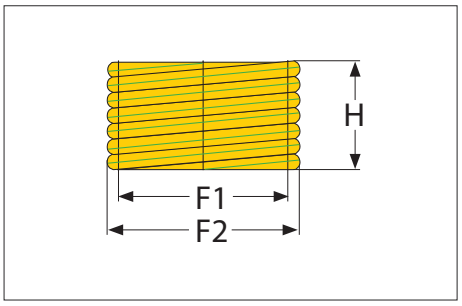
RC MAXIprotect PP/PR-d - pipes - dual-layer (black with distinct yellow outer layer as solid dual-layer carrier pipe) with PP/ PE outer jacket in yellow - type 3 - according to PAS 1075:2009.04, used for gas, manufactured in diameters between 25 and 630 mm.
The carrier pipe can also be executed as single-colour.

Gas pipes **RC MAXIprotect®PP** - coils



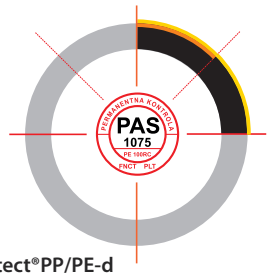
Type 3
2- or
1-layer pipe
Rury RC MAXIprotect®PP/PE-d



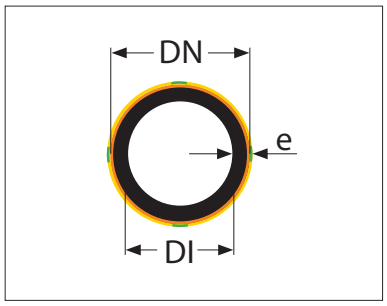


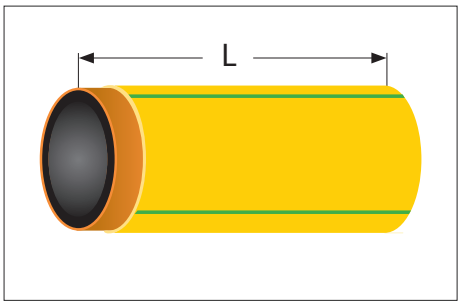
Diameter	Wall thickness SDR 11	Wall thickness SDR 17,6	Metres in coil
DN [mm]	**e** [mm]	**e** [mm]	[m]
25	2,3	-	200
32	3,0	-	200
40	3,7	-	200
50	4,6	-	100
63	5,8	-	100
75	6,8	-	100
90	8,2	5,4	100
110	10,0	6,6	50

Gas pipes **RC MAXIprotect®PP** - 12 m bars



Type 3
2- or
1-layer pipe
Rury RC MAXIprotect®PP/PE-d





Diameter	Wall thickness SDR 11	Wall thickness SDR 17,6	Metres in bundle
DN [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7,4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	40,9	26,7	24
500	45,4	29,7	24
560	50,8	33,2	24
630	57,2	37,4	24

* **CAUTION:** In pipes **RC MAXIprotect®PP/PE -d**optionally detection tape may be made of an aluminium, stainless steel, or copper (agreed individually). Specified wall thicknesses apply for pipe without the jacket, jacket thickness is specified on page 23. Diameters above 630 mm to be agreed.

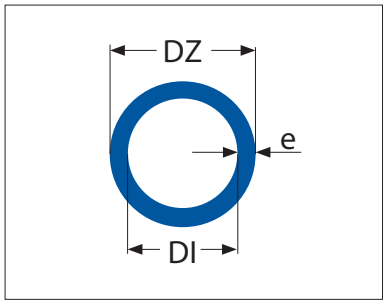
Drinking water pipes PE100 RC MULTIsafe®1L

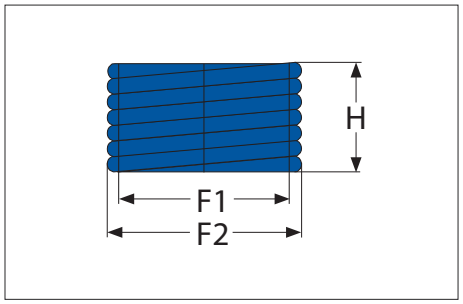
Pipes **RC MULTIsafe®1L** - solid, 1-layer (all dark blue - type 1 - acc. to PAS 1075:2009.04) for drinking water are manufactured in range of diameters 25 - 1000 mm for an individual request.

Drinking water pipes **RC MULTIsafe®1L** - coils

Type 1
1-layer pipe
RC MULTIsafe®1L





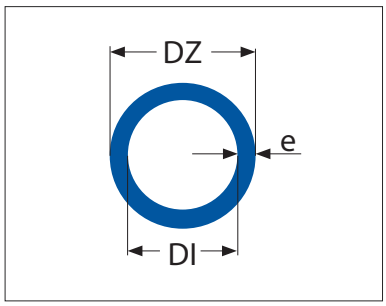


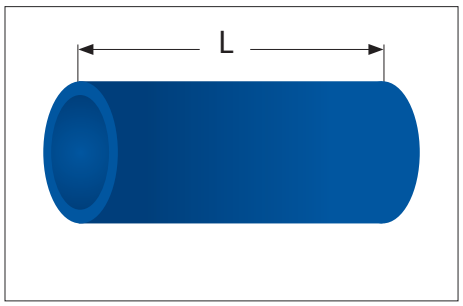
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	[m]
25	2,3	-	200
32	3,0	2,0	200
40	3,7	2,4	200
50	4,6	3,0	100
63	5,8	3,8	100
75	6,8	4,5	100
90	8,2	5,4	100
110	10,0	6,6	50

Drinking water pipes **RC MULTIsafe®1L** - 12 m bars

Type 1
1-layer pipe
RC MULTIsafe®1L







Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7 *	53,3	12
1000	90,8 *	59,3	12

* individual agreements

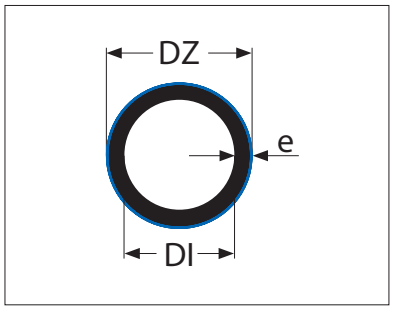
Drinking water pipes PE100 RC MULTIsafe®2L

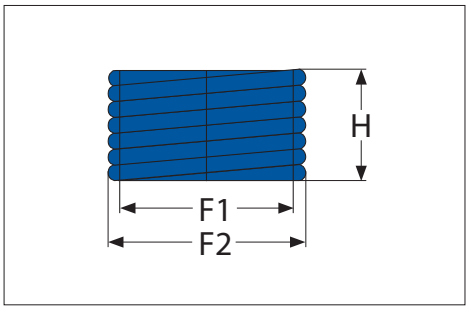
Pipes **RC MULTIsafe®2L** – 2-layer (black with distinguished dark blue external layer – type 2 – acc. to PAS 1075:2009.04) for drinking water are manufactured in range of diameters 25 – 1000 mm. Straight pipes ranging from DZ40 to DZ1000 diameter in 6-meter bars.

Drinking water pipes **RC MULTIsafe®2L** – coils

Type 2
2-layer pipe
RC MULTIsafe®2L







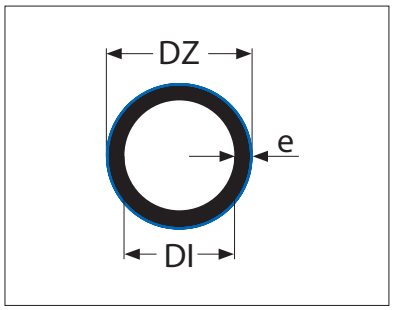
Diameter **DZ** [mm]	Wall thickness SDR 11 **e** [mm]	Wall thickness SDR17 **e** [mm]	Metres in coil [m]
25	2,3	–	200
32	3,0	2,0	200
40	3,7	2,4	200
50	4,6	3,0	100
63	5,8	3,8	100
75	6,8	4,5	100
90	8,2	5,4	100
110	10,0	6,6	50

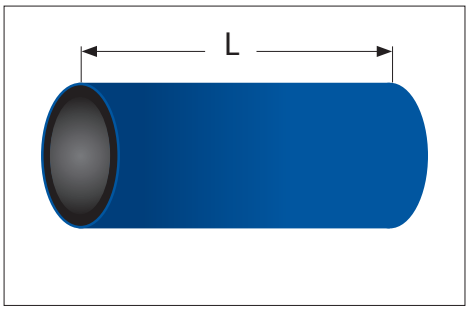
CAUTION: Upon customer request, we also offer a 20 mm diameter SDR11 option in a 200-meter coil for sale.

Drin king water pipes **RC MULTIsafe®2L** – 12 m bars

Type 2
2-layer pipe
RC MULTIsafe®2L







Diameter **DZ** [mm]	Wall thickness SDR 11 **e** [mm]	Wall thickness DR17 **e** [mm]	Metres in bundle [m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41 ,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

CAUTION: Upon customer request, we also offerthe possibility of manufacturing straight pipes ranging from DZ40 to DZ75 diameter in 12-meter bars.

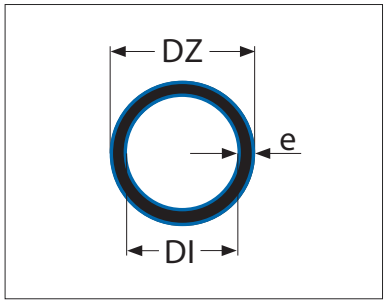
Drinking water pipes PE100 RC MULTIsafe®3L

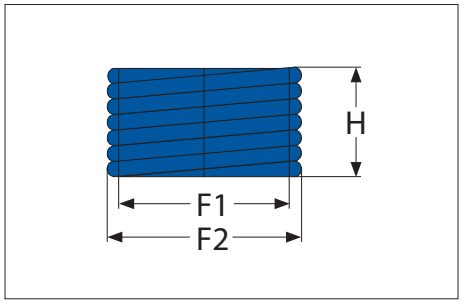
Pipes **RC MULTIsafe®3L** - 3-layer (black middle layer, dark blue extreme layer in thickness range 10% - 30%, whereas internal extreme layer min. 2.5 mm thick - type 2 - acc. to PAS 1075:2009.04) for drinking water are manufactured in range of diameters 90 - 500 mm.

Drinking water pipes **RC MULTIsafe®3L** - coils

Type 2
3-layer pipe
RC MULTIsafe®3L





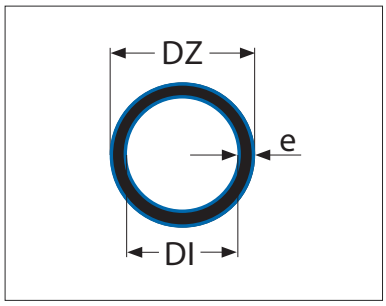


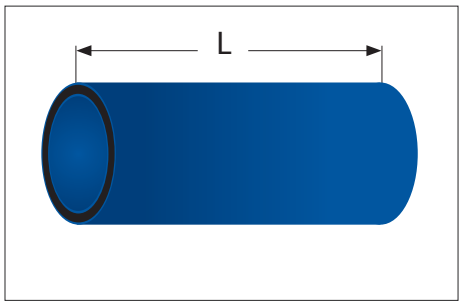
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	100
110	10,0	6,6	50

Drinking water pipes **RC MULTIsafe®3L** - 12 m bars

Type 2
3-layer pipe
RC MULTIsafe®3L





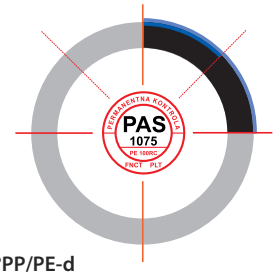


Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7,4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10.7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36.4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24

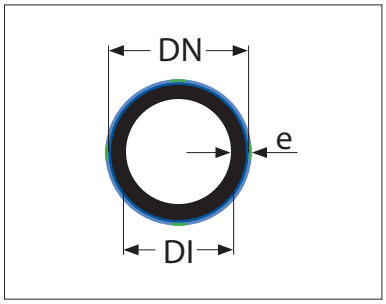
Drinking water pipes PE100 RC MAXIprotect®PP/PE-d 2-layer (or 1-layer) for water with additional protective jacket made of PE or PP and optionally with detection tape

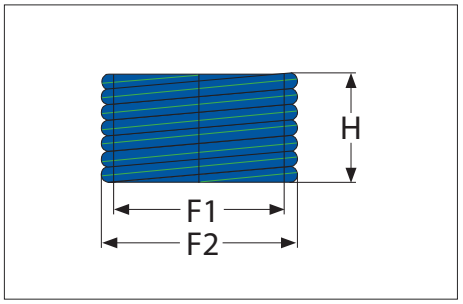
RC MAXIprotect PP/PR-d - pipes - dual-layer (black with distinct blue outer layer as solid dual-layer carrier pipe) with PP/ PE outer jacket in blue - type 3 - according to PAS 1075:2009.04 used for water, manufactured in diameters between 25 and 630 mm.
The carrier pipe can also be executed as single-colour.

Drinking water pipes **RC MAXIprotect®PP** - coils



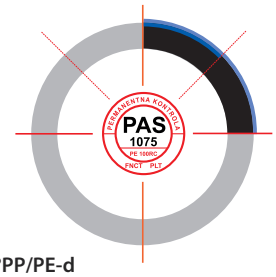
Type 3
2- or
1-layer pipe
RC MAXIprotect®PP/PE-d



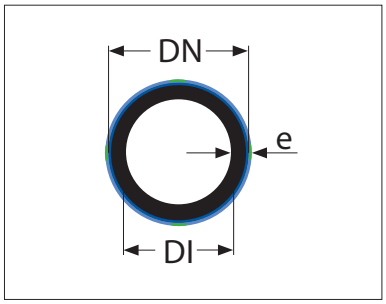


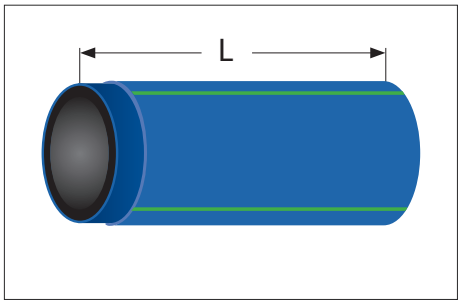
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DN [mm]	**e** [mm]	**e** [mm]	[m]
25	2,3	-	200
32	3,0	-	200
40	3,7	-	200
50	4,6	-	100
63	5,8	-	100
75	6,8	-	100
90	8,2	5,4	100
110	10,0	6,6	50

Drinking water pipes **RC MAXIprotect®PP** - 12 m bars



Type 3
2- or
1-layer pipe
RC MAXIprotect®PP/PE-d





Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DN [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7,4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,2	21,1	36
400	36,3	23,7	36
450	40,9	26,7	24
500	45,4	29,7	24
560	50,8	33,2	24
630	57,2	37,4	24

* **CAUTION:** W rurach **RC MAXIprotect®PP/PE -d**the optional detection tape may be made of an aluminium, stainless steel, or copper (agreed individually).
Specified wall thicknesses apply for pipe without the jacket, jacket thickness is specified on page 23. Diameters above 630 mm to be agreed.

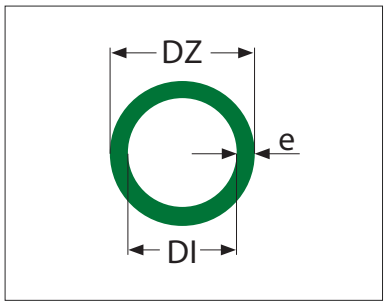
Utility water (sewage) pipes PE100 RC MULTIsafe®1L

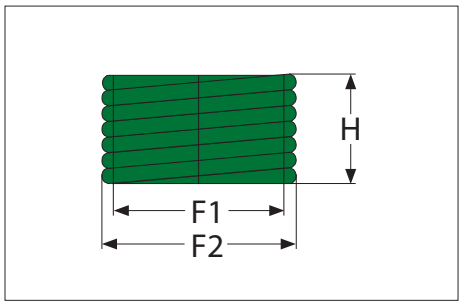
Pipes **RC MULTIsafe®** - solid, 1-layer (all green - type 1 - acc. to PAS 1075:2009.04) for utility water (sewage).
Manufactured in range of diameters 32 - 1000 mm for an individual request. Pipes may be black.

Sewer pipes **RC MULTIsafe®1L** - coils

Type 1
1-layer pipe
RC MULTIsafe®1L





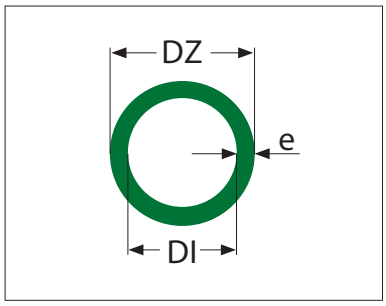


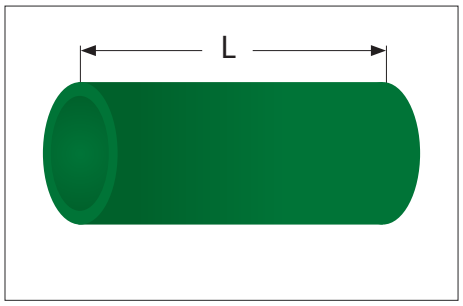
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	[m]
32	3,0	2,0	200
40	3,7	2,4	200
50	4,6	3,0	100
63	5,8	3,8	100
75	6,8	4,5	100
90	8,2	5,4	100
110	10,0	6,6	50

Sewer pipes **RC MULTIsafe®1L** - 12 m bars

Type 1
1-layer pipe
RC MULTIsafe®1L







Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

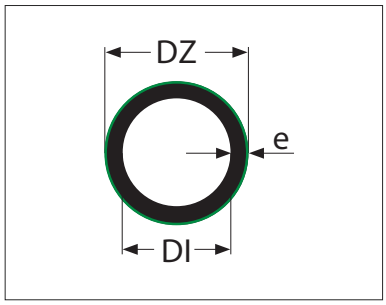
Utility water (sewage) pipes PE100 RC MULTIsafe®2L

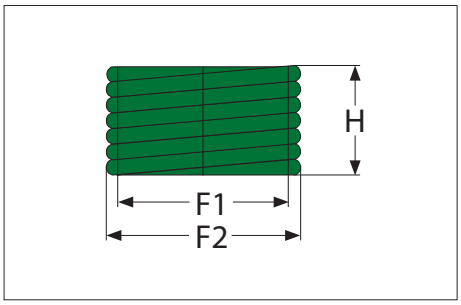
Pipes **RC MULTIsafe®** - 2-layer (black with distinguished green external layer - type 2 - acc. to PAS 1075:2009.04) for utility water (sewage) are manufactured in range of diameters 32 - 1000 mm.

Sewage pipes **RC MULTIsafe®2L** - coils

Type 2
2-layer pipe
RC MULTIsafe®2L





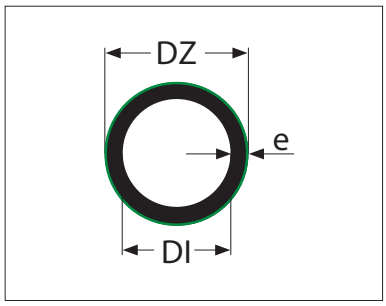


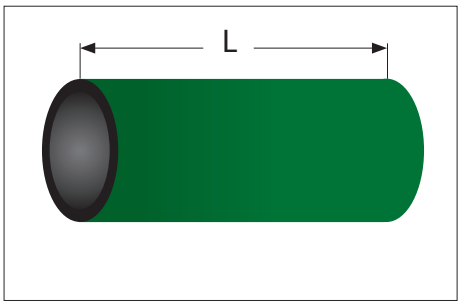
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	[m]
32	3,0	2,0	200
40	3,7	2,4	200
50	4,6	3,0	100
63	5,8	3,8	100
75	6,8	4,5	100
90	8,2	5,4	100
110	10,0	6,6	50

Sewage pipes **RC MULTIsafe®2L** - 12 m bars

Type 2
2-layer pipe
RC MULTIsafe®2L







Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

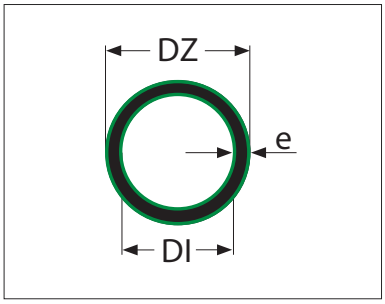
Utility water (sewage) pipes PE100 RC MULTIsafe®3L

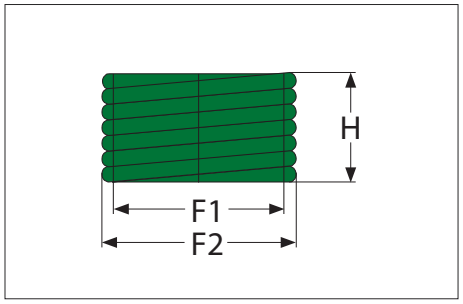
Pipes **RC MULTIsafe®3L** - 3-layer (black middle layer, green extreme layer in thickness range 10% - 30%, whereas internal extreme layer min. 2.5 mm thick - type 2 - acc. to PAS 1075:2009.04) for utility water (sewage) are manufactured in range of diameters 90 - 500 mm.

Sewer pipes **RC MULTIsafe®3L** - coils

Type 2
3-layer pipe
RC MULTIsafe®3L





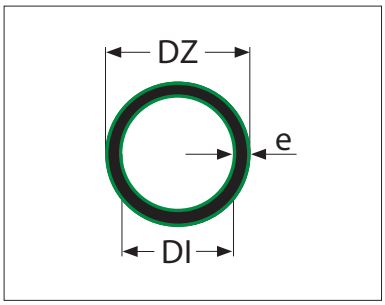


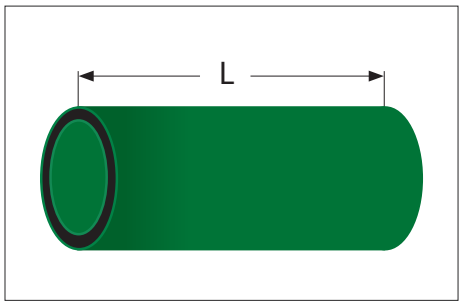
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	100
110	10,0	6,6	50

Sewer pipes **RC MULTIsafe®3L** - 12 m bars

Type 2
3-layer pipe
RC MULTIsafe®3L







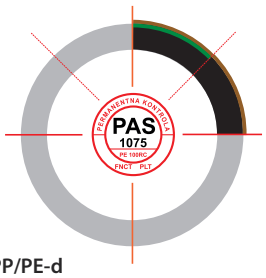
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7,4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36.4	23,7	36
450	41,0	26,9	24
500	45,5	29,7	24

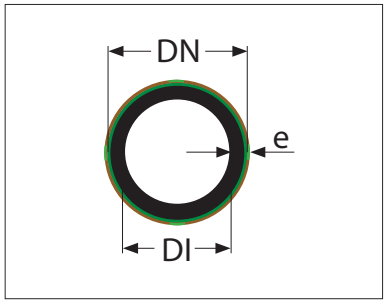
Utility water (sewage) pipes PE100 RC MAXIprotect®PP/PE-d 2-layer (or 1-layer) with additional protective jacket made of PE or PP and optionally with detection tape

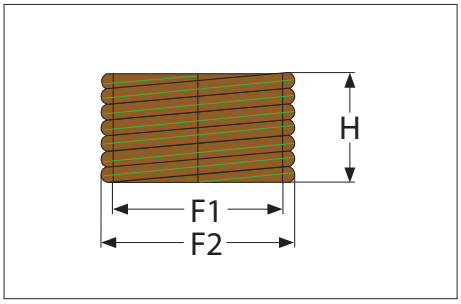
RC MAXIprotect PP/PR-d - pipes - dual-layer (black with distinct green/ brown outer layer as solid dual-layer carrier pipe) with PP/ PE outer jacket in green/ brown - type 3 - according to PAS 1075:2009.04 used for waste water, manufactured in diameters between 25 and 630 mm. The carrier pipe can also be executed as single-colour.

Sewer pipes **RC MAXIprotect®PP** - coils

Type 3
2- or
1-layer pipe
RC MAXIprotect®PP/PE-d



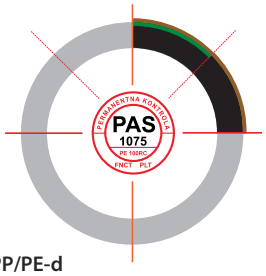


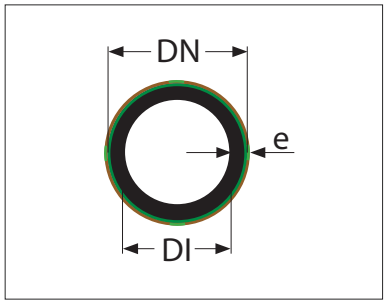


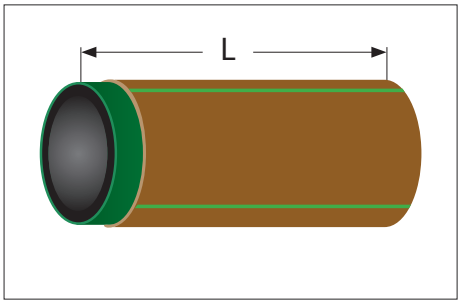
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in coil
DN [mm]	**e** [mm]	**e** [mm]	[m]
32	3,0	-	200
40	3,7	-	200
50	4,6	-	100
63	5,8	-	100
75	6,8	-	100
90	8,2	5,4	100
110	10,0	6,6	50

Sewer pipes **RC MAXIprotect®PP** - 12 m bars

Type 3
2- or
1-layer pipe
RC MAXIprotect®PP/PE-d







Diameter	Wall thickness SDR 11	Wall thickness DR 17	Metres in bundle
DN [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7,4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	40,9	26,7	24
500	45,4	29,7	24
560	50,8	33,2	24
630	57,2	37,4	24

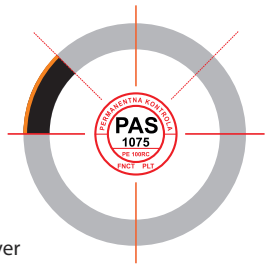
* **CAUTION:** In pipes **RC MAXIprotect®PE/PP -d** the optional detection tape may be made of an aluminium, stainless steel, or copper (agreed individually). Specified wall thicknesses apply for pipe without the jacket, jacket thickness is specified on page 23. Diameters above 630 mm to be agreed.

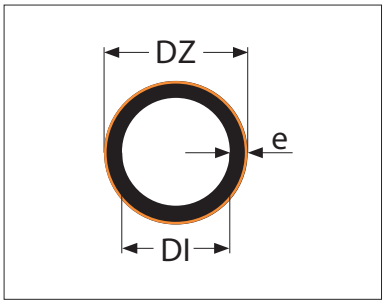
Gas pipes PE100 Smart 2L® with inspection layer

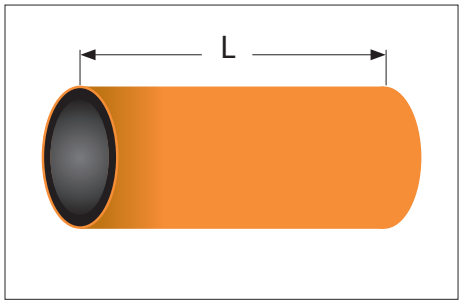
Pipes **PE 100 Smart 2L®** - 2-layer (black with distinguished orange external layer, similar to type 2 - acc. to PAS PN EN 12201, PN EN 1555, PN EN 12007) for gas are manufactured in range of diameters 90 - 1000 mm.

2-layer pipe PE 100 Smart 2L® with inspection layer - 12 m bars

Type 2
2-layer pipe
PE 100 Smart 2L®
with inspection layer







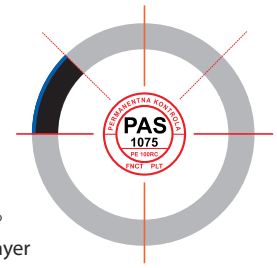
Diameter	Wall thickness SDR 11	Wall thicknesski SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

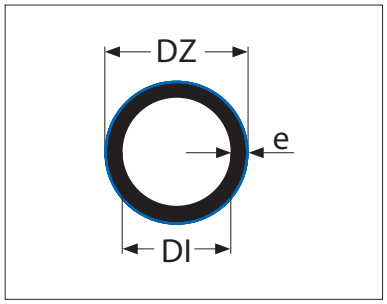
Drinking water pipes PE100 Smart 2L® with inspection layer

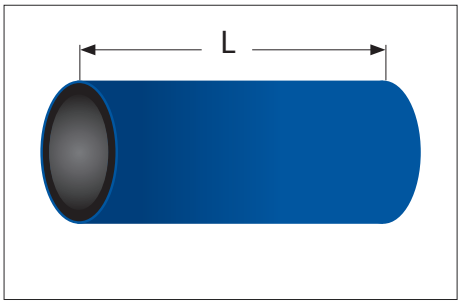
Pipes **PE 100 Smart 2L®** - 2-layer (black with distinguished dark blue external layer, similar to type 2 - acc. to PAS PN EN 12201, PN EN 1555, PN EN 12007) for drinking water are manufactured in range of diameters 90 - 1000 mm.

2-layer pipe PE 100 Smart 2L® with inspection layer - 12 m bars

Type 2
2-layer pipe
PE 100 Smart 2L®
with inspection layer







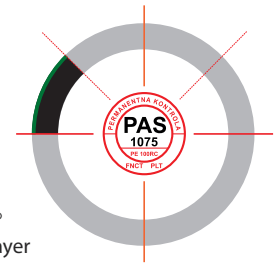
Diameter	Wall thickness SDR 11	Wall thickness SDR 17	Metres in bundle
DZ [mm]	**e** [mm]	**e** [mm]	[m]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

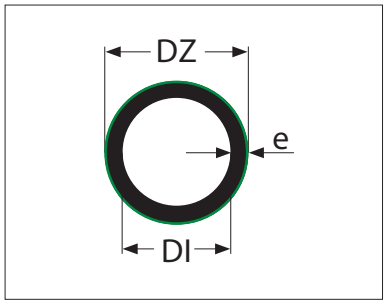
Utility water (sewage) pipes PE100 Smart 2L® with inspection layer

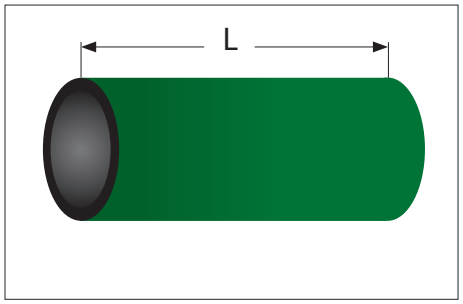
Pipes **PE 100 Smart 2L®** - 2-layer (black with distinguished green external layer, similar to type 2 - acc. to PAS PN EN 12201, PN EN 1555, PN EN 12007) for utility water (sewage) are manufactured in range of diameters 90 - 1000 mm.

2-layer pipe PE 100 Smart 2L® with inspection layer - 12 m bars

Type 2
2-layer pipe
PE 100 Smart 2L®
with inspection layer







Diameter **DZ** [mm]	Wall thickness SDR 11 **e** [mm]	Wall thickness SDR 17 **e** [mm]	Metres in bundle [mb]
90	8,2	5,4	384
110	10,0	6,6	312
125	11,4	7.4	276
140	12,7	8,3	240
160	14,6	9,5	204
180	16,4	10,7	72
200	18,2	11,9	72
225	20,5	13,4	60
250	22,7	14,8	48
280	25,4	16,6	48
315	28,6	18,7	36
355	32,3	21,1	36
400	36,4	23,7	36
450	41,0	26,7	24
500	45,5	29,7	24
560	50,9	33,2	24
630	57,3	37,4	24
710	64.5	42,1	12
800	72,6	47,4	12
900	81,7	53,3	12
1000	90,8	59,3	12

Accessories

Knifes for removing the external jacket from RC MAXIprotect® PP/PE pipes

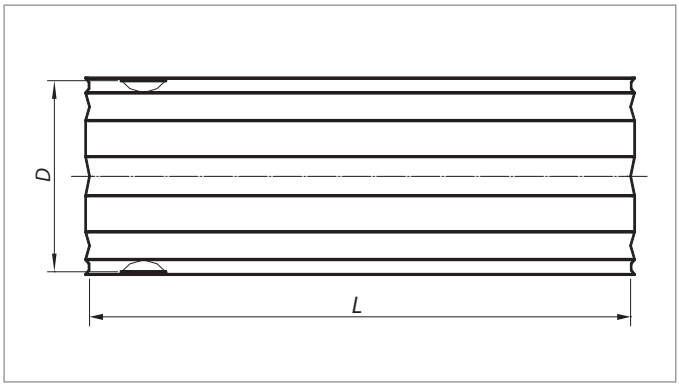
Knife RADPOL T1		
Pipe DN [mm] MAXIprotect ® PP/PE-d [mm]	Thickness of jacket [mm]	Range of application
90 - 180	1,2 - 3,5	allowed
200 - ...	2,7 - 6,0	recommended

Knife RADPOL T2		
Pipe DN [mm] MAXIprotect ® PP/PE-d [mm]	Thickness of jacket [mm]	Range of application
... - 180	1,2 - 3,5	recommended
200 - 250	2,7 - 4,0	useful
280 - ...	3,5 - 6,0	allowed



Heat-shrink sleeves for pipes RC MAXIprotect® PP/PE-d





Name / type	D	L cat.	L allowed	Pipe DN	Sleeve material
			[mm]		
RDK 55 L-150 MAXIprotect® PP/PE-d	55	150	150±15	DN 25, DN 32, DN 40, DN 50	radiationally crosslinked polyethylene
RDK 76 L-150 MAXIprotect® PP/PE-d	76			DN 63	
RDK 95 L-150 MAXIprotect® PP/PE-d	95			DN 75, DN 90	
TNK 90 L-150 MAXIprotect® PP/PE-d	105^{+5}	150	150±15	DN 90	radiationally crosslinked polyethylene
TNK 110 L-150 MAXIprotect® PP/PE-d	128^{+5}			DN 110	
TNK 125 L-150 MAXIprotect® PP/PE-d	142^{+5}			DN 125	
TNK 140 L-150 MAXIprotect® PP/PE-d	156^{+5}			DN 140	
TNK 160 L-150 MAXIprotect® PP/PE-d	180^{+10}			DN 160	
TNK 180 L-200 MAXIprotect® PP/PE-d	200^{+10}	200	200±15	DN 180	radiationally crosslinked polyethylene
TNK 200 L-200 MAXIprotect® PP/PE-d	220^{+10}			DN 200	
TNK 225 L-200 MAXIprotect® PP/PE-d	250^{+10}			DN 225	
TNK 250 L-200 MAXIprotect® PP/PE-d	278^{+10}			DN 250	
TNK 280 L-200 MAXIprotect® PP/PE-d	300^{+10}			DN 280	
TNK 315 L-200 MAXIprotect® PP/PE-d	340^{+15}			DN 315	
TNK 355 L-300 MAXIprotect® PP/PE-d	390^{+15}	300	300±15	DN 355	radiationally crosslinked polyethylene
TNK 400 L-300 MAXIprotect® PP/PE-d	430^{+15}			DN 400	
TNK 450 L-300 MAXIprotect® PP/PE-d	480^{+15}			DN 450	
TNK 500 L-300 MAXIprotect® PP/PE-d	540^{+20}			DN 500	
TNK 560 L-300 MAXIprotect® PP/PE-d	590^{+20}			DN 560	
TNK 630 L-300 MAXIprotect® PP/PE-d	660^{+40}			DN 630	

RDK - Heat-shrink sleeves, with glue inside on the whole length, round section without profiling. Designation according to sleeve diameter.

TNK - Heat-shrink sleeves, with glue inside on the whole length, round section technologically profiled. Designation according to MAXIprotect pipes diameter.

Accessories

Tapes for connecting detection tapes in pipes RC MAXIprotect® PP/PE-d

Type	Material	Glue	Range of application [°C]	Resistance [Ω]	Thickness w/o glue [mm]	Fire resistance acc. to IEC 60454-2	Roll tape length [m]	Roll tape width [mm]
90767	Al	acrylic, conductive	-30 ÷ +130	<=20	0,050 ±10%	non-flammable	50	25



TYPE CMC	90767
Carrier material	soft aluminium
Colour	silver
Thickness w/o glue in mm	0,050 ± 10%
Total thickness in mm	0,080 ± 10%
Glue parameters	
Glue type	acrylic, conductive
Peeling force in N/10mm	≥ 2
Resistance to shearing	w/o shearing
Shearing force after deforming with solvent in N/10mm	30 - 40
Heat parameters	
Application range °C	-40 ÷ +130
Short-term max. temp. in °C	+180
Flammability acc. to IEC 60454-2	fire-resistant
Electric parameters	
Resistance	≤ 20Ω
Mechanical parameters	
Peeling strength in N/10mm	40 - 50
Ultimate elongation in %	10 - 15

Accessories

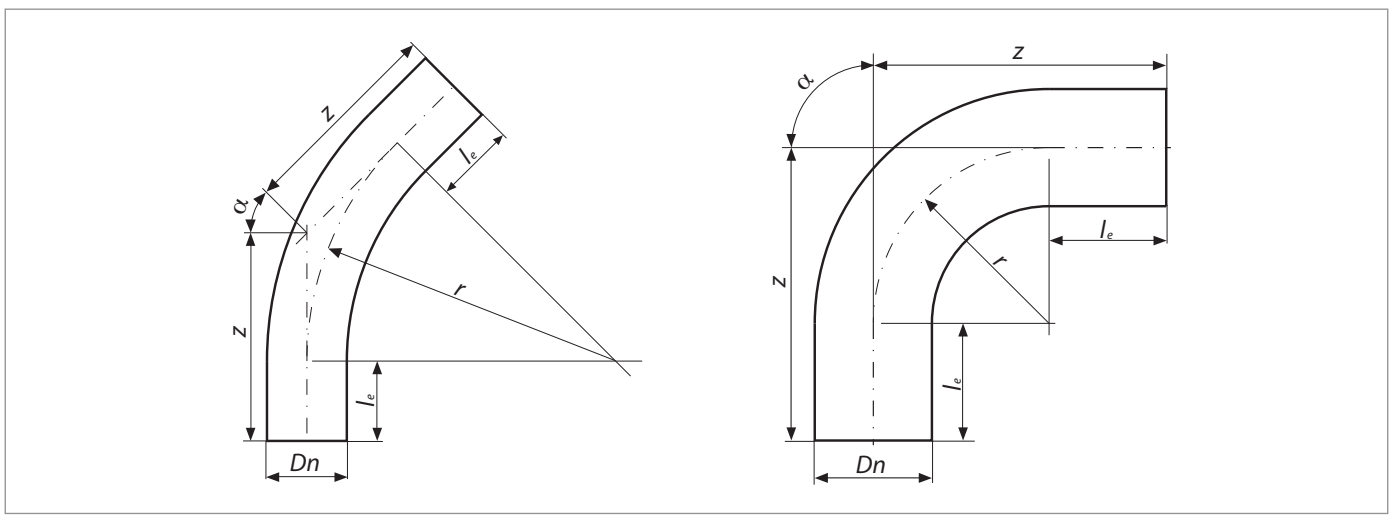
Bends RC MULTIsafe® 2L, 3L and PE 100 Smart 2L®



Summary of bends dimensions *

DN	α = 45°		α = 90°	
	$l_{e\ min}$	z_{min}	$l_{e\ min}$	z_{min}
90	150	280	150	465
110	150	309	150	535
125	150	331	150	587
140	150	353	150	640
160	150	382	150	710
200	150	440	150	849
225	150	476	150	937
250	250	612	250	1124
280	250	609	250	890
315	300	685	300	1026
355	300	761	300	1064
400	300	813	300	1129
450	300	930	300	1395
500	350	1066	350	1411
560	350	1118	350	1680
630	500	1170	500	1803
710	500	1581	500	2555
800	500	1785	500	2843
900	500	1989	500	3136
1000	**	**	**	**

* Other angles available after inquiry.
** Dimensions of bend DN1000 mm are agreed individually.



RADPOL PIPES

PIPE SOLUTIONS

PRE-INSULATED SYSTEMS

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