Loading and unloading

1. All work should be carried out by properly trained personnel using equipment ensuring safe performance of the work.
2. Personnel operating all types of lifting and auxiliary devices should have appropriate authorizations and training in the operation of these devices.
3. Employees of the pipe supplier/recipient involved in the loading and unloading operation should use appropriate personal protective equipment.
4. Loading and unloading of pipes should be done using:
   - Forklifts with smooth forks in the case of palletized pipes, the frames of which are not damaged so as not to pose a potential threat to employees,
   - cranes using soft slings: (loose or palletized pipes) using ropes or fibrous slings (nylon, cotton-hemp, etc.) with strength adapted to the load being transported.
5. Be especially careful when unloading in low temperatures. Impact resistance decreases as the ambient temperature decreases.

Forbidden is:

- using metal bars, hooks and chains for lifting, which may damage pipes,
- pipes to be lifted using strapping frames/pallets, they are not designed for this purpose and may not withstand the load,
- dump pipes in an uncontrolled manner, which may damage pipes and pose a threat to people.

Transport and handling

1. Transport of pipes by car is regulated by road traffic regulations on public roads and can practically be carried out by any means of transport, adapted, among others, to: length and height tonnage.
2. For transport, use cars with an even and flat floor, free of nails and other irregularities in the cargo space, or specialized cars.
3. Avoid contact during transport and storage with oils, fats, greases or other chemical substances causing permanent contamination.
4. Pipes should be secured against shifting during transport.
5. Side supports should be flat and without sharp edges.
6. Pipes with the largest diameter should be routed to the bottom of the cargo area.
7. Pipes may be transported outside the cargo space of the car if their part is shorter than five times the outer diameter (pipes with a diameter of up to 400 mm) or 2 m (pipes with a diameter of 400 mm and more).
8. Use fiber ropes or slings for lifting or carrying.
9. Pipes with smaller diameters (<160 mm) can be moved manually on the construction site.

Forbidden is:

- dragging pipes on the ground,
- dropping pipes from height,
- using metal to carry: ropes, beams, hooks, chains.

Storage
1. Pipes should be stored on an even, smooth surface, without sharp objects, using sleepers. 2. The supports should be spaced 2.5 m apart 3. The storage period from the date of production to the date of burial in the ground cannot be longer than 12 months (provided that the pipes are protected against weather conditions, in particular sunlight). 4. Pre-packed pallets can be stacked on top of each other up to a height of 3-4 m by arranging wooden pallet frames. 5. Pipes stored loose should be placed on wooden supports and secured with side supports. 6. The height of pipes stored loose in a stack should not exceed 1 m. 7. Pipes with the largest diameters should be placed at the bottom of the pile. 8. In extreme climatic conditions, it is necessary to provide special conditions for storing pipes.
Forbidden is: • storing pipes directly on the ground, • storing pipes in the immediate vicinity of fuels, solvents, oils, greases, paints and heat sources, • long (over 3 months) storage of pipes not protected against weather conditions, in particular against UV radiation (sunlight), • storing pipes at temperatures above 45℃.

Installation

All assembly works should be performed by properly trained personnel, using equipment ensuring safe and correct performance of these works.

Bending – minimum bending radius

Rigid ROS-Zk pipes can be bend to a limited extent, depending on the external diameter and ambient temperature. The minimum bending radius can be calculated using the formula:

$$R = Dn \cdot Cu$$

Where:

$R_g - bending\ radius\ [m]$
$D_n - nominal\ diameter\ of\ the\ pipe\ [m]$
$C_u - Deflection\ factor\ [-]$

Temperature	C_u Deflection factor
20°C	24
10°C	42
0°C	60

Sample: for ROS-Z 250x14,8 minimum bending radius at temperature 20°C are:
R=0,25x24 = 6 m

Welding

ROS-Z and ROS-Zk pipes can be connected by butt welding. The ends of both properly cut and heated pipes are touched and pressed together, forming a uniform and tight connection after cooling down. A properly made weld has the same strength parameters as the joined pipes

During the welding process, follow the procedures specified by the welding machine manufacturer. The welding parameters of different welding machine manufacturers may vary because they are developed based on different standards. Following all guidelines of the given procedures guarantees proper welding.

Examples of welding standards:
ISO 21307; DVS 2207-1; DS./INF 70-2; NEN 7200

It is recommended to use a temperature of 220 ^{O}C in the welding process.

In addition to the welding parameters, it is very important to maintain the pipe preparation regime and the welding site.

It is higly important:

- preparation of welded surfaces by milling and degreasing,
- matching pipe ends,
- providing protection against unfavorable weather conditions,

Work can be carried out provided that appropriate measures are taken when welding the pipes. It is advisable to use a tent to protect against wind, rain and moisture and/or a heater to raise the temperature near the welder.

If appropriate countermeasures are used, work can be carried out regardless of the weather.

Dragging a pipe underground

Axial forces in polyethylene pipes when pulling secondary sewage pipes into the primary sewage system or when pulling pipes into boreholes must not exceed permissible values. Typically, the stress at the yield point of polyethylene used to produce ROS-Zk pipes is above 20 MPa.

It follows from the above that the value of the axial force (DSO) that the pipe can carry while being pulled in depends mainly on the stress at the yield point (permissible tensile stresses taking into account safety factors) and on the cross-section of the pipe.

Safe tensile stress:

$$N_r = f_r \cdot f_t \cdot f_c \cdot T_y$$

Where:

$N_r - safe\ tensile\ stress\ for\ PE\ [MPa]$
$f_r -\ safety\ factor\ for\ tension\ [-]$
$f_t - temperature\ coefficient\ reducing\ tensile\ strength [-]$
$f_c - time\ factor\ reducing\ tensile\ strength\ [-]$
$T_y - tensile\ strength\ [MPa]$

Permissible axial tensile force:

$$DSO = 1000 \cdot N_r \cdot \pi \cdot D_n^2 \cdot \left(\frac{1}{SDR} - \frac{1}{SDR^2}\right)$$

Where:

$DSO -\ permissible\ axial\ tensile\ force\ of\ the\ pipes\ [kN]$
$D_n -\ nominal\ diameter\ of\ the\ pipe\ [m]$
$SDR - the\ ratio\ of\ the\ outer\ diameter\ of\ the\ pipe\ to\ its\ wall\ thickness\ [-]$

The safety factor f_r was set at 2.5, the remaining factors should be selected individually, taking into account the dragging conditions

If the remaining reduction factors cannot be determined, the total value of the coefficients should be assumed to be 8.

Linear extension of pipes

Pipes made of polyethylene are characterized by a relatively high coefficient of thermal expansion, which should be taken into account when laying and installing pipes. In the case of long sections, the amount of change in length is calculated from the formula:

$$\Delta L = \Delta t \cdot L \cdot \alpha$$

Where:

$\Delta L - amount\ of\ change\ in\ length\ [mm]$
$\Delta t - temperature\ difference\ T_1 - T_2\ [°C]$
$T_1 - Stable\ ground\ temperature\ [°C]$
$T_2 - pipe\ temperature\ at\ the\ time\ of\ laying\ [°C]$
$L - length\ of\ the\ pipe\ section\ [m]$
$\propto - coefficient\ of\ linear\ thermal\ expansion\ \left[\frac{mm}{m \cdot °C}\right]$
$\propto\ for\ HDPE\ the\ coefficient\ of\ linear\ thermal\ expansion\ is\ 0.20\ \left[\frac{mm}{m \cdot °C}\right]$

Pipes stored in the sun may heat up to temperatures above 50℃. The ground temperature at a depth of 1 m will be 10℃ at the same time. Hence the difference in length (pipe shrinkage), e.g. on a 100-meter long pipe it is 800 mm (80 cm).

It is recommended to leave a reserve of pipe at the ends of drillings and in wells.

Forbidden is:

- exceeding the minimum bending radii provided for a given temperature,
- changing in welding parameters included in the relevant standards, including: heating temperature, pressing force and cooling time,
- welding at negative temperatures and in fog, regardless of the ambient temperature,
- exceeding the specified parameters of the maximum resistance force,

If you do not follow the above instructions: the warranty becomes invalid.