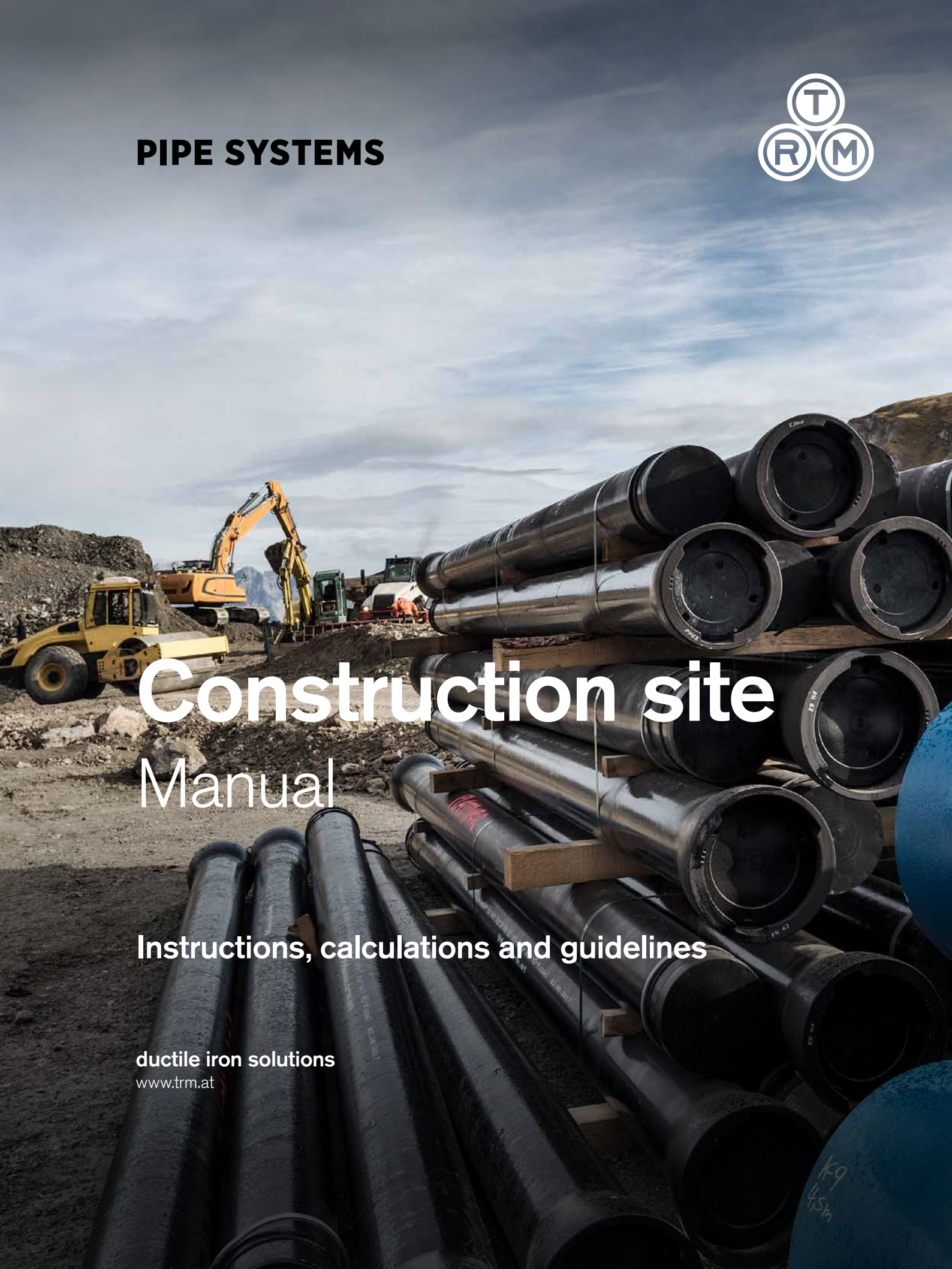
PIPE SYSTEMS



Construction site
Manual

Instructions, calculations and guidelines

ductile iron solutions
www.trm.at

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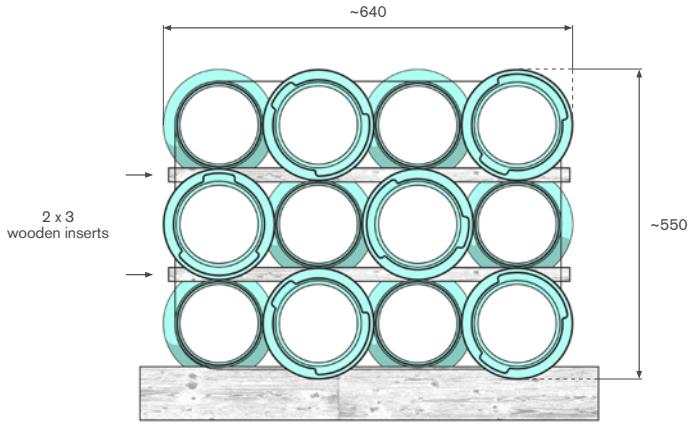


Pipe stack DN 125

Bundling

Safe transport

After the final inspection at the plant, pipes up to DN 300 are bundled and delivered as pipe bundles. Please refer to the table for the exact number of pipes per bundle. From DN 400 the pipes are stored and delivered individually on stacking timbers. If required, the pipe masses can be found in the respective product information.

⚠ For horizontally mounted bundles, the plastic straps can only be cut with a metal shear or a side cutter.

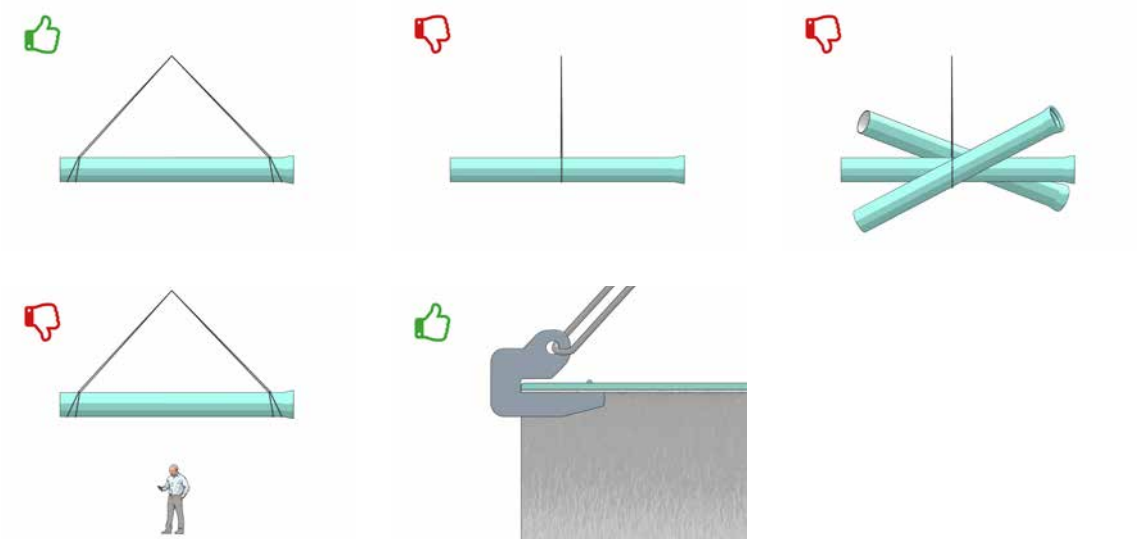
Number of pipes per bundle

DN	80	100	125	150	200	250	300	400	500	600
Number per bundle	15	15	12	8	6	4	4	1	1	1

Number of pipes per truck[a]

DN	80	100	125	150	200	250	300	400	500	600
Tarpaulin truck 24.5 tons	300	240	192	152	120	92	72	47	34	32
Crane truck 22.5 tons	270	225	180	144	108	84	68	43	32	30

[a] Wall thickness class K9 or K10



Transporting pipes

Care and safety

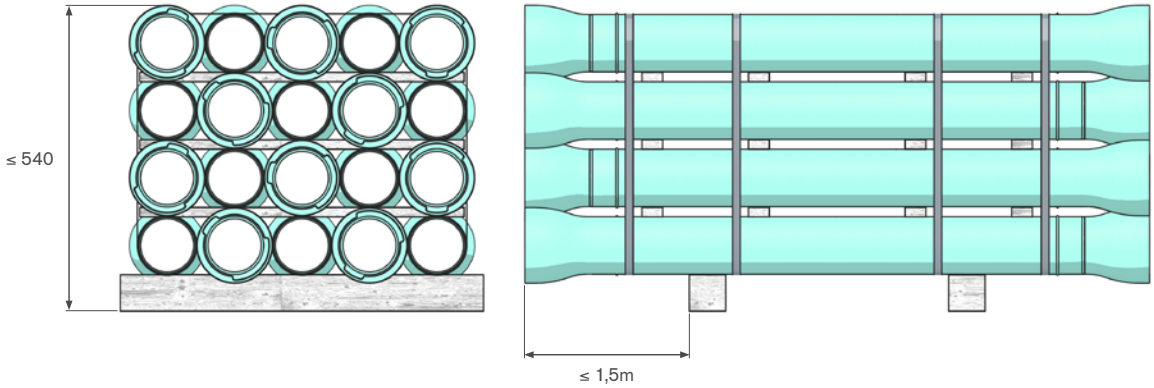
Careful handling of the pipe components during transport, unloading and stacking is the prerequisite for many years of trouble-free pipe operation. Belts should be used for loading and unloading pipes and pipe bundles.

Alternatively, suitable forklift trucks can also be used. In particular, you should ensure that:

+ the pipes cannot fall off the side of the fork (the forks should be at least 3 m apart),
+ the pipes cannot roll off the front of the fork,
+ the fork is sufficiently padded to prevent damage to the pipe.

⚠ During loading and unloading, nobody must be under or on the pipe, pipe bundle or in the danger area of the crane.

⚠ Any damage to the cement-mortar lining or the external protection must be repaired.



Pipe material on the construction site

Safe storage

Storing pipes

The pipes or pipe stacks can only be placed on wooden beams or other suitable materials. They should:

+ be set down gently,
+ not be dropped from the vehicle,
+ not be ground or rolled over long distances,
+ be secured against rolling and slipping,
+ be stored on a level and stable surface.

⚠ If ductile iron pipes are stored in a stack, they must be placed on wooden beams (min. 10/10 cm) approx. 1.5 m from the pipe ends.

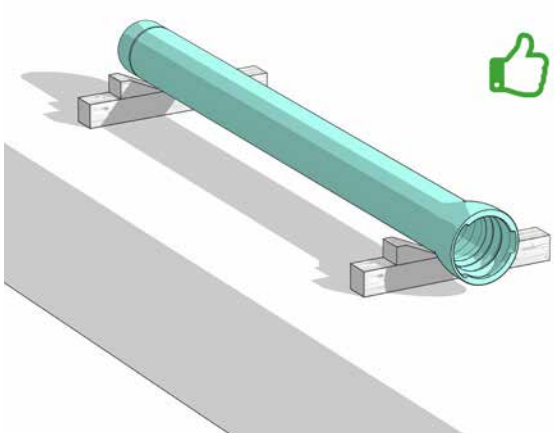
Maximum allowable stack height

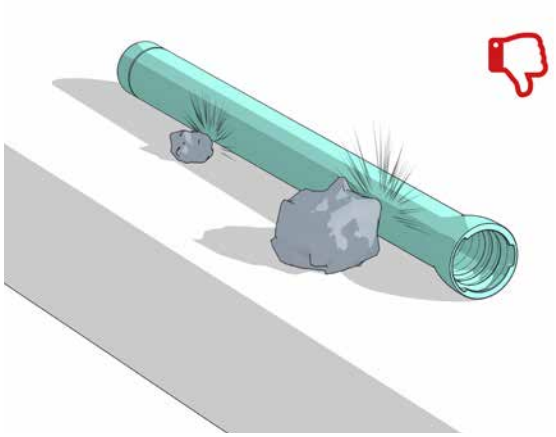
Stack heights over 3 m must be avoided for safety reasons! The number of possible stack heights for the bundles is indicated in the corresponding table.

⚠ Thermally insulated iron pipes (WKG) must not be stacked.

Maximum allowable stack height

DN	Bundle	Positions
DN 80 to DN 150	3	–
DN 200 to DN 300	3	–
DN 400 to DN 600	–	4
DN 700 to DN 1000	–	2





Storing gaskets

To ensure the operational safety of the pipe, only gaskets which comply with the quality regulations and which are supplied by the iron pipe manufacturer must be used. If other gaskets are used, warranty claims will be void.

The gaskets should be:

+ stored in a cool, dry place and not be deformed,
+ protected from direct sunlight,
+ free from damage,
+ free from dirt.

⚠ At temperatures below 0 °C, the gaskets will become somewhat harder. If external temperatures are below 0 °C, the rings must therefore be stored at a temperature above 10 °C to facilitate assembly (e.g. construction containers, excavator cabs).

⚠ The gaskets must only be removed from storage immediately before installation and must be checked for dirt and damage before being installed.

Opening the pipe bundles

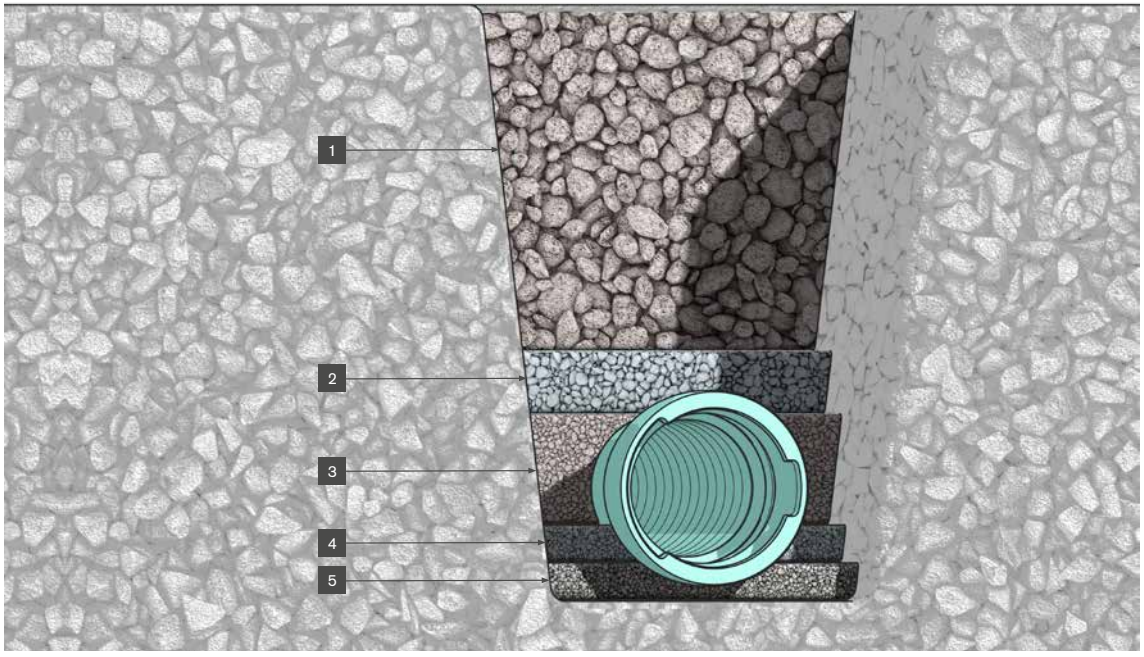
The pipes bundles are held together with plastic straps. The straps must only be cut with suitable tools, such as a metal shear or a side cutter. Chisels, crowbars, pickaxes, etc. can damage the pipe's external coating and also increase the risk of accidents. Before cutting the plastic straps, ensure that:

+ the pipe stack is placed on a surface that is as flat, level and stable as possible,
+ the pipes are secured against rolling and slipping,
+ no one is standing in front of or on the pipe stack.

Pipe distribution at the construction site

If the pipes are distributed along the pipe trench prior to installation, they must be stored on wooden beams or similar as described above and secured against slipping and rolling.

⚠ Sealing caps for drinking water pipes must only be removed immediately before installation.



1 main filling, 2 cover, 3 side filling, 4 upper bedding zone, 5 lower bedding zone

Pipe trench and filling

For long product life and to prevent damage

References to standards

Water pipes:
ÖNORM EN 545, ÖNORM EN 805 and ÖNORM B 2538

Wastewater pipe:
ÖNORM EN 598, ÖNORM EN 1610 and ÖNORM B 2503

Constructing the pipe trench

When constructing the pipe trench, sufficient working space must be provided to install the pipe, depending on the trench depth and the external pipe diameter. The Construction Workers Protection Ordinance, other regulations and the relevant standards and rules must be complied with. Pipe laying is governed by ÖNORM B 2538.

The pipe trench is divided into:

+ Main filling
+ Cover
+ Side filling
+ Bedding zone
+ Trench bottom

⚠ The pipe zone essentially determines the load and stress distribution at the pipe circumference. It consists of the bedding zone, the side filling and the cover.

Installation material[a]

External coating	Round grain material		Broken material	
	Sand / gravel		Grit / crushed stone	
	Sieved material	Single grains up to max.	Sieved material	Single grains up to max.
PUR-Longlife[b]	0 – 32 mm	63 mm	0 – 16 mm	32 mm
PUR-TOP	0 – 16 mm	32 mm	0 – 8 mm	16 mm
ZMU-Austria	0 – 63 mm	100 mm	0 – 63 mm	100 mm
WKG	0 – 16 mm	32 mm	0 – 8 mm	16 mm

[a] For use of recycled material, please observe the assessment according to DVGW Code of Practice GW 9.

[b] If compaction in the pipe zone is not required and subsequent settlements on the surface can be tolerated (forest soils, agricultural areas, etc.), the planner can determine a higher value for single grains in the pipe zone up to max. 100 mm for ductile iron pipes with PUR-LL coating if necessary (deviation from normal circumstances).

Bedding zone / trench bottom

The bottom of the trench should be designed so that the pipes lie along their entire length. For the pipe connections (sockets) it is advantageous to excavate corresponding recesses (head holes). For ductile iron pipes, the existing soil is usually suitable for bedding the pipe.

⚠ A lower bedding layer is therefore not required and the trench bottom becomes the lower bedding.

If the bottom of the trench is not suitable for the pipe bedding (rocky ground etc.), a lower bedding layer consisting of compactible sand, gravel sand or sifted soil must be provided.

⚠ When compacted, the height should be 100 mm + 1/10 of the external pipe diameter.

Side filling

Suitable material which does not damage the pipe components or the coating must be used for the pipe bedding. This filling material should be filled in layers on both sides of the pipe and sufficiently compacted. Compactible filling material must be used in the area around the pipe.

Cover

Before compaction of the main filling begins, the pipe cover must be made, depending on the compaction equipment used. This cover must only be compacted with hand tampers or suitable light compaction equipment.

⚠ As a rule, the cover should be 30 cm high (when compacted).

⚠ When using light compaction equipment, the cover can be reduced to at least 15 cm.

Special case: ZMU-Austria

For ductile iron pipes with cement-mortar coating, practically any excavated material can be used in the area around the pipe, including soils containing stones up to a maximum grain size of 100 mm.

⚠ This means that the bedding material does not have to be transported to the construction site at great expense.

⚠ Landfill costs are greatly reduced.

Pipe statics

Allowable cover height

As a rule, the use of a ductile iron pipe does not have to be checked on the basis of pipe statics according to ÖNORM B 5012. Only special installation cases such as load classes > SLW 60 (e.g. railroad or aircraft traffic loads) must be covered by separate pipe statics.

- ⚠ A form is available at **www.trm.at** to record the static boundary conditions.
- ⚠ The application engineering department at Tiroler Rohre GmbH can prepare verifiable pipe statics once you have submitted the completed and signed form. In all cases, this must be checked and approved by an authorized structural engineer.

As a rule, the tables listed are used for checking purposes.

Cover height

This table contains the most unfavorable value ranges of the allowable cover height for each nominal diameter group. The values can be applied without additional calculations.

Bedding factor, K

Depends on the earth pressure distribution over the pipe crown (on a distance corresponding to the external diameter) and the pipe support (on a distance corresponding to the theoretical bedding angle 2α).

- ⚠ K is usually between 0.11 when $2\alpha = 20°$ and 0.09 when $2\alpha = 120°$.
- ⚠ The value of 20° applies to a pipe resting on a smooth trench bottom without compaction.

Correction factor for traffic loads, β

Three types of traffic loads must be taken into account:

- + Traffic areas with main roads, $\beta = 1.5$: this is the general case, except for access roads;
- + Traffic areas with access roads, $\beta = 0.75$: roads where trucks are not allowed;
- + Rural areas, $\beta = 0.5$: all other cases.

- ⚠ Please note that all pipes should be designed for at least $\beta = 0.5$, even if they are not expected to be exposed to traffic loads.

Soil reaction module, E‘

Depends on the type of soil in the area around the pipe and the installation conditions.

In the table below, the values for E‘ are to be regarded as guide values.

- + $E' = 0$ kN/m² -> most unfavorable laying conditions in poor soils (no compaction, water level above the pipe, removal of trench shoring after filling or under embankment conditions)
- + $E' = 1{,}000$ kN/m² -> zero compaction
- + $E' = 2{,}000$ kN/m² -> low compaction
- + $E' = 5{,}000$ kN/m² -> good compaction

Cover heights for K classes according to ÖNORM EN 545:2006 - Table G.1[a]

DN	E‘	80 to 200	250 to 300	350 to 450	500 to 2000
K(2 α)	–	0.110 (20°)	0.110 (20°)	0.105 (45°)	0.103 (60°)
		[m]			
β = 0.50 Rural areas	E‘ = 0	0.3 to 15.4	0.3 to 9.9	0.3 to 6.9	0.3 to 2.2
	E‘ = 1000	0.3 to 15.9	0.3 to 10.6	0.3 to 7.8	0.3 to 3.5
	E‘ = 2000	0.3 to 16.4	0.3 to 11.3	0.3 to 8.7	0.3 to 4.7
	E‘ = 5000	0.3 to 17.9	0.3 to 13.4	0.3 to 11.4	0.3 to 8.3
β = 0.75 Access roads	E‘ = 0	0.3 to 15.3	0.3 to 9.8	0.3 to 6.8	0.5 to 2.0
	E‘ = 1000	0.3 to 15.8	0.3 to 10.5	0.3 to 7.7	0.3 to 3.4
	E‘ = 2000	0.3 to 16.4	0.3 to 11.2	0.3 to 8.7	0.3 to 4.6
	E‘ = 5000	0.3 to 17.9	0.3 to 13.3	0.3 to 11.3	0.3 to 8.2
β = 1.50 Main roads	E‘ = 0	0.3 to 15.2	0.3 to 9.7	0.4 to 6.6	[b]
	E‘ = 1000	0.3 to 15.8	0.3 to 10.4	0.4 to 7.6	0.6 to 3.0
	E‘ = 2000	0.3 to 16.3	0.3 to 11.1	0.3 to 8.5	0.5 to 4.4
	E‘ = 5000	0.3 to 17.8	0.3 to 13.2	0.3 to 11.2	0.3 to 8.1

[a] The specified values for the cover heights were calculated for the wall thickness class K9, and they also apply to classes ≥ K10.

[b] Not recommended; only one specific calculation for each individual case can give an answer.

Cover heights for C classes according to ÖNORM EN 545:2010 - Table F.1

DN	E‘	80 to 150	200 to 300	350 to 400	450 to 600	700 to 2000
		Class 40	Class 40	Class 30	Class 30	Class 25
K(2α)	–	0.110 (20°)	0.110 (20°)	0.105 (45°)	0.105 (45°)	0.103 (45°)
		[m]				
β = 0.50 Rural areas	E‘ = 0	0.3 to 12.0	0.3 to 7.0	0.3 to 3.8	0.3 to 3.1	0.5 to 1.6
	E‘ = 1000	0.3 to 12.6	0.3 to 7.8	0.3 to 4.8	0.3 to 4.2	0.3 to 3.0
	E‘ = 2000	0.3 to 13.2	0.3 to 8.6	0.3 to 5.7	0.3 to 5.2	0.3 to 4.2
	E‘ = 5000	0.3 to 15.0	0.3 to 11.1	0.3 to 8.5	0.3 to 8.1	0.3 to 7.8
β = 0.75 Access roads	E‘ = 0	0.3 to 12.0	0.3 to 6.9	0.4 to 3.7	0.5 to 3.0	0.9 to 1.2
	E‘ = 1000	0.3 to 12.6	0.3 to 7.7	0.3 to 4.7	0.4 to 4.1	0.4 to 2.9
	E‘ = 2000	0.3 to 13.2	0.3 to 8.6	0.3 to 5.6	0.3 to 5.1	0.3 to 4.1
	E‘ = 5000	0.3 to 14.9	0.3 to 11.0	0.3 to 8.5	0.3 to 8.1	0.3 to 7.8
β = 1.50 Main roads	E‘ = 0	0.3 to 11.9	0.4 to 6.7	0.9 to 3.2	1.2 to 2.2	[a]
	E‘ = 1000	0.3 to 12.5	0.4 to 7.7	0.7 to 4.3	0.8 to 3.7	1.0 to 2.3
	E‘ = 2000	0.3 to 13.1	0.3 to 8.4	0.6 to 5.4	0.6 to 4.8	0.7 to 3.9
	E‘ = 5000	0.3 to 14.8	0.3 to 10.9	0.4 to 8.3	0.4 to 7.9	0.4 to 7.7

[a] Not recommended; only one specific calculation for each individual case can give an answer.

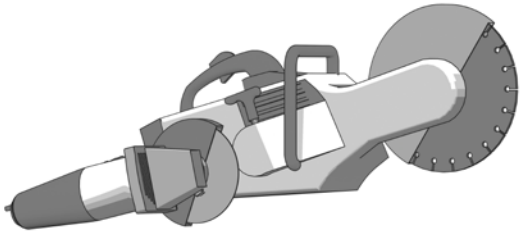
Shortening pipes

Tools

Pipes require pipe fittings of various lengths in order to install bends, outlets and valves. The exact lengths can only be determined on the construction sites, where you have to be able to cut pipes easily, quickly and safely. For pipes DN 80 - 500 no welded bead needs to be applied – a clamping ring can be used (see clamping ring installation instructions). From pipes DN 600, a welded bead must be applied again afterwards (see the section on welding).

Cut-off wheel for stone

Grinding disk for iron



Angle grinder with petrol engine, electric or compressed air drive

Angle grinders

For cutting ductile iron pipes, today angle grinders with various drive types are used almost exclusively. These can be devices with electric drive or compressed air drive, depending on the construction site aggregates, or independent devices with a petrol engine. In many of the commercially available angle grinders, the cut-off wheels for cutting and the rough grinding wheels for rounding off the cutting edge can be clamped.

Cut-off wheels

We recommend type C 24 RT Special silicon carbide cut-off wheels. These are cut-off wheels for stone, which have proven themselves in real-world applications when cutting ductile iron pipes with a cement-mortar lining.

Rough grinding wheel

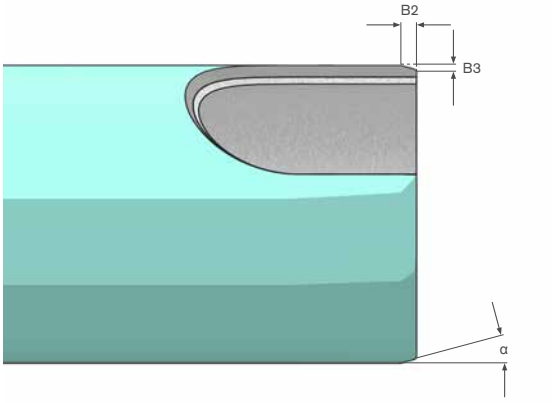
Rough grinding wheels for iron should be used to bevel the spigots.

Personal protective equipment

⚠ Please be aware of appropriate protective equipment such as gloves, goggles, hearing protection and respiratory protection.

Tables for shortening pipes

The following tables contain all dimensions required to shorten pipes correctly.

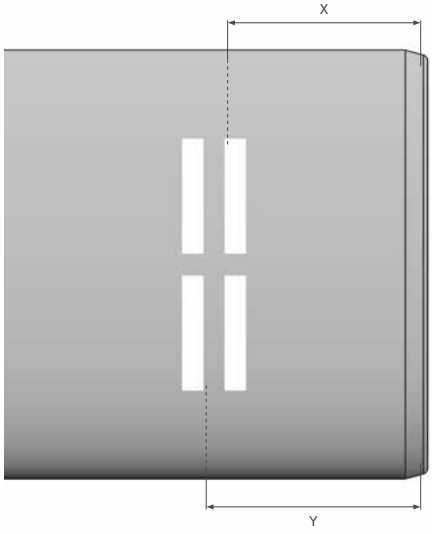


Beveling pipes at the cut surfaces

DN	Bevel		
	B2	B3	α
80	8–10	3–4	10
100			
125			
150			
200			
250			
300			
400			
500			
600			15
700	20-22	5-6	
800			
900			
1,000			

Marking the insertion depth

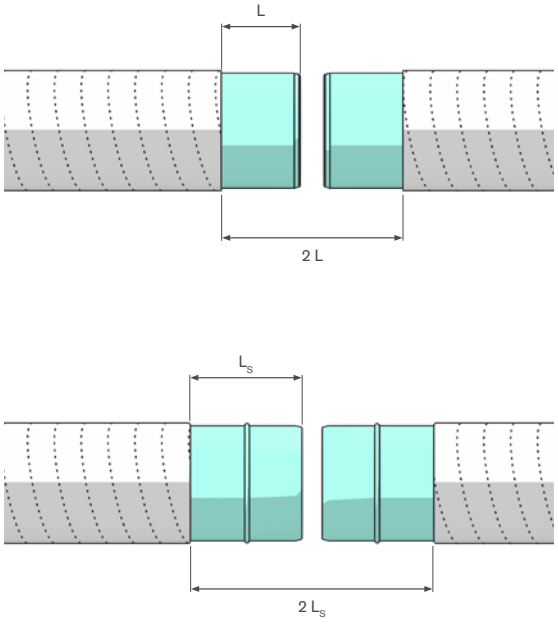
DN	Dimensions [mm]		
	Insertion depth		
	VRS®-T	TYTON	
		x	y
80	127	69	82
100	135	73	86
125	143	76	89
150	150	79	92
200	160	85	98
250	165	90	103
300	170	95	108
400	190	95	108
500	200	105	118
600	175	105	118
700	197	148	161
800	209	157	170
900	221	167	180
1,000	233	177	190



Special case: ZMU-Austria Coating [a]

DN	TYTON®	VRS®-T
	L (mm)	L_s (mm)
80	95	165
100	100	175
125	100	185
150	105	190
200	110	200
250	115	205
300	120	210
350	120	-
400	120	230
500	130	243
600	145	300
700	205	315
800	220	330
900	230	345
1,000	245	360

[a] ZMU-free TYTON® shank length applies to sockets according to DIN 28 603: up to DN 600 Form A.



Special case: PUR-TOP coating [a]

DN	TYTON®	VRS®-T / TKF
	L [mm]	L_s [mm]
80	95	165
100	100	175
125	100	185
150	105	190
200	110	200
250	115	205
200	120	210
350	120	-
400	120	230
500	130	245
600	145	300

[a] After the pipe joint is installed, the socket joint area must be provided with socket protection.

Diameters and dimensional tolerances

DN	Dimensions [mm]	
	Spigot diameter d1	Dimensional tolerances
80	98	+1.0 | -2.7
100	118	+1.0 | -2.8
125	144	+1.0 | -2.8
150	170	+1.0 | -2.9
200	222	+1.0 | -3.0
250	274	+1.0 | -3.1
300	326	+1.0 | -3.3
400	429	+1.0 | -3.5
500	532	+1.0 | -3.8
600	635	+1.0 | -4.0
700	738	+1.0 | -4.3
800	842	+1.0 | -4.5
900	945	+1.0 | -4.8
1,000	1,048	+1.0 | -5.0

Instructions for cutting pipes

PUR-Longlife and PUR-TOP coating

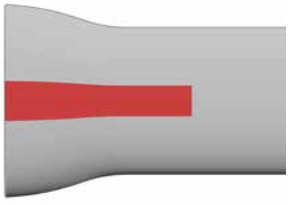
Preparing the cutting area

The pipe should be laid on a flat surface or on square timber so that neither the cut-off wheel is jammed nor the remaining pipe wall is torn off during cutting.

Checking whether pipes can be cut

DN 80 to 300: These pipes are measured as being in the permissible tolerance range up to 2/3 of the pipe shaft length from the spigot and can therefore be cut.

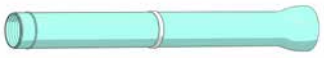
From DN 400: Specially labeled dimensionally stable pipes (which can be shortened) can be ordered.



⚠ Before cutting, always check the external diameter.
⚠ See "Diameters and dimensional tolerances" table

Cutting mark

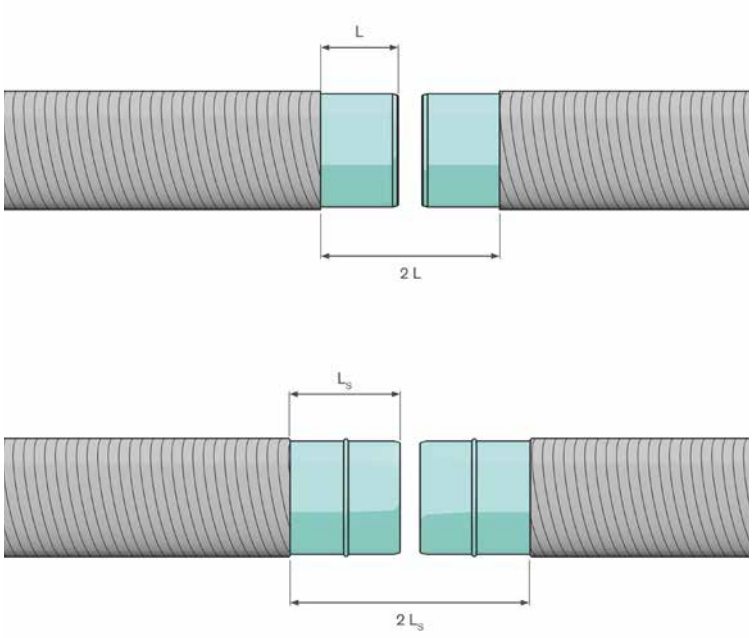
A line marked around the pipe facilitates a straight cut.
You can simply cut along a steel tape that is placed around the pipe.



Special case: PUR-TOP coating

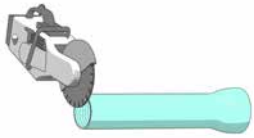
Before cutting PUR-TOP pipes, the PE bandage should be removed by pulling off the length 2 L or 2 LS according to the table above.

- ⚠ For push-on fittings, the „push-on“ dimension must also be taken into account.
- ⚠ See „Special case: PUR-TOP“ table



Cutting

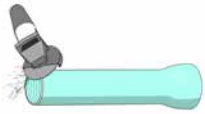
The cut-off wheel pierces the iron pipe wall and cement mortar at one point. The pipe can then be cut along the marked line in a single operation.



Beveling

For installation in plug-in sockets, the new spigot is rounded off or beveled like the original spigot. Only in this way can the spigot be pushed into the socket without damaging the gasket ring or pushing it out of its seat.

- ⚠ See "Bevel" table
- ⚠ A grinding disk for iron is used for beveling.



Sealing interfaces

In principle, all bare, uncoated areas (interfaces) must be coated and damage to the outer coating must be repaired. All materials required for this work can be obtained from us or our sales partners.

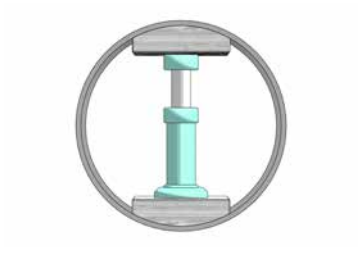
Marking the insertion depth

When installing the joint, a line marking in dicates the correct insertion depth of the spigot in the socket (socket depth + 100 mm)

- ⚠ See "Insertion depth" table
- ⚠ The insertion depth is different for VRS®-T and TYTON® joints.

Rounding pipes

With large nominal diameters, it may occasionally be the case that the spigot is no longer round after cutting. This is easy to remedy on site with the aid of a winch, which is placed inside the pipe. To prevent the cement-mortar lining from being damaged during this process, the lifting tools are clamped between hardwood blocks adapted to the internal shape of the pipe. The rounding device remains in or on the pipe during assembly.



Instructions for cutting pipes

ZMU-Austria coating

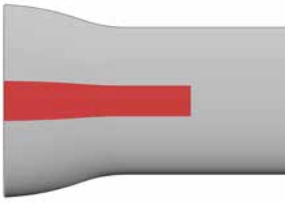
Preparing the cutting area

The pipe should be laid on a flat surface or on square timber so that neither the cut-off wheel is jammed nor the remaining pipe wall is torn off during cutting.

Checking whether pipes can be cut

DN 80 to 300: These pipes are measured as being in the permissible tolerance range up to 2/3 of the pipe shaft length from the spigot and can therefore be cut.

From DN 400: Specially labeled dimensionally stable pipes (which can be shortened) can be ordered.



⚠ The diameter cannot be checked due to the ZMU-Austria coating.

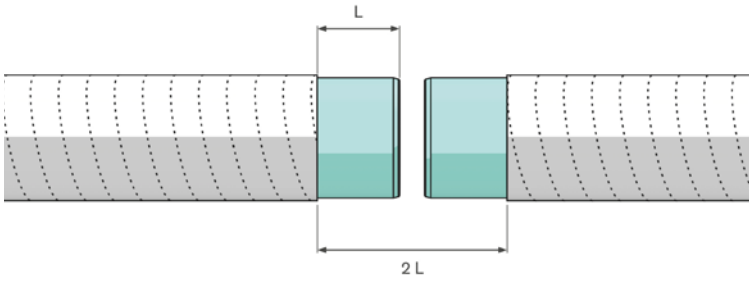
Shortening the pipe

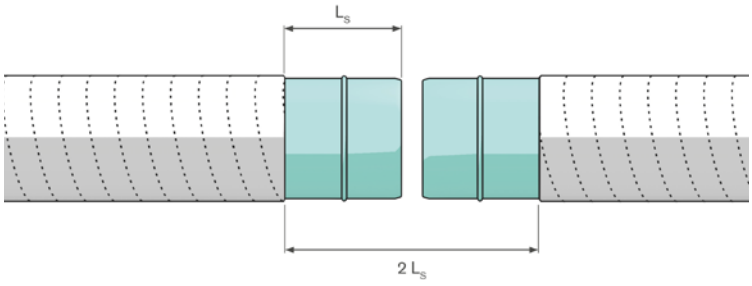
The cut-off wheel pierces the ZMU, the iron pipe wall and cement mortar at one point. The pipe can then be cut along the marked line in a single operation.

Special case: ZMU-Austria coating

After cutting ZMU-Austria pipes, the cement-mortar coating should be removed on the length 2 L or 2 LS according to the table above.

- ⚠ For push-on fittings, the „push-on“ dimension must also be taken into account.
- ⚠ See „Special case: ZMU-Austria“ table
- ⚠ Please follow the instructions for correct removal of the ZMU





Cutting into the ZMU

Cut the ZMU along the marking to about half the thickness of the lining (2-3 mm deep). Type C 24 RT cut-off wheels or special depth-limited cut-off wheels are suitable for cutting the ZMU.

- ⚠ Please note: Do not cut into the iron wall!
- ⚠ Wear suitable work clothing and protective equipment (e.g. glasses, respiratory protection, etc.).

Cutting into the ZMU lengthwise

Insert two to three longitudinal sections (as described previously) in the area to be stripped away, distributed around the circumference.

- ⚠ Please note: Do not cut into the iron wall!
- ⚠ Wear suitable work clothing and protective equipment (e.g. glasses, respiratory protection, etc.).

ZMU bonding agent

For pipes with a bonding agent between the zinc and the ZMU, the ZMU must be heated to approx. 160-200 °C before stripping away.

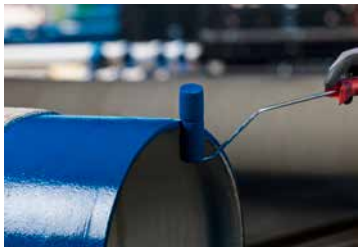
⚠ These pipes are marked by a line under the "EN 15 542" label.

Stripping away the ZMU

Strip away the ZMU by tapping it with a hammer, starting at the longitudinal joint. Separate all cuts with a chisel. Remove the ZMU and remove the ZMU residues from the shank using a scraper and wire brush.

Adding a top coat

The resulting galvanized shanks must be repainted with a suitable top coat!



Marking the insertion depth

When installing the joint, a line marking indicates the correct insertion depth of the spigot in the socket (socket depth + 100 mm)

⚠ See "Insertion depth" table

⚠ The insertion depth is different for VRS®-T and TYTON® joints.

PU-Repair Repair Kit

Two-component material for sealing and repairing cut surfaces

It can be used for sealing uncoated areas after cutting and chamfering pipes but also for repairing mechanical damage. The repair material is supplied in black.

PU-Repair is a ready-to-use, two-component material for sealing and repairing cut surfaces, packaged in the correct mix ratio of 1:1. User-friendly packaging in a two-chamber cartridge allows immediate sealing.

Drinking-water suitability
PU-Repair meets the requirements of ÖNORM B5014-1 (incl. LMSVG) as well as DVGW W270 and UBA guidelines. It has the corresponding ÖVGW and DVGW certification.

- ⚠ The material crystallizes when stored below 0 °C. When warmed to 25 °C (in an oven), the material becomes usable again.
- ⚠ Safety information can be found in the safety data sheet. This is available on request.
- ⚠ Further technical information can be found in the product data sheet.

PU-Repair repair kit

Preparing the subsurface

The subsurface must be dry and free of oil, grease, dust and other contaminants.

- ⚠ At low external temperatures the cure time of PU-REPAIR can be reduced significantly by pre-warming the pipe.
- ⚠ Processing above -10 °C.

Resin and hardener

Applying resin and hardener next to the cut surface or fault

- ⚠ Do not apply to the sealing surface area!

Homogeneous mixture

After applying small amounts, a homogeneous mixture of resin and hardener must be created. Mix using the sponge supplied.

Alternative

Alternatively, the 2-component material can be applied and mixed on a pipe cover.

Sealing

The cut surface or area to be repaired can then be coated. Due to the quick cure time of PU-REPAIR, for nominal diameters greater than DN 300 cut surfaces should be sealed in two or three stages, not the entire area in one go.

- ⚠ Ensure that an appropriate layer thickness is applied.
- ⚠ After closing the repair cartridge, PU-Repair can be used again.

Tapping into pipes

For tapping, which usually must be carried out once the pipes have been laid, suitable tapping equipment should be available. In addition to a wide range of tapping tools of all price classes, this industry offers carbide-tipped drills and milling cutters with which all types of drilling can be carried out on ductile iron pipes with a cement-mortar lining.

Specification proposal:

+ Machine: Hilti DD100 MEC
+ Drill: Hilti Diamond Core Drill DD-BI 32/320 P4

Special case: ZMU-Austria coating

Here the ZMU can be removed and recoated all around in the sealing area. In this case the mortar-free surfaces must be closed, e.g. with cement-mortar bandages.

Tapping saddles for ZMU-Austria pipes

House connections on ductile iron pipes with cement-mortar coating should ideally be installed using tapping saddles with internal sealing sleeves. This type of tapping saddle seals directly against the iron pipe surface in the hole. These types of saddles are supplied by numerous manufacturers such as Hawle, Erhard or EWE.

Repairing the cement-mortar lining

If the cement-mortar lining is damaged, we recommend using the Sikadur®-31 DW repair material, a moisture-compatible, thixotropic 2-component adhesive and repair mortar based on epoxy resin with special fillers, developed for the requirements of contact with drinking water. A professional repair is only possible at temperatures above 5 °C.

In addition to the repair material, the following are needed:

+ Rubber gloves
+ Dustproof goggles
+ Wire brush, spatula
+ Additional mixing vessel

Preparing the repair site

If there is minor surface damage, use the wire brush to remove only the loose components which are not adhering firmly in the damaged area. If there is major damage, you are advised to completely remove the cement mortar (except for the bare metal) at the damaged area with a hammer and chisel.
You must ensure that the intact cement-mortar lining adjacent to the damaged area is not damaged and does not stand out. The transition should be as straight an edge as possible.
The safety goggles must be worn here! Then remove any remaining loose material.

⚠ The area to be repaired must be dry and free of dust.

Mix the Sikadur®-31 DW

Mix the material in the correct ratio according to the manufacturer's instructions.

⚠ Comp. A : Comp. B = 3 : 1
weight or volume parts

Add Comp. B completely to Comp. A. Mix with an electric hand mixer for at least 3 minutes until no color streaks are visible in the mass at the edge or at the bottom of the can and an even grey tint is produced. Mix gently and slowly to introduce as little air as possible (max. 600 rpm). Then empty the mixed material into a clean container and mix again for approx. 1 minute.

⚠ Only mix as much as is consumed within the pot life (200 g at 23°C, approx. 90 min.)

Processing

Fill the damaged area with this material and smooth it down with a spatula or brush.

Drying and commissioning

The pipes can be installed directly. However, according to the manufacturer, the repaired area can only be stressed after 100 min. at 23°C. The pipe must not be put into operation for at least twelve hours after repair.

⚠ Source: Sikadur

Welding recommendations

Arc welding with nickel-based rod electrodes can be used, preferably in accordance with EN ISO 1071. This recommendation does not apply to fittings and pipe components manufactured by sand casting or to pipe components made of gray iron.

⚠ Pipes with a minimum wall thickness of less than 4.5 mm must not be welded!

Electrodes

Recommended electrode types: e.g. Castolin 7330-EC; UTP FN 86; ESAB OK 92.58; Gricast 31 or 32. In principle, the specifications of the German Welding Society (Deutsches Verband für Schweißtechnik e. V.) apply. (DVS): DVS 1502, Part 1 + 2; DVS 1148. Welders with DVS 1148 certification must be used.

Preparing for welding

The following points must be observed during welding:

+ Pipe wall temperatures during welding not below +20 °C
+ Dry workplace
+ Metallically bright welding zone
+ Remove impurities or zinc coatings by filing or grinding
+ Do not over-weld pinholes. Grind down to the bottom and fill up with weld metal.
+ Adjust socket to external shaft diameter (do not exceed gap of 0.5 mm)

Current type

Direct or alternating current can be used for welding. The processing guidelines of the electrode manufacturer must be observed.

Welding parameters

The current strengths and welding speeds specified by electrode manufacturers can be used as guide values.

Boundary conditions for crack-proof welding on ductile iron pipes [a]

Pipe wall thickness (real)	without water filling [b] with cement-mortar lining	with water filling with cement-mortar lining
≥ 4.7 - 6 mm	at 20 °C	not allowed
6 – 10 mm	at 20 °C	at 20 °C [c]
10 – 12 mm	150 °C preheating	at 20 °C [c]
> 12 mm	150 °C preheating	150 °C preheating

[a] Welded design with at least two layers (also for pipe/socket joints)

[b] Also applies to partially filled pipes in welding areas above the water level

[c] For pipe wall temperatures below 20 °C, preheating is recommended

Carrying out the welding

Preheating

Preheating is generally recommended. Before tacking and welding the root layer, preheat the welding area according to the table above.

Tacking

Fix the parts to be welded with suitable clamping devices. They must be tacked in at least two places. The tack weld outlets should be flat so that they can be over-welded; this can be achieved by grinding if necessary. The tack welds must be checked for cracks – tack welds with cracks must be grinded.

Welding

Each seam should be welded in one operation if possible – interruptions should be avoided. The preheating temperature must be maintained during welding. If welding is interrupted, preheat according to the table above before resuming the welding process.

Post-treatment

No thermal post-treatment of welded joints or welded components is required. The seam area must be cleaned once it has cooled down, and after testing it should be carefully repainted with a protective coating, for example with our PU-Repair repair kit.

Inspecting welded seams

The welded seams should always be visually inspected and, if necessary, non-destructively checked for surface defects and cracks. Welded seams that are not subjected to leakage tests, e.g. wall flanges, should be randomly tested for surface defects. Any defects detected during testing, such as surface pores or cracks in or adjacent to the welded seam, must be completely ground out prior to repair. Mistakes can only be corrected once.

Applying welded beads

If pipes need to be shortened on site, clamping rings must be used. If this is not possible, a welded bead must be applied by the customer.

Welded bead dimensions

The distance from the shank and the bead size must be in accordance with the table below. The welded beads are always applied in two layers, whereby from DN 400, the root layer is always welded with Ø 4 mm. The electrode requirements and the time required (as indicated in the table) are only a guide.

Copper welding gauge

In order to ensure a high-quality and consistent welded bead, a copper welding gauge must be attached to the shank at the intended distance for application. After removing the copper welding gauge, the cutting edge at the shank must be produced according to the original design and cleaned, as must the welded bead area.

Welding according to data sheet DVS 1502.

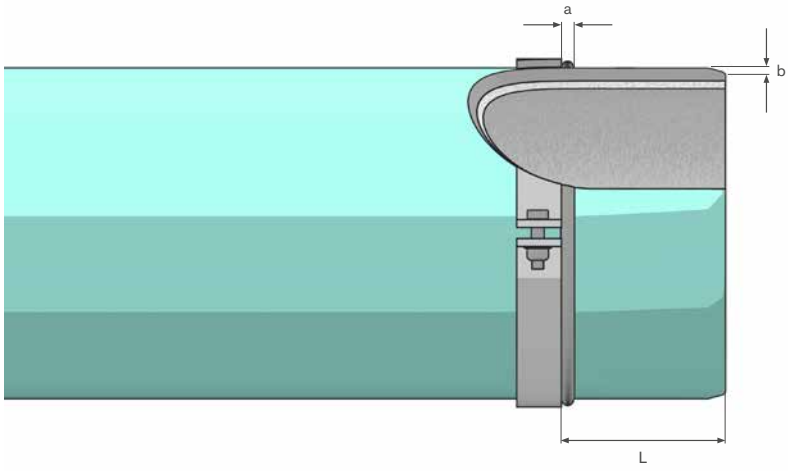
⚠ You must check whether the pipes can be cut.

Protective coating

Finally, the areas must be carefully repainted with an appropriate protective coating, e.g. with our PU-Repair repair kit.

Electrode type

e.g. Castolin 7330-EC; UTP FN 86; ESAB OK 92.58; Gricast 31 or 32. The electrode diameter should be 3.2 mm (from DN 400 it should be 4.0 mm).



Welded bead dimensions

DN	L	a	b
80	86 ±4	8 ±2	5 +0.5 | -1
100	91 ±4	8 ±2	5 +0.5 | -1
125	96 ±4	8 ±2	5 +0.5 | -1
150	101 ±4	8 ±2	5 +0.5 | -1
200	106 ±4	9 ±2	5.5 +0.5 | -1
250	106 ±4	9 ±2	5.5 +0.5 | -1
300	106 ±4	9 ±2	5.5 +0.5 | -1
400	115 ±5	10 ±2	6 +0.5 | -1
500	120 ±5	10 ±2	6 +0.5 | -1
600	115 ±1	9 ±1	6 +0.5 | -1

Electrode requirement [a]

DN	Electrodes/bead Ø 3.2 mm [pc.]	Electrodes/bead Ø 4.0 mm	Target requirement per welded bead [min]
80	5	–	15
100	6	–	18
125	8	–	24
150	9	–	27
200	12	–	36
250	15	–	43
300	17	–	50
400	8 + 11		57
500	11 + 14		75
600	13 + 16		87

[a] The welded beads are always applied in two layers, whereby from DN 400 the root layer is always welded with Ø 4 mm. The electrode requirements and the time required (as indicated in the table) are only a guide.

Welding outlets

Ductile iron or steel outlets DN 80 - 300.

The nominal diameter of the outlets DN 80 - 300 for pressure pipes must not exceed half the nominal diameter of the main pipe. The outlets are welded with fillet welds. The weld seam consists of two layers:

+ The first layer (root) should have an a-dimension of 3 mm.
+ The second layer is first welded between the root and the main pipe and then pendulum welded between the root and the outlet.

The finished seam should be flat to slightly hollow and have an a-dimension of 0.7s +2/-0.5 mm. For outlet diameters DN 250-300, a cover layer can be welded to achieve the a-dimension. It can be advantageous to buffer larger outlets. Carry out the leakage test before drilling with the system test pressure STP (nominal pressure + 5 bar).

When laying a new pipe, it is advisable to weld outlets outside the trench. In this case the main pipe can be tapped before welding the outlet. The internal pressure test can then be carried out together with the pipe pressure test.

Welding wall flanges

Pipes with wall flanges are used for integration into buildings. Welding allows wall flanges to be fixed at any point along the pipe shaft. Wall flanges are supplied as ring segments and must be fitted tightly to the pipe.

Wall flanges are welded with at least two-layer fillet welds, whereby the a-dimension must not be lower than 4 mm. For larger nominal diameters with corresponding wall thicknesses, a buffer layer is recommended. The welded seam length should be determined in accordance with the operational requirements (allowable shear stress $\tau zul = 130\ N/mm^2$). Ring segments must be welded together once they have been welded on.

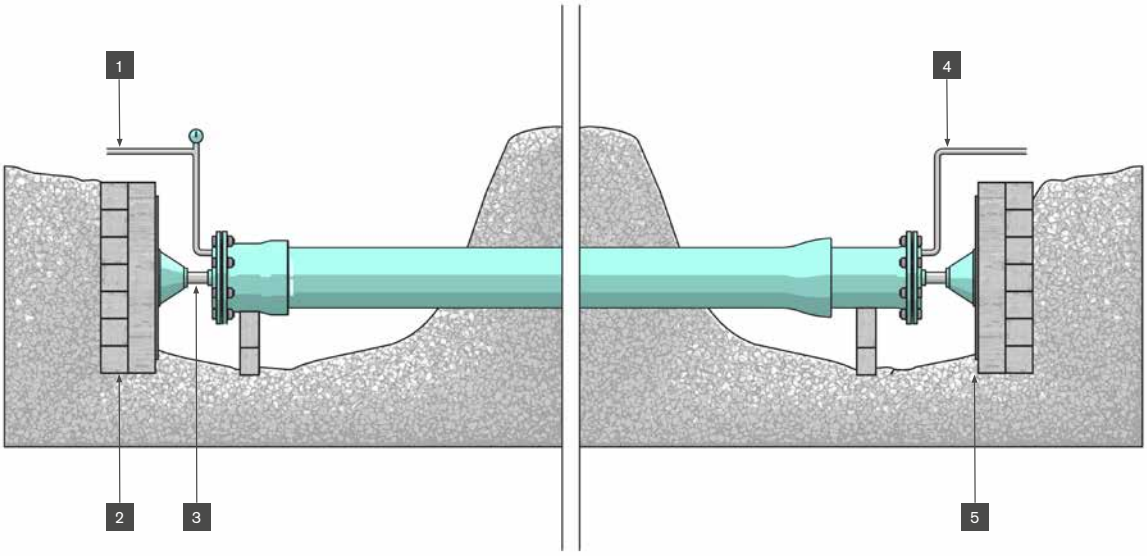
Welding sockets

Sockets made from ductile iron or steel DN 2".

Welding sockets made from ductile iron or steel DN 2" can be welded to water pipes up to 40 bar. The sockets are delivered ready for welding and can be welded with fillet welds after pre-treatment of the welding zone and adaptation to the external diameter. The weld seam consists of two layers:

+ The first layer (root) should have an a-dimension of 3 mm.
+ The second layer is pendulum welded over the root between the main pipe and the socket.

The finished seam should be flat to slightly hollow. Carry out the leakage test before drilling with the system test pressure STP (nominal pressure + 5 bar).



1 from the pressure pump, 2 thrust blocks, 3 winch, 4 vent, 5 steel plate

Pressure test

Brief instructions for the construction site

According to ÖNORM EN 805, pipes must undergo an internal pressure test. ÖNORM EN 805, ÖNORM B 2538, ÖNORM B 5050 and ÖVGW W 101 are relevant for carrying out the test on water pipes.

⚠ All work on the pipe to be tested must stop during the pressure test!

1. Test sections, filling and pipe filling

Test sections should be no longer than 2.5 – 3 km. Pipes must be covered with filling material before the pressure test to prevent changes in position or length. It is not advisable to separate off the pipe with closed valves. The pipe must be filled from the lowest point in such a way that the air inside can escape easily through the highest points.

⚠ See table for the recommended filling quantity.

2. Conducting the pressure test, test pressure

The testing method must be defined by the planner and may be carried out in up to three steps.

3. Preliminary test

Purpose:

+ Pipe stabilization (possible settlements, changes in length)
+ Ensuring sufficient water saturation for cemented pipes

The duration and pressure of the preliminary test are to be determined by the planner.

Recommended filling quantity depending on diameter

DN [mm]	80	100	125	150	200	250	300	400	500	600	700	800	900	1,000
Filling quantity [l/s]	0.2	0.3	0.5	0.7	1.5	2.0	3.0	6.0	9.0	14.0	19.0	25.0	32.0	40.0

4. Pressure drop test

Purpose: determining the remaining air in the pipe.
The planner decides whether to conduct this test.

5. Main pressure test

There are two basic methods:

+ **Water loss method:** The amount of water either drained or pumped back in is compared with the permissible water quantity in each case.
+ **Pressure loss method:** This is the most frequently used testing method. The pipe pressure is increased to the test pressure. The holding time is at least one hour, and during this hour the pressure loss may not exceed 20 kPa (0.2 bar). The test duration is determined by the planner.

6. Test pressure

The maximum design pressure (MDP) is used to determine the system test pressure (STP) as follows:

+ If the pressure surge is calculated:
  STP = MDPc + 100 kPa (1 bar)
+ If the pressure surge is not calculated:
  STP = MDPa x 1.5 or STP = MDPa + 500 kPa (5 bar)

⚠ The lower value is to be used in either case

7. Test report

The test results are to be documented fully and saved.

Commissioning

Planning Information

Drinking water is the most important thing we consume. Drinking water consists primarily of hydrogen and oxygen, but it also contains many other substances. Essential electrolytes, trace elements, nutrients and gases are always present in spring water. It therefore also serves as a habitat for countless microorganisms that are responsible for the quality of the water.

Water organisms occur in all habitats where water exists. They colonize all surfaces and form what is known as a biofilm, which is important for maintaining consistent water quality and is therefore used to indicate changes in drinking water.

A stable biofilm takes several weeks/months to form (depending on the water and the colonizable surfaces), and only then can it be used to evaluate the quality of the water.

Care must be taken with newly laid pipes (fittings, valves, pipes) which will carry water to ensure that the likelihood of impurities is as slim as possible. Contamination by personnel, tools (dirty cloths for wiping the socket) and through pollutants in the air (oil-containing exhaust fumes from 2-stroke pipe cutters) must be avoided. The ends of pipes must be sealed so that neither groundwater, soil, sewage nor animals can get into them.

Commissioning

However, to remove any organic contaminants, each pipe (after assembly and before connection to an existing network) must be flushed with sufficient levels of drinking water. The ÖVGW guideline W55 recommends replacing at least 3-5 times the pipe content at a flow rate of more than 1.5m/sec. In addition to a sufficient water supply for flushing, an adequate water disposal system must also be provided in order to properly dispose of the water contaminated with impurities. A water sample should then be taken to ensure that the flushing was successful. Only then should the pipe be connected to the network.

⚠ Normally, no additional disinfection of the pipe is necessary for commissioning.

After longer stagnation times or before taking a sample, 3-5 times the pipe content must be replaced at a low flow rate. It is important to keep the flow rate low in order to protect the biofilm in the pipe. Experimental investigations have shown that a flow rate of 0.1m/sec is sufficient to flush the pipe sufficiently and to avoid damaging the biofilm.

Disinfection

When disinfecting the pipe, it is important to remember that all the organisms in the water will die and the existing, healthy biofilm will be destroyed in the process. Therefore, after disinfection, a final shock flush is necessary to remove loose organic material from the pipe. The biofilm will reform in the months following disinfection, so successful disinfection is equivalent to a new installation.

Disinfection should in principle be carried out by qualified personnel (chemists who specialize in drinking water, application technicians, water engineers) in order to prevent damage to persons, the environment or the pipe caused by unsuitable chemicals or incorrect concentrations.

When is disinfection necessary?

If the microbacteriological parameters are not met and the water is therefore unsuitable for human consumption, the pipe section must be disinfected. To ensure that the pipe is free of (organic) impurities, the first step should be a shock flushing with drinking water. The parameters proposed by the ÖVGW guideline W55 (3-5 times the pipe content at a flow rate of at least 1.5m/sec) should also be applied here.
The pipe can then be disinfected with a suitable disinfectant.

⚠ Particular attention must be paid here to environmentally-friendly disposal of contaminated water.

Disinfectants

The disinfectant should be chosen according to local conditions. Care must be taken, for example, to ensure proper handling and effectiveness of the disinfectant and to ensure that it is disposed of correctly.

⚠ The most frequently used agents for disinfecting drinking water pipes are sodium hypochlorite, potassium permanganate, hydrogen peroxide and chlorine dioxide.

⚠ More details about disinfectants and correct disinfection can be found in international and national standards and regulations, for example ÖNORM EN 805.

⚠ If you have any questions or problems, our experienced application engineers are happy to help.

Detecting and locating leaks

Checklist for users

If the parameters for a successful pressure test have not been achieved, i.e., the pressure losses are too high, a systematic search for the cause must be carried out.

Here, the user can work through the following questionnaire on site before external companies have to be called in.

+ How big is the water loss you are looking for? - This can be calculated from the following table using the length and diameter of the pipe, and from the pressure drop and value from the table.
+ Has the pipe been filled with water for long enough that the cement-mortar lining is completely saturated and cannot absorb any more water?
+ Were there any critical moments during laying which could have caused an error (bad weather, steep sections, high mounting forces, change of pipe laying personnel)?
+ Can escaping water be seen anywhere when inspecting the length of the pipe (water discharge does not necessarily indicate a defect)?
+ Can the sound of water rushing or leaking be heard anywhere when inspecting the length of the pipe?
+ Are all tap shafts tightly closed (hydrants, ball valves, drain valves)?
+ Are the ventilation and exhaust valves, if present, tightly closed?
+ Are the sluice valves (avoid if possible) tightly closed?
+ Are the safety devices present in the pump house and pressure increasing and reduction stations tightly closed (pressure control valves etc.)?
+ Are the flanged joints tightly closed (incorrect gaskets or clamping torques on the bolts)?
+ Are the pipe end points properly closed?
+ Is the pipe still in the overpressure range or is the leak so large as to prevent this?
+ Where is the water column stopping (height can be used to locate the leak. Note: clamped gaskets can withstand a residual pressure of up to 15 bar)?
+ Are the other components sealed (drinking water supply apparatus, livestock troughs, etc.)?

Max. allowable water withdrawal rate in ml/m at 1 bar pressure drop:
ÖVGW W 101 Annex A, Table 4

DN	ml/m
80	0.5
100	0.8
125	1.3
150	1.8
200	3.6
250	5.7
300	8.6
400	15.9
500	25.8
600	38.3
700	53.4
800	71.4
900	92.0
1,000	115.2

If the above points do not apply and no obvious fault can be found (and the leak is therefore probably very small), a specialist company with substantial experience and the necessary special equipment must be tasked with locating the leak precisely, usually by way of correlation.
Using correlation to locate leaks is usually successful and is more effective the higher the test pressure (pay attention to the allowable pressures in the pipe system) and the shorter the sections to be tested (from sensor to sensor).

PIPE SYSTEMS

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