

Advantages of ductile iron pipe systems



Ductile Cast Iron Systems
trm.at

TIROLER ROHRE



VRS®-T/BLS® – the positive locking system

The VRS®-T/BLS® joint is a socket joint which operates on the basis of positive interengagement and which is restrained against longitudinal forces. Forces generated by internal pressure or external loads are absorbed by the pipeline and transferred to the surrounding soil by skin friction. Forces are transmitted between the individual pipes by means of a weld bead on the spigot end of the pipe or fitting. Via a mechanical lock, the weld bead transmits the forces into the locking chamber in the next pipe. Extremely high forces which would cause damage to the majority of other joints can be transmitted in this way. For example, depending on the nominal size, operating pressures of more than 100 bars or permitted tractive forces of up to 200 kN can be obtained.

Even though the VRS®-T joint is able to withstand extremely high loads, it is still flexible, easy and particularly quick to assemble. The joint will accept an angular deflection of up to 5° and a pipe string can thus be laid or pulled in to a radius of only 69 m – without fittings and without thrust blocks. The very short assembly times of around 5 minutes for the DN 80 size to a maximum of 30 minutes for the DN 1000 size do everything else that is needed to make the VRS®-T joint the joint that can be used almost anywhere with cast iron pipes.

One of the greatest advantages of the VRS®-T joint is the clamping ring. Normally, to give a positively interengaged joint, a weld bead would have to be applied retrospectively to the cut end when pipes are cut. On pipes of nominal sizes from DN 80 to DN 500 this can be almost entirely avoided by using the clamping ring.

As a system, the VRS®-T joint is available with a comprehensive range of fittings and with gate valves, butterfly valves, hydrants and air-bleeders.

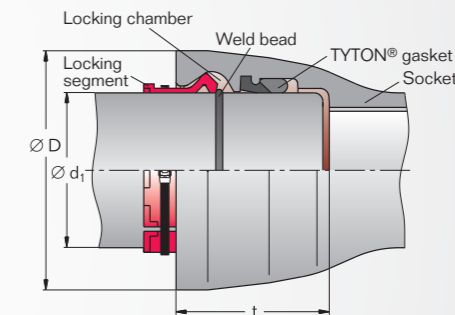
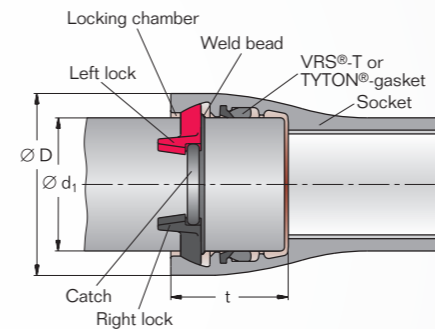


DN 80 – DN 500
Joggle set
optional high pressure lock
up to DN 250



DN 80 – DN 500
Clamping ring
use for cut pipes
without welded bead

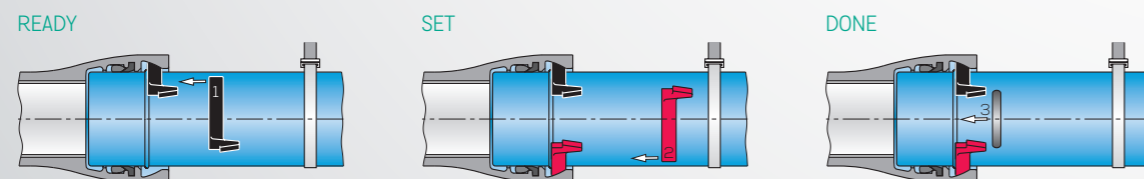
DN 600 – DN 1000
Locking segment



Areas of application

- As a replacement for concrete thrust blocks
- For angular deflections of up to 5°
- For operating pressures up to 100 bars
- High-pressure applications
- Pipe systems for snow-making facilities
- Turbine pipelines
- Fire-extinguishing pipes
- Culvert pipelines
- Bridge pipelines
- Collector pipes
- Trenchless laying
- Horizontal direction drilling (HDD)
- Ploughing-in with a rocket plough
- Press-pull technique/auxiliary tube technique
- Burstlining
- Pipe relining

Easy to assemble



VRS®-T/BLS® jointed valved tee with butterfly valve and gate valve



Pipe relining



Floating in a ductile cast iron pipeline



Temporary pipeline with VRS®-T/BLS® joints

DN	d ₁ [mm]	D [mm] ¹⁾	t [mm]	Component operating pressure PFA [bar] ²⁾	Permitted tractive force F [kN] ³⁾	Permitted angular deflection [°]	Number of locking segments
80 ⁵⁾	98	156	127	100/110 ⁴⁾	115	5	2/3 ⁴⁾
100 ⁵⁾	118	182	135	75/100 ⁴⁾	150	5	2/3 ⁴⁾
125 ⁵⁾	144	206	143	63/100 ⁴⁾	225	5	2/3 ⁴⁾
150 ⁵⁾	170	239	150	63/75 ⁴⁾	240	5	2/3 ⁴⁾
200	222	293	160	42/63 ⁴⁾	350	4	2/3 ⁴⁾
250	274	357	165	40/44 ⁴⁾	375	4	2/3 ⁴⁾
300	326	410	170	40	380	4	4
400	429	521	190	30	650	3	4
500	532	636	200	30	860	3	4
600	635	732	175	32	1525	2	9
700	738	849	197	25	1650	1,5	10
800	842	960	209	16/25 ⁵⁾	1460	1,5	10
900	945	1073	221	16/25 ⁵⁾	1845	1,5	13
1000	1048	1188	233	10/25 ⁵⁾	1560	1,5	14

¹⁾ Guideline value; ²⁾ Operating pressure (PFA); allowable component operating pressure in bars. Basis for calculation was wall-thickness class K9, up to and including DN 250 with high-pressure lock; ³⁾ When pipelines follow straight paths (max. deflection of 0.5° per pipe joint), the tractive forces can be raised by 50 kN. High-pressure locks are required for DN 80 – DN 250; ⁴⁾ with high-pressure lock ⁵⁾ Wall-thickness class K10

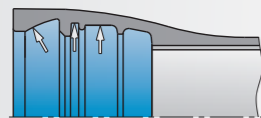
VRS®-T/BLS® – full speed in your hands

VRS®-T/BLS® positive locked joint system

Connection features:	
thrust blocks needed:	NO
can handle soil settlements:	YES
easy to dismount:	YES
trenchless usage:	YES
special indicator ring:	NO
radial movement after installation possible:	YES
handle high and often water hammers:	YES
usage for vibrating areas:	YES

push in forces:	25 % lower than TYTON® connection with VRS®-T gasket
pressure testing with open trench:	YES
pull back needed during installation for each pipe:	NO
indicator test needed during installation for each pipe:	NO
special safety instructions during reopening beside the operating pipeline:	NO
Earthquake safe:	YES

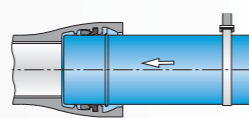
Step 1: Cleaning the joint and spigot end



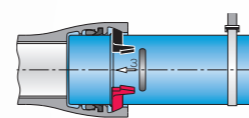
Step 2: Insert the gasket and apply lubricant to the gasket



Step 3: Push in



Step 4: Insert the locks



Step 5: Take a break or install the next pipe



Step 6: Take a break or install the next pipe



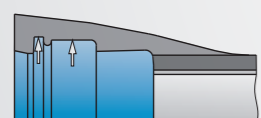
Step 7: Take a break or install the next pipe



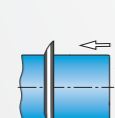
Average installation time per joint: 15min

Frictionally engaged joint system

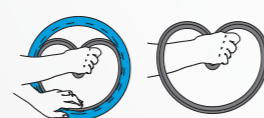
Step 1: Cleaning the joint and spigot end



Step 2: Place the indication ring on spigot end

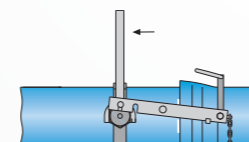


Step 3: Insert the gasket

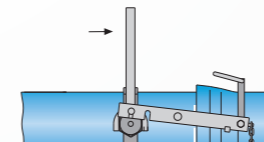


Note: The correct position of the segments is important!

Step 4: Push in



Step 5: Very important: pull back

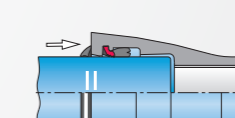


Do not remove whatever is being used to lift the pipe until the joint has been fully assembled.

Step 6: Depth gauge with indicator around the full diameter (to test correct position of gasket)



Step 7: Place the indication ring back to the joint



Average installation time per joint: 25min

Connection features:	
thrust blocks needed:	NO
can handle soil settlements:	YES
easy to dismount:	NO
trenchless usage:	NO
special indicator ring:	YES
radial movement after installation possible:	NO
handle high and often water hammers:	NO
usage for vibrating areas:	NO

push in forces:	even higher than TYTON®
pressure testing with open trench:	NO
pull back needed during installation for each pipe:	YES
indicator test needed during installation for each pipe:	YES – very important!
special safety instructions during reopening beside the operating pipeline:	YES
Earthquake safe:	NO

Fields of use of the positive locking system

There are almost no limits to the versatility with which pipes and fittings with VRS®-T/BLS® joints can be used. The quick and easy assembly and the very high allowable operating pressures and tractive forces for which they can be relied on make them suitable for virtually any conceivable application in the laying of pressure pipelines (for water or sewage).

Some typical fields of use are:

- urban water supply/replacement of concrete thrust blocks
- trenchless installation techniques
- snow-making systems
- turbine pipelines
- fire-fighting and fire-extinguishing pipelines (FM Approval and German Federal Railways approval)
- bridge pipelines/above-ground pipelines
- temporary pipelines (for temporary water supplies)
- floating-in
- crossings below waterways/culvert pipelines
- laying on steep slopes
- use in regions at risk of earthquakes or settlement

Brief explanations of the above fields of use are given in this chapter. Further details can be found in our information leaflets on particular fields or can be requested directly from us. We will be happy to arrange a meeting for consultation.

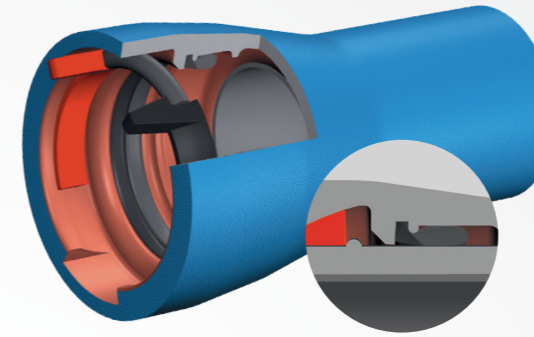
Trenchless installation techniques

There is a long tradition of the use of ductile iron pipes in trenchless installation techniques. The triumphal progress of these techniques began in the early 1980's and ductile iron pipes have been used for them ever since that time. The range of possible trenchless techniques for laying new pipes and replacing old ones covers the following:

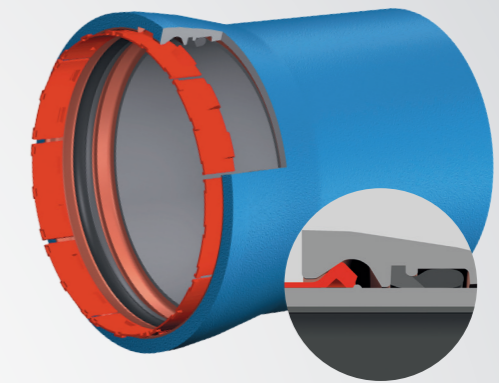
- **pipe relining (pulled)** under "DVGW Arbeitsblatt GW 320-1"
- **pipe relining (pushed)** under "DVGW Arbeitsblatt GW 320-1"
- **horizontal directional drilling (HDD) technique** under "DVGW Arbeitsblatt GW 321"
- **push-pull technique** under "DVGW Arbeitsblatt 322-1"
- **auxiliary tube technique** under "DVGW Arbeitsblatt 322-2"
- **burstlining** under "DVGW Arbeitsblatt GW 323"
- **ploughing and milling techniques** under "DVGW Arbeitsblatt GW 324"

Practically all the above mentioned techniques require the positive locking VRS®-T/BLS® joint, a cement mortar coating (ZMU) and sheet-metal cones to protect the sockets.

DN 80 – 500



DN 600 – 1000



The advantages of ductile iron pipes for trenchless installation techniques can be listed as follows:

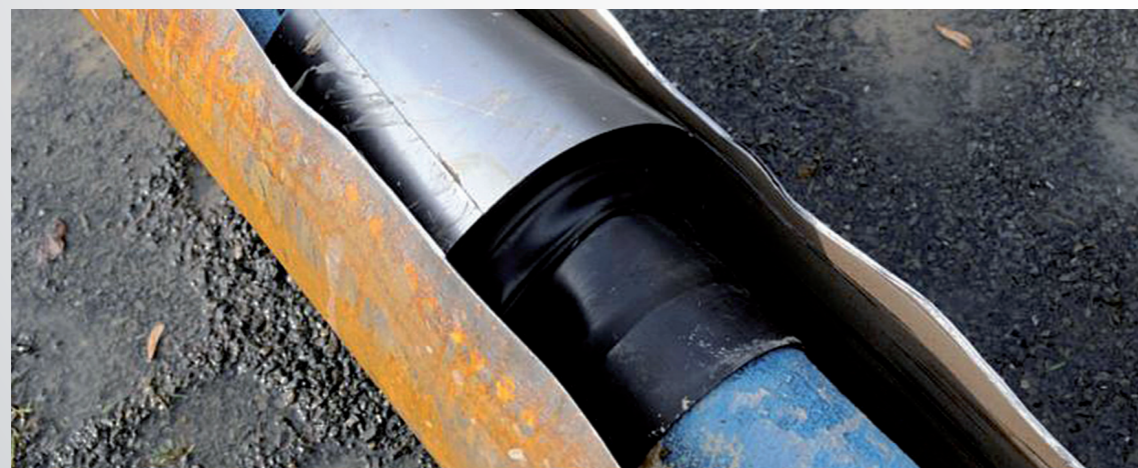
- very short assembly times (depending on DN between 5 min and 20 min)
- pipe-by-pipe assembly possible even in horizontal directional drilling
- small short pits possible due to the pipe-by-pipe assembly
- the joint able to carry loads immediately after assembly
- very high and reliable tractive forces compared with other materials
- extra measure of safety due to high tractive forces
- tractive forces not dependent on temperature or the duration of the pulling-in
- assembly possible in (almost) all weathers
- the cement mortar coating provides protection against mechanical and chemical attack
- long lifetime even at poor conditions due to high diametral and longitudinal stiffness
- no problem with stones and fragments of old pipes

DN	PFA [bar] ¹⁾	Allowable tractive force F _{all.} [kN]		Max. angular deflection at sockets ³⁾ [°]	Min. radius of curves [m]	Number of fitters	Assembly time without joint protection [min]	Assembly time when using a protective sleeve [min]	Assembly time when using a shrink-on sleeve [min]
		DV-GW ²⁾	TRM						
80*	110	70	115	5	69	1	5	6	15
100*	100	100	150	5	69	1	5	6	15
125*	100	140	225	5	69	1	5	6	15
150*	75	165	240	5	69	1	5	6	15
200	63	230	350	4	86	1	6	7	17
250	44	308	375	4	86	1	7	8	19
300	40	380	380	4	86	2	8	9	21
400	30	558	650	3	115	2	10	12	25
500	30	860	860	3	115	2	12	14	28
600	32	1,200	1,525	2	172	2	15	18	30
700	25	1,400	1,650	1.5	230	2	16	-	31
800	16	-	1,460	1.5	230	2	17	-	32
900	16	-	1,845	1.5	230	2	18	-	33
1000	10	-	1,560	1.5	230	2	20	-	35

¹⁾ Basis for calculation was wall-thickness class K9. Higher pressures and tractive forces are possible in some cases and should be agreed with the pipe manufacturer.

²⁾ When the route is straight (max. of 0.5° deflection per joint), the tractive forces can be raised by 50 kN. High-pressure lock is required on DN 80 to DN 250 pipes.

³⁾ At nominal dimension; * Wall-thickness classes K10



A burst steel pipeline

Snow making systems and turbine pipelines

For a snow-making system to operate satisfactorily, the main requirement is a reliable water supply able to meet all the demands that are made on it in high mountainous terrain and by very high pressures of up to 100 bars.

The ruggedness of the material and the flexible socket system, together with the speed and ease of assembly and laying, have made TRM the market leader all over the world in pipes and fittings for snow-making systems.

Turbine pipelines are laid predominantly in terrain which can be classified as extreme. Conditions of this kind and the high operating pressures demand equipment with a performance to suit – ductile iron pipes.

- working life of > 50 years
- good assortment of pipes and fittings held in stock so short delivery times are possible
- consultancy at the planning stage and training courses for layers given by experts
- technically and economically, the most efficient pipe system on the market
- laying rates of up to 400 m per day are possible
- we are specialists in the production of ductile iron pipes and have had decades of experience
- product quality monitored to EN standards; member of various quality assurance associations; ISO 9001 certified
- long reference list; full customer satisfaction shared by our partners

The advantages for you:

- maximum safety and reliability at operating pressures up to 100 bars
- fast and uncomplicated laying; no welding required
- a sophisticated product range covering pipes, fittings and the VRS®-T/BLS® joint all from one supplier; sizes from DN 80 to DN 1000
- deflectable to a max. of 5°, which saves on time and fittings

Our ductile iron pipes for snow making systems and turbine pipelines are available to the following specifications:

- laying length of 5 m or 6 m
- nominal sizes of DN 80 to DN 1000
- internal protection: cement mortar lining
- external protection: zinc coating (200 g/m²) plus finishing layer
- alternative coatings are possible, e.g. cement mortar (ZMU) or Zinc Plus

Operating pressures for VRS®-T/BLS® jointed snow-making systems and turbine pipelines

DN	PFA [bar]	Joint	Max. angular deflection [°]	Locks
80	100	VRS®-T/BLS®	5	2 locks + catch
100	100	VRS®-T/BLS®	5	2 locks + catch
125	100	VRS®-T/BLS®	5	2 locks + catch
150	100	VRS®-T/BLS®	5	2 locks + catch
200	100	VRS®-T/BLS®	4	2 locks + HP lock + catch
250	100	VRS®-T/BLS®	4	2 locks + HP lock + catch
300	100	VRS®-T/BLS®	4	4 locks + 2 catches
400	30	VRS®-T/BLS®	3	4 locks + 2 catches
500	30	VRS®-T/BLS®	3	4 locks + 2 catches
600	40	BLS®	2	9 segments
700	25	BLS®	1.5	10 segments
800	25	BLS®	1.5	10 segments
900	25	BLS®	1.5	13 segments
1000	25	BLS®	1.5	14 segments

Higher pressures available on enquiry!

The operating pressures shown also apply to the fittings. These are given an internal and external epoxy coating to EN 14 901.

Fire fighting and fire extinguishing pipelines

Nothing is more important than safety – in tunnels, in structures enclosing roads and railways and in industrial plants the outbreak of a fire is something which is particularly feared and catastrophic incidents in the past have shown how immensely important efficient protective systems are. A basic requirement for combating a fire successfully are pipelines for fire fighting and fire extinguishing water which will operate properly in an emergency and which are themselves able to withstand the effects of the fire. Like airbags in a car, fire fighting and fire extinguishing pipelines give an assurance of safety but will hopefully never have to demonstrate their reliability in an emergency. It is reassuring to know that only the best of equipment has been used for them. Ductile iron pipes from TRM provide this reassurance.

Basic documents for planning

In Germany, fire fighting pipelines and sprinkler systems are generally designed to meet technical rule VdS CEA 4001 (VdS Schadenverhütung GmbH, CEA – Comité Européen des Assurances). The principal parts of EN 12 845 are in conformity with VdS CEA 4001. In Austria, design is to TRVB S 127. However, the American standards of the NFPA (National Fire Protection Association) – and also, in a modified or developed form, the FM (Factory Mutual) standards – are becoming increasingly popular with international clients. In certain cases, there may also be company-specific, supplementary or independent sets of rules which are crucial. An example of this is the guideline issued by the German Federal Railway Authority dealing with “Anforderungen des Brand- und Katastrophenschutzes an den Bau und Betrieb von Eisenbahntunneln” [Requirements for protection against fire and disasters to be met in the construction and operation of railway tunnels].

There is a whole range of significant factors that allow them to do this:

- allowable operating pressures of up to 100 bars
- safety factor of 3 for the pipe wall thickness
- safety factor of 1.5 for the joint systems
- heat resistant and non-combustible material
- fire-resistant for 60 minutes at 900°C
- able to withstand high mechanical stresses
- restrained joints able to accept angular deflections
- experience gained from more than 400,000 m of fire fighting and fire extinguishing pipelines already laid
- a product of tested quality ISO 9001, MPA NRW (North-Rhine Westphalia Materials Testing Institute)
- FM approved, DB (Federal German Railways) approved, MA 39 (Research Centre, Laboratory and Certification Services of the City of Vienna)
- consultancy services at the planning stage, and training in laying given by experts

Additionally ductile iron pipes also have an extremely long technical working life, and have many possible uses and many ways in which they can be adapted, e.g. by means of different variant coatings.

Certificates/Approvals

Ductile iron pipes from TRM are a first choice for fire fighting or fire extinguishing systems regardless of whether these are wet pipelines (permanently charged with water) or dry pipelines (only charged with water when required). There is no better proof of this than the more than 400,000 metres of pipes which have already been installed. The logical consequence is that ductile iron pipes to EN 545 are listed in all the relevant standards, rules and requirements and are approved for use in fire fighting and fire extinguishing pipelines. In VdS CEA 4001, chapter 15.1.1, ductile iron pipes are listed in first place among the only pipeline materials which can be used. There is of course FM approval for underground pipes and fittings of nominal sizes from DN 80 to DN 500 with VRS®-T/BLS® push-in joints. The relevant details can be found in the Table below. Deutsche Bahn AG, the federal German railway company, shows ductile iron pipes with VRS®-T/BLS® push-in joints as suitable pipe equipment for fire fighting and fire extinguishing pipelines for use in its tunnels in its technical notice “TM 2010-024 I.NVT 4 (K)”. This applies both to pipelines laid in the floors of tunnel and to suspended pipelines.



Fire-extinguishing pipeline fitted with gate valves



The Plabutsch Tunnel near Graz



The Altenahr Tunnel



The Cochem Tunnel

Reference projects

Road tunnels

Hopfenbergtunnel on A 44 – D; DN 150; VRS®-T/BLS® 1.200 m
 Rennsteigtunnel etc. on A 71 – D; DN 150; VRS®-T/BLS® 26.800 m
 Dölzschentunnel on A 17 – D; DN 150; VRS®-T/BLS® 102 m
 Ditschardtunnel – D; DN 125; VRS®-T/BLS® 350 m
 Lohbergtunnel on B426 – D; DN 150; VRS®-T/BLS® 1.200 m
 Schloßbergtunnel at Dillenburg – D; DN 150; VRS®-T/BLS® 800 m
 Tauern tunnel, northern tube – A; DN 150; VRS®-T/BLS® 6.400 m
 Plabutsch tunnel – A; DN 200/DN 400; VRS®-T/BLS® 16.000 m
 Katschbergtunnel – A; DN 150; VRS®-T/BLS® 11.000 m
 Flüelen bypass tunnel – CH; DN 250; VRS®-T/BLS®, 2.570 m
 Autobahn link for Ebikon in the Rontal – CH; DN 250; VRS®-T/BLS®, 980 m
 Tunnel Grancia-Melide – CH; DN 250; VRS®-T/BLS®, 1.650 m
 Rofl atunnel – CH; DN 125-DN 150; VRS®-T/BLS®, 2.000 m
 West Zurich autobahn bypass – CH; DN 200; VRS®-T/BLS®, 18.950 m
 Stafflegg, Küttigen – CH; DN 150; VRS®-T/BLS®, 1.000 m
 Oberwil-Lieli – CH; DN 150; VRS®-T/BLS®, 1.050 m

Railway tunnels

Mainz tunnel – D; DN 100; VRS®-T/BLS®, 1.300 m
 Vienna underground rail – A; DN 80-DN 150; VRS®-T/BLS®, 65.100 m
 Austrian Fed. Railw. tunnel at Landeck – A; DN 125; VRS®-T/BLS®, 1.500 m

Industrial plants

Elettrinox Italia – I; DN 150-DN300; VRS®-T/BLS®, 3.000 m
 Fiat Auto – I; DN 250; VRS®-T/BLS®, 500 m
 Pirelli – I; DN 150-DN 300; VRS®-T/BLS®, 1.400 m
 Vienna Airport – A; DN 200; VRS®-T/BLS®, 4.000 m
 Minimax D, Az Zour – KT; DN 80-DN 400; VRS®-T/BLS®, 5.700 m
 S.C. Egger Romania – RO; DN 250; VRS®-T/BLS®, 4.000 m
 Loreal – RUS; DN 200-DN 300; VRS®-T/BLS®, 750 m
 Ikea Ostrava – CZ; DN 150-DN 300; VRS®-T/BLS®, 1.885 m
 Unionmatex – TM; DN 80-DN 200; VRS®-T/BLS®, 4.500 m
 Minimax D – UAE; DN 80-DN 150; VRS®-T/BLS®, 1.850 m
 Mercedes works at Kecskemet – H; DN 150-DN 300; VRS®-T/BLS®, 3.300 m
 LEGO, Hungary – DN 150-300 VRS®-T/BLS®, 3200m

Technical data

Connecting system

TRM provides the outstanding solution for connecting ductile iron pipes and fittings: The VRS®-T/BLS® joint (restrained on a positive-locking basis).

This type of joint can be used for the laying of fire-extinguishing pipelines and when so used is suitable for general application.

Because it is positive locking, the potential safety it offers is incomparably high. Operating pressures of up to 100 bars are allowable for the DN 80 and DN 100 nominal sizes – and this is true even at the maximum possible angular deflection of 5°. At the same time, an angular deflection of this kind makes it possible for pipelines to be curved to a radius of approximately 70 m (with pipes of a body length of 6 m). This enables the ductile iron pipeline to be smoothly harmonised with the path followed by the road, bridge or tunnel and enables a saving to be made on fittings.



Pipeline with VRS®-T/BLS® joints as a fire-extinguishing pipeline in a tunnel

Coatings

The VRS®-T/BLS® connecting systems can be combined almost as desired with all the external coatings which are available. This means that a tailor-made pipe system is available for virtually every application.

The following external coatings are a particularly obvious choice for use in fire-extinguishing systems:

- zinc coat with cover coating
- zinc-aluminium coat with cover coating
- zinc coat with cement mortar coating (ZMU)
- WKG coating (WKG = Wärme kompensierendes Gussrohr = heat-compensating ductile iron pipe)

Pipes with a zinc or zinc-aluminium coat and a cover coating are particularly suitable for suspended pipelines but can also be installed in beddings of sand or gravel or can be encased in concrete.

The cover coating consists of epoxy resin (RAL 5015 – sky blue) or polyurethane (RAL 5017 – traffic blue)*. Other colors are also available to special order. Pipes coated with cement mortar are used mainly for underground installation. They have the advantage of enabling stone-free infill and backfill material of grain sizes up to 100 mm to be used. Additionally, ZMU pipes can also be encased in concrete. In the area of tunnel portals, it is advisable for WKG pipes to be used when the pipeline concerned is wet (permanently charged with water). The WKG coating consists of a coating of polyurethane foam (4 to 8 cm thick depending on the nominal size) and an outer covering of folded spiral-seam tubing (e.g. of mild steel sheet or stainless steel) or high-density polyethylene. For extreme conditions, trace heating can be incorporated as well. Internally, pipes for pipelines for fire-extinguishing water are lined as standard with cement mortar based on blast furnace cement to ensure the maximum durability and long life in the interior too. Other types of cement mortar are possible to special order.

* Polyurethane coating only with zinc-coated pipes of 5 m body length



Detail view of a ZMU coating

Our ductile iron pipes for fire fighting and fire extinguishing pipelines are available to the following specifications:

- laying length of 5 m or 6 m
- nominal sizes of DN 80 to DN 1000
- internal protection: cement mortar lining
- external protection: zinc coating (200 g/m²) plus finishing layer
- alternative coatings are possible, e.g. cement mortar (ZMU), WKG or Zinc Plus

DN	d ₁ [mm]	D [mm] ¹⁾	t [mm]	PFA [bar] ²⁾	FM [bar]	Max. allowable angular deflection [°]	Number of locking segments
80 ⁴⁾	98	156	127	100/110 ³⁾	16	5	2/3 ³⁾
100 ⁴⁾	118	182	135	75/100 ³⁾	16	5	2/3 ³⁾
125 ⁴⁾	144	206	143	63/100 ³⁾	16	5	2/3 ³⁾
150 ⁴⁾	170	239	150	63/75 ³⁾	16	5	2/3 ³⁾
200	222	293	160	42/63 ³⁾	16	4	2/3 ³⁾
250	274	357	165	40/44 ³⁾	16	4	2/3 ³⁾
300	326	410	170	40	16	4	4
400	429	521	190	30	16 ⁵⁾	3	4
500	532	636	200	30	16 ⁵⁾	3	4
600	635	732	175	32	–	2	9
700	738	849	197	25	–	1.5	10
800	842	960	209	16/25 ⁴⁾	–	1.5	10
900	945	1,073	221	16/25 ⁴⁾	–	1.5	13
1000	1,048	1,188	233	10/25 ⁴⁾	–	1.5	14

¹⁾ Guideline value, ²⁾ Operating pressure (PFA): allowable operating pressure in bars – basis for calculation was wall thickness class K9, ³⁾ with high-pressure lock, ⁴⁾ wall-thickness class K10 ⁵⁾ applies to laying length of 5 m

The operating pressures shown also apply to the fittings. These are given an internal and external epoxy coating to EN 14 901.



Reliable and save: fire fighting pipe networks from TRM

Bridge pipelines and above-ground pipelines

Whether they are suspended from bridges or laid on supports, there are three main problems affecting pressure pipelines laid above ground:

1. the risk of freezing in winter
2. the heating up of the pipes and hence of the fluid in summer
3. massive cost and significant time loss for constructing reinforced thrust blocks

Heat-compensating ductile iron (=WKG; "wärmekompensierender Guss" in German) pipes and fittings with VRS®-T/BLS® joints provide a practicable solution to these three problems.

The advantages of VRS®-T/BLS® system are obvious:

- quick and easy to assemble
- no thrust blocks required
- insulation for pipes and double socket bends applied in the factory
- trace heating possible
- very low coefficient of thermal expansion
- any variations in length can generally be compensated by sockets and fittings
- one support per pipe is usually adequate

Temporary pipelines (for replacing water supplies)

Ductile iron pipelines with VRS®-T/BLS® joints can be laid above ground. Pipelines laid in this way do not always require thermal insulation. This is for example the case when the pipe diameter is large and the rate of flow high, when the medium carried stands still for only short periods, when there is no risk of freezing or when the medium is not sensitive to fluctuations in temperature.

The advantages of ductile iron pipe systems for temporary pipelines are as follows:

- protection against vandalism (ductile iron pipes will resist almost any attack)
- the joint is easy and quick to assemble
- high laying rates
- disassembly with no damage or destruction
- the pipes and fittings can be re-used
- no thrust blocks required
- high operating pressures are possible

Our ductile iron pipes for temporary pipelines are available to the following specifications:

- laying length of 5 m or 6 m
- nominal sizes of DN 80 to DN 1000
- internal protection: cement mortar lining
- external protection: zinc coating (200 g/m²) plus finishing layer
- alternative coatings are possible, e.g. cement mortar (ZMU), WKG or Zinc Plus



Temporary pipelines

Floating-in

The floating-in of ductile iron pipes is probably the most unusual of the “trenchless” techniques available. At sizes of DN 250 and above, the buoyancy of a sealed ductile iron pipe is so great that it is able to float without the need for any other bodies to provide buoyancy. This means that basically there are two possible ways of getting a pipe string out onto the water and, in the end, down below the water. At sizes up to and including DN 200 and depending on the wall thickness, additional floats may be required, while at sizes of DN 250 and above the pipe string can be installed as a self-supporting floating unit. Due to unpredictable loads from the waves, the sinking process, the nature of the sea or river bed and subsequent movements of the sea or river bed, etc., generally only pipes with the positive locking VRS®-T/BLS® joint which should be used for floating-in. As a result the pipeline should be pulled in so that the joints remain extended and thus securely locked. The preferred external coating for floating-in and for the subsequent laying in generally muddy sea or river beds is the cement mortar coating.

Our ductile iron pipes for floating-in are available to the following specifications:

- laying length of 5 m or 6 m
- nominal sizes of DN 80 to DN 1000
- internal protection: cement mortar lining
- external protection: cement mortar coating (ZMU)
- alternative coatings possible, e.g. zinc coating (200 g/m²) plus finishing layer, or Zinc Plus



Floating-in

Crossings below waterways/ culvert pipelines

Culvert pipelines are used to make crossings below waterways or below structures. The pre-assembly of the pipe string can be carried out in the dry – the positive locking VRS®-T/BLS® joint makes it possible for the subsequent pulling-in to be carried out. Culvert pipelines are often lifted in by cranes, pulled into prepared channels by winches or installed trenchlessly by the horizontal direction drilling technique.

All these techniques make severe demands on the material of the pipes, on the joint mechanism and on the external protection which the pipes have. Consequently only ductile iron pipes with positive locking joints and a cement mortar coating should be used for them.



Culvert pipeline

Laying on steep slopes

When a pipeline is being laid on a steep slope (gradient from 20% to 30%), there is a number of factors that make it advisable for the positive locking VRS®-T/BLS® system to be used.

In the first place there are sometimes tremendous forces that come into play, due to

- the weight of the pipes. The resultant force acting down the slope causes the pipe string to exert a pull at the top end of the steeply sloping pipeline. At this point there is usually a bend (a double socket bend) and a not inconsiderable tractive force may thus be generated at its socket
- the pressure in the pipeline. This causes additional forces to act both on the bend at the top and on that at the bottom
- slip of the material filling the trench. If the material filling the trench begins to slip, this exerts a pull on the pipeline due to the skin friction between the soil and the surface of the pipes. This transmits additional forces to the socket joints of the bend at the top.



Laying on steep slopes

In the second place, a steep slope usually constitutes inaccessible terrain and in terrain of this kind a pipe joint ought to be able to be assembled as quickly and as easily as possible. All the above factors make it advisable for the VRS®-T/BLS® system to be used.

This system combines very high tractive forces and operating pressures with very simple and hence very quick assembly. What is more, if our cement mortar coating (ZMU) is added, any replacement of soil on the steep slope can be dispensed with, thus reducing the risk of slippage of the material filling the trench.

Use in regions at risk of earthquakes or settlement

All over the world there are many settled areas which are situated in regions where the ground moves periodically, which may be the result of earthquakes or of mining subsidence in regions affected by mining. There are often large towns in these regions whose infrastructure is put at serious risk and there have been no lack of attempts to apply special methods of construction in order to minimise the damage in the event of earthquakes or mining subsidence.

Under EN 508, the designer is under an obligation to decide on the right pipe material for installation work which is planned. The designers and operators of water pipeline networks cannot always estimate all the imponderables which affect the loads on pipelines and their joints.

This is particularly true when installation takes place under the following conditions:

- regions affected by mining subsidence
- unstable soils
- regions at risk of earthquakes
- slopes

The allowable operating pressures and angular deflections of ductile iron pipes with restrained socket joints are laid down in the technical documentation such as in manufacturer's catalogues, FGR/EADIPS publications, e.g. FGR/EADIPS

standard 66, DVGW (German Technical and Scientific Association for Gas and Water) codes, e.g. "DVGW Arbeitsblatt GW 368", and so on. The figures laid down include a large safety factor but there are no quantitative details of the extreme loads which can be carried for brief periods, e.g. when acted on by an earthquake, without the pressure-tightness function being lost.

In a series of tests tailored specifically to the conditions existing during movements of the ground, it has been determined what actual safety factors ductile iron pipes can be expected to show under catastrophic conditions. For this purpose, leak tests were carried out on DN 200 pipes for water pipelines by applying to their joints angular deflections which went far beyond that laid down in the product standard EN 545. The aim was to find out up to what angular deflection the system would remain serviceable and leaktight under extreme circumstances. It was deliberately accepted that the components might suffer damage provided the system continued to function. A serious earthquake is generally accompanied by extensive destruction, which has to be repaired anyway after it has happened. The main problem is to ensure a supply of water for drinking and fire extinguishing which will operate reliably even

under catastrophic conditions. The test strings assembled consisted in each case of two socketed pipes. At the ends, the spigot ends and sockets were sealed off with fittings and blank flanges which had air inlet and outlet openings. One pipe was held fixed in the axial and horizontal directions. The test string was filled with water, bled of air and raised to an internal pressure of 20 bars. This pressure was selected to give conditions as close as possible to those existing in practice. The joint was then subjected to continuous angular deflection (to the point of failure).

Results:

The pipes with VRS®-T/BLS® joints could be deflected angularly by up to 24°. Only then did the first leaks become apparent. For a 6 metre long pipe, an angular deflection of 24° is equal to an off-axis deflection of around 2.5 m. Parts of the spigot ends of the pipes were damaged in the tests. The walls of the pipes were dented by the inner circumference of the socket, and the cement mortar coating flaked off at these points. Despite the extreme angular deflections and the dents which they caused, the joints remained serviceable and leaktight.

Urban water supply/replacement of concrete thrust blocks

Fittings for every non-restrained connection (f.e. TYTON®) have to be supported with concrete thrust blocks. In cities space for infrastructure is pure luxury. That's why in particular thrust blocks cause often conflicts with other infrastructure (f.e. gas-pipelines, sewage, electrical cables,...). Using the unique VRS®-T/BLS® positive locking system avoid thrust blocks complete.

The advantages of the VRS®-T/BLS® system for urban water supply are as follows:

- easy and above all safe to handle
- no special equipment required for assembly
- assembly is fast (about 5 min. per joint)
- angular deflectability up to a maximum of 5° (saves on fittings)
- joint rotatable through 360° with no loss of performance
- restrained (no thrust blocks required)
- clamping ring replaces welding on construction site
- full range of fittings
- gate valves, butterfly valves, hydrants, etc. are available
- gate-valve-equipped intersections with no flanged joints are possible
- no restrictions on use (e.g. can be used for trenchless techniques and on steep slopes)

Pipes with VRS®-T/BLS® joints are available to the following specifications

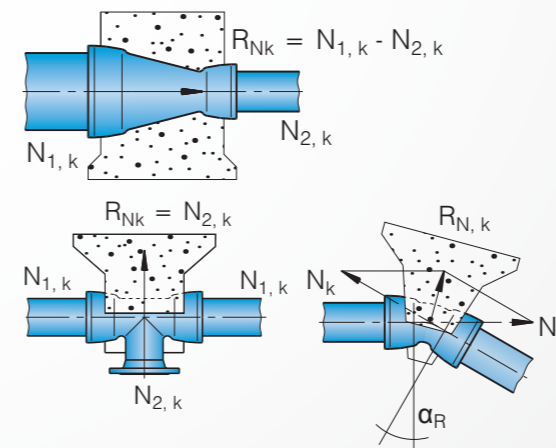
- laying length of 5 m or 6 m
- nominal sizes of DN 80 to DN 1000
- internal protection: cement mortar lining
- external protection: zinc coating (200 g/m²) plus finishing layer
- alternative coatings are possible, e.g. cement mortar (ZMU) or Zinc Plus

Fittings have internal and external epoxy coating to EN 14 901.



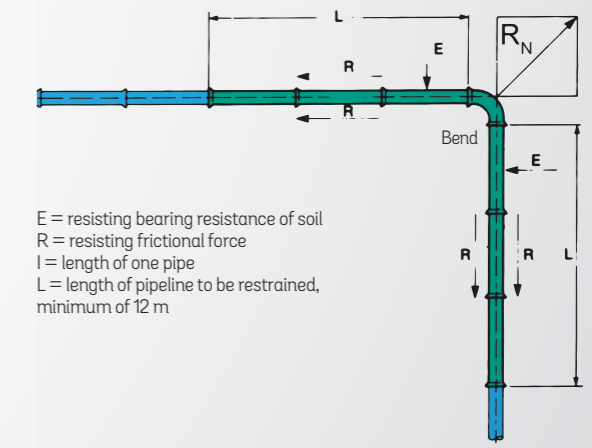
Deflection test: save connection up to 24°

Thrust blocks



Every not restrained fitting (TYTON®) has to be fixed with a concrete block

Save money & time with VRS®-T/BLS®



E = resisting bearing resistance of soil
R = resisting frictional force
l = length of one pipe
L = length of pipeline to be restrained, minimum of 12 m

Mix VRS®-T/BLS® and TYTON® pipes
VRS®-T/BLS® and TYTON® pipes 100% compatible

Safe money & time with VRS®-T/BLS® + TYTON®

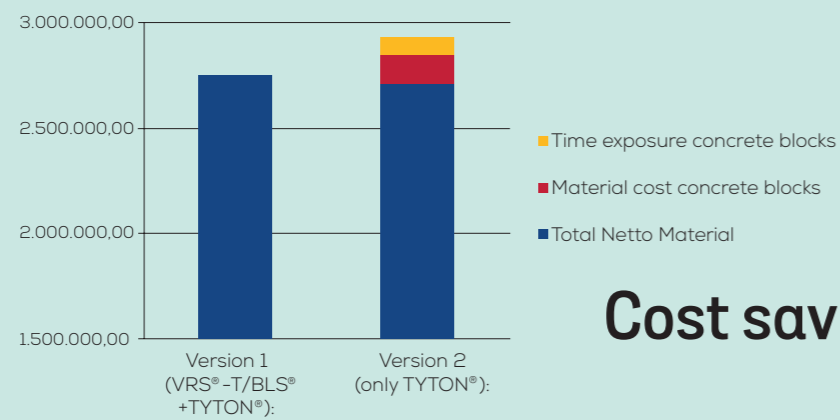
Comparison BLS® vs. TYTON®, DN 1000, 16bar, 4,5km, 71 fittings:

Version 1 (VRS®-T/BLS® + TYTON® mixed):

Total Netto Material:	2.754.575,00	€
Material cost concrete blocks:	0,00	€
Time exposure concrete blocks:	0,00	€
Total netto version 1:	2.754.575,00	€

Version 2 (only TYTON®):

Total Netto Material:	2.708.697,00	€
Material cost concrete blocks:	142.000,00	€
Time exposure concrete blocks:	85.200,00	€
Total netto version 2:	2.935.897,00	€



Cost saving: 6%



Modern installation without concrete thrust blocks



Conventional installation with concrete thrust block

Ductile iron pipe systems with cement mortar coating

Why cement mortar coating (ZMU)?

What is cement mortar coating?

Polymer-modified cement mortar based on blast furnace cement is applied to a zinc-coated pipe in a helix of a uniform thickness of approx. 5 mm from a fishtail nozzle. As this is done, the ZMU coating is provided with additional reinforcement by a net material similar to a bandage. ZMU coatings are available both for drinking water (blue) and for waste water and sewage (reddish brown). The ZMU Plus pipe, of constant outside diameter, is available for trenchless laying techniques in non-cohesive soils.

Provides mechanical protection

- ZMU pipes can be laid in soils with a maximum grain size of 100 mm regardless of whether the grains are round or irregular. This is why these pipes can also be used for trenchless installation techniques.
- Because of the high impact resistance of the ZMU coating, the pipes are particularly well suited to the usual rough treatment they can expect on buildingsites.
- Can be used for trenchless installation techniques for the press-pull, auxiliary tube, burstlining, horizontal directional drilling, rocket ploughing, and pipe relining techniques and others.

Advantages of the ZMU coating

Resistant to chemicals

- Under EN 545 and EN 15542, ductile cast iron pipes with a ZMU coating can be used in soils of any given corrosiveness class.

Economic advantages

- No need for exchanges of soil or for additional bedding for the pipes, and the soil excavated can be re-used.
- Savings of time and money, because the soil excavated does not have to be taken away and kept on a dumpsite.
- Long-term corrosion protection and hence a long life for the pipes (up to 140 years to DVGW (German Technical Association for Gas and Water)).



No bedding material needed



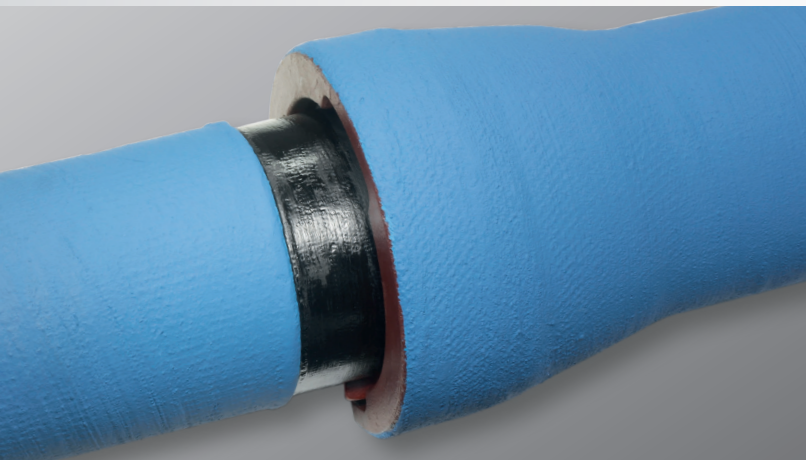
Close-up of a ZMU coating



Application of the ZMU coating in the factory

Ready for anything!

- Durability measured in decades (up to 140 years) and the good material properties do not change.
- High load-bearing capacity (for internal and external loads) and generous safety margins.
- Both deep and shallow top cover are possible.
- Wall thicknesses, coatings and linings optimised for the application make the pipes suitable for use in a vast variety of fields.
- A complete modular pipe and fitting system.
- Innovative restrained joints locked against longitudinal forces can be made.
- The material is environment-friendly (sustainable and recyclable and the materials used are inorganic).
- Drinking water and groundwater are protected by pipe walls which seal against diffusion.
- Cement mortar linings are safe for drinking water.
- Socket joints are capable of angular deflections of up to 5° so fewer fittings are needed.
- The most economically sensible solution on the market.
- Easy to connect and install.
- Certified to DVGW (German Technical Association for Gas and Water) standard VP545, monitored by the MPA NRW (North-Rhine Westphalia Materials Testing Institute).



ZMU pipe with a VRS®-T/BLS® joint



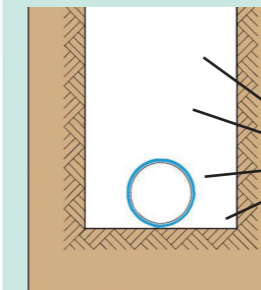
ZMU pipe profile



Laying in Alpine terrain

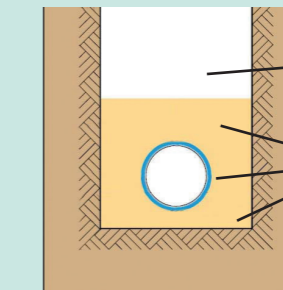
Safe money & time with PUR or ZMU

PUR or ZMU Coating:



excavated material,
individual grain
size maximum
100mm allowed

Typical coatings or plastic pipes:



$T = DN + OD + \text{bedding}$
excavated
material
grain size
maximum 16mm
or 32mm

Example: DN 500, 11,5km

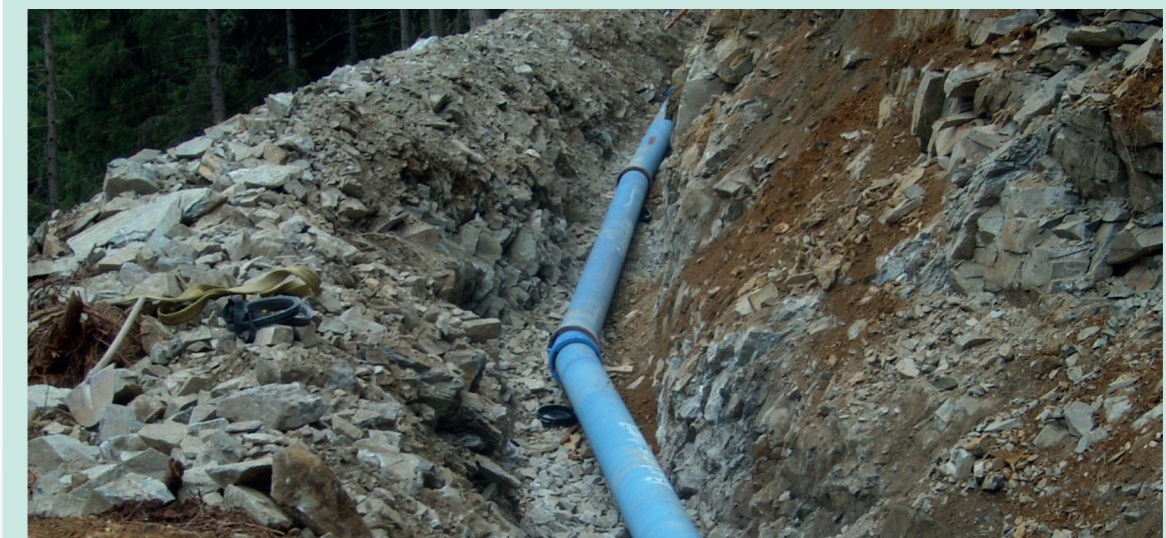
additional excavation, sand and manipulation: 135.746,90 €

Disposal of excavated soil: 39.592,85 €

Total savings: 175.339,75 €

Cost saving: 10%

Bedding	[m³]	€/m³	total	
additional excavation (bedding zone)	2.116,88	2,00	4.233,77 €	
sand (transport to construction site included)	11.312,24	9,00	101.810,18 €	
manipulation of sand at construction site	11.312,24	3,00	33.936,73 €	135.746,90 €
disposal of excavated soil (estimation 50%)				
disposal of excavated soil (transport + disposal)	5.656,12	7,00	39.592,85 €	39.592,85 €
			TOTAL	175.339,75 €



Cost saving and easy installation without any additional bedding material.

Ductile iron pipe systems for Trenchless laying

Trenchless laying

More than 30 years experience

There has been a very close relationship between the development of trenchless pipe-laying techniques and both ductile cast iron pipes and the joints and types of external protection for these pipes.

Restrained socket joints were developed as a replacement for thrust blocks and as the first trenchless laying techniques began to make their appearance it was soon recognised what potential these joints had. Since then, ductile iron pipes from TRM have been setting the standard for reliability and economy in trenchless laying techniques.

The first trenchless pipe-laying operations in the 70's marked the beginning of a speedy development process. More and more new techniques came on the market and the demand grew for larger sizes and longer pipelines.

The joint

In the majority of trenchless laying techniques, ductile iron pipes are pulled in. The only exception is pipe relining by the push-in process. Therefore, what is required for pulling-in is a joint which is "restrained" or in other words which is secure against tractive forces. Essentially, what a joint of this type needs to be based on is a positive interengagement. The feature by which positively interengaged socket joints can be recognised is a weld bead on the insertion end and this is what the VRS®-T/BLS® joint has.

The VRS®-T/BLS® joint is the joint that sets today's standard for ductile cast iron pipes when it comes to combining the greatest possible flexibility at the socket with very high tractive forces and, at the same time, very simple and fast assembly.

It was not only the types of joint that had to be matched to the demanding requirements of trenchless laying techniques but also the types of external protection. The result was the plastic-modified cement mortar coating, known to those in the industry as the ZMU coating.

These two developments, the VRS®-T/BLS® joint and the ZMU coating, laid the foundation for the success story of TRM's ductile cast iron pipes in the field of trenchless laying techniques. Impressive proof of this success is provided by an approximately 500 metre long culvert pipeline of the DN 900 size installed in Valencia in Spain which has, since 2007, held the world record for the largest culvert pipeline of ductile cast iron pipes ever installed by the directional drilling technique.



TRM – More than 30 years experience in trenchless laying techniques.

Replacement techniques

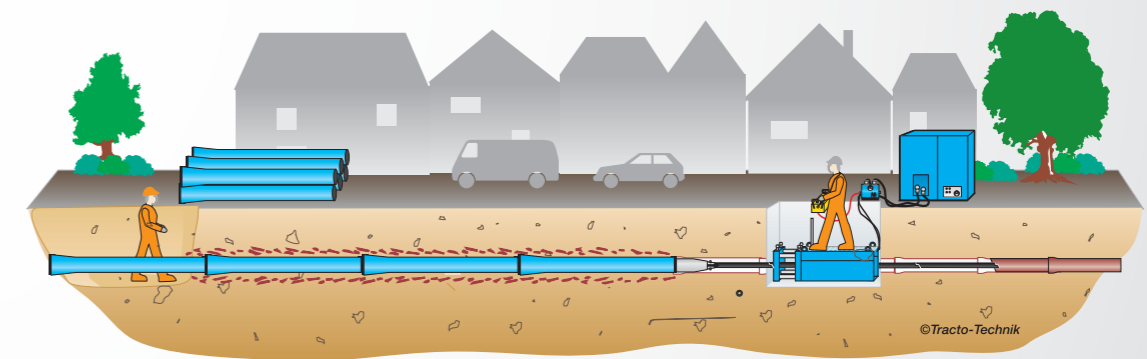
Burstlining

The burstlining technique is an environment-friendly method for the trenchless replacement of a pipeline where the new pipeline follows exactly the same route.

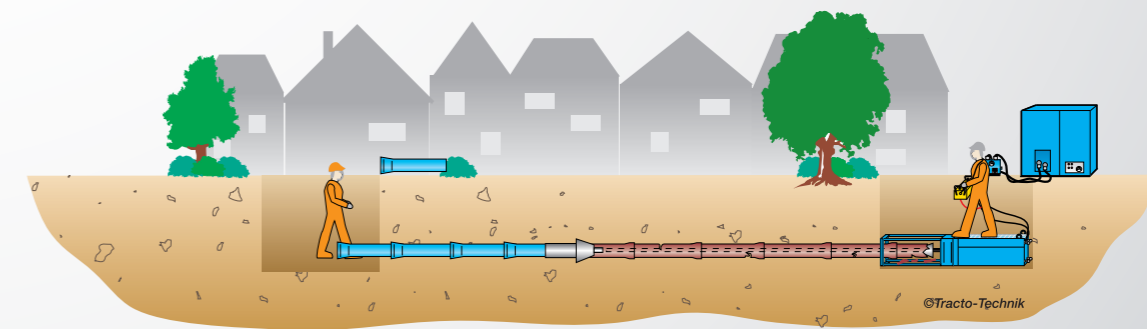
An old pipeline is burst with a bursting head and the fragments produced are forced into the surrounding earth. At the same time, the cavity produced is enlarged sufficiently to enable a new pipe of the same or a larger size to be pulled straight in. With the burstlining technique, a distinction is made between the dynamic and static variants. Burstlining is particularly well suited to use with old pipes of brittle materials such as asbestos cement, stoneware and grey cast iron. However, by using the static variant and special cutting heads it is also possible for steel and ductile cast iron pipes to be burst. The new pipe which is pulled in may be of the same nominal size as the old pipe or, as dictated by the size of the widening head which is used, of a larger size. An increase of up to two steps of nominal size is possible.

Push-pull technique/auxiliary tube technique

With this technique, the old pipe is pushed out of the ground by means of a traction linkage and a special traction and pushing head while the new ductile cast iron pipe with VRS®-T/BLS® socket joints and a ZMU coating is being pulled in along the same route as part of the same operation. Increases of several steps of nominal size are possible in this case. The technique of pushing/pulling along the same route is notable for its high efficiency, speed and reliability and therefore makes it very economical. A variant of the push-pull technique is the auxiliary tube technique. In this case, rather than a traction head which also pushes being pulled in, a steel auxiliary tube is pulled into the bore which the old pipeline follows and in this way the old pipeline is pushed out. The next step is for the new cast iron pipeline to be coupled to the auxiliary tube. The new cast iron pipeline is then pulled in along the same route while the auxiliary tube is pulled out. This technique is used mainly for the replacement of steel pipes. Since 2007, the Berlin water supply company Berliner Wasserbetriebe (BWB) has replaced about 30,000 metres of its pipeline network by using this technique. What have mainly been used for this purpose have been ductile cast iron pipes with a cement mortar coating and VRS®-T/BLS® joints.



Burstlining



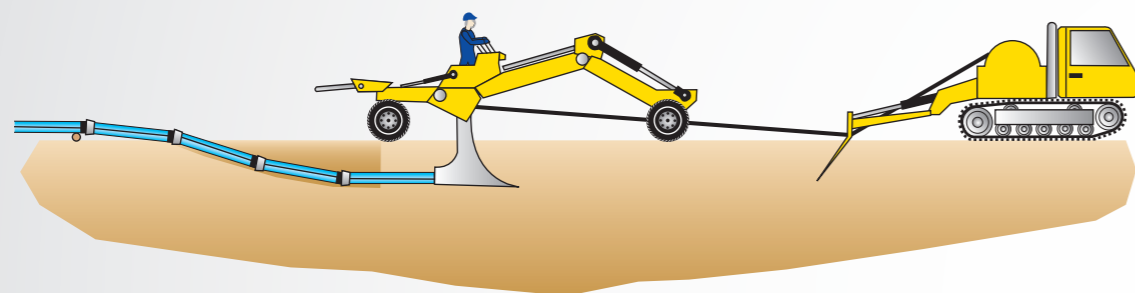
Push-pull technique/auxiliary tube technique

Laying of new pipelines

The rocket plough technique/milling-in

The rocket plough is used to pull in strings of pipes along new routes. It is a development of the pipe and cable ploughs which have been used for many years now for installing cables and flexible pipes. The rocket plough technique is suitable for ductile cast iron pipes of nominal sizes up to DN 300. The machinery used for the technique consists in essence of a traction vehicle which has a cable winch, and a plough. The most important part of the plough is the ploughshare. The plough is connected to the traction machine by a steel cable. In a starting pit, which is dug at a slope, the string of pipes is sloped down to the appropriate depth for installation and is fastened to the ploughshare.

The tractive force from the cable winch causes the ploughshare to move through the earth and force it aside in the region where the pipeline is going to be situated. This produces a cavity into which the pipeline is pulled directly. The plough technique is particularly suitable for rural areas where the density of population is low and where there is a need for pipelines of considerable length with only a small number of take-off points. Under conditions like these, not only can the rocket plough technique be used but ductile cast iron pipes can also be milled in.



Ploughing-in a pipeline

The directional drilling technique

Over the past few years the directional (or steered horizontal) drilling technique has gained for itself a firm position in the repertoire of pipeline installation techniques. It originated from the USA and was developed there in the seventies from the techniques for the deep drilling of oil and gas wells. Since then it has become an established trenchless laying technique for pipeline installation. Development of the technique has raced ahead.

The pipes are laid without trenches by the use of a drilling system. Instead of large amounts of money being spent on moving earth, a pilot bore is first drilled. Any obstacles or changes of direction are of no consequence because the top of the drilling head is fitted with a radio-controlled probe. The advance of the bore can be precisely followed, monitored and controlled in this way. This is followed by the trenchless pulling-in of the supply pipelines. The digging-out that has to be done with this technique is confined to a launch pit and an arrival pit. In directional drilling, TRM holds the world record for the largest culvert pipeline of cast iron pipes.

In 2007, in Valencia in Spain, a string of pipes of a nominal size of DN 900 with VRS®-T/BLS® joints and a cement mortar coating was pulled in for a length of some 500 m.



DN 900 directionally drilled curved pipeline in Valencia in Spain

Relining

Collector pipes

This technique is normally used not to replace an old pipeline but to pull a group of new pipelines intended for various purposes into a pipe forming a casing tube. This is generally done by means of transporting clamps to which the pipelines to be pulled in are fastened. One or more guide rails in the casing tube prevent the group of pipelines from twisting on its axis as it is being pulled in. The entire group is usually pulled in on the cast iron pipe. At TRM there are special traction heads available for this technique, as well as for all the other installation techniques.

To protect the outsides of the pipelines, a choice can be made between a conventional cover coating or a cement mortar coating (ZMU). The ZMU is usually used if the annular space which is left is not filled. With collector pipes too, the entire pipe group can be pulled or pushed in (provided VRS®-T/BLS® joints are used in it).



Ploughing-in a pipeline

Pipe relining

Over the past few decades there has been a continuous fall in per capita consumption of drinking water. That's why pipe relining has become an increasingly pertinent technique. Pipes of smaller diameter can now be used due to the smaller volumes of water and waste water that need to be transported. Pipe relining takes advantage of this fact. In it, new ductile cast iron pipes are pulled or pushed into existing pipes which are no longer suitable to carry drinking water. When this is done, ductile cast iron pipes can be pulled in or pushed in by sliding on their sockets either with the protection of a sheet metal cone or on transporting clamps.

For the pulling-in of pipes, use is made of the VRS®-T/BLS® joint. Pipes and cables for other services can be mounted on the transporting clamp (as in a collector pipe). All that is required is a launch pit and an arrival pit. This means correspondingly little expenditure on below-ground work and on road rebuilding and minor interference with traffic and residents. The cavity between the old and new pipes can be filled once the laying has been completed. If the cavity is not to be filled, pipes with a cement mortar coating (ZMU) should be used.



Pipe relining



Pipe relining



Above-ground demonstration of the burstlining technique



DN 400 ductile cast iron pipes with VRS®-T/BLS® socket joints being pushed into a stretch of protective tubes



The horizontal directional drilling technique

Reference projects

Directional drilling

Berlin – Stahnsdorf (DN 250), Gent – Belgium (DN 600), Valencia – Spain (DN 900), Blankenfelde Mahlow – Intersection on L40 road (DN 300), Schwante – Dorfstrasse (DN 300), Nieder Neuendorf – Culvert under Havel canal (DN 200), Wolfenbüttel (DN 500), Halle – Maxim-Gorki-Strasse (DN 150), Rügen – 3rd section of building project in Prora (DN 300 and DN 250), Grossbeeren – Kleinbeerener Strasse (DN 300), Nieder Neuendorf – 1st section of building project (DN 200), Eichwalde (DN 300), Berlin Frohnau (DN 100), Münster bei Dieburg (DN 100), Dieburg – Gross-Umstädterstrasse (DN 150), Pegau (DN 300), Schönebeck – Pressure wastewater pipeline (DN 500), Rostock (DN 500), Wutha (DN 400), Henningsdorf (DN 500), Oranienburg (DN 500), Frankfurt am Main (DN 100), Offenbach (DN 100), Kinheim – Culvert under the Mosel (DN 150)

Rocket ploughing

Laue-Possdorf (near Delitzsch) (DN 200), Impfingen (DN 150), Hergenstadt (DN 150), Untersollbach (DN 150), Bad Wimpfen im Tal (DN 200)

Pipe relining/collector pipe

Berlin – Tagostrasse (DN 800), Berlin – B101 road at state border (2 x DN 800), Berlin – Berliner Allee (DN 800), Leipzig Mölkau (DN 900), Leipzig – Thallwitz long-distance pipeline (DN 900), Elbaue-Ostharz long-distance water supply company, Güsten pipeline (DN 800), Briesen near Frankfurt an der Oder (DN 500), Berlin – Bornholmer Strasse (DN 700), Berlin – Hauptstrasse (DN 800), Frankfurt am Main (DN 400), Budapest (DN 600 and DN 800)

Floating in

Gstaad – Switzerland (DN 200), Binz on the island of Rügen (DN 1000)

Burstlining

Erfurt (DN 150), Gladenbach – Erdhausen (DN 150 and DN 100), Bad Laasphe (DN 100 and DN 200), Ober Rabenstein (DN 250), Zittau (DN 200), Siegen (DN 150), Vienna (DN 200, DN 150, DN 300 and DN 150), Salzburg (DN 200)

Temporary pipeline

Berlin Olympic Stadium (DN 200), Hartenstein – Chemnitz (DN 600)

Push-pull technique/auxiliary pipe technique

Since 2007, more than 30,000 metres of TRM ductile cast iron pipes of nominal sizes ranging from DN 80 to DN 300 and with VRS®-T/BLS® joints and cement mortar coatings have been successfully laid by these techniques in the metropolitan area of the city of Berlin. It is not just in the area supplied by the Berlin metropolitan water supply company that the push-pull technique has been used but also in other parts of Switzerland and Western Europe. In Switzerland alone, some 10,000 metres of ductile cast iron pipes with VRS®-T/BLS® joints and cement mortar coatings have been installed using this technique over the past few years.

OD or DN – did you know?

For PE-HD pipes OD (= outside diameter) is often misunderstood with the nominal diameter DN of ductile cast iron pipes.

PE-HD pipe OD630

SDR11 -> s=57,2mm -> c - (2x57,2mm) = 515,6 mm inside diameter

Ductile iron pipe DN600

C30 -> s=11,7mm (incl. cement lining) -> 635mm - 23,4mm = 611,6 mm inside diameter

Ductile iron pipe DN500

C30 -> s=10mm (incl. cement lining) -> 532mm - 20mm = 512 mm inside diameter

>> Save money with ductile cast iron pipes <<

DN600, 12km, PN16, Q = 300 l/s, main pipeline



PE pipe OD630, SDR11

v = 1,50m/s

Pressure loss: 3,482m/km à 41,8m



Ductile iron pipe DN600

v = 1,04m/s

Pressure loss: 1,389m/km à 16,7m

Pressure loss is **60%** lower.

Save massive energy cost for pumping annually!

Calculated according to DVGW GW303-1 and DVGW GW 400-1 guideline with integral roughness $k_i = 0,1$ mm for main pipelines.

Tiroler Rohre GmbH develops, produces and markets high quality systems for transporting water and for laying deep foundations for structures – made of ductile cast iron.

The durable properties of the material, innovative product technologies and a proven track record in the applications of our customers make us the leading provider of water and foundation engineering solutions.

Our Products and Services

Our products are efficient, durable and robust. They are known especially for their ecological and economic benefits. Thanks to the properties of ductile cast iron and our expertise in the areas where our products are used, we are able to overcome extreme challenges.

We are known for our skill, network of industry partners and reliability. Thanks to their long service life and the careful use of resources, our products and services help to protect precious water resources.

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