CONSOLIS

BONNA TP

The Reinforced Concrete Cylinder Pipe

PRESSURE PIPES

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afaq QSE Qualité Sécurité Environnement AFNOR CERTIFICATION ISO 9001 - ISO 45001 ISO 14001

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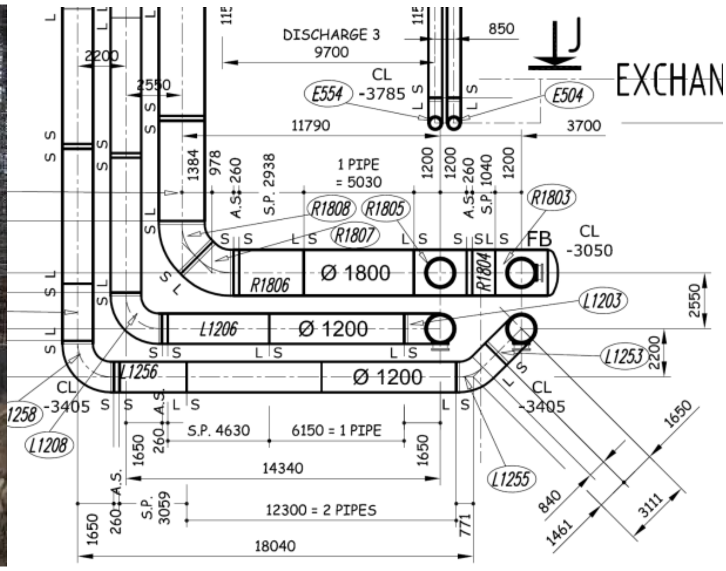
The BONNA® pipe:
The Reinforced Concrete Cylinder Pipes

A custom-made integrated solution

The Bonna pipe is a reinforced concrete pressure pipe with an embedded steel cylinder. The pipes and fittings are designed to suit each project characteristics and the chosen laying method (service pressure, maximum working pressure, height of backfill, trench installation, jacking and microtunnels, etc…). A huge range of diameters are available from Ø300 mm to 4000 mm.
The pipe elements are connected by welded joints SL or by an elastomeric gasket ER.

The BONNA® pipe complies with EN 639 & 641 standards.

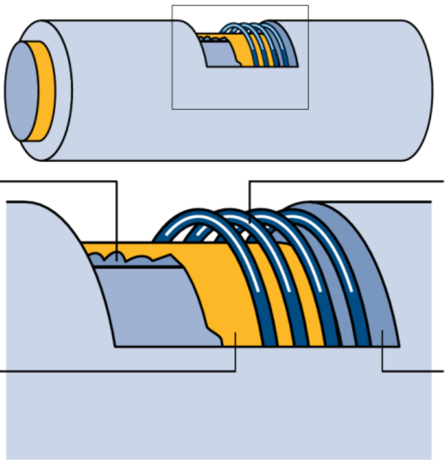
The steel cylinder pipes combine a significant resistance to external loads, internal pressure and vacuum conditions and confer a great durability to the pipe networks.
The Bonna® pipes are used throughout the world for a large number of cooling water system pipeworks in thermal and nuclear power stations, in potable water supply systems, in intake and sea outfalls and in sewage networks requiring full water tightness (pipes, manholes, etc…)



Integrated services available:

. Engineering, design
. Manufacturing & Supply
. Technical assistance or even laying the pipes

The steel-concrete concept



The steel cylinder reinforced concrete pipe offers an optimum combination between the performances and specifications of concrete and steel.

Each pipe comprises:
(1) an internal high cement content mortar wall and very smooth; it protects the steel cylinder from corrosion by passivation and from abrasion phenomena. Unlike the thin coatings of other pipe materials, this contributes to the vacuum and vibration,
(2) A metal core made from rolled steel sheets and welded lengthwise or helically, providing full water tightness and self-anchoring of the pipeline,
(3) a steel reinforcement made by helical winding of a steel wire at a constant pitch,
(4) an outer reinforced concrete wall which durably protects the steel against external aggressions (ground, water table, etc.) and absorbs the stresses due to backfilling and external loads.

The durable performance of the steel reinforced concrete cylinder pipes has been demonstrated for more than a century of utilization. It is attributable to its composite design using the steel/concrete complex.

The manufacturing process within the controlled conditions of the factory prefabrication allows reaching an optimum product quality in term of material performances (compactness, resistance, compliance to tolerances…) and contributes to the durability of the reinforced concrete steel cylinder pipeline.

Fitted to the project, recyclable, traceability, resistant, economical

1. COMPLETED CUSTOM MADE ENGINEERED SOLUTIONS with ADDITIONAL VALUE-ADDED SERVICES such as:

Layout drawings
Design calculations
Full specific studies (seismic design, settlement behaviour, weak soils, etc…)

2. ENVIROMENTALLY SUSTAINABLE AND FULLY RECYCLABLE PRODUCT (made up of steel and concrete)

3. TRACEABILITY OF THE PRODUCTS (ISO 9001)

4. PROVEN SAFE & DURABLE SOLUTIONS (more than 100 years of references)

5. BEST COST EFFECTIVENESS when taking into account total project owner's cost.

BONNA TP team not only manufacture the STEEL CYLINDER REINFORCED CONCRETE PIPE pressure pipes, but can also accompany you from initial design until completion of your project.

Proven durability / self-anchored / resistant / water tight

1. Specific design, laying method fitted to the project
2. Self-anchoring: 2 solutions - a full-welded solution « SL » or a mixed solution « SL-ER »
3. Inherent robust, not time-degrading material
4. High shock resistant
5. The BONNA® pipe can be laid in any type of soil without additional protection *
6. Simple backfilling with native excavated material *
7. Roughness coefficient (k = 0.0001 m).
8. No risk of pipe collapse under negative pressure or full vacuum
9. No cathodic protection required *

* *Contact us for special cases*

Pipes – manufacturing processes

The Reinforced Concrete Steel Cylinder Pipes are manufactured according to EN 639 & EN 641 standards.

The pipe type ATM (moulded concrete steel cylinder pipe)

Manufacturing

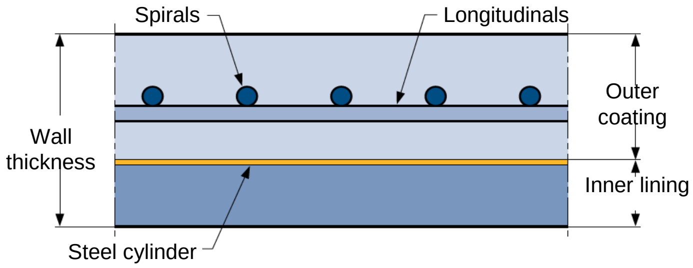
The steel cylinder is made from rolled steel plates welded lengthwise or helically. It ends in spigot or socket sections by means of which the pipes can be assembled using welded joints or joints with elastomer gaskets. The watertightness of the welding is checked on all the steel cylinders by means of a porosity test and hydrostatic testing..

The steel reinforcement is made by helical winding of a steel wire at constant pitch around longitudinals forming the reinforcement cage.

The execution of inner and outer concrete is made by casting in one single operation into a metallic mould at high frequency controlled vibrations.

Pipes – type ATM (moulded concrete steel cylinder pipe)

Cross section pipe wall



		Wall thickness (mm)			Effective length (m)		Approximate Weight in t/m
Internal diameter (mm)	External diameter (mm)	Total	Inner lining	Outer coating	Welded joint SL	Flexible joint ER	
250	420	85	37	48	6.07	-	0.23
300	420	60	27.5	32.5	6.07	-	0.17
400	520	60	24	36	6.15	6.15	0.22
500	630	65	24	41	6.15	6.15	0.29
600	730	65	24	41	6.15	6.15	0.35
700	840	70	26	44	6.15	6.15	0.43
800	950	75	26	49	6.15	6.15	0.53
900	1060	80	28	52	6.15	6.15	0.63
1000	1164	82	28	54	6.15	6.15	0.71
1100	1276	88	30	58	6.15	6.15	0.84
1200	1390	95	30	65	6.15	6.15	0.99
1250	1470	110	30	80	6.15	6.15	1.20
1400	1640	120	40	80	5.03	5.03	1.46
1500	1740	120	40	80	5.03	5.03	1.56
1600	1880	140	40	100	5.03	4.96	1.95
1700	1980	140	40	100	5.03	4.96	2.06
1800	2100	150	37	113	5.03	4.96	2.34
2000	2320	160	45	115	4.50	4.43	2.77
2100	2440	170	45	125	4.50	4.41	3.09
2200	2560	180	45	135	4.50	4.41	3.43
2350	2730	190	45	145	4.00	3.91	3.87
2400	2800	200	50	150	5.03	4.94	4.17
2500	2910	205	50	155	4.00	3.91	4.44
2600	3030	215	50	165	2.91	2.82	4.85
2800	3250	225	50	175	3.50	3.41	5.45
3000	3480	240	50	190	2.91	2.82	6.23
3200	3720	260	50	210	2.91	2.82	7.21
3500	4080	290	55	235	2.41	-	8.80
4000	4640	320	60	260	2.01	-	11.07

Effective lengths are the total lengths of the pipe less the theoretical fitting depth. They are given for reference only, other lengths may be considered according to the project size and/or the production site location.

Pipes of non-standard length or cut pipes
Straight elements can be manufactured in the factory to the desired length.
Possibility of using standard length pipes with a steel cylinder of minimum 3 mm thickness, for cutting to size and fitting of an end joint directly on site.

Fittings

Design of BONNA® special fittings

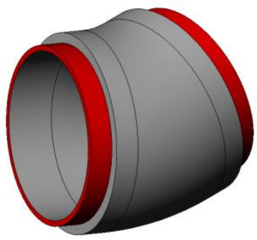
Bonna TP manufactures a range of custom made connection fittings, elbows with special radii of curvature, tees with axial or tangential branches under any angle, reducers, combined elbow-reducers or tee reducers, wyes, end adaptors with or without integrated flanges and including complex fittings such as cross-sectional change pieces (e.g. round to square), movement compensators, etc.

Special fittings comprise:

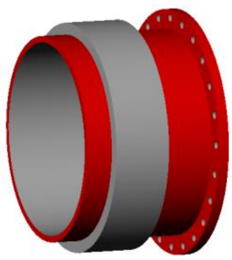
- a steel cylinder made of welded steel sheets,
- a reinforcement cage, comprising spirals and longitudinals,
- an inside lining and an outside concrete coatings embedding the reinforcement perfectly.

End-rings or flanges are welded to the ends of the steel cylinder. An appropriate type of joint is used: welded joint “SL”, rubber gasket joint “ER”, flanged joint, etc.

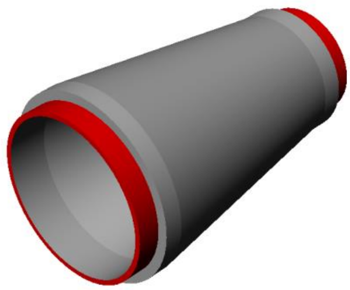
All the special fittings can, on request, include one or more watertightness collars, supporting collars, anchoring starter bars, etc.



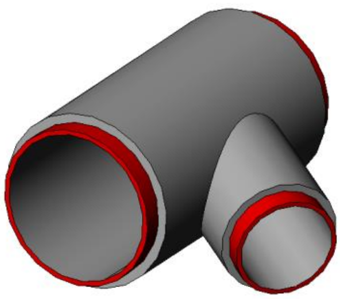
Elbow



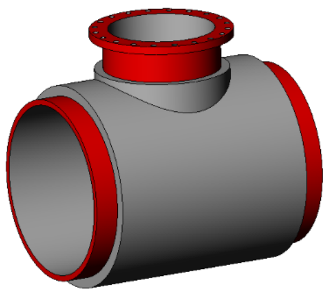
Flanged end-adaptor



Reducer



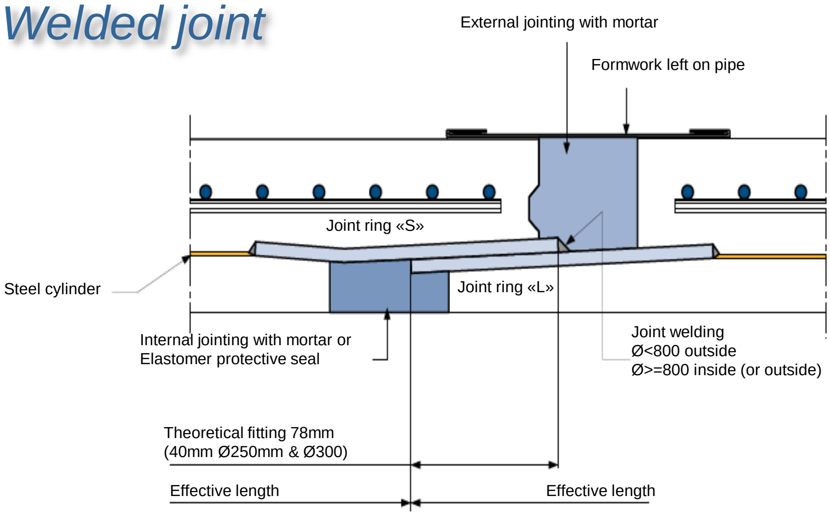
Wye



Tee with square branch

The joints

SL joint: Welded joint



The « Slip joint » (in short "SL") is an arc welded joint.

Joint rings

The joint rings, which from integral parts of the pipe, consist of two conical rings, one female (socket), conventionally referred as "S", and the other male (spigot), referred to as "L". These steel rings are swaged on the press to the correct shape for an accurate fitting and to allow for the best welding conditions.

The rings are cut out from broad steel plates in compliance with European Standards EN 10-25 in weldable grade S235 - JRG2:
- Ultimate tensile strength = 340 to 470 N/mm²
- Yield strength 235 N/mm²
- Total elongation under load 26 %.

Joint welding

After laying and adjustment of the pipes, the joint is arc welded manually or with a semi-automatic machine.
The joint extremities of the pipes or special fittings have cutbacks cleared of concrete to enable welding:
- on the outside for diameters < 800 mm
- on the inside or outside for 800 ≤ Ø < 1200mm
- on the inside for diameters ≥ 1200 mm (on request, the external cutbacks may be arranged for external welding).

Weld quality

The weld, performed as fillet weld, must be watertight. This weld watertightness will be checked by the porosity test with red coloured penetrant.
The weld thickness will be no less than 0.7 e.

Inside pressure thrust

The welded joint withstands longitudinal tensile stresses which avoids the need to build thrust blocks, especially at the elbows, when the pipes and the special fittings have been designed to make a self-anchored pipeline..

Curved alignment

The deflection between two consecutive pipeline elements fitted together can reach from 0,5° to 2,2° depending on the diameter of the pipe and the type of joint. They can then be laid around a minimum radius of curvature close to 150 to 300 m, depending on the effective lengths and diameters of the pipes.

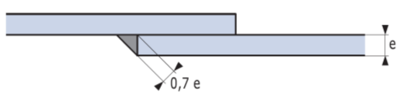
Protection of metal parts

After welding the joint and testing its watertightness, the exposed metal parts are protected by a mortar joint on the inside and outside.

The external jointing is cast by pouring mortar inside a plastic formwork left on the pipe.

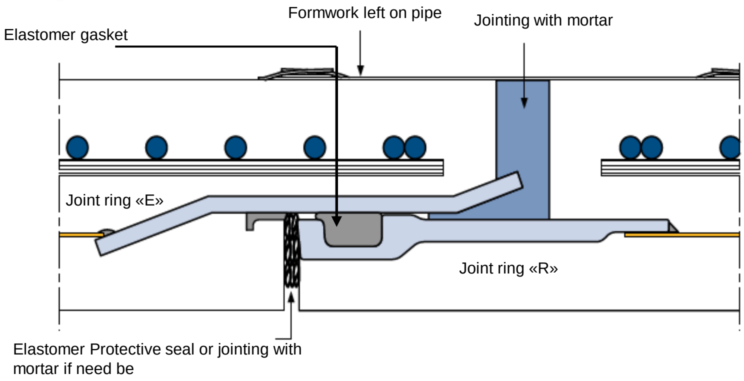
The Internal jointing is cast by applying a mortar manually or mechanically, and then smoothing its surface.

In the case of external welding, the internal joint can be replaced by an elastomer protective seal.



The joints

ER joint: Flexible joint



Joint rings

The metal parts of the joint, which form integral parts of the pipe, comprise two rings, one female (socket), referred as “E”, and the other male (spigot), referred as “R”.

The steel rings are swaged on a press to obtain a precise watertight fit, through regular compression of the elastomer gasket, making pipe assembly easier and quicker for laying operations..

The rings are cut from broad steel plates, the spigot ring is made of special, rolled steel with a groove designed for sealing the gasket. These plates are in accordance with the European Standard EN 10-025, in weldable grade S235 – JRG2:
- Ultimate tensile strength = 340 to 470 N/mm²
- Yield strength 235 N/mm²
- Total elongation under load 26 %.

When exposed, metal parts are protected with a zinc or/and paint coating or, if necessary, any other coating depending on the corrosive nature of the surrounding environment.

Jointing

When laying the pipes, their jointing is performed as follows:
- The elastomer gasket is placed into the groove of the spigot end, previously lubricated with a non-caustic soap supplied with the pipes.
- The inside of the socket, in particular at entrance, is also lubricated with soap.
- Using a lever-tackle or other suitable device, the spigot is guided into the socket of the previously laid pipe (recommended laying direction) or the other way round. The spigot end is self-centering when pushed in.

Jointing is completed when laying clearance between the spigot and the socket bottom has reached its norminal value.

When performing jointing one must make sure that the elastomer gasket remains in the groove.

When jointing is completed, an external mortar joint is cast inside a plastic formwork on the pipe.

The internal mortar joint, if any, is applied manually or mechanically and then smoothed so as to flush with the pipe inside surface.

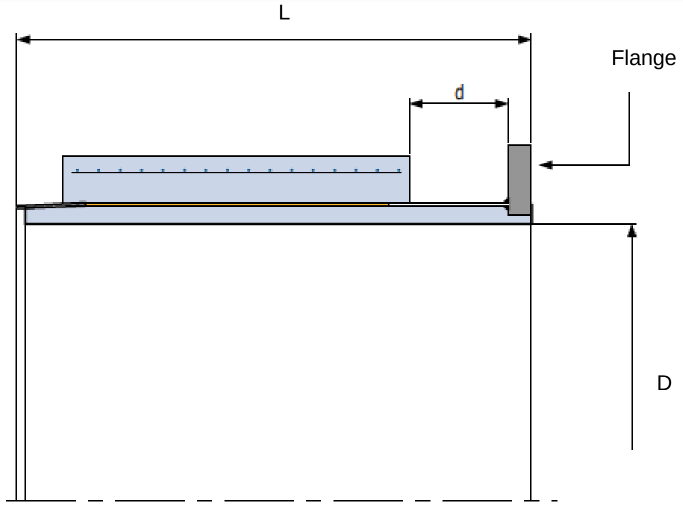
Elastomer gasket rings

The elastomer gasket consists of a circular section ring sealed by vulcanised welding. It must have a smooth surface, showing no defects such as pitting, cracks, blisters, air cavities, or any defect that may cause tearing.

The elastomer complies with the quality and good conservation criteria of the gasket.

Various types of elastomer can be used to suit the project requirements including SBR, NBR and EPDM.

Connection (flanged apparatuses or to other materials)



L = Effective length in m
D = internal diameter in mm
d = cleared cutback length
(variable depending on flange type)

Internal diameter (mm)	Effective length (m)	Internal diameter (mm)	Effective length (m)
250	0.50	1600	1.00
300	0.50	1700	1.00
400	0.50	1800	1.20
500	0.60	2000	1.20
600	0.60	2100	1.20
700	0.60	2200	1.20
800	0.60	2350	1.20
900	0.60	2400	1.40
1000	0.80	2500	1.40
1100	0.80	2600	1.40
1200	0.80	2800	1.40
1250	0.80	3000	1.40
1400	1.00	3200	1.40
1500	1.00	3500	1.40

Application

The apparatuses to be fitted on a pipeline (valves, air vent, pumps, etc.) are connected to it by means of steel flanges. Others (HDPE, steel, ductile iron…) are connected to the BONNA pipes by flanges.

BONNA special fittings, their branches and, if necessary the pipes, are equipped with such flanges on request.

Description

These flanges are made out of thick metal plates and comprise a sleeve for connection to the pipe steel cylinder. For diameters equal to or less than 150 mm, the internal diameter of the steel sleeve is the same as that of the pipe.

The flange-sleeve connection is made by welding and strengthened by means of shoulder brackets for large diameters.

Usually, the flanges have raised face and upon request with round-nose grooves.
All the common type can be provided: PN6, PN10, AWWA, ANSI, API, NF, BS, DIN, JIS, etc.

Protection

Depending on the laying conditions, various types of protection may be used: paint, galvanization, metallization, or any other coating or stainless steel. It is also possible to use flanges with special protection designed for ensuring electrical discontinuity.

Electrical discontinuity

It is implemented, if necessary between two different materials by using a insulation kit (joint, insulating tubes & washers).

Self-anchoring

A self-anchored pipeline does not need thrust blocks at changes in direction / bends.

The BONNA® pipe offers two possibilities achieve this self-anchoring:

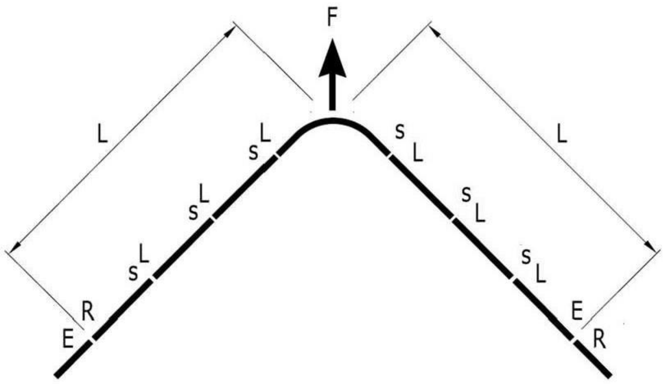
A pipeline completely with SL welded joints

The SL welded joint is self-anchored and the weld provides a mechanical continuity of the pipe steel cylinder.

A pipeline mixed with ER-SL joints

To avoid the need of thrust blocks when using the flexible ER joint, a linear section of several self-anchored welded SL joints is laid on either side of the elbow. This provide a skid type stopping mechanism. This linear section is calculated according to the pressure, the pipe diameter, the angle and the soil characteristics.

The diagram is as follows:



La formula for calculating the length L is as follows::
$L = H_{et} \times S \sin(\alpha/2) / f\,P$
H_{et} = field test pressure
S = internal pipe cross-section
α= angle of elbow
f = soil / pipe friction coefficient

• If the pipeline is not backfilled:
P = weight per linear meter of the filled pipeline
• If the pipeline is backfilled:
P' = weight per linear meter of the filled pipeline + earth weight

Note The possible presence of the water table must be taken into account by correcting the weight of the filled pipe by the buoyancy

Example

1/8 elbow Ø 800 mm H_{et}= 12 bars = 1200 kN/m² f = 0,7
$S = \pi \times 0.8^2/4 = 0.5027$ m²
• Pipeline not backfilled:
P = 526 + 503 = 1029 daN/m = 10.29 kN/m
L = 1200 x 0.5027 x sin(22.5°) / 0.7 / 10.29 = 32.05 m
i.e. twice 6 pipes
• Pipe under 1.5m of backfill of 18 kN/m3 density and 0.95 Marston Coefficient:
P = 10.29 + 1.5 x 18 x 0.95 = 35.94 kN/m
L = 1200 x 0.5027 + sin(22.5°) / 0.7 / 35.94 = 9.18 m
i.e. twice 2 pipes

Micro-tunnelling and Pipe Jacking

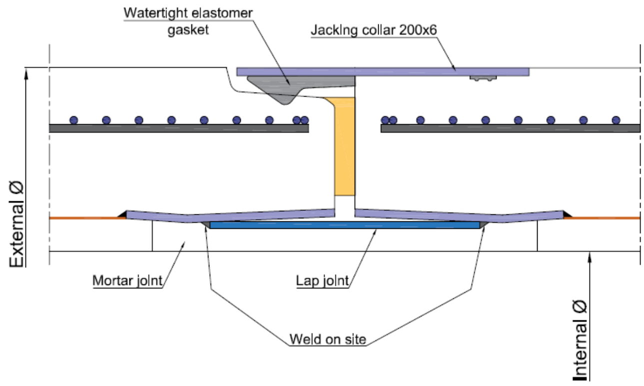
The reinforced concrete cylinder pipes can be designed to a pressure jacking pipe.
This method overcomes the need to jack regular concrete jacking pipe before installing other pressure pipe materials inside and then grout around them.

Choose BONNA® Jacking pipe and in a single operation, the final pipeline is installed.

Use : drinking water, raw water, cooling water system, etc…
Drive: Straight or curved

The pipes used are steel cylinder type with SS (welded) or ER (elastomer gasket) end rings.

Micro-tunnelling and Pipe Jacking with welded joint (SS)



Range of diameters:

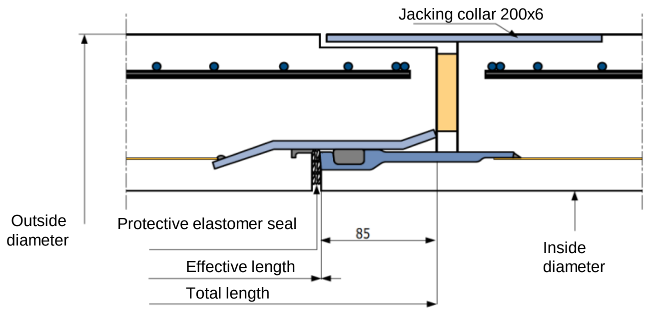
Inside diameter: 800mm,1000mm, 1200mm, 1400mm,… and over
Outside diameter: can be configured to suit the external diameter of the micro-tunnelling machine.
(Consult us)

Pipes for interjack stations

In order to increase the lengths of the drive made by micro-tunnelling and pipe jacking, it is possible to install interjack stations (consult us).

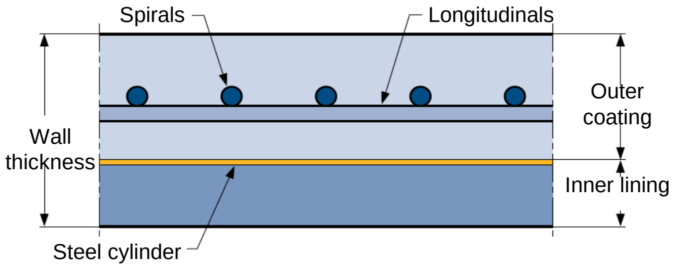
Depending on your project, we could propose you jacking pipes with elastomer gasket ER.

(Consult us).



Micro-tunnelling and Pipe Jacking

Cross section pipe wall



Characteristics

Diameter (mm)		Wall thickness (mm)		Approximate Weight in t/m	Maximum thrust allowed in En kN Deflection 0°	
internal	external	Inner lining	Outer coating		Welded Joint	Elastomer Joint ER
800	1080	26	114	1,00	6480	6449
1000	1276	28	110	1,26	8716	7423
1200	1470	30	105	1,44	9706	8166
1400	1740	40	130	2,14	14476	12672
1500	1880	40	150	2,57	18156	14884
1600	1980	40	150	2,73	19211	15736
1800	2320	37	223	4,29	33517	29647
2000	2440	45	175	3,91	28054	23744
2200	2730	45	220	5,23	39584	35867

- Length of pipes (2m à 6m) is determined by the characteristics of the project (length, radius if curvature) and/or the production site location.
- These pipes are specially designed, and manufactured at request.
- Others diameters can be designed according the request.
- Thrust applied to wooden ring : initial thickness 30mm – thickness after crushing 15mm

Pipes for Horizontal Jacking

Pipes characteristics

The technique of horizontal jacking allows for use of pipes or sleeves in small diameters (300 to 1400mm) without opening a laying trench, under natural or artificial barriers.

The BONNA® pipe for "Horizontal Jacking" is identical in design to the usual BONNA® Reinforced Concrete Cylinder Pipe. Only its steel reinforcement characteristics differ as being adapted to the jacking thrust forces to be supported during its execution. The Reinforced Concrete Cylinder Pipes for horizontal jacking are fitted with SL type end joints.

Range of Reinforced Concrete Cylinder Pipes for horizontal jacking with SL welded joints

Internal Diameter (mm)	Total wall thickness (mm)	External diameter (mm)	Effective length (m)	Linear Weight in (kg/m)	Maximum allowable thrust force (kN)
300	60	420	6,00	173	712
400	60	520	6,00	221	985
500	65	630	6,00	294	1366
600	65	730	6,00	346	1597
700	70	840	6,00	432	1981
800	75	950	6,00	526	2497
900	80	1060	6,00	628	2717
1000	82	1164	6,00	711	2825
1200	95	1390	6,00	986	4059
1400	120	1640	6,00	1461	5881

Notes : The maximum allowable thrust indicated supposes that the pipes are assembled without any deflexion. It should only be applied to the external concrete coating and not to the steel cylinder. These pipes are not fitted with injection tubes, unless expressly requested by the customer..

Execution

The pipes are laid in accordance with the conventional auger type drilling technique. However, the following precautions must be taken:

- the thrust forces should only be applied to the external concrete coating and not to the steel end ring plates (this force can be transmitted by a self-tightening collar if necessary)
- The external and internal concrete jointing must be performed as follows:

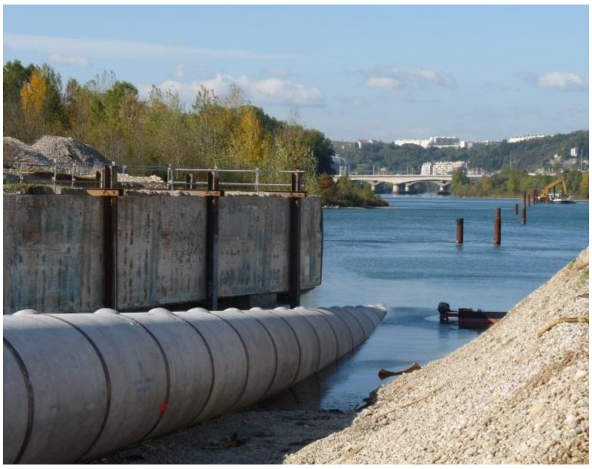
Internal jointing
Using a spatula, arrange special mortar on the S end ring against the internal concrete at roughly 45°.
The fit the next pipe. The excess mortar forms a bead which is then flushed by a screw of the drilling machine.
External jointing
It is performed after the pipes are fitted and welded. A metal jacking collar is installed around the fitting and a fast setting concrete is poured into the joint.
SL welded joint
Assembly between two pipes is performed by means of the conventional "SL" (slip-joint) type joint.
This joint, which is commonly used for pipelines under medium and strong pressures, guarantees that the drilled pipes are rigorously watertight.

Pipes for underwater projects

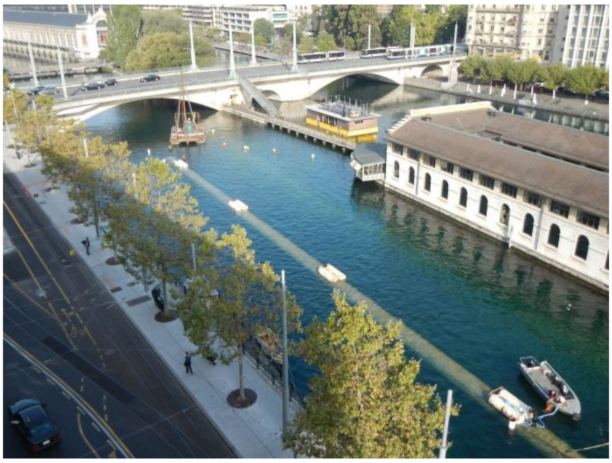
The Reinforced Concrete Cylinder Pipe has many benefits for underwater installation:

- Complete integrated solutions adapted to the project: non-buoyancy pipes, laying method (pulling, pushing, towing, sinking…);
- Customised pipe wall thickness to ensure an optimised and steady pipeline ballast;
- Wide range of diameters
- Inherently robust, not time-degrading material;
- Absolute watertightness
- Several types of joints: SL, locked single or double ER, , flanges…;
- Resistance to pressure, to negative pressure and to full vacuum conditions;
- High resistance against shock (boat anchors…);
- Major stability with respect to swell and sea currents;
- Significant ability to resist to longitudinal flexure in case of scouring and soil erosion;
- Use of "Sulphate Resisting" cement for sea water immersion conditions;
- Recyclable material;
- No need for cathodic protection*;
- Laying in any type of soil;
- No need for trenching & burial.

Please contact us to discuss your project.



Lyon (France) – 600m Ø2000



Genève (Switzerland) – 2000m Ø1500

Marineland (France) – 600m Ø400

Gruissan (France) – 300m Ø1200

Span pipes

Designed to suit the individual project, the reinforced concrete cylinder pipe can be used as a span pipe to overcome various problems including crossing a river, crossing a road, etc…

Pipes will be installed on discontinuous supports. The pipes, thus welded are self-supporting for spans up to 20 metres according to the project characteristics.

Some examples:

Ø 1800mm : Marseilles (France)
Free span of 20m

Ø 800mm : CNM Nîmes Costières (France)
free span of 15,6 m
test pressure: 10bar

Ø 800: Marseilles (France)
Free span of 12,3m

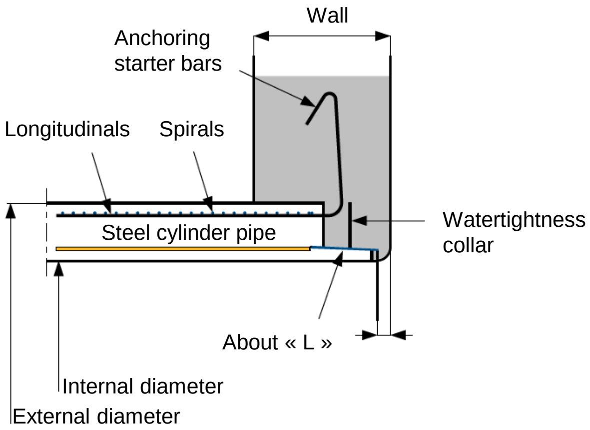
Ø 2000 mm: Skikda (Algeria)
free span of 26m
test pressure: 6b

Civil structure connections

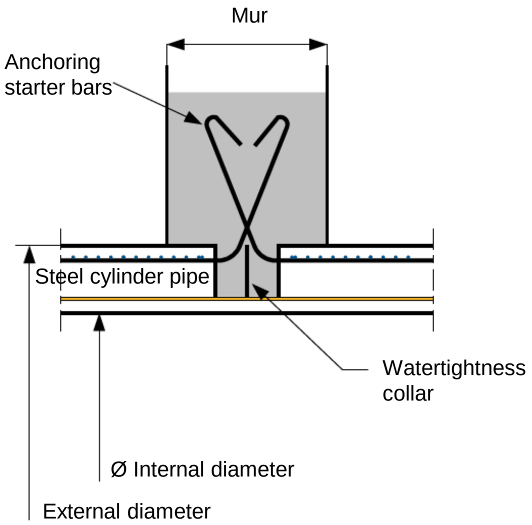
Watertightness collar

When good watertight performance is required where a pipeline crosses a wall (e.g. where it enters a basin) one or more watertightness collars are fitted on the pipe or on the special fitting.
Where necessary, starter bars strengthen the anchoring into the structure.

Connection to the end of the pipeline



Wall crossing

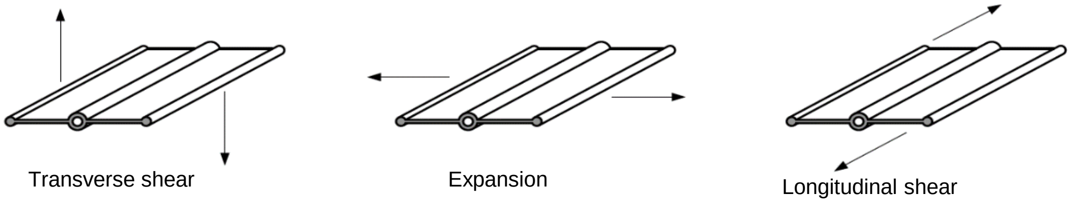


Civil structure connections

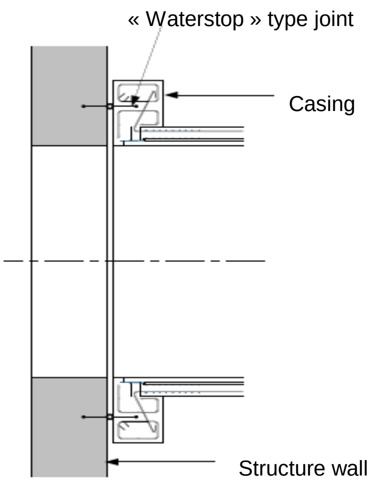
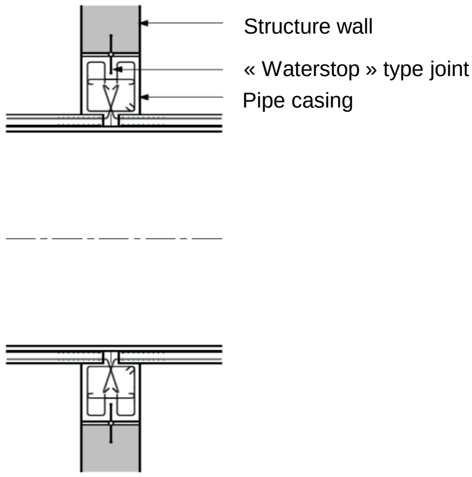
Bulkhead wall crossing

When a pipeline enters a building, a settlement joint can be placed inside the structure. In such cases, provision should be made for a flexible passageway for the pipeline through the wall of the structure so that the pipeline can move in relation to the structure and so that the connection is watertight.

Pipe casing with “WATERSTOP” type joint

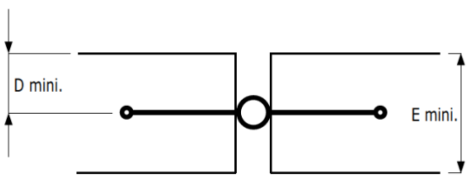


Owing to these properties of the WATERSTOP joints, we recommend installing a pipe casing as described in “a” for differential settlements that generate shear and as described in “b” for settlements that necessitate only the possibility of angulation between the pipe and the structure.

Pipe casing for absorbing shear	**Carcan pour reprise d’angulation ou faible cisaillement**
	
The pipe casing is placed with respect to the structure so as to enable the WATERSTOP joint to handle transverse shear	The pipe casing is placed with respect to the structure so that it will work at lateral shear under angulation of the pipeline. A displacement over one third of the gap between the pipe casing and the shell would damage the joint.

Construction related arrangements

- The pipe casing is attached to the pipeline by means of anchoring starter bars.
- The minimum dimensions of the pipe casing and of the wall of the structure, the minimum distance between the joint and the concrete surface (D mini.) and the minimum thickness of the casing (E mini.), are mandatory parameters laid down by the supplier of the joint.
- The space between the pipe casing and the wall of the structure should be filled by polystyrene whose density is equal to or less than 28 kg/m^3 so that it can be deformed.

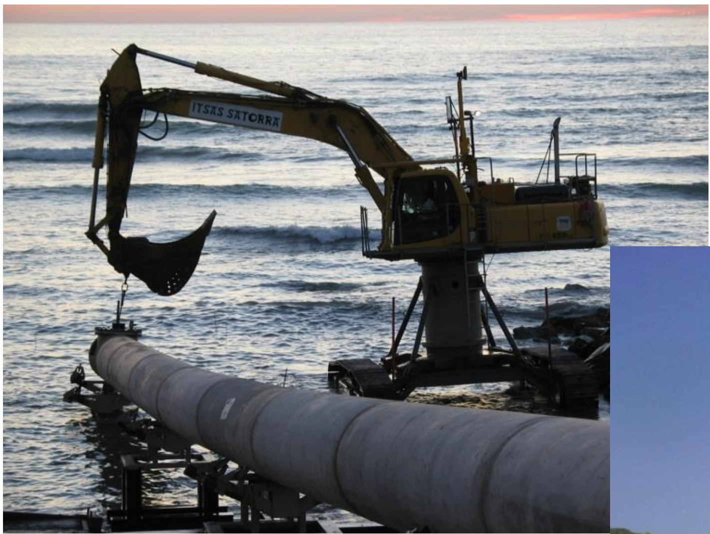


Settlements

A pipeline consisting of reinforced concrete cylinder pipes with SL or ER joints can be installed in any type of ground. The reinforced concrete cylinder pipes with SL or ER joints can withstand the ground settlements resulting in a deformation of the pipe, the local curvature radius of which must not be less than 1500 times the diameter. *(Example : For ND 1200 pipes, the allowable local curvature radius will be greater than or equal to 1800 m).* For specific cases, please contact us.

In the case of low bearing capacity soils, laying on ballast (substitute layer wrapped in a geotextile fabric) is frequently used.

In major differential settlements, usually in close proximity to large civil works structures, the use of self-anchored movement compensators (SMC) as shown in the following page is recommended. Other solutions of transition slabs type can be used as well.

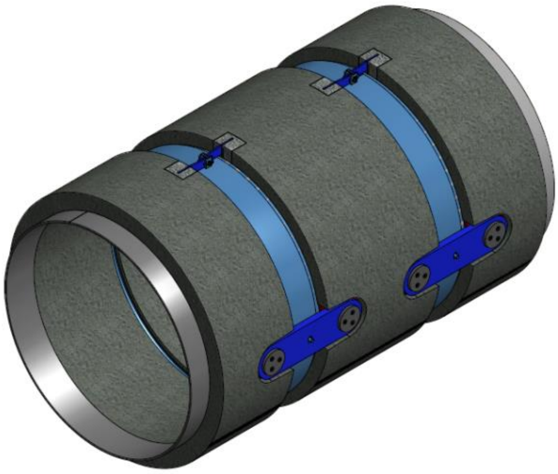


The allowable curvature radius of a reinforced concrete cylinder pipe allows the laying of sea or river outfalls, particularly in the case of “S” installation in the immersion phase.

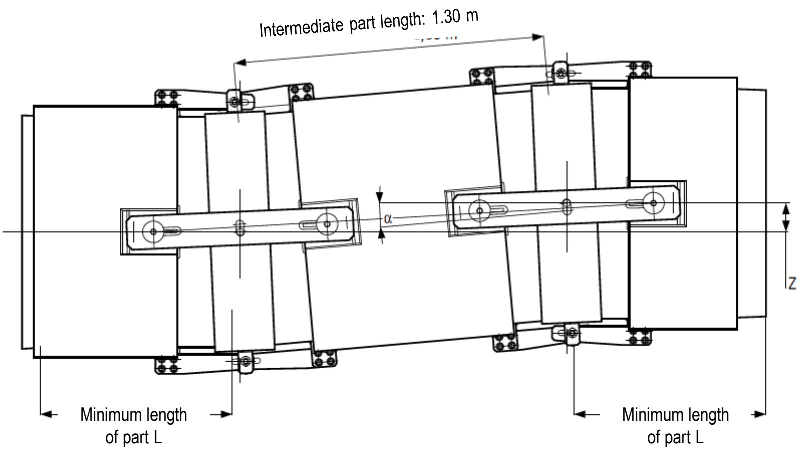
Self-anchored movement compensator

Description

The self-anchored movement compensator allows for instance in case of major differential settlements, for misalignment and offset while maintaining the continuity of the pipeline self-anchoring mechanism.
It consists of 3 parts connected together by self-anchoring articulation arms and connecting rods. These can be placed inside or outside the compensator depending on the product definition.
The compensator is backfilled and does not need being located inside a pit.



Example of misalignment and off-set according to the compensator lengths



Pipe nominal diameter	Maximum Deflexion a	Maximum offset Z (mm)	L (m)
300	5°	120	0.70
400	5°	120	0.70
500	5°	120	0.70
600	5°	120	0.70
700	5°	120	0.70
800	5°	120	0.70
900	5°	120	0.80
1000	5°	120	0.80
1100	4°30'	110	0.90
1200	4°30'	110	0.90
1250	4°15'	100	1.00
1400	4°	95	1.00
1500	3°40'	85	1.10

Laying operations

The aim of these laying instructions is to define the standard laying scenarios. They do not claim to be exhaustive. If you have any doubts, please discuss with us and we will advise you on your specific circumstances.

Laying of BONNA® pipes with median steel cylinder and double reinforced concrete coating consists of the following operations:

- trench digging and levelling of trench bottom,
- digging of niches if necessary,
- lowering and fitting pipeline elements (pipes, short pipes and special fittings)
- joint welding and checking of watertightness, in the case of an SL joint,
- concrete jointing,
- pipeline backfilling,
- Hydrostatic trench test on the pipeline.

Trench digging and levelling of trench bottom

It is necessary to take any suitable measures in order to avoid trench collapse and to comply with the personnel safety rules in force, by bank-sloping, shoring, sheet piling or strengthening the trench walls by any means suitable to the ground type/condition (timbering, bracing, sheet piling or mechanical sheeting,…).

Throughout the works, care should be taken not to deposit excavated materials or operate any vehicle that might cause crumbling.

It is also necessary to organize the site works so as to avoid any inflow of water likely to impair the stability of the trench walls or the reliability of the trench bottom. For this purpose and according to the needs, current techniques may be used, such as drainage, dewatering, watertight sheeting or lowering of groundwater surface or even more specific techniques like injections or freezing by taking the precautions relevant to each process.

Whenever several pipelines are laid parallel in the same trench, the clear space between them shall be at least:
0.40 metre for pipe Ø ≤ 800 mm
0.50 metre for pipe Ø > 800 mm
These values vary according to the backfilling and compacting criteria and may vary depending on the haunching material used.

Mechanical excavation shall produce a trench width with a minimum 0.40 m clearance on each side of the pipes at trench bottom. In any case, the trench should be wide enough to allow the traffic and compacting operations required for the pipe bedding, but shall not be wider than the trench width taken into account in the calculation note justifying the pipe characteristics.

This extra width is designed to make it easier to lay the pipe, to check the assembly, and to facilitate the backfilling around the pipe.

The altimetry of the trench bottom should be suitably adjusted and its bearing capacity checked. The pipe may be laid directly on natural ground, even if it contains stones.

In the case of rocky ground, the trench bottom should be made 10 cm deeper and the bottom of the trench reconstituted with a layer of quarry-run, gravel or ballast.

In the case of welding from the outside, provision must be made for a niche one meter long and 50 cm deep.

Never lay the pipes on supports or shims, to avoid crushing or pinching after backfilling

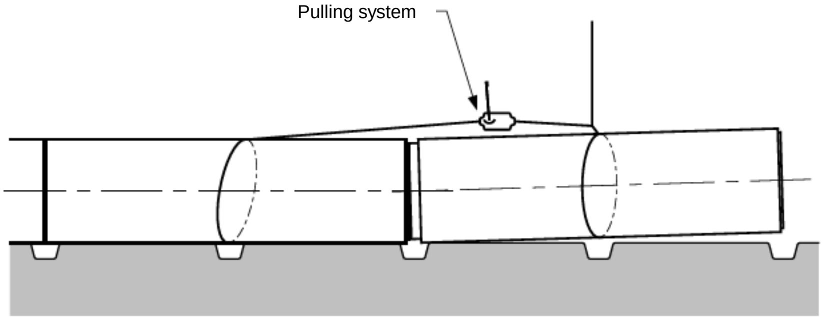
Lowering and fitting of pipes and special parts

Pipes with diameter ≤ Ø 1200

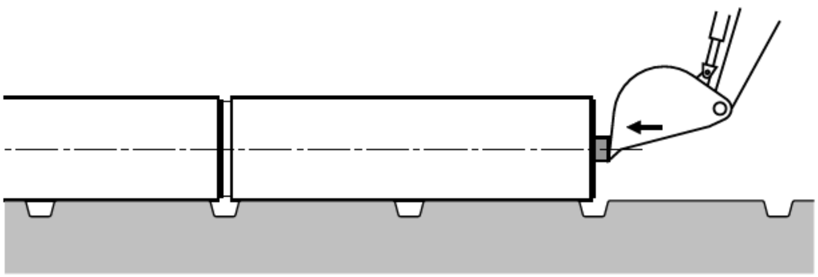
The pipe or special part is first held by a sling so that its position is parallel with its final position. It is lifted by means of the laying machine such as a crane, for instance, and then lowered into the trench.

It is recommended to lay the pipes in such a way that the spigot of the pipe to be laid fits into the socket of the previously laid pipe. This makes it easier to control the jointing operation and also to check the socket surface condition of the pipe waiting in the trench.

The pipes should be fitted using a pulling system (such as Tirfor) placed on the outside while maintaining the pipe to be laid suspended from the crane or other laying device..

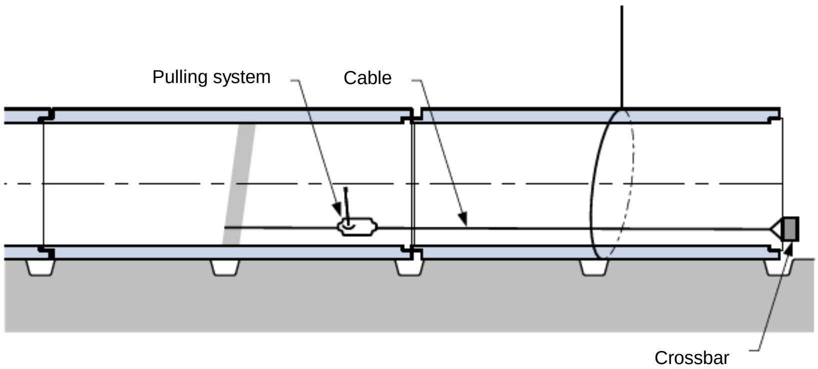


It is possible to use the hydraulic force of digger bucket, but it is essential to place a wooden plank bet-ween the pipe and the bucket.



Pipes with diameter > Ø 1200

The pipe to be laid is fitted in its front with a wooden crossbar placed against the socket of the pipe. A cable fitted with a pulling system (e.g. Tirfor) connects this beam to another crossbar (set inside the pipe) or fixed point installed in a previous pipe (see sketch below).



Pipe jointing

This operation is vital. It is essential to guarantee that the pipeline passes the hydrostatic tests.

Steel cylinder pipe with "ER" elastomer gasket joint

The pipe with ER end is fitted with a steel ring at each end:
- The E socket end-ring comprises a steel plate which is shaped on the press so as to give it a highly precise diameter and a shape suitable for easy fitting,
- The R spigot end-ring comprises a special laminated steel plate provided with a calibrated groove. It is also shaped on the press so as to give it a highly precise diameter and circularity.

It is important, in order to install the gasket ring correctly, that the surfaces of the joint ends are free of all dirt or contamination.

Lubricate the elastomer gasket by hand using the special soap and place it in the spigot groove.

The inside wall of the socket, in particular at the entrance to the fit, is coated with a non-caustic soap provided with the pipes.

The pipes thus prepared are then fully fitted..

Steel cylinder pipe with "SL" welded joint

The "slip-joint" welded joint ("SL" for short) is an electric arc welded joint.

The joint ends, which form integral parts of the pipe, consist of two conical rings, one female, conventionally referred to as "S", and the other male, referred to as "L".

The ends of the pipes or specials are not coated with concrete to enable welding:
- Outside only for diameters less than 800 mm
- Inside or outside for diameters ranging between 800 and 1200 mm
- Inside only for diameters larger than 1200 mm

Electrodes to be used

We recommend the use of
- either NF 50 basic or L 51 rutile electrodes
- and electrodes corresponding to international ISO (International Standardisation Organisation)
- designation E 51 5B 120 29 (H) or E 51 5B 110 55 (H).

The electrodes should not be fused under excess current, the values of the welding current should be as close as possible to the average current intensity recommended by the electrode manufacturer, i.e. approximately 115 A for a 3.15 mm diameter electrode and 170 A for a 4 mm diameter electrode.

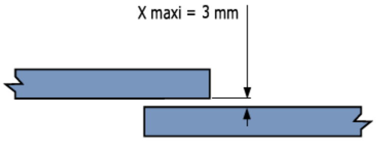
Pipe laying

Steel cylinder pipe with "SL" welded joint

Preparing the end rings

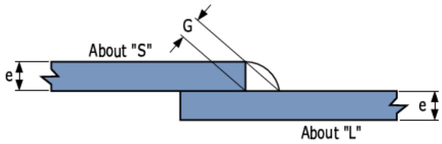
The edges to be assembled and the areas next to the weld to be performed shall be free of any stain, dirt, grease, etc. and scrubbed with a wire brush in order to get rid of any recently formed rust.

The gap between the spigot end and the socket end should not exceed 3 mm at the weld.



Welding the "SL" gaskets

The normal operating conditions are those that allow the execution of welds in accordance with the safety standards in force, away from wind, draughts, rain and surface water. In cold weather, the steel sheets to be welded are preheated at a minimum temperature of 10°C before tacking and welding. Welding operations are stopped if the ambient temperature drops below – 10°C.



The thickness "G" of the weld shall be theoretically:
G = 0.7 e:

where e is the thickness of the end-ring plate that make up the spigot and socket.

For welding gaskets under significant surface water runoff, or even underwater: contact us.

Weld inspection on site

The "SL" joints should be subjected to the following inspections in the order given:

- visual inspection
- watertightness check

Visual examination

The weld geometry shall be checked and shall conform to the values above.

The following cannot be accepted:

- cracks
- pitting (blisters opening on the surface in craters)
- shrinkage craters

Watertightness test by porosity test

After cleaning the welding:

- application of a fine layer of the tracer type PC AS 764 – 51, or white wash,
- application on the opposite side with a brush, by spraying or injection or any other appropriate means, of PC AS 138 B or equivalent,
- after one hour: check, if there is a leak, repair of the leaking weld area if necessary and check again, if there is no leak, final inspection the next day.

For inspection by means of dye-penetrant test, if required please contact us.

Angular deflection

For ER elastomer gasket joints

The pipeline layout may call for an angular deflection between two successive pipes.

The following tables give the allowable values according to the type of joint.

Internal Diameter (mm)	Permissible Deviation angle	Effective pipe Length * (m)	Deviation corresponding To the pipe end (mm)
400	1°48’	6.15	197
500	1°24’	6.15	152
600	1°06’	6.15	120
700	54’	6.15	96
800	42’	6.15	78
900	36’	6.15	64
1000	30’	6.15	53
1100	24’	6.15	43
1200	21’	6.15	36
1250	18’	5.03	26
1400	15’	5.03	18
1500	54’	5.03	83
1600	51’	4.96	75
1700	48’	4.96	68
1800	42’	4.96	63
2000	36’	4.43	46
2100	1°06’	4.41	86
2200	1°02’	4.41	80
2350	57’	3.41	57
2400	54’	4.41	71
2500	51’	3.91	59
2800	42’	3.41	43
3000	39’	2.82	32
3200	36’	2.82	28

* According to the production factory
In the case of an inner elastomer protective seal, it should be checked that the seal is compressed around its entire circumference.

Angular deflection

For SL welded joints

Internal Diameter (mm)	Permissible Deviation angle	Effective pipe Length * (m)	Deviation corresponding To the pipe end (mm)
250	Contact us	6.07	-
300	Contact us	6.07	-
400	2.2°	6.15	236
500	2.1°	6.15	225
600	2°	6.15	215
700	1.8°	6.15	193
800	1.7°	6.15	183
900	1.6°	6.15	172
1000	1.5°	6.15	161
1100	1.4°	6.15	150
1200	1.4°	6.15	150
1250	1.3°	5.03	114
1400	1.2°	5.03	105
1500	1.2°	5.03	105
1600	1.1°	5.03	97
1700	1.1°	5.03	97
1800	1.1°	5.03	97
2000	1.0°	4.50	79
2100	0.9°	4.50	71
2200	0.9°	4.50	71
2350	0.9°	3.50	71
2400	0.8°	4.50	63
2500	0.8°	4.00	56
2800	0.8°	3.50	49
3000	0.7°	2.91	36
3200	0.7°	2.91	36
3500	0.6°	2.41	25
4000	0.5°	2.05	18

* According to the production factory
In the case of an inner elastomer protective seal, it should be checked that the seal is compressed around its entire circumference.

Laying a closure pipe

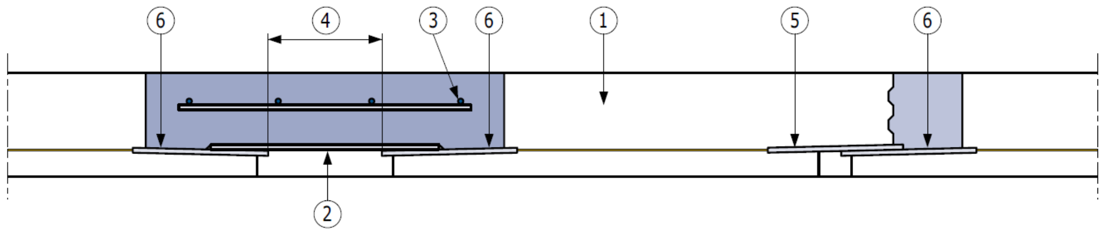
It may be possible, on request, to connect two already installed sections, by means of:
- a precast element
- or a short-pipe cut from a pipe designed for that purpose, on site (steel cylinder thickness 3 mm minimum).

This solution provides the possibility to install several runs of pipes according to a project schedule and to connect each other later on. The connection is made according to the sketch below.

Length adjustment

The piping systems include straight sections of different lengths consisting of pipes and specials (tees, elbows, short pipes etc.).
The combination of the laying (fitting) and the manufacturing tolerances results in a discrepancy between the designed theoretical lengths and the length actually obtained on site.
Therefore, an adjustment ring is included in the pipe work design (see sketch here under) before any change of direction or special (Tees, flanges...) whose position is imperative.

The connection of this element is made according to the instructions on the sketch below



1 Element with “S” or “L” end-rings
2 adjustment ring
3 Concrete reinforcement
4 Clearance enabling the lowering of the pipe
5 “S” female end-rings
6 “L” male end-rings

This sketch presents an adjustment ring lap joint welded on two “S” end-rings.
The same connection can be set up with two “L” end-rings. The lap-joint is welded inside.

Length adjustment for short pipes

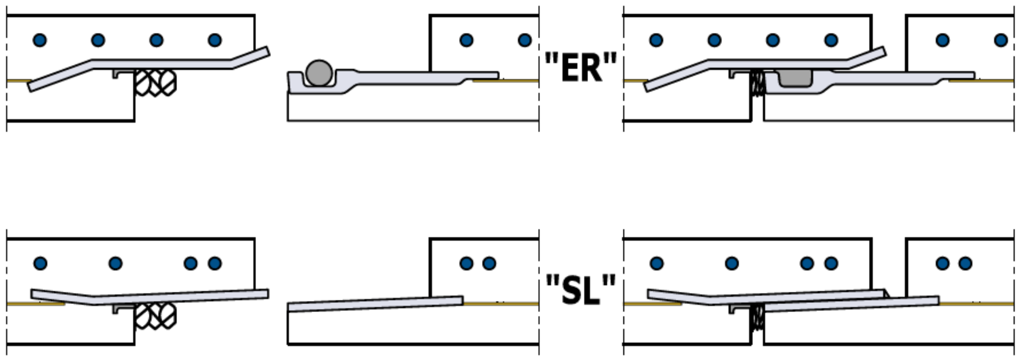
The sections may be factory manufactured according to the pipe layout arrangement drawing.
They may, however, be manufactured on site.
To do this, use is made of short pipes with a minimum steel cylinder thickness of 3 mm.
The procedure is as follows:
- with a mechanical or hand chipping hammer or a chain saw, the inside and outside concrete is cut at the appropriate location,
- the steel cylinder is cut to the desired length
- the end rings are welded at the desired location. This operation must be carried out by an approved welder.
- the following parts are then restored:
    - the external reinforcement if necessary
    - the internal concrete
    - the external concrete

or when executing the internal and external concrete joints..

Internal mortar jointing

This can be performed in one of two ways:

The pipes are delivered with an elastomer protective seal anchored in the internal lining of the pipe



When fitting, depending on the laying clearance and the deflection values (e.g. for curving), the concrete edge surface of the spigot compresses the protective seal, which conserves its effectiveness in a range from 7 to 30mm. The steel rings are protected after the inner protective seal has been pressed in.

This compression has no impact on the fitting force.

The pipes are delivered without a protective joint,
in which case it is necessary to grout the joint using a mortar.

A ready-mix mortar of one of the following types is applied, by mechanical or manual spraying:
- Lankorep 731, Lankorep 736 pre-dosed mortar for drinking water, untreated and industrial water
- Or a mortar made up on site with cement, sand, Dow-Latex 465 or Sika Latex, silica powder (Plenamix1013) if necessary and water (for the mix dosing, please contact us).

In all cases the water used for the mix shall be clean and chloride-free.

In order to avoid crazing, the surface of the mortar should be smoothed using a small hawk.

It is recommended to carry out this joint grouting before the hydrostatic tests.

External concrete jointing

The pipes can be delivered with canvas or plastic forms to be left on pipe and the steel strip necessary to hold them. They are installed when and as the pipes are laid or the welding checked.

The next step is to pour into this form, either:
- Lankorep 731 or 736, or PCI-Seltex pre-dosed mortar,
- or a mortar made up on site with cement, sand, Dow-Latex 465 or Sika Latex and water (for the mix dosing, please contact us).

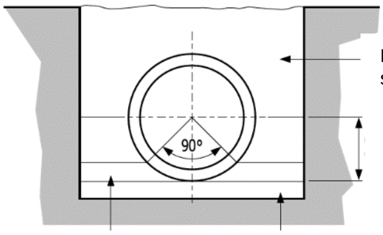
In all cases the water used for the mix shall be clean and chloride-free.

Backfilling

The bedding and backfilling of the pipeline shall be performed so as to meet the design assumptions.

In general, a compacted backfill shall secure a uniform bedding angle of 90°.

A sound bedding of the pipeline is obtained by carefully compacting successive layers of backfill roughly 30 cm thick, up to the pipeline spring line. The material of the first layers shall be pushed and rammed under the pipeline haunches. It shall belong to classes 1 to 3 of the following table and compacting shall be checked and reach 95 % of the Optimum Proctor without any results lower than 90 % of OPN.



No other precaution is required for the Reinforced Concrete Cylinder pipe.
The backfilling above the pipe may be the ground extracted from the excavation.

Soil classification

Soil Group	Brief description
1	Clean or moderately silty sand and sand-gravel mix (elements to sizes less than 50 mm)
2	Silty or moderately clayish sand and sand-gravel mix
3	Clay with flint and millstone grit. Hillside debris. Moraines, altered rocks, coarse sediments with high content of fine products
4 [1]	Silt, fine sand, shale, more or less flexible marl (Ip < 50)
5a [2]	Very flexible/soft clay and marl (Ip > 50) Organic, soluble and polluting materials
5b [3]	Evolutive rock such as chalk sandstone, shale… Compound soils (clay with millstone grit and flint, hillside debris, moraines altered rocks, coarse sediments with elements of sizes beyond 250 mm) Clean sand-gravel mix, non evolutive rocks with elements of sizes larger than > 50 mm

[1] These materials may not be used when there is underground water in the area surrounding the pipe.
[2] These materials may neither be used in the pipe surrounding area, nor in the backfill area.
[3] These materials that cannot be used in the pipe surrounding area, may sometimes be used in the backfill area.

***Nota* : If the trench is sheetpiled, it is advisable to partly lift the sheetpiles before carrying out the bedding, so as not to decompress it afterwards.**

Above the bedding, backfilling and compacting are followed by successive symmetrical layers, followed by uniform layers of the excavated material removed of elements greater than 100 mm in size, or using any material that can be used to make a backfilling of the quality required by the prime contractor.

The height of the backfill shall not exceed that specified in the drawings. Similarly, machinery should not circulate on this backfilling if it has not been taken into account in the calculations for the relevant height

Hydrostatic trench test

The BONNA Steel cylinder pipelines are tested after backfilling at the test pressure considered for their design.

It is preferable to perform the tests after internal and external concrete joints are made, so that:
. the steel plates of the end-rings are protected against corrosion,
. the test may, if necessary, be performed using seawater, in which case it is not necessary to empty the pipeline and dry it thoroughly.

Procedure

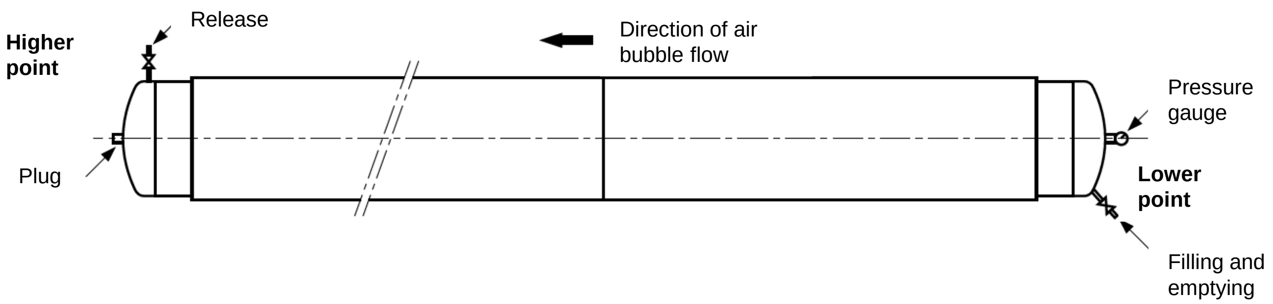
The maximum length of the pipes to be tested, in accordance with this procedure, shall not exceed 2000 m.

The pipelines to be tested at the field test pressure will be plugged at the ends with dished ends to be welded onto the end rings or with blank flanges if the ends are flanged.

The dished ends will be fitted with branch inlets and outlets needed for filling, air release, pressure tapping and emptying. A calibrated pressure gauge will be used.

Before the test, the pipe shall be filled for 48 hours, at a pressure of 1 bar. The pipeline shall be filled, in so far as possible, from the lower point of the pipeline. The pressure is then gradually increased, bar by bar, releasing the air at each increment so as to correctly soak the internal coating.

Filling diagram



Acceptance criterion

The test pressure is applied for 60 minutes, during which period the pressure should not exceed 0.2 bar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AFNOR CERTIFICATION
ISO 9001 - ISO 45001
ISO 14001

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