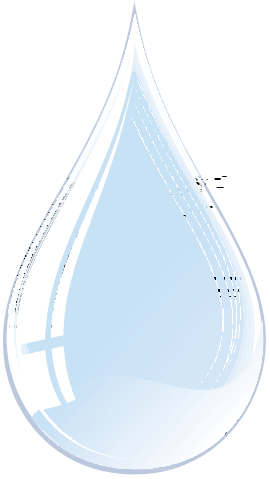
ELECTROSTEEL

Ductile Iron Pipes and Fittings



Carrying life to people

Safe drinking water for all

Electrosteel Castings Ltd

USERS GUIDE ON DUCTILE IRON PIPE

1.0 INTRODUCTION

This guide is designed to assist organisations and individuals who specify and install Ductile Iron pipelines. The content herein is based on best practice derived from within the Industry over many years. It is aimed at providing the installer with guidance in the process of receiving product, handling, installation, through to commissioning and is designed to ensure the process is undertaken safely, efficiently and that the performance of the product once installed is not compromised.

1.1 STANDARDS & SPECIFICATIONS

Electrosteel Castings ductile iron pipes and fittings are manufactured in accordance with the latest editions of BS EN 545 and BS EN 598, and where applicable they are marked with the BSI Certification Quality Mark (Kitemark).

a) BS EN 545
   The pipe supplied for the UK water industry complies with the requirements of DWI Regulation 31 for use with potable water. The normal coating and lining system for the drinking water product [illegible] is:
   i. Internally cement mortar lined and oversprayed with an approved epoxy seal coat.
   ii. Externally Zinc Aluminium coating applied at 400g/m² with a blue epoxy finishing layer.

b) BS EN 598
   Supplied particularly for sewage and drainage applications;
   i. Internally lined with a high alumina cement lining.
   ii. Externally Zinc Aluminium coating applied at 400g/m² with a red epoxy finishing layer.

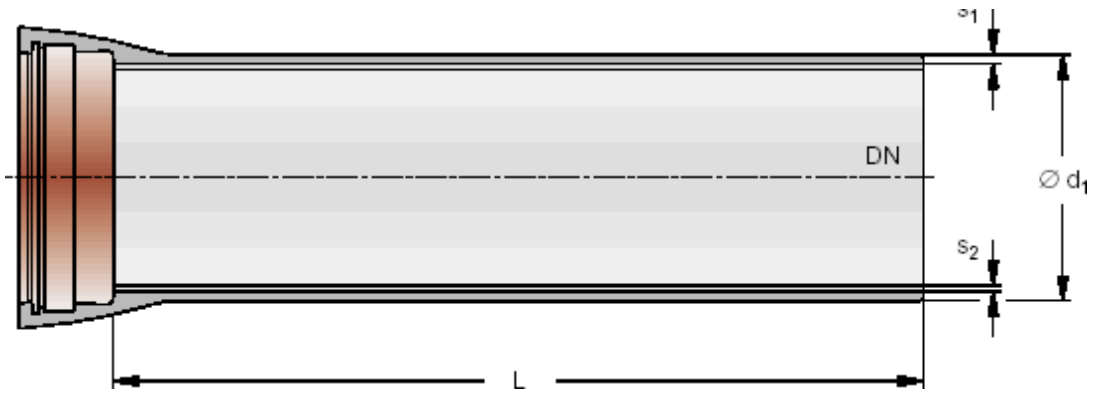
NB.
It should be noted that whilst the standard product features the Zinc Aluminium coating alternative external protection coatings may be available on request.

General requirements for the installation of pipelines can be found in the Civil Engineering Specification for the Water Industry (CESWI) & BS EN 805 codes of practice for pipeline installation. References from these standards are used as the basis of this document with additional information provided as necessary.

Information contained within these instructions is given in good faith. The sole responsibility for the correct installation of pipes and fittings is that of the contractor. Electrosteel Castings cannot accept any responsibility for any actions taken as a result. Ultimately the contract specification and/or drawings will prevail if they differ from these guidelines.

2.0 CLASSIFICATION AND DIMENSION OF PIPES

2.1 WALL THICKNESS



Ductile Iron Pipe manufactured by Electrosteel Castings has been classified as preferred C class for EN 545 potable water applications, and Pressure pipe for EN 598 sewer applications

Pipe wall thickness and allowable pressures can be identified in the appropriate tables found within this guidance document, and in accordance with the relevant national and international standards.

Table of approximate weights for a single 5.5 metre long ductile iron pipe

Pipe Size DN	Average Pipe Weight Kg	Pipe Size DN	Average Pipe Weight Kg
80	72	**450**	613
100	88	**500**	712
150	134	**600**	928
200	188	**700**	1196
250	249	**800**	1332
300	316	**900**	1469
350	402	**1000**	1767
400	506		

DIMENSIONS OF SOCKET AND SPIGOT PIPES (PREFERRED C CLASS EN 545 & PRESSURE PIPE EN598)

Nominal Diameter DN	Barrel Wall Thickness (e) in mm				
	C40 min	C30 min	C25 min	Pressure Pipe	
				Nominal	Deviation
80	3.0	-	-	4.8	-1.3
100	3.0	-	-	4.8	-1.3
150	3.0	-	-	4.8	-1.3
200	3.1	-	-	4.9	-1.3
250	3.9	-	-	5.3	-1.6
300	4.6	-	-	5.6	-1.6
350	-	4.7	-	6.0	-1.7
400	-	4.8	-	6.3	-1.7
450	-	5.1	-	6.7	-1.8
500	-	5.6	-	7.0	-1.8
600	-	6.7	-	7.7	-1.9
700	-	-	6.8	9.6	-2.0
800	-	-	7.5	10.4	-2.1
900	-	-	8.4	11.2	-2.2
1000	-	-	9.3	12.0	-2.3

(Refer: Table 16 of EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines & Table 11 of EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage applications)

2.2 EXTERNAL DIAMETER

The values for the tolerance on external diameter are as given below. The external diameter of the pipe and its tolerance are kept same universally so that all pipes are interchangeable, irrespective of the country of origin.

EXTERNAL DIAMETER 'DE'

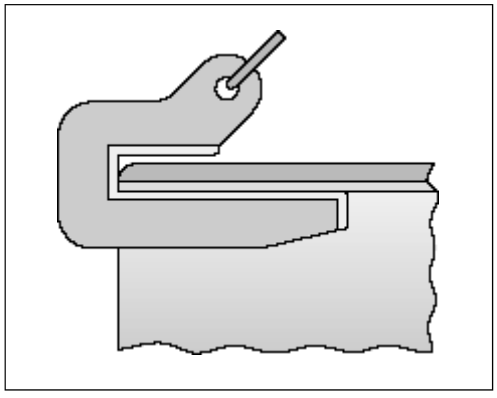
DN	Nominal DE	Tolerance (mm)
80	98	+1 / -2.7
100	118	+1 / -2.8
150	170	+1 / -2.9
200	222	+1 / -3.0
250	274	+1 / -3.1
300	326	+1 / -3.3
350	378	+1 / -3.4
400	429	+1 / -3.5
450	480	+1 / -3.6
500	532	+1 / -3.8
600	635	+1 / -4.0
700	738	+1 / -4.3
800	842	+1 / -4.5
900	945	+1 / -4.8
1000	1048	+1 / -5.0

(Refer: Table 16 of EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines & Table 11 of EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage application)

3.0 TRANSPORTATION

Although Ductile Iron Pipes are not susceptible to breakage by impact loading, bad handling can result in damaged coatings and / or linings and, in severe cases, deformation of the spigot, which could affect the sealing of the joint.

1. Pipes should be loaded with reasonable care and should be secured to the lorry or railway wagon during transit to prevent movement.



2. Sharp edges of the angle iron frame should not rub on pipe surface. The handling sling should be padded to avoid damage to lining and coating. The means of securing should be so designed as to minimise damage to the pipes coating protection system.

4.0 HANDLING AND STORAGE

4.1 OFF LOADING BY EXCAVATOR/CRANE

- Pipe masses, type of stacking, outreach required and site conditions must be taken into account when determining the suitability of lifting equipment.

- The lifting machine should be of the type, which retains the load safely in the event of a power failure.

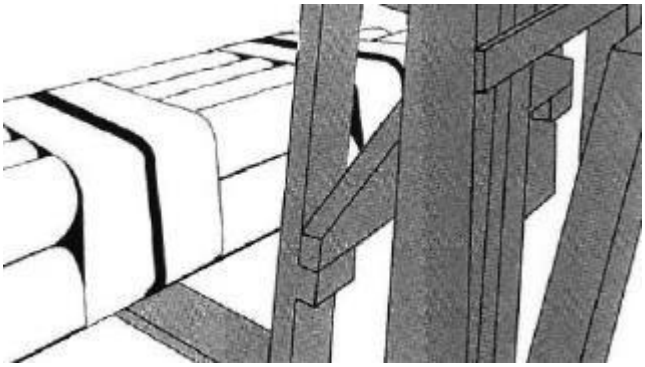
- When excavator/cranes are used for off-loading bundles or individual pipes, slings (made of Terylene, nylon or other suitable material) or lifting beams with purpose designed padded hooks should always be used.

Note: *never attempt to utilise chains or wire ropes as slings, these may cause slippage and/or damage to the external protection system, and/or the bundle assembly.*

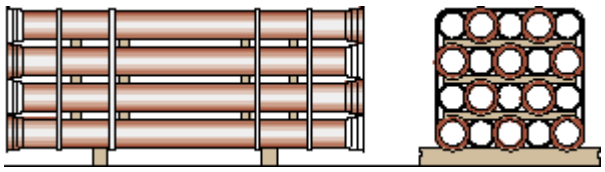
4.2 OFF LOADING BY FORKLIFT TRUCK

- Ensure that the forklift is operating on hard, level and stable ground and the forklift must be capable of lifting the load. If the forklift is not capable of lifting the entire bundle, then remove one layer at a time, or individually.

- Make sure that the forks do not damage the pipes or their external protection when manoeuvring the forks under and back out of the pipes, and also that the pipes do not move on the forks when lifting or manoeuvring.



5.0 STACKING



Two types of stacking are recommended:

a) Stacking bundled pipes, in banded format from the manufacturer.

b) Parallel stacking individual pipes using timber.

Points to remember for stacking:

1. The stacking area should provide a firm foundation with a suitable approach road for vehicles. Also stacks should be arranged in a format which provides safe vehicular and pedestrian access.

2. When stacking bundled pipes, each bundle should be stacked one on top of the other with the pipe axes parallel. **The maximum stacking height should not exceed five bundles.**

3. Where individual pipes are to be stacked in a central stocking ground for storage and pending further distribution, it is recommended the parallel stacking method is used using wooden bearers between rows.

5. Pipes should be stacked on a base of raised wooden battens at least 100 mm thick, 225 mm wide and placed approximately 600mm from each end of the pipes. The sockets of the pipes in each successive row should be reversed as to prevent metal to metal contact.

6. The bottom layer of pipes should be securely anchored.

7. During stacking and removal operations, safe access to the top of the stack is essential.

STACKING HEIGHTS

Diameter (mm)	No. Of Layers
100	16
150	14
200	12
250	10
300	8
350 and 400	7
450 and 500	6
600	4
700	3
800 and above	2

6.0 STORAGE OF GASKETS

Often pipes are laid much after the pipes and gaskets are procured. For storing gaskets, certain precautions need to be taken because of their characteristics. The important parameters are:

- **Storage Temperature:** The storage temperature must be below 25°C. Before use, their temperature must be brought to about 20°C over several hours, e.g. by immersion in tepid water. Gaskets must not be stretched or deformed at low temperature.

- **Humidity or Dryness of the Storage Atmosphere:** Vulcanised elastomeric joint gaskets must be stored under clean and moderately humid conditions.

- **Exposure to Light:** Elastomers are sensitive to ultra-violet light and ozone. Stored gaskets must therefore be screened from light (direct sunlight and artificial light)

- **Duration of Storage:** Normal joint gaskets and flat gaskets stored under the above conditions can be safely used within a period of six years from the date of manufacture.

7.0 PIPE DISTRIBUTION ALONG THE ALIGNMENT

- Stringing of the pipes end to end along the alignment in such a manner that the least interference is caused.

- Gaps should be left at intervals to permit the passage of equipment.

- Pipes should be laid out carefully to prevent damage to the pipe or coatings.

- Pipes should be wedged to prevent accidental movement.

8.0 TRENCHING

BS EN 805 & CESWI are publications that give recommendations regarding standards of good practice for trench excavation. Trenching is a hazardous operation requiring specialised civil engineering skills and knowledge of the detailed statutory regulations that govern this kind of operation. Therefore these instructions are for the sole purpose of guidance as to ensure that the quality of pipes and fittings are not impaired during installation.

- The width of the trench should be as narrow as practicable, taking into consideration the type of native soil, backfill and the compaction equipment required.

- The width of the trench should be typically Pipe OD + 600 mm where mechanical compaction is required and Pipe OD + 300 mm where mechanical compaction is not required.

- Special consideration should be given to the depth of the trench. The depth of cover should not be less than 900 mm. When embedded in concrete, 600 mm covers can be given under roadways. Joint sections should not be embedded in concrete.

- It may be necessary to increase the depth of trench for pipelines following hydraulic gradients, to avoid land drains, drainage systems, roads, railways or other crossings and other reasons such as marshy land peat and flooded areas.

- In rocky ground, rough grazing, or by special arrangement, the cover may be reduced, provided the contents of the pipeline are not affected by frost and the compacted backfill is strong enough to withstand the loading of any anticipated vehicular traffic.

- The bed should be provided with joint holes to ensure that the pipe rests on the barrel and not on the socket.

- In rocky ground, the trench should be excavated at least 100 mm deeper than normally required and then made up to the required level by the addition of well compacted, selected bedding or imported granular bedding.

- Where a change in direction is being given by deflection available from flexible joints, the trench should be cut to give sufficient room for the joint to be made with the pipes in line.

9.0 DITCHES

Where a pipeline passes underneath a trench, ditch or culvert, it should be suitably protected with concrete having a minimum cover of 300 mm. Ditches, drains, culverts and watercourses should be maintained in effective condition during the construction period and be restored finally to as good a condition as possible.

10.0 CANAL, RIVER, ROAD AND RAIL CROSSINGS

Special methods of construction may be required when pipelines cross canals, roads and railways. Agreements should be reached with the appropriate authorities before construction. The design may vary according to the size of the pipeline, the material conveyed and the nature of the crossing.

11.0 PIPE INSPECTION AND REPAIR

Inspection

Ductile Iron Pipes are not normally susceptible to handling and transport damage but mishandling can damage protective coatings and linings or bruise and deform jointing surfaces and may create ovality.

On receipt, all pipes and fittings should be inspected for damage to:

- The pipe or fitting itself.
- Cement mortar linings.
- Coating damage.
- Jointing surfaces.

Repairs of Damaged External Coatings

Standard coating

The method of surface preparation required for the repair of coating damage depends upon the severity and extent of the incurred damage.

Where damage does not expose the iron substrate or where the damage exposes less than 25cm² and the width of the damage is less than 5mm, roughen the surface of the coating and any bare metal area with a wire brush or abrasive paper.

Remove all traces of rust and non adherent material and apply the appropriate paint, criss cross passes until it is up to the level of the original coating and leave to dry.

Where the damage exposes more than 25cm² of iron substrate, or the width of the damage is greater than 5mm, then thoroughly wire brush the surface of the damaged area to remove all traces of rust and non adherent material. Prime the exposed surface with a zinc rich primer (containing a minimum of 90% zinc solids by mass) to a minimum thickness of 50 microns and allow to dry. Once the zinc primer is completely dry, apply the appropriate paint, by brush in criss まcross passes until it is up to the level of the original coating and leave to dry.

12.0 REPAIR OF DAMAGED CEMENT MORTAR LINING

When repairing damaged cement mortar linings, the following procedures should be used:

Materials

- Potable water.
- Cement that is compatible with the original lining i.e. Ordinary Portland Cement / Blast Furnace Slag Cement / Sulphate Resisting Cement / High Alumina Cement.
- A non coarser sand, having an average grain size of around 270 まで300 microns.

Composition of the Repair Mix

- Mix the sand and cement dry in proportions of 2 parts sand to 1 part cement.
- Add sufficient potable water to the mix as to form a thick paste which is workable.

Repair Procedure

- Carefully chip out the damaged lining.
- [illegible] as to create a [illegible]he repair mix.
- Brush off any loose mortar, and thoroughly wet the area to be repaired.
- Apply the repair mix to the exposed area, working it well into the existing lining.
- Build up the thickness to above the original lining, and finally smooth down to the required thickness.
- Leave to cure for one day. On hot days cover with a wet rag, or similar, as to prevent rapid evaporation and until the mortar is sufficiently hardened.

(Refer: Section 4.5.3.4 of EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines & Section 4.4.3.3 of EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage application)

13.0 CUTTING

Pipes suitable for cutting

Pipes DN80 – 300:
All Electrosteel Castings pipes from DN80 ま300 are manufactured suitable for cutting at site up to a maximum of 2/3 of the length of the pipe length measured from the spigot end.

Pipes DN350 – 1000:
Pipes DN350 ま1000 required to be suitable for cutting at site must be specifically requested upon placement of the order. Pipes supplied as being suitable for cutting at [illegible] up to a maximum of 2/3 of the length of the pipe length measured from the spigot end.

Procedure for Cutting Pipes

All pipes: use a diameter tape around the circumference of the pipe at the proposed cutting point and check that the external diameter complies with the limits as specified in the below table.

Pipes DN350 ま1000: after cutting check the cut end, if this is found to be oval, locate and mark the major axis. Measure the length of the major axis and if this exceeds the dimensions as specified in the below table, then ovality correction must take place prior to jointing.

MAXIMUM & MINIMUM EXTERNAL DIAMETER OF PIPE AND MAXIMUM MAJOR AXIS OF SPIGOT END

DN Size	Measured Circumferentially With Diameter Tape		Max. Major Axis of Spigot
	Max. (mm)	Min. (mm)	
80	99	95.3	99
100	119	115.2	119
150	171	167.1	171
200	223	219	223
250	275	270.9	275
300	327	322.7	327
350	379	374.6	379
400	430	425.5	430
450	481	476.4	481
500	533	528.2	533
600	636	631	636
700	739	733.7	739
800	843	837.5	843
900	946	940.2	946
1000	1049	1043	1049

Methods of cutting Ductile Iron Pipe should be selected from the following:

ごBy power driven abrasive disc まfitted to suitable hand tools, driven by compressed air or small internal combustion engines.

ごBy pipe cutting machine まusing cutting tools of the simple lathe or milling saw type.

ごBy reciprocating power saws まthese tools are usually electrically driven and are principally used within workshops where a power supply is available.

14.0 END PREPARATION OF CUT PIPES FOR JOINTING

Any burrs or sharp edges left after conducting the cutting of the pipe must be trimmed off by filing or grinding. Where the pipe is to be jointed into a socket, the spigot end should be chamfered by filing or grinding to obtain a bevelled edge with a minimum radius of 3mm and a chamfer profile similar to the original spigot end. (see. 17.0 Chamfering Dimensions)

15.0 OVALITY CORRECTION

Method A

The use of this method is recommended possible to remove the tackle after ovality correction and subsequent jointing.

- Position the timber strut and jack (approx. 5 Tonne capacity) 100 ま200mm inside the spigot end and at 90° to the major axis. Rubber pads should be placed into position as to prevent damage to the linings.
- Extend the jack until the major axis has been reduced to the appropriate limit as specified in the table detailed in section 13.0.
- Complete the jointing operation, ensuring that the major axis of the spigot end is vertical.
- After jointing, remove the tackle.

Method B

The use of this method is recommended where it is not possible to remove the tackle as described in Method A, after ovality correction and subsequent jointing.

- Place the tackle around the spigot end of the pipe at approximately 400 - 500mm away from the pipe end with the major axis of the spigot vertical.
- Rubber pads or similar should be placed between the re-rounding tackle and the pipe to prevent damage to the pipes protective coating.
- Extend the jack until the major axis has been reduced to the appropriate limit specified in the table detailed in section 13.0.
- Complete the jointing operation with the major axis of the spigot end in a vertical position.
- After jointing remove the tackle.

Method A

Method B

15.0 LAYING

- Pipes should at all times be handled with care. Pipes should be lowered into the trench with tackle suitable for the mass of the pipes

- A mobile crane or excavator backhoe should be used and the position of the sling checked when the pipe is just clear of the ground, to ensure a proper balance.

- All personnel should vacate the section of the trench into which the pipe is being lowered.

- All construction debris should be cleared from inside of the pipe either before or just after a joint is made. This can be done by passing a pull-through along the pipe, or by hand, depending on a diameter of the pipe.

- When laying is not in progress, a temporary end closure should be fitted securely to the open end of the pipeline. In the event of the trench becoming flooded, in which case the pipes should be held down either by partial re-filling of the trench or by temporary strutting.

16.0 JOINTING

Jointing procedures will vary according to the type of joint being used. Basic conditions, which should be ensured for all types of joint, are:

- Cleanliness of all parts.

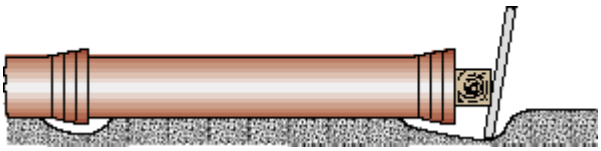
- Correct location of components.

- Centralisation of spigot within the socket.

- Strict compliance with recommended jointing instructions.

CROWBAR METHOD (for DN 80 to 150)

The crowbar levers against the ground. The pipe socket face must be protected with a piece of hard wood. The jointing takes place by the leverage of the crowbar.

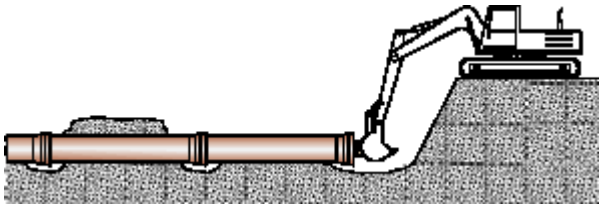


EXCAVATOR BUCKET (for all Diameter)

The hydraulic force of the arm of a mechanical digger can be effectively used to assemble pipes and straight fittings. However the following precautions are to be taken:

ごBetween the socket and excavator bucket place a wooden batten to act as a cushion.

ごExert a slow and steady force observing the rules for joint assembly.



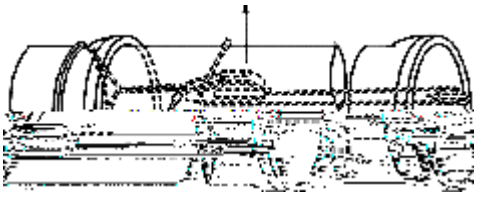
TIRFOR

type mechanical winches or chain pulley ま

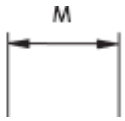
ごDN 150 to 300: TIRFOR type winch, capacity 1.6 Ton, steel cable and rubber protected hooks

ごDN 350 to 600: TIRFOR type winch, capacity 3.5 Ton, steel cable and rubber protected hooks

ごDN 700 to 1200: 2 TIRFOR type winches, capacity 3.5 Ton, diametrically opposite, 2 steel cables and 2 rubber protected hooks.

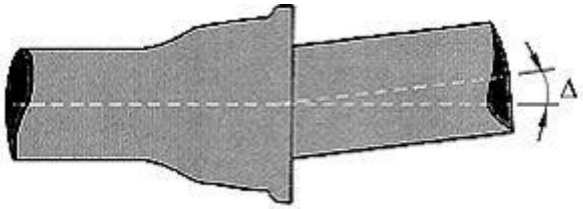


17.0 CHAMFERING DIMENSIONS



DN	DE (mm)	m (mm)	n (mm)
80	98	9 ま12	3
100	118	9 ま12	3
150	170	9 ま12	3
200	222	9 ま12	3
250	274	9 ま12	3
300	326	9 ま12	3
350	378	9 ま12	3
400	429	9 ま12	3
450	480	9 ま12	3
500	532	9 ま12	3
600	635	9 ま12	3
700	738	15 ま20	5
800	842	15 ま20	5
900	945	15 ま20	5
1000	1048	15 ま20	5

18.0 PERMISSIBLE DEFLECTION AFTER LAYING

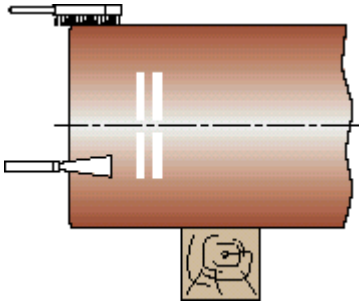


Δθ = Deflection, Δd = Deviation, for Push-on Joint

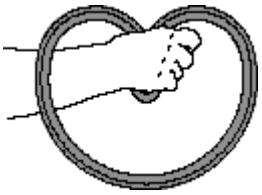
DN	Permissible Deflection After Laying Δθ (Degrees)	Pipe Length (m.)	Bend Radius R (m.)	Displacement Δd (cm.)
80 - 150	5°	5.5	63	48
200 - 300	4°	5.5	79	38
350 - 600	3°	5.5	105	29
700 - 800	2°	5.5	158	19
900 - 1200	2°	5.5	158	19

19.0 JOINTING METHODS FOR PUSH–ON JOINTS

Thoroughly clean both the spigot end (up to the maximum insertion mark) and the inside of the socket as to ensure both areas are free from any contaminant that could prevent correct jointing from taking place.

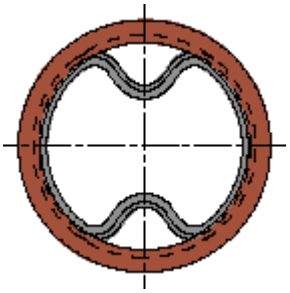


Ensure the gasket is clean and squeeze into a heart shape as shown opposite.

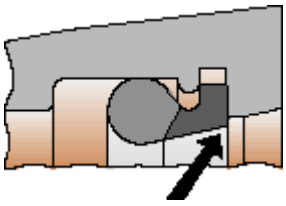


Press the loop until the gasket fits evenly in to the anchoring groove.

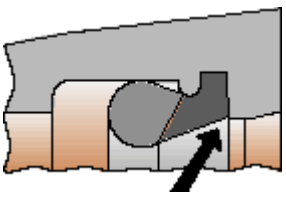
To facilitate the bedding of the gasket in pipes and fittings greater than DN600, it is advisable to form a second loop on the opposite side. The two smaller loops can then be easily bedded into their final position.



Place the gasket correctly into the groove. Check that the heel is locked in the anchoring groove as shown in the opposite figure.

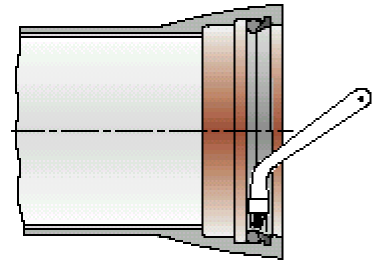


INCORRECT GASKET SEATING



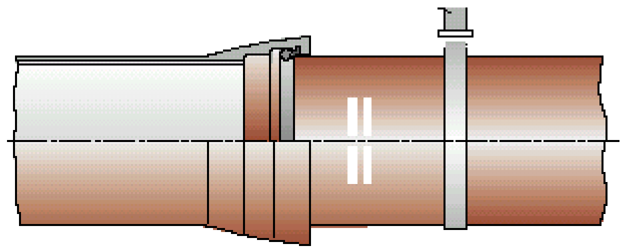
CORRECT GASKET SEATING

After insertion of the gasket, apply lubricant around the entire surface of the gasket. Also apply a generous coating of lubricant to the spigot end of the pipe to be inserted as to facilitate jointing.



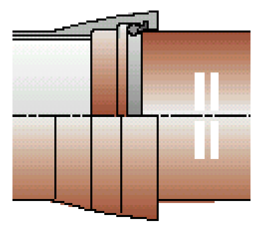
Note: never use petroleum based lubricants.

Centralise the spigot in the socket and keep it in this position. Where lifting gear has been used to place the pipe in the trench it should be used to support the pipe assist in centralising the spigot in the socket.

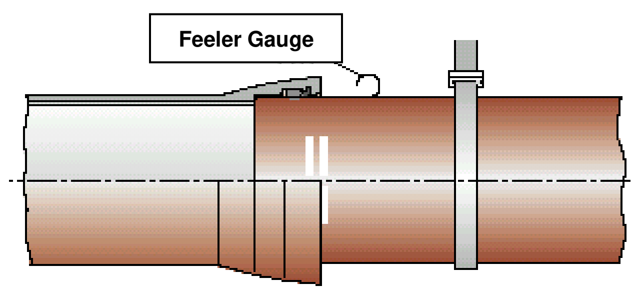


Before insertion it must be ensured that the spigot end is properly chamfered (Refer 17.0 Chamfering Dimensions)

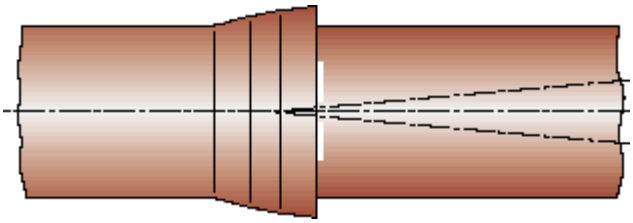
Push the spigot into the socket, maintaining a straight alignment. A suitable gap should be left between the end of the spigot and the bottom of the socket to take care of any axial movement if the pipeline is subjected to ground settlement or temperature variation. To ensure this, two white band marks are made near the spigot end. These bands act as も。やand む。-ｏ。や gauges.



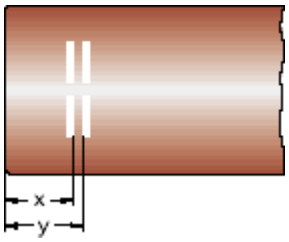
After jointing, the end of the socket must lie between these two bands. Spigot should be inserted in socket and not vice versa. After assembling the joint fully, examine the position of the gasket with the use of a feeler gauge to ensure gasket displacement has not occurred.



Deflection if required should be provided only after full jointing and within the permissible limits (Refer 18.0 Permissible Deflection after Laying)



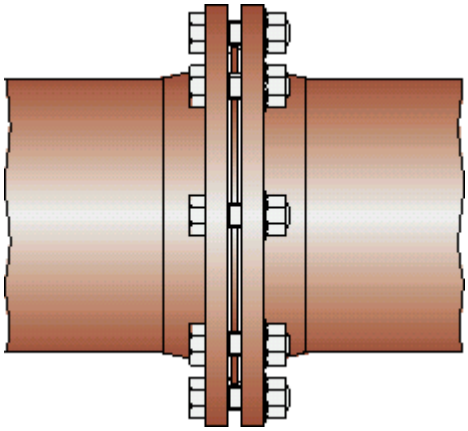
20.0 DEPTH OF INSERTION



DN (mm)	X (mm)	Y (mm)
80	64	87
100	64	87
150	64	87
200	72	95
250	77	100
300	82	105
350	82	105
400	87	110
450	87	110
500	92	115
600	97	120
700	110	145
800	125	160
900	145	180
1000	155	190

21.0 FLANGED JOINT

21.1 NOMENCLATURE



In any pipeline system there are certain lengths, which are exposed and are not buried under the earth. These lengths need to be tied down to pillars to avoid movements. For these joints often-self restrained rigid joints are provided e.g. Flanged Joints.

Double Flanged Joint Pipes are necessary in all water supply systems at the following locations.

- Connections to overhead reservoirs
- Connections in a pump house where a number of pumps and valves are connected to a rigid exposed pipe network through a common manifold where all the joints are rigid
- In the filtration plants and sewage treatment plants where the various units are connected with one another with exposed pipes.
- Used over pillars crossing a canal, river or laid over roads or railway bridges.

Often a combination of various lengths offer a length required for the system. The standard lengths of Double Flanged Pipe as per EN 545 & EN 598 are 1m, 2m, 3m, 4m and 5m.

NB.
Flange pipes are not recommended for underground installation, as the flange joint is completely rigid and cannot cope with any stress loading same as a flexible joint.

21.2 JOINTING PROCEDURE

1. Ensure the flange faces are clean and free from dirt or particles of foreign matter.

2. Location bolts may be inserted to enable the positioning of the gasket to the flange face.

2. Use 3 mm thick, rubber gaskets conforming to ISO 4633 and with dimensions to suit the flange drilling.

3. Lubricate bolt threads, all mating surface and flanges using a suitable lubricant.

4. Position the gasket on to the location bolts.

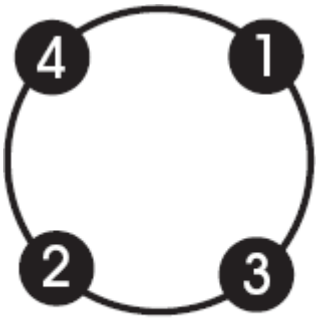
5. Offer the adjoining flange to the bolts.

6. Tighten the four location bolts in the order as shown in the figure below, as to secure the adjoining flange.

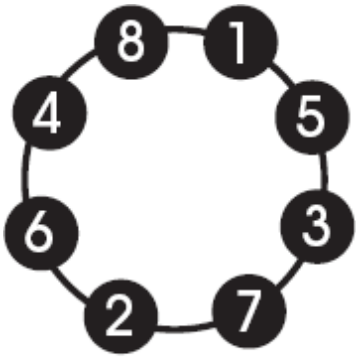
4. Insert the remaining bolts one by one, and tighten diametrically opposite bolts to the recommended torques.

5. Tighten bolts. If necessary, re-tighten bolts before pressure testing.

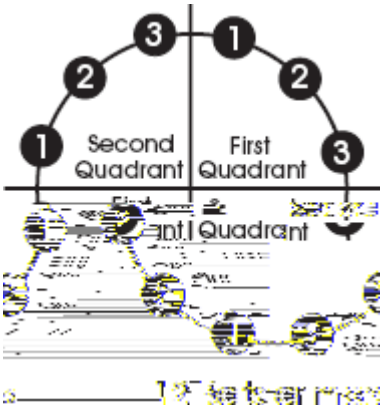
For sizes having 12 bolts or more it is recommended that two jointers work simultaneously on diametrically opposite bolts. Each jointer tightens the first nut in the first quadrant, then the nut in the second quadrant, returns to the second nut in the second quadrant and so on. (See 12 bolts or more diagram)



4 Bolts



8 Bolts



For jointing Flanged Pipes and Fittings, it is recommended that the following minimum bolting torques are observed for flanged joints:

APPROXIMATE MINIMUM BOLTING TORQUE (Nm) FOR FIXED FLANGES												
NOMINAL	PN 10 FLANGE JOINTS			PN 16 FLANGE JOINTS			PN25 FLANGE JOINTS			PN40 FLANGE JOINTS		
SIZE DN	BOLT SIZE M	NO. OF BOLTS	TORQUE Nm	BOLT SIZE M	NO. OF BOLTS	TORQUE Nm	BOLT SIZE M	NO. OF BOLTS	TORQUE Nm	BOLT SIZE M	NO. OF BOLTS	TORQUE Nm
80	16	8	20	16	8	20	16	8	30	16	8	40
100	16	8	20	16	8	30	20	8	50	20	8	70
150	20	8	40	20	8	60	24	8	90	24	8	130
200	20	8	60	20	12	60	24	12	100	27	12	160
250	20	12	60	24	12	90	27	12	160	30	12	240
300	20	12	70	24	12	120	27	16	160	30	16	240
350	20	16	70	24	16	120	30	16	230	33	16	350
400	24	16	110	27	16	170	33	16	320	36	16	470
450	24	20	110	27	20	170	33	20	320	36	20	490
500	24	20	120	30	20	240	33	20	370	39	20	650
600	27	20	190	33	20	350	36	20	550	45	20	1040
700	27	24	240	33	24	350	39	24	600	-	-	-
800	30	24	300	36	24	490	45	24	880	-	-	-
900	30	28	320	36	28	520	45	28	930	-	-	-
1000	33	28	410	39	28	690	52	28	1320	-	-	-

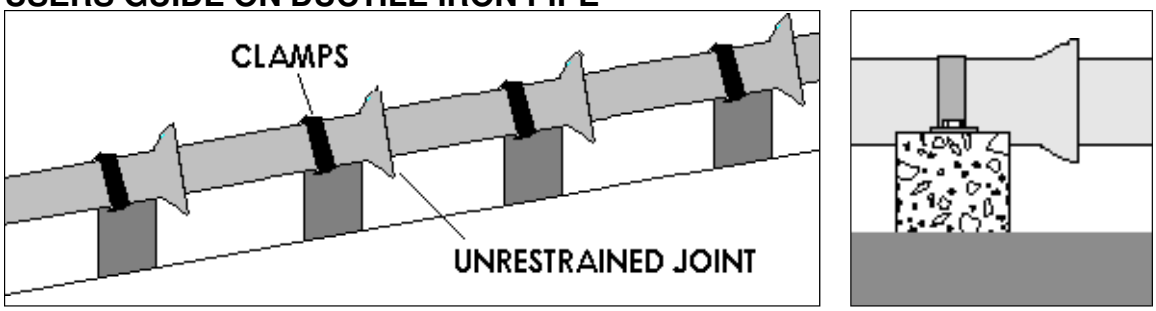
On flanged joints using elastomeric gaskets some relaxation of the gasket will be experienced and it should be ascertained that the bolting torque required to effectively seal at the appropriate pressure, as shown in the above chart, is effective at the time of pressure testing.

22.0 JOINTING PIPES LAID ON SLOPES

Certain precautions need to be taken when laying ductile iron pipes on slopes:

- If pipes are to be laid on steep gradients where the soil-pipe friction is low, care should be taken to ensure that no excessive spigot entry or withdrawal occurs. As soon as the joint assembly has been made, the pipe should be held in place and the trench backfilled over the barrel of the pipe.

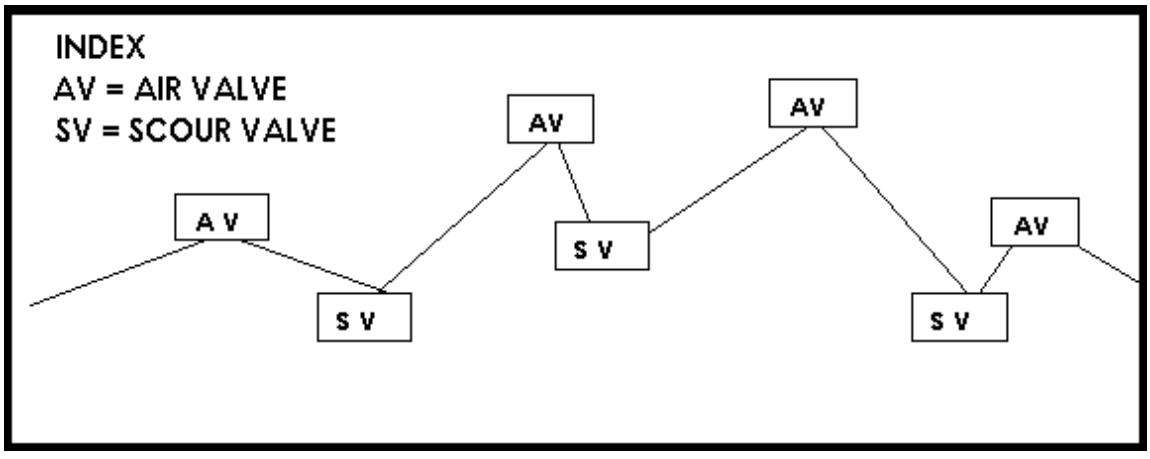
- Whether installing over ground or underground, the socket should face uphill when pipeline is laid on a slope as shown in the figure below. Remember that in a push-on joint, the direction of flow has nothing to do with direction of the socket. For over ground installation, when pipes are laid on a slope it is prudent to anchor all the pipes to the pedestal with steel straps as shown below. If the gradient is 1:2 or steeper, even in case of underground installation, the pipes neck should be anchored by concrete. If the ground is loose and has low bearing capacity, concrete packing to be provided behind the socket to avoid down-sliding / snaking of pipes and subsequent joint separation. For very steep gradients, restrained joints / flanged joints or providing concrete anchor blocks behind each socket is recommended, even when laid underground.



- When you are going down the hill after reaching a hilltop, ensure to change socket direction, which can be facilitated with the use of double spigot pipe sections.

- All fittings should be suitably anchored against displacement as recommended in the laying specification. External anchorage should be provided at blank ends, bends, tees, tapers and valves also to resist the thrust arising from internal pressure and dynamic loading. Concrete anchor blocks should be of such a shape as to leave the joint area clear.

- Effective purging of air from the pipeline is absolutely vital for the smooth operation of the pipeline. Every high point on the pipeline profile, where the pipeline converts from a positive gradient to a negative gradient, an air valve must be provided. Even minimal high points with small air pockets can cause reduction of flow and serious surge problems. In addition, it is recommended that air valves be installed every 1000 m on straight horizontal runs. Similarly scour valves are to be provided at all low points.



- The joint deflection should not be more than the recommended deflection (for 600 mm. diameter 3° maximum). For a 6 m. long pipe the maximum deflection from straight line will be about 11 cm. at the end for every degree of deflection.

23.0 ANCHORING PIPELINE

- Unless an adequate length of the line is fitted with restrained joints, external anchorage should be provided at blank ends, bends, tees, tapers and valves to resist the thrust arising from internal pressure and dynamic loading.

- Anchors and thrust blocks should be designed to withstand the forces resulting from the internal pressure when the pipeline is under test, taking into account the safe bearing pressure of the surrounding soil.

- Consideration should also be given to forces on the pipeline, when empty, and precautions taken against possible flotation.

- Wherever possible, concrete anchor blocks should be of such a shape as to leave the joint area clear. Often joints can also be restrained with external clamps or anchor gaskets.

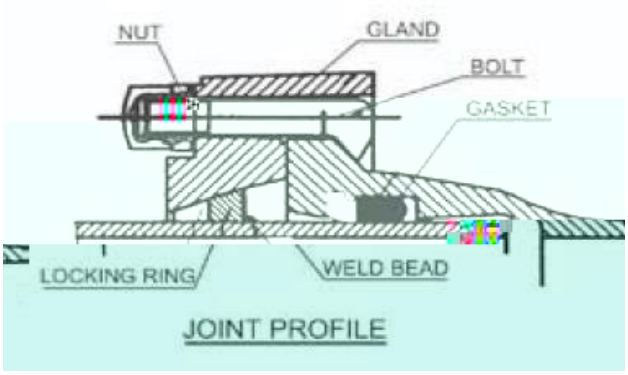
THRUST FORCE (Kgf) IN FITTINGS AT 1 BAR WATER PRESSURE

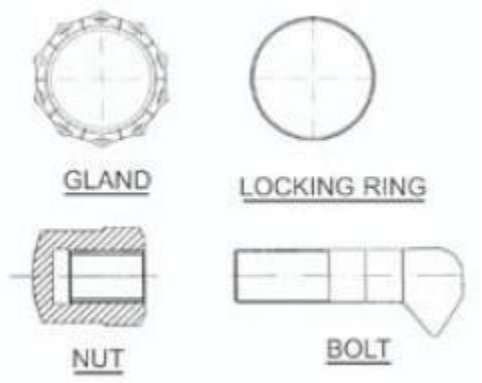
Nominal Diameter (mm)	Dead End	90° Bend	45° Bend	22½° Bend	11¼° Bend

Such joints ideally suite the following conditions:

- Directional changes in pumping.
- Unstable ground conditions such as marshy grounds, areas of subsidence etc.
- Hilly terrains.

The restrained joint involves a weld bead at the spigot end, gland, locking ring, nuts and bolts. The gland and locking ring are connected to the socket collar and create a restraining force against the weld bead on the adjoining spigot, as such, preventing joint separation when subjected to axial forces. The restrained joint assembly offers the same degree of joint deflection as a standard push fit joint.





Nom. Dia	PFA Bar	Gland Bolts		Tightening Torque (Nm)		Max Angular* Deflection
		Hole size	No. of holes	PRE	Final (Max)	
80	64	25	4	20	100	4.0°
100		25	4	20	80	
150	55	25	6	20	60	
200	44	25	8	20	60	
250	39	30	6	20	70	3.0°
300	37	30	8	20	60	
350	32	30	8	10	20	
400	30	30	10	10	20	
450		30	12	10	20	
500		30	16	10	30	
600	27	30	20	10	20	
700	25	30	24	10	10	2.0°
800	16	30	30	20	90	
900		30	30	10	30	
1000		30	30	10	10	

PFA = Allowable operating pressure

*For higher angular deflection please contact Electrosteel

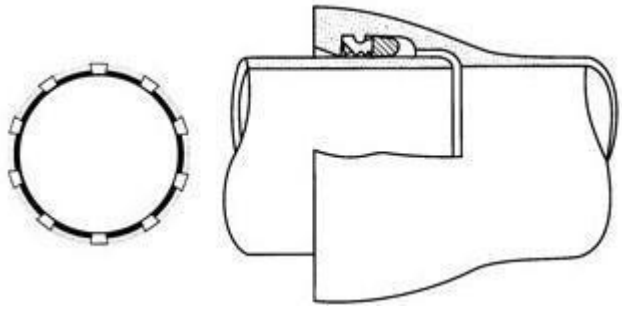
Anchor Gaskets

The use of anchor gaskets provides a cost effective solution to anchoring problems such as confined spaces where standard thrust blocks cannot be employed. Resistance to joint separation is provided by the means of stainless steel teeth, which are moulded into the rubber gasket.

The jointing method for pipes and fittings using anchor gaskets is the same as if normal gaskets were being used, and all forms of jointing tackle can be used. However, when using anchor gaskets extra care must be taken as to ensure the joint is made

With anchor gaskets a certain amount of axial withdrawal occurs as anchorage is taken to ensure that the pipe layout is such that this movement does not cause excessive deflection at any other joints.

On buried mains the anchor joint on fittings and pipes must be buried before pressure testing, in order to minimise movement. Where mains are not buried all of the necessary securing and strapping of the pipework appropriate to final installation must be carried out before testing, again to minimise movement.



DN	Tyton SIT PLUS		
	Max Operating Pressure (PFA)	Max Site Test Pressure (PEA)	Max Deflection
80	16	24.2	3°
100	16	24.2	3°
150	16	24.2	3°
200	16	24.2	3°
250	16	24.2	3°
300	16	24.2	3°
350	16	24.2	3°
400	16	24.2	3°
450*	16*	24.2*	2°
500*	16*	24.2*	2°
600*	16*	24.2*	2°

**10 bar operating & 17 bar test for EN 598 pipework in these DN sizes*

For higher PFA requirements please contact the manufacturer

NB.
Electrosteel cannot be held responsible for any issues arising with anchor gaskets sourced via a third party.

Please contact Electrosteel Technical Team directly in relation to calculating exact pipeline anchorage length requirements.

25.0 PE SLEEVING

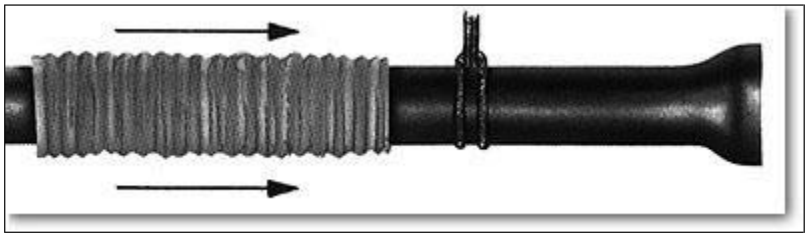
25.1 MATERIAL CHARACTERISTICS

- The material used for making the film is polyethylene or a mixture of polyethylenes and / or ethylene and olefin copolymers
- Density shall be between 910 and 930 kg/m^3
- The nominal thickness shall be not less than 200 µ
- Tensile strength shall be not less than 8.3 MPa.
- The elongation at fracture shall be not less than 300%.
- The Dielectric Strength of the film should be [illegible] minimum

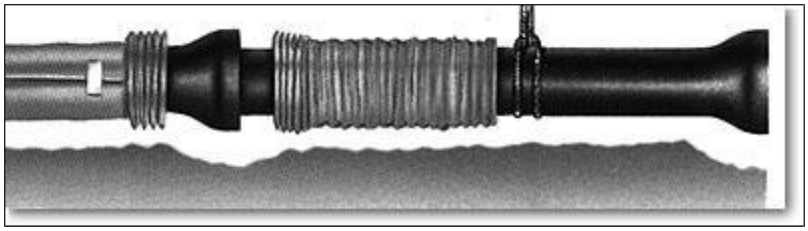
Layflat Width of Tubular Polyethylene Film	
Nominal Diameter of Pipe (mm)	**For Use with Pipeline Incorporating Push-On Flexible Joints (mm)**
80	350
100	350
150	450
200	550
250	650
300	700
350	800
400	1100
450	1100
500	1350
600	1350
700	1750
800	1750
900	2000
1000	2000

25.2 INSTALLATION PROCEDURE

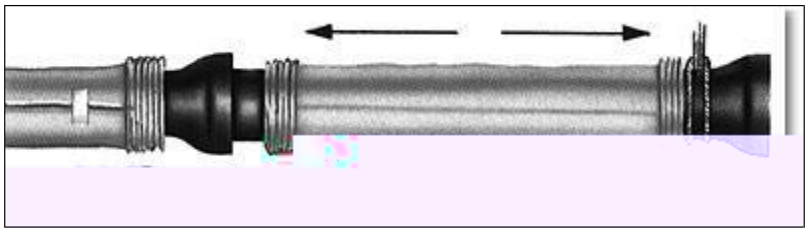
Cut a section of polyethylene tube / sheet approximately two feet longer than the pipe section. Remove all lumps of clay, mud, cinders, or other material from the pipe surface. Slip the polyethylene tube around the pipe, starting at the spigot end. Bunch the tube accordion-fashion on the end of the pipe.



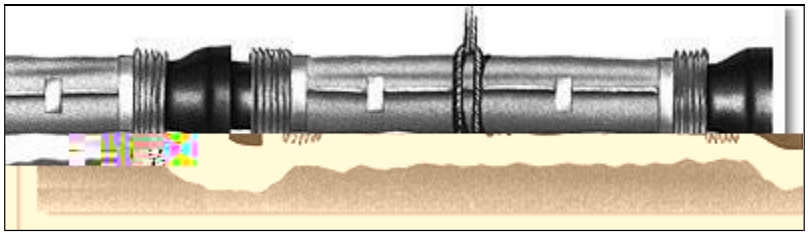
Dig a shallow hole in the trench bottom at the joint location to facilitate installation of the polyethylene tube. Lower the pipe into the trench and make the pipe joint with the preceding section of pipe.



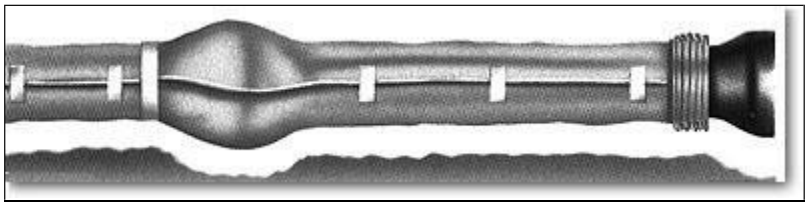
Move the sling to the socket end of the pipe, and lift the pipe slightly to provide enough clearance to easily slide the tube. Spread the tube over the entire barrel of the pipe.



Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and securing it in place. Note: The polyethylene may be secured in place by using adhesive tape.



Overlap the secured tube end with the tube end of the new pipe section. Secure the new tube end in place. Take up slack in the tube along the barrel of the pipe to make a snug, but not tight fit. Excess polyethylene is pulled back over the top of the pipe. Secure the fold at several locations along the pipe barrel (approximately every metre). Repair all small rips, tears, or other tube damage with adhesive tape.



Carefully backfill the pipe according to the standard backfill procedure. To prevent any damage during backfilling, allow adequate slack in the tube at the joint. The backfill should be free of cinders, rocks, boulders, nails, sticks, or other materials that might damage the polyethylene sleeving.

26.0 BACKFILLING

- Backfilling operations should be immediately done after the laying of pipes.

- In order to minimise misalignment of the bed with resulting shear across the joint, backfill material should not be placed on a pipe until the next pipe is laid and jointed.

- If the joints are to be individually inspected during hydrostatic testing, it is not practicable to backfill the trench completely.

- It is important, however, to backfill over the barrel of each pipe and to compact the backfill as to prevent movement of pipes during the testing procedure.

- On pipes greater than DN500 special attention should be given to the compaction of the backfill material under the socket of the pipe.

- Neither topsoil nor material harmful to the pipeline should be used in backfilling.

- The trench should be backfilled with selected material from the excavation to preserve as far as possible the original soil sequence and should be compacted to minimise subsequent settlement.

- Top soiling and reinstatement work should only be carried out when ground and weather conditions are suitable.

- In most cases, selected excavated material, from the trench will be suitable for the backfill.

27.0 CLEANING

Before a pipeline can be considered ready for service it should be cleaned internally as thoroughly as possible to ensure that no foreign matter remains inside the pipe. Cleaning individual pipes during jointing, should be performed. Pigs of suitable design e.g. polyurethane swabs may be used provided that the pipeline has been constructed to allow the passage of such pigs. Where the pipeline is to be tested with water, the filling and emptying of the pipeline may to some extent cleanse the line.

28.0 TESTING PIPELINE

28.1 INTRODUCTION

All pipelines should be tested before being brought into service. The type of test will be Hydrostatic using either the pressure drop or water loss methods (usually as stipulated by the designer) It is recommended that all pressure testing is carried out in accordance with EN 805.

28.2 HYDROSTATIC TESTING

It is recommended that testing is conducted in accordance to EN 805

This standard specifies that the site test pressure for ductile iron pipes, fittings and flanged joints should not be less than:

- Maximum design pressure under surge conditions; but should not exceed the test rating (PEA) of the pipeline components.

The complete pipeline may be either in one length or in sections. During laying sectional tests should be carried out to ensure leak proof jointing. The length of section should be decided by considering:

- Availability of suitable water.
- Number of joints to be inspected.
- Difference in elevation between one part of the pipeline and another.

Where joints are left uncovered until after testing, sufficient material should be backfilled over the centre of each pipe, as to prevent movement under the test pressure.

28.3 PREPARATION FOR TESTING

- Begin testing any particular pipeline in comparatively short lengths say 500 m. and increase the length of test section progressively as experience is gained, until lengths of about 1.5 km. can be tested in one section.

- Each test section should be properly sealed off, with special stop ends, designed for the safe introduction and disposal of water and release of air, which should be secured by adequate temporary anchors.

- The thrust on the stop ends should be calculated on the full spigot external diameter and on the anchors designed to resist it.

- It may often be economical to provide a concrete anchor block, which has subsequently to be demolished, rather than risk movement of the stop ends during testing. Hydraulic jacks may be inserted between temporary anchors and stop ends to take up any horizontal movement of the temporary anchors.

- All permanent anchors should be in position and if manufactured from concrete, should develop adequate strength before testing begins.

- The section under test should be filled with clean, disinfected water, taking care that all air is displaced through vents at high points.

- After filling, the pipeline should be left at working pressure for a period in order to achieve conditions as stable as possible for testing.

- Pressure measurements are to be made at the lowest point of the section, and to ensure that the maximum pressure is not exceeded.

28.4 TEST PROCEDURE

Water Loss Method (EN 805)

- After the line is filled up with water, it should be left in that condition for 24 hours, to allow the cement mortar lining to absorb water and the dissolved air to come out.

- The pressure in the pipeline should be raised steadily until the site test pressure is reached in the lowest part of the section.

- The pressure should be maintained, by pumping if necessary, for a period of 1 hour.

- The pump should then be disconnected and no further water permitted to enter the pipeline for a period of 1 hour.

- At the end of this period, the original pressure should be restored by pumping and the loss measured by drawing off water from the pipeline until the pressure reached at the end of the test is obtained again.

Pressure Loss Method (EN 805)

- After the line is filled up with water, it should be left in that condition for 24 hours, to allow the cement mortar lining to absorb water and the dissolved air to come out.

- The pressure in the pipeline should be raised steadily until the site test pressure is reached in the lowest part of the section.

- The duration of the pressure test shall be 1 hour or a longer period if specified by the designer.

- During the main test, the pressure shall display a regressive tendency and shall not exceed the following value at the end of the first hour:

  - 20 kPa for pipes such as ductile iron with or without cement mortar linings, steel pipes with or without cement mortar linings.

HYDRAULIC WORKING PRESSURE AND HYDROSTATIC TEST PRESSURE

DN	EN 545 Water Pipe (preferred class)				EN 598 Pressure Pipe		
	C Class	PFA	PM A	PEA	PFA	PM A	PEA
80	C40	40	48	53	40	48	53
100	C40	40	48	53	40	48	53
150	C40	40	48	53	40	48	53
200	C40	40	48	53	40	48	53
250	C40	40	48	53	38	46	51
300	C40	40	48	53	35	42	47
350	C30	30	36	41	32	39	44
400	C30	30	36	41	30	36	41
450	C30	30	36	41	29	35	40
500	C30	30	36	41	28	33	38
600	C30	30	36	41	26	31	36
700	C25	25	30	35	29	35	40
800	C25	25	30	35	28	33	38
900	C25	25	30	35	27	32	37
1000	C25	25	30	35	26	31	36

28.5 DETECTION OF LEAKS

If the test is not satisfactory, the fault should be found and rectified. Consideration should be given to leak detection methods such as:

- Visual inspection of pipelines, especially each joint, if not covered by the backfill.
- Aural inspection, using a stethoscope or listening stick is contact with the pipeline.
- Use of electronic listing devices including leak noise correlators which detect and amplify the sound of any escaping fluid; actual contact between the probe and the pipe may or may not be essential.
- Use of a bar probe to detect signs of water in the vicinity of joints, if backfilled.
- Where there is difficulty in locating a fault, the section under test should be subdivided and each part tested separately.

Note: A pneumatic test with an air pressure not exceeding 2 bars may be used to detect leaks in pipelines laid in waterlogged ground.

After all section has been jointed together on completion of section testing, a test should be carried out on the complete pipeline. During the test, all work, which has not been subject to sectional tests, should be inspected.

28.6 DISPOSAL OF WATER

It is important to ensure that proper arrangements are made for the disposal of water from the pipeline after completion of hydrostatic testing and consent which may be required from land owner and occupiers, and from river drainage and water authorities have been obtained.

29.0 PIPELINE COMMISSIONING

- If the pipeline is intended to carry potable water, it should be thoroughly flushed with clean water, where feasible.
- It should then be disinfected by contact for 24 hours with water containing at least 20 mg/l of free chlorine, then emptied and filled with potable water. The chlorinated water should receive treatment to dilute the chlorine to an acceptable level before discharge to sewer or watercourse.
- After a further 24 hours, samples should be taken for bacteriological examination at a number of points along the pipeline and at all extremities.
- The pipeline should be not brought into service until the water at each sampling point, having stood in the pipeline for 24 hours, has maintained a satisfactory potable standard.

References

1. BS EN 545: 2010: Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods..
2. ISO 2531: Ductile iron pipes, fittings, accessories and their joints for water and gas applications.
3. BS EN 598: 2007: Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods.
4. ISO 7186: Ductile iron products for sewerage applications.
5. BS EN 1092: Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated まPart 2: Cast iron flanges
6. Civil Engineering Specification for the Water Industry (CESWI) 7th Edition. WRc Publications.
7. BS EN 805: 2000 Water supply まRequirements for systems and components outside buildings.
8. BS EN 681-1: 1996: Elastomeric seals まMaterial requirements for pipe joint seals used in water and drainage applications.
9. Regulation 31. Water supply regulations for England and Wales.
10. The Water Supply (Scotland) Regulations 1990.

NOTES:

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