TECHNICAL GUIDE

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concrete pipeline systems association

N° 2 – Installation - Pipes

2 - INSTALLATION – PIPES

This section describes the recommended procedure for the installation of concrete pipelines in trenches for non-pressure applications or when occasional periods of hydraulic surcharge may occur. It covers the types of laying conditions most commonly encountered in practice. In situations beyond these general conditions, the pipeline designer and the site engineer should give suitable instructions to supplement this guidance.

Pipelines laid under embankments require special consideration whilst those installed by pipe jacking require the use of specialised techniques.

2.1 PLANNING

General

Prior to constructing the pipeline the contractor will need to organise the work from the contract documents - specification, drawings and bill of quantities.

The line and level of the sewer, any side connections and the positions of the manholes will have been determined at the design stage but some flexibility in construction should be permitted to cater for circumstances such as foundations or buried services not shown on the drawings. An agreed re-siting of a manhole may save time and additional expense.

Sequence of operations

a) Plan and set out the work including location of manholes.
b) Receive, check against specification and store deliveries of materials on site.
c) Excavate trench and install trench support system.
d) Lay bedding material forming socket holes as appropriate.
e) Check for damage, lay and joint pipes, air testing every third or fourth pipe as laying proceeds. Check line and level.
f) Place and compact sidefills with bedding or selected materials.
g) Continue placing and compacting sidefills withdrawing trench sheeting in stages.
h) Place initial backfill above pipe continuing withdrawal of sheeting.
i) Air and/or water test or inspect visually prior to final backfill.
j) Complete backfill, compacting as appropriate.
k) Final acceptance, air and/or water test or inspection.
l) Reinstatement of surface as appropriate.

2.2 HANDLING AND STORAGE

Lifting equipment

Time and place of off-loading should be agreed before units arrive at site. The contractor should provide suitable equipment for off-loading, stacking and stringing out of pipes and other units on site.

All lifting tackle must be of good sound construction and should be regularly tested and certificated. Lifting appliances should be capable of smooth hoisting, handling and lowering of the heaviest pipe or other unit to be handled.

Off-loading

Whenever possible, pipes and other units should be off-loaded in the reverse order to which they are loaded. The vehicle must not be moved if any part of the load is unsecured.

Off-loading should take place at the nearest hard standing to the point of installation; all units must be left in a stable position well clear of the edge of the trench.

Use of tackle

Slings must never be passed through the bore of the pipe or other unit for lifting. This is important in order to avoid damage to jointing surfaces and consequent leakage of the laid pipeline.

Pipes

Small diameter pipes may be palletted, large diameters will need individual handling. Pipes should be handled using a properly designed “C” hook, beam sling or other purpose-designed system. Slings may be made of cordage, canvas, or man-made fibres, but not unprotected chains.

Many manufacturers now offer a combined lifting and jointing system using a three-legged chain and cast-in lifting facilities (larger pipe sizes only). For further details refer to individual manufacturers.

Other units

Where lifting eyes or lifting holes are provided they should be used. Extra care should be taken when lifting bends and junctions (pipes with inlet).

Chocks

When pipes are loaded, transported or stacked, sufficient timber chocks should be provided. Chocks or packing between individual units should not be removed until lifting tackle is secured.

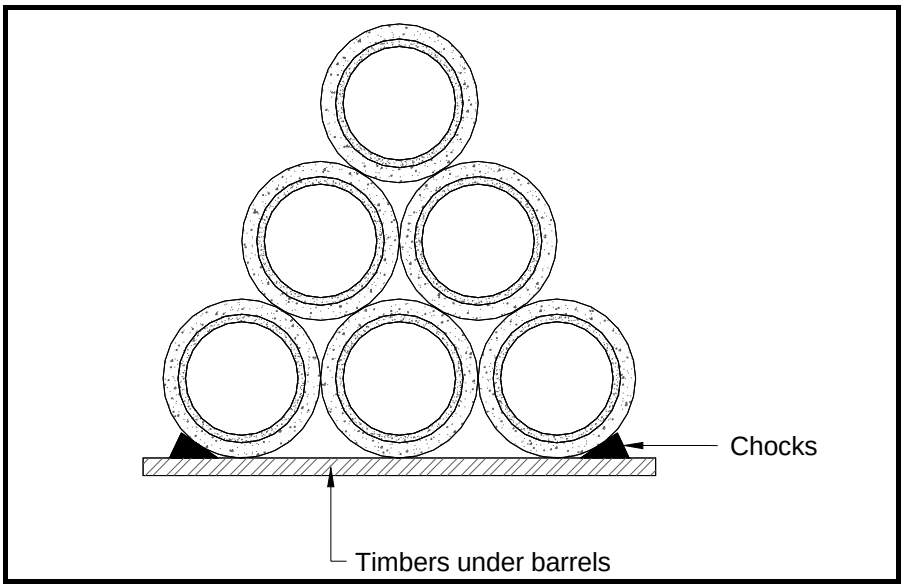
Care in handling

Pipes and other units must never be dropped. Pipes which have to be moved should be lifted and never dragged. When pipes have to be rolled, beware of rocks or boulders. Care should be taken to avoid damage especially to jointing profiles.

Stacking on site

Ideally, pipes should be strung out and secured beside the trench where they are to be used. Where stacking is necessary this should be on level ground and the bottom layer of pipes securely chocked to prevent the stack from collapsing. Pipes should be supported under the barrel so that the socket is free of load and so that the jointing faces are not damaged. They should be stacked barrel to barrel with sockets overhanging, or with spigots protruding as preferred.

Fig. B1 Typical stacking arrangement



For safety reasons and to prevent damage to the lower layers of pipes in the stack, pipes should not be loaded or stacked in a greater number of layers than shown in Table C1.

Table B1 Pipe stacking layers

Nominal size (DN)	Number of layers
150-225	6
300-375	4
450-600	3
675-975	2
above 975	1

Storage of jointing materials

The quantity, type and diameter of jointing rings or other jointing materials should be checked with the delivery note at the time of off-loading. Elastomeric rings should be carefully stored and protected from sunlight, oils, greases and heat. If the rings have been tied they should be separated a few days before use in order to eliminate minor impressions which the ties may have caused. Rings should not be stored hanging from a hook.

2.3 EXCAVATION AND LAYING

Trench excavation

The trench should be dug to the line, gradient and width indicated on the drawings or in the specification or as agreed with the Engineer. The safety of the public and site personnel is of paramount importance.

Trench width

Any increase in trench width above that specified could increase the load on the pipe and increase the quantity of the excavation, and of bedding material.

A trench narrower than that specified may impede the proper placing and consolidation of the bedding material and restrict working conditions in the trench during pipe laying.

A trench adjacent to a manhole may need to be wider but this should be taken into account at the design stage.

The trench width should allow for safe working alongside the pipeline. For recommended trench widths see load tables in section 1.2.7.

Formation

Uniform support along the pipeline is essential.

Rock outcrops and soft zones such as peat or boggy material which can cause differential settlement should be dug out and replaced with well tamped selected material.

Ground water should be kept below the bottom of the trench during pipe laying operations by the use of temporary drains, sumps, or a designed well-point system. The water level should not be allowed to rise before backfilling is completed.

If the trench bottom is likely to be disturbed by trampling during pipe laying, selected material should be placed to protect it.

Where the trench bottom is unstable, for example in marshy ground or running sands, special measures are necessary to ensure proper embedment.

A trench excavated in clay should not be kept open any longer than necessary so as to avoid instability due to change in moisture content.

Pipe laying

Before lowering into the trench, each unit should be inspected carefully for any damage which may have occurred in transit or during handling and storage on site. Pay special attention to jointing surfaces. Units should be lowered carefully into the trench with tackle suitable for their weight and for the depth of the trench.

The contractor should have available, at the required time, all material and equipment necessary for carrying out the work in accordance with the specification

and statutory safety requirements.

The contractor must ensure that the size and class of pipes or other units conform to the contract specifications and manufacturer's recommendations and that joint rings are compatible with the units being laid.

Normal gradients

The pipes should be supported by the bedding over the length of their barrels and their weight must never be carried by the sockets or by bricks and rocks in the trench bottom. Socket holes must be provided at each joint. The pipes should be laid and assembled in correct alignment.

If, in order to curve the pipeline, it is necessary to deflect the pipes at the joints, the deflection should be applied only after the joint has been made in the normal manner and should be limited to 75% of the manufacturer's recommended limits to allow for any subsequent movement.

Mechanical plant must not be used to press pipes down to their correct level.

Changing direction

Change in direction, either horizontal or vertical, should be made at a manhole or by means of a precast bend unit.

Passing through rigid structures

For a pipeline connection to a manhole or passing through a wall it is essential to ensure that the pipeline retains its flexibility. This may be achieved by casting into the wall of the structure a short length of pipe such that there are flexible joints adjacent to the wall. Depending on ground conditions short length pipes (rockers) should be used (see Section 1.3.6).

Unstable ground

In unstable ground an appropriate installation method should be determined.
The following possibilities should be taken into account:

- Use of short lengths of pipe.
- Use of continuous support on pile caps/beams.
- Special preparation of trench bottom.
- Trenchless methods of construction such as pipe jacking or heading.

Passing under highways or railways

If disruption of traffic is to be avoided, pipes should be installed by jacking or in heading.

2.4 JOINTING

A number of different joint designs are manufactured, all of which comply with the performance requirements of BS EN 1916 and BS 5911-1.

The pipe manufacturer's jointing instructions should be complied with but the basic

requirements for jointing concrete pipes are:

a) Ensure by checking the delivery note against the printed information on the ring that it is compatible with the pipes.

b) Before jointing, clean the spigot, socket and the ring before fitting and ensure that all surfaces are dry.

c) Locate the joint ring (if required) onto the spigot without twisting and even out the stretch around the spigot.

d) Lubrication – if required, follow the manufacturer's instructions. A rolling ring should not be lubricated.

e) Suspend the pipe at the balance point, clear of the bedding. Ensure that the pipe to be joined is well aligned both horizontally and vertically. With rolling ring joints, offer up the pipe spigot to the socket, but keep clear of engagement by about 25mm so that the joint ring is not disturbed. With sliding ring joints, the joint ring should be just in contact with the socket.

f) Jointing tackle or chain systems, should be used in accordance with the pipe manufacturer's instructions.

g) Fully support the pipe so that it does not rest on the joint ring whilst closing the recommended joint gap.

h) Joint the pipes in accordance with manufacturer's recommendations, making sure that the pipe moves without excessive slew or misalignment, that extraneous matter does not enter the joint and that the joint ring is correctly positioned. For jointing bends, special procedures may be appropriate.

i) After adjusting for line and level, release the tackle. Care should be taken not to disturb the pipe or bedding material when removing slings.

Reassertion of rolling rings

With most types of rolling ring joint there is a tendency for the ring to reassert and, with small pipes, this will tend to widen the joint gap, unless the last pipe laid is temporarily held in the trench. A suitable gap must be left between the end of the spigot and the shoulder of the socket of the next pipe to permit movement. The manufacturer's guidelines must be followed.

Back laying

In special circumstances, such as at manhole connections, it may be necessary to joint a pipe socket onto the spigot of a pipe already laid.

When this is done, additional care is necessary to ensure that the joint is properly made with the joint ring correctly positioned and that bedding material is not scooped into the joint.

Fig.B2 Sliding Ring

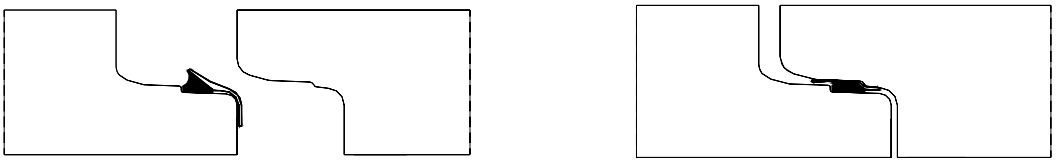


Fig. B3 Rolling Ring – circular/tear drop/'G' ring

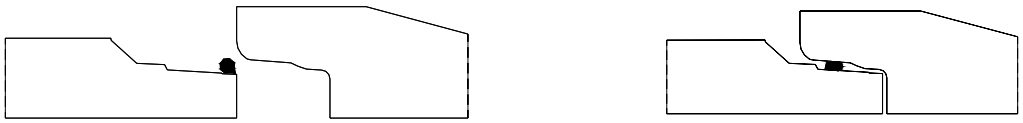
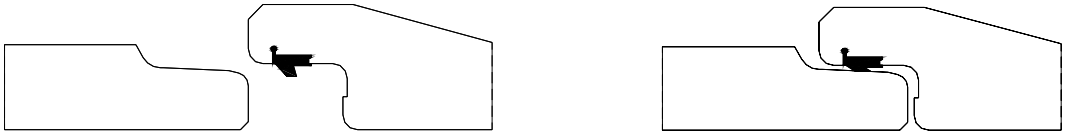


Fig. B4 Integral sealing ring



NOTES:

1. Each joint type is diagrammatic and typical.
2. Rolling and fixed rings may be one of a variety of different profiles/cross sections/designs.
3. Tolerances of joint profiles shall be determined by the pipe manufacturer and described in factory documents.
4. Joint assembly shall be watertight/ airtight when constructed in strict accordance with the manufacturer's recommendations.
5. Pipes with integral seals offer some protection to the seal, however the same precautions should still apply to protect the seal.

2.5 REINSTATEMENT

Trench reinstatement

After inspection and testing, backfilling should proceed whilst withdrawing trench sheeting in stages where practicable.

The sidefill is of great importance and close attention to its selection, placing and compaction will protect a new pipeline.

Good trenching practice including controlled removal of temporary supports and compaction of backfilling as described above not only protects the pipeline but will also reduce settlement and the risk of damage to adjacent underground services or structures.

The trench should be backfilled as soon as possible after the pipes are laid bearing in mind any specified test and inspection requirements.

Compaction of the envelope of material immediately around the pipe is extremely important. In trench installations, as space is limited, mechanical compactors are commonly used but caution should be exercised so as not to damage or displace the pipe. The material should be compacted at near optimum moisture content and should be brought up evenly in layers on both sides of the pipe, withdrawing trench sheeting as backfill proceeds. Backfill material should not be pushed into the trench from the surface nor dropped in bulk directly onto the pipe.

Heavy mechanical equipment should not be allowed to traverse pipelines with limited cover except at prepared crossing places.

Fill material

Material for sidefill, initial and final backfill should be similar in character to the surrounding soil; for example, the use of single size granular material in a clay soil will create a natural drainage channel that could cause subsequent settlement.

Sidefill and initial backfill should be free from large stones, heavy lumps of clay, frozen soil, tree roots and other rubbish, and should be readily compactable.

Sidefill

The sidefill should be placed and compacted as soon as possible after laying, or as soon as it is safe to do so without damaging concrete beddings. Compaction should be carried our evenly on each side of the pipe to prevent lateral or vertical displacement.

Initial backfill

This should also be placed as soon as possible in order to provide protective cover of not less than 300mm compacted depth. This should consist of bedding or selected material placed carefully and evenly over the top of the pipe and lightly compacted by hand.

Removal of trench supports

Trench sheeting should be removed as backfilling proceeds, where practicable as soon as it is safe to do so.

Remaining backfill

This should be placed evenly in layers and compacted as appropriate.

2.6 TESTING

Acceptance tests on the completed pipeline give an indication of the level of control of workmanship and materials during construction.

Visual inspection

Check for: -

a) Obstructions and debris.
b) Structural soundness of pipes.
c) Joints properly sealed.
d) Line and level within tolerance.

Man entry sized pipelines can be physically inspected whilst smaller diameters can be visually inspected from manholes or by means of CCTV cameras.

Air and water tests

All lengths of drain and sewer up to DN 750 should be tested for leakage by means of air or water tests.

These tests should be carried out after laying and before backfilling. Some backfill may be placed at the centre of each pipe to prevent movement during testing. Short branch drains connected to a main sewer between manholes should be tested as one system with the main sewer. Long branches should be separately tested.

Air test

The air test is more convenient than the water test, but the leakage rate cannot be measured accurately. An excessive drop in pressure in the air test may indicate a fault in the line such as a displaced sealing ring or it may be due to faults in the testing apparatus. Therefore the first check must be on the apparatus, especially the seals of the stop ends and all connections.

The point of any leakage may be difficult to detect but spraying with soap solution could indicate such leakage by the presence of bubbles.

Failure to pass this test is not conclusive and, when marginal failure does occur, a water test should be made and the leakage rate determined before a decision on rejection is made.

Air test requirements are specified in ‘Civil Engineering Specification for the Water Industry’.

Water test

A water test is the more conclusive method of testing a completed pipeline but problems of availability and disposal of the quantity of water involved may cause difficulty. Before backfilling, leakage can be clearly located, its amount assessed and where necessary appropriate remedies applied.

To test the pipeline:-

a) Insert plugs in both ends of the drain or sewer and in connections if necessary. Precautions should be taken by strutting or otherwise, to prevent any movement of the drain or sewer during testing.
b) Fill the system with water ensuring all the air has been expelled.
c) Allow at least two hours before test readings are taken to permit conditions to

stabilise, adding water to maintain the test head.
It may be necessary to extend this period for large diameter pipes, up to twenty-four hours or more before a stable condition is reached.

d) Apply required test head at the upper end by means of a flexible pipe leading from a graduated container or stand pipe.

e) Apply the test pressure of 1.2m head of water above the soffit of the drain or sewer at the high end with a maximum of 6m head at the low end. If this exceeds 6m test the drain or sewer in stages.

f) Measure the loss of water over a period of 30 minutes by adding and metering quantities of water at intervals of 5 minutes to maintain original water level in the standpipe.

Over this 30 minute period the quantity of water added should not exceed 0.05 litre per 100 linear metres per millimetre of nominal size of the drain or sewer.

For example:

For a 150m length of DN 800 the allowable leakage would be:

$$0.05 \times \frac{150}{100} \times 800 = 60 \text{ litres}$$

Should the pipeline not comply with these requirements it will probably be attributable to one of the following:-

a) Leakage from test equipment.

b) Trapped air

c) Leakage from joints, e.g. displaced ring

d) Leakage from damaged or defective pipe

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