Swan Plastics

Installation Practices

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1. INSTALLATION

The practices detailed herein are equally applicable for pressure pipe and sewer pipe in most cases. However where differences occur these will be highlighted in the appropriate section.

1.1 BURIED INSTALLATIONS

It is common practice for engineers to refer to the various sections of SANS 1200 with regard to the underground installation of PVC pipes. What follows are additional points which are considered as good practice.

1.1.1 Trenches

The alignment and gradient of a trench is generally specified by the engineer in charge. It is important that the trench is not opened too far in advance of the pipe laying operation so as to minimize the risks associated with open trenches.

Trench widths

Trench widths should always be kept to a minimum, allowing just enough working space for jointing and initial compaction around the pipe. A rule of thumb is that the trench width should be 300mm wider than the diameter of the pipe.

Trench depths - minimum cover

The minimum cover over the crown of a pipe is determined by the loads imposed on the pipe by the mass of the backfill material, the degree of compaction of the backfill, the expected traffic loads and any other superimposed loads. Another factor is the likelihood, or otherwise, of future excavations in the vicinity of the pipeline.

Common practice in South Africa is that the cover should be no less than 900mm (as per SANS 1200).

The actual trench depth will allow for the specified minimum cover, the pipe diameter, and the specified minimum bedding depth (which should be no less than 100mm).

Recommended Fall

Grade the sewer to follow the slope of the ground as far as practical. Follow the minimum permissible full-bore velocity of 0,9m/s as a minimum gradient to ensure proper gravitational flow. It is important to note that if the correct backfilling and compaction procedures are followed then there is no theoretical limit to the depth that PVC sewer pipes may be buried. However practical issues related to safety and site soil and backfilling conditions may dictate otherwise. The recommendations of the engineer should be followed.

Preparation

The bed of the trench must be free from any hard or sharp projections which may damage the pipe. The bedding should be thoroughly and uniformly compacted and leveled.

Refer to SANS 2001 DPI 2 for specification on bedding

Bedding material

The suitability of a material depends on its compactability.

Granular materials (containing little or no fines) that require minimal compaction and are preferred.
The majority of particles in a bedding material should be less than 20mm in size. A small percentage of particles may be larger than 20mm but no more than 40mm in size.

1.1.2 Pipe Laying

Prior to installing any pipes it is important to ensure that each pipe is free of any defect which may have been caused during transport to the installation point.

In particular the following should be checked;

- Damage to the external or internal surfaces should be limited to superficial scratches or scores (depth not more than 5% of the standard wall thickness).
- The spigot and socket ends of the pipe must be free of dirt and burrs.
- The spigot end must have a uniform chamfer of about 15° around the circumference of the pipe.

1. INSTALLATION

1.1.3 Joint deflection and longitudinal bending

Each rubber ring joint can accommodate up to 0.5° of misalignment and in addition each length of pipe may be deliberately and uniformly bent to a limited extent. As a rule of thumb the radius of such a bend must not be less than 300 times the pipe diameter .

1.1.4 Backfilling material

The material used for side filling and initial backfilling (also referred to as "overlay") should be identical to the bedding material. This material should, when compacted, provide a cover of 300mm above the crown of the pipe

The rest of the backfilling material may be the excavated material from the site unless otherwise specified by the engineer

1.1.5 Backfilling

Frequently, pipes that are being laid have been lying in the sun alongside the trench and may therefore have expanded slightly. Once these pipes are installed they are likely to contract because the bed of the trench is often in shadow. It is therefore recommended that each pipe be at least partially backfilled immediately after installation. This will restrict the contraction to each individual pipe length and this can be adequately catered for by the rubber ring joint.

It should be noted that the rubber ring jointing system is designed to cater for considerably more than this and therefore, if correct installation procedures are followed, separation of the spigot and socket will not occur

Side filling and Overlay

The selected material should be carefully placed in un-compacted layers of about 75mm.Tamping should follow with a hand tamper.

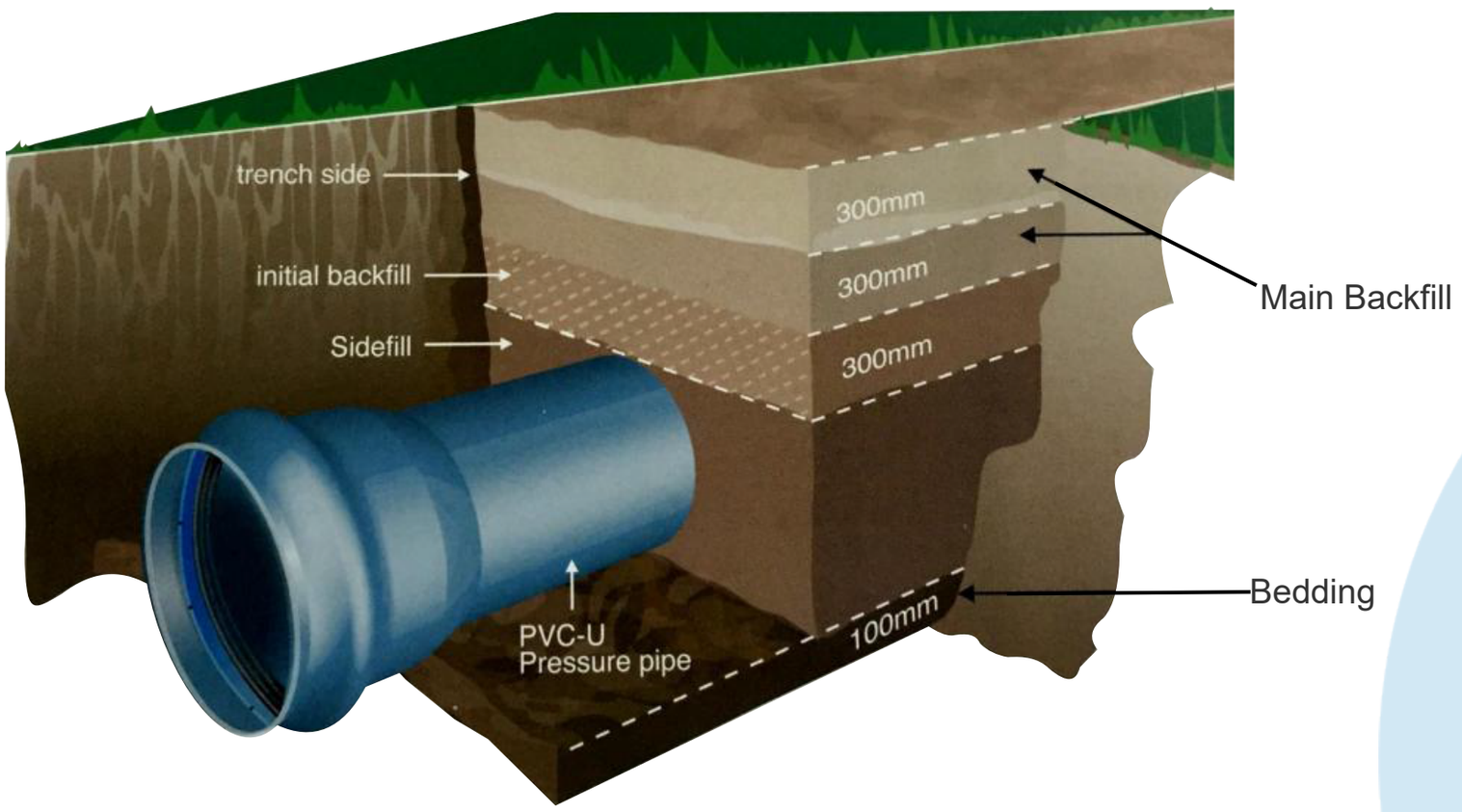
This should continue until level with the crown of the pipe. Lateral movement of the pipe can be limited by simultaneous filling and even compaction on either side of the pipe. Thereafter 150mm un-compacted layers can be placed and hand tamped until 300mm above the crown.

During this process all joint must be left exposed so that possible leaks can easily be detected during subsequent pressure (or air testing for sewer pipes) testing.

Main backfill

The remainder of the backfilling should be in layers of 300mm and at this stage mechanical compaction equipment may be used if necessary.

All joints must still be left exposed until pressure (or air) testing has been successfully completed.



1. INSTALLATION

1.1.6 Backfilling at joints

After successful pressure (or air) testing backfilling can proceed at the joints using the same procedure outlined above.

1.1.7 Anchoring

All buried PVC pressure pipes with rubber ring joints must have concrete thrust blocks to prevent movement, and possible failure, of the pipeline when pressure is applied.

The thrust blocks are designed to spread load from a pressurized pipe over a larger bearing area and against the undisturbed surface of the trench side wall.

An unbalanced thrust is developed by a pressurized pipeline at;

- Changes of direction greater than 10° e.g. Tees and Bends.
- Changes in pipeline size.
- Valves and end caps.

The engineer must design appropriately sized thrust blocks for all the above situations and will consider the load bearing capacity of the soil, the test pressure, the size of the pipe and the direction of the resultant thrust. Some guidance in this regard can, if required, be obtained from the Swan Plastics technical department.

It is often necessary to construct temporary thrust blocks at the two ends of a test section for use during the pressure testing process. Such blocks would usually be removed after the testing is complete.

1.2 Expansion and contraction

In the case of buried PVC pressure pipes with rubber ring joints, expansion and / or contraction is catered for during installation and in service. A PVC pressure pipe will expand or contract 0.06mm per meter per °C rise or fall in temperature. A 30°C temperature rise will therefore result in a 10,8mm expansion of a 6m pipe.

1.3 Casting pipes in concrete

If it is necessary to cast PVC pipes into concrete it is very important to take the following precautions.

- The portion of pipe to be cast into the concrete should first be completely wrapped with a compressible material such as rubber insertion. The minimum thickness of this wrapping should be 5% of the pipe diameter
- As an alternative to the wrapping it is necessary to ensure that a flexible joint (such as the rubber ring joint) is used at the entry to, and at the exit from, the concrete.
- If the concrete has an expansion joint incorporated then it is necessary to incorporate a coinciding rubber ring joint into the pipeline

2. TESTING

2.1 GENERAL

Since PVC pressure or sewer pipes carrying the SANS mark of approval (SANS 966) will have been subjected to numerous quality tests prior to despatch it is therefore logical that the purpose of a field pressure or air test will be to test the design of the pipeline and the quality of workmanship applied during construction.

2.2 PRESSURE TESTING

Prior to the commencement of testing all bedding and backfilling should be completed and all joints must be uncovered for inspection during the test. All thrust blocks for fittings and valves must be finished and adequately cured. All blank ends (installed temporarily for the test) must be properly secured and supported to deal with the thrust of the pressure test.

Test lengths

Testing of the pipeline can be done as a whole, or in sections, depending on the diameter and length of the line. As a rule of thumb any pipeline which is less than 1000m long can be tested as a whole. Longer pipelines should be divided into sections of not more than 1000m and it is advisable for the first section to be about 500m long (so as to quickly identify possible areas of faulty installation and/or handling).

Filling of test section

The pipeline must be filled from the lowest point so as to ensure that no air is entrapped. It is also very important that the line is not filled too rapidly and the following table gives recommended maximum filling rates for the various sizes.

Size (mm)	Max Filling Rate (l/min)
50	5
63	8
75	11
90	15
110	20
125	30
140	37
160	50
200	95
250	150
315	215
355	290
400	380

Applying pressure

A period of about twelve hours should elapse, after the pipeline has been filled, before commencing the pressure test. This is to allow any remaining air in the line to reach the highest points where it can be bled off before testing.

It is recommended that the pressure test should be applied for a period of one hour at a pressure not exceeding 1.25 times the rated pressure (class) of the pipe under test as per SANS 2001 DPI 2 Requirements. It is often specified that a pressure test be at 1.5 times and in such cases it is recommended that it be 1.5 times the design working pressure of the pipeline (as opposed to 1.5 times the class of the pipe). Pressure readings must be taken at the lowest point on section being tested.

After the test pressure has been achieved it is advisable to record the drop in pressure (if any) every 15 minutes and to restore the pressure – while recording the quantity of water required to make up the pressure. The pressure drop between the readings should decrease and if this is not the case it is possible that a leak is occurring. If, after inspecting the line for leaks, no cause is found then it may be as a result of entrapped air. In such a case it is necessary to allow a flow of water through the line in order to move the air to the air valve points.

2. TESTING

Allowable leakage rates

During a pressure test a pressure drop may occur as a result of a number of causes such as, leaking joints or valve glands, expansion of the pipe, air going into solution or movement of thrust blocks. None of these should continue and hence there is a limit to the amount of make up water required to restore pressure.

A pressure test is considered successful if the quantity of make up water does not exceed the liters given by the following formula, as per SANS 2001 DPI 2 section 7.3.3 (b) recommendation.

0.01 x diameter of pipe in millimeters
x length of test section in kilometers
x square root of the test pressure in mega pascals

e.g. A 200mm Class 16 pipeline which is 1500 meters long and being tested at 20 bar (125 x 16) must not use more than the following quantity of water to restore the test pressure after one hour

0.01 x 200 x 1.5 x 4.24 liters

After successful completion of pressure testing
all joints, that were left exposed for the test, must be backfilled in exactly the same manner as that used for the rest of the

Allowable leakage rates - Liters/kilometer/hour at a test pressure of 1.25 times the pipe class.

Pipe Diameter (mm)	Test Pressure 750 kPa (Class6)	Test Pressure 1125 kPa (Class 9)	Test Pressure 1500 kPa (Class 12)	Test Pressure 2000 kPa (Class 16)	Test Pressure 2500 kPa (Class 20)	Pressure Test 3125 kPa (Class 25)
50	0.43	0.53	0.61	0.71	0.79	0.88
63	0.55	0.67	0.77	0.89	1.00	1.11
75	0.65	0.8	0.92	1.06	1.19	1.33
90	0.78	0.95	1.10	1.27	1.42	1.59
110	0.95	1.17	1.35	1.57	1.72	1.94
125	1.08	1.33	1.53	1.77	1.98	2.21
140	1.21	1.48	1.71	1.98	2.21	2.47
160	1.39	1.70	1.96	2.26	2.53	2.83
200	1.73	2.12	2.45	2.83	3.16	3.54
250	2.17	2.65	3.06	3.54	3.95	4.42
315	2.73	3.34	3.86	4.46	498	5.57
355	3.07	3.77	4.35	5.02	5.61	6.28
400	3.46	4.24	4.90	5.66	6.32	7.07

2. TESTING

Entrapped air in pressurized pipeline

The potential negative effects of entrapped air in a pipeline can be catastrophic and every effort must be made to ensure that it has adequate escape routes. This is particularly important when pipelines are laid along very flat terrain as it is more difficult to remove air from such lines.

It is always advisable to follow rigidly the directions of the design engineer or those of reputable air valve manufacturers.Taking short cuts in this regard can lead to serious problems.

Similarly, the consequences of inadequate vacuum relief can also be very costly.

2.3 AIR TESTING

To ensure that a newly laid sewer line does not leak contaminated water into the surrounding soil it is necessary to carry out an air test (manometer test) as is recommended in SABS 0252-2.The equipment needed to carry out such a test is as follows:

- A manometer with an air pump and connecting hoses.
- Test plugs and end caps.
- Soapy water (or smoke producing equipment).

2.3.1 Procedure

- Fill all traps (in the section to be tested) with water
- Fit test plugs to all open ended pipes and fittings in the section to be tested.
- Ensure that all access covers are securely in place.
- Fit the manometer to one of the test plugs and ensure that the water level is adjusted to zero.
- Pump air into the system until the manometer gives a pressure reading of about 350mm of water
- Close the valve on the manometer and allow the water level to stabilise for a couple of minutes.
- Make sure there are no leaks in the test equipment.
- Adjust the pressure down to 250mm of water

Start recording the time. The pressure is allowed to drop to no less than 125mm of water within a minimum period of time which varies according to the size of the line being tested.

Table of minimum times for pressure drop to no less than I 25mm of water.

Pipe Size (mm)	Minimum Time (Minutes)
110	2
160	3
200	4
250	4.5
315	6
355	7.5
400	8

3. TRANSPORTATION

When PVC pipes are being transported the following points should be observed:

- The design of the vehicles load area should not have any sharp projections — it should have a flat bed and uprights that are at least 100mm wide.
- Pipes should have continuous contact over their entire length with the load bed.
- When a mixed load of pipe sizes and classes is being transported the heaviest / largest pipes must be loaded first and followed progressively by lighter / smaller pipes.
- Adequate precautions should be taken to ensure that pipes cannot slide during braking or acceleration.

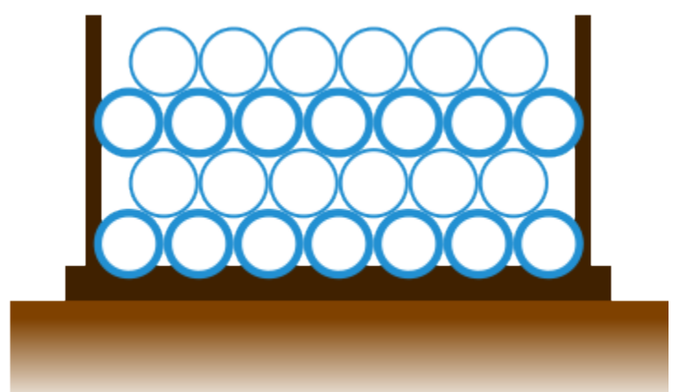
4. HANDLING & STORAGE

PVC pipes are often mishandled due to their lightness — being thrown from vehicles instead of careful offloading for example. Despite their toughness it is still possible that they may be damaged and all normal care should be taken to avoid this.

The following procedures will minimize the possibility of damage and ensure a trouble free installation:

- The following 3 methods of stacking are recommended:

- The ground on which pipes are stored should be reasonably level and free of sharp objects and dry grass or any material which may constitute a fire hazard.
- Avoid exposure to excessive heat which may lead to distortion of the pipes.
- Avoid long term exposure to sunlight / ultraviolet light which can discolour the pipes and in extreme cases lead to embrittlement. It is recommended that shade cloth be used to minimize such exposure. The time that pipes can be exposed varies according to local conditions but as a rule a period of 2 months will not be harmful.



4. HANDLING & STORAGE

4.1 Handling and storage

Due to the extreme lightness of PVC pressure pipes, there is a tendency for the pipe to be thrown off vehicles onto the ground during offloading. This should be avoided as damage can occur to the ends of the pipes resulting in unnecessary repair work before installation can begin.

Contrary to the stacking procedure, it is permissible to load pipe to a greater height than 1.0 meter on vehicles providing the pipe is removed immediately the vehicle reaches the delivery point and is correctly stacked.

Socketed pipes should be loaded in a similar manner to the stacking images in Figure 4.1.1.1; 4.1.1.2 and 4.1.1.3 and the heavy pipes must be placed at the bottom of the load.

As far as possible, pipes should be stored in the shade to eliminate distortion caused by excessive heat. Long term exposure to sunlight and ultra-violet radiation must be avoided. Storage in this case should be effected under cover, i.e. pipe racks or under shade cloth. During prolonged exposure to UV radiation PVC pipes will discolour/in this case Swan Plastics' Technical Advisor could be consulted to advise if the pipes are still suitable for use as intended.

When pipes are temporarily stored in the field, care must be taken to ensure that the ground is level and free from stones or sharp projections.

NB. Make sure that the area is free from dry grass or any material likely to constitute a fire hazard.

NB. Socketed Pipe - It is essential that pipes are stacked with the socket and spigot ends alternating and with the sockets projecting so that there is a barrel to barrel contact along the lengths of pipe. This eliminates the bowing of pipe and the possible distortion of sockets caused by the riding of one socket on another.

4.1.1 Pipe stacking

The bottom row of pipe should be raised on supports spaced at 1-2m intervals along the length of the pipe. The width of the supports must not be less than 75mm.

Figure 4.1.1.1 typifies this type of stack.

Figure 4.1.1.2 gives a frontal view of this stack and use is again made of timber supporting struts.

Figure 4.1.1.3 and the picture typifies a practical method cross-stacking.)fie socket and spigot ends must alternate on each row so that barrel to barrel contact is afforded, the difference being that rows are placed in alternate directions until approximately 1,5m high.

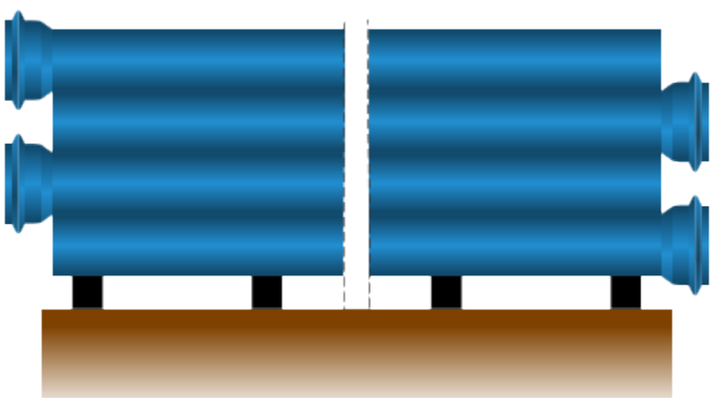


Figure 4.1.1.1

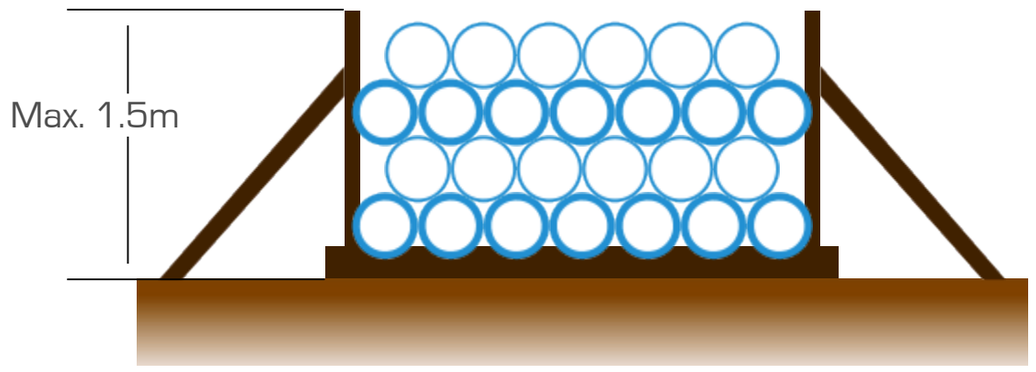


Figure 4.1.1.2

Figure 4.1.1.3

5. JOINTING

5.1 CUTTING

PVC pipes can be easily cut using a number of different cutting tools, such as proprietary cutting tools which cut, deburr and chamfer in one operation, circular saws or hand saws. It is important to ensure that, after cutting, the pipe end is thoroughly deburred.

5.2 SOLVENT WELD JOINTS

It must be stressed that solvent cement jointing is a welding and not a glueing process. It is important therefore that there is an interference-fit between the spigot and socket to be joined. Do not attempt to make a joint when an interference-fit between a dry spigot and socket is not achieved (i.e a rattle fit).

There are different types of solvent cement available for pressure pipes and for non-pressure applications. Make sure that the appropriate cement is being used. Do not dilute or add anything to the solvent cement.

-Jointing procedure

Assemble all the required fittings, pipes and equipment. See below.

For the best results, follow the Jointing procedure below:

1. Make sure that the spigot has been cut square and that all burrs have been removed.
2. Mark the spigot with a pencil line (or similar) at a distance equal to the internal depth of the socket.
3. Check that, while dry, there is an interference fit between the spigot and the socket before the spigot reaches the full depth indicated by the pencil line.
4. Ensure that both the spigot and the socket are properly dry.
5. Degrease and clean both with an appropriate etch cleaner.
6. With a suitable brush apply a thin film of solvent cement to the internal surface of the socket first. Then apply the solvent cement in a similar manner up to the mark on the spigot. Do not use excess solvent cement. The brush width should be such that the solvent cement can be applied to both surfaces within about 30 seconds.
7. Make the joint immediately. While inserting the spigot rotate it by about 90° and ensure that it is fully inserted up to the pencil mark, as well as a bead of excess solvent cement indicating the correct amount has been applied. Hold steady for at least 30 seconds. Mechanical assistance may be necessary for large pipes.
8. Wipe off any excess solvent cement with a clean rag.
9. Do not disturb for at least 5 minutes.
10. Do not apply pressure for at least 24 hours.

5. JOINTING

5.3 RUBBER RING JOINTS

The rubber ring joint is integrally molded on one end (socket end) of the pipe. The joint incorporates a factory fitted rubber sealing ring which is retained in position by a polypropylene lock ring. The opposite end of the pipe (spigot end) is suitable chamfered and has a "depth of entry mark" near its end. Each joint is capable of handling some expansion and contraction as well as angular deflection. The seal ring is designed to provide a watertight joint at high and low pressures.

5.3.1 Depth of entry

The "depth of entry" mark on the spigot end of the pipe is a guide to ensure correct depth of insertion of the spigot into the socket of the next pipe.

If pipes are cut to measure on site it is necessary to re-mark the "depth of entry" according to the dimension given in the following table. Re-marking can be done with a permanent felt tipped marker pen.

5.3.2 Chamfering

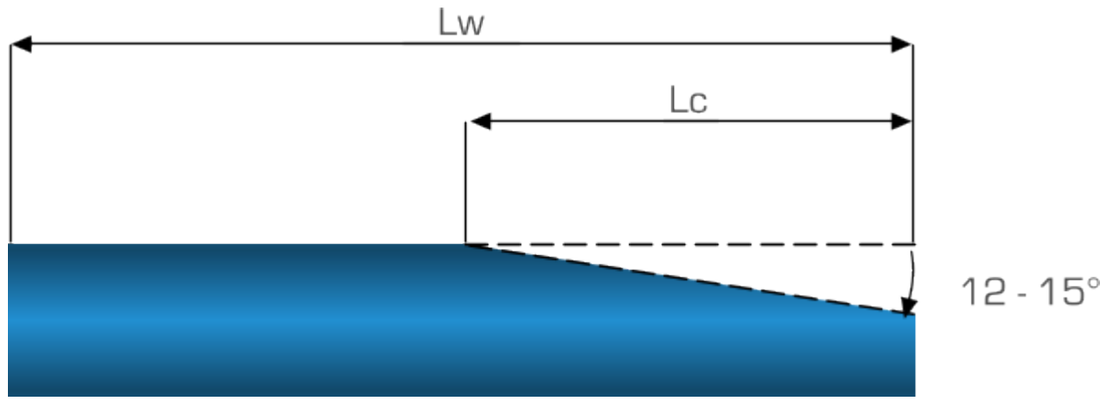
The spigot end of all rubber ring jointed pipes is chamfered at the time of manufacture. Chamfering facilitates the insertion of the spigot end into the socket of the next pipe without damaging or dislodging the rubber ring. If however the chamfering has been cut off it is important to re-chamfer the end correctly.

Pipe Size mm	Depth of Entry mm (Lw)	Approx Length of Chamfer mm (Lc)
50	88	5
63	93	5
75	98	5
90	105	5
110	113	8
125	114	8
140	126	8
160	129	10
200	159	13
250	183	15
315	189	20
355	203	23
400	225	25

Re-chamfering can easily be done using a file that leaves no sharp edges which may cut the rubber ring. It should be at an angle of about 12 -15° and the length of the chamfer should be such that at least half of the wall thickness is removed. The chamfering should not be done to such an extent that a sharp edge is made at rim of the bore.

5.3.3 Lubricant

It is most important to use correct lubricant when making a joint. The lubricant considerably reduces the effort required to insert the spigot into the socket and at the same time minimizes the possibility of dislodging the rubber ring. The lubricant should be water soluble, non toxic and of a gel consistency Alternative lubricants such as oil, grease, diesel, dish washing liquid etc. must under no circumstances be used.



5. JOINTING

5.3.4 Jointing procedure

1. Check the spigot end of the pipe for correct chamfering (12 - 15° with the correct length) as described in "Chamfering" above. Ensure that the "depth of entry" mark is visible and that there are no burrs or damage present.

2. Wipe the spigot end clean.

3. Check the socket end of the pipe to ensure that the rubber ring is present an correctly fitted. Make sure that that no dirt or mud is present

4. Apply a thin film of lubricant evenly around the circumference of the spigot up to about half the distance to the "depth of entry" mark.

5. Lubricate the rubber ring sparingly.

6. Place the spigot end of the pipe into the socket so that it rests against the rubber ring.

7. Ensure the two pipes are correctly aligned both horizontally and vertically. Failure to do this could lead to the rubber ring being dislodged when the next step is carried out (not illustrated).

8. Push the spigot into the socket until the "depth of entry" mark is just visible at the end of the socket. It should not be necessary to use undue force — if this becomes necessary it is normally an indication that something is amiss and the joint making process should be started again.