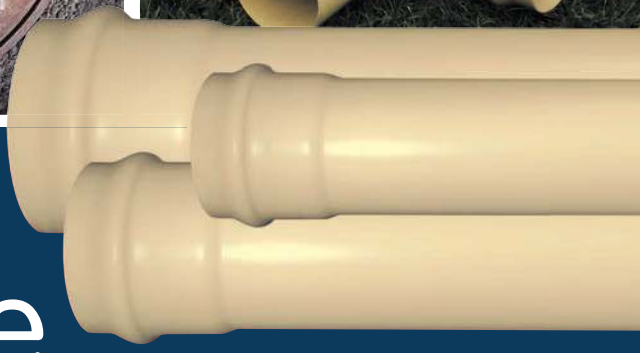
Swan Plastics









DESIGN MANUAL 2022

Sewer PVC Pipe Installation Practices



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Pipe Dimensions

FREEFLO Soil, Vent and Waste Pipes

Outside diameter (mm)	Nominal Wall Thickness (mm)	Mass (kg/meter)
40	2,0	0,40
50	2,2	0,53
75	2,2	0,79
110	3,2	1,67
160	3,3	2,54

FREEFLO soil, waste and vent pipes and fittings are manufactured to SANS 967 and are designed specifically for use above ground and outdoor in non-pressure drains and venting applications.

DURODRAIN Sewer & Drain Pipes

Class 51 – Normal Duty

Outside diameter (mm)	Nominal Wall Thickness (mm)	Mass (kg/meter)
110	2,2	1,14
160	3,2	2,51
200	3,9	3,80
250	5,0	6,18
315	6,2	9,69
355	7,0	12,30
400	7,9	15,68

DURODRAIN normal duty sewer and drainage pipes are manufactured to SANS 791 and are used in underground drains. Swan Plastics offer a range of DURODRAIN fittings to complete the range.

Class 34 – Heavy Duty

Outside diameter (mm)	Nominal Wall Thickness (mm)	Mass (kg/meter)
110	3,0	1,55
160	4,7	3,67
200	5,9	5,63
250	7,3	8,97
315	9,2	14,15
355	10,2	18,45
400	11,7	22,83

DURODRAIN heavy duty sewer and drainage pipes are manufactured to SANS 791 and are used in underground sewers. The DPI Plastics DURODRAIN range of fittings is used with these pipes.

SUPERSWAN Structured Wall PVC Pipes

Outside Diameter (mm)	Class 100 Normal Duty		Class 200 Medium Duty		Class 400 Heavy Duty	
	E4 / ID (mm)	Mass (kg/m)	E4 / ID (mm)	Mass (kg/m)	E4 / ID (mm)	Mass (kg/m)
110	0,4 / 105	1,0	0,4 / 103	1,1	0,4 / 100	1,4
160	0,5 / 154	2,0	0,5 / 152	2,5	0,5 / 150	2,8

SUPERSWAN structured wall sewer and drainage pipes are manufactured to SANS 1601 and are used in underground drains and sewers. Swan Plastics multi-layer, foamed center technology offers high stiffness and low weight, compared to solid wall PVC sewer and drainage pipes. SUPERSWAN also uses 100% recycled material in the centre layer, thereby re-using PVC material for a greener product.

PVC Fittings

Swan Plastics manufactures a complete range of fittings for above ground and below ground sewer applications. Fittings have been designed to meet the relevant SANS criteria and for ease of use, longevity and cost effectiveness. Swan Plastics uses underground ribbed fittings, with ribs specifically designed to optimize stiffness, whilst reducing fitting mass and cost. The following fittings are manufactured by Swan Plastics.

FREEFLO Soil & Vent Fittings

Type	40mm	50mm	75mm	110mm
Bend 87.5°, Plain or Access	○	○	○	○
Bend 45°, Plain or Access	○	○	○	○
Adaptor, 1 ½ - 2" BSP, Male and Female	○	○		
Single Socket	○	○	○	○
Double Socket (Repair)	○	○	○	○
Junction 45° Single	○	○	○	○
Junction 87.5° Single	○	○	○	○
Junction 45° Reducing Single			○	○
Junction 87.5° Reducing Single			○	○
Pan Connector, Straight, Bent, Offset			○	○
Reducer, Eccentric, Concentric			○	○
Holder Bat, PVC or Aluminum	○	○	○	○
Vent Valve, One way or Two way		○		○
Stop End, Male or Female	○	○	○	○
Gulley Head and Grate, Round or Square				○









DURODRAIN 110mm Underground Sewer & Drain Fittings

Type	110mm	Seal Type
Junction, Square, Plain	○	Rubber Ring or Spigot/Socket
Gulley P-Trap	○	Rubber Ring and Spigot
ABC Rodding Eye	○	Rubber Ring
Stop End, Male and Female	○	Solvent Weld (f); Spigot End (m)
Stop End Access, Female	○	Solvent Weld
PVC/EW Adaptor, Female	○	Rubber Ring
Double Socket, Kimberley or Repair	○	Rubber Ring
Single Socket	○	Rubber Ring/Solvent Weld
Inspection Pipe, Access	○	Rubber Ring
Plain Bend, 22½°, 45°, 90°	○	Rubber Ring
Access Bend, 45°, 90°	○	Rubber Ring

NOTE: 160mm and larger fabricated fittings also available.







Installation

Joining of Pipes – Rubber Ring Joints



Cutting

Cut the pipe square with a cross cut saw or angle grinder depending on pipe size. Observe all safety requirements for the equipment being used. Clean away swarf and chamfer the pipe end to 15° and at least 50% through the pipe wall to ensure easy insertion when making a joint.



Cleaning the seal

It is important to ensure that the seal is free of grit and mud before making the joint. Pipe ends are often accidentally dipped into the sand.



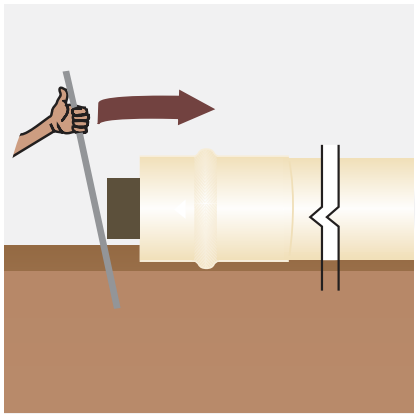
Lubrication

Swan Plastics can supply liquid lubricant or jelly-like lubricant, known as gel or soft soap. Both products are designed for lubricating pipe seals. In order to make a leak-free joint effortlessly, use liberal amounts of lubricant, but avoid getting it into the seal housing. Lumps of gel lubricant on pipe seals or spigots can be smoothed with a wet rag. Take care not to leave lumps of gel lubricant on the seal or pipe spigot. Take care to keep pipe ends free of dirt.



Depth of Entry

When making a joint, push the pipe fully home into the socket to avoid hang-up and possible blockages. For large, heavy pipes, take care not to damage the socket by pushing with excessive force when the pipe nears the end of insertion, when using mechanical means to join pipes.



Jointing

It is important that the pipe ends and socket are aligned and free of burrs, otherwise insertion into the seal ring will be difficult, or damage to the seal may occur. For protection of the pipe ends use a lever against a wooden block.



Joints

Flexible rubber ring joints are available for all types of pipe and should be used in preference to rigid joints, allowing the pipeline to flex in the event of soil movements and also allowing for thermal change.

Joining of Pipes – Solvent Cement Joints

Solvent cement joining of small bore (up to 160mm) PVC pipes is an effective joining method, provided that care is taken when joining the pipes. When done properly, solvent cement joints are just as strong as the pipe and fittings being used. The guidelines below will assist in ensuring that a proper joint is made every time.

Equipment

In order to make a solvent cement joint you need:

- A fine tooth hack saw or angle grinder
- A sealed container with fresh solvent cement. Non-pressure solvent cement is designed for use with sewer pipes
- A clean brush for applying solvent cement. A 50mm paint brush works well on larger joints, while a 25mm brush is fine for smaller SV joints
- A clean rag or paper towel for cleaning the pipe and fitting surfaces to be joined
- A pipe cleaning solution. These are normally available with the solvent cement and used to degrease the surfaces to be joined. Alternatively one can sand the surfaces using a 200 grit sandpaper.

Procedure

- Use the rag or towel paper and pipe cleaning solution to clean the pipe and socket surfaces to be joined. Do not touch the surfaces after cleaning as oils from your skin prevent bonding where you touch the joining surface. Let the solvent evaporate before continuing. When using sanding paper, sand the surfaces in the circumferential direction. Only dull the surface, do not sand too much
- Apply the solvent cement evenly to the pipe and socket using the brush. Rather apply too much than too little
- Immediately after applying the solvent cement, push the pipe into the socket, turning the pipe a quarter turn as it is pushed home. Wipe any excess solvent cement from the joint
- Leave the joint to cure before use. Instructions on the solvent cement container will indicate the curing time. Rule of thumb: curing period of not less than 4 hours is recommended.

Trenching, Bedding and Backfilling

The procedures for trenching is based on the standard specification for civil engineering construction, SANS 2001 DB1 and DB4. Additional standards and recommendations are based on the code of practice SANS 0120 and the application of the national building regulations SANS 10400 series.

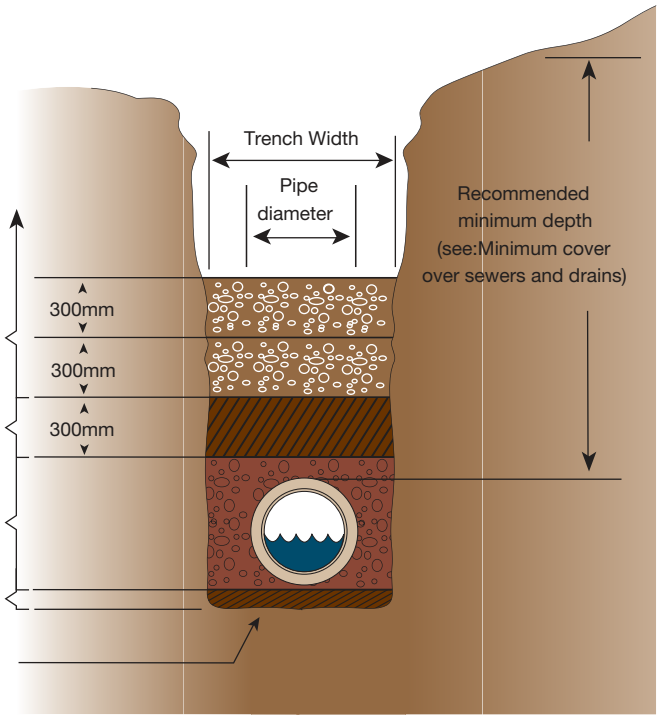
Fill in with excavated trench material tamping at each 300mm layer

Selected fill blanket compacted uniformly

Bedding cradle and sidefill of compacted, selected granular material. Allow 150mm sidefill (minimum) on both sides of the pipe and 100mm above the pipe.

Bedding (not less than 100mm, not more than 200mm)

Level required to obtain specified minimum bedding cradle thickness



Excavation

Pipe trenches shall be excavated to a depth suitable for the provision of adequate cover over the crown of the pipe, and to a specified or allowable width.

The sides of the trenches shall be as near vertical as possible for a height of at least a full diameter of the pipe, plus the specified depth of selected fill blanket over the pipe.

Trench bottom: material unsuitable for the bottom of the trench shall be excavated. The trench must be refilled with selected material and compacted. Bedding must be smooth and level.

It is important that the trench is not opened too far in advance of the pipe laying operation. Pipes must be backfilled immediately after laying, with joints left open for testing. It is recommended that the depth of cover, from the top of the pipe to the ground surface, be not less than 0.9m for sewers and 0.3m for drains.

Bedding

Bedding and fill shall be selected granular material. The trench bed must be free of stone or hard projections which are likely to cause damage to the pipe.

Backfill Material

Selected fill material shall be used and shall be free of vegetation, lumps or stones or any other foreign particles of diameter exceeding 30mm.

Bedding Cradle

PVC-U pipe must be supported on a continuous bed of selected granular material of compacted depth of at least 100mm, and covering the full width of the trench.

- Selected granular material must be of a granular, non-cohesive nature, graded between 0.6mm and 19mm, free draining and the specified compactability
- Compaction density for the bedding cradle must be 90% modified AASHTO
- Additional selected granular material must be placed around the pipe in layers of approximately 100mm and compacted to the specified density up to a height of 100mm above the crown of the pipe.

Fill Blanket

The fill blanket must be compacted to 90% modified AASHTO up to a depth of at least 300mm above the pipe crown. Take particular care not to damage, deflect or displace the pipeline during laying.

Minimum Cover over Sewers and Drains

Design the sewer invert level to provide a minimum crown depth cover over the top of the pipeline of 900mm for sewers and 300mm for drains. Calculate the expected traffic loads on sewers and drains where they run under roads or sidewalks, and, if necessary, increase the minimum cover in such areas.

Backfilling

Backfilling of pipe trenches must commence after the pipe has been laid and firmly bedded in the bedding cradle, and the selected fill blanket placed and compacted, as specified above. The pipe must be backfilled immediately after laying, leaving the joints exposed for testing. The pipeline must be laid directly on the prepared bedding in the trench, and any temporary supports, bricks or other foreign hard bodies must be removed.

Compaction

Backfilling must be done in 300mm layers and each layer compacted to 90% modified AASHTO density. In areas of road traffic loads, trenches must be backfilled in layers not exceeding 150mm (after compaction) and the material compacted to 93% modified AASHTO density for cohesive soils and to 98% in the case of non-cohesive soils.

Encasing Pipe in Concrete

Concrete encasing of horizontal PVC pipelines is not recommended, as it converts a flexible pipeline into a long, unreinforced concrete beam of negligible strength, likely to fracture with minor ground movement.

Under concrete slabs of raft foundations, a minimum compacted cushion of 75mm fill between the pipe crown and soffit of the slab should be provided. Where the pipe passes through a ground beam or footing, a lintel, reveling arch, or similar device, should be used to provide a minimum of 50mm clearance.

When casting concrete around a vertical pipe, note that concrete has a high density and it is recommended that casting be done slowly, taking care not to collapse the pipe. The critical buckling strength of the pipe has to be taken into consideration.

Recommended Fall

Maximum Gradients and Anchoring

Grade the sewer to follow the slope of the ground as far as practical. Where slopes greater than 1 in 10 are required, provide 20MPa concrete anchor blocks that are at least 300mm wide and that are embedded into the sides and bottom of the trench to a depth of 150mm. Avoid sharp transitions at the bottom of steep slopes.

Minimum Gradients

The minimum permissible full bore velocity, normally 0.9m/s, determines the minimum gradient. In exceptional circumstances only, a minimum velocity of 0.6m/s may be used. The minimum gradient is required to ensure movement of solids and liquids in the sewer pipeline, to prevent blockage. The flow in a gravity sewer can be calculated using Manning's equation. See section Design for details.

Repairs

The Kimberley socket is used to make repairs to pipework or to insert new fittings into the pipeline.

To insert a socketed fitting, proceed as below, but first fit a length of pipe into each socket of the fitting and position it between two Kimberley sockets as before.



Cut and remove the portion of the pipe to be replaced

a. Chamfer and remove burrs
b. Prepare the replacement pipe and fittings



Lubricate both seal rings of the Kimberley socket and locate the fitting on the existing pipe



Fit the replacement unit into position



Slide the Kimberley socket over the joint between the new and existing pipe

Rodding

If the drainage system is designed and laid correctly, rodding is seldom needed. Note that incorrect rodding procedures can lead to damage to the drain, regardless of what material it is constructed from. It is strongly recommended that a drain cleaning expert is consulted for advice on the correct type of equipment to use.

It is imperative that one ensures that the rubber seal ring and pipe are well cleaned before making a connection. The major reason for rodding is caused by root ingress which can be avoided if rubber seal rings are not dislodged or damaged during installation.

- Ensure rubber seal ring and pipe are well cleaned before making a joint
- Correct amount of lubrication must be used.

Correct system design is also very important to ensure rodding friendly pipelines. The use of ABC rodding eyes at the end of every straight pipe section and long radius or 45 degree bends where rods can pass are recommended.

Water Jetting

Water jetting is becoming increasingly popular as a method for cleaning and maintaining sewers and drains. This method is suitable for use on PVC-U systems.

DPI Plastics successfully conducted a series of tests under the auspices of the Structured Wall Pipe Association of South Africa. The United Kingdom based Water Research Council's acceptance testing methods were adopted as a pipe material selection criteria suited for installation where water jetting is to be carried out. DURODRAIN solid wall, ULTRACOR and ULTRAPIPE structured wall pipe systems meet the test criteria which is far more onerous than operating conditions.

Equipment manufacturers provide instructions for correct cleaning methods that will prevent unnecessary accidents to the operations and the sewer system.

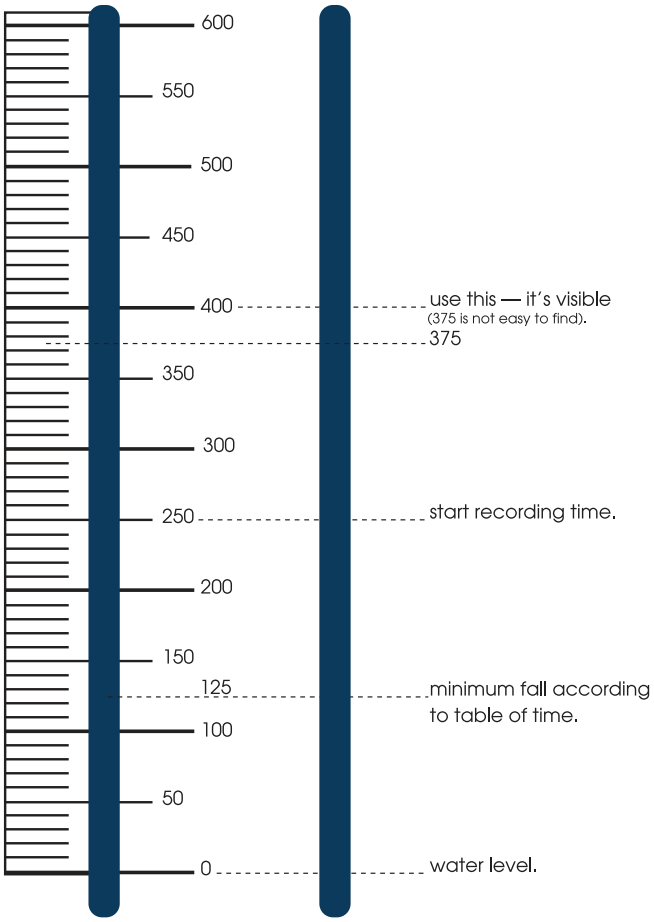
Testing

Air testing (manometer test) in sewers and drains is the accepted method that has been adopted by the industry as the most effective means of establishing acceptance by the respective authorities. Water testing is an easier method of finding leaks, but water is not always available and generally is too costly an exercise. SANS 2001: DP 4 describes the test and acceptance / rejection criteria.

Equipment required

- An approved Manometer in a leak free condition
- Testing plugs in a leak free condition (ensure the rubber seals are not perished and that end caps are sealed and not cracked)
- Stopwatch for recording the time
- Bottle of soapy water to check for air leaks
- Large bucket
- Small funnel for filling the Manometer tube.

Scale on Manometer in mm



Procedure

- Check all the equipment for leaks
- Ensure that the section of pipeline to be tested has been sealed off at all branches and that all access openings are secure
- Insert testing plugs and secure properly
- Adjust the water level in the Manometer to zero on the scale (by adding water slowly)
- Open the valve on the Manometer and pump until a reading of 400mm is reached (this reading equals a pressure of 4.00kPa). 400mm has been selected as it is easier to read than 375mm (3.75kPa) referred to in the specification
- Close the valve and allow the water column to settle for two minutes. There might be a marginal drop in pressure. Should it not stabilise, check the connections on the Manometer and plugs for leaks by pouring soapy water on them. Should there be any leaks, these must be repaired before proceeding with the test
- Open the valve and adjust the pressure to a reading of 250mm (2.50kPa) and start recording time. The pressure is permitted to drop to a reading of 125mm (1.25kPa) and the time taken to drop to this level should be no less than the time stated in the table below.

Pipe Size (mm)	Minimum Time for Pressure to Drop from 250mm (2.50kPa) to 125mm (1.25kPa) in min.
110	2
160	3
200	4
250	4.5
315	6
355	7.5
400	8
450	9
500	10
560	11
630	12

Useful tip

Test the line at short intervals to simplify the locating of possible leaks. Allocate responsibility of testing to a crew. Their familiarity with the equipment will save time and effort.

Support Spacing for Suspended Pipes

Using Pipe Hangers and Supports

All piping in a plumbing system must be supported using various pipe hangers, clamps, brackets or other supports that are capable of keeping the pipe and its contents, from unwanted movement. Without proper support for pipes, some or all of the following adverse effects may cause problems with your plumbing systems:

- **Pipe sag** - Plastic pipes are especially susceptible to sagging from heat and even under it's own weight if improperly supported. Sagging can cause blockages and improper venting within the system
- **Mechanical failure** - Improperly supported pipe causes extra strain on joints that can lead to breakages or joint separation
- **Thrust** - A properly supported pipe will limit the effects of thrust; this will extend the piping's longevity and limit noise from vibration
- **Expansion** - Every type of pipe will expand and contract with temperature fluctuations. Using the right hangers and supports to accommodate these changes, will protect the piping from damage.

Rules for pipe supports

Swan Plastics recommends that FREEFLO pipe clips or holder bats be used with FREEFLO SVW piping systems, as they are specifically designed to work with the pipes and offer good grip and support.

Piping, fixtures, tanks and equipment are to be supported independent of each other. (e.g. You can't hang a pipe from another pipe.)

When supporting plastic pipes, care must be taken not to compress or damage the pipe.

Expansion type inserts or built in hanger supports are to be used when supporting pipe from concrete. Always keep thermal expansion of PVC pipe in mind when installing a pipeline. PVC pipe will expand / contract linearly by 0.06mm per 1 meter of pipe for every degree Celsius (°C) rise/fall.

Pipe hanger spacing

Vertical pipe is supported at its base and at alternating floors to a maximum spacing of 5 meters.

Horizontal pipe and tubing is supported at intervals along its length depending on the material and pipe size. PVC plumbing pipes require the following maximum spacing between hangers and supports:

Type of Pipe	Maximum Hanger Spacing
PVC	1.2 m
PP	0.8 m

Bending and Angular Deflection

Swan Plastics pipes and rubber ring joint fittings can be deflected up to 2 degrees through each socket to accommodate small changes in direction. Small bore pipes (up to 110mm) can also accommodate up to 2 degrees of bowing through a 6 meter length. Larger changes in direction are accommodated by using DURODRAIN bends.

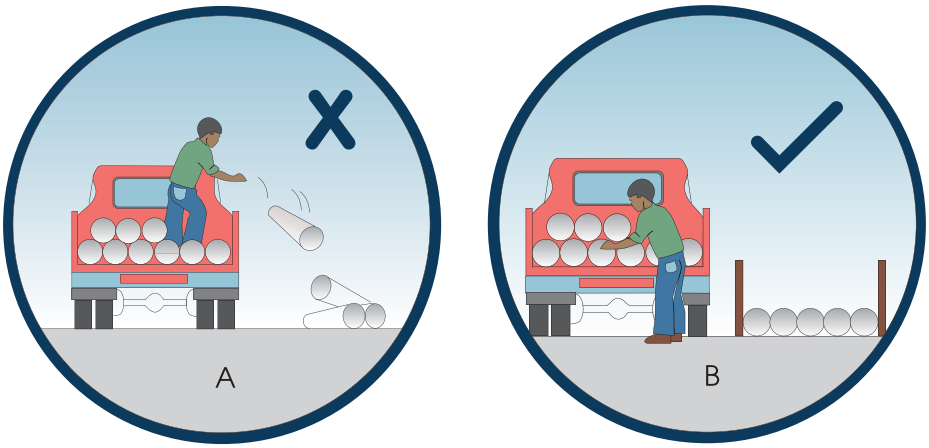
Take care to keep the pipes aligned during installation / jointing. The required deflection should be done after jointing. This minimizes the risk of damage to the rubber ring during jointing. Also note that solvent weld joints offer no deflection through the joint.



Storage, Loading and Transport

Handling

Pipes and fittings manufactured in PVC-U are strong, durable and light weight and easy to handle. In common with most construction materials, they should nevertheless not be handled carelessly, as this may cause damage. Pipe should not be dropped or dragged along the ground.

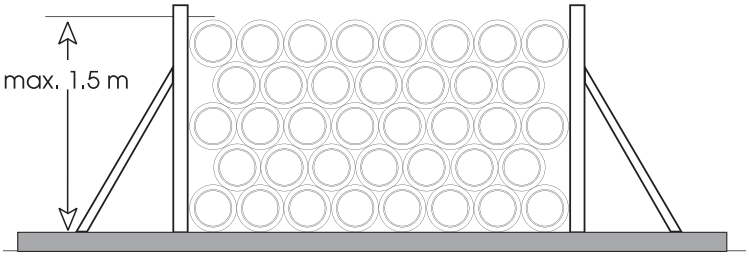


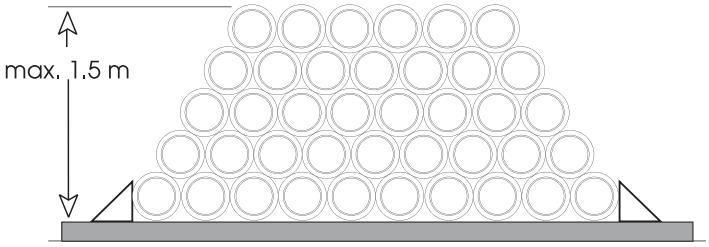
Storage

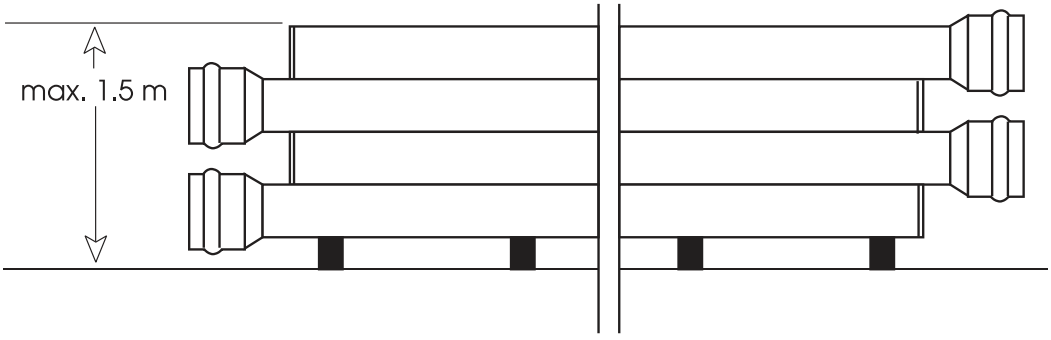
Pipe should be stored on level, flat ground, free of stones or sharp protrusions. Alternatively, they may be stored on timber supports of at least 75mm width placed 1.5m apart with side supports.

The height of pipe stacks should not exceed 1.5 metres. All pipe stacks and stored fittings should be covered to avoid prolonged exposure to direct sunlight. Where the pipes are fitted with an integral socket, they should be stacked with sockets protruding at alternate ends.

Fitting boxes should not be stacked higher than 1/3 of the shortest base length. All products must be stacked on a hard, even surface. Keep fitting boxes dry when stacked to preserve the rigidity of the box material and prevent movement.







Loading & Transport

Pipes containing integral sockets should always be loaded with sockets and spigots alternating and sockets protruding from spigots to avoid damage. A flat-bodied vehicle is ideal for transporting pipes. When a mixed load of pipes (i.e. pipes of varying diameters) is to be transported, the larger pipes should be placed at the bottom. Pipes should not overhang the vehicle by more than 1m.

Ensure that the load is securely tightened so that pipes do not move during transport. Protection should be used on corners when using straps to tighten pipes, so that corner pipes are not flattened / damaged.

PVC Properties

Polyvinyl Chloride (PVC) is a thermoplastic resin with specific properties. PVC raw material is derived from salt (57%) and ethylene, derived from oil (43%). Because of the low dependence of PVC feedstock on oil, it is considered to be one of the least energy intensive thermoplastics. It is also not as taxing on valuable oil or coal reserves as many other thermoplastics. PVC resins are blended with a variety of additives to obtain dry blends of raw material which are tailored to make products with specific properties. Types of additives which are added to give specific properties are, among others, UV stabilisers, impact modifiers, colourants and plasticisers. The adjacent table lists the properties of PVC-U material, used in the production of aboveground and below ground sewer pipes.

Physical Property	Units	PVC-U Values
Co-efficient of linear expansion	K^{-1}	6×10^{-5}
Density	Kg/m^3	1.45×10^3
Flammability (oxygen index)	%	45
Shore Hardness (D)		70 - 80
Softening point (Vicat – minimum)	°C	78 - 81
Specific heat	J/kg/K	1.0×10^3
Thermal conductivity (at 0° - 50°C)	W/m/K	0.14
Mechanical Property		
Elastic modulus	MPa	3 300
Tensile strength	MPa	45
Elongation at break	%	45
Poisons ratio		0.4
Friction Factor		
Manning		0.008 – 0.009

Pipe Stiffness

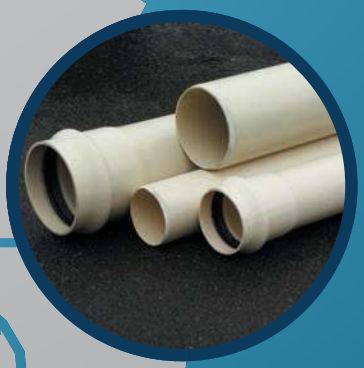
The introduction of structured wall pipes to the South African market led to the preparation of the SANS 1601 specification. This introduced the concept of pipe stiffness ratings as a pipe classification. The use of kPa rating (100, 200 and 400kPa) is often confused with a pressure class rating, but in fact relates to the amount of external pressure needed to deform the pipe by 5% of its diameter.

The Durodrain solid wall PVC-U sewer pipes manufactured to SANS 791 contains two stiffness classes – Class 51 (normal duty), being 100kPa minimum and class 34 (heavy duty), being 300kPa minimum.



Type of pipe	Applicable standard	Pipe class	Stiffness (kPa)	Stiffness (SN)
Solid Wall				
PVC-U	SANS 791	51	100	2
PVC-U	SANS 791	34	300	6
Structured Wall				
PVC-U	SANS 1601	100	100	2
PVC-U	SANS 1601	200	200	4
PVC-U	SANS 1601	400	400	8









Products available from DPI Plastics, SA's leading manufacturer of plastic piping systems for water and sanitation, include:

- Durodrain uPVC solid wall sewer and drain systems to SANS 791
- Superswan uPVC structured wall sewer and drain systems to SANS 1601
- Freeflo uPVC soil, vent and waste systems to SANS 967
- Polydrain polypropylene structured wall sewer and drain fittings to SANS 21138-3PP
- Rainflo uPVC D-shaped gutter and downpipe systems to SANS 11
- Aquaflo uPVC pressure pipes systems to SANS 966-1
- Amanziflo mPVC pressure pipe systems to SANS 966-2
- Mineflo mPVC pressure pipe systems to SANS 1283
- Hi-impact mPVC pressure pipe systems to SANS 1283

Swan Plastics

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