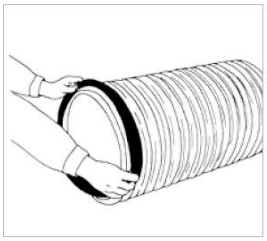
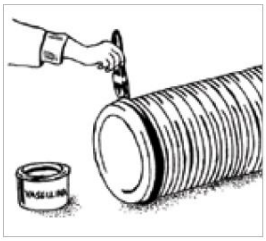
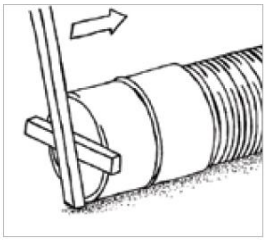
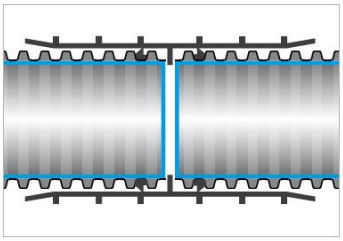
MAGNUM – USE AND INSTALLATION GUIDELINES

A correct installation is, together with the quality and characteristics of the material, one of the key aspects of the final results. This section describes different types of connections of **MAGNUM** pipes (couplers or welds), the general instructions for correct installation and instructions for making tests.

1 – JOINT SYSTEMS

1.1 – CONNECTION BY COUPLERS

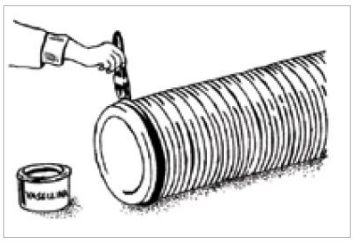
The characteristics of jointing couplers manufactured by SPC (length and thickness) are in compliance with SANS 21138-3 UNI standard. These are high-density polyethylene products made by injection moulding up to DN/OD 630 and by rotomoulding starting from DN/ID 600. **MAGNUM** pipes manufactured by SPC have a standard connection by couplers up to DN/ID 400.
The most important geometrical element of the coupler is the inside diameter which must be in compliance with the outside diameter of the MAGNUM pipe. SPC coupler lengths are remarkably higher than those provided for by the standard. This allows the insertion of at least 2-3 ribs on each side to ensure the pipe concentricity.
The special shape and position of the coupler length ensure that the coupler is neither damaged during installation nor an angular deflection occurs which may cause several deflections and consequent leaks.
Insertion must be made after the coupler inside has been lubricated. This operation must be carried out using levers or by applying a steady thrust or axial pulling and making sure that connection is correct and the seals and/or the coupler are not damaged.

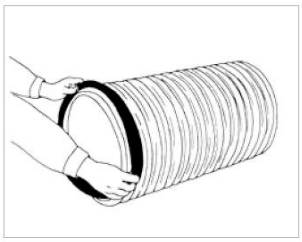





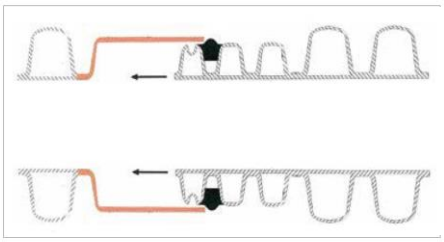
1.2 – CONNECTION BY SOCKET SYSTEM

The **MAGNUM** pipes connection with a socket is made through a special junction socket situated at the end of each bar. The socket length allows the insertion of more corrugations inside to ensure the correct alignment of the pipes. Magnum pipes have a socket connection as standard connecting system starting from DN/OD 500 up to DN/OD 1200.
The sockets are compliant with SANS 21138-3:2008.
Two steps for the pipe jointing are recommended for the correct installation on site, and for better efficiency of subsequent operations:

- The first step is to clean the outside wall of the pipe, the inside wall of the sleeve/socket and the gasket, in order to prevent the dirt from disrupting the connection;
- The second step is the determination of the lengths of the pipe that can be inserted into the socket.







The gasket, in EPDM, produced in accordance with SANS 4633, is made to guarantee a perfect hydraulic seal. For the gasket to function properly, it needs to be installed in the lip in the opposite direction to the threading.

The MAGNUM pipes with DN/OD starting from DN/OD 500mm have an INTEGRATED socket system, which means that the socket is formed directly on the pipe during the production phase.

With this production method, the pipe comes out with two distinctive ends on each bar:

- The socket;
- Male thread.

The "socket" is formed by a special mold directly during the production and it is formed from the external wall of the pipe (the full wall part). The external diameter of the socket corresponds the external diameter of pipe.

The "male" is the part of the next pipe bar, which can be inserted into the socket. The male part of the **MAGNUM** INTEGRATED system is made of the first three corrugations of the pipe, with the reduced height in the corrugation rings, in order to enable it to be threaded into the socket. The normal ring stiffness (SN) in the connection point is guaranteed by the socket overlapping the male.
In the **MAGNUM** INTEGRATED joint system the gasket is positioned inside a special seat designed on the superior part of the first corrugation ring of the male. This solution allows the gasket to move towards design the central junction point, and to make the connection with the use of a much smaller gasket.
This system has the same external diameter on all the junction points, which allows a perfect alignment of the pipes during the installation. This means that no additional excavation for the socket is needed.

1.3 – CONNECTION BY WELDING

One advantage of MAGNUM pipes is that connection can be made by butt welding. The space between ribs and the length between the ribs allow proper welding. Welding being a delicate operation, it must be carried out by qualified and authorised welders. Do not forget that butt welding is used to seal the pipe but does not ensure a geometrical stiffness comparable with that of the coupler because the real thickness is lower than that of the smooth pipe having an equal ring stiffness. Welding technologies and machines are the same used for polyethylene smooth pipes; also, times and pressures are comparable to those used for welding smooth pipes with small thickness. Each supplier of welding equipment supplies a table indicating the recommended times and temperatures.

Heating must be made carefully in order to avoid heating the rib.

2 – INSTALLATION AND LAYING

This section describes how to install and lay the polyethylene corrugated pipes for sewer systems. It is important to point out that transport, installation and laying procedures are not dissimilar from those of other plastic pipes.
In particular, the following document is referred to:

- UNI SANS 2001 standard (Construction Works)

2. 1 – PIPE TRANSPORT AND ACCEPTANCE

MAGNUM pipes are transported like all other standard pipes. Because of their reduced weight and considerable ring stiffness, the pipes can be piled up.

Pipes up to diameter DN/OD 500mm are generally supplied on pallets while starting from diameter DN/OD 630 mm to diameter DN/OD 1200 mm are supplied loose.
Upon receipt, the pipe must be checked for compliance with the supply as per the specifications and contractual conditions. Pipe acceptance must comply with the directions provided for by the supply specifications or the special general conditions.
All pipes, joints and special components must be delivered to the building yard with the corresponding markings or labels indicating the manufacturer, the nominal diameter and the class of usage. Upon demand, SPC supplies the reports with the results of the tests carried out by the internal laboratory on raw materials and finished product.

The acceptance tests made on pipes, joints and special components carried out internally for production are regularly made according to the reference standard and what has been agreed with the certification bodies.

2.2 – OFFLOADING AND STORAGE AT THE YARD

Loading, transport, unloading and all operations must be made with great care and using appropriate means according to the pipe type and diameter and by adopting all the necessary measures to avoid bursts, cracks or other damage.
Avoid impacts, deflections or excessive projections, sliding, contacts with other parts that may damage or deflect the pipes. The yards must be equipped with the suitable means and supporting surfaces to rest the pipes, the special components and fittings that need to be installed. Unloading must be carried out either directly with the entire pallet or individually depending on how the pipes are transported. When corrugated pipes are used, avoid hooks on the pipe ends and always use non-abrasive belts or hemp ropes.

2.3 – PIPE PILING-UP

The pipes must be piled up by putting them on a flat and stable surface protected from the risk of fire and from the sun if the pipes are subject to deflection caused by temperature changes. The pile base must rest on well-sp aced out boards or a supporting bed. The pile height depends on the pipe diameters in order to avoid deflections on the pipe base and for easier handling. The piled-up pipes must be blocked with wedges to prevent rolling.

Moreover, protective measures must be adopted to avoid the pipe heads are damaged. The first layer of pipes resting on the ground must rest on a uniform surface to avoid deflections and damage to the pipe external surface.

Until the moment when they are used, joints and material in general must be stored in closed spaces and inside boxes protected from the sun or other heat sources, away from oils or grease and must not be put under loads. To extract the pipes follow the same procedures as for unloading and transport and avoid sliding.

2.4 – EXCAVATIONS

The South African standards give clear instructions on how to make excavations for laying sewer pipes.

The first recommendation is that the specification should suggest using a narrow trench whose width is 2 to 3 times the diameter, at least up to 1 m above the upper pipe top. The walls, at least in this area, should be vertical and sufficiently stable (stability can be ensured by means of proppings or sheet piles) to protect the persons who work inside the excavation. The sheet piles must be immediately removed after partial embankment and before compaction. In the case of an embankment or large trench, we suggest that a contrast area to the covering material is prepared to restore a narrow trench.

Limits are put to the minimum size of the trench: according to the directions of SANS 2001-DP1 standard, the minimum width must be at least the double of the values shown on Table 1.

Table 1 — Side allowances

1	2
External diameter of pipe barrel (*D*) mm	**Side allowance on either side** mm
≤ 700 701 – 1 000 1 001 – 2 000 > 2 000	300 400 500 600

If two or more pipes are laid in the same trench, according to the standard a minimal horizontal distance is required between the two pipes:

- 0.35 meters up to DN 700 included;
- 0.50 meters for pipes larger than DN 700.

2.5 – BEDDING

Once the pipes, joints and special components have been carefully checked and the damaged ones have been replaced, the pipes can be put in place. To lift and lay the pipes in the excavation, on a relief or supports, follow the same procedures as for the previous operations and make sure the pipe surfaces are not damaged. To do so, use suitable means according to the pipe diameters. When laying the pipes, make sure no foreign matter or debris enter inside the pipes and that the inner surface is not damaged.

First of all check that the bed is flat and levelled and remove any projection that may damage the pipes. If you need to prepare a bedding or use for the first embankment materials other than those coming from the excavation, remove the materials that may damage the pipe during laying. Never adjust the pipe position inside the trench using stones or bricks or other unstable supports. The bedding surface must be stable and in those parts where ground settling is expected, use suitable joints or treat the trench bottom.

If the excavation bottom is made of soft material, without stones or hard debris, the **MAGNUM** pipe can be installed directly on the excavation bottom, provided the gradient is correct. Generally speaking, a sand bed or small size gravel bed should be prepared, avoiding sharp edges and that the rib top rests on the excavation ground. According to SANS 2001 standard, the bedding thickness must not be thinner than:

- 100 mm in normal grounds;
- 150 mm in stone or hard ground.

Pipes damaged during laying should be repaired or replaced if damaged.

2.6 – INSTALLATION

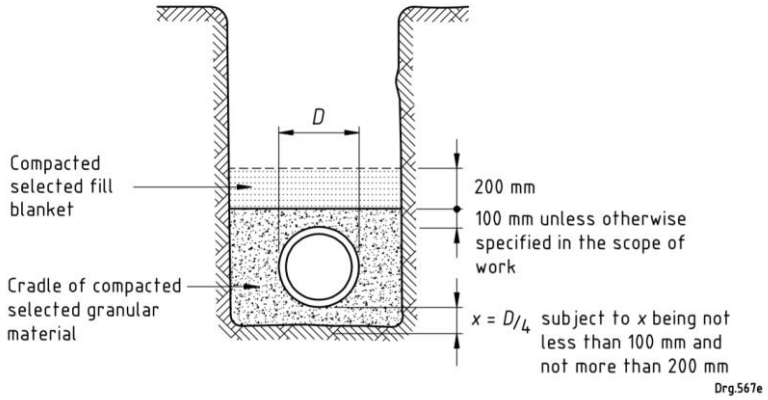
MAGNUM is generally connected to couplers after it has been laid on the excavation bottom. Because of its lightness, it can also be connected outside the excavation and then laid on the bottom. In all cases, the ends of pipes and special components to be connected must be cleaned before jointing. Moreover, every time a 6 or 12 m length is laid and connected, its slope and alignment must be checked.

During laying, special attention should be paid to expansion though the **MAGNUM** pipe has a remarkably lower expansion (around 50%) than polyethylene solid wall pipes. In theory, when couplers are connected, pipe displacement could occur; to avoid it, block the pipe with partial filling every 30÷40 m and complete filling, after you have controlled any possible movement, in the early hours of the day.

If filling is correct, there will be no longitudinal movement as the compacted ground around the ribs prevents pipe expansion.

2.7 – BACKFILLING

This is a very delicate operation for the installation of sewer pipes. Filling without correct compaction has negative effects on both stiff and flexible pipes. Compaction made without taking the necessary measures may result in burst; during television inspections made after installation, cement, stoneware and PVC manifolds were completely destroyed even before their use. Regardless of the type of pipe to be installed, for a long lasting and correct installation follow the instructions below:



1) choose the correct backfilling: the material must be dry, with low grading, without sharp edges, stones or debris at least in the part which comes in contact with the pipe and at least up to 30 cm over the pipe.
2) careful compaction: compaction must be carried out in 30 cm thick successive layers using suitable equipment at least up to one metre over the upper top of the pipe. A good compaction should have a Proctor index equal to 90–92 %. The first sidefill layer must be higher than the pipe semidiameter to prevent the pipe from raising or it may be required to block the pipe temporarily during compaction. According to the South African standards, after filling the excavation with suitable material up to 1 metre over the top of the pipe, the same excavation material can be used to complete filling.

3) regular compaction: avoid discontinuous compaction to prevent pipe misalignment and excessive strain on the joints or abnormal bending of the pipe body.
4) compacting means: up to one metre above the top of the pipe, compaction must be carried out with light-duty means while normal means may be used over 1 metre. Be careful when using heavy-duty vehicles for compaction if the effects of the dynamic load on the underlying pipe have not been calculated.

Table 3, taken from UNI ENV 1046 standard, shows the maximum thickness values recommended for the layers and the number of passages required to obtain the compaction classes according to the equipment used and the backfilling around the pipe. It also shows the minimum thickness values recommended for covering the pipe before the suitable equipment is used on the pipe.

Compaction method	*Number of passages for different compaction classes*			*Thickness after compaction for different ground classes, m*				*Minimum thickness before compaction m*
	W (good)	M (medium)	N (without)	Group 1	Group 2	Group 3	Group 4	Groups 1-4
Manual sledge 15 kg	3	1	0	0.15	0.10	0.10	0.10	0.20
Vibrating tube 70 kg	3	1	0	0.30	0.25	0.20	0.15	0.35
Flat vibrator								
50 kg	4	1	0	0.10	--	--	--	0.15
100 kg	4	1	0	0.15	0.10	--	--	0.20
200 kg	4	1	0	0.20	0.15	0.10	--	0.25
400 kg	4	1	0	0.30	0.25	0.15	0.10	0.35
600 kg	4	1	0	0.40	0.30	0.20	0.15	0.50
Vibrating roll								
15 kN/m	6	2	0	0.35	0.25	0.20	--	0.60
30 kN/m	6	2	0	0.60	0.50	0.30	--	1.20
45 kN/m	6	2	0	1.00	0.75	0.40	--	1.80
65 kN/m	6	2	0	1.50	1.10	0.60	--	2.40
Vibrat. double roll								
5 kN/m	6	2	0	0.15	0.10	--	--	0.20
10 kN/m	6	2	0	0.25	0.20	0.15	--	0.45
20 kN/m	6	2	0	0.35	0.30	0.20	--	0.60
30 kN/m	6	2	0	0.50	0.40	0.30	--	0.85
Heavy triple roll, without vibration								
50 kN/m	6	2	0	0.25	0.20	0.20	--	1.00

Table 3: Recommended thickness for layers and number of passages for compaction

Soil types (for more info refer to Annex A, ENV 1046:2001 standard):

- Group 1 (granular): single-sized gravels; well-graded gravels, gravel-sand mixtures; poorly graded gravel-sand mixtures;
- Group 2 (granular): single-sized sands; well-graded sands, sand-gravel mixtures; poorly graded sand-gravel mixtures zones;

- Group 3 (granular): Silty gravels, poorly graded gravel-sand-silt mixtures; clayey gravels, poorly graded gravel-sand-clay mixtures; silty sands, poorly graded sand-silt mixtures; clayey sands, poorly graded sand-clay mixtures;
- Group 4 (cohesive): inorganic silts, very fine sands, rock flour, silty or clayey fine sands; inorganic clay, distinctly plastic clay

2.8 – LAYING PIPES WITH GROUNDWATER

The corrugated pipe is for non-pressure sewer systems and therefore the jointing system is tested to withstand temporary pressure and negative pressure phenomena. When there is constantly groundwater around the pipe, it is recommended to use smooth polyethylene pipes with compact walls working under pressure, jointed by butt welding or electro-welded couplers.

When groundwater fluctuates throughout the year, structured plastic pipes may be used, while following further instructions: they must be laid with the excavation bottom dry, to guarantee the creation of bedding and correct sloping. Well-point systems should be used to remove extra water in order to perform laying in the above-mentioned conditions.
As you may guess, MAGNUM as other types of plastic structured wall pipes, has a floatation thrust when plunged into the water. Filling must prevent floatation or failure of walls. The grading of backfilling must be such as to prevent the particle migration to the surrounding ground or vice versa. Migration may be avoided by applying a suitable fabric filter (geotextile membrane).

3 – HYDRAULIC TESTING

3.1 – LABORATORY TEST

According to the UNI SANS 21138 standard, the **MAGNUM** pipe-coupler system resists to 0.5 bar pressure and - 0.3 bar pressure at 23 °C for 15 minutes. These conditions are also guaranteed in the case of a diametrical deflection (10% of the pipe and 5% of coupler) or an angular deflection of the system (which varies from 2° to 1° according to diameter). These parameters are dully tested after production on our in-house laboratory facilities.

3.1 TESTS ON SITE

In any case, it is necessary to make sure that no initial considerable deflections occur during filling and compaction. It is always advisable to make a hydraulic test on the installed pipe.
The test must be carried out according to the South African SANS 2001-DP4 standard (Construction Works – Sewers). The standard provides:

- An air test on pipes of all sizes;
- A water test for pipes up to DN/OD 750mm (**whereas the air test fails**); and
- A visual internal inspection test for pipes greater than 750mm.

3.1.1 AIR TEST

For the air test, the test equipment is composed of a number of rubber balloons which must stick to internal wall of the pipe, one compressor, one pressure gauge connected to a detector with a diagram. The test consists in placing two watertightness balloons for closing the downflow section upstream and downstream the section which is being tested. One balloon is equipped with a through valve for air filling into the pipe, which is connected to an external recording and detection device. The SANS 2001-DP4 standard provides different test methods according to pipe diameters and materials. Table 4 indicates test pressure, pressure drop and test times for air testing for pipes "other than concrete pipes".

Nominal diameter of pipe, mm	Minimum time (in min) taken for pressure to drop from 2.5 kPa to 1.25 kPa
100	2
150	3
200	4
225	4.2
250	4.5
300	6
375	7.5
450	9
600	12
750	15

Table 4: Data concerning air testing from SANS 2001-DP4:2008

For testing, follow the instructions below:

1. for about 2 minutes, keep an initial pressure of 3.75 kPa;
2. adjust pressure to test pressure as shown in table 4;

According to the norm (SANS 2001:DP4:2008, section 5.3.2.2), no further testing is required on pipelines which pass the air test. If the air test fails, a water test has to be carried out to locate the source of failure.

3.1.2 WATER TEST

The section of the pipeline under test and, unless otherwise indicated, the manhole chamber at the upper end of the said section shall be filled with water to such depth that the end of the section of pipeline being tested is subjected to a pressure of 0,04 MPa. During the test there shall be no discernible leakage of water. An appropriate period, which shall be at least 10 min, shall be allowed for initial absorption, and the make up water over the next 30 min shall be noted. The amount of make up water shall not exceed 0,1 litres per square metre of internal pipe surface after 30 min.