

**BOREX**<sup>®</sup>  
S Y S T E M

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## BOREX PVC-U WASTE WATER SYSTEMS

### **SPECIFICATIONS:**

BOREX waste water systems include pipe and fittings which are produced by PVC-U raw material, and manufactured according to TS 275-1 EN 1329-1,2 standards with sealing gaskets.

PVC-U pipe and fittings are used for following purposes;

- Hot and Cold domestic waste water,
- Ventilating systems for domestic waste water,
- Rain water installations.

**Application area code:** according to TS 275-1 EN 1329 -1; application area code is the code which indicates the application areas for pipe and fittings.

**B:** Pipe and fittings applications inside the building or pipe and fittings applications outside the buildings mounted on the wall.

**D:** To make a connection to the underground drainage and sewerage systems under the building or 1 meter distance, for pipe and fittings used in buried under ground.

**BD:** Pipe and fittings which can be used both in B and/or D for application area codes

Note: Pipe and fittings which are used as BD application code should be a minimum of 75 mm diameter.

Other type of standard plastic pipe system can be used with TS 275-1 EN 1329 -1,2 pipe and fittings if they ensure the dimensions and functional specifications.

BOREX PVC-U pipe and fittings are produced in dimensions; DN 50, DN 75, DN 110, DN 125, DN 160, DN 200 and DN 250. Installation technique is a reliable system with a long life and trouble free. Casketed with a long-lasting and comfortable passing system is easy to use.

BOREX PVC-U pipes and fittings gaskets are coated with a layer of a special silicone therefore the sun's rays deformations are prevented.

BOREX PVC-U pipes and fittings with smooth and shiny interior and exterior surfaces offer lower level of accumulation of lime residue and prevents blockage, the installation is fast and provides a smooth flow.

# PHYSICAL AND MECHANICAL PROPERTIES OF PVC-U RAW MATERIAL

**Formulation of Vinyl Chloride** :  $\text{CH}_2=\text{CH}-\text{Cl}$

**Formulation of polymer** :  $(\text{CH}_2-\text{CHCl}-\text{CH}_2-\text{CHCl}-\text{CH}_2-\text{CHCl})_n$

**Crystal Structure** : Amorphous, around % 5 crystallization.

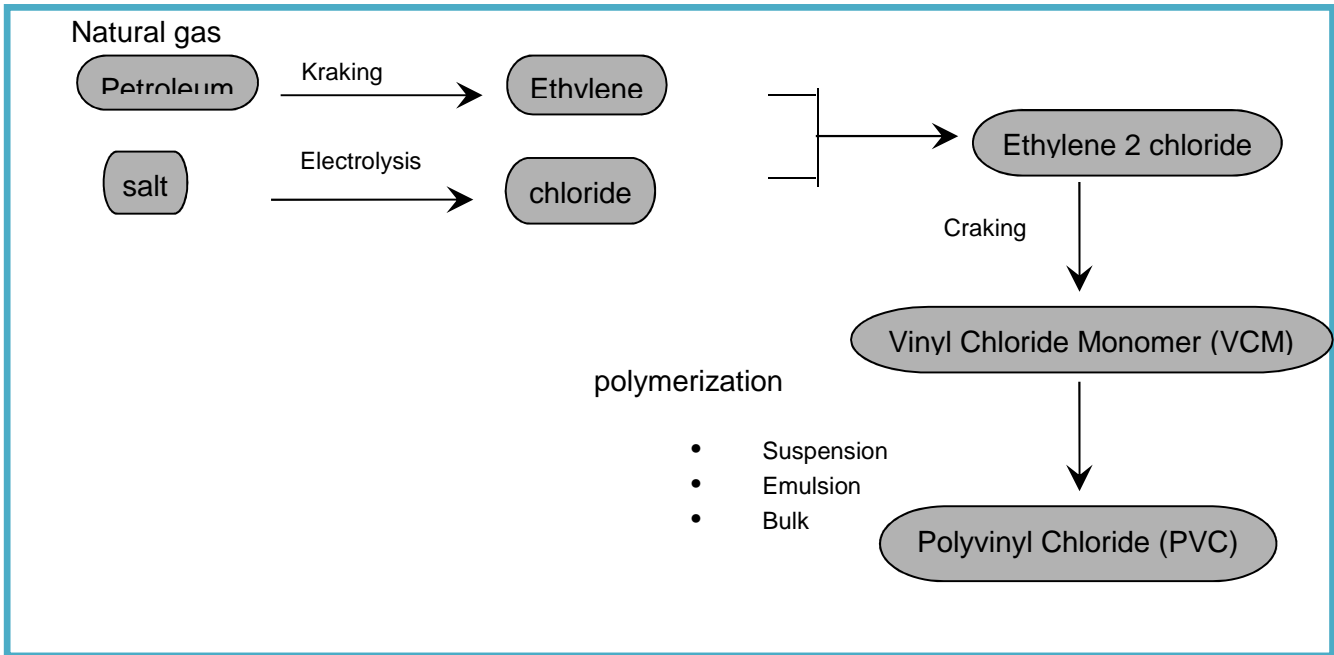
**Glass Transition Temperature:** 80 °C

**Process Temperature** : 140 - 200 °C

Polyvinyl chloride comes under the amorphous plastics and it is a granulated polymer with white or light yellow color. It is possible to process polyvinyl chloride up to 60°C. When it is heated, it is solved by chlorinated hydrocarbons. It is resistant against the effect of acids and bases. Water, alcohol and benzene do not show any reaction to PVC. PVC has high electrolysis feature and it is a fireproofing polymer. PVC decomposes slowly at 140°C and easily at 170°C by HCL decomposition and double bond is formed at the polymer. Thus stabilizers partake in the polymer.

PVC has two usage areas as rough and flexible. Rough PVC is mainly used in the areas such as pipes, window profiles, wall coverings etc. These are weather-resistant, have high durability, are rough and are self fireproofing material properties.

## FORMATION OF PVC



## DEFORMATION OF PVC

PVC degrades by two ways.

1. by HEAT
2. by LIGHT

1- Its degradation by heat is formed by HCl (Hydrogen Chloride) liberation. Together with this gas liberation, yellowing occurs on the PVC Color.

When PVC is directly exposed to heat, hydrogen chloride (HCl) liberates and yellowing occurs on the PVC color. Related to the degradation level; yellowing, reddening, brown and black colors are seen on the PVC color. Together with this, changes in the physical and chemical properties of the product are seen. The waste gases and humidity which are formed during the process are removed from the environment and then eliminated.

2 – When PVC does not include any stabilizer material, it degrades either it is heated at a temperature over 100 °C or it is exposed to UV rays or gamma rays.

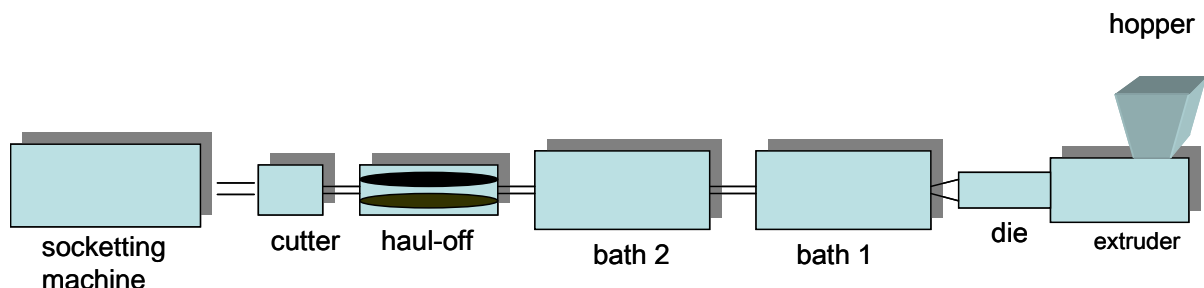
## PVC-U FORMULATION

PVC-U is the material which some additives are added in the raw material. The PVC content of the material is at least 80% by mass for the pipes suitable to EN 1905 and at least 85% by mass for the fittings which are produced by injection molding. In PVC-U processes, according to the product type, it is compulsory to add some adjuvant additives. This means to prepare a formulation for PVC. Correspondingly, the formulation is generally as follows:

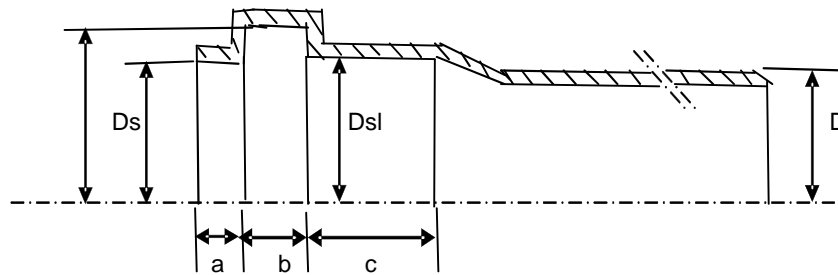
- |                          |                      |                |
|--------------------------|----------------------|----------------|
| 1. PVC resin,            | 2. Stabilizers,      | 3. Lubricants, |
| 4. Durability improvers, | 5. Process adjuvant, | 6. Pigments    |

Together with the above mentioned items, some other additives such as fire protectors, optic bleaches are used in the formulation.

## PVC PIPE PRODUCTION LINE:



## PVC-U PIPE TECHNICAL DIMENSIONS:



D	Dsm	Dsl	Ds	a	b	c
50	59,5	50,6	50,6	7,0	8,5	32,0
75	85,3	75,6	75,6	8,0	8,5	34,0
110	121,3	110,8	110,8	9,5	10,5	38,0
125	137,5	125,9	125,9	10,5	11,2	39,5
160	174,5	161,0	161,0	12,0	14,0	42,5
200	216,5	201,0	201,0	12,5	15,2	57,7
250	273,5	251,2	251,2	13,5	21,5	59,0

All dimensions are mm.

BOREX PVC –U pipe is produced in lengths of 150, 250, 500, 1000, 2000, 3000 and 6000 mm for each diameter.

### PERFORMED TEST TO PVC-U PIPE AND FITTINGS:

BOREX PVC-U pipes and fittings are tested in each stage of production in the following test table, in accordance with TS 275-1 EN 1329 -1.

Name of the test	Test Standard	Test Condition	Duration	Result
Leakage test	TS EN 1277	P= 0,5 bar T= 23 °C	15 min.	No leakage
Falling ball test	TS EN 744	T= 0 °C	-	< %10 damage
Resistance to Dichloromethane	TS EN 580	T= 15 °C	30 min.	No deterioration on the surface
Vicat Softening Temperature (VST)	TS EN 727	T= ≥79 °C	-	No visual distortion
Longitudinal change in dimension	TS EN 743 Method B Air	T= 150 °C	30 min.	≤ %5 No cracking or swelling in pipe.
Effect of temperature test <sup>1</sup>	TS EN 763 Method A Air	T= 150 °C	30 min.	No cracking or swelling in fittings.
Vicat Softening Temperature (VST) <sup>1</sup>	TS EN 727	T= ≥79 °C	-	No visual deterioration.

1- This test is applied to fittings.

## MECHANICAL PROPERTIES OF PVC-U RAW MATERIAL

**Resistant:** BOREX PVC-U Waste water Pipes and Fittings keep its physical properties up to 60 °C. In case no internal pressure is applied and no external mechanical impact is applied, it is resistant against pH 2-7 acids at 20 °C and pH 7 -12 alkaline. BOREX PVC-U Waste Water Pipes and fittings are resistant against various mechanical effects. The impact durability is controlled with the falling ball test.

**Abrasion-proofing:** Because BOREX PVC-U Waste water Pipes and Fittings is rough PVC, it is more resistant against the external factors.

**Smooth Internal Surface:** The smooth and flat internal surface of BOREX PVC-U Waste water pipes and fittings provide ideal viscosity property. It is out of question to develop pollution which will cause choking.

**Explosion-proof:** The BOREX PVC-U Waste Water Pipes and Fittings do not have spontaneous combustion property because of the structure of PVC-U and fittings. They can only burn under open flame.

BOREX rigid PVC-U pipes and fittings are building materials; specified in DIN 4102 standard and National Fire regulations as B1 class.

### Chemical resistance table of PVC-U according to ISO/TR 10358, TS 11448

Chemical Material	Concentration (%)	Temperature ( °C )	
		20	60
Adipic acid	saturated solution % 1,4	D	YD
Aluminium hydroxide	suspension	D	D
Ammonia, aqueous	saturated solution	D	D
Ammonium chloride	saturated solution	D	D
Ammonium sulphate	saturated solution	D	D
Acetic acid	50	D	YD
Acetone	ts-s	ZD	ZD
Copper 2 sulphate	saturated solution	D	D
Benzene	ts-s	ZD	ZD
Gasoline	Working solution	D	D
Beer	Working solution	D	D
Mercury	ts-s	D	D
Iron 2 chloride	saturated solution	D	D
Iron 3 chloride	saturated solution	D	D
Ethanol	95	D	YD
Phenol	90	ZD	ZD
Formaldehyde	30-40	D	D
Phosphoric acid	25-85	D	-
Glycerine	ts-s	D	D
Hydrogen peroxide	30	D	D

Hydrofluoric acid gas	ts-g	YD	ZD
Hydrofluoric acid	up to 10	D	D
Hydrofluoric acid	40	YD	ZD
Urine		D	YD
Calcium carbonate	suspension	D	D
Calcium chloride	saturated solution	D	D
Carbon dioxide, gas	ts-g	D	D
Carbon monoxide, gas	ts-g	D	D
Carbon tetrachloride	ts-s	ZD	ZD
Chlorine, dry gas	ts-g	YD	ZD
Chloroform	ts-s	ZD	ZD
Sulphur dioxide, dry gas	susp.	D	D
Methyl alcohol	ts-s	D	YD
Nitric acid	25	D	-
Nitric acid	>50	ZD	ZD
Oxygen, gas	ts-g	D	D
Aliphatic hydrocarbons		ZD	ZD
Potassium hydroxide	solution	D	D
Potassium hydroxide	up to 50	D	D
Soap	solution	D	YD
Vinegar	Working solution	D	D
Sodium bicarbonate	saturated solution	D	D
Sodium hydroxide	saturated solution	D	D
Sodium carbonate	saturated solution	D	D
Sodium chloride	saturated solution	D	D
Sodium sulfate	saturated solution	D	D
Water distilled		D	D
Water, use, mineral	Working solution	D	D
Sulfuric acid	50	D	D
Sulfuric acid	98	ZD	ZD
Sulfuric acid	smoky	ZD	ZD
Milk	Working solution	D	D
Wine	Working solution	D	D
Toluene	ts-s	ZD	ZD
Trichloroethylene	ts-s	ZD	ZD
Oils plant and animal	ts-s	D	D

#### Abbreviations

D: Resistant

YD: Resistant adequately

ZD: Poor resistance

Saturated aqueous solution, at 20 °C

Solution: more than 10% concentrated but unsaturated aqueous solution

Working solution: at the concentration which is commonly used in the industry

Suspension: prepared at 20 °C saturated solution

Ts-k: at technical purity, solid

Ts-s: at technical purity, liquid

Ts-g: at technical purity, gas

Ts: at technical purity, at least



# BOREX PVC WASTE WATER PIPE INSTALLATIONS

This section is only for the present current recommendations, See ASTM D2321 *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications* for detailed design installation recommendations

**RECEIVING OF PRODUCTS:** When a load of pipes and fittings arrive at your job site, it is your full responsibility to check them thoroughly. If possible, inspect each piece for damage. Check quantities against the shipping list. Note that once the pipes and fittings leave the plant, they become the property of the trucker. Any damaged and missing items must be documented on the Truck Transportation Form, and fax the form to plant in 24 hours. Set aside any damaged items and notify the shipper. If you don't send the form in 24 hours that means that there are no any damaged or missed items and goods received very well conditions.

Truck Transportation Form

**UNLOADING PRODUCTS:**

It is also your responsibility to unload the shipment. **DO IT WITH REASONABLE CARE.** Careless unloading can result in damaged product or personal injury. PVC pipes and fittings are tough but **DON'T** slam them around. When unloading by hand, remove one piece or bundle at a time, and block the shipment to keep pipe from rolling off the truck.



Correct Unloading



Wrong Unloading

**STORAGE OF PRODUCTS:**

If you can unload the shipment in unit packages, the pipe will be easier to store.

Stack it on reasonably level ground. If you unload one piece at a time, place the pipe bevel to bell. Never stack over 2,5 mt in

height. Stack thick wall thicknesses pipe bottom, if you will stack different wall thickness pipe in same stack.

Exposure in excess of 6 months to direct sunlight is unavoidable. PVC pipe and fittings should be covered with an opaque material while permitting adequate air circulation above and around the pipe and fittings, as required to prevent excessive heat accumulation.



Stacking pipes in factory stock area.



Stacking pipes in your site.

### **HANDLING THE PRODUCT:**

**DON'T DROP THE PIPE.** String pipe close to the trench with the bell ends pointing in the direction of work progress to save extra effort. Be particularly careful in very cold weather.



Carrying pipes in bundle at installation site

**ABOVE GROUND INSTALLATIONS:**

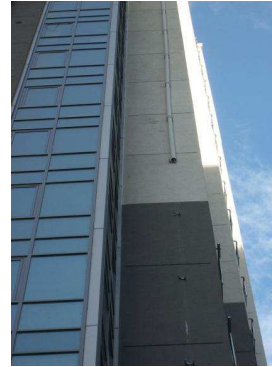
Use appropriate amount of clamps when installing inside or outside the buildings. Using enough amounts of clamps, help your lines alignments and keep the weight of pipes. If you want to use less amount of clamps other than required, it will cost you more in technical and financial sides. If you use clamps 1-1,5 m apart, it will eliminate many potential problems.



Correct applied clamps.



Less amount of clamps



Result of less amount of clamps

Clamps must be used in every branch points and elbows on the installing line. Use appropriate clamp with pipe dimensions. When you want to use metal clamps take excessive care not to damage to pipe. It is recommended for very high buildings to use metal clamps with rubber in it. Bottom of vertical lines (like rain water) must be fixed and supported to carry the pipe line and its content.

PVC pipe has certain durability to sunlight (U.V). If they can be exposed to very long time to sunlight (U.V), they can be protected by very economic ways such as painting light colored water base paints.

PVC pipes can be used as high as 60 °C water temperature. But if there exist any heat source closed to pipe line, pipes should be insulated against heat.

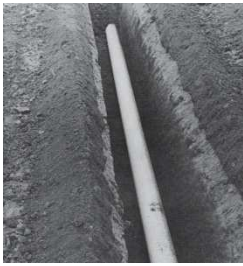
**Points to pay attention:**

- Use experienced and skilled personnel for transportation and installing of pipes.
- Transport and store PVC pipes as described above.
- Take care for elongation/shrinkage of PVC line.
- Use appropriate clamps and clamps distances.
- Don't use pressurized air and gas in testing.
- Protect the line from outside damages.

**Preparing Underground Installation:**

Clean trenches save time and money. Don't let the excavated material block sidewalks, drive or utility outlets. Follow all safety rules and regulations and check them frequently.

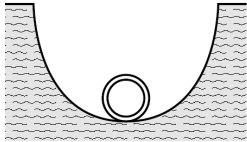
Keep the trench as dry as possible until the pipe has been installed and enough backfill placed to prevent the pipe from floating. PVC pipe will readily float if not filled with water or weighted down. Height of loose backfill material required to prevent floatation of empty pipe is conservatively equal to 1,5 times the pipe diameter.



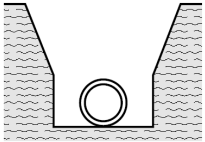
Smooth and clean trench



Water should not be left in the trench



Wrong cross section of trench



Correct cross section of trench

**FIELD PIPE CUTTING:**

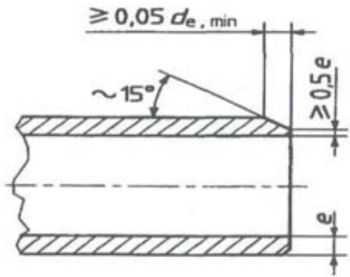
It is possible to get any length of pipe from BOREX, although you must need to cut pipe in the field. Pipe can be easily cut with a hacksaw or power driven abrasive disc, be sure you make a square cut. Bevel the end of pipe with a beveling tool, wood rasp or power sander to the same angle as provided on the factory finished pipe (15°). If you don't do the beveling correctly, insertion of pipe can be very difficult and dislocation of gasket in its place is inevitable.



Cutting PVC pipe in the field



Beveling end of PVC pipe



Technical dimensions of bevel



**PIPE ASSEMBLY:**

Remove any mud, sand or other foreign material from the bell interior and spigot exterior that could prevent an effective seal between the bell and spigot. Carefully clean gasket area with your hand and make sure the gasket is seated uniformly in the groove by running your finger around the edge of the gasket. If the cleaning is not done exactly, assembly of pipe will be very difficult and leakage is inevitable.

To make easy assembly and avoiding dislocation of gasket, fully apply liquid soap on gasket and on spigot area. After applying liquid soap, immediately perform the assembly. Push lubricated end past gasket into the bell until the insertion line on the spigot is even with the edge of the bell, you will feel when it seated to its place. **DO NOT OVERINSERT.**



Applying liquid soap on gasket



Applying liquid soap on spigot.



Assembling of pipe

Pipe should be inserted sweet tight to each other. If you have trouble assembling the joint, disassemble and examine the gasket. Replace if damaged. Be sure the gasket is properly seated and both pipe lengths are in straight alignment. Repeat assembly steps. Correct assembly is achieved when the insertion line on the spigot is lined up with the edge of the bell. If difficulties continue pipeline may be not aligned. Check and align the line to resolve the itching and repeat the process of assembly, cleaning should be kept in mind.



Dislocation of gasket

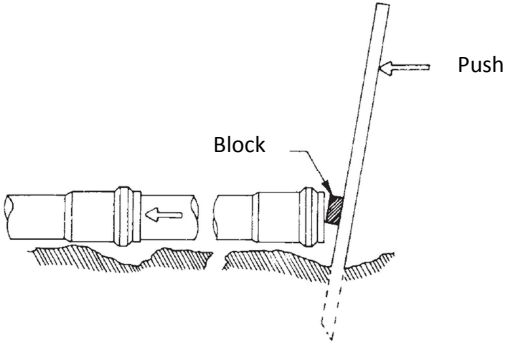


Don't use damaged gasket

If necessary, long length used lines, the bar and block method is recommended as a worker is able to feel the amount of force being used and whether the joint goes together smoothly. Care must be taken to insure that the spigot is NOT OVERINSERTED and that previously assembled pipe joints are not disturbed. This is accomplished by inserting only to the insertion line on the spigot end. In all cases, good alignment of the pipe is essential for proper assembly and sealing.



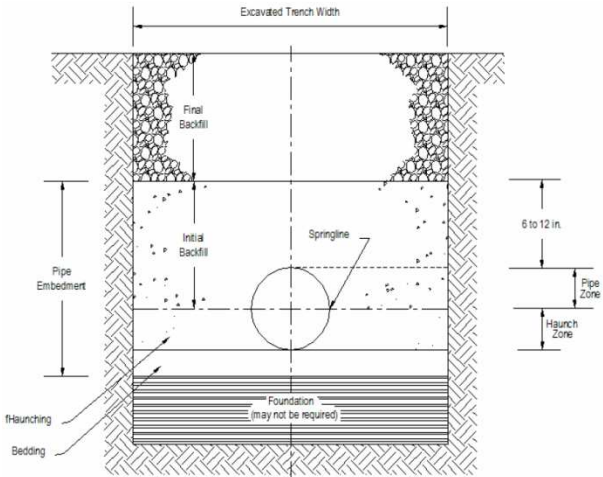
Bar and Block Method



**EMBEDMENT OF PIPES:**

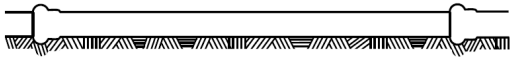
The use of proper embedment materials is very important to trouble-free operation of the pipe system. Avoid using rocks larger than 25-30 mm for embedment

Bedding may be used to bring the trench bottom up to grade before the pipe is installed. Its purpose is to provide continuous and uniform support. Where required, a maximum depth of 10-15 cm. is normal.



Typical trench cross section

Placement of haunching material is the most important factor affecting pipe performance and deflection. Proper placement of material in the haunch reduces voids and increases pipe support.



Haunching of pipeline.

A foundation is required when the trench bottom is unstable. Any foundation that will support a rigid pipe without causing loss of grade or structural breakage will be more than adequate for PVC pipes.

Granular materials may be properly placed using techniques such as shovel slicing. Place material under the haunches and at least halfway up the pipe to provide side support. Make sure the material is properly (at least 90%) compacted.

**INITIAL BACKFILL:**

Keep the initial backfill free from rocks which could damage the pipe during final backfill. Depth of the initial backfill should be at least 20 cm over the top of the pipe. Initial backfill protects the pipe from damage during the final backfill. Manual compaction of initial backfill should be applied as 10 cm layers. Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe.



Manuel compaction



Machine compaction

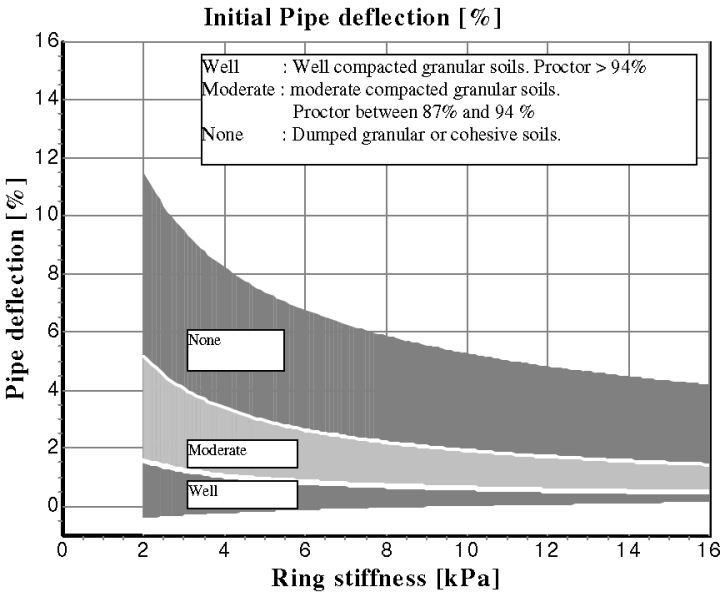
For a pipe under a road surface at shallow depths between 25 and 50 cm, specific embedment materials and compaction levels are recommended. The embedment material should be Class 1 (crushed rock) or Class 2 (clean sand and gravel) as described in ASTM D2321. This material should be installed from the bottom of the trench up to the bottom of the pavement and compacted to 95 percent of proctor density.

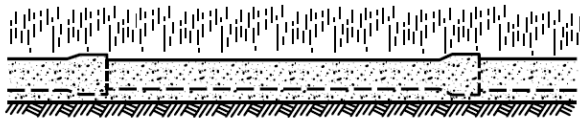
**FINAL BACKFILL:**

In the final backfill, avoid using rocks over 100 mm, clumps of frozen soil, rubble and other such material. In general, the material which was originally excavated can be used, and it must be compacted to suit the engineer.

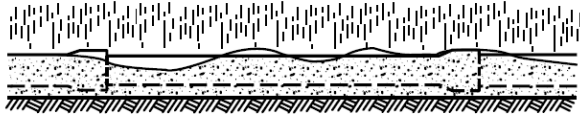
At the end of each working day, be sure that all installed pipe ends are covered to keep dirt, debris and animals from entering the pipe.

Pipe deflection (%) vs. ring stiffness graph is shown below for different compaction types. As you notice, pipe deflection is minimum at well compaction for same ring stiffness.





A. **Right**—Backfill correctly placed by hand filling all voids.



B. **Wrong**—Backfill not placed evenly.

**CAREFUL: DON'T MOVE THE PIPE. DON'T DISTURB SIDE SUPPORT WHEN MOVING SHEETING OR TRENCH BOX.**

**THERMAL EFFECTS:**

PVC will display a variation in physical properties with changes in temperature. Extremely cold temperatures result in increases in pipe stiffness and tensile strength and decreases in impact strength. The decrease in impact strength requires care in handling during installation in cold temperatures.

Increases in temperature above 23 oC result in decreases in tensile strength and pipe stiffness and increased impact strength. Decreases in pipe stiffness require that more care be taken during installation to avoid excessive deflection.

**CHECKLIST – Don't Forget!**

- Take all sensible precautions necessary to protect workers and materials.
- Plan ahead for fittings.
- Use trench boxes for shoring in unstable conditions.
- Don't disturb pipe when moving trench boxes or shoring materials.
- Properly assemble joints by inserting until the insertion line is even with the lip of the bell.
- Insure water tight seal at manhole connection.
- Keep trench bottom as dry as possible.
- See ASTM D2321 *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications* for detailed design installation recommendations.
- Consult BOREX for specifics regarding gaskets or lubricants.
- Check with engineer regarding specifications and procedures.