Qatar National Plastic Factory produces a full range of uPVC pipes according to various Qatari and International Standards. These includes:

BS EN 1401 UD
DIN 19534
BSEN 1329 BD

These pipes are designed for underground drainage and sewerage evacuation.

In addition, Qatar National Plastic produces these pipes using the new chemART technology designed to improve the properties of uPVC pipes without a significant increase in cost. These pipes are available for diameters greater than 63 mm.

Introducing chemART Technology for uPVC Pipes

"ChemART" technology is a new Chemical and Antimicrobial Resistance Technology for uPVC pipes. It is applied to standard uPVC pipes to increase resistance to biological attack, to resist degradation from chemical attack from acids, greases and disinfectants, and especially resists Chlorine Dioxide degradation. It has been extensively tested and is completely harmless, providing better protection and increasing the life of the pipes.
Qatar National Plastic will commence the manufacture of pipes using chemART from January 2019.

Resistance to Biological attack with chemART

uPVC pipes using ChemART will not deteriorate or break down under biological attack, as the internal walls of the treated uPVC does not serve as a nutrient for micro or macro organisms. Also there is no proof to discover a single case in which buried uPVC pipe products have suffered degradation or deterioration due to biological attack. Once uPVC pipe has been installed underground in normal water and sewer systems, it is not susceptible to the normal processes of deterioration found in nature. It does not slime as readily as many other materials and will usually require less maintenance in comparison with clays and metal pipes.

General Chemical Resistance of uPVC chemART

In general, uPVC is suitable to convey most strong acids, alkalis and aqueous solutions (except strongly oxidising solutions). However, uPVC should not be used with aldehydes, ethers, esters, aromatics, chlorinated hydrocarbons, ketones, benzene mixtures or similar solvents[1]. The application of chemART technology enhances resistance and provides increased resistance to solvent attack.

Resistance to corrosion acid/ gases with chemART

The sewer contains inorganic gases created by action of anaerobic bacteria on sewage and sludge. Hydrogen sulfide, ammonia, carbon dioxide, methane, hydrogen and nitrogen are all released by this process with the major portion being hydrogen sulfide. This gas reacts to form dilute sulfuric and sulfurous acids especially in turbulent areas. chemART PVC pipes have increased resistance to hydrogen sulfide and sulfuric acid and have a life span of 30-50 year under normal operating conditions.

Resistance to chlorinated water with chemART

chemART exhibits excellent resistance to chlorinated water. When chlorine is added to water for disinfection it turns to hypochlorous acid. Hypochlorous acid is strong oxidiser that breaks the carbon-to-carbon bond in polyolefin pipes (HDPE, PPR). This leads eventually polymer chain disintegration inner wall erosion in pipes. In PVC the comparatively large chlorine atom surrounding the carbon chain provides protection from hypochlorous acid attack. chemART increases this protection and it is for this reason chemART pipes are preferable for potable water applications.

Abrasion Resistance

Various European studies evaluating abrasion resistance using river sand and gravel in unlined concrete pipe, lined concrete pipe, glazed vitrified clay pipe and uPVC pipe have demonstrated higher abrasion resistance of uPVC pipes. With minimal wear at 260,000 cycles and less accelerated than vitrified clay pipes and concrete pipes.

Low frictional losses

chemART pipes exhibit low frictional losses especially compared to metal pipe. The coefficient of flow velocity degree of smoothness of pipe inner wall is higher than other piping materials, which resulting low frictional losses.

[1] Temperature, length of exposure and concentration are the variables that dictate the rate of degradation. Given the normal operation of pipe systems the rate of degradation is very slow in PVC pipes and is only significant if exposure is prolonged, concentrated, or at elevated temperature. If highly stressed, deterioration can involve absorption of the corroding medium, which leads to swelling, a reduction in tensile strength, reduction in ring stiffness and a change in elongation at break

Standard: BS EN1401 - SDR 51, SDR 41, SDR 34

Scope: The standard BS EN 1401 specify the requirement for pipes in the field of non pressure underground drainage and sewerage, both outside the building structure and those buried in ground within the building structure.
Colour: Terracotta RAL 8023
Appearance: 6 / 5.8 meter with spigot end and socket push fit rubber ring / solvent cement type.

Mean Outside Diameter		SN 2 (2000N/m²)		SN 4 (4000N/m²)		SN 8 (8000N/m²)	
Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
mm	mm	mm	mm	mm	mm	mm	mm
110.0	110.3	-	-	3.2	3.8	3.2	3.8
160.0	160.4	3.2	3.80	4.0	4.6	4.7	5.4
200.0	200.5	3.9	4.50	4.9	5.6	5.9	6.7
250.0	250.5	4.9	5.60	6.2	7.1	7.3	8.3
315.0	315.6	6.2	7.10	7.7	8.7	9.2	10.4
400.0	400.7	7.9	8.90	9.8	11.0	11.7	13.1
500.0	500.9	9.8	11.0	12.3	13.8	14.6	16.3
630.0	631.1	12.3	13.8	15.4	17.2	18.4	20.5

QA/QC Test: Heat reversion, vicat softening point, impact resistance, dichloromethane test, long term hydrostatic pressure test, Ring stiffness.
Fittings: Please refer Qatar National Plastic fittings catalogue.

Standard: DIN 19534

Scope: Underground Drains and Sewerage
Colour: Terracotta RAL 8023
Appearance: 5.8 meter with spigot end and socket solvent cement type.

Nominal Size	Mean Outside Diameter		Wall Thickness	
In mm	Minimum mm	Maximum mm	Minimum mm	Maximum mm
110 mm	110	110.3	3.0	3.5
160 mm	160	160.4	3.6	4.2

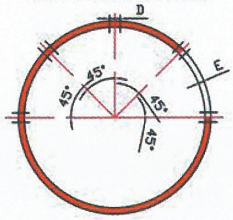
QA/QC Test: Long term hydrostatic pressure test, vicat softening point, heat reversion, dichloromethane test.

Semi / Fully Perforated Pipes

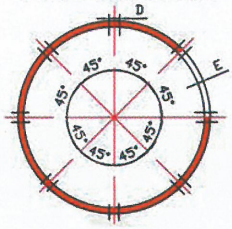
Scope: Perforated pipes are manufactured from solid uPVC pipes conforming BSEN 1401 or any relevant standard. This pipe are used as soakways / french drains. Qatar National Plastic standard perforation details are provided below table and figure UGD 1-1. However, perforation are 100% customizable upon client request. The minimum water inlet area for straight and staggered row type will be the same.
Colour: Terracotta RAL 8023
Appearance: 6 / 5.8 meter with spigot end and socket push fit rubber ring / solvent cement type.

UGD 1-1

Semi Perforated Pipe

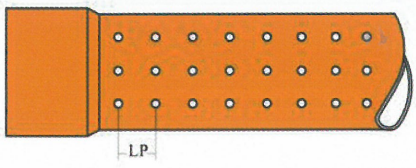


Fully Perforated Pipe

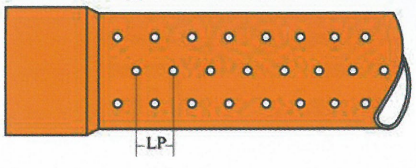


			Type 'A' with Perf. Hole Diameter 10mm			Type 'B' with Perf. Hole Diameter 13mm		
Outside Diameter	Wall Thickness	Angular Pitch	Longitudinal Pitch	Min. Water Inlet Area Semi Perf.	Min. Water Inlet Area Fully Perf.	Longitudinal Pitch	Min. Water Inlet Area Semi Perf.	Min. Water Inlet Area Fully Perf.
mm	mm	Degree	mm	Cm²/meter	Cm²/meter	mm	Cm²/meter	Cm²/meter
110	3.2	45°	200	19	31	180	34	54
160	4.0	45°	200	19	31	180	34	54
200	4.9	45°	200	19	31	180	34	54
250	6.2	45°	200	19	31	180	34	54
315	7.7	45°	200	19	31	180	34	54
400	9.8	45°	200	19	31	180	34	54
500	12.3	45°	200	19	31	180	34	54
630	15.4	45°	200	19	31	180	34	54

Straight Row Type



Staggered Row Type



Qplast

Pipe deflection (Vertical)

$$\Delta/D = \frac{K_x\{(D_L P_e) + P_s\}}{8EI/D^3 + 0.061E'}$$

Where:

- Δ = Pipe diameter change
- D = Pipe diameter
- K_x = Deflection coefficient (see table UGD 1)
- D_L = Deflection lag factor
- P_e = Vertical soil pressure or soil load
- P_s = Surcharge pressure or Traffic load (see table UGD 2 and 3)
- E = Flexural modulus of elasticity of Pipe material
- I = Second moment of area of unit length of pipe wall
- E' = Overall modulus of soil reaction

Vertical Soil Pressure Pe

Pe= ℓ H

Where:

- ℓ = Unit weight of soil
- H = Depth of cover to top of pipe

Table UGD 1 Flexible and semi-rigid pipe embedment properties

Embedment class as table UGD4 and deflection coefficient K_x	Compaction *Mp* (See NOTE 3) %	Modulus of soil E'^2 MN/m²	Deflection lag factor D_L[1]	Strain factor D_f for various pipe stiffness [1] kN/m² 1.25	2.5	5.0	10	15	30 or more
Class S1	Uncompacted	5	1.5	4.7	4.5	4.3	4.0	3.75	3.0
K_x=0.083	80	7	1.25	4.7	4.5	4.3	4.0	3.75	3.0
	85	7	1.0	4.7	4.5	4.3	4.0	3.75	3.25
	90	10	1.0	4.7	4.5	4.3	4.0	3.75	3.5
	95	14	1.0	--	--	--	--	3.75	3.5
Class S2	Uncompacted	3	1.5	4.7	4.5	4.3	4.0	3.75	3.0
K_x=0.083	80	5	1.25	4.7	4.5	4.3	4.0	3.75	3.0
	85	7	1.0	4.7	4.5	4.3	4.0	3.75	3.25
	90	10	1.0	4.7	4.5	4.3	4.0	3.75	3.5
	95	20	1.0	--	--	--	--	3.75	3.5
Class S3	85	5	1.5	6.2	5.5	4.75	4.25	4.0	3.25
K_x=0.100	90	7	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	14	1.0	--	--	--	--	4.75	3.5
Class S4	85	3	1.5	6.2	5.5	4.75	4.25	4.0	3.5
K_x=0.100	90	5	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	10	1.0	--	--	--	--	4.75	3.5
Class S5	85	1	3.0	--	--	--	--	4.0	3.5
K_x=0.100	90	3	2.0	--	--	--	--	4.25	3.5
	95	7	1.25	--	--	--	--	4.5	3.5
Class B1	85	5	1.5	--	--	--	5.0	4.0	3.5
K_x=0.083	90	7	1.25	--	--	--	5.5	4.25	3.5
Class B2	85	3	2.0	--	--	--	5.5	4.25	3.5
K_x=0.083	90	5	1.75	--	--	--	6.0	5.0	3.5

1) Pipe stiffness referred to this table are initial values.
2) Where the designer can be certain that initial pressurization will take place within one year backfilling, a value of 1.0 may be taken for deflection lag factor.
Note1: For construction details of embedment classes see table UGD 4.
Note2: Quoted values E'_2 assume pipeline will be installed below groundwater.
Note3: *Mp* indicates modified Proctor density and corresponds to the heavy compaction test in BS 1377.

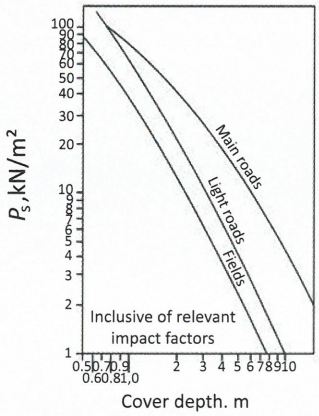


Figure UGD 2 Surcharge pressure P_s due to vehicle wheels

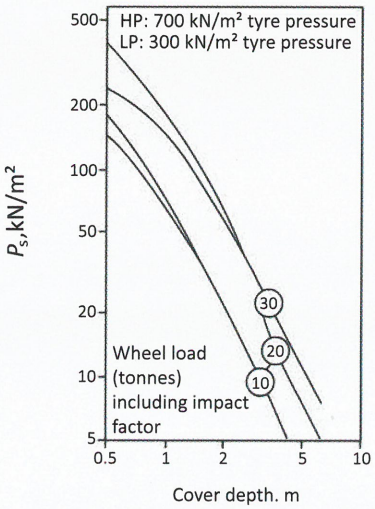
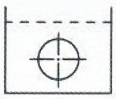
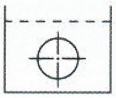
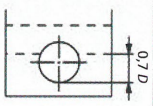
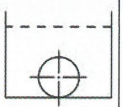


Figure UGD 3 Surcharge pressure P_s due to construction vehicle

Table UGD 4 Semi-rigid and flexible pipe embedments			
Embedment class	Embedment configuration	Bed and sidefill materials	Notes
S1 and S2		Class S1: Gravel (single size) Class S2: Gravel (graded)	Normally processed grannular materials
S3 and S5		Class S3: Sand and coarse grained soil with more than 12% fines Class S4: Coarse grained soil with more than 12% fines OR Fine grained soil, liquid limit less than 50% medium to no plasticity and more than 25 % coarse grained material Class S5: Fine grained soil, liquid limit less than 50% medium to no plasticity and less than 25 % grained material	These represents 'as dug' soils and require particularly close control when used with low stiffness pipes. Class S5 only recommended for use with semi-rigid pipes.
B1 and B2		Class B1: Upper surround as for S3 and S4 Lower surround as for S1 or S2 Class B2: upper surround as for S5 Lower surround as for S1 and S2	Class B embedments not recommended for use with pipes of less than 10kN/m² stiffness
D		Classes S1 to S5	Only suitable for semi-rigid pipes with high beam strength. Soil properties from table UGD 1 except K_x = 0.110

Flow Rate: Hydraulic Capacity

The hydraulic capacity of a pipe system is dependent on the layout design, and influenced by pipe wall roughness and pipe deformation. Qatar National Plastic Factory uPVC pipes exhibit excellent flow properties. Below figures illustrate the flow capacity with K values of 0.25 and 0.4 for straight line pipe and pipe with fittings respectively. See figure UGD 5 & 6.

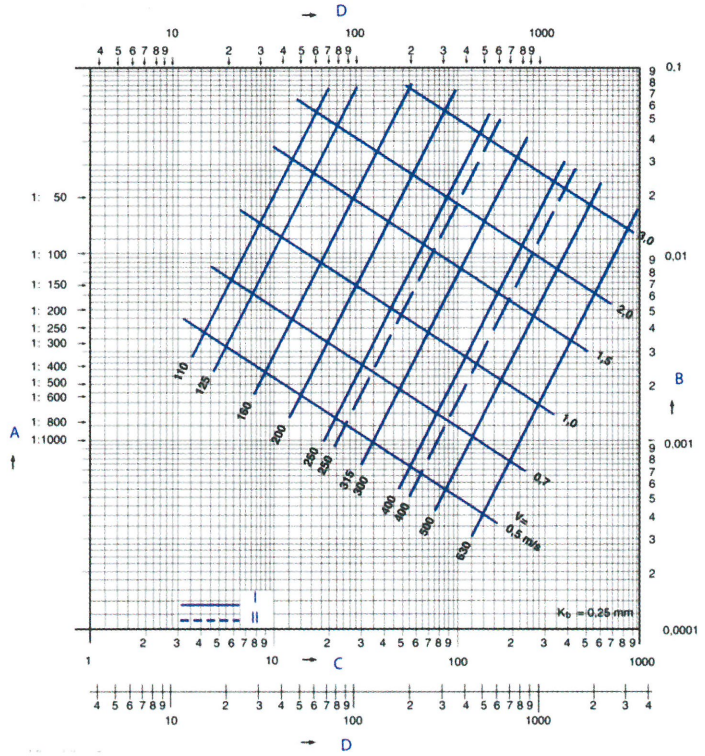


Figure : UGD 5 Flow capacity charts using k = 0,25

Where:

A downslope [m/m]
B Pressure loss [m/m]
C flow capacity[l/s]
D flow capacity[m3/h]
I outer diameter (Pipe OD)
II Inner diameter (pipe ID)

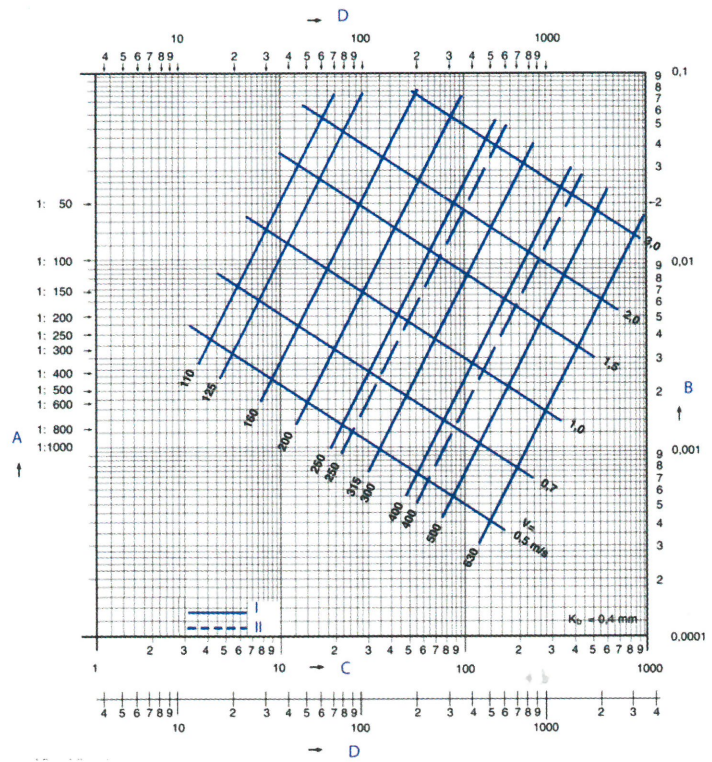


Figure : UGD 6 Flow capacity charts using k = 0,4

Where:

A downslope [m/m]
B Pressure loss [m/m]
C flow capacity[l/s]
D flow capacity[m3/h]
I outer diameter (Pipe OD)
II Inner diameter (pipe ID)

Rubber Ring Seal Joint Method





- Clean the pipe spigot.
- Ensure the ring groove and rubber ring are clean.
- Insert the rubber ring with the sealing lip facing inwards and the ring evenly and fully housed in the groove.
- Inspect the chamfered end (15°- 45°) of the pipe and mark the insertion length with reference to the socket length.
- lubricant the chamfered end. Do not lubricate rubber ring groove.
- Align the two pipes for both line and graded before making the insertion.
- Enter the spigot into the socket mouth, being careful not to introduce any dirt.
- Firmly push the pipe into the socket up to the insertion mark. Do not use excessive force. If excessive force is required to make the joint, disassemble and check the following:
    - The ring is facing the correct direction.
    - The ring and spigot are clean and have been lubricated.
    - The ring and pipe spigot are correctly seated.
- If the pipe is pushed past the insertion mark withdraw immediately; if the lubricant is left to dry it will be much more difficult to withdraw.
- To ensure an even graded, the bedding should be removed in the pipe socket area to accommodate the wider socket.
- Jointing may be assisted with a crow bar or shovel and a block of wood. Do not attempt to force the assembly. Machinery should only be used on larger pipe sizes, if necessary, and then only with extreme caution.

Allowable Deviation from Straightness

Qatar National Plastic uPVC pipe should be installed in a straight line or using fittings to alter direction. However, uPVC pipes are flexible, and under following conditions, deviations are possible. Special care must be taken to avoid any stress on the socket joint. See figure UGD 7.

If nominal diameter (dn) ≤200mm: the radius of the permitted bend (R) ≥300dn

If nominal diameter (dn) >200mm: the radius of the permitted bend (R) ≥500dn

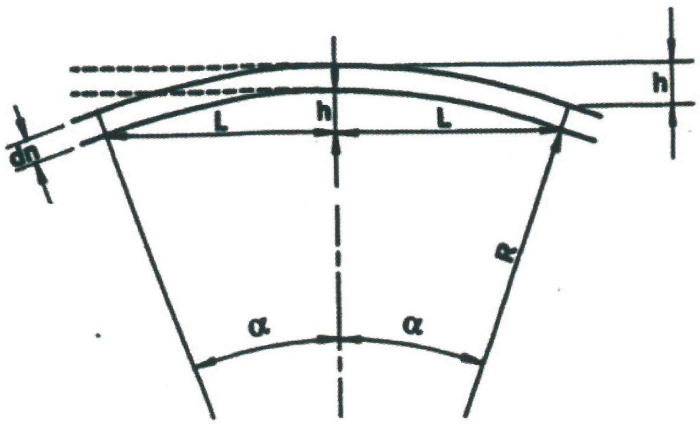


Figure : UGD 7

Note : Approximately $h = L^2/2R$ and $\alpha = L/R$.

Permitted angular deflection:

2° for pipe with a nominal diameter of ≤315mm

1.5° for pipe with a nominal diameter of 315mm and nominal diameter ≤630mm

1° for pipe with a nominal diameter of >630mm

Fall/Gradients in Drainage Pipe

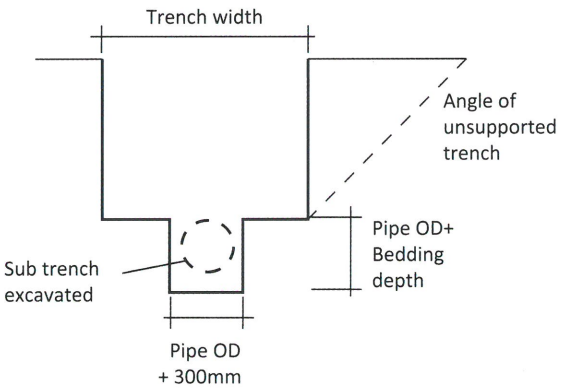
The gradient in foul water drainage pipes are designed to give a filling degree of 75% (i.e. to contain 25% air) thus ensuring that the pipe bore velocity shall not be less than 0.70m/s and will therefore be self-cleaning. Gradients are given in the table below. For Example: 110mm foul drain pipe should have gradient of 1:40 to ensure a correct discharge rate of 1 l/s (ie.25mm per meter).

Peak flow(a) liters/second	Pipe size (mm)	Minimum gradient
<1	110	1:40
>1	110	1:80 (Min.1WC)
	160	1:150 (Min.5WC)

Excavation

Trenches prepared for underground drainage and sewerage pipe must not be kept open for an extended period. Pipe should be laid and trenches backfill as quickly as possible to avoid trench collapse and side fall that creates an uneven, inconsistent trench bottom. Trench width should as be narrow as possible, but not less than 300mm plus pipe diameter to accommodate a good backfill (example: 315mm pipe should have minimum trench width 615mm, ie150+315+150). Please refer to the figure below.

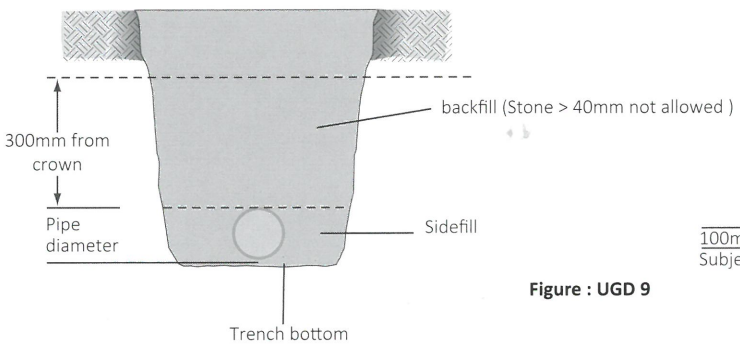
Figure : UGD 8



Pipe Bedding and Surround Materials

Trenches should be excavated to allow for the depth of the bedding material. Before any pipework is installed the bedding material should be laid evenly along the bottom of the trench. The side fill material must be the same as the bedding material and extend to the crown of the pipe and be thoroughly compacted. Where the backfill above the pipe contains stones larger than 40mm or where the pipework is deeper than 2m in poor ground, the granular material must extend at least 100mm above the pipe crown. Alternatively, backfill material can be graded to eliminate stones exceeding 40mm and this selected material used for the first 300mm above the pipe. If the pipes are to be laid in rock, compacted sand or gravel, or in very soft or wet ground requiring mechanical means of trimming, a minimum of 100mm bedding should be maintained. See figure UGD 9.

Nominal pipe size	Granular material size
110mm	10mm nominal single size
	14-5mm course graded
160mm	10-14mm nominal single size.
	14-5mm course graded
225mm and above	10,14, or 20mm nominal single size
	14 or 20 to 5mm course graded



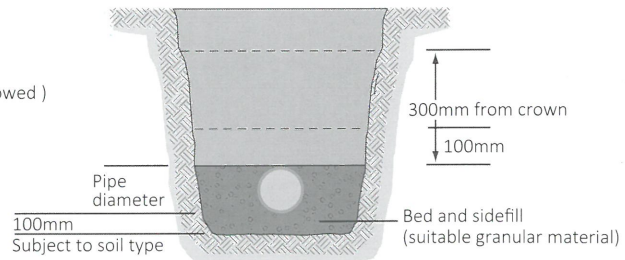


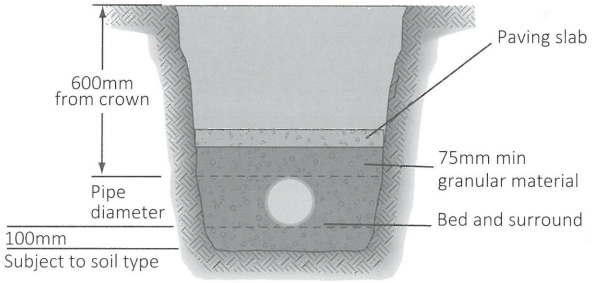
Figure : UGD 9

Laying Shallow Domestic Drains

Domestic drains are often shallow laid. This is acceptable provided the pipe is not under a road and is protected against damage by placing a layer of concrete, paving slabs or similar over the pipes. A minimum 75mm cushioning layer of granular material must also be placed between the pipes and the slabs or the concrete. Where there is a danger from construction vehicles or heavy transport, concrete slabs must be used. See figure UGD10

This method is preferred for pipe laid at less than 600mm of depth.

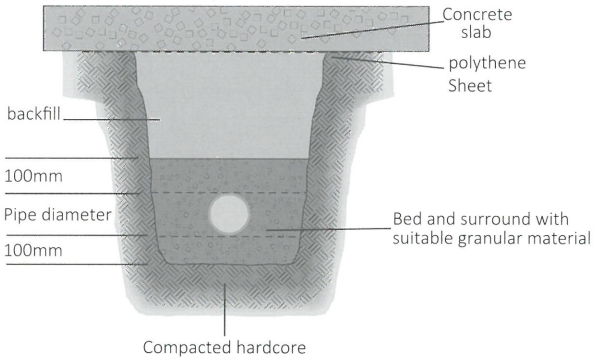
Figure : UGD 10



Laying Drains Under Solid Ground Floors or Building Premises

Where pipes are to be laid under solid floors or building premises, especially where intended to connect sanitary drainage, it is essential the ground must be initially compacted with deep hardcore material within the foundation boundaries. A trench for the pipe should then be excavated, and suitable material employed for the bedding and backfilling operation. If trenches are dug from the original ground, pipes may be laid and surrounded as necessary before the top layer of hardcore is formed. If the pipe passes through a wall or foundation of a building, a duct or sleeve should be built-in to provide clearance around the pipe. See figure UGD 11.

Figure : UGD 11



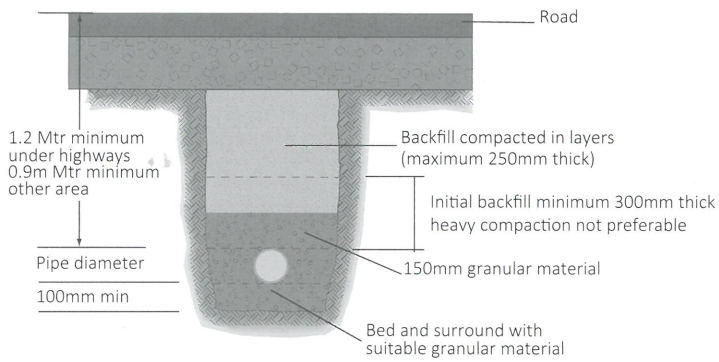
Laying for Heavy Protection (Concrete Bed and Surround)

It is never recommended to lay uPVC pipe on a concreate bed and surround. uPVC pipes are flexible and thermal movement will result in stress. In cases where the use of concrete beds and surrounds are unavoidable, it is recommended that pipes are laid in 3 - 3.5 meter lengths and a compressible board is shaped to fit around each joint. Pipes should also be wrapped with polythene to prevent the penetration of cement grout into rubber ring seal joints.

Laying for Sewer Lines

For Sewer lines, given the importance of flows and the inconsistency of the effluent, must obligatorily to be studied and designed correctly based on project specification and structural analysis of pipes. The minimum cover under public roads should be 1.2m to the crown of the pipe. Certain cover specifications are shown in figure below for reference purposes only. Please refer to UGD 12 .

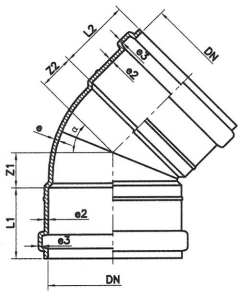
Figure : UGD 12



Standard: BSEN1401
SDR: 41
SN: 4

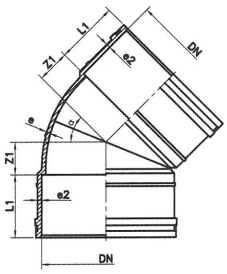
Colour: Terracotta RAL 8023
Application: "UD" under ground
F/F: Female/Female socket

M/F: Male/Female socket
RRJ: Rubber Ring Joint
SCJ: Solvent Cement Joint



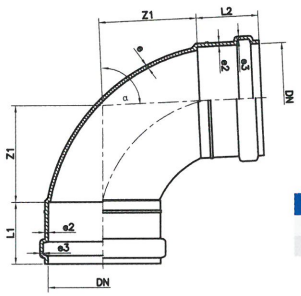
Elbow 45° F/F RRJ

DN	α	e	e2	e3	L1	L2	Z1	Z2
110	45°	3.2	2.9	2.4	61	61	30	30
160	45°	4	3.6	3	83	83	44	44
200	45°	4.9	4.4	3.7	79.5	79.5	68.5	68.5



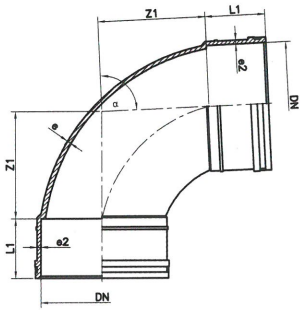
Elbow 45° F/F SCJ

DN	α	e	e2	L1	L2	Z1	Z2
110	45°	3.2	2.9	54	54	28	28
160	45°	4	3.6	76	76	44	44



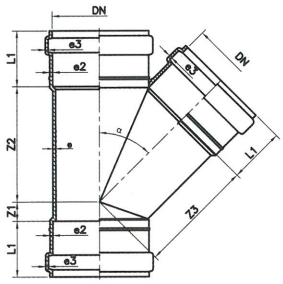
Bend 87.5° Swept F/F RRJ

DN	α	e	e2	e3	L1	L2	Z1	Z2
110	87.5°	3.2	2.9	2.4	61	61	99	99
160	87.5°	4	3.6	3	83	83	127	127



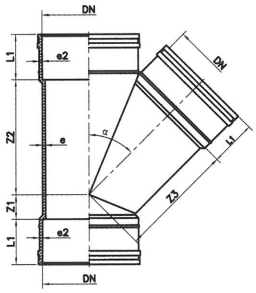
Bend 87.5° Swept F/F SCJ

DN	α	e	e2	L1	Z1
110	87.5°	3.2	2.9	54	97
160	87.5°	4	3.6	76	127



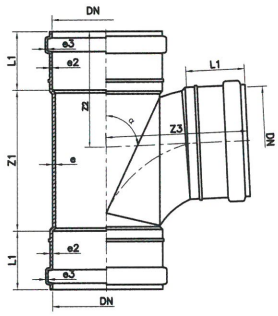
TEE 45° F/F RRJ

DN	α	e	e2	e3	L1	Z1	Z2	Z3
110	45°	3.2	2.9	2.4	61	23	138	138
160	45°	4	3.6	3	83	44	197.5	197.5



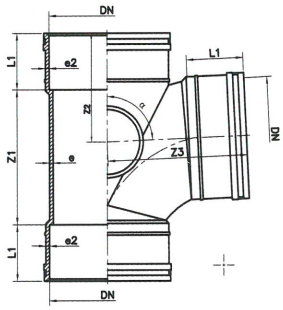
TEE 45° F/F SCJ

DN	α	e	e2	L1	Z1	Z2	Z3
110	45°	3.2	2.9	54	29	137	137
160	45°	4	3.6	76	44	197.5	197.5



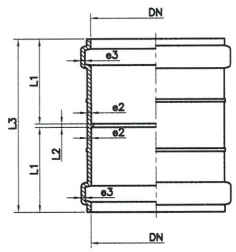
TEE 87.5° Swept F/F RRJ

DN	α	e	e2	e3	L1	Z1	Z2	Z3
110	87.5°	3.2	2.9	2.4	61	131	111	142
160	87.5°	4	3.6	3	83	212	169	207



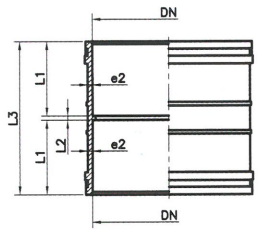
TEE 87.5° Swept F/F SCJ

DN	α	e	e2	L1	Z1	Z2	Z3
110	87.5°	3.2	2.9	54	127	104	133
160	87.5°	4	3.6	76	212	162	200



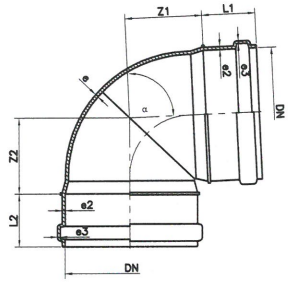
Coupler F/F RRJ

DN	e2	e3	L1	L2	L3
110	2.9	2.4	71	3	145
160	3.6	3	85	4	174
200	4.4	3.7	94	5.5	193.5



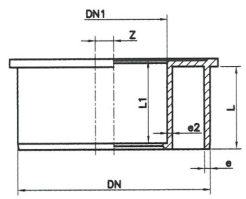
Coupler F/F SCJ

DN	e2	L1	L2	L3
110	2.9	54	3	111
160	3.6	78	4	160



Bend 87.5° Unswept F/F RRJ

DN	α	e	e2	e3	L1	L2	Z1	Z2
200	87.5°	4.9	4.4	3.7	79.5	79.5	119	119



Reducer Bush M/F SCJ

Size	DN	DN 1	e	e2	L	L1	Z
160 x110	160	110	4	2.9	76.8	54	20.6