Excellent Pipes
Company L.L.C.

Pioneering Excellence in Plastics

EXCELLENTPIPES

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EXCELLENT PIPES COMPANY L.L.C

Established in 2000, Excellent Pipes Co. (EXCELLENT) operates a state-of-the-art plant in Abu Dhabi for the manufacture and supply of uPVC, ABS, PE Pipes and Sub-Ducts as well as Fittings and other associated services to government projects, infrastructure contractors and the construction industry at large.

EXCELLENT adopts a policy of continuous development as an integral part of its operation. We have in place advanced technology coupled with extensive research and assured quality. Our products are used in pressure application, underground drain and sewer systems, electrical and telephone networks, soil and waste discharge utilities.

We offer support services to our clients and assist them with their project implementation from conception to successful commissioning.

EXCELLENT's pipes are manufactured to close dimensional tolerance with an uncompromising emphasis on quality and performance. As an industrial offshoot of Bin Hafeez Group, we enjoy a unique standing in the business community, capitalizing on the group's long history of successful achievements and awards. Our group's road to success is marked with several recognitions, including the Shaikh Khalifa industrial and Excellence Awards, American Concrete Pipe Association Certification, triple certification under ISO 9001, 14001 &18001 and the highly acknowledged BSI Kitemark certification.

Our technical and operational expertise supported by technology transfer from leaders in the pipe industry, bring EXCELLENT to the forefront of international plastic manufacturers, providing value to our customers, in line with our motto of "PIONEERING EXCELLENCE IN PLASTICS".

Pioneering Excellence in Plastics

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INTRODUCTION

Equipped with the latest extrusion machinery, EXCELLENT manufactures and supplies uPVC Pipes and Fittings that are highly resistant to chemicals, alcohols, oil and acids, all in accordance with the requirements of international standards.

Compared with other conventional pipes, the exceptional quality and smooth bore of uPVC offers the best pipe characteristics in corrosion resistance and improved flow co-efficient, thereby eliminating the build-up of deposits, tuberculation and scales.

uPVC pipe is non-toxic and does not affect the taste, odor or color of the water nor does it react with other fluids.

With its integral insulation and non-conductive properties, uPVC Pipe is ideal for use as conduit for electric, telephone and other media cables, since electromechanical and galvanic corrosions do not take place.

Furthermore, uPVC is widely used in sewer applications because it is not affected by the Hydrogen Sulfide (H_2S) that is usually generated from the presence of Sulfuric acid (H_2SO_4) found in the sewer schemes.

The economy of use, ease of installation, non-corrosive characteristics as well as the light weight and flexibility, all make uPVC a reliable and ideal pipe to use in pressure applications, soil and waste discharge, underground drain and sewer, electrical and telephone cable ducts and other applicable installations.

uPVC has been extensively used for over 50 years in all situations, applications and climatic conditions.

General Properties

GENERAL PROPERTIES OF uPVC PIPE MATERIAL

The table below shows the physical characteristics of the uPVC, that may vary with temperature, being a thermoplastic material. The variation of uPVC physical properties with temperature and the effects of such variation on the working pressure are shown in Appendix-B.

General Properties of uPVC Material

PROPERTY	UNIT	VALUE
Density	gr/cc	1.4-1.46
Tensile Strength	MPa	45-50
Elongation	%	80-150
Compressive Strength	MPa	59
Modulus of Elasticity	MPa	3000
Specific Heat	Cal/g/°C	0.24
Thermal Conductivity	Kcal/m/h/°C	0.12
Heat Distortion Temperature at 18.5 Kgf/cm2	°C	70
5 Kg. Vicat Softening Point	°C	80
Linear Expansion	mm/m/°C	0.08
Volume Resistivity	ohm/cm	10^{15}
Flammability	Self Extinguishing	

PLANT AND PROCESS

ENVIRONMENTAL FRIENDLY PLANT

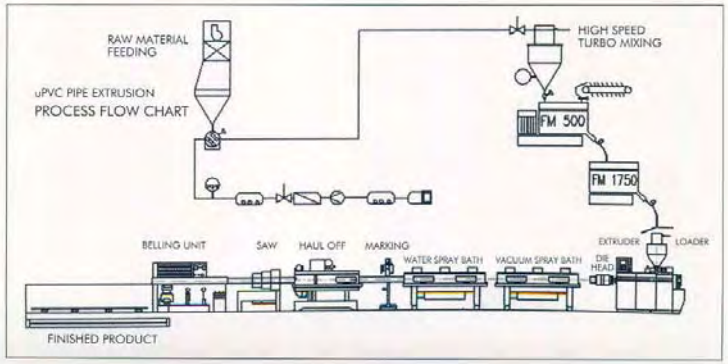
The manufacturing process starts with the preparation of uPVC dry blend in a high speed mixer. The blend consists of pure PVC Resin and one pack of stabilizing system developed by reputed stabilizer manufactures to which are also added the pigments to obtain the required color. All these ingredients are mixed in a high speed mixer until the required temperature is attained. The hot compound is discharged into the cooling chamber and cooled to the room temperature and then discharged into a collection silo, that forms part of a fully integrated PLC controlled material feeding and storage system consisting of a total of seven silos. This system unique to Excellent Pipes, acquired at a very high capital cost investment, was found necessary to ensure consistency in material flow thus improving its properties and avoiding dust pollution. The material is allowed to rest in the silos before being transferred to the extruder, allowing it to give better mechanical properties in the pipe. From the time of feeding the raw material in the mixer to the stage where the finished product is released for packing, the system is fully enclosed with no human interference and this fully sealed integrated system helps to eliminate pollution and protect the environment.

PROCESS DESCRIPTION

uPVC Pipe is manufactured by the extrusion process. Twin screw extruder of both parallel and conical designs are used for extruding dry blends. The extruder mainly consists of a barrel and a pair of screws specially designed with nitrided surfaces to ensure proper plastification of the material. While the barrel is fixed, the screws rotate in counter clock-wise direction by the use of variable DC drive or frequency controlled motor through reduction and distribution gears.

Depending on the size to be produced, a suitable die head is selected and assembled with the die set, and then mounted on to the barrel through an adapter. The barrel, the die head and die set are heated by a set of a heater bands and temperature is controlled through electronic controls.

Once the required temperature is attained, the extruder hopper is fed with the ready mixed uPVC compound and the main motor started. The plasticized material gradually come out of the die opening and once the flow is uniform, the extrudate is cooled and sized into a pipe. The OD of the pipe is controlled by a calibrator mounted in the vacuum spray bath. The pipe is pulled by a haul-off machine at a set constant speed to ensure that wall thickness is uniform throughout the length of the pipe. As the pipe passes through a saw machine, it is cut to the required length as per the length set in the computer. The cut length of pipe is then transferred on to the belling machine and the socket is formed prior to transporting the finished product to the crating area and finally to the storage yard for shipment.



Extracts from Process Flow

High Speed Mixing Plant

Mixed Materials Storage and Conveying System

Big Diameter Head and Die-Set

Cutting and Belling Machine

Stronge in Shaded Conditions

PVC Pipes Installed on an Infrastructure Project

MANUFACTURING STANDARDS

Manufacturing Standards

1. uPVC PIPES TO DIN 8061/8062 (Based on ISO 161/1 Metric Series)
2. uPVC PIPES TO BS EN 1452 (Formerly BS 3505)
3. uPVC PIPES TO BS 3506
4. uPVC PIPES TO ISO 4422-2
5. uPVC UNDERGROUND DRAIN & SEWER PIPES TO BS EN 1401-1 (Formerly BS 4660 and BS 5481)
6. uPVC SOIL AND VENTILATING PIPES TO BS 4514 AND BS EN 1329-1
7. uPVC DUCTS FOR ELECTRICAL/TELEPHONE CABLES AS PER ETISALAT SPECIFICATIONS.
8. uPVC DUCTS
   (Based on ISO 161/1 Recommended Diameters)
   a) For Services Ducts.
   b) For Electrical Conduits

Manufacturing at EXCELLENT is based on approved international standards such as ISO, DIN and BS EN Standards.

EXCELLENT has also incorporated into its manufacturing range certain popular sizes of other standards viz. Etisalat etc., in order to serve customer's interests.

Upon specific request from the customers, EXCELLENT also produces non-standard pipes, which are specifically formulated to suit their requirements.

MANUFACTURING RANGE

At present EXCELLENT manufactures DIN Standard size range from 20 mm to 500 mm outside diameter in various pressure classes (4, 6, 10 and 16 bar).

Pressure pipes to ISO and BS EN Standards are manufactured from size range of 20 mm to 500 mm outside diamter in four pressure classes (6, 10, 12.5 and 16 bar) and BS EN (inch) sizes from 1/2" to 12" outside diamter in 9, 12 and 15 bar pressure classes.

Sewer and drainage pipes to BS EN Standards are manufactured in size range 110 mm to 500 mm.

Soil and Waste Discharge pipes to BS EN Standards are manufactured in the nominal sizes 36 to 160mm.

EXCELLENT uPVC pipes are available with plain ends or integral socketed ends suitable for solvent welding (S/W). The pressure pipes from dia 110 mm upwards are available with push-fit (R/R) sockets in various pressure classes. The standard length of pipe is 6 meters including the integral socket.

Excellent's pipe manufacturing details are shown below.

MANUFACTURING RANGE

Application	Standard	Range (Outer diameter)	Pressure Class (Bar)
Pressure	DIN	20 mm to 500mm	4,6,10 and 16
Pressure	ISO and BS EN	20 mm to 500mm	6,10,12.5 and 16
Pressure	BS EN (inch)	1/2" to 12"	9, 12 and 15
Pressure	BS	1/2" to 12"	6,9,12 and 15
Sewer and Drainage Pipes	BS EN	110 to 500mm	Gravity (SDR-41&34)
Soil and Waste Discharge	BS and BS EN	36 to 160 mm	Gravity
Telephone Ducts	Etisalat	53.9,96.5	Non-Pressure
Service Ducts and Conduits	Based on ISO 161/1	50mm to 315 mm	Non-Pressure

uPVC PIPE FITTINGS

INJECTION MOULDED FITTINGS

Most injection moulded fittings can be supplied ex-stock. Any special fittings required may also be supplied by importing them from reputed manufactures.

FABRICATED FITTINGS

Special fittings manufactured from uPVC pipe or a combination of pipe and sheet material and fabricated by PVC welding techniques may be supplied against specific orders.

LONG RADIUS BENDS AND OTHER SPECIALS

Long radius bends fabricated from uPVC pipes can be supplied at angles of 11 $^1/_4$°, 22 $^1/_2$°, 45° and 90°. Other specials including uPVC Push-Fit (R/R) couplers and repairs couplers may be supplied upon request.

FLOW CHARACTERISTICS

The smooth bore of uPVC pressure pipe offers less resistance to flow than conventional pipes. The pipe wall is resistant to corrosive attacks, and tuberculation or build-up are almost non-existent. This superior performance will be enhanced during the life of the uPVC pressure piping.

Loss in straight pipes

The Kinematic energy of a fluid flowing in a pipeline decreases with the increasing distance, which is due to the friction between the fluid and the pipe wall. The smoother the inner surface of the pipe, the lesser the friction. This loss of energy is called frictional or head loss and is calculated from the following formula.

$$hr = \frac{L}{D}\,\frac{f.V^2}{2g}$$ (Darcy-Weisback's Formula)

Where

- hr = Loss of head in straight pipe (m)
- L = Length of pipeline (m)
- f = Friction factor
- V = Velocity of liquid (m/sec)
- D = Inside diameter of the pipe (m)
- g = Gravitational acceleration (m/sec2)

Loss in Fittings and Valves

$$hr = \frac{K.V^2.N}{2g}$$

Where

hr, V, g from previous formula

- N = Number of fittings (bends, elbows, tees, valves, etc.)
- K = Constant, depending on the type Of fittings, as per the values below.

Type of fitting	K value
Elbow 45°	0.40
Elbow 90°	1.00
Long Radius Bend 22 ½°	0.10
Long Radius Bend 45°	0.20
Long Radius Bend 90°	0.40
Tee (Flow in line)	0.35
Tee (Flow in line to branch)	1.20
Tee (Flow in branch to line	0.80
Valve	0.70
Fully released valve	0.50

QUALITY CONTROL

EXCELLENT is equipped with most modern Laboratory for the testing of plastic raw materials and finished products. The testing scheme include sophisticated type test equipment, computerized logging systems to record test data for further retrieval and analysis, large size ovens, cooling fridges and liquid baths for heat reversion testing of uPVC Pipes up to Dia 500 mm in

circular shape in addition to a comprehensive list that makes the EXCELLENT laboratory a complete center for research and development approached by many clients, consultants and manufacturers seeking reference and support.

UTM

Custom made UTM is procured to conduct various tensile, compressive and stiffness tests on a single machine using a software specially developed for this purpose and installed on a dedicated computer and printer to produce and assess the test results.

DENSITY

Density is tested using a very highly sensitive balance of 0.0001 gram sensitivity with custom made density measurement apparatus.

INTEGRAL SOCKET JOINT TEST

Pipe integral socket and spigot assembly is tested in straight alignment as well as with angular deflection for leak tightness under positive pressure and negative pressure, in order to ascertain that the joint system is functional against both exfiltration and infiltration.

DUMB-BELL MILLING MACHINE

EXCELLENT has procured a modern Milling Machine to shape the pipe strips in to specified dumb-bell shape. The dumb-bell milling machine produces test samples that are essential to achieve accurate Tensile Test results.

HYDROSTATIC TEST

EXCELLENT is equipped with the latest computerized Hydrostatic Test equipment from IPT Germany, the world leader in this field. This equipment consists of two individual water baths to test at two different temperatures with

several pressure transducers to apply different pipe samples simultaneously. The pressure test data is continuously logged into the computer for accurate monitoring of the test.

IMPACT TEST

The impact test machine from IPT, Germany is one of the most advanced equipment for conducting impact test on uPVC pipes. The impact tests are done as per latest ISO standards at zero degree centigrade.

OPACITY TESTER

Opacity test is done on UPVC Pipes to ensure that the visible light transmission is limited to the specified values.

VSP TEST

Vicat softening point test is conducted in order to verify that the pipe material has sufficient rigidity.

CHEMICAL RESISTANCE TEST

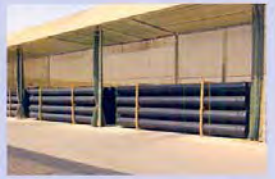
uPVC Pipe samples are immersed in Sulphuric Acid (93% w/w concentrated) for 14 days at 55°C to ensure chemical resistance of the pipe material.

Other test equipment include Bulk Density tester to check that the flowability of the material is maintained at sufficiently high and consistent level in order to obtain a uniform flow. Water Absorption test is done to

ascertain that the finished pipe absorbs water within the given limits. Furthermore, the laboratory is fully furnished with all necessary equipment to perform tests and measurements stipulated in its quality control program or required by the clients' specifications. EXCELLENT's laboratory is a source of pride to the company in its pursuit of leadership in the world of Plastics.

HANDLING, STORAGE & TRANSPORTATION

EXCELLENT uPVC pipes are strong though light in weight being about one-fifth the weight of steel or cast iron. In the factory uPVC Pipes are crated and strapped according to predefined lots. The pipe crates are then stored carefully in the yard. If the crate is opened at the site, these instructions should be followed for Storage, Handling and Transportation of pipes.



Storage & Handling

a) Pipes shall be supported adequately at all times and shall be stacked on a flat surface free of sharp objects.

b) Pipes shall be uniformly supported throughout the length. Alternatively timber supports of 3 inch wide shall be placed beneath the pipes with a spacing not greater than 1.5 meters.

c) Pipe stack height shall be kept to a minimum to ensure that the bottom pipes do not deform, and the stack shall be provided with side supports at spacing not greater than 1.5 meters.

d) Socketed pipes shall be stacked in layers with sockets placed at alternate ends of the stack, with the sockets protruding, to avoid deformation of sockets and to ensure even support for the pipe lengths.

e) In U.A.E and other Gulf countries, the uPVC pipes shall not be stored for extended periods under direct sunlight to avoid ultraviolet degradation. Even if the pipes are sorted under cover, the stack heights shall be reduced to a minimum during high ambient temperature levels.

f) Since the soundness of the joint depends on the condition of the spigot and socket, special care shall be taken at all times to avoid damage to these joints.

Transportation

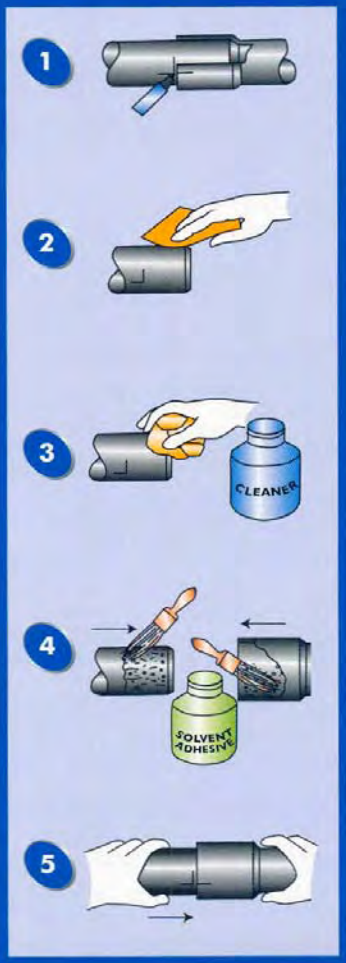
a) When loading pipes onto vehicles, care shall be taken to avoid impact and ensure the vehicle board is free of any sharp objects such as nails, cope irons etc.

b) Where mechanical handling is employed, metal slings, hooks or chains shall not come into direct contact with the pipe.

c) While in transit, pipes shall be well secured and well supported over their entire length.

d) Pipes may be off-loaded from vehicles by rolling them gently over timbers without causing any impact to the pipe.

SOLVENT CEMENT JOINTING OF uPVC PIPES



All EXCELLENT uPVC pipes up to 500 mm diameter can be supplied complete with integral solvent weld sockets. Sockets are slightly tapered for easy spigot entry. A pressure-tight joint is formed when the spigot is bonded into the socket by the action of solvent cement applied to both bonding surfaces. The following procedure is to be strictly followed to make a leak-proof joint:

1. Entry of the spigot and the alignment shall be marked.
2. Sand paper shall be used to abrade spigot and socket bonding surfaces.
3. Clean bonding surfaces mentioned in (2) above with cleaning fluid, e.g. MEK cleaner.
4. Using a clean brush, cement shall be applied evenly in one coat to spigot and socket in longitudinal strokes. Where uncoated spots are found, a second coat shall be applied to the spigot end.
5. Immediately insert spigot into the socket until entry- mark, hold in position for few seconds, then wipe off excess cement. This insertion of the spigot shall be done without any twisting.

Important Note :

- Allow a minimum of 24 hrs. before pressure testing. Drying time varies according to ambient temperature, pipe diameter, type and amount of cement used.
- Replace the lid onto the container as soon as the cement is applied and observe the instructions given on the container.
- Solvent cement and cleaner shall be stored in a cool and dry place, away from direct sunlight or any source of high temperature.
- The solvent cement shall not be diluted with any other fluids.
- Use the brands supplied or approved by EXCELLENT to ensure a leak-proof joint.

PUSH-FIT (R/R) JOINTING OF uPVC PIPES

The Push-Fit (R/R) socket is an integral part of the pipe. The elastomeric sealing ring locates positively within the socket groove permitting easy entry of the spigot while ensuring a pressure-tight seal under all working pressures.

Jointing Procedure

Push the spigot of one pipe into the socket of the other up to the home line after making sure that the pipes are aligned both in horizontal and vertical planes.

INSTALLATION GUIDELINES

TRENCH PREPARATION

The width of the trench at the crown of the pipes shall not be less than the outside diameter of the pipe plus 300 mm to allow proper compaction of the side fill material.

The trench bottom shall be carefully examined for presence of hard matters such as flints, rocky projections, sharp objects, etc. Ideally, the prepared bedding shall consist of a free-running granular material passing a 19 mm sieve but with minimum of fine particles or silt in order to achieve the desired compaction.

The thickness of the prepared bedding shall be at least 100 mm. It shall be well compacted and brought to an even surface to maintain uniform support to the pipe.

PIPE LAYING

a) Push-Fit (R/R) Socket Pipes

uPVC pipes with integral Push-Fit (R/R) sockets are preferably installed and joined in the trench. Pipes up to 6" in diameter may, if necessary, be joined at the trench side and thereafter lowered into the trench. In such cases extreme care should be taken to ensure that no separation of the joints occurs during this operation and the joints shall be checked after the pipes are in position to ensure their integrity.

The Push-Fit (R/R) sockets will not resist end thrust, hence the pipes shall be laid on a prepared bedding as described above and anchored at all changes of direction, valves, reducers and plugged ends. For typical anchor details, see the figures on the right side. All temporary pipe supports, leveling pegs etc. must be removed from beneath the pipe prior to backfilling. The amount of expansion and contraction of buried pipes carrying cold water will normally be small and easily accommodated by the Push-Fit (R/R) socket.

Push-Fit R/R uPVC Pipes

b) Solvent Cement Socket Pipes

In order to take full advantage of the flexibility of the uPVC Pipes made by EXCELLENT, the pipes can be joined along trench side by solvent welding and then lowered in to the trench. A minimum of four hours shall be allowed between making the last joint and lowering a long length of pipe into the trench. Pipe may individually be joined in the trench if preferred.

Solvent cement joints will sustain end loads created by internal fluid pressure. Therefore, anchors providing restraint against joint separation are not essential. However, proper consideration shall be given to the anchorage of all pipelines.

When laying pipes with solvent cemented joints in hot weather, it is recommended that the temperature of the pipe be minimized by partial back-filling before making final connections and locating anchor blocks.

SIDE FILLING

Before commencing to place any side –fill material, all trench sheeting should be partially withdrawn and pipe bedding checked for rocks or other sharp objects which may have fallen into the trench after the pipe was laid.

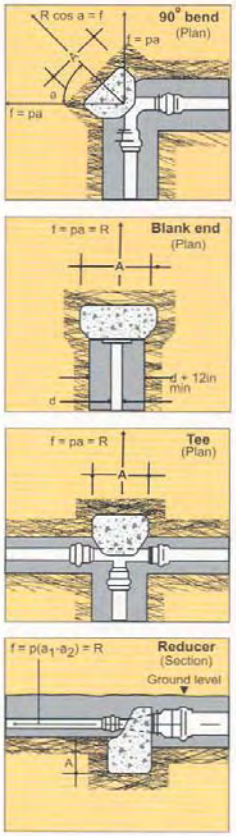
Due to reaction from the side-fill, which is necessary for a flexible pipe to sustain back loads, some deformation of the pipe's cross section may occur. It is generally considered that the maximum vertical deflection of the pipe should be within 5% of the pipe's outside diameter.

The selection, placing and compaction of side fill material is of supreme importance to ensure that the 5% maximum deflection is not exceeded. Granular material as described in "Trench Preparation" and having a compaction fraction of 0.1 or less, shall be placed carefully between the pipe and trench wall and thoroughly compacted by hand in layers not exceeding 75 mm. This shall continue up to a level of at least 100 mm above the crown of the pipe.

BACK FILLING

Selected excavated material may be used for the remainder of the backfilling and special consideration of its suitability may be necessary where the risk of surface subsidence is a consideration e.g. under roads. The backfill material shall be compacted in 300 mm layers or in compliance with special requirements of the specifications. Stones or any other objects larger than 150 mm or mechanical compactors shall not be used until the fill has reached a height of at least 300 mm above the crown of the pipe.

Arrangement of thrust blocsk



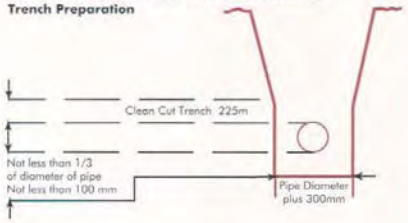
The required area of the thrust block of position A is obtained by dividing the resultant force R by the bearing capacity of the soil.

Note:

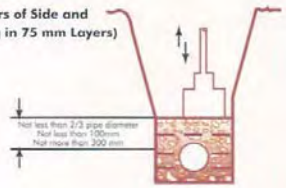
a = cross sectional area of pipe bore
p = max. applied pressure (e.g. field test pressure)
f = axial force
R = resultant force (Thrust)

Examples of Trench Preparation and Backfilling

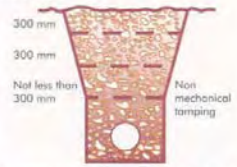
Trench Preparation



Compacting Layers of Side and Backfill (Tamping in 75 mm Layers)



Normal Filling (300 mm layers Tamped by non-mechanical means)



When pipelines are laid in hot climatic conditions, it is advisable to fill the pipe with cold water to bring the pipe lengths to the normal contracted dimension, and check the joints to ensure that socket insertion depth is satisfactory.

FIELD PRESSURE TESTING

The purpose of a field pressure test is to establish that the installed section of pipeline under test in general, and all joints and fittings in particular, will withstand the design working pressure with an additional safety margin without leakage. Generally, a test pressure of 1.5 times the working pressure for the installed pipe is adequate. All site pressure testing of EXCELLENT uPVC pressure pipes shall be carried out hydrostatically and under no circumstances shall compressed air be used for testing as this may result in injury or damage.

Several acceptable specifications are available for applying hydrostatic pressure tests to pipelines. The method described below is one commonly used and intended as a guide only.

Because of the elastic characteristics and relatively high thermal expansion and contraction of uPVC, it is advisable to conduct a preliminary test for a duration of 12 hrs. at 1.5 times the working pressure, followed by the main test at 1.3 times the pressure for a duration of 3 hours for diameters up to 6" and 6 hours for above 6" diameter pipes. By conducting the preliminary test, any change in volume of the pipeline caused by the internal pressure, time and temperature factors can be avoided, so that the reading obtained in the main test will provide unquestionable evidence on the soundness of the tested section.

Variation of the above nature are more evident in the case of exposed pipes under free end conditions than in the case of backfilled pipes. A convenient and acceptable practice to backfill the pipe trench prior to Testing keeping all pipe joints, fittings, connections etc., exposed until the test is done and judged satisfactory.

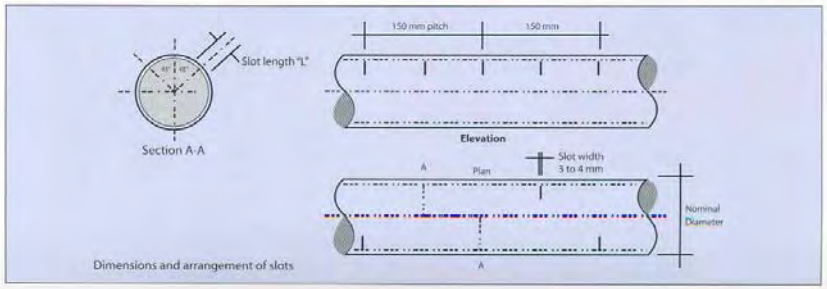
While carrying out pressure test, it should be ensured that the line is completely filled with water and that all the air is removed from the system. Otherwise, surge pressures of sufficient magnitude that cause bursts may occur. Care should be taken to ensure that all air is released from the line through air release valves located at points of maximum elevation in the pipeline.

Where possible the line shall be filled at a lowest point. One method of ensuring that the line is completely free of air is for a foam swab to be forced through the line under the pressure of the incoming water.

Test Procedure

1. Slowly fill the pipe with water and release all entrapped air in the process.
2. Gradually raise the pressure in the system to the specified test pressure. The test can be said to have started when the test pressure level reached and the flow from the pump to the system is disconnected.
3. The system shall remain under pressure for a specified period.
4. Should there be a drop in pressure at the end of the specified period, then a measured quantity of water is pumped into the system until the original test pressure level is reached.
5. The pipe shall be judged to have passed the test satisfactorily if the quantity of water required to restore the test pressure does not exceed the amount calculated by the formula:

Quantity ≤ 4,5 liters per - 1,6 km of pipe length
- 25 mm of inner Dia
- 30 m testing head
- 24 hrs test time



Dimensions and arrangement of slots

uPVC SLOTTED PIPES FOR SURFACE WATER AND UNDER-DRAINAGE

INTRODUCTION

Slotted uPVC pipe for drainage application has an advantage over traditional clay and porous concrete materials. uPVC slotted pipes are well suited for storm drainage application especially in the Middle East. uPVC has exceptional flow characteristics and the infiltration rates of slotted pipes are greater than a fully porous concrete pipe for any given size. The pipes are available in 6 meter lengths, socketted at one end for positive location and accurate alignment.

PURPOSE AND USE

Slotted drain pipe are used to control the water content of a roadway formation and sub-base, collect large quantities of surface water, or act as both collector and formation drain. Provided sufficient capacity is available, it is also permissible for the slotted drain pipe to be used as the main carrier. This 'one pipe' system is being increasingly adopted in motorway and trunk road drainage projects.

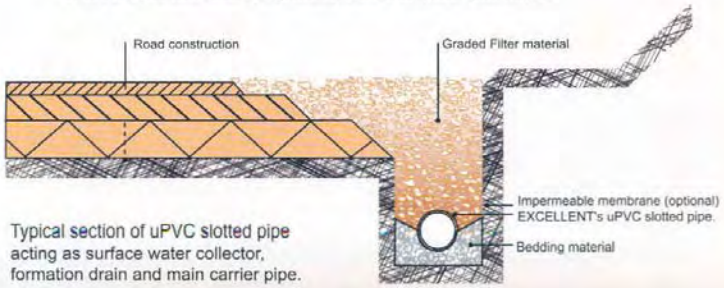
SLOT GEOMETRY

The slots are designed to give at least the minimum infiltration rates for porous concrete pipes as specified by BS 5911: Part 114 : 1992, "concrete porous pipes for drainage". Two longitudinal rows of slots are machine cut in the pipe and are separated radially. Longitudinally, slot centers are staggered and the complete details of slotted pipes dimensions are given below.

Slotted pipes dimensional data

Nominal Diameter mm	Slot Lenght (mm)		Slot Width (mm)		Minimum Slot Area (mm^2/m)	Pitch
	Min.	Max.	Min.	Max.		Min.
110	25	30	3	4	1000	150
160	43	48	3	4	1720	150
200	55	60	3	4	2200	150
225	61	66	3	4	2440	150
250	68	73	3	4	2720	150
315	81	86	3	4	3200	150
400	90	95	3	4	3600	150
500	100	105	3	4	4000	150

- N.B. 1. Any standard PVC Pipe can be slotted with the above dimensions.
  2. uPVC pipes with other slot geometry can be supplied upon request.



Typical section of uPVC slotted pipe acting as surface water collector, formation drain and main carrier pipe.

Appendix A

APPENDIX - A

PRODUCT STANDARDS AND DIMENSIONS

uPVC PIPES TO DIN 8061/8062

(Based on ISO 161/1Metric Series)

Outside Diameter mm	Wall Thickness			
	Series-2 4 bar (Class-4) mm	Series-3 6 bar (Class-6) mm	Series-4 10 bar (Class-10) mm	Series-5 16 bar (Class-16) mm
20	-	-	-	1.5
25	-	-	1.5	1.9
32	-	-	1.8	2.4
40	-	1.8	1.9	3.0
50	-	1.8	2.4	3.7
63	-	1.9	3.0	4.7
75	1.8	2.2	3.6	5.6
90	1.8	2.7	4.3	6.7
110	2.2	3.2	5.3	8.2
160	3.2	4.7	7.7	11.9
200	4.0	5.9	9.6	14.9
225	4.5	6.6	10.8	16.7
250	4.9	7.3	11.9	18.6
280	5.5	8.2	13.4	20.8
315	6.2	9.2	15.0	23.4
400	7.9	11.7	19.1	-
500	9.8	14.6	23.9	-

- The above dimensions are based on ISO Standard 161/1 and equation

  $e = \frac{p.d.}{2\sigma + p}$ where $\sigma = 10\ N/mm^2$
- The pressure rating given above in bars is the working pressure at 20°C
- Pipes to this specification will be supplied in 6 meter lengths with integral Solvent Weld Sockets. Dia. 110mm and above are also available with Push-Fit (R/R) Sockets in 6,10 and 16 bar range.

PRODUCT STANDARDS AND DIMENSIONS

uPVC PIPES TO BS EN 1452-2 (Formerly BS 3505)

Outside Diameter	Wall Thickness			
	PN-6 6 bar	PN-10 10 bar	PN-12.5 12.5 bar	PN-16 16 bar
mm	mm	mm	mm	mm
20	-	-	-	1.5
25	-	-	1.5	1.9
32	-	-	1.9	2.4
40	-	1.9	2.4	3.0
50	1.6	2.4	3.0	3.7
63	2.0	3.0	3.8	4.7
75	2.3	3.6	4.5	5.6
90	2.8	4.3	5.4	6.7
110	2.7	4.2	5.3	6.6
160	4.0	6.2	7.7	9.5
200	4.9	7.7	9.6	11.9
225	5.5	8.6	10.8	13.4
250	6.2	9.6	11.9	14.8
280	6.9	10.7	13.4	16.6
315	7.7	12.1	15.0	18.7
400	9.8	15.3	19.1	23.7
500	12.3	19.1	23.9	-

Above dimensions up to 90 mm are based on a service design Coffcient : C = 2.5 and from 110 mm and above : C = 2.0

The pressure rating given above in bars is the working pressure at 20 deg. C

Pipe to this specification will be supplied in 6 meter lengths with integral Solvent Weld Socket. Dia . 110mm and above are also available with Push-Fit (R/R) Sockets

Appendix A

PRODUCT STANDARDS AND DIMENSIONS

uPVC PIPES TO BS EN 1452-2

Annex - B
Imperial (Inch) - Sized Pipes (Formerly BS 3505)

Nominal Size	Wall Thickness			
	Mean outside Diameter (Min)	PN-9 9 bar	PN-12 12bar	PN-15 15 bar
(in)	mm	mm	mm	mm
½	21.2	-	-	1.7
¾	26.6	-	-	1.9
1	33.4	-	-	2.2
1 ¼	42.1	-	2.2	2.7
1 ½	48.1	-	2.5	3.1
2	60.2	2.5	3.1	3.9
3	88.7	3.5	4.6	5.7
4	114.1	4.5	6.0	7.3
6	168.0	6.6	8.8	10.8
8	218.8	7.8	10.3	12.6
10	272.6	9.7	12.8	15.7
12	323.4	11.5	15.2	18.7

- The pressure rating given above in bars is the working pressure at 20°C.
- Pipes to this specification will be supplied in 6 meter lenghts with integral Solvent Weld Sockets. Size 3" to 8" are also available with Push-fit (R/R) Sockets.

PRODUCT STANDARDS AND DIMENSIONS

uPVC PIPES TO BS 3506

Nominal Size (in)	Wall Thickness: Mean outside Diameter mm	Class-B 6 bar mm	Class-C 9 bar mm	Class-D 12 bar mm	Class-E 15 bar mm
½	21.2	-	-	-	1.7
¾	26.6	-	-	-	1.9
1	33.4	-	-	-	2.2
1 ¼	42.1	-	-	2.2	2.7
1 ½	48.1	-	-	2.5	3.1
2	60.2	-	2.5	3.1	3.9
2 ½	75.0	-	3.0	3.9	4.8
3	88.7	2.9	3.5	4.6	5.7
4	114.1	3.4	4.5	6.0	7.3
6	168.0	4.5	6.6	8.8	10.8
8	218.8	5.3	7.8	10.3	12.6
10	272.6	6.6	9.7	12.8	15.7
12	323.4	7.8	11.5	15.2	18.7

- The pressure rating given above in bars is the working pressure at 20°C.
- Pipes to this specification will be supplied in 6 meter lenghts with integral Solvent Weld Sockets. Size 3" to 8" are also available with Push-fit (R/R) Sockets.

PRODUCT STANDARDS AND DIMENSIONS

uPVC PIPES TO ISO 4422-2

Outside Diameter mm	Wall Thickness: PN-6 6 bar mm	PN-10 10 bar mm	PN-12.5 12.5 bar mm	PN-16 16 bar mm
20	-	-	-	1.5
25	-	-	1.5	1.9
32	-	-	1.9	2.4
40	-	1.9	2.4	3.0
50	1.6	2.4	3.0	3.7
63	1.9	3.0	3.8	4.7
75	2.2	3.6	4.5	5.6
90	2.7	4.3	5.4	6.7
110	2.7	4.2	5.3	6.6
160	4.0	6.2	7.7	9.5
200	4.9	7.7	9.6	11.9
225	5.5	8.6	10.8	13.4
250	6.2	9.6	11.9	14.8
280	6.9	10.7	13.4	16.6
315	7.7	12.1	15.0	18.7
400	9.8	15.3	19.1	23.7
500	12.3	19.1	23.9	-

Above dimensions up to 90mm are based on a service design coefficient:

C = 2.5 and from 110mm and above the service design coefficient C = 2.0

The pressure rating given above in bars is the working pressure at 20 deg. C

Pipes to this specification will be supplied in 6 meter lengths with integral Solvent Weld Sockets.

Dia. 110mm and above are also available with Push-Fit (R/R) Sockets.

PRODUCT STANDARDS AND DIMENSIONS

uPVC UNDERGROUND DRAIN & SEWER PIPES TO BS EN 1401-1

(Formerly BS 4660 and BS 5481)

Nominal Size	Wall Thickness			
	Minimum	Maximum	SN4 SDR 41	SN8 SDR 34
mm	mm	mm	mm	mm
110	110.0	110.3	3.2	3.2
160	160.0	160.4	4.0	4.7
200	200.0	200.5	4.9	5.9
250	250.0	250.5	6.2	7.3
315	315.0	315.6	7.7	9.2
400	400.0	400.7	9.8	11.7
500	500.0	500.9	12.3	14.6

- Pipe to this specification will be supplied in 6 meter lengths with integral Push-Fit (R/R) socket in "Golden Brown " color.
- Pipes with Solvent Weld Socket or Plain ends can be supplied upon request.

PRODUCT STANDARDS AND DIMENSIONS

uPVC SOIL AND WASTE DISCHARGE PIPES

TO BS 4514 : 2001

Nominal Size	Mean Outside Diameter		Minimum Wall Thickness
	Min	Max	
	mm	mm	mm
82	82.4	82.8	3.2

TO BS EN 1329-1 : 2000

(Formerly BS 5255 and BS 4514 : 1983)

Nominal Size	Mean Outside Diameter		Minimum Wall Thickness
	Min	Max	
	mm	mm	mm
36	36.2	36.5	3.0
43	42.8	43.1	3.0
56	55.8	56.1	3.0
110	110.0	110.3	3.2
160	160.0	160.4	3.2

Pipes to above specifications will be normally supplied in 4 meter lenghts with Plain ends in "Light Grey" colour.

PRODUCT STANDARDS AND DIMENSIONS

uPVC DUCTS FOR ELECTRICAL/TELEPHONE CABLES AS PER ETISALAT SPECIFICATIONS

Duct Number	Outside Diameter		Wall Thickness	
	Mean O.D.	Tolerance	Minimum	Tolerance
	mm	mm	mm	mm
56	53.9	± 0.1	1.55	+ 0.15
54D	96.5	± 0.2	3.25	+ 0.40

Pipes to this specification will be supplied in 6 meter lenghts with integral Solvent Weld Socket in black colour.

uPVC DUCTS (Based on ISO 161/1 Recommended Diameters)

A) For Services Ducts

Nominal Size	Outside Diameter		Wall Thickness	
	Minimum	Maximum	Minimum	Maximum
	mm	mm	mm	mm
4"	110.0	110.3	3.4	4.0
6"	160.0	160.4	4.5	5.2
8"	200.0	200.4	5.3	6.1
10"	250.0	250.5	6.6	7.6
12"	315.0	315.6	7.8	9.0

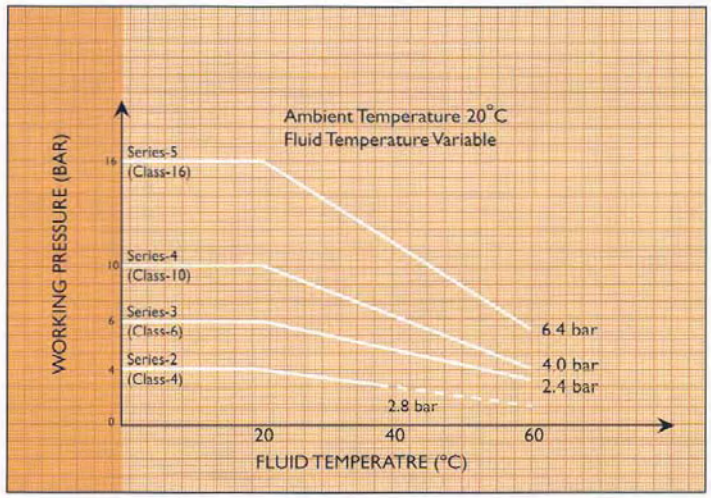
B) For Electrical Conduits

Nominal Size	Outside Diameter		Wall Thickness	
	Minimum	Maximum	Minimum	Maximum
	mm	mm	mm	mm
50	50.0	50.2	3.7	4.3
60	63.0	63.2	4.7	5.4
100	110.0	110.3	6.0	6.8
150	160.0	160.4	7.1	8.1
200	200.0	200.4	8.2	9.3

Pipes to this specification will be supplied in 6 meter lengths with integral Solvent Weld Sockets.

Appendix- B

EFFECT OF TEMPERATURE ON PRESSURE RATING OF UPVC PRESSURE PIPES



uPVC being a thermoplastic material is temperature sensitive, i.e. the working pressure capacity reduces with the rise in ambient temperature.
The effect of changes in fluid temperature on the working pressure rating of uPVC pipes is shown graphically above.

Appendix- C

TABLES OF CHEMICAL RESISTANCE OF uPVC

Introduction

The resistance of plastic pipe materials to a wide range of chemical is listed in the following tables. The chemical names used in the tables are wherever possible in accordance with the recommendations contained in BS 2474 ; other chemical names commonly used are frequently included as well with a cross-reference to the preferred name. the symbols used in the tables are as follows :

S – Satisfactory

U – Unsatisfactory. So rated because of decomposition, solution, swelling, loss of ductility etc., of the samples tested.

D – Some attack or absorption. The material may be considered for use when alternative materials are unsatisfactory, and where limited life is acceptable. When plastics are to be used with such chemicals, full scale trials under realistic conditions are particularly necessary.

* Predicted results. In order to cover as wide a range of named chemicals as possible, the resistance of plastics to some chemicals has been predicted from its resistance to other chemicals which have similar composition.

†- Reference should be made to Section 21 (pipes for food and drink other than water) of BS CP 312 Part 1: 1973.

Chemical	Concentration	Temperature 20° C	Temperature 60° C
Acetaldehyde	40%(w/v) soln.	S	U *
	100%	U	U
Acetic acid	10% (v/v) soln.	S	S
	60% (v/v)	S	D
	glacial	U	U
Acetic anhydride		U	U
Acetone		U	U
Acetonitrile			U *
Acetophenetidine		S *	S *
Acetophenone		U *	U *
Adipic acid		S	D
Alcohols, see specific alcohols			
Aliphatic hydrocarbons		S	S
Allyl alcohol		D	U
Allyl chloride		U	U
Alum, see aluminium Potassium sulphate			
Aluminium acetate		S *	S *
Aluminium chloride		S	S
Aluminium fluoride		S *	S *
Aluminium hydroxide		S *	S *
Aluminium nitrate		S	S
Aluminium oxalate		S *	S *
Aluminium oxychloride		S	S
Aluminium potassium sulphate (alum)		S	S
Aluminium sulphate		S	S
Ammonia	Dry gas	S	S
	Liquid	U	U *
Ammonia solution (ammonium hydroxide)	35% (m/v) soln. (0-88 g/ml)	S	S
Ammonium bicarbonate see ammonium hydrogen carbonate			
Ammonium carbonate		S	S
Ammonium chloride		S	S
Ammonium ferrous citrate		S *	S *
Ammonium fluoride		S	S
Ammonium hydrogen Carbonate		S *	S*
Ammonium hydroxide see ammonia solution			
Ammonium metaphosphate		S	S
Ammonium nitrate		S	S
Ammonium orthophosphate		S *	S *
Ammonium oxalate		S *	S *
Ammonium persulphate		S	S
Ammonium sulphate		S	S
Ammonium sulphide		S	S
Ammonium thiocyanate		S	S
Ammonium zinc chloride (zinc ammonium chloride)		S *	S *
Amyl acetate		U	U
Amyl alcohol		S *	U
Amyl chloride		U	U
Aniline		U	U
Aniline hydrochloride		U	U
Aniline sulphate		U	U
Animal oils †		S *	S *
Antraquinone		S	U
Antraquinone sulphonic acid		S	U
Antinomny chloride		S	S *
Aqua regia **	Conc.	U	U
Aromatic hydrocarbons		U	U
Arsenic : acid (syrupy)	75% (m/m) Or 2 g/ml	S	D
Aryl sulphonic acid		S	U
Barium carbonate		S *	S *
Barium chloride		S *	S *
Barium hydroxide		S	S
Barium sulphate		S *	S *
Barium sulphide		S	S
Beer †		S	
Benzaldehyde	Trace	U	U
	100%	U	U
Benzene		U	U

** Containing 3 parts by volume of concentrated hydrochloric acid to one part by volume of concentrated nitric acid

** At 20% concentration

Chemical	Concentration	Temperature 20° C	Temperature 60° C
Benzoic acid		D	U
Benzoyl chloride		U *	U *
Benzyl acetate		U	U *
Benzyl alcohol (phenylcarbinol)		U *	U *
Bismuth carbonate		S	S
Borax, see disodium tetraborate			
Boric acid		S	S
Boron trifluoride		S	
Brine		S	S
Bromine	Trace	S	U
	100% dry gas	U *	U
	Liquid	U	U
Bromomethane (methylbromide)		U *	U *
Butadiene		S	S
Butane		S	S
Butanediols		U	U
Butanols (butyl alcohols)		S	D
Butyl acetate		U	U
Butyl chloride		U *	U *
isoButyl methyl ketone (4-methylpentan-2-one)		U *	U *
Butylphenols		U	U
Butyraldehyde		U *	U *
Butyric acid	20% aq. soln.	S	U*
	Conc.	U	U
Calcium carbonate		S	S
Calcium chlorate		S	S
Calcium chloride	aq. soln.	S	S
Calcium hydrogen sulphite (calcium bisulphite)		S *	S *
Calcium hydroxide		S	S
Calcium hypochlorite		S	S
Calcium nitrate		S	S
Calcium orthophosphates		S*	S*
Calcium sulphate		S	S
Calcium sulphide		S	S
Carbon dioxide (gas)	U	S	S
Carbon disulphide			
Carbon monoxide		S	S
Carbon tetrachloride		D	U
Casein		S *	S *
Castor Oil †		S	S
Ceryl alcohol, see hexadecanol			
Chloral hydrate		S	S
Chloric acird		S	S **
Chlorine, gas	10% dry	D	
	100% dry	D	U
	10% moist	U	U
Chlorine	sat.aq.soln.	D	U*
Chlorine trifluoride		U*	U*
Chloracetic acid		S	D
Chlorobenzene		U	U
Chloroethane (ethyl chloride)		U	U
2-Chloroethanol (ethylene chlorohydrin)		U	U
Chloroform		U	U
Chloromethane (methyl chloride)		U	U
Chlorosulphonic acid		D	U

Chemical	Concentration	Temperature 20° C	Temperature 60° C
Chromic acid	plating soln.	S	S
Chromic potassium sulphate (chrome alum)		S	S
Cider †		S*	
Citric acid †		S	S
Copper ** chloride		S*	S*
Copper ** cyanide		S*	S*
Copper ** fluoride		S	S
Copper ** nitrate		S*	S*
Copper ** sulphate		S	S
Creosote		U	U
Cresols		U	U
Cresylic acid		U	U*
Crotonaldehyde		U	U
Cyclohexanol		U	U
Cyclohexanone		U	U
Detergent (synthetic)	diluted for use	S	S*
Developers (photographic)		S	S
Dextrin		S	S
Dextrose †	sat. soln.	S	S
Diamyl ether		U*	U*
Diazo salts		S	S
Dibromoethane (ethylene dibromide)		U*	U*
Dibutyl phthalate		U*	U*
Dichlorobenzene		U*	U*
Dichlorodifluoromethane		S	
Dichloroethane (ethylene dichbride)		U	U
Dichloroethylene		U*	U*
1,2-Dichloropropane (propylene dichloride)		U	U
Diethyl ether		U	U
Diethyl ketone		U*	U*
Diethyl sulphate (ethyl sulphate)		U	U
Digol (diethylene glycol)		S*	S*
Dimethylsulphate (methyl sulphate)		S	U
Dimethylamine		S	S
Dimethylcarbinol, see Isapropyl alcohol			
Dioctyl phthalate		U*	U*
Dioxan		U*	U*
Diphenyl ether		U	U
Disodium phosphate, see disodium hydrogen orthophosphate			
Dodecanoic acid (lauric)		S	S
Dodecanol (lauryl alcohol)		S*	S*
Emulsifiers	All	S *	S*
Emulsions (photographic)		S	S
Ethane		S *	
Ethanediol (ethylene glycol)		S	S
Ethanol (ethyl alcohol) †	95 – 100%	S	D
	40% (v/v) aq. soln.	S	D
Ethers (see also diethyl ether)		U	U
Ethyl acetate		U	U
Ethyl acrylate		U	U

** Cuprous or cupric.

Chemical	Concentration	Temperature	
		20° C	60° C
Ethyl alcohol, see ethanol			
ethyl butyrate		U*	U*
Ethyl chloride, see chloroethane			
Ethyl formate		U*	U*
Ethyl lactate		U*	U*
Ethyl methyl ketone (methyl ethyl ketone)		U	U
Ethyl sulphate, see diethyl sulphate			
Ethylene chlorohydrin, see 2-chloroethanol			
Ethylene dibromide, see dichloroethane			
Ethylene dichloride, see dichloroethane			
Ethylene glycol, see ethanediol			
Ethylene oxide (oxiran)		U	U
Fatty acids, higher		S	S
Ferric chloride		S	S
Ferric nitrate		S	S
Ferric sulphate		S	S
Ferrous ammonium citrate, see ammonium ferrous			
Citrate			
Ferrous chloride		S*	S*
Ferrous sulphate		S*	S*
Fixing soln. (photographic)		S	S
Fluorine		U	U
Fluorosilic acid	40% aq. soln.	S	S
	conc.	S	S
Formaldehyde	40% (w/w) aq. soln.	S	S
Formic acid	3% aq. soln.	S	S
	10% aq. soln.	S	S
	25% aq. soln.	S	D
	50% aq. soln.	S	U
	98 – 100%	U	U
Fructose †		S	S
Fruit juices †		S	S
Fuel oil		S	S
Furfuraldehyde (furfural)	100%	U	U
Furfuryl alcohol		U*	U
Gallic acid, see 3, 4, 5-trihydroxybenzoic acid			
Gasoline, see petrol			
Glucose †		S	S
Glycerol		S	S
Glycerol monobenzyl ether		U*	U*
Glycol, see ethanediol			
Glycollic acid	30% alc. Soln.	S	S
Grape sugar †		S	S
Heptane		S	U
Hexadecanol (cetyl alcohol)		S*	S*
Hexanol (hexyl alcohol)		S	S
Hydrobromic acid	50% w/v) aq. soln.	S	S
	100% (w/v) aq. soln.	S*	S*
Hydrochloric acid	10% (w/v) aq. soln.	S	S
	22% (w/v) aq. soln.	S	S
	Concentrated (36%)	S	S
Hydrocyanic acid	10% (w/v) aq. soln.	S	S
Hydrofluoric acid	4% (w/v) aq. soln.	S	S
	40% (W/v) aq. soln.	S	U
	60% (w/v) aq. soln.	D	U*
	Concentrated	U*	U*
Hydrogen		S	S
Hydrogen bromide	Anhydrous	S*	S*
Hydrogen chloride	Anhydrous	S*	S*
Hydrogen fluoride	Anhydrous	S*	S*
Hydrogen peroxide	3% (w/v) aq. soln.	S	S
	12% (w/v) aq. soln.	S	S
	30% (w/v) aq. soln.	S	S
	90% (w/v) or greater	U	U
Hydrogen sulphide		S	S
Hydroquinone, see quinol			
hydroxylammonium sulphate		S	S
Hypochlorous acid		D	U*
Iodine	soln. In potassium iodide	U	U
iso-octane (2, 2, 4-trimethylbentane)		S	U
Isophorone		U	U
Isopropanol, see isopropyl alcohol			
Lactic acid	10% (W/v) aq. soln.	S	S
	100% (w/v) aq.	U	U
Lanolin		S*	S*
Latex		S	S
Lauric acid, see dodecanoic acid			
Lauryl alcohol, see dodecanol			
Lead acetate		S	S
Lead arsenate		S*	S*
Lead nitrate		S*	S*
Lead tetraethyl, see tetraethyl lead			
Linoleic acid		S	S
Linseed Oil		S	S
Lubricating oil		S	S
Magnesium carbonate		S	S
Magnesium chloride		S	S
Magnesium hydroxide		S	S
Magnesium nitrate		S	S
Maleic acid	25% (w/v) aq. soln.	S	S
	50% (w/v) aq. soln.	S	S
	Concentrated	S	S

Chemical	Concentration	Temperature	
		20° C	60° C
Malic acid		S	S
Manganese sulphate		S*	S*
Margarine †		S	S
Mercuric chloride		S	S
Mercuric cyanide		S	S
Mercurous nitrate		S	S
Mercury		S	S
Mesityl oxide		U	U
Metallic soaps (water soluble)		S*	S*
Methanol (methyl alcohol)	100%	S	D
	(6% (w/v) aq. soln.	S	S*
Methyl acetate		U*	U*
Methyl bromide, see bromomethane			
Methyl isobutyl ketone, see isobutyl methyl ketone			
Methyl chloride, see chloromethane			
Methyl ethyl ketone, see ethyl methyl ketone			
Methyl glycol		S	S
Methyl hydrogen sulphate (methyl sulphuric acid)	50% (w/v) aq. soln.	S	S
	60% (w/v) aq. soln.	S	S
	75% (w/v) aq. soln.	S	S
	90% (w/v) aq. soln.	S	S
Methyl methacrylate		U	U
Methyl sulphate, see dimethyl sulphate			
Methylated spirits		S	D
Methylcyclohexanone		U	U
Methylsulphonic acid		S	D
Milk †		S*	S*
Mineral oils		S	S
Mixed acids **			U
Molasses †		S	S
Monochlorobenzene		U*	U*
Naphtha		S	S
Naphthalene		U	U
Nickel chloride		S	S
Nickel nitrate		S	S
Nickel sulphate		S	S
Nicotine		S	S
Nictonic acid		S	S
Nitric acid	5% (w/v) aq. soln.	S	
	10% (w/v) aq. soln.	S	D
	25% (w/v) aq. soln.	S	D
	50% (w/v) aq. soln.	S	U
	70% (w/v) aq. soln.	D	U
	98% (w/v) aq. soln.	U	U
Nitrobenzene		U	U

** Various proportions of concentrated nitric acid and concentrated hydrochloric acid (see also aqua regia).

Chemical	Concentration	Temperature	
		20° C	60° C
Nitropropane		U	U
Nitrous fumes	moist	D	U
Nonanol (nonyl alcohol)		S*	S*
Octane		S*	U*
Octanol (octyl alcohol)		S*	
Oils and fats †		S	S
Oleic acid		S	S
Orthophosphoric acid	20% aq. soln.	S	S
	30% aq. soln.	S	S
	50% aq. soln.	S	S
	95% aq. soln.	S	S
Oxalic acid		S	S
Oxygen		S	S
Ozone		S	S
Palmitic avid	10%	S	S
	70%	S	S
Paraffin		S	S
Paraffin wax		S	S
Pentane		S*	
Perchloric acid	10%	S	D
Petrol		S	U
Petrol/benzene mixture	80:20 ratio	U	U
Petroleum spirit (petroleum ether)		U	U
Phenol		S	U
Phenylcarbinol, see benzyl Alcohol			
Phenylhydrazine		U	U
Phenylhydrazine hydro-Chloride		U	U
Phosgene	Gas	S	U
	Liquid	U	U
Phosphates (see also under ammonium, potassium, sodium etc.)		S*	S*
Phosphine		S	S
Phosphoric acid, see orthophosphoric acid			
Phosphorus		S	U
Phosphorus pentoxide		S	S*
Phosphorus trichloride		U	U
Phosphoryl chloride (phosphorus oxychloride)		U	U
Phthalic anhydride		S*	S*
Picric acid	1% (w/v) aq. soln.	S	S*
	10% (w/v) alc. soln.	U	U
Plating solutions:	brass	S	S
	cadmium	S	S
	chromium	S	S
	copper	S	S
	gold	S	S
	indium	S	S
	lead	S	S
	nickel	S	S
	rhodium	S	S
	silver	S	S
	tin	S	S
	zinc	S	S
Polyglycol ethers		U*	U*
Potassium acid sulphate,			

Chemical	Concentration	Temperature	
		20° C	60° C
see potassium hydrogen sulphate			
Potassium antimonate		S*	S*
Potassium bicarbonate, see potassium hydrogen carbonate			
Potassium bichromate, see potassium dichromate			
Potassium bisulphate, see potassium hydrogen sulphite			
Potassium borate		S	S
Potassium bromate		S	S
Potassium bromide		S	S
Potassium carbonate		S	S
Potassium chlorate		S	S
Potassium chloride		S	S
Potassium chromate		S	S
Potassium cuprocyanide		S*	S*
Potassium cyanide		S	S
Potassium dichromate (potassium bichromate)		S	S
Potassium ferricyanide		S	S
Potassium ferrocyanide		S	S
Potassium fluoride		S	S
Potassium hydrogen carbonate (potassium bicarbonate)		S	S
Potassium hydrogen sulphate (potassium acid sulphate)		S*	S*
Potassium hydrogen sulphite (potassium bisulphite)		S*	S*
Potassium hydroxide	1% (w/v) aq. soln.		
	10% (w/v) aq. soln.	S	S
	Conc. Soln.	S	S
Potassium hypochlorite		S*	S*
Potassium nitrate		S	S
Potassium orthophosphate		S*	S*
Potassium perborate		S	S
Potassium perchlorate	10% solution	S	S
Potassium permanganate	20% solution	S	S
Potassium persulphate	5% solution	S	S
Potassium sulphate		S	S
Potassium sulphide		S*	S*
Potassium thiosulphate		S*	S*
Propane		S	S
Propane-1, 2-diol (propylene glycol)		S*	S*
Propargyl alcohol (prop-2-yn-l-ol)		S	S
Propionic acid	50% aq. soln.	S*	S*
	100% aq. soln.	S*	U*
IsoPropyl alcohol (isopropanol)		S	S
Propylene dichloride, see 1, 2-dichloropropane			
Propylene oxide		U*	U*
Pyridine		U	U

Chemical	Concentration	Temperature	
		20° C	60° C
Quinol (hydroquinone)		S*	S*
Rayon coagulating bath		S*	S*
Sulphur trioxide		S*	S*
Salicylic acid		S	S
Seawater		S	S
Selenic acid		U	U
Shortening		S*	S*
Silicic acid		S	S
Silver acetate		S*	S*
Silver cyanide		S	S
Silver nitrate		S	S
Soap solutions (aqueous)		S	S
Sodium acetate		S	S
Sodium acid sulphate, see sodium hydrogen sulphate			
Sodium aluminate		S*	S*
Sodium antimonate		S*	S*
Sodium benzoate		S	D
Sodium bicarbonate, see sodium hydrogen carbonate			
Sodium bisulphate, see sodium hydrogen sulphate			
Sodium bisulphite, see sodium hydrogen sulphite			
Sodium borate, see disodium tetraborate			
Sodium bromide		S	S
Sodium carbonate		S	S
Sodium chlorate		S	S
Sodium chloride		S	S
Sodium cyanide		S*	S*
Sodium ferricyanide		S	S
Sodium ferrocyanide		S	S
Sodium fluoride		S	S
Sodium hydrogen carbonate (sodium bicarbonate)		S	S
diSodium hydrogen orthophosphate		S*	S*
Sodium hydrogen sulphate (sodium bisulphate)		S	S
Sodium hydrogen sulphite (sodium bisulphate)		S	S
Sodium hydroxide	1% (w/v) aq. soln.	S	S
	10% (w/v) aq. soln.	S	S
	40% (w/v) aq. soln.	S	S
	Conc.	S	S
Sodium hypochlorite	15% available chlorine	S	S
Sodium hyposulphite, see sodium thiosulphate			
Sodium metaphosphate		S*	S*
Sodium nitrate		S	S
Sodium nitrite		S	S
triSodium orthophosphate		S*	S*
Sodium perborate		S*	S*
Sodium peroxide		S*	S*
Sodium silicate		S*	S*
Sodium sulphate		S	S
Sodium sulphide	aq. soln.	S	S

Chemical	Concentration	Temperature	
		20° C	60° C
diSodium tetraborate (borax)		S	S
Sodium thiosulphate (sodium hyposulphite)		S*	S*
Soft soap		S*	S*
Stannic chloride		S	S
Stannous chloride		S	S
Starch		S	S
Stearic acid		S	S
Sucrose †		S*	S*
Sulphur	colloidal	S	S
Sulphur dioxide	dry	S	S
	moist	S	U
	liquid	D	U
Sulphur trioxide		S	S
Sulphuric acid	10% (w/v) aq. soln.	S	S
	20% (w/v) aq. soln.	S	S
	30% (w/v) aq. soln.	S	S
	40% (w/v) aq. soln.	S	S
	50% (w/v) aq. soln.	S	S
	55% (w/v) aq. soln.	S	S
	60% (w/v) aq. soln.	S	S
	70% (w/v) aq. soln.	S	S
	80% (w/v) aq. soln.	S	S
	90% (w/v) aq. soln	D	D
	95% (w/v) aq. soln.	D	U
	98% (w/v) aq. soln.	U	U
	fluming	U*	U*
Sulphurous acid	10% (w/v) aq. soln.	S	S
	30% (w/v) aq. soln.	S	S
Surface active agents	All	S*	S*
Tallow		S*	S*
Tannic acid		S	S
Tanning extracts		S	S*
Tartaric acid †		S	S
Tetraethyl lead (lead tetraethyl)		S	S
Tetrahydrofuran		U	U
Tetrahydronapthalene (tetralin)		U	U
Thionyl chloride		U	U
Titanium tetrachloride		U	U
Toluene		U	U
Transformer oil		S*	S*
Tributyl phosphate		U	U
Trichloroacetic acid		S*	S*
Trichlorobenzene		U*	U*
Trichloroethane		U*	U*

Chemical	Concentration	Temperature	
		20° C	60° C
Trichloroethylene		U	U
Tricresyl phosphate, see Tritolyl phosphate			
Triethanolamine		S	U
Trigol (tryethylene glycol)		S*	S*
3, 4, 5-Trihydroxybenzoic acid (gallic acid)		S*	S*
Trimethylamine		S	U*
Trimethylol propane (2-ethyl-2-hydroxymethyl propanediol)		S	U
Trisodium phosphate, see sodium orthophosphate			
Tritolyl phosphate (Tricresylphosphate)		U*	U*
Turpentine		S	S
Urea		S	S
Urine		S	S
Vanilla extract †		S*	S*
Vegetable oil †		S	S
Vinegar †		S	S
Vinyl acetate		U	U
Water		S	S
Wetting agents		S*	S*
Whey †		S*	S*
Wines and spirits †		S	S
Xylene		U*	U*
Xylenol		U*	U*
Yeast †		S	S
Zinc ammonium chloride, see ammonium zinc chloride			
Zinc carbonate		S*	S*
Zinc chloride		S	S
Zinc Oxide		S	S
Zinc sulphate		S	S

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AWARDS AND ACHIEVEMENTS

Excellent uPVC Kitemark pipes

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