Technical Catalogue
2010 - 2011

HYDROSEAL CANADA PRODUCT MANAGEMENT INC.

LIMITED WARRANTY

Applicable to HYDROSEAL CANADA PRODUCT MANAGEMENT INC. Plumbing Plastic Pipes, Fittings and Valves. HYDROSEAL CANADA PRODUCT MANAGEMENT INC. warrants each HYDROSEAL CANADA plumbing plastic fitting (including plumbing valves) to be free from defects in materials and workmanship under designed use and service for a period of five (5) years from the date of purchase. In the event any defect occurs which the owner believes is covered by this Warranty, the owner should immediately contact the nearest HYDROSEAL CANADA representative, either in writing (by email, fax or letter), or by telephone call. The owner will be instructed to return said pipe, fitting or valve, at the owner's expense to HYDROSEAL CANADA PRODUCT MANAGEMENT INC. or an authorized HYDROSEAL CANADA representative for inspection. In the event said inspection discloses to the satisfaction of HYDROSEAL CANADA PRODUCT MANAGEMENT INC. that said fitting or valve is defective, a replacement shall be mailed free of charge to the owner. Claims for labor costs and other expenses required to replace such defective product or to repair any damage resulting from the use thereof will not be allowed by HYDROSEAL CANADA PRODUCT MANAGEMENT INC. Our liability is limited to the price paid for the defective product. HYDROSEAL CANADA PRODUCT MANAGEMENT INC. will not be bound by any warranty, other than above set forth, unless such warranty is in writing.

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FOREWORD..

In the old Soviet Union they used to say that anything that wasn't forbidden was compulsory; the trick was to remember which was which. In the West we've always congratulated ourselves on taking a slightly more relaxed, commonsense view of things, and forget that common sense is often just as arbitrary. You've got to know the rules.

Especially if you plan on operating in different parts of the world.

A few days ago - I can't tell when exactly - I had a little run in with the police. I was driving along the highway into Ningbo, China with my friend, who was six months pregnant, and I overtook on the inside lane. Not a piece of wild and reckless driving in the circumstances, honestly, it was just the way the traffic was flowing; but anyway I suddenly found myself being flagged down by a police car. The police-men signalled me to follow them down off the highway and - astonishingly - to stop behind them on a bend in the slip road, where we could all get out and have a little chat about my heinous crime. I was aghast. Cars, trucks, and worst of all, white vans were careening down the slip road, none of them, I'm sure, expecting to find a couple of cars actually parked there, right on the bend. Any one of them could easily have rear-ended my car - with my pregnant friend inside. The situation was frightening and insane. I made this point to the police officer, who, as is so often the case with the police, took a different view.

The officer's point was that overtaking on an inside lane was inherently dangerous. Why? Because the law said it was. But being parked on a blind bend on a slip road was not dangerous because I was there on police instructions, which made it legal and hence (and this was the tricky bit to follow) safe.

My point was that I accepted I had (quite safely) made a manoeuvre that was illegal under the laws of China, but that our current situation, parked on a blind bend in the path of fast-moving traffic, was life-threatening by reason of the actual physical laws of the universe.

The officer's next point was that I wasn't in the universe, I was in China, a point that has been made to me before. I gave up trying to win an argument and agreed to everything so that we could just get out of there.

When it comes to Industrial plastics and engineering, we've had to incorporate such mindsets - one of the reasons we go around calling ourselves "re-engineers" and not "factory such and such". Looking around it's fairly evident there's nothing much that has changed about piping standards the past few decades. It's funny to think the entire world and way we seem to interact with it has changed, but piping systems and solutions are exactly the same as the 1950's. Being a start-up in the new millennium, we've had to ask the question: what can we do that other's aren't?

While we're pretty certain we have the skills and resources to deliver as good a product as anybody else in the industry, what we specialize in is shared information.

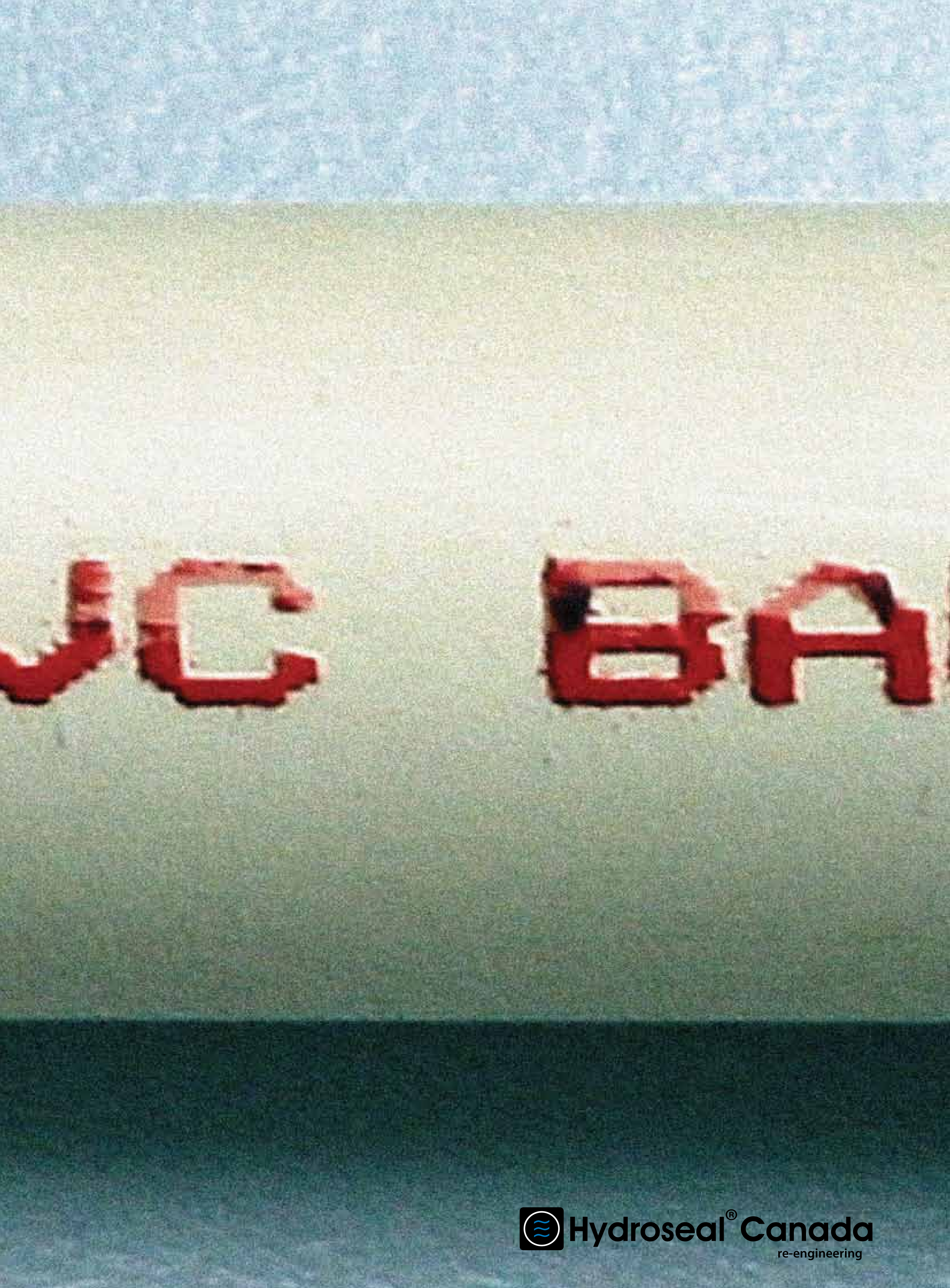
Once you realise a computer is actually a modelling device, you see that you can model anything in it. Not just things we are used to doing in the real world, but the things the real world actually prevents us from doing. Like seeing live inventory in some remote corner of the world. Or determining how best to get your client exactly what he needs in an instant. Or suffering from an ulcer on a Friday afternoon in the Middle East and getting online to figure out exactly where things are at with your order, instead of having to steel yourself until your distributor is done with his weekend. Or, simply trying to ascertain whether or not X & Y item is good enough for your application and perusing external, unbiased, third-party opinion.

For some reason it's taken a long time and a big deep breath by some of the largest companies to realise they are part of the community they sell to. For Hydroseal Canada, this is our focus. From advanced moulding, reverse-engineering, cross-cultural standards, accessible laboratories, logistics, software and finance, our goal is servicing our community in the most effective way possible.

What are the rules you need to know if you are operating across several countries and regions? What are the things that are compulsory in one country and forbidden in another? Common sense won't tell you. We have to tell each other. And if you're especially particular about your industrial piping systems, you'll probably want to get in touch with us.

Hydroseal® Canada
re-engineering


nm CP


JC BA
Hydroseal® Canada
re-engineering

CARBONE™ Series

Carbone™ Series PVC and CPVC Schedule 80 fittings incorporate and exceed major international standards for industrial piping solutions. This product line incorporate rigorous aspects of European, Canadian and Japanese systems in areas such as testing, molding, chemical resistance, marking, temperature considerations and aesthetic design. Carbone series represents the latest, cutting-edge technology in the field of industrial plastics, applied to ASTM Standard D-2467, Schedule 80.

PVC and CPVC products marked "Carbone" are time stamped for traceability of the manufacturing process and individual machine where the item is injected. Twin time clocks indicate the month and year of manufacture. Markings on external packaging reflect batch numbers, which are maintained for fifteen years. Reported product failures in the field or in application may be traced to point and country of delivery, so as to avoid future complications.

Carbone™ Series has been re-engineered to improve upon the following areas which typically affect plastic piping systems:

- Tolerance-issues
- Smooth-flow of process-media
- Expansion and contraction related inconsistencies
- Cross-standard adaptability

CARBONE™ Series
Schedule 80 fittings
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WTF™ Series

WTF™ product series are designed not only to meet the requirements outlined by various international standard institutions, but to exceed them.

Products, documentation and services marked with the WTF™ symbols have been reverse engineered down to a product's basic function and then reworked to meet current needs existing in modern industry today.

Guideline tenets that influence the creation of WTF™ products are:

- Minimization of confusion between various international standards. Products that are designed to be compatible with Canadian, American, British, German, Japanese and Chinese piping systems. A good example of this is the WTF™ flange shown in the below picture. The PCD (or hole) pattern is designed to mate with North American, European and Asian flanged equipment.
- Improving upon standards for PVC and CPVC products that may not work in alternate regions where climatic conditions may alter the physical and mechanical properties of PVC and CPVC products.
- Reduction of real time cost, effort, labor and financing through innovative analysis.
- Commitment to understanding each client's individual needs.

WTF™ Series Universal Van Stone Backing Rings

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HYDROSEAL

INTRODUCTION TO PLASTIC 1.00

History

As early as 1838 Viktor Regnault succeeded in producing polyvinylchloride in a laboratory by exposing vinylchloride to the sun.

In 1912 Fritz Klatte discovered the fundamentals for the practical production of PVC.

During World War I, plastics, which were still new, had to replace other materials falling into short supply. They were then sometimes overspecified with respect to their application. Therefore, plastics needed to be improved. It was necessary to scrutinise the internal structure of these new materials closely.

Only in 1938 did the production of plastics in any significant volume begin, when the numerous application possibilities had been recognised.

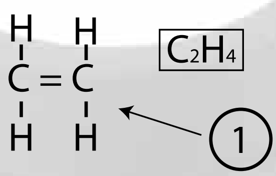
Structure of plastics

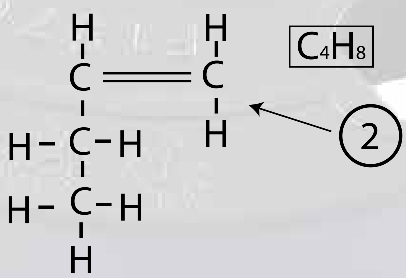
Plastics are materials which are created by chemical conversion of natural products or in a synthetic[1)] manner from organic[2)] compounds. The main components are the elements carbon (C) and hydrogen (H). The basis of most plastics are carbon-hydrogen compounds , from which the single components of plastics, the so-called monomers[3)], are produced.

1) Synthesis: production of a chemical compound from different elements or simple molecules. Synthesis is the opposite of analysis

2) Organic media are pure non-metals of natural occurrence, e. g. petroleum, coal, wood, natural gas. Inorganic media are compounds of metal and non-metals, e .g. minerals, ores etc.

3) Monomers are the basic molecules, i. e. the smallest components of which plastics are built.





1 Ethylene-Monomer
2 Butylene-Monomer

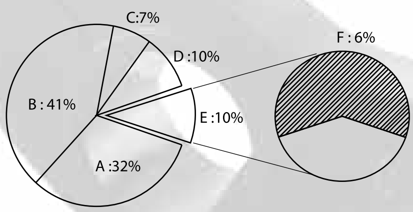
Raw material

Raw materials for the manufacture of plastics are natural compounds, such as cellulose, coal, petroleum and natural gas. In a refinery, petroleum is separated into several components by means of distillation. Grouped into evaporisation ranges, gas, benzene, petroleum, gaseous oil and, as a residue, bitumen, are obtained during distillation.

All components consist of hydrocarbons which only differ in size and form of the molecules. The most important component for plastics production is crude benzene.

In a heat cracking process this crude benzene is broken down into ethylene, propylene, butylene and other hydrocarbons and is then modified.

Production of plastics



A Heating 32%
B Traffic 41%
C Other 7%
D Industry 10%
E Chemical 10%
F incl. 6% Plastics

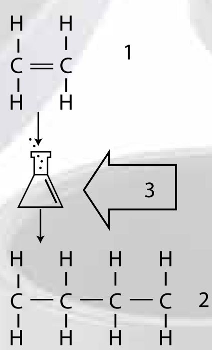
Plastics are manufactured by compounding together large number of similar basic components (monomers) through chemical bonding.

The plastic industry only consumes approximately 6% of the petroleum products originating from refineries. In Germany the chemical industry uses approximately 10% of the entire crude oil consumption and this includes 6% for plastics.

To produce plastics three different processes are used:

- Polymerisation
- Polycondensation
- Polyaddition

The production of plastics

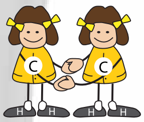


1 Monomer: Ethylene
2 Macromolecule chain: Polyethylene
3 Polymerisation process —> Energy, Catalist, Additives

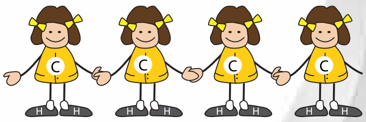
Polymerisation is the most frequently used procedure for the synthesis of plastics. Polymerisation means the lining up of macromolecule chains without separation of foreign matter.

For example polyethylene, polybutene, polypropylene, polyvinylchloride and other plastics are all produced by means of polymerisation.

Examples:



Ethylene C_2H_4



Polyethylene

Polycondensation

Phenol + Formaldehyde
↓ ↓
Phenolic resin Water

Polyethylene

During polycondensation similar and dissimilar monomers are lined up to become macromolecule chains, at the same time separating a by product, e. g. water, hydrochloric acid, etc.

Polycondensation is applied, for example, to produce phenolic resins and polyamids.

Polyaddition

During polyaddition macromolecules are created from chemically different molecules, however without separating a by-product.

Polyaddition is used for the production of polyurethanes and exposed resins (e. g. Araldit).

Classification of plastics

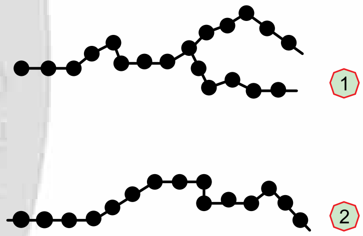
Plastics are subdivided into three main groups:	» Thermoplastics » Thermosets » Elastomers
Thermoplastics are again divided into:	» amorphous » semi-crystalline
Thermosets are divided into:	» Thermoelastics » Resins
Elastomers are divided into:	» Synthetic caoutchouc (rubber)

Distinction of plastics

In the production process, the procedure and the addition of additives (stabilisers, catalists, fibres, slip additives, etc.) create macromolecules with different basic structures.

Thermoplastics

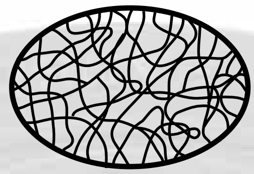
Thermoplastics consist of long filamentary molecules with or without branches.



1 Filamentary molecules without branches
2 Filamentary molecules with branches

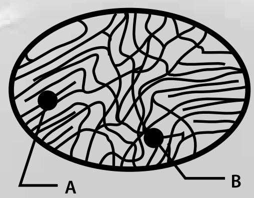
These filamentary molecules can be arranged as follows:

amorphous, i. e. in an inordinate structure or



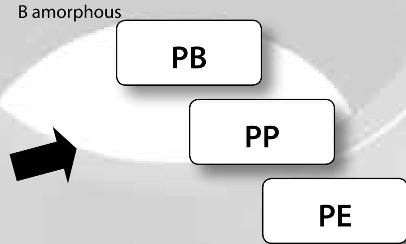
semi-crystalline, i. e. in a partially ordinate structure

Crystallisation is increased by slow cooling.

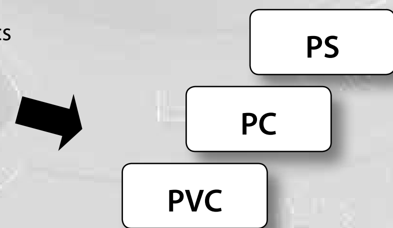


A crystalline
B amorphous

Semi-crystalline thermoplastics are polyolefines, for example:



Amorphous thermoplatics are styrenes and vinyl chlorides, for example:



PE	Polyethylene	**PVC**	Polyvinylchloride
PB	Polybutene	**PS**	Polystyrene
PP	Polypropylene	**PC**	Polycarbonate

Thermoplastics are plastics with simple or branched filamentary molecules (macromolecules) which have an inordinate or partially ordinate structure. They distort during heating, melt and solidify again on cooling. This process can be repeated at all times. They can be plastically deformed, distended and recovered. Due to these properties, thermoplastics are suited for injection-moulding, extrusion and fusion.

"Plastic deformation" is the processing of a material by means of e. g. injection moulding, extrusion etc.

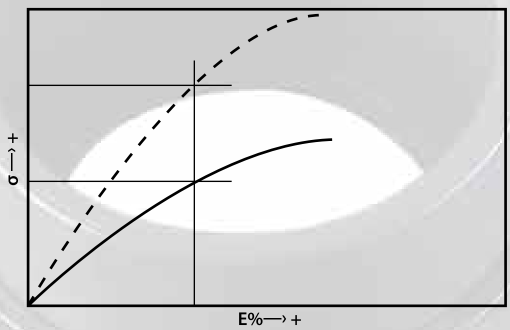
"Distension" is the longitudinal or longitudinal and transversal stretching of amorphous molecule chains to improve the material properties.

The "recovery ability" is the memory behaviour of a material where the material is melted by heating and recovers again in the original order during the cooling phrase.

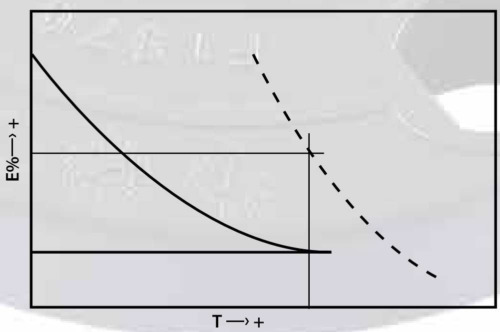
Polyolefines belong to the semi-crystalline thermoplastics group. Compared with amorphous thermoplastics (e. g. PVC, CPVC) they show less tensile strength, hardness, melting temperature and a lower E modulus. However they exhibit higher impact resistance, elongation at rupture and thermal expansion.

Semi-crystalline thermoplastics are more suited for fusion jointing than amorphous thermoplastics which are ideal for solvent cement jointing.

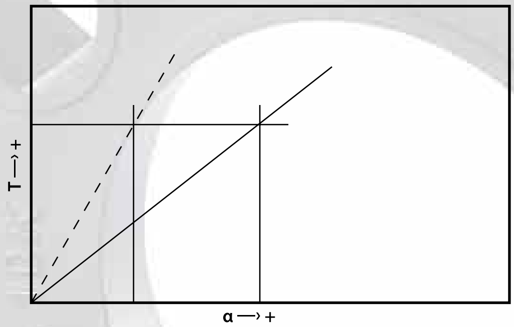
- - - - amorphous -------- semi-crystalline



σ Tensile strength
E Strain %



ε Strain
T Temperature



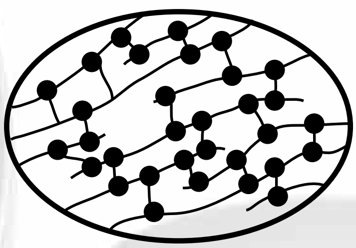
α Thermal expansion
T Temperature

Thermosets

By means of a hardener the polymer chains of the fluid and solid thermoset resins are cross-linked. Thermosets which have been hardened in this way cannot be melted, fused or deformed.

Thermosets are normally reinforced with glass, textile or carbon fibres and other filling materials.

PF Phenolic resin
EP Epoxy resin
UP Polyester resin
GFK Glass fibre plastic
CFK Carbon-fibre plastic
GF-EP Glass-fibre epoxy resin
CF-PF Carbon-fibre phenolic resin

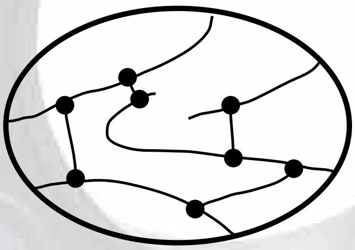


Elastomers

Elastomers are rubber-elastic plastics, also called "synthetic caoutchouc". In contrast to thermosets, the network has a large mesh width. By means of vulcanisation aids the polymer chains are cross-linked. The amount of the cross-links, determines the hardness (the hardness is indicated in Shore degrees of hardness) of the rubber.

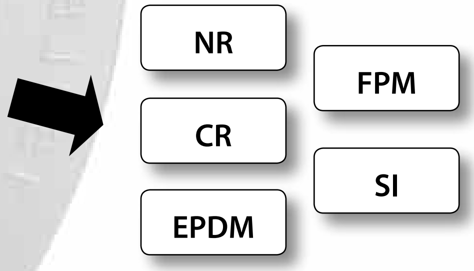
The elastomer is very elastic, can not be melted, is not fusible, can be deformed, but not reshaped.

Elastomers are for example



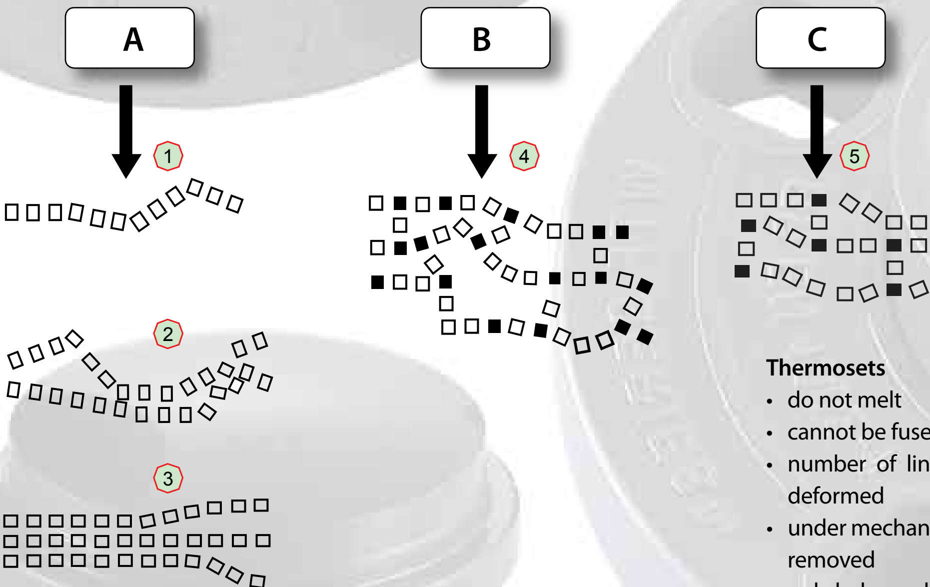
Wide meshed, low cross-linked elastomer net

NR	Natural rubber
EPDM	Ethylene propylene rubber
CR	Chloroprene rubber
SI	Silicone rubber
FPM	Fluorocarbon rubber



Planning Fundamentals Industry

Comparison of thermoplastics, thermosets and elastomers



1 Filamentary molecules
2 Amorphous
3 Semi-crystalline
4 Space-net molecules, close-meshed
5 Space-net molecules, wide-meshed
A Thermoplastic
B Thermoset
C Elastomer

Thermoplastics
- repeated melting
- fusible
- the amount of crystallites determines the density and mechanical properties
- under strong mechanical stress they tend to creep and show lasting deformation
- the strength value decreases with increased heating
- can be transformed and deformed several times

Thermosets
- do not melt
- cannot be fused
- number of links is decisive for mechanical properties can be deformed
- under mechanical load, but regain their original form after load is removed
- only behave elastically in a relatively narrow upper temperature range, therefore more heat stable
- can only be deformed once

Elastomers
- do not melt
- cannot be fused
- number of links is decisive for the rubber hardness
- can be strongly deformed under mechanical stress
- remain elastic down to low temperatures

Relevant properties of thermoplastics

Compared to conventional materials, plastics offer the following general advantages:

- low weight
- high elasticity
- chemical resistance
- low heat conduction
- smooth surfaces

RELEVANT PROPERTIES OF THERMOPLASTICS	
LOW DENSITY = LOW WEIGHT	Plastic 0.9 - 1.5 g/cm^3
CHEMICAL RESISTANCE = NO CORROSION, UNLIKE METALS	Metals link with oxygen and rust, except for stainless and acids-resistant steel.
LOW HEAT CONDUCTIVITY = SMALL THERMAL LOSS	Plastics are poor heat conductors, but good insulators Thermal conductivity: PB 0.22 W/m K PE 0.38 W/m K PVC 0.15 W/m K
LOW CONDENSATION	Due to the poor thermal conductivity of plastic, less condensation occurs than with metal pipes.
HIGH ELASTICITY	Resistant against impact and bending stresses.
ABRASION RESISTANCE	Approximately four times more abrasion resistant than steel pipelines.
LEAKPROOF CONNECTIONS	Plastics can be fused, solvent-cemented and compression jointed. Fusion connections and solvent-cemented joints can be made which are absolutely leakproof without any additional components.
SMOOTH SURFACE	Smooth surfaces ensure low pressure losses and no encrustation.
EXPANSION	Plastics react more to temperature changes than metals. The longitudinal expansion of plastics is approx. 10 to 20 times greater than that of steel.
BEHAVIOUR IN FIRE	Most thermoplastics are combustible. Classification is made according to the standard material fire test.
ELECTRICALLY NONCONDUCTING	No electrolytic corrosion
SUN RAYS	Some plastics are sensitive to UV rays and have to be protected - however, resistance to weathering is good.

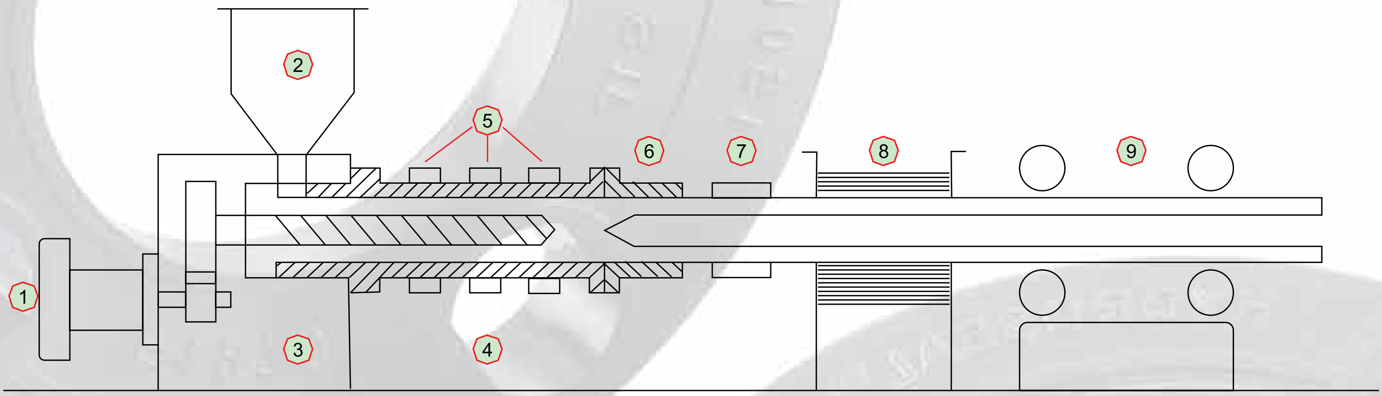
Processing of plastics

Plastics are processed differently depending on the material and application. Some common methods are:

- Extrusion
- Compression moulding
- Injection moulding
- Foaming

Extrusion

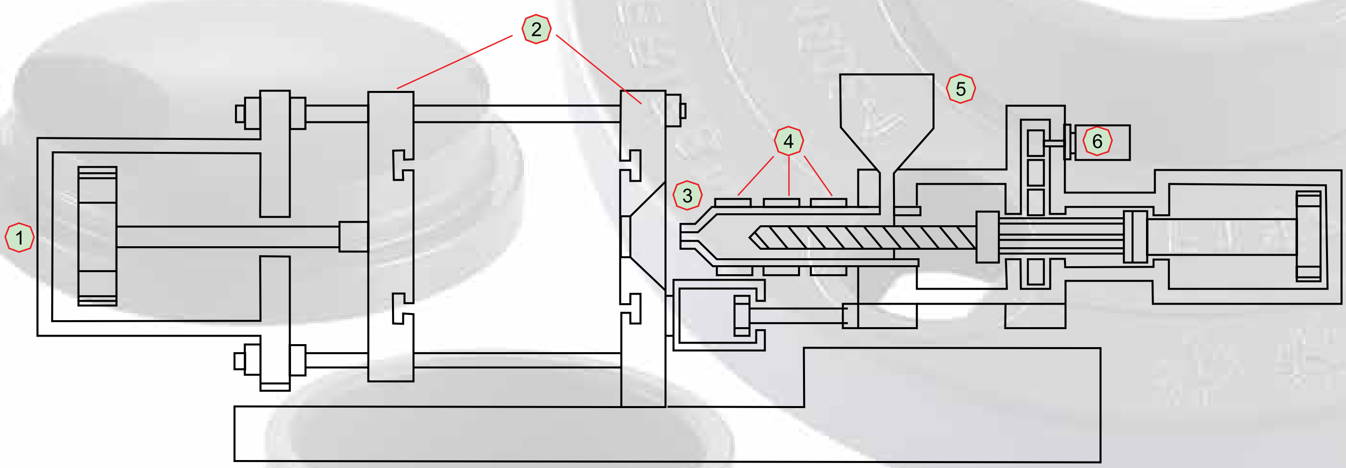
In this process thermoplastic material is melted and is continuously forced through a tool via a worm screw. The extruded bar is then calibrated, allowed to cool, and is then withdrawn via a take-off unit.



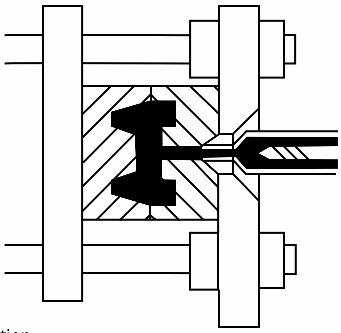
1 Driving motor
2 Material supply
3 Extruder
4 Plasticizing worm
5 Electric heat strips
6 Die
7 Calibration device
8 Cooling tank
9 Take-off unit

Processing of plastics

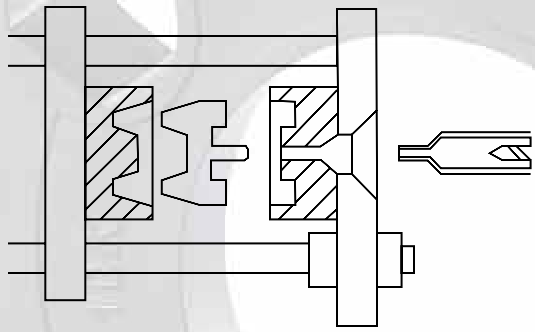
Thermoplastic material in granular or powder form is gradually melted in the cylinder and the mass is injected by means of the worm screw into a mould under high pressure. The plastic then solidifies and is ejected from the mould as a finished part.



1 Hydraulic mould closing cylinder
2 Mounting plates for both halves of the injection mould
3 Cylinder with injection nozzle
4 Electric cylinder heating
5 Material conveyor
6 Driving motor for worm screw



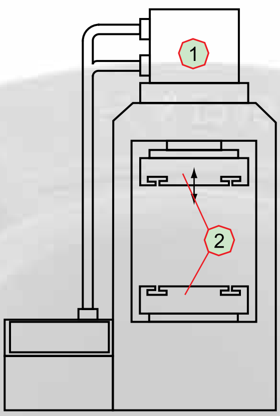
Injection



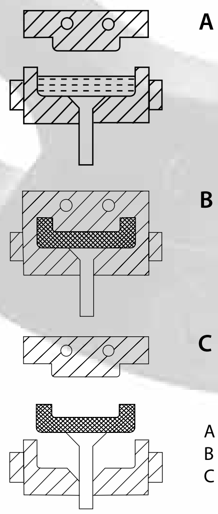
Ejection of the finished part

Compression moulding

Thermosetting material is poured into the open compression mould in powder form. Under the impact of the mould pressure and heat, it then chemically reacts and solidifies to the desired finished part.



1 Pressure cylinder
2 Mounting plates for both halves of the pressure mould

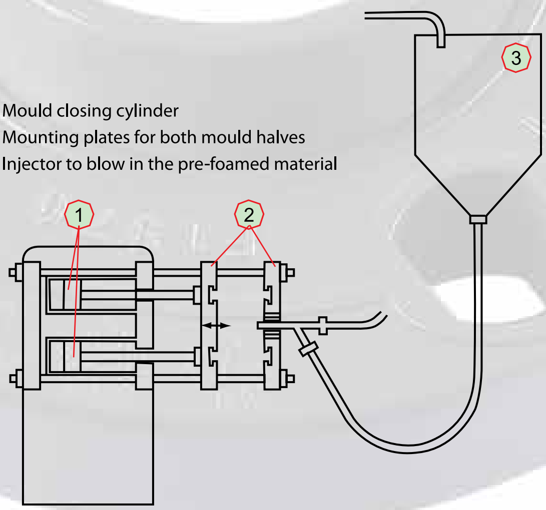


A Fill in
B Press
C Ejection

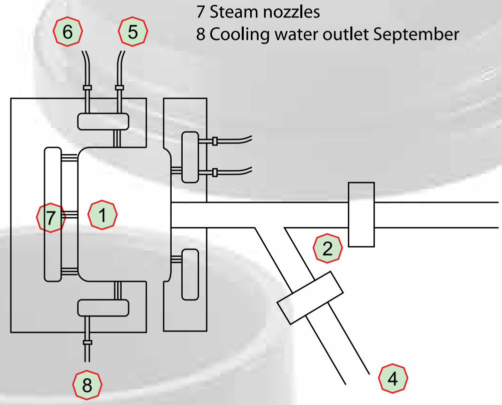
Steam foaming

Foam machine

1 Mould closing cylinder
2 Mounting plates for both mould halves
3 Injector to blow in the pre-foamed material



1 Mould cavity
2 Injector
3 Compressed air
4 Pre-foamed granulates
5 Steam
6 Cooling water
7 Steam nozzles
8 Cooling water outlet September



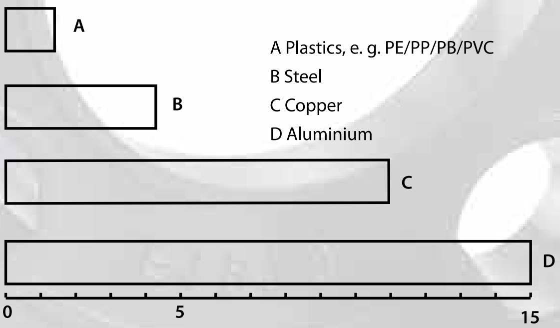
Granular plastic containing a blowing agent is injected into the mould, expanded by means of hot steam, cooled with water and ejected from the foam mould as an extremely light weight part. Water absorption is impossible as all pores are closed.

Plastics and the environment

Using plastics means saving energy

Plastics constitute only a small percentage of the entire crude oil usage. However, crude oil resources are limited. Already today we have to fall back upon raw materials which can be recycled and extend alternative energy sources. In this context we talk about re-usable raw materials.

All working processes need energy (heat, pressure, motor power). In comparison with metals, manufacturing plastics requires less energy. The production of 1 dm3 material requires an amount of energy which is given in kilograms oil equivalent per litre material in the chart below.



Recycling

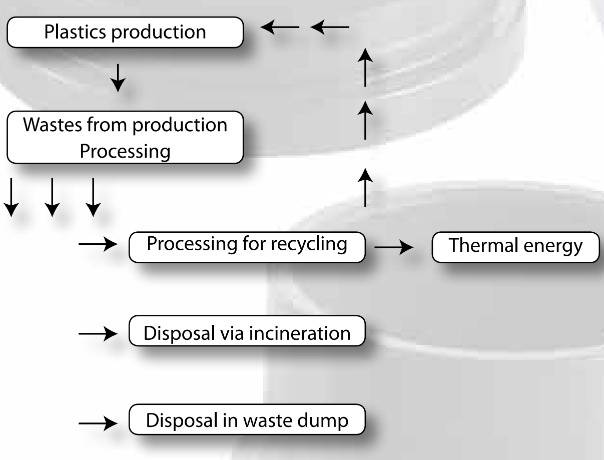
Although plastics make up only 6% of oil consumption, the conclusion is that the energy value of plastic must be used. There are two possibilities of recycling:

- **reutilisation**, production of new products
- **combustion**, production of thermal energy.

In the case of reutilisation the plastic waste is brought back to its original form in different procedures (hydrolysis, pyrolysis, regranulation).

At HYDROSEAL, production waste is regranulated and integrated into the production process of products with lower quality and hygienic requirements than that of pipes and fittings.

All thermoplastics are recyclable, e. g. PE, PP, PB, PVC, CPVC, ABS or PVDF. This is, however, not the case for thermosetting plastics and thermoelastomers such as PE-X.



Incineration together with domestic waste (no PVDF) does not pose any problems. In this case we talk about energy recycling, as almost all incineration plants recover waste heat. For example in Germany the annual plastic waste incinerated in this way supplies as much energy as 500 000 t of heating oil.

Thermal value of different materials

PE/PP/PB	44000 kJ/kg
Heating oil	44000 kJ/kg
Coal	29000 kJ/kg
PVC/CPVC	19000 kJ/kg
Paper	16800 kJ/kg
Wood	16000 kJ/kg
Domestic waste	8000 kJ/kg

The production of corrosive combustion products is not possible in the case of polyolefines (PE, PP, PB) and ABS as halogens (e. g. chlorine) are missing in the molecular structure. In the case of PVC, CPVC and PVDF special scrubbing towers are installed.

Plastics as well as other materials cannot be transformed into nothing, so disposal in waste dumps is not the solution. This is why the use of recyclable and energy recyclable plastics should be promoted.

Reflections on pipeline work

Planning and installation of piping systems is a true engineering task, necessitating the organisation of a multitude of requirements and goals. For piping installations, simple, critical and aggressive media in each case require suitable materials. The idea is to especially cover the requirements of functionality, operating safety, optimal service life, environmental conditions and adequate profitability. Included in this are overall ecological, technical and economic assessments. High-performance plastics for piping installations, such as those, which you can obtain from our company, are proven and implementable where special endurance problems in connection with the media need solving.

Environmental protection is an important responsibility affecting us all. Each one of us, businesses and industrial concerns alike have to meet this great challenge. We at Hydroseal actively pursue these responsibilities in the development of our products as well as for investments in our production facilities. In 2009 our company was distinguished within the scope of a competition for ecologically sound technology by the Environmental Protection Minister.

Our manufacturing plant is systematically analysed in accordance with strict criteria for improving environmental protection and updated accordingly. In this sector we have had outstanding success, which our customers can themselves appraise on-site.

Political approaches or one-sided evaluations of individual aspects of materials, products and processes for piping installations do not lead to intelligent solutions. Only comprehensive and objective as well as comparative balancing of accounts can bring us forward at any one time. In this respect, ecological balance is especially useful.

In the following we present an ecological balance for plastic piping installations:

Ecological balance for plastic piping systems

Passive
- Raw material requirements

- Energy requirements

- Impact on:
- hygiene
- air
- water
- disposal

- Profit:
- economic
- technical
- ecological

Active
- Applications

- Product use
- long service life
- proven in practice
- good recycling characteristics
- high chemical resistance

- Properties
- simple handling
- negligible piping losses
- cost-effective

If one analyses the individual positions of such an ecological balance, it can be demonstrably established that plastic piping systems are not only economical, but also technically and especially ecologically profitable when compared with other material systems.

Following many years of research, Prof. Georg Menges has concluded that: "Consistent environmental protection would intrinsically require that crude oil be first processed to plastic for use as commodity goods wherever possible and only then be allowed to be burned."

We have inhouse a PVC sample pipe that was installed in Hamburg in 1937. The PVC pipes were joined using bonding agents. The system was operated at 4 to 6 bar. The material was used to supply drinking water to the public and was, without exception, successful. Even after this long operational period, there was no evidence of incrustation or deposits.

Currently PVC, besides polyethylene, is the most important material of consideration which, because of its versatility, is not achieved by any other raw material. Piping components of PVC have attained such great significance that not using them in many applications is no longer imaginable. Even in the case of public criticism from various sources, assertions and facts have been known to deviate greatly from one another.

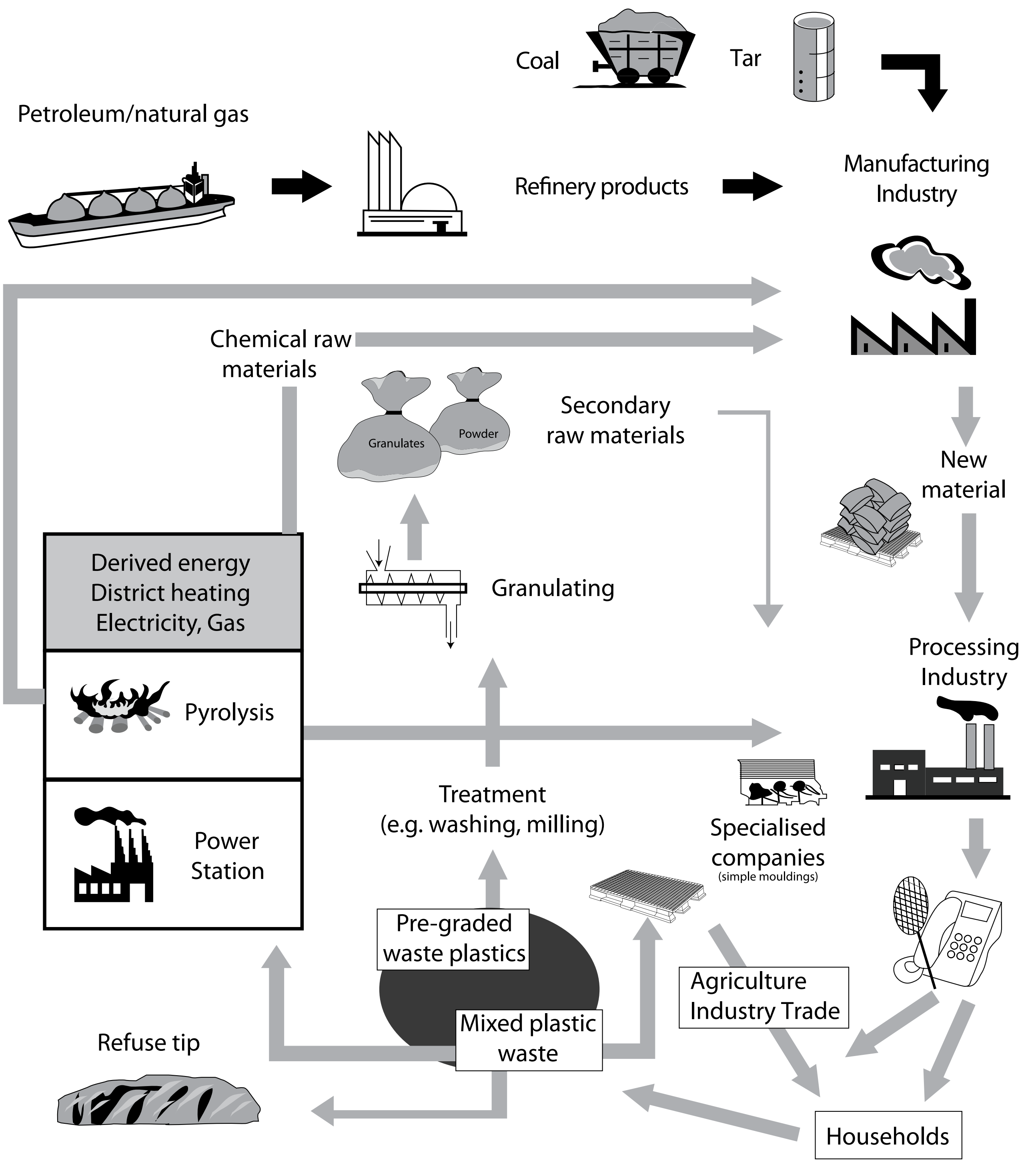
During PVC manufacture, pool concentrations of all dangerous intermediate products are abided by or only handled in closed systems, allowing the exclusion of risks to employees. During PVC processing, all effective industrial safety regulations are clearly improved upon and, with lowered energy requirements, the impact on the environment is additionally reduced. Owing to their chemical stability, PVC products are completely non-toxic in normal use, are suitable for use with food, and are used in applications involving blood conservation and dialysis. Tin is used as a stabiliser for our PVC materials so that risks associated with heavy metals are not a consideration.

It is frequently claimed that during fires additional hazards from PVC exist for those in the immediate area. Intensive fire testing has been carried out with PVC. Building fires can also set fire to the difficult-to-ignite and self-extinguishing PVC. PVC, however, does not contribute to the spread of the fire. In cases of fire, the fumes are always toxic, regardless of the type of material burning. The greatest danger in a fire arises from the production of highly poisonous carbon monoxide gas. From an insurance viewpoint, PVC is handled in the same manner as other customary construction materials. Dioxins/furans have been shown to be produced in all combustion processes. PVC components have even been shown to play a subordinate role.

If all the positions of the above ecological balance are taken into account, then the conclusion is that currently there are no acceptable substitutions for PVC piping installations.

PVC and the other high-performance plastics have many positive and few critical characteristics from an ecological viewpoint. If you would like more information about these considerations, our specialists would be happy to be of service to you.

Recycling possibilities



ABS PROPERTIES (REFERENCE VALUES)			
CHARACTERISTICS	VALUE	UNITS	TEST STANDARD
Density	≥ 1.035	g/cm^3	ISO 1183-1
Yield Stress At 23°C	≥ 40	N/mm^2	EN ISO 527-1
Tensile E-Modulus At 23°C	≥ 1600	N/mm^2	EN ISO 527-1
Charpy Notched Impact Strength At 23°C	42 k	kJ/m^2	EN ISO 179-1/1eA
Charpy Notched Impact Strength At -40°C	≥10	kJ/m^2	EN ISO 179-1/1eA
Ball Indentation Hardness (358N/30S)	87	MPa	EN ISO 2039-1
Heat Distortion Temperature Hdt A 1.82 Mpa	≥ 74	°C	EN ISO 75-2
Vicat-Heat Distortion Temperature B/50N	≥ 94	°C	ISO 306
Thermal Expansion Coefficient	0.1	mm/mK	DIN 53752
Heat Conductivity At 23°C	0.17	W/mK	EN 12664
Water Absorption At 23°C	≤ 0.45	%	EN ISO 62
Colour	similar 7001	-	RAL
Limiting Oxygen Index (Loi)	19	%	ISO 4589-1

General
Standard polymer. In addition to its application in piping systems, ABS is mainly common in automotive applications and in high-quality household devices.

The wide area of application relates to the versatile characteristic profile of ABS. It can be adapted to the application by varying the composition of its three components:
acrylonitrile, styrene and polybutadiene.

While acrylonitrile provides strength to the material and gives ABS an improved chemical resistance relative to polystyrene, the styrenic component provides both strength and a quality surface finish. The chemically bound polybutadiene-rubber particles, on the other hand, give the material its toughness and impact strength, even at very low temperatures.

The ABS used by HYDROSEAL shows a good balance between toughness and strength, making it especially suitable for low temperature applications. Accordingly the areas of application are mainly refrigeration and air-conditioning systems as well as water treatment.

The advantages of ABS include:
- high impact strength even at low temperatures
- corrosion resistance
- simple installation via solvent cement joints
- low heat conductivity
- halogen free
- non-toxic
- biologically inert; no support of microbial growth
- low weight
- low pressure losses due to smooth surfaces
- good abrasion resistance
- problem-free recycling

Mechanical properties
In addition to the good strength and stiffness, ABS is especially characterised by a very high impact strength. Impact strength is a measure of impact energy that the material absorbs until it breaks. For this test, a specimen is weakened with a sharp notch and then struck. Without a notch, there is no breakage of the test specimen. The exceptionally high notched impact strength values, even at low temperatures, indicate the material's high robustness and tolerance against surface damage.

HYDROSEAL ABS pipes are routinely tested for their toughness according to EN ISO 15493. In this test, a weight falling from, a height of 2 metres hits the pipe that has been cooled to 0°C. The mass of the falling weight varies, depending on the pipe dimensions, from 0.5 (dn = 20 mm) to 9 kg (dn = 225 mm). The high load in the falling- weight test ensures that the excellent toughness of the material is not reduced as a result of processing into pipe.

The internal pressure resistance is provided by the hydrostatic strength curve based on the EN ISO 15493 standard. The application limits for pipes and fittings, as shown in the pressure-temperature diagram, can be derived from these curves.

Chemical, weathering and abrasion resistance
ABS is characterised by its good resistance to various chemicals. In general, ABS is resistant to water, salt solutions and most dilute acids and bases. Its resistance to alcohols, aliphatic hydrocarbons,

Materials used for industrial pipe work

The Material Acrylonitrile-Butadienestyrene (ABS)

oils and greases is, however, to be regarded as limited. ABS is not resistant to concentrated mineral acids, organic acids and solvents such as esters, ketones and chlorinated and aromatic hydrocarbons. For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your local HYDROSEAL subsidiary.

If the ABS piping system is exposed to direct sunlight over a long period, its surface loses its shine and the colour shifts to light grey. Due to the very high impact strength of ABS, the resulting loss of toughness generally causes no problems in moderate climate zones. For extreme weather conditions or very high loads on the piping system, we nevertheless recommend protecting the surface from direct sunlight.

In addition to the excellent impact strength, the polybutadiene rubber particles in ABS cause an outstanding resistance against abrasion. Because of this, ABS piping systems have been used for a long time to transport solids and slurries, for example, in mining applications.

Experience has shown that ABS, as well as PE, offers considerable advantages over metal and other plastics for many such applications. Please contact HYDROSEAL if you are planning such an application. We would be glad to advise you about the suitability of ABS, PE and other materials for your media.

Thermal properties

The outstanding characteristics of ABS allow its application in a wide temperature range between - 40°C and + 60°C. At higher temperatures, the tensile strength and stiffness of the material drop and at lower temperatures, they rise.

As all thermoplastics, ABS shows a higher thermal expansion than metals. This is not a problem if the thermal expansion is taken into account during the planning stage of the piping system. The expansion coefficient amounts to 0.1 mm/m K in the application temperature range.

At 0.17 W/m K, the heat conductivity of ABS is very low. Because of the insulation properties of the material and the resulting savings in energy or insulation, an ABS piping system is notably more economical in comparison to a system made of copper (370 W/m K) or other metals.

Should there be a need for additional insulation, e. g. in cooling applications, HYDROSEAL offers a system specially dedicated to this market. It is a preinsulated ABS system that has the advantage of quick and easy installation.

Combustion behaviour

ABS self-ignites at temperatures exceeding 450°C, and burns when exposed to an open flame. After removing the flame, the material continues burning. The oxygen index amounts to 19%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable).

According to UL-94, ABS has a HB (Horizontal Burning) flammability coefficient and falls into building material class B2 (conventional inflammable, non-dripping) according to DIN 4102-1. Basically, toxic substances are released by all burning processes. Carbon monoxide is generally the combustion product most dangerous to humans. When ABS burns, primarily carbon dioxide, carbon monoxide and water are formed. Tests have shown that the relative toxicity of the products of combustion are similar or even lower than those of natural products such as wood, wool and cotton. ABS combustion gases are not corrosive. Nevertheless, the burning forms soot. Because of this, smoke develops during combustion. Water, foam and carbon dioxide are suitable fire-fighting agents.

Electrical properties

ABS has good electrical insulation capacity. The specific volume resistance is 3.5×10^{16} Ωcm and the specific surface resistance is 10^{13} Ω. These figures have to be taken into account wherever there is a danger of fires or explosion.

Physiological properties

The HYDROSEAL ABS is toxicologically harmless and biologically inert. Drinking water approvals in the UK (DWI) and in Germany (KTW) have been applied for.

Materials used for industrial pipe work
The Material Polyvinyl Chloride Unplasticized (PVC)

PVC PROPERTIES (REFERENCE VALUES)			
CHARACTERISTICS	Value	Units	TEST STANDARD
Yield stress at 23 °C	≥ 52	N/mm²	EN ISO 527-1
Charpy notched impact strength at 23 °C	≥ 6	kJ/m²	EN ISO 179-1/1eA
Ball indentation hardness (358N)	≥ 105	MP	EN ISO 2039-1
Vicat heat distortion temperature B/50N	≥ 76	°C	ISO 306
Heat conductivity at 23 °C	0.15	W/m K	EN 12664
Colour	7011	-	RAL
Density	1.38	g/cm³	EN ISO 1183-1
Tensile e-modulus at 23 °C	≥ 2500	N/mm²	EN ISO 527-1
Charpy notched impact strength at 0 °C	≥ 3	kJ/m²	EN ISO 179-1/1eA
Heat distortion temperature HDT A 1.80 MPa	66	°C	EN ISO 75-2
Thermal expansion coefficient	0.07··· 0.08	mm/mK	DIN 53752
Water absorption at 23 °C	≤ 0.1	%	EN ISO 62
Limiting oxygen index (LOI)	42	%	ISO 4589-1

General
Polyvinylchloride, widely known by its abbreviation PVC, is one of the most important and oldest mass-produced polymers. World-wide consumption of PVC is only exceeded by PE and PP, PVC was first produced in the middle of the nineteenth century. An industrial production process was, however, first patented in 1913. Nowadays, many industrial applications couldn1.t be realised without PVC. But also in the use of daily products, PVC has become irreplaceable. PVC is a polymer having approximately 56% by weight of chlorine. Only by using additives does it become a processable and usable material. The additives allow a wide variation of its characteristics and allows it to be adjusted to the planned application. There are two classes of PVC materials. Soft PVC (PVC-P), produced by adding plasticizers (such as, Hard PVC, the so-called unplasticized PVC (PVC-U) is used for pipeline engineering. PVC is an amorphous thermoplastic. The characteristics of PVC moulded parts are strongly dependent on the composition of the formula, but also on the processing. Because of our 40-year experience in PVC processing and the continuous advancement of our own formula.

HYDROSEAL 's PVC is characterised by the following characteristics:
- universal use
- very good chemical and corrosion resistance
- proven physiological harmlessness and therefore suitable for contact with food
- no influence on drinking water quality
- biologically inert; no support of microbial growth
- high mechanical tensile strength with good impact strength
- self-extinguishing
- secure solvent cementing.
- adhesive development designed for HYDROSEAL PVC.
- use of tin stabilisers for fittings and valves
- low friction loss owing to smooth surfaces
- recyclable

Mechanical properties
PVC from HYDROSEAL reflects a balanced picture regarding the mechanical short-term properties. Because of the strong interaction between the chlorine atoms in the polymer chain, PVC shows a high tensile strength and stiffness. At the same time, the elasticity of the HYDROSEAL structural parts is good, a characteristic guaranteed by regular quality control testing.

The long-term behaviour for internal pressure resistance is provided by the hydrostatic strength curve based on the EN ISO 15493 or DIN 8061 standards. The application limits for pipes and fittings, as shown in the PVC pressure-temperature diagram, can be derived from these curves.

Behaviour during dynamic loading corresponds to the highest quality requirements and is tested regularly.

Chemical and weathering resistance
The outstanding chemical resistance of PVC extends to high concentrations. Resistance against the influence of most mineral acids, bases and salt solutions and also sodium hypochlorite solutions is very good. Resistance to aliphatic hydrocarbons and elemental chlorine is also good. PVC , in general, shows weakness against aromatic or chlorinated solvents, esters and ketones. Use with gases is also not recommended. If the use of oils, varnish or fats is being considered, a prior investigation is advisable.

Materials used for industrial pipe work

The Material Polyvinyl Chloride Unplasticized (PVC)

For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your HYDROSEAL subsidiary.

These specifications are also valid with exceptions for adhesive joints, which normally are implemented by applying strongly dissolving gap-filling solvent cement to the PVC.

PVC is very resistant to weathering. Long-term influence of direct sunlight as well as the effect of wind and rain damage the material only superficially. Despite its very good weathering resistance regarding ultraviolet radiation, PVC loses some of its impact strength. In extreme applications it can be advantageous to protect the material from direct sunlight exposure.

Thermal properties

PVC shows very good characteristics in the temperature range from 0 to 60 ºC. At lower temperatures, the impact strength drops considerably. Tensile strength and stiffness drop with increased temperatures. Please consult the pressure-temperature diagram especially for your maximum working temperature. Because the softening-point temperature of the fitting and valve materials lies above 76°C, applications must remain limited to temperatures below 60°C.

The thermal expansion coefficient of PVC at 0.07 to 0.08 mm/mK lies clearly above that of metals. Of all the materials for industrial piping installations, available from HYDROSEAL, PVC shows one of the lowest expansion coefficients. Nevertheless, the thermal expansion has to be taken into account during the planning of the installation.

Similar to all polymers, PVC is a good thermal insulator. At 0.15 W/m K, the heat conductivity of PVC is very low. The value for steel, on the other hand, is 250 W/m K.

Combustion behaviour

The high chlorine content of PVC causes an advantageous combustion behaviour. Self-ignition resulting from temperature influences occurs only at 450°C. PVC burns when exposed to an open flame, but extinguishes immediately after removing the flame.

The oxygen index amounts to 42%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable).

PVC thus falls in the best flammability class V0 according to UL94, and in the B1 building material class (difficult to ignite) according to DIN 4102-1. According to the French test method NF P 92-501, HYDROSEAL PVC is tested as M2.

Because the combustion of PVC produces hydrogen chloride, which forms a corrosive acid in connection with water, immediate cleaning of areas susceptible to corrosion is necessary after a fire. Danger to personnel from HCl is minimal because its pungent odour allows early escape from toxic combustion gases, mainly from the odourless carbon monoxide.

There are no restrictions concerning the choice of fire-fighting agents.

Electrical properties

HYDROSEAL is, as all unmodified thermoplastics, non-conductive. This means that no electrochemical corrosion takes place in PVC systems. On the other hand, these non-conductive characteristics have to be taken into account because an electrostatic charge can develop in the piping. It is especially important to take this condition into account in areas where explosive gases can appear. There are various methods available to avoid the occurrence of electrostatic charges on polymer piping systems. Please contact your HYDROSEAL representative for more information regarding these methods.

The specific volume resistance is >10^{15} Ωcm.

Physiological properties

The PVC formulas were developed by HYDROSEAL for use with drinking water and food. PVC's physiological harmlessness regarding neutral, acidic and alcoholic foods and the non-influence on drinking water in respect to odour, taste or microbiological effects is regularly checked and monitored by neutral institutions in various countries.

HYDROSEAL offers PVC systems free from lead and cadmium for your applications in the fields of drinking water or food. The residual monomer content of vinyl chloride lies below the detection limit of modern analytical methods.

CPVC PROPERTIES (REFERENCE VALUES)			
CHARACTERISTICS	VALUE	UNITS	TEST STANDARD
Yield stress at 23 °C	≥ 53	N/mm^2	EN ISO 527-1
Charpy notched impact strength at 23 °C	≥ 6	kJ/m^2	EN ISO 179-1/1eA
Heat distortion temperature HDT A 1.80 MPa	≥ 102	°C	EN ISO 75-2
Thermal expansion coefficient	0.06 ... 0.07	mm/mK	DIN 53752
Water absorption at 23 °C	0.1	%	EN ISO 62
Limiting oxygen index (LOI)	60	%	ISO 4589-1
Density	1.5	g/cm^3	EN ISO 1183-1
Tensile e-modulus at 23 °C	≥ 2550	N/mm^2	EN ISO 527-1
Ball indentation hardness (358N)	≥110	MPa	EN ISO 2039-1
Vicat-heat distortion temperature B/50N	≥ 103	°C	ISO 306
Heat conductivity at 23 °C	0.15	W/m K	EN 12664
Colour	7038	-	RAL

General
The abbreviation CPVC stands for chlorinated polyvinyl chloride, a material in use since 1958. CPVC is an amorphous thermoplastic. It is made by post-chlorination of PVC whereby chlorine is attached to the PVC chain. Thus CPVC is a transformed PVC material which, because of its chemical structure, is characterised by a higher temperature resistance than PVC , with simultaneously higher tensile strength, good toughness and an exceptional chemical resistance. Its flame resistance is even better than that of PVC. These characteristics have made CPVC an interesting material for piping and fabrication of devices in the chemical industry as well as for several other industrial applications with high requirements (e. g. the aeroplane industry).

In pressure piping systems, CPVC is suitable for strongly corrosive environments, where materials such as stainless steel or even GFK demonstrate only a short service life. CPVC is used for semi-finished products, pumps, valves as well as for the entire range of accessories associated with transport of liquids.

Some of the advantages of CPVC for piping systems are:

· very good mechanical characteristics, also at increased temperatures
· outstanding chemical resistance
· no electrochemical corrosion
· long service life, even under intensely corrosiveconditions
· no support of microbial growth
· simple installation using solvent cementing
· smooth inner surface
· very low heat conductivity
· exceptional flammability resistance
· no influence on drinking water

Mechanical properties
The mechanical short-term characteristics of CPVC are very similar to those of PVC at room temperature. CPVC is a material with high tensile strength and stiffness and simultaneously good impact strength. CPVC 's advantages are particularly prevalent at higher temperatures. The reason for this is its high chlorine content, which causes a strong interaction between the CPVC chains. This, in turn, displaces the softening and the loss of attributes to higher temperatures and also has an effect on the outstanding long-term creep strength, which among the HYDROSEAL piping materials isonly exceeded by PVDF.

The long-term behaviour for internal pressure resistance is provided by the hydrostatic strength curve based on the EN ISO 15493 standard. The application limits for pipes and fittings, as shown in the-pressure-temperature diagram, can be determined fromthese curves.

Chemical and weathering resistance
The excellent chemical resistance of CPVC extends to high temperatures and to high concentrations of media. Resistance against the influence of most mineral acids, bases and salt solutions is distinctive, but is also good against sodium hypochlorite and chlorine solutions. Resistance to aliphatic hydrocarbons and elemental chlorine is also good. CPVC shows weakness against aromatic or chlorinated solvents, esters and ketones. Use with gases is also not recommended. If oils, varnish or fats are being considered, a prior investigation is advisable.

For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your HYDROSEAL subsidiary.

Materials used for industrial pipe work

The Material Polyvinyl Chloride Chlorinated (CPVC)

These specifications are also valid - with exceptions - for adhesive joints, which normally are implemented by applying strongly dissolving gap-filling solvent cement on the CPVC. CPVC is weather resistant over the long term, so it can be exposed to direct sunlight as well as wind and rain. Resistance to ultraviolet radiation is very good in comparison to other materials, but nevertheless, CPVC loses some of its impact strength. In extreme applications it can be advantageous to protect the material from direct sunlight exposure.

Thermal properties

CPVC piping materials have a Vicat softening temperature (above 103°C) that is over 20°C higher than that of PVC. The highest temperature of application of +80°C is derived from this heat resistance. HYEDOSEAL recommends an operational temperature range from 0°C to +80°C.

The material characteristics of CPVC are ideal between +40°C and +80°C.,The thermal expansion coefficient of CPVC at 0.06 to. 0.07 mm/m K lies clearly above that of metals. On the other hand, with respect to the other materials used in industrial piping installations, CPVC shows the lowest expansion coefficient. This is not a problem if the thermal expansion is taken into account during the planning of the installation.

Combustion behaviour

Due to its high chlorine content, CPVC shows an exceptionally good combustion behaviour without the addition of flame retardants.

Under the influence of temperature, CPVC self-ignites only above 400°C. CPVC burns when exposed to an open flame, but immediately extinguishes when the flame is removed.

The oxygen index amounts to 60%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable).

CPVC thus also falls in the best flammability class V0 according to UL94, and in the building materials class B1 (difficult to ignite) according to DIN 4102-1. Smoke development is also low.

Since the combustion of CPVC produces hydrogen chloride, which forms a corrosive acid in connection with water, immediate cleaning of areas susceptible to corrosion with water containing detergent is necessary after a fire. Danger to personnel from HCl is minimal because of its pungent odour even in very low concentrations (1-5 ppm), allowing an early escape from toxic combustion gases, mainly from the odourless carbon monoxide. Concerning the choice of fire-fighting agents, water, powder-type extinguishing agents or foam are recommended.

Electrical properties

CPVC is, like all unmodified thermoplastics, non-conductive. This means that no electrochemical corrosion takes place in CPVC systems. On the other hand, these non-conductive characteristics have to be taken into account because an electrostatic charge can develop in the piping. It is especially important to take this condition into account in areas where explosive gases can appear. There are various methods available to avoid the occurrence of an electrostatic charge on polymer piping systems. Please contact your HYEDOSEAL representative if you should have applications where this needs to be considered. The specific volume resistance is $>10^{15}\Omega$cm.

Physiological properties

CPVC is an inert and toxically harmless material. Tests have shown that there is no support of microbiological growth in water systems from CPVC.

Materials used for industrial pipe work

The Material Polyethylene (PE)

PE PROPERTIES (REFERENCE VALUES)				
CHARACTERISTICS	VALUE		UNITS	TEST STANDARD
Density	0.93	0.95	g/cm^3	EN ISO 1183-1
Yield stress at 23 °C	18	25	N/mm^2	EN ISO 527-1
Tensile e-modulus at 23 °C	700	900	N/mm^2	EN ISO 527-1
Charpy notched impact strength at 23 °C	110	83	kJ/m^2	EN ISO 179-1/1eA
Charpy notched impact strength at -40 °C	7	13	kJ/m^2	EN ISO 179-1/1eA
Ball indentation hardness (132N)	37		MPa	EN ISO 2039 - 1
Crystallite melting point	131	130	°C	DIN 51007
Thermal expansion coefficient	0.15 ... 0.20		mm/m K	DIN 53752
Heat conductivity at 23 °C	0.43	0.38	W/m K	EN 12664
Water absorption at 23 °C	0.01 - 0.04		%	EN ISO 62
Colour	9005	-	-	RAL
Limiting oxygen index (LOI)	17.4	%	%	ISO 4589 -1

General

Polymers which consist only of carbon and hydrogen (hydrocarbons) are called polyolefins.

Polyethylene (PE) belongs to this group. It is a semicrystalline thermoplastic. Polyethylene is the best known standard polymer. The chemical formula is: $(CH_2\text{-}CH_2)n$, and it is an environmentally friendly hydrocarbon product.

PE and PP belong to the non-polar materials. Because of this, the material does not dissolve in common solvents and, in addition, hardly swells. As a result, PE pipes cannot be solvent cemented. The appropriate jointing method for this material is welding. For piping installations we offer three welding techniques in our product range: butt fusion, socket welding and electrofusion.

The latter jointing technique is preferred for piping systems transporting gas, water, compressed air or other less aggressive media. Butt and socket welding are preferably used on a diameter-specific basis.

High molecular PE grades of medium to high density have become state of the art for industrial piping installations. The grades are classified in accordance with their internal pressure resistance in PE80 (MRS 8 MPa) and PE100 (MRS 10 MPa).

In this context, we also talk about PE grades of the 3rd generation. PE80 grades belong, in most cases, to the 2nd generation. PE grades of the 1st generation – PE63 according to current classifications—have practically no application anymore.

In piping construction, PE is mostly used for buried gas and water lines. For this range of applications, polyethylene has become the dominant material in numerous countries. But also building technology and industrial piping installations make use of the advantages of this material.

The advantages include:
- low weight
- outstanding flexibility
- good abrasion resistance
- corrosion resistance
- high impact resistance even at very low temperatures
- good chemical resistance
- safe and easy jointing by welding
- excellent cost-performance ratio

Mechanical properties

Modern PE100 grades show a bimodal molecular weight distribution, i. e. they consist of two different kinds of molecular chains (short and long). These polyethylenes combine a high tensile strength with a high resistance against fast and slow crack propagation. In addition, the short molecular chains provide a good processability.

Similar to ABS, PE also shows a very high impact strength, even at low temperatures. For this test, a specimen is weakened with a sharp notch and then struck. In doing this the impact energy absorbed by the material is measured. This test proves that polyethylene is insensitive to surface damage with subsequent impact stress. A robust behaviour like this, combined with a high elongation to break, is of big advantage in a lot of applications, e.g. in regions that have a high risk of earthquakes.

Materials used for industrial pipe work

The Material Polyethylene (PE)

The long-term behaviour for internal pressure resistance is provided by the hydrostatic strength curve based on the EN ISO 15494 standard.

Chemical, weathering, and abrasion resistance

Due to its non-polar nature as a hydrocarbon of high molecular weight, polyethylene shows a high resistance against chemical attack. PE is resistant to acids, alkaline solutions, solvents, alcohol and water. Fat and oil swell PE slightly. PE is not resistant against oxidising acids, ketones, aromatic hydrocarbons and chlorinated hydrocarbons.

For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your local HYDROSEAL subsidiary.

If polyethylene is exposed to direct sunlight over a long period of time, it will, like most natural and plastic materials, be damaged by the short wave UV portion of sunlight together with oxygen in the air, causing photo-oxidation. Because of this, our black polyethylene grades are effectively stabilised against UV light by adding carbon black.

As with ABS, PE also has excellent resistance against abrasion. As a result, PE piping systems are used in numerous applications for transporting solids and slurries. Experience has shown that PE as well as ABS offers considerable advantages over metal and other plastics for many such applications.

Please contact HYDROSEAL if you are planning such an application. We would be glad to advise you about the suitabilit of our PE, ABS and other materials for your media.

Thermal properties

Polyethylene pipes can be used at temperatures ranging from -50°C to +60°C.

At higher temperatures, the tensile strength and stiffness of the material are reduced. For temperatures below 0°C it must be ensured, as for every other, material, that the medium does not freeze, consequently damaging the piping system.

Like all thermoplastics, PE shows a higher thermal expansion than metal. Our PE has a coefficient of linear thermal expansion of 0.15 to 0.20 mm/m K, which is 1.5 times greater than that of e. g. PVC. As long as this is taken into account during the planning of the installation, there should be no problems in this regard.

The thermal conductivity is 0.38 W/mK. Because of the resulting insulation properties, a PE piping system is notably more economical in comparison to a system made of a metal like copper.

Combustion behaviour

Polyethylene belongs to the flammable plastics. The oxygen index amounts to 17%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable).

PE drips and continues to burn without soot after removing the flame. Basically, toxic substances are released by all burning processes. Carbon monoxide is generally the combustion product most dangerous to humans. When PE burns, primarily carbon dioxide, carbon monoxide and water are formed.

The following classifications in accordance with different combustion standards are used: According to UL94, PE is classified as HB (Horizontal Burning) and according to DIN 53438-1 as K2. According to DIN 4102-1 and EN 13501-1, PE is listed as B2 (normally flammable). In the French classification of building materials, polyethylene corresponds to M3 (of average flammability rating).

The self-ignition temperature is 350°C.

Suitable fire-fighting agents are water, foam, carbon dioxide or powder.

Electrical properties

Because of the low water absorption of PE, its electrical properties are hardly affected by continuous water contact.

Since PE is a non-polar hydrocarbon polymer, it is an outstanding insulator. These properties, however, can be worsened considerably as a result of pollution, effects of oxidising media or weathering. The specific volume resistance is $>10^{17}$ Ωcm; the dielectric strength is 220 kV/mm.

Because of the possible development of electrostatic charges, caution is recommended when using PE in applications where the danger of fires or explosion is given.

Physiological properties

The black material types from HYDROSEAL are authorised for use in food applications. The fittings are odourless and tasteless as well as physiologically inert. Usage in all related areas is thus possible.

Materials used for industrial pipe work

The Material Polypropylene (PP)

PP PROPERTIES (REFERENCE VALUES)				
CHARACTERISTICS	PP-R	β PP-H	UNITS	TEST STANDARD
Density	0.90-0.91	0.90-0.91	g/cm³	EN ISO 1183-1
Yield stress at 23 °C	25	31	N/mm²	EN ISO 527-1
Tensile e-modulus at 23 °C	900	1300	N/mm²	EN ISO 527-1
Charpy notched impact strength at 23 °C	30.98	5	kJ/ m²	EN ISO 179-1/1eA
Charpy notched impact strength at 0 °C	3.44	.8	kJ/ m²	EN ISO 179-1/1eA
Ball indentation hardness (132N)	49	58	MPaE	N ISO 2039 - 1
Heat distortion temperature HDT B 0.45 MPa7	59	5°	CE	N ISO 75 - 2
Crystallite melting point	145 -150	150 -167	°C	DIN 51007
Thermal expansion coefficient	0.16 ... 0.18m		m/m K	DIN 53752
Heat conductivity at 23 °C	0.23		W/m K	EN 12664
Water absorption at 23 °C	0.1	0.1%		EN ISO 62
Colour	neutral	7032	-R	AL
Limiting oxygen index (LOI)	19		%	ISO 4589 -1

General

Polypropylene is a thermoplastic belonging to the polyolefin group. It is a semi-crystalline material. Its density is lower than that of other well-known thermoplastics. Its mechanical characteristics, its chemical resistance and especially its relatively high heat deflection temperature have made polypropylene one of the most important materials used in piping installations today.

PP is formed by the polymerisation of propylene (C3H6) using Ziegler-Natta catalysts.

There are three different types which are conventionally supplied for piping installations:
- Isotactic PP Homopolymeride (PP-H)
- PP block co-polymeride (PP-B)
- PP random co-polymeride (PP-R).

Because of its high internal pressure resistance, PP-H is preferred for industrial applications. On the other hand, PP-R is used predominantly in sanitary applications because of its low e-modulus (flexible piping) and its high internal pressure resistance at high temperatures. PP-B is mainly used for sewage piping systems because of its high impact strength especially at low temperatures and its low thermal endurance.

Beta (ß)-PP-H

Most of the grades are offered with nucleating agents (crystallisation seeds), because PP crystallises at least 10 times slower than PE. This way, we achieve lower internal stress and a finer structure. We differentiate between α and β nucleation.

Nucleation is realised by merely adding ppm (parts per million)

PP is one of the non-polar materials whose surface hardly swells or dissolves. Cementing is not possible without special surface treatment.

On the other hand, PP welds very well. Pressure piping systems can use heating element socket welding, heating element butt welding.

The internal pressure resistance is ensured through long-term testing in accordance with EN ISO 9080 and certified with the value of MRS 10 (minimum required strength).

The Beta (ß)-PP used by HYDROSEAL for industrial pipeline engineering is characterised by:
- good chemical resistance
- high internal pressure resistance
- high impact strength
- high thermal ageing and thermal forming resistance
- high stress fracture resistance
- outstanding weldability
- homogeneous, fine structure

Mechanical properties

PP-H has the highest crystallinity and therefore the highest hardness, tensile strength and stiffness, so the pipes hardly sag and a greater distance between supports is possible. PP-R has a very good long-term creep strength at higher temperatures, such as, for example, 80°C at continuous stress.

Unlike PE, PP is not as impact resistant below 0°C. Because of this, HYDROSEAL recommends ABS or PE for low temperature applications.

The long-term behaviour for internal pressure resistance is provided by the hydrostatic strength curve based on the EN ISO 15494 standard.

Chemical, weathering and UV resistance

Due to its non-polar nature, polypropylene shows a high resistance against chemical attack.

The resistance of PP is nevertheless lower than that of PE because of its tertiary C atoms.

PP is resistant against acids, alkaline solutions, solvents, alcohol and water. Fats and oils swell PP slightly. PP is not resistant to oxidising acids, ketones, petrol, benzene, halogens, aromatic hydrocarbons, chlorinated hydrocarbons and contact with copper. For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your local HYDROSEAL subsidiary.

If polypropylene is exposed to direct sunlight over a long period of time, it will, like most natural and plastic materials, be damaged by the short-wave UV portion of sunlight together with oxygen in the air, causing photo-oxidation.

Fluorescent tubes create weakening the same effect.

PP fittings and valves are highly heat stabilised. As per approvals, polypropylene has no special additive against the effects of UV radiation. The same applies to PP piping. Piping which is exposed to UV light should therefore be protected. This is achieved by covering the pipes, e. g. with insulation or also by painting the piping system with a UV absorbing paint.

Thermal properties

In general polypropylene can be used at temperatures from 0°C to +80°C, β-PP-H in the range from -10°C up to 95°C. Below -10°C, the outstanding impact strength of the material is reduced. On the other hand, the stiffness is even higher at low temperatures. Please consult the pressure-temperature diagram for your maximum working temperature. For temperatures below 0°C it must be ensured, as for every other material, that the medium does not freeze, consequently damaging the piping system.

As with all thermoplastics, PP shows a higher thermal expansion (0.16 to 0.18 mm/mK) than metal. As long as this is taken into account during the planning of the installation, there should be no problems in this regard.

The thermal conductivity is 0.23 W/mK. Because of the resulting insulation properties, a PP piping system is notably more economical in comparison to a system made of a metal like copper.

Combustion behaviour

Polypropylene is a flammable plastic. The oxygen index amounts to 19%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable).

PP drips and continues to burn without soot after removing the flame. Basically, toxic substances are released by all burning processes. Carbon monoxide is generally the combustion product most dangerous to humans. When PP burns, primarily carbon dioxide, carbon monoxide and water are formed.

The following classifications in accordance with differing combustion standards are used: According to UL94, PP is classified as HB (Horizontal Burning) and according to DIN 53438-1 as K2. According to DIN 4102-1 and EN 13501-1, PP is listed as B2 (normally flammable). In the French classification of building materials, polypropylene corresponds to M3 (of average flammable rating). According to ASTM D 1929, the self-ignition temperature is 360°C. Suitable fire-fighting agents are water, foam or carbon dioxide.

Electrical properties

Since PP is a non-polar hydrocarbon polymer, it is an outstanding insulator. These properties, however, can be worsened considerably as a result of pollution, effects of oxidising media or weathering.

The dielectric characteristics are essentially independent of temperature and frequency. The specific volume resistance is $>10^{16}\,\Omega$cm; the dielectric strength is 75 kV/mm.

Because of the possible development of electrostatic charges, caution is recommended when using PP in applications where the danger of fires or explosion is given.

Physiological properties

The HYDROSEAL polypropylene grades satisfy the material requirements for articles or components of articles that come into contact with food. The fittings are odourless and tasteless as well as physiologically inert. Usage in all related areas is thus possible.

Materials used for industrial pipe work

The Material Polyvinylidenefluoride (PVDF)

PVDF PROPERTIES (REFERENCE VALUES)			
CHARACTERISTICS	VALUE	UNITS	TEST STANDARD
Density	1.78	g/cm^3	EN ISO 1183-1
Yield stress at 23 °C	>51	N/mm^2	EN ISO 527-1
Tensile e-modulus at 23 °C	>1800	N/mm^2	EN ISO 527-1
Charpy notched impact strength at 23 °C	> 9	kJ/m^2	EN ISO 179-1/1eA
Charpy notched impact strength at 0 °C	> 8	kJ/m^2	EN ISO 179-1/1eA
Ball indentation hardness (358N)	>115	MPa	EN ISO 2039-1
Heat distortion temperature HDT A 1.80 MPa	>113	°C	EN ISO 75-2
Crystallite melting point	173	°C	DIN 51007
Thermal expansion coefficient	0.12 ... 0.18	mm/mk	DIN 53752
Heat conductivity at 23 °C	0.19	W/mk	EN 12664
Water absorption at 23 °C/24h	under 0.04	%	EN ISO 62
Colour	opaque	-	-
Limiting oxygen index (LOI)	44	%	ISO 4589 - 1

General

Polyvinylidenfluoride (PVDF) is a semi-crystalline thermoplastic having outstanding mechanical, physical and chemical properties. These result from the chemical structure of PVDF. Polyvinylidenfluoride belongs to the class of fluorinated polymers, whose best-known representative is polytetrafluoroethylene (PTFE, trade name: Teflon). PTFE is characterised by a superb heat resistance and the best chemical resistance of all polymers; a great disadvantage is that it is not melt processable - e.g. into fittings. PVDF, on the other hand, combines various advantages of PTFE with good workability into structural parts. The fluorine content in PVDF amounts to 59% by weight.

PVDF from HYDROSEAL is characterised by a very good mechanical behaviour and high temperature resistance. Because of the exceptionally wide pressure / temperature range in which PVDF can be used, it has opened, in connection with the specific characteristics of this material, completely new areas of application in plastic piping fabrication. These include applications in the semi-conductor, chemical and pharmaceutical industry, electroplating, paper and cellulose processing, the automotive industry and water treatment. Pipes, fittings and valves of PVDF are uncoloured and opaque (milky, translucent). By avoiding the addition of any additives, the outstanding characteristics of the material remain to the fullest extent, especially concerning the chemical resistance and physiological harmlessness.

Some of the advantages of PVDF:

- outstanding mechanical properties, even at high temperatures
- excellent chemical resistance
- no electrochemical corrosion long service life, even under intensely corrosive conditions
- outstanding resistance against UV and γ-radiation
- very pure material by implementing without additives
- no support of microbial growth
- physiologically harmless
- secure jointing by high-quality welding technology
- smooth inner surface
- very low heat conductivity
- excellent flame retardant properties

Mechanical properties

PVDF has a high tensile strength and stiffness. The impact strength is still good at temperatures around 0°C. PVDF's advantages are particularly prevalent at higher temperatures. This is due to the high fluorine content which causes strong interactions between the PVDF chains. This, in turn, displaces the softening and the loss of properties to higher temperatures. This also has an effect on the long-term creep strength.

PVDF has the highest long-term creep strength of all the polymers used for HYDROSEAL piping systems. The long-term behaviour for internal pressure resistance is provided by the hydrostatic strength curve based on the DVS 2205-1 Guidelines, Supplement 4.

Chemical and weathering resistance

PVDF is resistant to most inorganic solvents and additionally to aliphatic and aromatic hydrocarbons, organic acids, alcohol and halogenated solvents. PVDF is also not attacked by dry and moist halogens with the exception of fluorine. PVDF is not resistant against strong basic amines, alkalis, and alkaline metals. Strong polar solvents, such as ketones and esters and organic acids can cause PVDF to swell somewhat.

For detailed information, please refer to the detailed list of chemical resistance from HYDROSEAL or contact your HYDROSEAL subsidiary.

Materials used for industrial pipe work

The Material Polyvinylidenefluoride (PVDF)

Outstanding resistance against UV light as well as gamma radiation permits, among other applications, the use of PVDF piping outdoors. No loss of properties occurs. Abrasion resistance is considerable and approximately comparable to that of polyamide.

Thermal properties

PVDF shows its outstanding properties in a temperature range from -20°C to +140 ºC. This allows using the material in a wide range of applications. Especially at high temperatures, PVDF provides maximum security. Its high crystalline melting point at around 173°C speaks for itself.

Please consult the pressure-temperature diagrams for your operational temperature. For temperatures below 0°C, the media must be prevented from freezing to avoid damaging the piping (as for other piping materials).

The thermal expansion coefficient of PVDF of 0.12 to 0.18 mm/mK lies clearly above that of metals. Because of this, its thermal expansion must be taken into account during the planning of the piping system. As for all polymers, PVDF is a good thermal insulator because its heat conductivity of 0.19 W/m K is very low. (For comparison, the value for steel is 250 W/mK).

Combustion behaviour

PVDF displays an exceptionally good combustion behaviour without the addition of fire protection additives. Material decomposition begins at 380°C.

The oxygen index amounts to 44%. (Materials that burn with less than 21% of oxygen in the air are considered to be flammable). PVDF thus also falls in the best flammability class V0 according to UL94, and in the building materials class B1 (difficult to ignite) according to DIN 4102-1. Smoke development is also moderate. HYDROSEAL PVDF products show such excellent fire safety behaviour that they are accepted and listed by Factory Mutual for use in clean rooms (FM 4910).

Since the combustion of PVDF produces hydrogen fluoride, which forms a corrosive acid in connection with water, immediate cleaning of areas susceptible to corrosion with water containing detergent is necessary after a fire. Additional combustion products are carbon monoxide and carbon dioxide. Concerning the choice of firefighting agents, sand or powder-type extinguishing agents are recommended because the use of water may result in the development of corrosive acids.

Electrical properties

PVDF is a good electrical insulator. Because of the possible electrostatic charges, caution is recommended when using PVDF in applications where combustion or explosion dangers exist.

The specific volume resistance is $>10^{14}\Omega$cm; the specific surface resistance is $10^{14}\Omega$.

Physiological properties

PVDF is physiologically non-toxic as long as it is used below the maximum temperature of 150°C. During welding, good ventilation is required or alternately the released gases must be extracted.

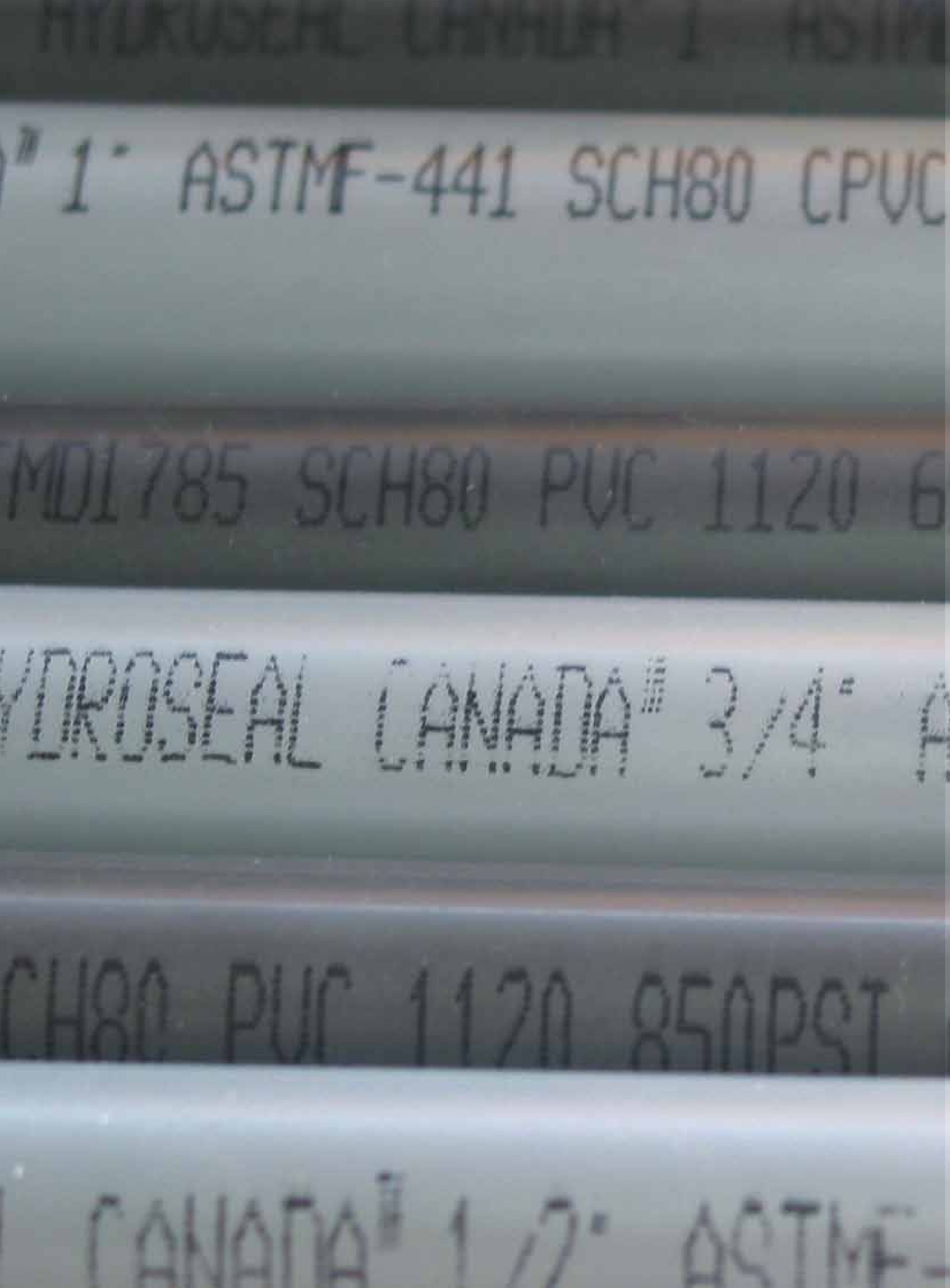
PVDF can be used in the USA in accordance with the relevant regulations of the Food and Drug Administration(FDA) for food packaging and items that come into contact with food.

High purity properties

Due to the excellent stability of the PVDF molecule, it is one of the very few materials that can be processed, welded and used under severe conditions without the use of additives (no pigments, thermostabilisers, processing aids or fillers are used in the HYDROSEAL piping grades). This makes it the material of choice for applications that demand a very high purity of the medium and have stringent requirements stipulating that the materials which come in contact with the medium do not leach contaminants.

The PVDF raw materials used by HYDROSEAL fulfill the most rigid requirements of the semiconductor and pharmaceutical industry regarding high purity. In addition, products made of PVDF exhibit a very smooth surface.

Leach out tests according to SEMI57 are done regularly for quality control.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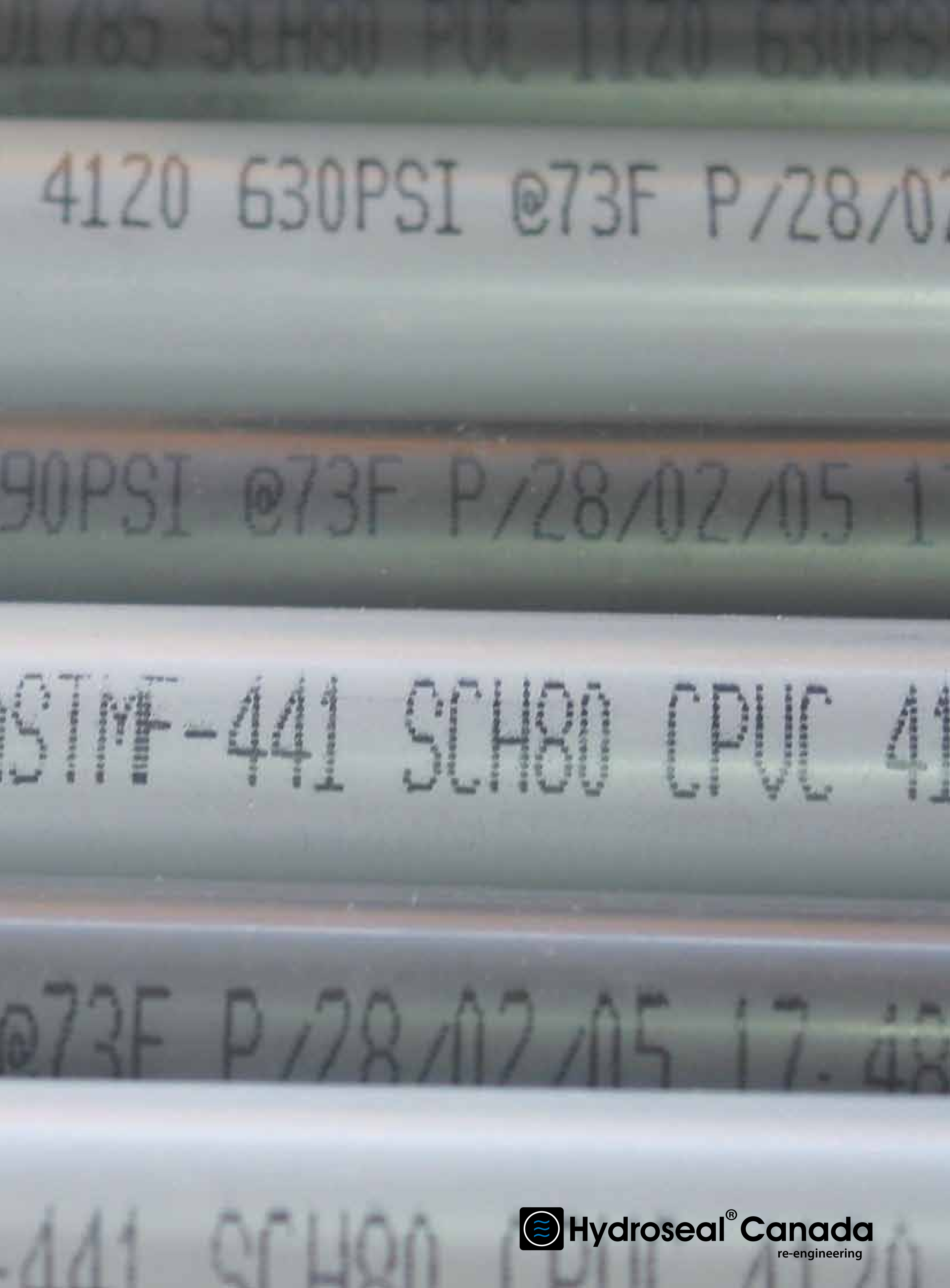
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Hydroseal® Canada
re-engineering


ASTM F-441 SCH80 CPVC 4120 630PSI @73F
HYDROSEAL CANADA 3/4" ASTM F-441 SCH80 CPVC

PVC AND CPVC PIPES

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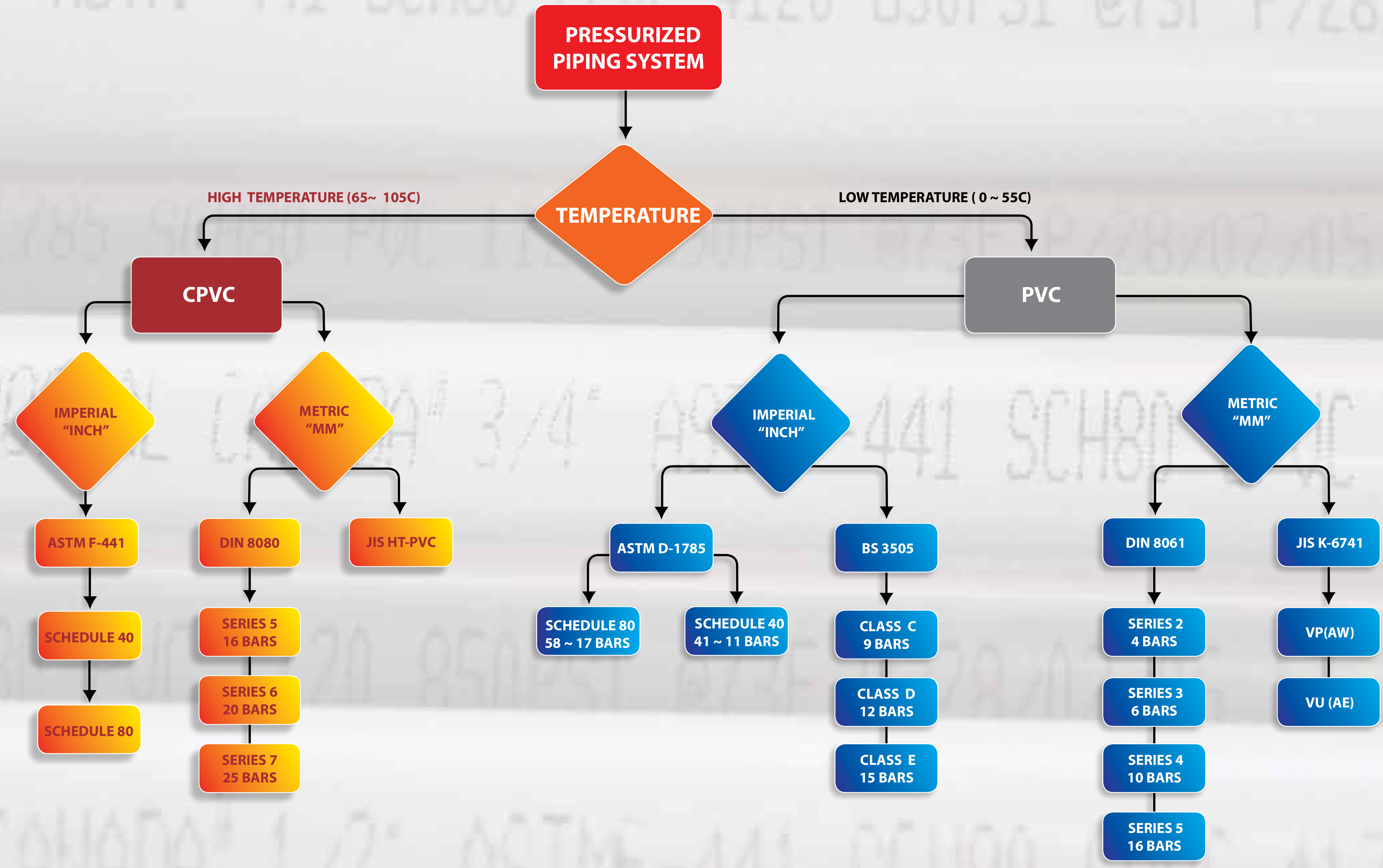
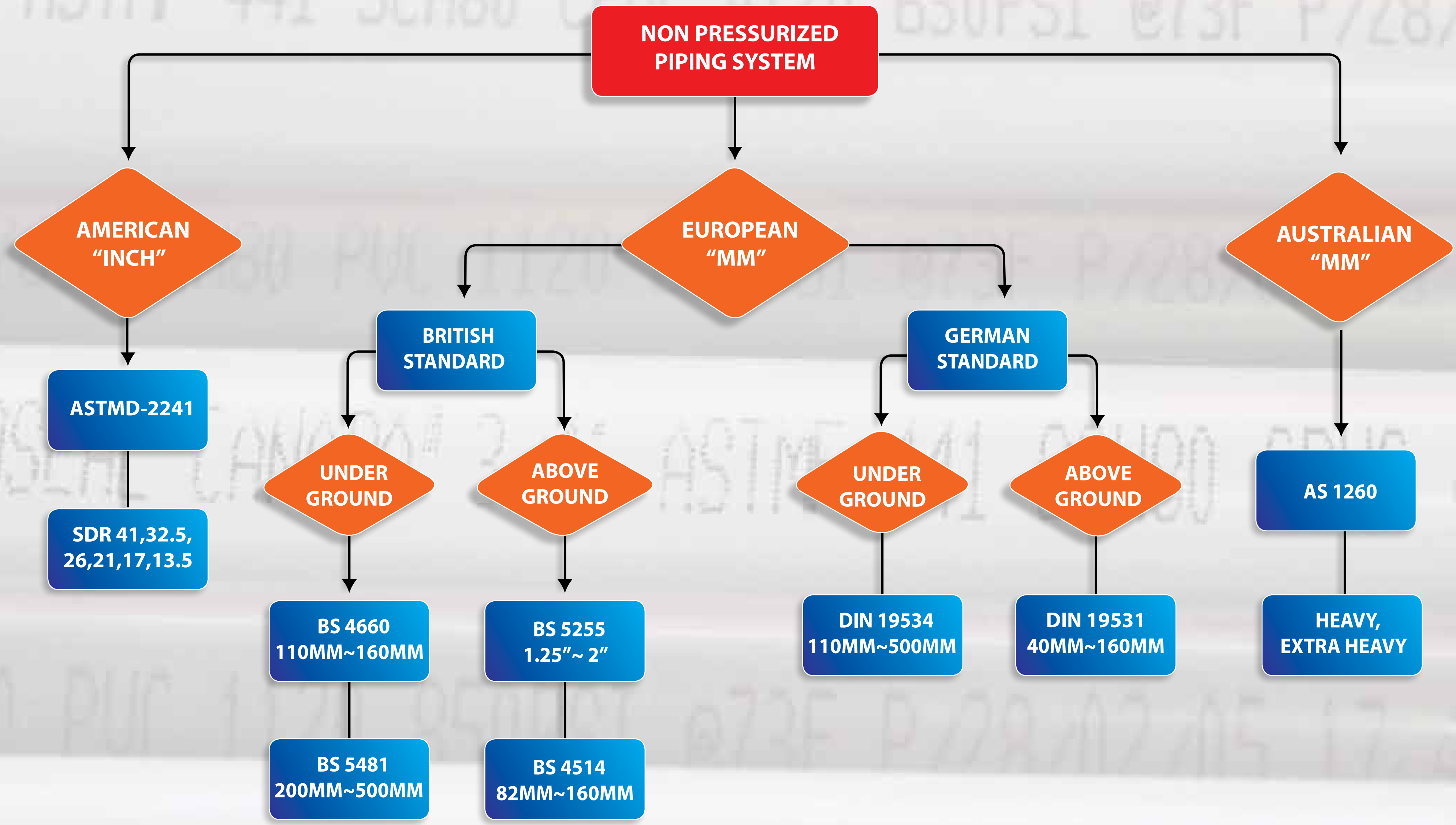
PVC AND CPVC PRESSURE PIPES
Selection Chart



PVC SEWEAGE PIPES
Selection Chart



PVC AND CPVC PIPES
Manufacturer's Product Specification

SECTION 2

Scope
This specification sheet covers the manufacturer's requirements for PVC and CPVC pipes in accordance with respective international standards. These pipes meet or exceed the standards set by the American Society for Testing and Materials, the National Sanitation Foundation, British Standards Institute, German Industrial Norms and Japanese Industrial Standards.

PVC and CPVC Materials
Rigid PVC (polyvinyl chloride) and CPVC (chlorinated polyvinyl chloride) used in the manufacture of pipes is Type I, Grade 1 PVC compound, and Type IV, Grade 1 CPVC compound as stated in ASTM D-1784. Raw material used in extrusion shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions and Wall Thicknesses
Physical dimensions, wall thickness and tolerances of PVC and CPVC pipes meet the requirements of ASTM, DIN and BS specifications for pipes.

Marking
PVC and CPVC pipes are marked as prescribed in ASTM D-1784 to indicate the manufacturer's name or trademark, size of pipe, material designation, batch number and month of production. There must be clear distinguishing on those products that are PVC and those products that are CPVC. Where there is no restriction of space, wall thicknesses shall also be indicated.

Outside Dimensions

MEAN OUTSIDE DIAMETER COMPARISONS (MM)				
SIZE	ASTM D-1784	BS 3505	DIN 8061	JIS K-6741
1/2	21.34	21.34	20.00	21.34
3/4	26.67	26.67	25.00	26.67
1	33.40	33.40	32.00	32.00
1 1/4	42.16	42.16	40.00	38.00
1 1/2	48.26	48.26	50.00	48.26
2	60.33	60.33	63.00	60.33
2 1/2	73.03	75.00	75.00	76.00
3	88.90	88.90	90.00	88.90
4	114.30	114.30	110.00	114.30
5	141.30	140.00	140.00	140.00
6	168.28	168.28	160.00	165.00
8	219.08	219.08	200.00	216.00

Figures in orange typeface indicate matching Outer Dimensions

Wall Thicknesses

MEAN WALL THICKNESS COMPARISONS (MM)				
SIZE	ASTM D-1784 SCH 80	BS 3505 CLASS E	DIN 8061 SR5"PN16"	JIS K-6741 VP (AW)
1/2	3.73	1.70	1.50	2.70
3/4	3.91	1.90	1.90	2.70
1	4.54	2.20	2.40	3.10
1 1/4	4.85	2.70	3.00	3.10
1 1/2	5.08	3.10	3.70	3.60
2	5.54	3.90	4.70	4.10
2 1/2	7.01	4.80	5.60	4.10
3	7.62	5.70	6.70	5.50
4	8.56	7.30	8.20	6.60
5	9.53	9.00	10.40	8.90
6	10.97	10.80	11.90	8.90
8	12.70	12.60	14.90	10.30

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC PIPE PHYSICAL PROPERTIES		
GENERAL	**VALUE**	**TEST METHOD**
Cell Classification	12454	ASTM D1784
Maximum Service Temp.	140°F	
Color	White, Dark Gray	
Specific Gravity, (g/cu.cm @ 73°F)	1.40 +/-.02	ASTM D792
Water Absorption % increase 24 hrs @ 25°C	0.05	ASTM D570
Hardness, Rockwell	110 - 120	ASTM D785
Poisson's Ratio @ 73°F	0.410	
Hazen-Williams Factor	C =150	
MECHANICAL		
Tensile Strength, psi @ 73°F	7,450	ASTM D638
Tensile Modulus of Elasticity, psi @ 73°F	420,000	ASTM D638
Flexural Strength, psi @ 73°F	14,450	ASTM D790
Flexural Modulus, psi @ 73°F	360,000	ASTM D790
Compressive Strength, psi @ 73°F	9,600	ASTM D695
Izod Impact, notched, ft-lb/in @ 73°F	0.75	ASTM D256
THERMAL		
Coefficient of Linear Expansion (in/in/°F)	2.9×10^{-5}	ASTM D696
Coefficient of Thermal Conductivity (Cal.)(cm)/(cm2)(Sec.)(°C) BTU/in/hr/ft.2/°F Watt/m/°K	3.5×10^{-4} 1.02 0.147	ASTM C177
Heat Deflection Temperature Under Load (264 psi, annealed)	170	ASTM D648
Specific Heat, Cal./°C/gm	0.25	ASTM D2766
ELECTRICAL		
Dielectric Strength, volts/mil	1,413	ASTM D149
Dielectric Constant, 60Hz, 30°F	3.70	ASTM D150
Volume Resistivity, ohm/cm @ 95°C	1.2×10^{12}	ASTM D257
Harvel PVC Pipe is non-electrolytic		
FIRE PERFORMANCE		
Flammability Rating	V-0	UL-94
Flame Spread Index	<10	
Flame Spread	0-25	ULC
Smoke Generation	80-225	ULC
Flash Ignition Temp.	730°F	
Average Time of Burning (sec.)	<5	ASTM D635
Average Extent of Burning (mm)	<10	
Burning Rate (in/min)	Self Extinguishing	
Softening Starts (approx.)	250°F	
Material Becomes Viscous	350°F	
Material Carbonizes	425°F	
Limiting Oxygen Index (LOI)	43	ASTM D2863
Clean Room Materials Flammability Test	N/A	FM 4910

Note: The physical properties shown are considered general PVC physical properties. HYDROSEAL utilizes several PVC compounds for the production of different PVC product lines. PVC compounds may exhibit slight variations in actual physical properties as compared to those stated. Contact your HYDROSEAL representative for additional information if necessary.

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC AND CPVC PIPES

Physical properties CPVC

CPVC PIPE PHYSICAL PROPERTIES		
GENERAL	**VALUE**	**TEST METHOD**
Cell Classification	23447	ASTM D1784
Maximum Service Temp.	200°F	
Color	Medium Gray	
Specific Gravity, (g/cu.cm @ 73°F)	1.52 $^{\pm 0.02}$	ASTM D792
Water Absorption % increase 24 hrs @ 25°C	0.03	ASTM D570
Hardness, Rockwell	117	ASTM D785
Poisson's Ratio @ 73°F	0.386	
Hazen-Williams Factor	C =150	
MECHANICAL		
Tensile Strength, psi @ 73°F	7,750	ASTM D638
Tensile Modulus of Elasticity, psi @ 73°F	360,000	ASTM D638
Flexural Strength, psi @ 73°F	13,000	ASTM D790
Flexural Modulus, psi @ 73°F	360,000	ASTM D790
Compressive Strength, psi @ 73°F	10,000	ASTM D695
Compressive Modulus, psi @ 73°F	196,000	ASTM D695
Izod Impact, notched, ft-lb/in @ 73°F	2.0	ASTM D256
THERMAL		
Coefficient of Linear Expansion (in/in/°F)	3.7×10^{-5}	ASTM D696
Coefficient of Thermal Conductivity (Cal.)(cm)/(cm2)(Sec.)(°C) BTU/in/hr/ft.2/°F Watt/m/°K	 3.27×10^{-4} .95 0.137	ASTM C177
Heat Deflection Temperature Under Load (264psi, Annealed)	226°F	ASTM D648
ELECTRICAL		
Dielectric Strength, volts/mil	1,250	ASTM D149
Dielectric Constant, 60Hz, 30°F	3.70	ASTM D150
Volume Resistivity, ohm/cm @ 73°F	3.4×10^{15}	ASTM D257
Power Factor, 1000Hz	0.007%	ASTM D150
Harvel CPVC Pipe is non-electrolytic		
FIRE PERFORMANCE		
Flammability Rating	V-0, 5VB, 5VA	UL-94
Flame Spread Index	<10	
Flame Spread	<25	ASTM E-84/UL 723
	<25	ULC
Smoke Generation	≤50	ASTM E-84/UL 723
	<50	ULC
Flash Ignition Temp.	900°F	
Average Time of Burning (sec.)	<5	ASTM D635
Average Extent of Burning (mm)	<10	
Burning Rate (in/min)	Self Extinguishing	
Softening Starts (approx.)	295°F	
Material Becomes Viscous	395°F	
Material Carbonizes	450°F	
Limiting Oxygen Index (LOI)	60	ASTM D2863
Clean Room Materials Flammability Test	FPI= 1.20 SDI= 0.09	FM 4910

Note: The physical properties shown are considered general CPVC physical properties. HYDROSEAL utilizes several CPVC compounds for the production of different CPVC product lines. CPVC compounds may exhibit slight variations in actual physical properties as compared to those stated. Contact your HYDROSEAL representative for additional information if necessary.

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC AND CPVC PRESSURE PIPES
ASTM D-1785 and F-441 Schedule 40

PVC ASTM D1785 SCHEDULE 40

PART	NOMINAL SIZE	OUTSIDE DIAMETER		PVC SCHEDULE 40			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @73F	LB/FT
10000	1/8	0.41	10.41	0.068	1.73	810	0.05
10001	1/4	0.54	13.72	0.088	2.24	780	0.09
10002	3/8	0.68	17.15	0.115	2.92	620	0.12
10003	1/2	0.84	21.34	0.109	2.77	600	0.17
10004	3/4	1.05	26.67	0.113	2.87	480	0.23
10005	1	1.32	33.40	0.133	3.38	450	0.33
10006	1 1/4	1.66	42.16	0.140	3.56	370	0.45
10007	1 1/2	1.90	48.26	0.145	3.68	330	0.54
10008	2	2.38	60.33	0.154	3.91	280	0.72
10009	2 1/2	2.88	73.03	0.203	5.16	300	1.14
10010	3	3.50	88.90	0.216	5.49	260	1.49
10011	4	4.50	114.30	0.237	6.02	220	2.12
10012	5	5.56	141.30	0.258	6.55	190	2.87
10013	6	6.63	168.28	0.280	7.11	180	3.73
10014	8	8.63	219.08	0.322	8.18	160	5.62
10015	10	10.75	273.05	0.365	9.27	140	7.97
10016	12	12.75	323.85	0.406	10.31	130	10.53
10017	14	14.00	355.60	0.438	11.13	130	12.46
10018	16	16.00	406.40	0.500	12.70	130	16.29
10019	18	18.00	457.20	0.562	14.27	130	20.59
10020	20	20.00	508.00	0.593	15.06	120	24.18
10021	24	24.00	609.60	0.687	17.45	120	33.65

DERATING FACTOR

PVC	
TEMP (F)	FACTOR
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

CPVC ASTM F441 SCHEDULE 40

PART	NOMINAL SIZE	OUTSIDE DIAMETER		CPVC SCHEDULE 40			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @180F	LB/FT
11001	1/4	0.54	13.72	0.088	2.24	195	0.10
11002	3/8	0.68	17.15	0.115	2.92	155	0.13
11003	1/2	0.84	21.34	0.109	2.77	150	0.19
11004	3/4	1.05	26.67	0.113	2.87	120	0.25
11005	1	1.32	33.40	0.133	3.38	113	0.37
11006	1 1/4	1.66	42.16	0.140	3.56	93	0.50
11007	1 1/2	1.90	48.26	0.145	3.68	83	0.60
11008	2	2.38	60.33	0.154	3.91	70	0.80
11009	2 1/2	2.88	73.03	0.203	5.16	75	1.27
11010	3	3.50	88.90	0.216	5.49	65	1.66
11011	4	4.50	114.30	0.237	6.02	55	2.36
11013	6	6.63	168.28	0.280	7.11	45	4.16
11014	8	8.63	219.08	0.322	8.18	40	6.27
11015	10	10.75	273.05	0.365	9.27	35	8.89
11016	12	12.75	323.85	0.406	10.31	33	11.75
11017	14	14.00	355.60	0.438	11.13	33	13.92
11018	16	16.00	406.40	0.500	12.70	33	18.17
11019	18	18.00	457.20	0.562	14.27	33	22.97
11020	20	20.00	508.00	0.593	15.06	30	29.98
11021	24	24.00	609.60	0.687	17.45	30	37.54

DERATING FACTOR

CPVC	
TEMP (F)	FACTOR
73	1.00
80	1.00
90	0.91
100	0.82
110	0.72
120	0.65
130	0.57
140	0.50
150	0.42
160	0.40
170	0.29
180	0.25
200	0.20

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC AND CPVC PRESSURE PIPES
ASTM D-1785 and F-441 Schedule 80

PVC ASTM D1785 SCHEDULE 80

PART	NOMINAL SIZE	OUTSIDE DIAMETER		PVC SCHEDULE 80			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @73F	LB/FT
10022	1/8	0.41	10.41	0.095	2.41	1230	0.06
10023	1/4	0.54	13.72	0.119	3.02	1130	0.10
10024	3/8	0.68	17.15	0.126	3.20	920	0.14
10025	1/2	0.84	21.34	0.147	3.73	850	0.21
10026	3/4	1.05	26.67	0.154	3.91	690	0.28
10027	1	1.32	33.40	0.179	4.55	630	0.41
10028	1 1/4	1.66	42.16	0.191	4.85	520	0.57
10029	1 1/2	1.90	48.26	0.200	5.08	470	0.69
10030	2	2.38	60.33	0.218	5.54	400	0.96
10031	2 1/2	2.88	73.03	0.276	7.01	420	1.46
10032	3	3.50	88.90	0.300	7.62	370	1.95
10033	4	4.50	114.30	0.337	8.56	320	2.84
10034	5	5.56	141.30	0.375	9.53	290	3.95
10035	6	6.63	168.28	0.432	10.97	280	5.43
10036	8	8.63	219.08	0.500	12.70	250	8.25
10037	10	10.75	273.05	0.593	15.06	230	12.24
10038	12	12.75	323.85	0.687	17.45	230	16.83
10039	14	14.00	355.60	0.750	19.05	220	19.96
10040	16	16.00	406.40	0.843	21.41	220	26.55
10041	18	18.00	457.20	0.937	23.80	220	33.54
10042	20	20.00	508.00	1.031	26.19	220	41.05
10043	24	24.00	609.60	1.218	30.94	210	58.23

DERATING FACTOR

PVC	
TEMP (F)	FACTOR
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

CPVC ASTM F441 SCHEDULE 80

PART	NOMINAL SIZE	OUTSIDE DIAMETER		PVC SCHEDULE 80			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @180F	LB/FT
11023	1/4	0.54	13.72	0.119	3.02	283	0.12
11024	3/8	0.68	17.15	0.126	3.20	230	0.16
11025	1/2	0.84	21.34	0.147	3.73	213	0.24
11026	3/4	1.05	26.67	0.154	3.91	173	0.32
11027	1	1.32	33.40	0.179	4.55	158	0.47
11028	1 1/4	1.66	42.16	0.191	4.85	130	0.65
11029	1 1/2	1.90	48.26	0.200	5.08	118	0.79
11030	2	2.38	60.33	0.218	5.54	100	1.10
11031	2 1/2	2.88	73.03	0.276	7.01	105	1.67
11032	3	3.50	88.90	0.300	7.62	93	2.24
11033	4	4.50	114.30	0.337	8.56	80	3.28
11035	6	6.63	168.28	0.432	10.97	70	6.26
11036	8	8.63	219.08	0.500	12.70	63	9.51
11037	10	10.75	273.05	0.593	15.06	58	14.10
11038	12	12.75	323.85	0.687	17.45	58	19.39
11039	14	14.00	355.60	0.750	19.05	55	23.26
11040	16	16.00	406.40	0.843	21.41	55	29.89
11041	18	18.00	457.20	0.937	23.80	55	37.42
11042	20	20.00	508.00	1.031	26.19	55	45.88
11043	24	24.00	609.60	1.218	30.94	53	64.96

DERATING FACTOR

CPVC	
TEMP (F)	FACTOR
73	1.00
80	1.00
90	0.91
100	0.82
110	0.72
120	0.65
130	0.57
140	0.50
150	0.42
160	0.40
170	0.29
180	0.25
200	0.20

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC AND CPVC PRESSURE PIPES
ASTM D-1785 and F-441 Schedule 120

PVC ASTM D1785 SCHEDULE 120

PART	NOMINAL SIZE	OUTSIDE DIAMETER		PVC SCHEDULE 120			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @73F	LB/FT
10557	1/2	0.84	21.34	0.170	4.32	1010	0.24
10558	3/4	1.05	26.67	0.170	4.32	770	0.31
10559	1	1.32	33.40	0.200	5.08	720	0.46
10560	1 1/4	1.66	42.16	0.215	5.46	600	0.65
10561	1 1/2	1.90	48.26	0.225	5.72	540	0.79
10562	2	2.38	60.33	0.250	6.35	470	1.11
10563	2 1/2	2.88	73.03	0.300	7.62	470	1.62
10564	3	3.50	88.90	0.350	8.89	440	2.31
10565	4	4.50	114.30	0.437	11.10	430	3.71
10566	6	6.63	168.28	0.562	14.27	370	7.13
10567	8	8.63	219.08	0.718	18.24	380	11.28

DERATING FACTOR

PVC	
TEMP (F)	FACTOR
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

CPVC ASTM F441 SCHEDULE 120

PART	NOMINAL SIZE	OUTSIDE DIAMETER		PVC SCHEDULE 120			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @180F	LB/FT
11557	1/2	0.84	21.34	0.170	4.32	253	0.25
11558	3/4	1.05	26.67	0.170	4.32	193	0.34
11559	1	1.32	33.40	0.200	5.08	180	0.50
11560	1 1/4	1.66	42.16	0.215	5.46	150	0.70
11561	1 1/2	1.90	48.26	0.225	5.72	135	0.85
11562	2	2.38	60.33	0.250	6.35	118	1.20
11563	2 1/2	2.88	73.03	0.300	7.62	118	1.74
11564	3	3.50	88.90	0.350	8.89	110	2.49
11565	4	4.50	114.30	0.437	11.10	108	4.01
11566	6	6.63	168.28	0.562	14.27	93	7.70
11567	8	8.63	219.08	0.718	18.24	95	12.18

DERATING FACTOR

CPVC	
TEMP (F)	FACTOR
80	1.00
90	0.91
100	0.82
110	0.72
120	0.65
130	0.57
140	0.50
150	0.42
160	0.40
170	0.29
180	0.25
200	0.20

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC ASTM D-2241 SDR Series

NOMINAL SIZE	OUTSIDE DIAMETER		PVC SDR 41				PVC SDR 26			
			PART	WALL THICKNESS		WEIGHT	PART	WALL THICKtNESS		WEIGHT
IN	IN	MM		IN	MM	LB/FT		IN	MM	LB/FT
1	1.32	33.40	10045	0.032	0.81	0.09	10085	0.060	1.52	0.17
1 1/4	1.66	42.16	10046	0.040	1.03	0.15	10086	0.064	1.63	0.23
1 1/2	1.90	48.26	10047	0.046	1.18	0.19	10087	0.073	1.85	0.30
2	2.38	60.33	10048	0.058	1.47	0.29	10088	0.091	2.31	0.46
2 1/2	2.88	73.03	10049	0.070	1.78	0.42	10089	0.110	2.79	0.66
3	3.50	88.90	10050	0.085	2.17	0.61	10090	0.135	3.43	0.97
4	4.50	114.30	10051	0.110	2.79	1.00	10091	0.173	4.39	1.57
5	5.56	141.30	10052	0.136	3.45	1.53	10092	0.214	5.44	2.41
6	6.63	168.28	10053	0.162	4.10	2.16	10093	0.255	6.48	3.41
8	8.63	219.08	10054	0.210	5.34	3.66	10094	0.332	8.43	5.78
10	10.75	273.05	10055	0.262	6.66	5.70	10095	0.413	10.49	8.97
12	12.75	323.85	10056	0.311	7.90	8.01	10096	0.490	12.45	12.62
14	14.00	355.60	10057	0.341	8.67	9.65	10097	0.538	13.67	15.21
16	16.00	406.40	10058	0.390	9.91	12.61	10098	0.615	15.62	19.88
18	18.00	457.20	10059	0.439	11.15	15.96	10099	0.692	17.58	25.16
20	20.00	508.00	10060	0.488	12.39	19.70	10100	0.769	19.53	31.06
24	24.00	609.60	10061	0.585	14.87	31.82	10101	0.823	20.90	44.74

NOMINAL SIZE	OUTSIDE DIAMETER		PVC SDR 21			
			PART	WALL THICKNESS		WEIGHT
IN	IN	MM		IN	MM	LB/FT
1	1.32	33.40	10105	0.063	1.60	0.18
1 1/4	1.66	42.16	10106	0.079	2.01	0.28
1 1/2	1.90	48.26	10107	0.090	2.29	0.36
2	2.38	60.33	10108	0.113	2.87	0.55
2 1/2	2.88	73.03	10109	0.137	3.48	0.80
3	3.50	88.90	10110	0.167	4.24	1.17
4	4.50	114.30	10111	0.214	5.44	1.93
5	5.56	141.30	10112	0.265	6.73	2.95
6	6.63	168.28	10113	0.316	8.03	4.19
8	8.63	219.08	10114	0.410	10.41	7.07
10	10.75	273.05	10115	0.512	13.00	11.12
12	12.75	323.85	10116	0.607	15.42	15.64
14	14.00	355.60	10117	0.667	16.93	18.84
16	16.00	406.40	10118	0.762	19.35	24.63
18	18.00	457.20	10119	0.857	21.77	31.16
20	20.00	508.00	10120	0.952	24.19	38.46
24	24.00	609.60	10121	1.143	29.03	62.13

DERATING FACTOR

PVC	
TEMP (F)	FACTOR
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC PRESSURE PIPES
BS 3505/3506 and DIN 8061/8062 and JIS K-6741

PVC BS 3505/3506

NOMINAL SIZE	O.D.	CLASS E				CLASS D				CLASS C			
		PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT
IN	MM		MM	BARS	KG/MT		MM	BARS	KG/MT		MM	BARS	KG/MT
1/2	21.34	10223	1.70	15	0.14	N/A	-	-	-	N/A	-	-	-
3/4	26.67	10224	1.90	15	0.20	N/A	-	-	-	N/A	-	-	-
1	33.40	10225	2.20	15	0.30	N/A	-	-	-	N/A	-	-	-
1 1/4	42.16	10226	2.70	15	0.48	10206	2.20	12	0.39	N/A	-	-	-
1 1/2	48.26	10227	3.10	15	0.64	10207	2.50	12	0.51	N/A	-	-	-
2	60.33	10228	3.90	15	1.02	10208	3.10	12	0.81	10188	2.50	9	0.65
2 1/2	75.00	10229	4.80	15	1.51	10209	3.90	12	1.23	10189	3.00	9	0.95
3	88.90	10230	5.70	15	2.20	10210	4.60	12	1.78	10190	3.50	9	1.35
4	114.30	10231	7.30	15	3.63	10211	6.00	12	2.99	10191	4.50	9	2.24
6	168.28	10233	10.80	15	8.03	10213	8.80	12	6.54	10193	6.60	9	4.91
8	219.08	10234	12.60	15	11.59	10214	10.30	12	9.48	10194	7.80	9	7.18

PVC DIN 8061/8062

NOMINAL SIZE	O.D.	SERIES 6 PN20				SERIES 5 PN16				SERIES 4 PN10			
		PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT
MM	MM		MM	BARS	KG/MT		MM	BARS	KG/MT		MM	BARS	KG/MT
DN15	20.00	10479	1.90	20	0.14	10453	1.50	1	0.11	N/A	-	-	-
DN20	25.00	10480	2.30	20	0.23	10454	1.90	1	0.19	10428	1.50	1	0.15
DN25	32.00	10481	3.00	20	0.39	10455	2.40	2	0.31	10429	1.60	1	0.21
DN32	40.00	10482	3.70	20	0.62	10456	3.00	3	0.50	10430	1.90	2	0.32
DN40	50.00	10483	4.60	20	0.98	10457	3.70	5	0.79	10431	2.40	3	0.51
DN50	63.00	10484	5.80	20	1.58	10458	4.70	7	1.28	10432	3.00	5	0.82
DN65	75.00	10485	6.90	20	2.18	10459	5.60	10	1.77	10433	3.60	7	1.14
DN80	90.00	10486	8.20	20	3.20	10460	6.70	15	2.62	10434	4.30	10	1.68
DN100	110.00	10487	10.00	20	4.79	10461	8.20	23	3.93	10435	5.30	15	2.54
DN150	160.00	10490	14.50	20	10.25	10464	11.90	49	8.41	10438	7.70	32	5.44
DN200	200.00	10492	18.20	20	15.29	10466	14.90	73	12.51	10440	9.60	47	8.06

PVC JIS K-6741

NOMINAL SIZE	O.D.	VP (AW)				VU (AE)			
		PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT
IN	MM		MM	BARS	KG/MT		MM	BARS	KG/MT
1/2	22.00	10333	2.70	25	0.26	10318	1.80	15	0.17
3/4	26.00	10334	2.70	25	0.31	10319	1.80	15	0.21
1	32.00	10335	3.10	25	0.46	10320	1.80	15	0.26
1 1/4	38.00	10336	3.10	25	0.69	10321	1.80	15	0.40
1 1/2	48.00	10337	3.60	25	0.80	10322	1.80	15	0.40
2	60.00	10338	4.10	25	1.13	10323	1.80	15	0.49
2 1/2	76.00	10339	4.10	25	1.46	10324	2.20	15	0.78
3	89.00	10340	5.50	25	2.20	10325	2.70	15	1.08
4	114.00	10341	6.60	25	3.42	10326	3.10	15	1.61
6	165.00	10342	8.90	25	6.71	10327	5.10	15	3.84
8	216.00	10343	10.30	25	10.13	10328	6.50	15	6.39

DERATING FACTOR

PVC	
TEMP (C)	FACTOR
23	1.00
27	0.88
32	0.75
38	0.62
43	0.51
49	0.40
54	0.31
60	0.22

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC PRESSURE PIPES
DIN 8079/8080 and D2846 CTS Series

CPVC DIN 8079/8080

NOMINAL SIZE	O.D.	SERIES 7 PN25				SERIES 6 PN20				SERIES 5 PN16			
		PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT	PART	WALL THICKNESS	WORKING PRESSURE	WEIGHT
MM	MM		MM	BARS	KG/MT		MM	BARS	KG/MT		MM	BARS	KG/MT
DN15	20.00	11505	2.30	25	0.17	11479	1.90	20	0.14	11453	1.50	16	0.109
DN20	25.00	11506	2.80	25	0.27	11480	2.30	20	0.22	11454	1.90	16	0.18
DN25	32.00	11507	3.60	25	0.45	11481	3.00	20	0.38	11455	2.40	16	0.30
DN32	40.00	11508	4.50	25	0.72	11482	3.70	20	0.59	11456	3.00	16	0.48
DN40	50.00	11509	5.60	25	1.13	11483	4.60	20	0.93	11457	3.70	16	0.75
DN50	63.00	11510	7.00	25	1.83	11484	5.80	20	1.51	11458	4.70	16	1.23
DN65	75.00	11511	8.40	25	2.52	11485	6.90	20	2.07	11459	5.60	16	1.68
DN80	90.00	11512	10.00	25	3.71	11486	8.20	20	3.04	11460	6.70	16	2.49
DN100	110.00	11513	12.30	25	5.55	11487	10.00	20	4.51	11461	8.20	16	3.70

CPVC ASTM D2846 CTS Series

PART	NOMINAL SIZE	OUTSIDE DIAMETER		CPVC CTS SERIES (SDR11)			
				WALL THICKNESS		WORKING PRESSURE	WEIGHT
	IN	IN	MM	IN	MM	PSI @180F	LB/FT
11123	1/2	0.63	15.88	0.068	1.73	100	0.08
11124	3/4	0.88	22.23	0.080	2.03	100	0.13
11125	1	1.13	28.58	0.102	2.59	100	0.22
11126	1 1/4	1.38	34.93	0.125	3.18	100	0.34
11127	1 1/2	1.63	41.28	0.148	3.76	100	0.48
11128	2	2.13	53.98	0.193	4.90	100	0.83

DERATING FACTOR

CPVC										
TEMPERATURE (F)	73	90	100	110	120	150	160	170	180	200
FACTOR	1.00	0.91	0.82	0.72	0.65	0.42	0.40	0.29	0.25	0.20

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC SEWERAGE PIPES
British Standard and DIN Series

SECTION 2

PVC BRITISH STANDARD

NOMINAL SIZE	O.D.	BS 5255			BS 4514			BS 4660			BS 5481		
		PART	WALL THICKNESS	WEIGHT	PART	WALL THICKNESS	WEIGHT	PART	WALL THICKNESS	WEIGHT	PART	WALL THICKNESS	WEIGHT
IN	MM		MM	KG/MT		MM	KG/MT		MM	KG/MT		MM	KG/MT
1 1/4	36.15	10301	1.80	0.14	N/A	-	-	N/A	-	-	N/A	-	-
1 1/2	42.75	10302	1.90	0.20	N/A	-	-	N/A	-	-	N/A	-	-
2	55.75	10303	2.00	0.30	N/A	-	-	N/A	-	-	N/A	-	-
3	82.40	N/A	-	-	10304	3.20	0.39	10307	3.20	-	N/A	-	-
4	110.00	N/A	-	-	10305	3.20	0.51	10308	3.20	-	N/A	-	-
6	160.00	N/A	-	-	10306	3.20	0.81	10309	4.10	0.65	N/A	-	-
8	200.00	N/A	-	-	N/A	-	-	N/A	-	-	10310	4.90	1.51
10	250.00	N/A	-	-	N/A	-	-	N/A	-	-	10311	6.10	2.20
12	315.00	N/A	-	-	N/A	-	-	N/A	-	-	10312	7.70	3.63
14	355.00	N/A	-	-	N/A	-	-	N/A	-	-	10313	8.70	-
16	400.00	N/A	-	-	N/A	-	-	N/A	-	-	10314	9.80	-
18	450.00	N/A	-	-	N/A	-	-	N/A	-	-	10315	11.00	8.03
20	500.00	N/A	-	-	N/A	-	-	N/A	-	-	10316	12.20	11.59

PVC DIN SERIES

NOMINAL SIZE	O.D.	DIN19531			DIN19534		
		PART	WALL THICKNESS	WEIGHT	PART	WALL THICKNESS	WEIGHT
IN	MM		MM	KG/MT		MM	KG/MT
1 1/2	40.00	10529	1.80	0.20	N/A	-	-
2	50.00	10530	1.80	0.30	N/A	-	-
3	75.00	10531	1.80	-	N/A	-	-
4	110.00	10532	2.20	-	10535	3.00	0.51
6	160.00	10534	3.20	-	10537	3.60	0.81
8	200.00	N/A	-	-	10538	4.50	-
10	250.00	N/A	-	-	10539	6.10	-
12	315.00	N/A	-	-	10540	7.70	-
16	400.00	N/A	-	-	10541	9.80	-
20	500.00	N/A	-	-	10542	12.20	-

Notes: PVC/CPVC material meets ASTM Standard D-1784
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

TABLE 1

ASTM STANDARD SPECIFICATIONS	
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D6263	Standard Specification for Extruded Bars Made From Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC)
ASTM D2464	Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
ASTM F441	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM D2672	Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
ASTM D2846	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D2466	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2672	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F437	Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F480	Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F493	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F656	Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM F913	Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM D1866	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings

ASTM STANDARD TEST METHODS	
ASTM D1598	Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe & Fittings
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D2444	Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2152	Standard Test Method for Adequacy of Fusion by Acetone Immersion
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe & Fittings
ASTM F610	Standard Test Method for Evaluating the Quality of Molded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings by the Heat Reversion Technique

TABLE 2 (CONTINUED)

ASTM STANDARD PRACTICES	
ASTM D2855	Standard Practice for Marking Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM F402	Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastics Pipe and Fittings
ASTM F690	Standard Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation System
ASTM F1057	Standard Practice for Evaluating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
ASTM F645	Standard Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Systems

TOXICOLOGICAL	
NSF INTERNATIONAL NSF STANDARD 061	Drinking Water System Components - Health Effects
NSF INTERNATIONAL NSF STANDARD 14	Plastics Piping System Components and Related Materials
UNITED STATES FDA CODE OF FEDERAL REGULATIONS	Title 21

FIRE PERFORMANCE	
ULC-S102.2-M88	Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies
UL 723	Test for Surface Burning Characteristics of Building Materials
UL1821	Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
UL 1887	Standard for Safety for Fire Test of Plastic Sprinkler Pipe for Flame and Smoke Characteristics
UL 94	Test for Flammability of Plastic Materials for Parts in Devices and Appliances
FM1635	Plastic Pipe & Fittings for Automatic Sprinkler Systems
FM4910	Clean Room Materials Flammability Test Protocol
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E162	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
ASTM D2863	Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

OTHER	
CSA STANDARD B137.3-99	Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications

PVC AND CPVC PIPES

Schedule 40 Flow Velocity & Friction Loss

SECTION 2

TABLE 1

SCHEDULE 40 FLOW VELOCITY & FRICTION LOSS

SCH40 Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)
GPM	1/8″			1/4″			3/8″		
0.25	1.64	6.54	2.83	0.86	1.36	0.59	0.46	0.29	0.12
0.50	3.27	23.60	10.23	1.72	4.90	2.12	0.91	1.04	0.45
0.75	4.91	50.00	21.68	2.59	10.38	4.50	1.37	2.20	0.96
1	6.55	85.18	36.93	3.45	17.68	7.66	1.82	3.75	1.63
2	13.09	307.52	133.31	6.90	63.82	27.67	3.65	13.55	5.88
5				17.25	348.29	150.98	9.11	73.96	32.06
7							12.76	137.93	59.79
10									

Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	SCH40 Flow Rate (Gallons per Minute)
GPM	1/2″			3/4″			1″			1 1/4″			1 1/2″			2″			2 1/2″			3″			GMP
1	1.13	1.16	0.50	0.63	0.28	0.12	0.39	0.09	0.04	0.22	0.02	0.01	0.16	0.01	0.00	0.10	0.00	0.00	0.07	0.00	0.00	0.04	0.00	0.00	1
2	2.25	4.19	1.82	1.26	1.03	0.44	0.77	0.31	0.13	0.44	0.08	0.03	0.32	0.04	0.02	0.19	0.01	0.00	0.14	0.00	0.00	0.09	0.00	0.00	2
5	5.63	22.88	9.92	3.16	5.60	2.43	1.93	1.69	0.73	1.10	0.43	0.19	0.81	0.20	0.09	0.49	0.06	0.03	0.34	0.02	0.01	0.22	0.01	0.00	5
7	7.88	42.66	18.49	4.42	10.44	4.53	2.70	3.14	1.36	1.55	0.81	0.35	1.13	0.38	0.16	0.68	0.11	0.05	0.48	0.05	0.02	0.31	0.02	0.01	7
10	11.26	82.59	35.80	6.31	20.21	8.76	3.86	6.08	2.64	2.21	1.57	0.68	1.62	0.73	0.32	0.97	0.21	0.09	0.68	0.09	0.04	0.44	0.03	0.01	10
15	4″			9.47	42.82	18.56	5.78	12.89	5.59	3.31	3.32	1.44	2.42	1.55	0.67	1.46	0.45	0.20	1.02	0.19	0.08	0.66	0.07	0.03	15
20	0.51	0.03	0.01	12.63	72.95	31.36	7.71	21.96	9.52	4.42	5.65	2.45	3.23	2.64	1.15	1.95	0.77	0.34	1.37	0.33	0.14	0.88	0.11	0.05	20
25	0.64	0.05	0.02	5″			9.64	33.20	14.39	5.52	8.55	3.71	4.04	4.00	1.73	2.44	1.17	0.51	1.71	0.49	0.21	1.10	0.17	0.07	25
30	0.77	0.06	0.03	0.49	0.02	0.01	11.57	46.54	20.17	6.62	11.98	5.19	4.85	5.60	2.43	2.92	1.64	0.71	2.05	0.69	0.30	1.32	0.24	0.10	30
35	0.89	0.08	0.04	0.57	0.03	0.01				7.73	15.94	6.91	5.65	7.45	3.23	3.41	2.18	0.94	2.39	0.92	0.40	1.54	0.32	0.14	35
40	1.02	0.11	0.05	0.65	0.04	0.02				8.83	20.41	8.85	6.46	9.54	4.14	3.90	2.79	1.21	2.73	1.18	0.51	1.76	0.41	0.18	40
45	1.15	0.13	0.06	0.73	0.04	0.02	6″			9.94	25.39	11.00	7.27	11.87	5.15	4.39	3.47	1.51	3.07	1.46	0.63	1.99	0.51	0.22	45
50	1.28	0.16	0.07	0.81	0.05	0.02	0.56	0.02	0.01	11.04	30.86	13.38	8.08	14.43	6.25	4.87	4.22	1.83	3.41	1.78	0.77	2.21	0.61	0.27	50
60	1.53	0.23	0.10	0.97	0.08	0.03	0.67	0.03	0.01				9.69	20.22	8.77	5.85	5.92	2.56	4.10	2.49	1.08	2.65	0.86	0.37	60
70	1.79	0.30	0.13	1.14	0.10	0.04	0.79	0.04	0.02							6.82	7.87	3.41	4.78	3.32	1.44	3.09	1.15	0.50	70
75	1.92	0.34	0.15	1.22	0.11	0.05	0.84	0.05	0.02							7.31	8.94	3.88	5.12	3.77	1.63	3.31	1.30	0.56	75
80	2.04	0.39	0.17	1.30	0.13	0.06	0.90	0.05	0.02							7.80	10.08	4.37	5.46	4.25	1.84	3.53	1.47	0.64	80

PVC AND CPVC PIPES

Schedule 40 Flow Velocity & Friction Loss

SECTION 2

TABLE 2 (CONTINUED)

SCHEDULE 40 FLOW VELOCITY & FRICTION LOSS

SCH40 Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	SCH40 Flow Rate (Gallons per Minute)
GPM	4″			5″			6″									2″			2 1/2″			3″			GMP
90	2.30	0.48	0.21	1.46	0.16	0.07	1.01	0.07	0.03	8″						8.77	12.53	5.43	6.15	5.28	2.29	3.97	1.82	0.79	90
100	2.55	0.59	0.25	1.62	0.19	0.08	1.12	0.08	0.03	0.65	0.02	0.01				9.74	15.23	6.60	6.83	6.42	2.78	4.41	2.22	0.96	100
125	3.19	0.89	0.38	2.03	0.29	0.13	1.40	0.12	0.05	0.81	0.03	0.01				12.18	23.03	9.98	8.54	9.70	4.21	5.52	3.35	1.45	125
150	3.83	1.24	0.054	2.43	0.41	0.18	1.68	0.17	0.07	0.97	0.04	0.02							10.24	13.60	5.90	6.62	4.70	2.04	150
175	4.47	1.65	0.72	2.84	0.55	0.24	1.96	0.22	0.10	1.13	0.06	0.03	10″									7.72	6.25	2.71	175
200	5.11	2.12	0.92	3.25	0.70	0.30	2.25	0.29	0.12	1.29	0.08	0.03	0.82	0.02	0.01							8.82	8.00	3.47	200
250	6.39	3.20	1.39	4.06	1.06	0.46	2.81	0.43	0.19	1.62	0.11	0.05	1.03	0.04	0.02							11.03	12.10	5.24	250
300	7.66	4.49	1.95	4.87	1.49	0.65	3.37	0.61	0.26	1.94	0.16	0.07	1.23	0.05	0.02	12″									300
350	8.94	5.97	2.59	5.68	1.98	0.86	3.93	0.81	0.35	2.27	0.21	0.09	1.44	0.07	0.03	1.01	0.03	0.01	14″			16″			350
400	10.22	7.64	3.31	6.49	2.54	1.10	4.49	1.03	0.45	2.59	0.27	0.12	1.64	0.09	0.04	1.16	0.04	0.02	0.96	0.02	0.01	0.73	0.01	0.01	400
450				7.30	3.15	1.37	5.05	1.29	0.56	2.91	0.34	0.15	1.85	0.11	0.05	1.30	0.05	0.02	1.08	0.03	0.01	0.82	0.02	0.01	450
500	18″			8.11	3.83	1.66	5.61	1.56	0.68	3.24	0.41	0.18	2.05	0.14	0.06	1.44	0.06	0.02	1.19	0.04	0.02	0.91	0.02	0.01	500
750	1.08	0.02	0.01	20″						4.85	0.87	0.38	3.08	0.29	0.12	2.17	0.12	0.05	1.79	0.08	0.03	1.37	0.04	0.02	750
1000	1.45	0.04	0.02	1.16	0.02	0.01				6.47	1.48	0.64	4.10	0.49	0.21	2.89	0.21	0.09	2.39	0.13	0.06	1.83	0.07	0.03	1000
1250	1.81	0.06	0.03	1.45	0.03	0.01	24″						5.13	0.74	0.32	3.61	0.31	0.14	2.99	0.20	0.09	2.29	0.10	0.04	1250
1500	2.17	0.08	0.04	1.74	0.05	0.02	1.21	0.02	0.01				6.15	1.03	0.45	4.33	0.44	0.19	3.58	0.28	0.12	2.74	0.14	0.06	1500
2000	2.89	0.14	0.06	2.32	0.08	0.04	1.61	0.03	0.01							5.78	0.75	0.33	4.78	0.47	0.20	3.66	0.25	0.11	2000
2500	3.61	0.21	0.09	2.91	0.12	0.05	2.01	0.05	0.02							7.22	1.13	0.49	5.97	0.71	0.31	4.57	0.37	0.16	2500
3000	4.34	0.29	0.13	3.49	0.17	0.08	2.41	0.07	0.03										7.17	1.00	0.43	5.49	0.52	0.23	3000
3500	5.06	0.39	0.17	4.07	0.23	0.10	2.81	0.09	0.04													6.40	0.70	0.30	3500
4000	5.78	0.50	0.22	4.65	0.30	0.13	3.21	0.12	0.05																4000
4500	6.50	0.62	0.27	5.23	0.37	0.16	3.62	0.15	0.06																4500
5000				5.81	0.45	0.19	4.02	0.18	0.08																5000
5500				6.39	0.53	0.23	4.42	0.22	0.09																5500
6000				6.97	0.63	0.27	4.82	0.25	0.11																6000
7000							5.62	0.34	0.15																7000
7500							6.03	0.39	0.17																7500
8000							6.43	0.43	0.19																8000
8500							6.83	0.49	0.21																8500

NOTE: HYDROSEAL recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6″ diameter and larger) to minimize the potential for hydraulic shock. Refer to section HYDROSEAL engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

PVC AND CPVC PIPES
Schedule 80 Flow Velocity & Friction Loss

TABLE 1

SCHEDULE80 FLOW VELOCITY & FRICTION LOSS

SCH80									
Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)
GPM	1/8″			1/4″			3/8″		
0.25	2.67	21.47	9.31	1.29	3.57	1.55	0.63	0.63	0.27
0.50	5.35	77.52	33.60	2.59	1288	5.58	1.25	2.27	0.98
0.75	8.02	164.25	71.20	3.88	27.29	11.83	1.88	4.80	2.08
1	10.69	279.84	121.31	5.17	46.49	20.15	2.51	8.18	3.55
2	21.39	1010.21	437.93	10.35	167.84	72.76	5.01	29.54	12.81
5				25.87	397.07	397.07	12.53	161.23	69.89
7							17.54	300.66	130.34
10									

Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute) SCH80
GPM	1/2″			3/4″			1″			1 1/4″			1 1/2″			2″			2 1/2″			3″			GMP
1	1.48	2.24	0.97	0.78	0.48	0.21	0.47	0.14	0.06	0.26	0.03	0.01	0.19	0.01	0.01	0.11	0.00	0.00	0.08	0.00	0.00	0.05	0.00	0.00	1
2	2.96	8.08	3.50	1.56	1.73	0.75	0.93	0.49	0.21	0.52	0.12	0.05	0.38	0.05	0.02	0.22	0.02	0.01	0.16	0.01	0.00	0.10	0.00	0.00	2
5	7.39	44.12	19.12	3.91	9.45	4.10	2.33	2.67	1.16	1.30	0.64	0.28	0.96	0.29	0.13	0.56	0.08	0.04	0.39	0.03	0.01	0.25	0.01	0.01	5
7	10.35	82.27	35.66	5.48	17.62	7.64	3.26	4.98	2.16	1.81	1.20	0.52	1.34	0.54	0.24	0.78	0.15	0.07	0.55	0.06	0.03	0.35	0.02	0.01	7
10	14.78	159.26	69.04	7.82	34.11	14.79	4.66	9.65	4.18	2.59	2.32	1.00	1.92	1.05	0.46	1.12	0.30	0.13	0.78	0.12	0.05	0.50	0.04	0.02	10
15	4″			11.74	72.27	31.33	6.99	20.44	8.86	3.89	4.91	2.13	2.87	2.23	0.97	1.67	0.63	0.27	1.17	0.26	0.11	0.75	0.09	0.04	15
20	0.57	0.04	0.02	15.65	123.13	53.38	9.33	34.82	15.09	5.18	8.36	3.62	3.83	3.80	1.65	2.23	1.07	0.47	1.56	0.45	0.19	1.00	0.15	0.07	20
25	0.71	0.06	0.03	5″			11.66	52.64	22.82	6.48	12.64	5.48	4.79	5.74	2.49	2.79	1.63	0.70	1.95	0.68	0.29	1.24	0.23	0.10	25
30	0.85	0.08	0.04	0.54	0.03	0.01	13.99	73.78	31.98	7.77	17.71	7.68	5.75	8.04	3.49	3.35	2.28	0.99	2.34	0.95	0.41	1.49	0.32	0.14	30
35	1.00	0.11	0.05	0.63	0.04	0.02	16.32	98.16	42.55	9.07	23.56	10.21	6.71	10.70	4.64	3.91	3.03	1.31	2.73	1.26	0.55	1.74	0.43	0.18	35
40	1.14	0.14	0.06	0.72	0.05	0.02	18.65	125.70	54.49	10.37	30.17	13.08	7.66	13.71	5.94	4.46	3.88	1.68	3.11	1.62	0.70	1.99	0.54	0.24	40
45	1.28	0.17	0.08	0.81	0.06	0.02	6″			11.66	37.53	16.27	8.62	17.05	7.39	5.02	4.83	2.09	3.50	2.01	0.87	2.24	0.68	0.29	45
50	1.42	0.21	0.09	0.90	0.07	0.03	0.63	0.03	0.01	12.96	45.62	19.77	9.58	20.72	8.98	5.58	5.87	2.54	3.89	2.45	1.06	2.49	0.82	0.36	50
60	1.71	0.30	0.13	1.08	0.10	0.04	0.75	0.04	0.02	15.55	63.94	27.72	11.50	29.04	12.59	6.69	8.22	3.56	4.67	3.43	1.49	2.99	1.15	0.50	60
70	1.99	0.39	0.17	1.26	0.13	0.06	0.88	0.05	0.02	18.14	85.06	36.87	13.41	38.64	16.75	7.81	10.94	4.74	5.45	4.56	1.98	3.48	1.54	0.67	65
75	2.14	0.45	0.19	1.35	0.15	0.06	0.94	0.06	0.03	19.43	96.66	41.90	14.37	43.90	19.03	8.37	12.43	5.39	5.84	5.18	2.25	3.73	1.74	0.76	70
80	2.28	0.51	0.22	1.44	0.16	0.07	1.00	0.07	0.03	20.73	108.93	47.22	15.33	49.48	21.45	8.93	14.01	6.07	6.23	5.84	2.53	3.98	1.97	0.85	75

PVC AND CPVC PIPES

Schedule 80 Flow Velocity & Friction Loss

SECTION 2

TABLE 2 (CONTINUED)

SCHEDULE 80 FLOW VELOCITY & FRICTION LOSS

SCH80 Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	SCH80 Flow Rate (Gallons per Minute)
GPM		4″			5″			6″						1 1/2″			2″			2 1/2″			3″		GMP
90	2.56	0.63	0.27	1.62	0.20	0.09	1.13	0.09	0.04				17.24	61.54	26.68	10.04	17.42	7.55	7.01	7.26	3.15	4.48	2.45	1.06	90
100	2.85	0.76	0.33	1.80	0.25	0.11	1.25	0.10	0.04		8″		19.16	74.80	32.42	11.16	21.18	9.18	7.79	8.83	3.83	4.98	2.97	1.29	100
125	3.56	1.16	0.50	2.24	0.38	0.16	1.57	0.16	0.07	0.89	0.04	0.02	23.95	113.07	49.02	13.95	32.02	13.88	9.73	13.34	5.78	6.22	4.49	1.95	125
150	4.27	1.62	0.70	2.69	0.53	0.23	1.88	0.22	0.10	1.07	0.06	0.02	28.74	158.49	68.71	16.74	44.88	19.45	11.68	18.70	8.11	7.47	6.30	2.73	150
175	4.98	2.16	0.93	3.14	0.70	0.30	2.19	0.29	0.13	1.25	0.07	0.03		10″		19.53	59.70	25.88	13.63	24.88	10.79	8.71	8.38	3.63	175
200	5.70	2.76	1.20	3.59	0.90	0.39	2.51	0.37	0.16	1.43	0.10	0.04	0.91	0.03	0.01	22.32	76.45	33.14	15.57	31.86	13.81	9.96	10.73	4.65	200
250	7.12	4.17	1.81	4.49	1.36	0.59	3.13	0.57	0.25	1.78	0.14	0.06	1.13	005	0.02	27.90	115.58	50.10	19.47	48.17	20.88	12.44	16.22	7.03	250
300	8.55	5.85	2.54	5.39	1.90	0.83	3.76	0.79	0.34	2.14	0.20	0.09	1.36	0.07	0.03		12″		23.36	67.52	29.27	14.93	22.74	9.86	300
350	9.97	7.78	3.37	6.29	2.53	1.10	4.38	1.05	0.46	2.50	0.27	0.12	1.59	0.09	0.04	1.12	0.04	0.02		14″			16″		350
400	11.39	9.96	4.32	7.18	3.24	1.41	5.01	1.35	0.59	2.85	0.34	0.15	1.81	0.11	0.05	1.28	0.05	0.02	1.06	0.03	0.01	0.81	0.02	0.01	400
450	12.8	12.39	5.37	8.08	4.04	1.75	5.64	1.68	0.73	3.21	0.43	0.19	2.04	0.14	0.06	1.44	0.06	0.03	1.19	0.04	0.02	0.91	0.02	0.01	450
500		18″		8.98	4.90	2.13	6.26	2.04	0.89	3.57	0.52	0.23	2.27	0.17	0.07	1.60	0.07	0.03	1.33	0.05	0.02	1.01	0.02	0.01	500
750	1.19	0.03	0.01		20″					5.35	1.10	0.48	3.40	0.36	0.16	2.40	0.16	0.07	1.99	0.10	0.04	1.52	0.05	0.02	750
1000	1.59	0.05	0.02	1.29	0.03	0.01				7.13	1.87	0.81	4.53	0.62	0.27	3.20	0.27	0.12	2.65	0.17	0.07	2.02	0.09	0.04	1000
1250	1.99	0.07	0.03	1.61	0.04	0.02		24″					5.66	0.94	0.41	4.00	0.40	0.17	3.31	0.25	0.11	2.53	0.13	0.06	1250
1500	2.39	0.10	0.04	1.93	0.06	0.03	1.34	0.03	0.01				6.80	1.32	0.57	4.80	0.57	0.24	3.98	0.36	0.15	3.03	0.18	0.08	1500
2000	3.18	0.18	0.08	2.57	0.10	0.05	1.78	0.04	0.02							6.40	0.96	0.42	5.30	0.61	0.26	4.04	0.31	0.14	2000
2500	3.98	0.27	0.12	3.22	0.16	0.07	2.23	0.06	0.03										6.63	0.92	0.40	5.05	0.48	0.21	2500
3000	4.78	0.37	0.16	3.86	0.22	0.10	2.67	0.09	0.04										7.95	1.29	0.56	6.06	0.67	0.29	3000
3500	5.57	0.50	0.22	4.50	0.30	0.13	3.12	0.12	0.05													7.07	0.89	0.38	3500
4000	6.37	0.64	0.28	5.15	0.38	0.16	3.56	0.15	0.07																4000
4500	7.16	0.79	0.34	5.79	0.47	0.20	4.01	0.19	0.08																4500
5000				6.43	0.57	0.25	4.45	0.23	0.10																5000
5500				7.08	0.68	0.30	4.90	0.28	0.12																5500
6000				7.72	0.80	0.35	5.34	0.33	0.14																6000
7000							6.23	0.44	0.19																7000
7500							6.68	0.49	0.21																7500
8000							7.12	0.56	0.24																8000
8500							7.57	0.62	0.27																8500

NOTE: HYDROSEAL recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6″ diameter and larger) to minimize the potential for hydraulic shock. Refer to section HYDROSEAL engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

PVC AND CPVC PIPES
Schedule 120 Flow Velocity & Friction Loss

TABLE 1

SCHEDULE 120 FLOW VELOCITY & FRICTION LOSS

SCH120																									SCH120
Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
	1/2″			3/4″			1″			1 1/4″			1 1/2″			2″			2 1/2″			3″			
1	1.77	3.50	1.52	0.86	0.60	0.26	0.51	0.17	0.07	0.28	0.04	0.02	0.20	0.02	0.01	0.12	0.00	0.00	0.08	0.00	0.00	0.05	0.00	0.00	1
2	3.54	12.62	5.47	1.72	2.16	0.94	1.03	0.62	0.27	0.56	0.14	0.06	0.40	0.06	0.03	0.24	0.02	0.01	0.16	0.01	0.00	0.11	0.00	0.00	2
5	8.86	68.86	29.85	4.29	11.78	5.11	2.57	3.40	1.47	1.41	0.78	0.34	1.01	0.35	0.15	0.60	0.10	0.04	0.41	0.04	0.02	0.27	0.01	0.01	5
7	12.41	128.41	55.67	6.00	21.97	9.52	3.60	6.33	2.75	1.97	1.46	0.63	1.41	0.65	0.28	0.84	0.18	0.08	0.57	0.07	0.03	0.38	0.03	0.01	7
10	17.72	248.59	107.76	8.58	42.53	18.43	5.15	12.26	5.31	2.82	2.83	1.23	2.02	1.26	0.54	1.20	0.36	0.15	0.82	0.14	0.06	0.54	0.05	0.02	10
15	4″			12.87	90.11	39.06	7.72	25.98	11.26	4.23	6.00	2.60	3.03	2.66	1.15	1.80	0.75	0.33	1.22	0.29	0.13	0.81	0.11	0.05	15
20	0.64	0.05	0.02	17.16	153.52	66.56	10.30	44.25	19.18	5.64	10.23	4.43	4.04	4.54	1.97	2.40	1.28	0.56	1.63	0.50	0.22	1.07	0.18	0.08	20
25	0.80	0.08	0.03				12.87	66.90	29.00	7.05	15.46	6.70	5.04	6.86	2.97	3.00	1.94	0.84	2.04	0.76	0.33	1.34	0.27	0.12	25
30	0.96	0.11	0.05				15.45	93.77	40.65	8.46	21.67	9.39	6.05	9.61	4.17	3.60	2.72	1.18	2.45	1.06	0.46	1.61	0.38	0.17	30
35	1.12	0.14	0.06				18.02	124.75	54.08	9.87	28.83	12.50	7.06	12.79	5.54	4.20	3.61	1.57	2.85	1.41	0.61	1.88	0.51	0.22	35
40	1.28	0.19	0.08				20.60	159.75	69.25	11.28	36.92	16.01	8.07	16.37	7.10	4.80	4.63	2.01	3.26	1.80	0.78	2.15	0.65	0.28	40
45	1.44	0.23	0.10	6″						12.69	45.92	19.91	9.08	20.37	8.83	5.40	5.76	2.50	3.67	2.24	0.97	2.42	0.81	0.35	45
50	1.60	0.28	0.12	0.69	0.04	0.02				14.09	55.82	24.20	10.09	24.75	10.73	6.00	7.00	3.03	4.08	2.73	1.18	2.69	0.99	0.43	50
60	1.92	0.39	0.17	0.83	0.05	0.02				16.91	78.24	33.92	12.11	34.70	15.04	7.20	9.81	4.25	4.89	3.82	1.66	3.22	1.39	0.60	60
70	2.24	0.52	0.23	0.97	0.07	0.03				19.73	104.09	45.12	14.12	46.16	20.01	8.40	13.05	5.66	5.71	5.09	2.21	3.76	1.84	0.80	70
75	2.40	0.59	0.26	1.04	0.08	0.03				21.14	118.27	51.27	15.13	52.45	22.74	9.00	14.82	6.43	6.11	5.78	2.51	4.03	2.10	0.91	75
80	2.56	0.67	0.29	1.11	0.09	0.04				22.55	133.29	57.78	16.14	59.11	5.62	9.60	16.71	7.24	6.52	6.51	2.82	4.30	2.36	1.02	80
90	2.88	0.83	0.36	1.25	0.11	0.05				25.37	165.78	71.87	18.16	73.52	31.87	10.81	20.78	9.01	7.34	8.10	3.51	4.84	2.94	1.27	90
100	3.20	1.01	0.44	1.38	0.13	0.06	8″						20.18	89.36	38.74	12.01	25.26	10.95	8.15	9.85	4.27	5.37	3.57	1.55	100
125	4.00	1.53	0.66	1.73	0.20	0.09	0.99	0.05	0.02				25.22	135.09	58.56	15.01	38.18	16.55	10.19	14.89	6.45	6.72	5.40	2.34	125
150	4.80	2.14	0.93	2.08	0.28	0.12	1.19	0.07	0.03				30.26	189.35	82.08	18.01	53.52	23.20	12.23	20.87	9.05	8.06	7.57	3.28	150
175	5.60	2.85	1.24	2.42	0.37	0.16	1.38	0.10	0.04							21.01	71.20	30.86	14.27	27.76	12.04	9.40	10.07	4.36	175
200	6.40	3.65	1.58	2.77	0.48	0.21	1.58	0.12	0.05							24.01	91.17	39.52	16.30	35.55	15.41	10.75	12.89	5.59	200
250	8.00	5.52	2.39	3.46	0.72	0.31	1.98	0.18	0.08							30.01	137.83	59.75	20.38	53.75	23.30	13.43	19.49	8.45	250
300	9.60	7.74	3.36	4.15	1.01	0.44	2.37	0.26	0.11										24.46	75.34	32.66	16.12	27.32	11.84	300
350	11.20	10.30	4.46	4.84	1.34	0.58	2.77	0.34	0.15																350
400	12.80	13.19	5.72	5.54	1.72	0.74	3.16	0.44	0.19																400
450	14.40	16.40	7.11	6.23	2.14	0.93	3.56	0.55	0.24																450
500				6.92	2.60	1.13	3.95	0.67	0.29																500
750				10.38	5.50	2.38	5.93	1.14	0.61																750
1,000				13.84	9.37	4.06	7.91	2.40	1.04																1,000
1,250							9.88	3.63	1.57																1,250
1,500							11.86	5.09	2.21																1,500
2,000							15.81	8.67	3.76																2,000

NOTE: HYDROSEAL recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6″ diameter and larger) to minimize the potential for hydraulic shock. Refer to section HYDROSEAL engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

PVC AND CPVC PIPES
SDR 21 Flow Velocity & Friction Loss

TABLE 1

SDR 21 FLOW VELOCITY & FRICTION LOSS

SDR 21 Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	SDR 21 Flow Rate (Gallons per Minute)
GMP	1/2″			3/4″			1″			1 1/4″			1 1/2″			2″			2 1/2″			3″			GMP
1				0.49	0.16	0.07	0.30	0.05	0.02	0.19	0.01	0.01	0.14	0.01	0.00	0.09	0.00	0.00	0.06	0.00	0.00	0.04	0.00	0.00	1
2				0.99	0.56	0.24	0.60	0.17	0.07	0.37	0.05	0.02	0.28	0.03	0.01	0.18	0.01	0.00	0.12	0.00	0.00	0.08	0.00	0.00	2
5				2.46	3.06	1.33	1.49	0.91	0.39	0.93	0.29	0.12	0.71	0.15	0.06	0.45	0.05	0.02	0.31	0.02	0.01	0.21	0.01	0.00	5
7				3.45	5.71	2.48	2.09	1.69	0.73	1.30	0.53	0.23	0.99	0.27	0.12	0.63	0.09	0.04	0.43	0.04	0.02	0.29	0.01	0.01	7
10				4.93	11.06	4.80	2.99	3.27	1.42	1.86	1.03	0.45	1.41	0.53	0.23	0.90	0.18	0.08	0.61	0.07	0.03	0.41	0.03	0.01	10
15	4″			7.39	23.44	10.16	4.48	6.93	3.00	2.79	2.18	0.95	2.12	1.12	0.49	1.35	0.37	0.16	0.92	0.15	0.06	0.62	0.06	0.02	15
20	0.50	0.03	0.01	9.86	39.94	17.31	5.97	11.81	5.12	3.72	3.72	1.61	2.83	1.91	0.83	1.80	0.64	0.28	1.23	0.25	0.11	0.83	0.10	0.04	20
25	0.62	0.04	0.02	5″			7.47	17.85	7.74	4.65	5.63	2.44	3.53	2.89	1.25	2.25	0.97	0.42	1.53	0.38	0.16	1.03	0.14	0.06	25
30	0.75	0.06	0.03	0.49	0.02	0.01	8.96	25.02	10.85	5.58	7.89	3.42	4.24	4.05	1.75	2.70	1.35	0.59	1.84	0.53	0.23	1.24	0.20	0.09	30
35	0.87	0.08	0.03	0.57	0.03	0.01	10.45	33.28	14.43	6.51	10.49	4.55	4.94	5.38	2.33	3.15	1.80	0.78	2.15	0.71	0.31	1.44	0.27	0.12	35
40	1.00	0.10	0.04	0.65	0.04	0.02				7.43	13.44	5.83	5.65	6.89	2.99	3.60	2.31	1.00	2.45	0.90	0.39	1.65	0.34	0.15	40
45	1.12	0.13	0.05	0.73	0.04	0.02	6″			8.36	16.71	7.25	6.36	8.57	3.72	4.05	2.87	1.24	2.76	1.12	0.49	1.86	0.43	0.19	45
50	1.25	0.15	0.07	0.82	0.05	0.02	0.58	0.02	0.01	9.29	20.31	8.81	7.06	10.42	4.52	4.50	3.49	1.51	3.06	1.37	0.59	2.06	0.52	0.23	50
60	1.50	0.21	0.09	0.98	0.08	0.03	0.69	0.03	0.01				8.48	14.60	6.33	5.41	4.89	2.12	3.68	1.91	0.83	2.48	0.73	0.32	60
70	1.75	0.29	0.12	1.14	0.10	0.04	0.81	0.04	0.02				9.89	19.43	8.42	6.31	6.50	2.82	4.29	2.55	1.10	2.89	0.97	0.42	70
75	1.87	0.32	0.14	1.22	0.12	0.05	0.86	0.05	0.02				10.59	22.08	9.57	6.76	7.39	3.20	4.60	2.89	1.25	3.09	1.10	0.48	75
80	2.00	0.37	0.16	1.31	0.13	0.06	0.92	0.06	0.02							7.21	8.32	3.61	4.90	3.26	1.41	3.30	1.25	0.54	80
90	2.24	0.46	0.20	1.47	0.16	0.07	1.04	0.07	0.03	8″						8.11	10.35	4.49	5.52	4.06	1.76	3.71	1.55	0.67	90
100	2.49	0.55	0.24	1.63	0.20	0.09	1.15	0.08	0.04	0.68	0.02	0.01				9.01	12.58	5.46	6.13	4.93	2.14	4.13	1.88	0.82	100
125	3.12	0.84	0.36	2.04	0.30	0.13	1.44	0.13	0.06	0.85	0.04	0.02							7.66	7.46	3.23	5.16	2.85	1.23	125
150	3.74	1.17	0.51	2.45	0.42	0.18	1.73	0.18	0.08	1.02	0.05	0.02							9.19	10.45	4.53	6.19	3.99	1.73	150
175	4.36	1.56	0.68	2.86	0.56	0.24	2.01	0.24	0.10	1.19	0.07	0.03							10.73	13.90	6.03	7.22	5.31	2.30	175
200	4.99	2.00	0.87	3.26	0.71	0.31	2.30	0.30	0.13	1.36	0.08	0.04										8.25	6.80	2.95	200
250	6.24	3.02	1.31	4.08	1.08	0.47	2.88	0.46	0.20	1.70	0.13	0.06										10.31	10.27	4.45	250
300	7.48	4.23	1.84	4.90	1.51	0.65	3.45	0.65	0.28	2.04	0.18	0.08													300
350	8.73	5.63	2.44	5.71	2.01	0.87	4.03	0.86	0.37	2.38	0.24	0.10													350
400	9.98	7.21	3.13	6.53	2.57	1.12	4.61	1.10	0.48	2.71	0.30	0.13													400
450	11.21	8.97	3.89	7.35	3.20	1.39	5.18	1.37	0.59	3.05	0.38	0.16													450
500				8.16	3.89	1.69	5.76	1.66	0.72	3.39	0.46	0.20													500
750							8.64	3.52	1.53	5.09	0.97	042													750
1000										6.79	1.66	0.72													1000
1250										8.48	2.51	1.09													1250

NOTE: HYDROSEAL recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6″ diameter and larger) to minimize the potential for hydraulic shock. Refer to section HYDROSEAL engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

PVC AND CPVC PIPES
SDR 26 Flow Velocity & Friction Loss

TABLE 1

SDR 26 FLOW VELOCITY & FRICTION LOSS

SDR 26 Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/100ft)	SDR 21 Flow Rate (Gallons per Minute)
GMP	1/2″			3/4″			1″			1 1/4″			1 1/2″			2″			2 1/2″			3″			GMP
1							0.30	0.04	0.02	0.18	0.01	0.01	0.14	0.01	0.00	0.09	0.00	0.00	0.06	0.00	0.00	0.04	0.00	0.00	1
2							0.59	0.16	0.07	0.36	0.05	0.02	0.27	0.02	0.01	0.17	0.01	0.00	0.12	0.00	0.00	0.08	0.00	0.00	2
5							1.48	0.88	0.38	0.89	0.26	0.11	0.68	0.13	0.06	0.43	0.04	0.02	0.29	0.02	0.01	0.20	0.01	0.00	5
7							2.07	1.65	0.71	1.25	0.48	0.21	0.95	0.25	0.11	0.61	0.08	0.04	0.41	0.03	0.01	0.28	0.01	0.01	7
10							2.96	3.19	1.38	1.79	0.94	0.41	1.36	0.48	0.21	0.86	0.16	0.07	0.59	0.06	0.03	0.40	0.02	0.01	10
15	4″						4.44	6.76	2.93	2.68	1.98	0.86	2.04	1.02	0.44	1.30	0.34	0.15	0.88	0.13	0.06	0.59	0.05	0.02	15
20	0.48	0.03	0.01				5.91	11.52	4.99	3.57	3.38	1.46	2.72	1.73	0.75	1.73	0.58	0.25	1.18	0.23	0.10	0.79	0.09	0.04	20
25	0.60	0.04	0.02	5″			7.39	17.41	7.55	4.47	5.10	2.21	3.40	2.62	1.14	2.16	0.87	0.38	1.47	0.34	0.15	0.99	0.13	0.06	25
30	0.72	0.05	0.02	0.47	0.02	0.01	8.87	24.40	10.58	5.36	7.15	3.10	4.07	3.67	1.59	2.59	1.23	0.53	1.76	0.48	0.21	1.19	0.18	0.08	30
35	0.84	0.07	0.03	0.55	0.03	0.01	10.35	32.46	14.07	6.25	9.52	4.13	4.75	4.89	2.12	3.03	1.63	0.71	2.06	0.64	0.28	1.39	0.24	0.11	35
40	0.96	0.09	0.04	0.63	0.03	0.01	11.83	41.57	18.02	7.14	12.19	5.28	5.43	6.26	2.71	3.46	2.09	0.90	2.35	0.82	0.35	1.58	0.31	0.14	40
45	1.08	0.11	0.05	0.70	0.04	0.02	6″			8.04	15.16	6.57	6.11	7.78	3.37	3.89	2.60	1.13	2.65	1.02	0.44	1.78	0.39	0.17	45
50	1.19	0.14	0.06	0.78	0.05	0.02	0.55	0.02	0.01	8.93	18.43	7.99	6.79	9.46	4.10	4.32	3.16	1.37	2.94	1.24	0.54	1.98	0.47	0.20	50
60	1.43	0.19	0.08	0.94	0.07	0.03	0.66	0.03	0.01	10.72	25.83	11.20	8.15	13.26	5.75	5.19	4.42	1.92	3.53	1.73	0.75	2.38	0.66	0.29	60
70	1.67	0.26	0.11	1.10	0.09	0.04	0.77	0.04	0.02				9.51	17.64	7.65	6.05	5.88	2.55	4.12	2.30	1.00	2.77	0.88	0.38	70
75	1.79	0.29	0.13	1.17	0.10	0.05	0.83	0.04	0.02				10.19	20.05	8.69	6.49	6.69	2.90	4.41	2.62	1.13	2.97	1.00	0.43	75
80	1.91	0.33	0.14	1.25	0.12	0.05	0.88	0.05	0.02				10.87	22.59	9.79	6.92	7.54	3.27	4.70	2.95	1.28	3.17	1.13	0.49	80
90	2.15	0.41	0.18	1.41	0.15	0.06	0.99	0.06	0.03	8″			12.22	28.10	12.18	7.78	9.37	4.06	5.29	3.67	1.59	3.57	1.40	0.61	90
100	2.39	0.50	0.22	1.56	0.18	0.08	1.10	0.08	0.03	0.65	0.02	0.01	13.58	34.16	14.81	8.65	11.39	4.94	5.88	4.46	1.93	3.96	1.71	0.74	100
125	2.99	0.75	0.33	1.96	0.27	0.12	1.38	0.11	0.05	0.81	0.03	0.01				10.81	17.22	7.47	7.35	6.74	2.92	4.95	2.58	1.12	125
150	3.58	1.06	0.46	2.35	0.38	0.16	1.65	0.16	0.07	0.98	0.04	0.02							8.82	9.45	4.10	5.94	3.62	1.57	150
175	4.18	1.41	0.61	2.74	0.50	0.22	1.93	0.21	0.09	1.14	0.06	0.03	10″						10.29	12.57	5.45	6.93	4.81	2.09	175
200	4.78	1.80	0.78	3.13	0.64	0.28	2.21	0.27	0.12	1.30	0.08	0.03	0.84	0.03	0.01							7.92	6.16	2.67	200
250	5.97	2.72	1.18	3.91	0.97	0.42	2.76	0.42	0.18	1.63	0.11	0.05	1.05	0.04	0.02							9.91	9.31	4.04	250
300	7.17	3.81	1.65	4.69	1.36	0.59	3.31	0.58	0.25	1.95	0.16	0.07	1.26	0.06	0.02	12″						11.89	13.06	5.66	300
350	8.36	5.07	2.20	5.48	1.81	0.79	3.86	0.77	0.34	2.28	0.21	0.09	1.47	0.07	0.03	1.04	0.03	0.01	14″			16″			350
400	9.56	6.50	2.82	6.26	2.32	1.01	4.41	0.99	0.43	2.60	0.27	0.12	1.68	0.09	0.04	1.19	0.04	0.02	0.99	0.03	0.01	0.76	0.01	0.01	400
450	10.75	8.08	3.50	7.04	2.89	1.25	4.96	1.23	0.53	2.93	0.34	0.15	1.88	0.12	0.05	1.34	0.05	0.02	1.11	0.03	0.01	085	0.02	0.01	450
500	18″			7.82	3.51	1.52	5.52	1.50	0.65	3.25	0.41	0.18	2.09	0.14	0.06	1.49	0.06	0.03	1.23	0.04	0.02	0.95	0.02	0.01	500
750	1.12	0.02	0.01	20″			8.27	3.17	1.38	4.88	0.88	0.38	3.14	0.30	0.13	2.23	0.13	0.06	1.85	0.08	0.04	1.42	0.04	0.02	750
1000	1.49	0.04	0.02	1.21	0.03	0.01	11.03	5.41	2.34	6.51	1.50	0.65	4.19	0.51	0.22	2.98	0.22	0.10	2.47	0.14	0.06	1.89	0.07	0.03	1000
1250	1.87	0.06	0.03	1.51	0.04	0.02	24″			8.13	2.26	0.98	5.23	0.78	0.34	3.72	0.34	0.15	3.09	0.21	0.09	2.36	0.11	0.05	1250
1500	2.24	0.09	0.04	1.81	0.05	0.02	1.26	0.02	0.01	9.76	3.17	1.38	6.28	1.09	0.47	4.47	0.47	0.21	3.70	0.30	0.13	2.84	0.16	0.07	1500
2000	2.99	0.15	0.07	2.42	0.09	0.04	1.68	0.04	0.02				8.38	1.85	0.80	5.95	0.81	0.35	4.94	0.51	0.22	3.78	0.27	0.12	2000
2500	3.73	0.23	0.10	3.02	0.14	0.06	2.10	0.06	0.02							7.44	1.22	0.53	6.17	0.77	0.34	4.73	0.40	0.18	2500
3000	4.48	0.32	0.14	3.63	0.19	0.08	252	0.08	0.03										7.41	1.08	0.47	5.67	0.57	0.25	3000
3500	5.23	0.42	0.18	4.23	0.25	0.11	2.94	0.10	0.05													6.62	0.75	0.33	3500
4000	5.97	0.54	0.24	4.84	0.33	0.14	3.36	0.13	0.06													6.62	0.75	0.33	4000
4500	6.72	0.68	0.29	5.44	0.41	0.18	3.78	0.17	0.07																4500
5000				6.05	0.49	0.21	4.20	0.20	0.09																5000
5500				6.65	0.59	0.25	4.62	0.24	0.10																5500
6000				7.26	0.69	0.30	5.04	0.28	0.12																6000
7000							5.88	0.38	0.16																7000
7500							6.30	0.43	0.19																7500
8000							6.72	0.48	0.21																8000
8500							7.14	0.54	0.24																8500

NOTE: HYDROSEAL recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6″ diameter and larger) to minimize the potential for hydraulic shock. Refer to section HYDROSEAL engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

PVC AND CPVC PIPES
SDR 41 Flow Velocity & Friction Loss

TABLE 1

SDR 41 FLOW VELOCITY & FRICTION LOSS

SDR 41										SDR 41
Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
GMP	18"			20"			24"			GMP
750	1.05	0.02	0.01							750
1000	1.40	0.04	0.02							1000
1250	1.75	0.05	0.02	1.42	0.03	0.01				1250
1500	2.10	0.08	0.03	1.70	0.05	0.02	1.18	0.02	0.01	1500
2000	2.81	0.13	0.06	2.27	0.08	0.03	1.58	0.03	0.01	2000
2500	3.51	0.20	0.08	2.84	0.12	0.05	1.97	0.05	0.02	2500
3000	4.21	0.27	0.12	3.4	0.16	0.07	2.37	0.07	0.03	3000
3500	4.91	0.36	0.16	3.98	0.22	0.09	2.76	0.09	0.04	3500
4000	5.61	0.47	0.20	4.55	0.28	0.12	3.16	0.12	0.05	4000
4500	6.31	0.58	0.25	5.11	0.35	0.15	3.55	0.14	0.06	4500
5000				5.68	0.42	0.18	3.95	0.17	0.08	5000
5500				6.25	0.50	0.22	4.34	0.21	0.09	5500
6000				6.82	0.59	0.26	4.73	0.24	0.11	6000
7000							5.52	0.32	0.14	7000
7500							5.92	0.37	0.16	7500
8000							6.31	0.42	0.18	8000
8500							6.71	0.47	0.20	8500

NOTE: Harvel recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to section Harvel engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.


ASTM F-441 SCH80 CPVC 4120 630PSI @73F
3/4" ASTM F-441 SCH80 CPVC

B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PRESSURE FITTINGS
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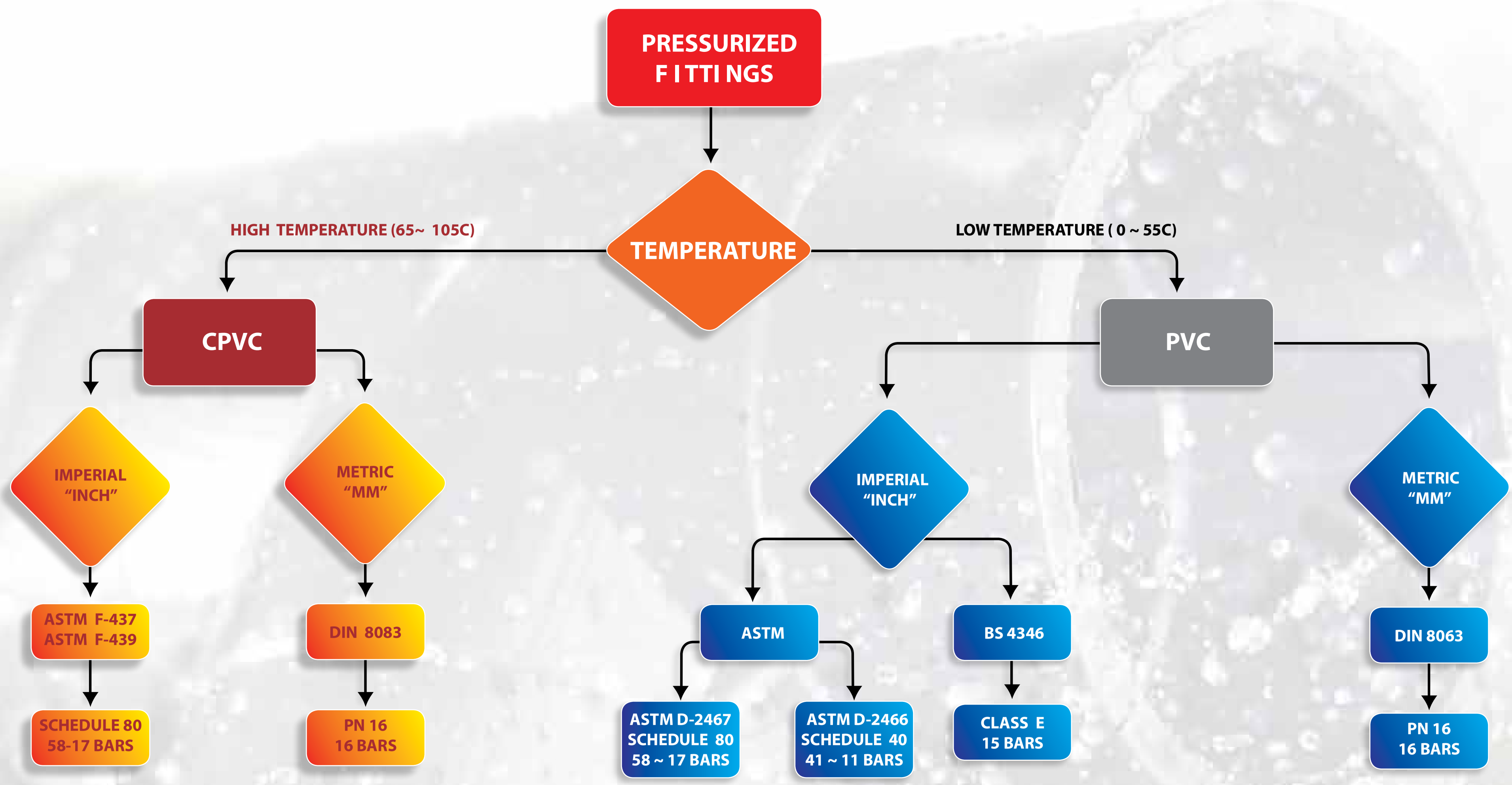
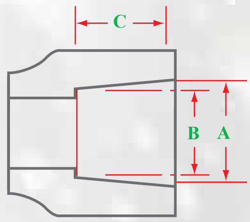
PVC AND CPVC PRESSURE PIPES
Selection Chart



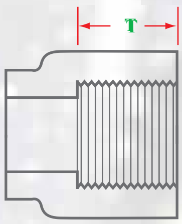
PRESSURE FITTINGS

Schedule 80 Socket and Thread Dimensions

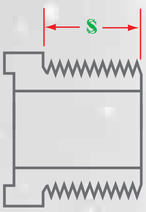


PVC AND CPVC SCHEDULE 80 TAPER SOCKET DIMENSIONS
(SOLVENT WELD TYPE)
ASTM D-2467 (PVC) / F-439 (CPVC)

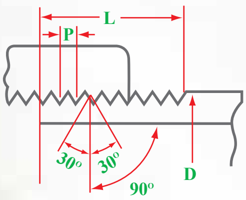
NOM. PIPE SIZE	PIPE O.D.	SOCKET ENTRANCE I.D.(A)		SOCKET BOTTOM I.D. (B)		MIN. SOCKET LENGTH (C)
		MIN.	MAX.	MIN.	MAX.	
1/2	0.840	0.844	0.852	0.832	0.840	0.875
3/4	1.050	1.054	1.062	1.042	1.050	1.000
1	1.315	1.320	1.330	1.305	1.315	1.125
1 1/4	1.660	1.665	1.675	1.650	1.660	1.250
1 1/2	1.900	1.906	1.918	1.888	1.900	1.375
2	2.375	2.381	2.393	2.363	2.375	1.500
2 1/2	2.875	2.882	2.896	2.861	2.875	1.750
3	3.500	3.508	3.524	3.484	3.500	1.875
4	4.500	4.509	4.527	4.482	4.500	2.250
6	6.625	6.636	6.658	6.603	6.625	3.000
8	8.625	8.640	8.670	8.595	8.625	4.000



FEMALE TAPER THREADS
ASTM D-2467 (PVC) / F-437 (CPVC)



MALE TAPER THREADS
ASTM D-2467 (PVC) / F-437 (CPVC)



AMERICAN NATIONAL STANDARD
TAPER PIPE THREADS (NPT)
ASME (ANSI) B1.20.1

NOM. PIPE SIZE	PIPE O.D.(D)	FEMAL THREAD MIN. LENGTH (T)	MALE THREAD MIN. LENGTH (S)	OVERALL PIPE THREAD LENGTH (L)	PITCH OF THREAD (P)	THREADS PER INCH	DEPTH OF THREAD
1/2	0.840	0.64	0.53	0.7815	0.07143	14	0.05714
3/4	1.050	0.65	0.55	0.7935	0.07143	14	0.05714
1	1.315	0.81	0.68	0.9845	0.08696	11 1/2	0.06957
1 1/4	1.660	0.85	0.71	1.0085	0.08696	11 1/2	0.06957
1 1/2	1.900	0.85	0.72	1.0252	0.08696	11 1/2	0.06957
2	2.375	0.90	0.76	1.0582	0.08696	11 1/2	0.06957
2 1/2	2.875	1.21	1.14	1.5712	0.12500	8	0.10000
3	3.500	1.30	1.20	1.6337	0.12500	8	0.10000
4	4.500	1.38	1.30	1.7337	0.12500	8	0.10000

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439, D-2467 for socket type fittings and F-437, D-2464 for threaded fittings. All dimensions are in inches unless otherwise specified. Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

Scope

This specification sheet covers the manufacturer's requirements for PVC Schedule 80 pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

PVC Materials

Rigid PVC (polyvinyl chloride) used in the manufacture of Schedule 80 fittings is Type I, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

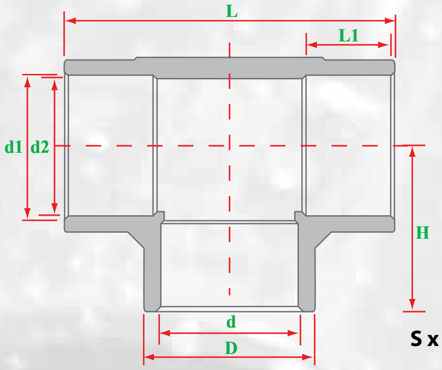
Dimensions

Physical dimensions and tolerances of PVC Schedule 80 IPS (Iron Pipe Size) fittings meet the requirements of ASTM specification D-2467 for all fittings. Threaded fittings have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

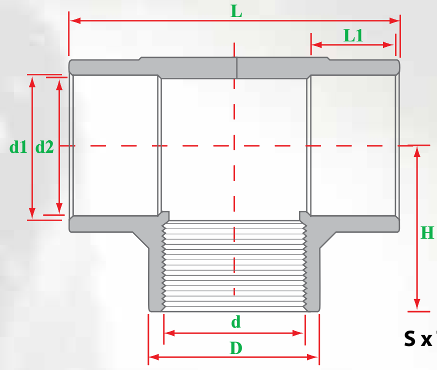
Marking

PVC Schedule 80 fittings are marked as prescribed in ASTM D-2467 to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation D-2467.

Tees



S x S



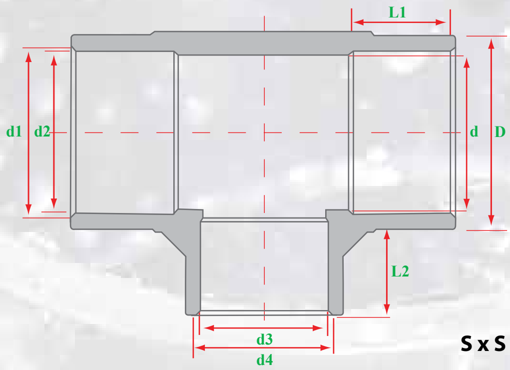
S x T

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM						
		D	d	d1	d2	L	L1	H	APPROX. WT.
24216	1/2"	29.5	19.00	21.54	21.23	70.00	22.50	35.00	0.05
24217	3/4"	35.0	24.00	26.87	26.57	80.00	25.50	40.00	0.07
24218	1"	43.0	31.00	33.65	33.27	95.00	29.00	47.50	0.11
24219	1 1/4"	52.5	40.00	42.42	42.04	112.00	32.00	55.00	0.17
24220	1 1/2"	59.0	46.00	48.56	48.11	124.00	35.00	62.00	0.22
24221	2"	72.0	58.00	60.63	60.17	143.00	38.50	71.50	0.34
24222	2 1/2"	87.5	70.00	73.38	72.85	167.00	44.50	83.50	0.58
24223	3"	105.0	86.00	89.31	88.70	190.00	48.00	95.00	0.86
24224	4"	132.0	110.00	114.76	114.07	235.00	57.50	117.50	1.48
24226	5"	-	-	-	-		-	-	3.20
24227	6"	193.0	164.00	168.83	168.00	334.00	77.00	167.00	4.30
24229	8"	245.0	214.00	219.84	218.70	448.00	100.00	224.00	8.00
24231	10"	318.0	-	273.81	272.67	585.00	140.00	292.00	21.00
24233	12"	356.0	-	324.61	323.47	672.00	160.00	338.00	29.00
24234	14"	399.0	-	356.39	-	738.00	178.00	370.00	35.00
24235	16"	450.0	-	407.19	-	866.00	204.00	433.00	38.00
24236	18"	505.0	-	457.99	-	980.00	228.00	490.00	48.00
24237	20"	563.0	-	517.07	-	1022.00	254.00	510.00	56.00
24238	24"	674.0	-	611.58	-	1225.00	305.00	613.00	84.00

PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM						
		D	d	d1	d2	L	L1	H	APPROX. WT.
24113	1/2"	29.5	19.00	21.54	21.23	70.00	22.50	35.00	0.05
24114	3/4"	35.0	24.00	26.87	26.57	80.00	25.50	40.00	0.07
24115	1"	43.0	31.00	33.65	33.27	95.00	29.00	47.50	0.11
24116	1 1/4"	52.5	40.00	42.42	42.04	112.00	32.00	55.00	0.17
24117	1 1/2"	59.0	46.00	48.56	48.11	124.00	35.00	62.00	0.22
24118	2"	72.0	58.00	60.63	60.17	143.00	38.50	71.50	0.34
24119	2 1/2"	87.5	70.00	73.38	72.85	167.00	44.50	83.50	0.58
24120	3"	105.0	86.00	89.31	88.70	190.00	48.00	95.00	0.86
24121	4"	132.0	110.00	114.76	114.07	235.00	57.50	117.50	1.48

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Tees

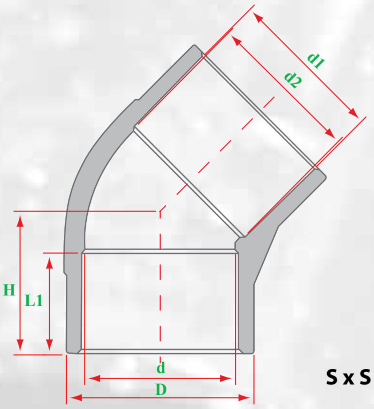


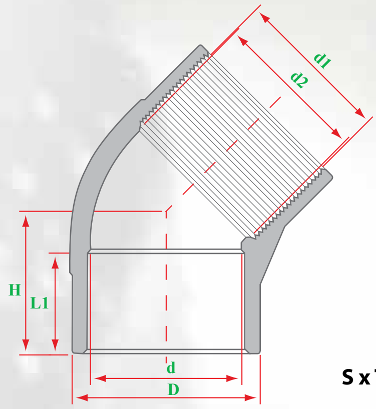
S x S

PART	NOMINAL SIZE	RED TEE - S x S	UNIT OF MEASURE: MM							
		D	d	d1	d2	d3	d4	L1	L2	APPROX. WT.
24551	3/4" > 1/2"	35.00	24.00	26.87	26.57	21.54	21.23	25.50	22.50	0.06
24554	1 > 1/2"	43.00	31.00	33.65	33.27	21.54	21.23	29.00	22.50	0.10
24555	1 > 3/4"	43.00	31.00	33.65	33.27	26.87	26.57	29.00	25.50	0.10
24558	1 1/4 > 1/2"	52.50	40.00	42.42	42.04	21.54	21.23	32.00	22.50	0.15
24559	1 1/4 > 3/4"	52.50	40.00	42.42	42.04	26.87	26.57	32.00	25.50	0.15
24560	1 1/4 > 1"	52.50	40.00	42.42	42.04	33.65	33.27	32.00	29.00	0.16
24563	1 1/2 > 1/2"	59.00	46.00	48.56	48.11	21.54	21.23	35.00	22.50	0.20
24564	1 1/2 > 3/4"	59.00	46.00	48.56	48.11	26.87	26.57	35.00	25.50	0.20
24565	1 1/2 > 1"	59.00	46.00	48.56	48.11	33.65	33.27	35.00	29.00	0.20
24566	1 1/2 > 1 1/4"	59.00	46.00	48.56	48.11	42.42	42.04	35.00	32.00	0.21
24569	2 > 1/2"	74.00	58.00	60.63	60.17	21.54	21.23	38.50	22.50	0.30
24570	2 > 3/4"	74.00	58.00	60.63	60.17	26.87	26.57	38.50	25.50	0.30
24571	2 > 1"	74.00	58.00	60.63	60.17	33.65	33.27	38.50	29.00	0.30
24572	2 > 1 1/4"	74.00	58.00	60.63	60.17	42.42	42.04	38.50	32.00	0.31
24573	2 > 1 1/2"	74.00	58.00	60.63	60.17	48.56	48.11	38.50	35.00	0.32
24578	2 1/2 > 1 1/2"	87.50	70.00	73.38	72.85	48.56	48.11	44.50	35.00	0.52
24579	2 1/2 > 2"	87.50	70.00	73.38	72.85	60.63	60.17	44.50	38.50	0.54
24582	3 > 1"	105.00	86.00	89.31	88.70	33.65	33.27	48.00	29.00	0.76
24584	3 > 1 1/2"	105.00	86.00	89.31	88.70	48.56	48.11	48.00	35.00	0.77
24585	3 > 2"	105.00	86.00	89.31	88.70	60.63	60.17	48.00	38.50	0.78
24586	3 > 2 1/2"	105.00	86.00	89.31	88.70	73.38	72.85	48.00	44.50	0.81
24592	4 > 2"	134.00	110.00	114.76	114.07	60.63	60.17	58.00	38.50	1.35
24593	4 > 2 1/2"	134.00	110.00	114.76	114.07	73.38	72.85	58.00	44.50	1.38
24594	4 > 3"	134.00	110.00	114.76	114.07	89.31	88.70	58.00	48.00	1.40
24620	6 > 3"	193.00	164.00	168.83	168.00	89.31	88.70	77.00	48.00	3.85
24621	6 > 4"	193.00	164.00	168.83	168.00	114.76	114.07	77.00	58.00	3.95
24637	8 > 6"	246.00	210.00	219.84	218.70	168.83	168.00	102.00	77.00	7.00
24650	10 > 8"	305.00	265.00	273.81	272.67	219.84	218.70	127.00	102.00	24.00
24660	12 > 10"	362.00	315.00	324.61	323.47	273.81	272.67	152.50	127.00	32.00

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

45° Elbows



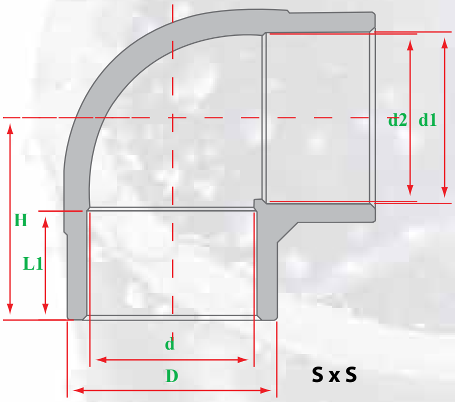


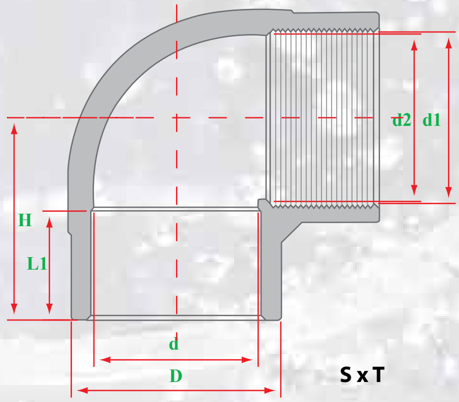
PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
24168	1/2"	29.5	19.00	21.54	21.23	22.50	29.50	0.03
24169	3/4"	35.0	24.00	26.87	26.57	25.50	33.00	0.04
24170	1"	43.0	31.00	33.65	33.27	29.00	38.50	0.07
24171	1 1/4"	52.5	40.00	42.42	42.04	32.00	44.00	0.11
24172	1 1/2"	59.0	46.00	48.56	48.11	35.00	48.50	0.14
24173	2"	72.0	58.00	60.63	60.17	38.50	54.50	0.21
24174	2 1/2"	87.5	70.00	73.38	72.85	44.50	63.00	0.36
24175	3"	105.0	86.00	89.31	88.70	48.00	70.00	0.55
24176	4"	132.0	110.00	114.76	114.07	57.50	85.00	0.90
24178	5"	-	-	-	-	-	-	1.67
24179	6"	193.0	164.00	168.83	168.00	77.00	119.50	2.65
24181	8"	245.0	214.00	219.84	218.70	100.00	153.90	7.00
24183	10"	318.0	-	273.81	272.67	140.00	206.30	11.00
24185	12"	356.0	-	324.61	323.47	160.00	271.40	15.00
24186	14"	399.0	-	356.39	-	178.00	298.60	21.00
24187	16"	450.0	-	407.19	-	204.00	345.00	24.00
24188	18"	505.0	-	457.99	-	228.00	381.00	32.00
24189	20"	563.0	-	517.07	-	254.00	405.00	38.00
24190	24"	674.0	-	611.58	-	305.00	478.00	53.00

PART	NOMINAL SIZE	45 ELL - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
25594	1/2"	29.5	19.00	21.54	21.23	22.50	29.50	0.03
25595	3/4"	35.0	24.00	26.87	26.57	25.50	33.00	0.04
25596	1"	43.0	31.00	33.65	33.27	29.00	38.50	0.07
25597	1 1/4"	52.5	40.00	42.42	42.04	32.00	44.00	0.11
25598	1 1/2"	59.0	46.00	48.56	48.11	35.00	48.50	0.14
25599	2"	72.0	58.00	60.63	60.17	38.50	54.50	0.21
25600	2 1/2"	87.5	70.00	73.38	72.85	44.50	63.00	0.36
25601	3"	105.0	86.00	89.31	88.70	48.00	70.00	0.55
25602	4"	132.0	110.00	114.76	114.07	57.50	85.00	0.90

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

90° Elbows



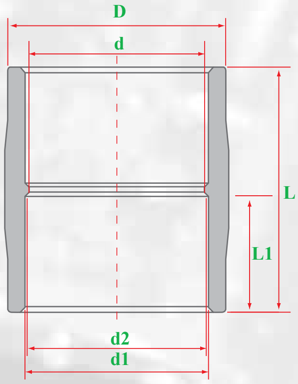


PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
24003	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.03
24004	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.05
24005	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.08
24006	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.13
24007	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.17
24008	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.26
24009	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.45
24010	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.70
24011	4"	132.0	110.00	114.76	114.07	57.50	117.50	1.17
24013	5"	-	-	-	-	-	-	1.94
24014	6"	193.0	164.00	168.83	168.00	77.00	167.00	3.03
24016	8"	246.0	214.00	219.84	218.70	100.00	224.00	7.80
24018	10"	314.0	-	273.81	272.67	140.00	340.00	13.00
24020	12"	362.0	-	324.61	323.47	160.00	338.00	23.00
24021	14"	397.0	-	356.39	-	178.00	369.00	27.00
24022	16"	450.0	-	407.19	-	204.00	427.00	29.00
24023	18"	505.0	-	457.99	-	228.00	490.00	38.00
24024	20"	563.0	-	517.07	-	254.00	510.00	47.00
24025	24"	674.0	-	611.58	-	305.00	617.00	63.00

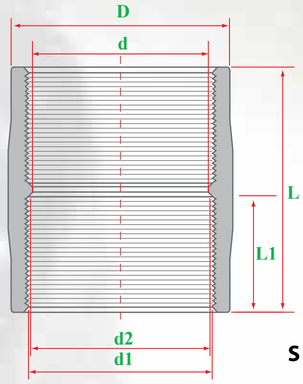
PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
24094	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.03
24095	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.05
24096	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.08
24097	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.13
24098	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.17
24099	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.26
24100	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.45
24101	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.70
24102	4"	134.0	110.00	114.76	114.07	57.50	117.50	1.17

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Couplings



S x S



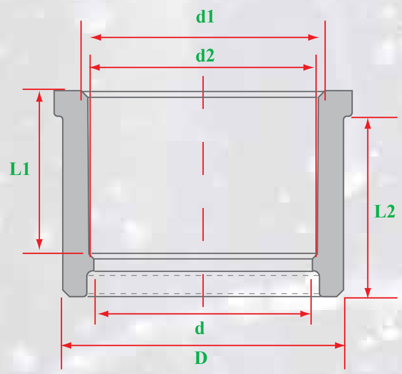
S x T

PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L	APPROX. WT.
24240	1/2"	29.5	19.00	21.54	21.23	22.50	48.00	0.02
24241	3/4"	35.0	24.00	26.87	26.57	25.50	54.00	0.03
24242	1"	43.0	31.00	33.65	33.27	29.00	61.00	0.05
24243	1 1/4"	52.5	40.00	42.42	42.04	32.00	68.00	0.08
24244	1 1/2"	59.0	46.00	48.56	48.11	35.00	74.00	0.10
24245	2"	72.0	58.00	60.63	60.17	38.50	81.00	0.14
24246	2 1/2"	87.5	70.00	73.38	72.85	44.50	93.00	0.26
24247	3"	105.0	86.00	89.31	88.70	48.00	100.00	0.38
24248	4"	132.0	110.00	114.76	114.07	57.50	120.00	0.58
24250	5"	-	-	-	-	-	-	1.06
24251	6"	193.0	164.00	168.83	168.00	77.00	162.00	1.62
24253	8"	246.0	214.00	219.84	218.70	100.00	216.00	3.17
24255	10"	305.0	-	273.81	272.67	140.00	270.00	6.00
24257	12"	370.0	-	324.61	323.47	160.00	338.00	10.00
24258	14"	393.0	-	356.39	-	178.00	406.00	14.00
24259	16"	450.0	-	407.19	-	204.00	439.00	18.00
24260	18"	505.0	-	457.99	-	228.00	496.00	22.00
24261	20"	563.0	-	517.07	-	254.00	522.00	27.00
24262	24"	674.0	-	611.58	-	305.00	652.00	34.00

PART	NOMINAL SIZE	COUPLING - T x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
25501	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.02
25503	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.03
25505	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.05
25507	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.08
25508	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.10
25509	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.14
25510	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.26
25511	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.38
25512	4"	132.0	110.00	114.76	114.07	57.50	117.50	0.58

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Bushes

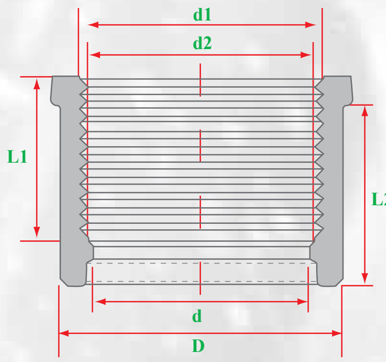


S x S

PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
24819	3/4" > 1/2"	26.67	19.00	21.54	21.23	22.50	25.50	0.01
24822	1 > 1/2"	33.40	19.00	21.54	21.23	22.50	29.00	0.03
24823	1 > 3/4"	33.40	24.00	26.87	26.57	25.50	29.00	0.02
24826	1 1/4 > 1/2"	42.16	19.00	21.54	21.23	22.50	32.00	0.05
24827	1 1/4 > 3/4"	42.16	24.00	26.87	26.57	25.50	32.00	0.05
24828	1 1/4 > 1"	42.16	31.00	33.65	33.27	29.00	32.00	0.03
24831	1 1/2 > 1/2"	48.26	19.00	21.54	21.23	22.50	35.00	0.04
24832	1 1/2 > 3/4"	48.26	24.00	26.87	26.57	25.50	35.00	0.06
24833	1 1/2 > 1"	48.26	31.00	33.65	33.27	29.00	35.00	0.06
24834	1 1/2 > 1 1/4"	48.26	40.00	42.42	42.04	32.00	35.00	0.04
24837	2 > 1/2"	60.33	19.00	21.54	21.23	22.50	38.50	0.10
24838	2 > 3/4"	60.33	24.00	26.87	26.57	25.50	38.50	0.09
24839	2 > 1"	60.33	31.00	33.65	33.27	29.00	38.50	0.09
24840	2 > 1 1/4"	60.33	40.00	42.42	42.04	32.00	38.50	0.09
24841	2 > 1 1/2"	60.33	46.00	48.56	48.11	35.00	38.50	0.07
24846	2 1/2 > 1 1/2"	73.03	46.00	48.56	48.11	35.00	44.50	0.17
24847	2 1/2 > 2"	73.03	58.00	60.63	60.17	38.50	44.50	0.10
24850	3 > 1"	88.90	31.00	33.65	33.27	29.00	48.00	0.24
24852	3 > 1 1/2"	88.90	46.00	48.56	48.11	35.00	48.00	0.24
24853	3 > 2"	88.90	58.00	60.63	60.17	38.50	48.00	0.25
24854	3 > 2 1/2"	88.90	70.00	73.38	72.85	44.50	48.00	0.17
24860	4 > 2"	114.30	58.00	60.63	60.17	38.50	58.00	0.42
24861	4 > 2 1/2"	114.30	70.00	73.38	72.85	44.50	58.00	0.42
24862	4 > 3"	114.30	86.00	89.31	88.70	48.00	58.00	0.35
24863	5 > 4"	141.30	-	-	-	-	-	0.65
24886	6 > 2"	168.28	58.00	60.63	60.17	38.50	77.00	1.20
24888	6 > 3"	168.28	86.00	89.31	88.70	48.00	77.00	1.28
24889	6 > 4"	168.28	110.00	114.76	114.07	58.00	77.00	1.30
24900	8 > 2"	219.08	58.00	60.63	60.17	38.50	102.00	2.50
24902	8 > 3"	219.08	86.00	89.31	88.70	48.00	102.00	2.50
24903	8 > 4"	219.08	110.00	114.76	114.07	58.00	102.00	2.50
24905	8 > 6"	219.08	164.00	168.83	168.00	77.00	102.00	2.50
24913	10 > 4"	273.05	110.00	114.76	114.07	58.00	127.00	4.50
24916	10 > 6"	273.05	164.00	168.83	168.00	77.00	127.00	3.00
24918	10 > 8"	273.05	214.00	219.84	218.70	102.00	127.00	2.50
24926	12 > 8"	323.85	214.00	219.84	218.70	102.00	152.50	5.50
24928	12 > 10"	323.85	268.00	273.81	272.67	127.00	152.50	6.40
24934	14 > 12"	355.60	318.00	324.61	323.47	152.50	178.00	34.00
24940	16 > 14"	406.40	350.00	357.55	355.00	178.00	202.00	44.00
24943	18 > 16"	-	-	-	-	-	-	-
24946	20 > 16"	-	-	-	-	-	-	-
24947	20 > 18"	-	-	-	-	-	-	-
24948	24 > 20"	-	-	-	-	-	-	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Female Reducing Bushes



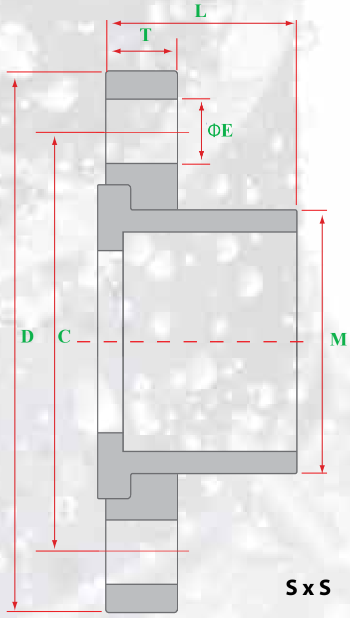
S x T

PART	NOMINAL SIZE	REDUCER - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
24999	1/2 > 3/8"	21.34	17.00	-	-	14.00	-	0.01
25000	1/2 > 1/4"	21.34	13.00	-	-	14.00	-	0.01
25001	3/4 > 1/4"	26.67	13.00	-	-	17.00	-	0.02
25002	3/4" > 1/2"	26.67	19.00	21.54	21.23	22.50	25.50	0.02
25005	1 > 1/2"	33.40	19.00	21.54	21.23	22.50	29.00	0.03
25006	1 > 3/4"	33.40	24.00	26.87	26.57	25.50	29.00	0.02
25009	1 1/4 > 1/2"	42.16	19.00	21.54	21.23	22.50	32.00	0.05
25010	1 1/4 > 3/4"	42.16	24.00	26.87	26.57	25.50	32.00	0.05
25011	1 1/4 > 1"	42.16	31.00	33.65	33.27	29.00	32.00	0.03
25014	1 1/2 > 1/2"	48.26	19.00	21.54	21.23	22.50	35.00	0.04
25015	1 1/2 > 3/4"	48.26	24.00	26.87	26.57	25.50	35.00	0.06
25016	1 1/2 > 1"	48.26	31.00	33.65	33.27	29.00	35.00	0.06
25017	1 1/2 > 1 1/4"	48.26	40.00	42.42	42.04	32.00	35.00	0.04
25020	2 > 1/2"	60.33	19.00	21.54	21.23	22.50	38.50	0.10
25021	2 > 3/4"	60.33	24.00	26.87	26.57	25.50	38.50	0.09
25022	2 > 1"	60.33	31.00	33.65	33.27	29.00	38.50	0.09
25023	2 > 1 1/4"	60.33	40.00	42.42	42.04	32.00	38.50	0.09
25024	2 > 1 1/2"	60.33	46.00	48.56	48.11	35.00	38.50	0.07
25036	3 > 2"	88.90	58.00	60.63	60.17	38.50	48.00	0.25
25043	4 > 2"	114.30	58.00	60.63	60.17	38.50	58.00	0.42
25045	4 > 3"	114.30	86.00	89.31	88.70	48.00	58.00	0.42

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

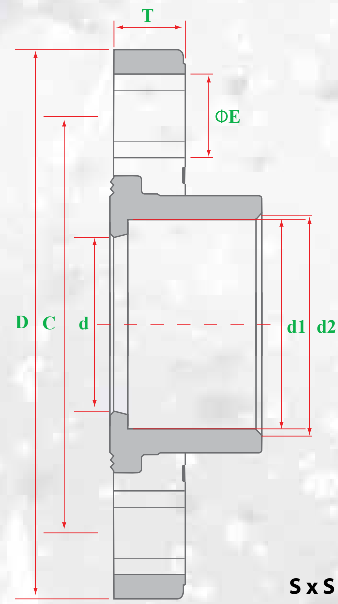
Van Stone Flanges

PART	NOMINAL SIZE	FLANGE S x S	UNIT OF MEASURE: MM					
		D	C	M	T	L	ΦE- N	APPROX. WT.
25291	1/2"	89.0	60.30	31.00	12.70	25.40	14.20	0.10
25292	3/4"	98.0	69.90	36.50	14.20	28.50	14.20	0.11
25293	1"	108.0	79.40	44.50	16.60	31.30	13.00	0.18
25294	1 1/4"	116.0	88.90	54.00	16.60	34.10	15.00	0.22
25295	1 1/2"	125.0	98.40	60.30	17.50	35.00	21.10	0.29
25296	2"	149.0	120.70	73.00	20.60	38.10	21.10	0.40
25297	2 1/2"	176.0	139.50	90.50	22.20	49.20	21.10	0.57
25298	3"	190.0	152.40	108.00	25.40	57.10	18.00	0.68
25299	4"	230.0	190.50	133.30	25.40	62.00	18.20	1.07
25301	5"	257.0	215.90	158.70	28.50	73.00	22.00	1.53
25302	6"	285.0	241.50	192.00	34.90	82.50	22.00	1.90
25304	8"	343.0	298.50	242.00	37.30	111.00	22.00	3.80
25306	10"	410.0	362.00	298.50	42.80	142.00	23.80	5.00
25308	12"	489.0	431.80	349.00	42.80	184.00	25.40	9.00
25309	14"	535.0	477.80	394.50	50.80	193.00	27.00	14.00
25310	16"	597.0	541.30	450.00	60.30	216.00	28.50	-
25311	18"	635.0	577.90	508.00	60.30	228.00	31.80	-
25312	20"	698.0	635.00	561.20	63.50	264.00	31.80	-
25313	24"	813.0	749.30	671.50	72.20	290.00	35.00	-



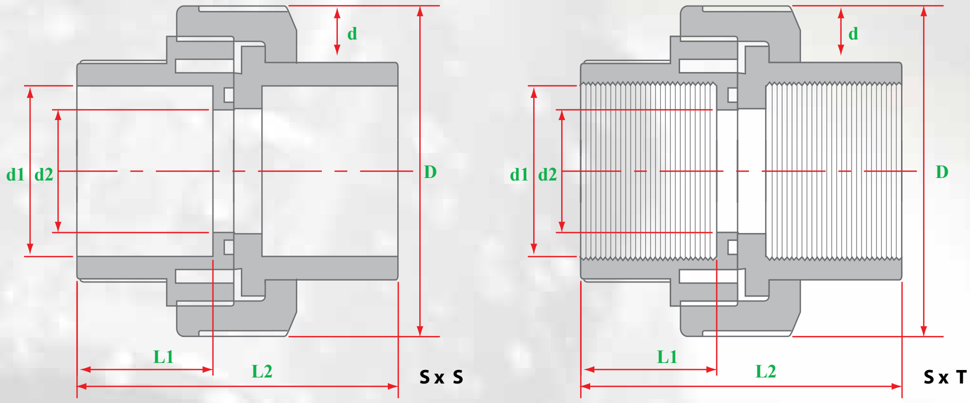
WTF[TM] Flanges

PART	NOMINAL SIZE	FLANGE S x S	UNIT OF MEASURE: MM						
		D	d	d1	d2	C	T	ΦE- N	APPROX. WT.
25318	1 1/2"	140.0	46.00	48.56	48.11	111.00	19.00	17 - 4	0.29
25319	2"	158.0	58.00	60.63	60.17	120.00	20.00	19 - 4	0.40
25320	2 1/2"	180.0	70.00	73.38	72.85	142.00	23.00	19 - 4	0.57
25321	3"	192.0	86.00	89.31	88.70	153.10	27.00	19 - 8	0.68
25322	4"	230.0	110.00	114.76	114.07	184.20	28.00	19 - 8	1.07
25325	6"	280.0	164.00	168.83	168.00	240.00	31.00	24 - 8	1.90
25327	8"	343.0	204.00	219.84	218.70	298.00	36.00	22 - 8	3.80
25328	10"	406.0	256.00	273.81	272.67	362.00	42.00	25 - 12	5.00
25329	12"	481.0	307.00	324.61	324.47	432.00	42.00	25 - 12	9.00



Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Unions



PART	NOMINAL SIZE	UNION - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
24124	1/2"	44.2	13.00	21.54	21.23	22.20	55.00	0.05
24125	3/4"	55.6	18.20	26.87	26.57	26.00	63.80	0.08
24126	1"	66.5	24.00	33.65	33.27	28.60	69.50	0.13
24127	1 1/4"	82.2	30.50	42.42	42.04	33.80	79.90	0.19
24128	1 1/2"	98.1	38.20	48.56	48.11	34.80	81.50	0.34
24129	2"	120.0	50.00	60.63	60.17	38.10	98.00	0.58
24130	2 1/2"	120.0	50.00	73.38	72.85	41.50	98.00	0.60
24131	3"	184.0	75.00	89.31	88.70	47.60	118.00	1.30
24132	4"	199.0	100.00	114.76	114.07	57.20	156.00	2.17

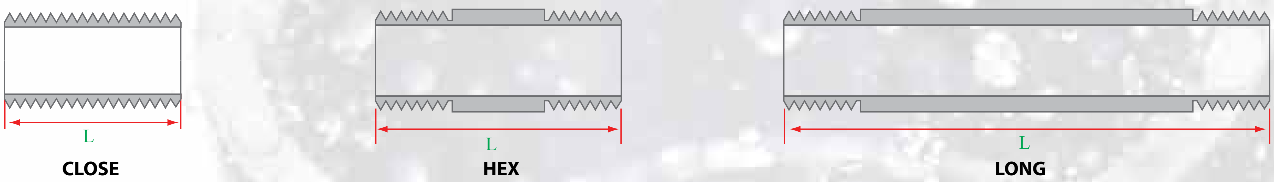
PART	NOMINAL SIZE	UNION - T x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
24135	1/2"	44.2	13.00	21.54	21.23	22.20	55.00	0.05
24136	3/4"	55.6	18.20	26.87	26.57	26.00	63.80	0.08
24137	1"	66.5	24.00	33.65	33.27	28.60	69.50	0.13
24138	1 1/4"	82.2	30.50	42.42	42.04	33.80	79.90	0.19
24139	1 1/2"	98.1	38.20	48.56	48.11	34.80	81.50	0.34
24140	2"	120.0	50.00	60.63	60.17	38.10	98.00	0.58
24141	2 1/2"	120.0	50.00	73.38	72.85	41.50	98.00	0.60
24142	3"	184.0	75.00	89.31	88.70	47.60	118.00	1.30
24143	4"	199.0	100.00	114.76	114.07	57.20	156.00	2.17

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC SCHEDULE 80 FITTINGS
Weights, Dimensions and Tolerances

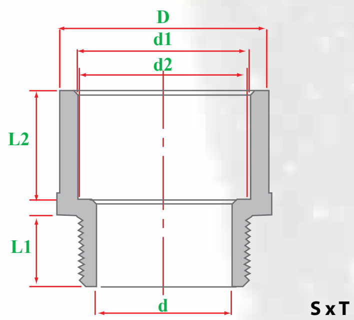
SECTION 3

Nipples



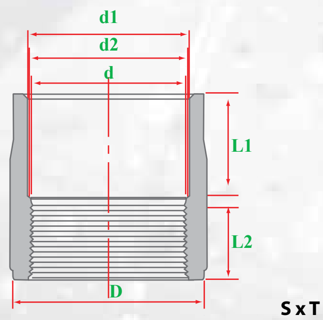
NOM. PIPE SIZE	CLOSE		HEX		3"LONG	4"LONG	5"LONG	6"LONG	8"LONG	10"LONG	12"LONG
	PART NO.	L	PART NO.	L	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.
1/2	25231	1 1/4	27220	1 1/2	25674	25688	25702	25716	25730	25744	25758
3/4	25232	1 3/8	27221	2	25675	25689	25703	25717	25731	25745	25759
1	25233	1 1/2	27222	2	25676	25690	25704	25718	25732	25746	25760
1 1/4	25234	1 5/8	27223	2 1/2	25677	25691	25705	25719	25733	25747	25761
1 1/2	25235	1 3/4	27224	2 1/2	25678	25692	25706	25720	25734	25748	25762
2	25236	2	27225	2 1/2	25679	25693	25707	25721	25735	25749	25763
2 1/2	25237	2 1/2	25226	3	-	25694	25708	25722	25736	25750	25764
3	25238	2 5/8	27227	3	-	256t95	27709	25723	25737	25751	25765
4	25239	2 7/8	27228	4	-	-	27710	25724	25738	25752	25766

Male Adaptors



PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
25056	1/2"	29.5	15.00	21.54	21.23	22.50	18.00	0.02
25057	3/4"	35.0	20.00	26.87	26.57	25.50	18.00	0.03
25058	1"	43.0	25.00	33.65	33.27	29.00	20.00	0.04
25059	1 1/4"	52.5	32.00	42.42	42.04	32.00	22.00	0.07
25060	1 1/2"	59.0	38.00	48.56	48.11	35.00	22.00	0.09
25061	2"	72.0	48.00	60.63	60.17	38.50	25.00	0.12
25062	2 1/2"	87.5	60.00	73.38	72.85	44.50	32.00	0.24
25063	3"	105.0	75.00	89.31	88.70	48.00	33.00	0.32
25064	4"	132.0	100.00	114.76	114.07	57.50	36.00	0.55

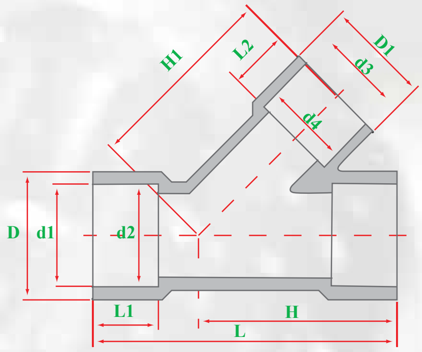
Female Adaptors



PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
25107	1/2"	29.5	18.00	21.54	21.23	22.50	20.00	0.02
25108	3/4"	35.0	22.50	26.87	26.57	25.50	20.00	0.04
25109	1"	43.0	28.00	33.65	33.27	29.00	22.50	0.06
25110	1 1/4"	52.5	36.00	42.42	42.04	32.00	23.00	0.10
25111	1 1/2"	59.0	43.00	48.56	48.11	35.00	25.00	0.14
25112	2"	72.0	55.00	60.63	60.17	38.50	27.00	0.22
25113	2 1/2"	87.5	64.00	73.38	72.85	44.50	35.00	0.34
25114	3"	105.0	80.00	89.31	88.70	48.00	38.00	0.52
25115	4"	132.0	106.00	114.76	114.07	57.50	38.00	0.75

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

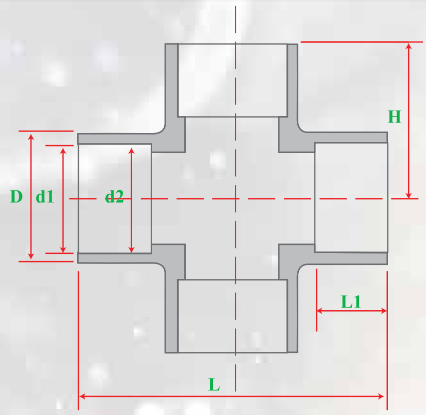
Wyes



S x S x S

PART	NOMINAL SIZE	WYE - S x S x S	UNIT OF MEASURE: MM					
		D	d1	d2	L1	L	H	APPROX. WT.
25661	1/2"	31.0	21.54	21.23	22.30	82.50	50.80	-
25662	3/4"	37.3	26.87	26.57	25.40	94.50	58.70	-
25663	1"	43.0t	33.65	33.27	28.60	111.10	71.40	-
25664	1 1/4"	54.8	42.42	42.04	31.80	128.60	85.70	-
25665	1 1/2"	62.7	48.56	48.11	35.00	146.00	100.00	-
25666	2"	77.0	60.63	60.17	38.20	175.40	120.60	-
25667	2 1/2"	88.9	73.38	72.85	44.50	209.50	154.00	-
25668	3"	109.5	89.31	88.70	44.70	244.50	173.00	-
25669	4"	136.5	114.76	114.07	57.20	297.00	209.50	-
25671	6"	196.0	168.83	168.00	76.20	403.00	311.00	-
25673	8"	258.0	219.84	218.70	102.00	600.00	435.80	-

Crosses

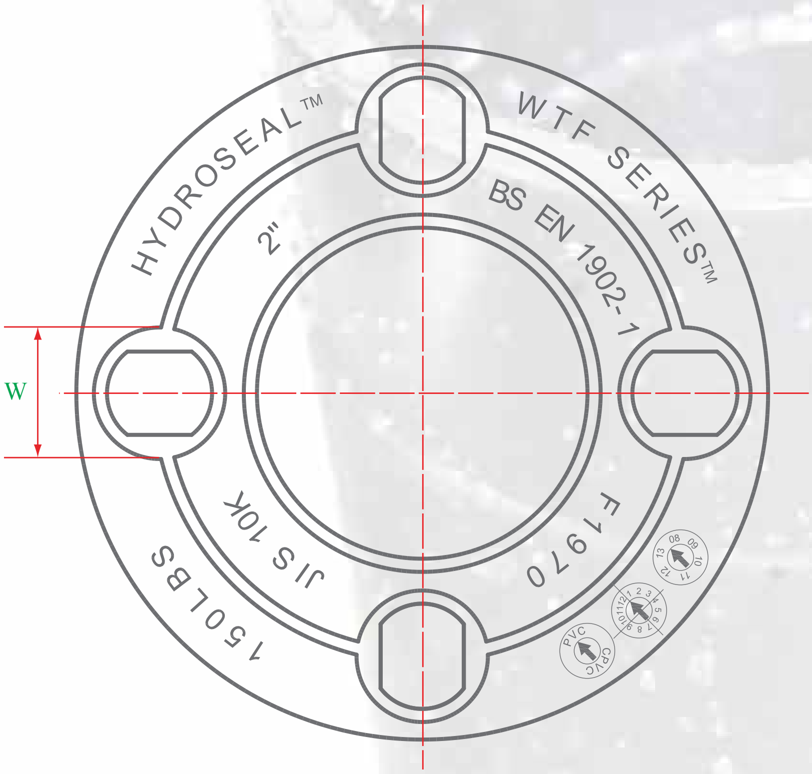


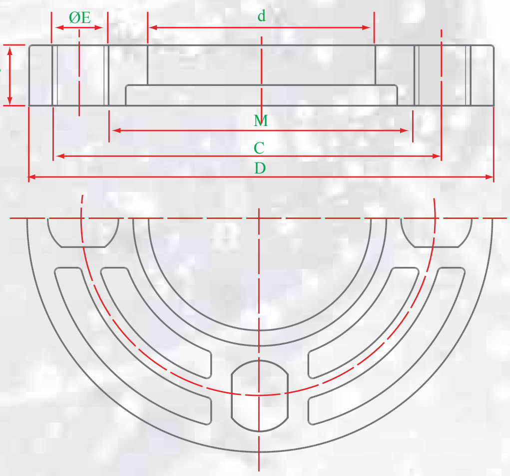
S x S x S x S

PART	NOMINAL SIZE	CROSS S x S x S x S	UNIT OF MEASURE: MM					
		D	d1	d2	L	L1	H	APPROX. WT.
24196	1/2"	30.2	21.54	21.23	69	22.3	34.1	-
24197	3/4"	35	26.87	26.57	82.5	25.4	41.3	-
24198	1"	42.8	33.65	33.27	106.4	28.6	53.2	-
24199	1 1/4"	52.4	42.42	42.04	119	28.6	59.5	-
24200	1 1/2"	61.9	48.56	48.11	133.4	35	66.7	-
24201	2"	77.8	60.63	60.17	152.4	38.2	76.2	-
24202	2 1/2"	91.3	73.38	72.85	174.6	44.5	87.3	-
24203	3"	106.3	89.31	88.70	200	47.7	100	-
24204	4"	133.3	114.76	114.07	247.6	57.2	123.8	-
24206	6”	190.5	168.83	168.00	533.4	76.2	266.7	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2467. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

WTF™ Series Universal Van Stone Backing Rings





PART	NOMINAL SIZE	WTF FLANGE S x S	UNIT OF MEASURE: MM						
		d	M	C	D	T	ΦE-N	W	APPROX. WT.
25314	1/2"	31.50	37.00	64.76	95.00	12.00	20.5 - 4	16.00	0.09
25315	3/4"	36.50	42.50	71.80	100.00	13.50	18.0 - 4	16.00	0.11
25316	1"	44.50	51.00	85.20	118.00	15.50	21.8 - 4	17.00	0.18
25317	1 1/4"	53.00	61.50	95.00	128.00	17.00	22.0 - 4	17.00	0.22
25318	1 1/2"	62.00	71.50	105.00	140.00	18.50	22.0 - 4	17.00	0.29
25319	2"	75.50	86.00	120.00	158.00	20.00	24.0 - 4	19.00	0.40
25320	2 1/2"	92.00	100.00	137.00	180.00	23.00	26.0 - 4	19.00	0.58
25321	3"	109.00	119.00	153.10	192.00	27.00	24.0 - 8	19.00	0.75
25322	4"	135.00	151.00	184.20	230.00	28.00	24.0 - 8	19.00	1.10
25325	6"	195.00	206.00	240.00	280.00	31.00	24.0 - 8	24.00	1.80
25329	8"	-	-	-	-	-	-	-	-

Notes: Flange bolt hole patterns meet ANSI B16.5 as well as BS 4504. PVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC SCHEDULE 80 FITTINGS

Manufacturer's Product Specification

Scope

This specification sheet covers the manufacturer's requirements for CPVC Schedule 80 pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

CPVC Materials

Rigid CPVC (chlorinated polyvinyl chloride) used in the manufacture of Schedule 80 fittings is Type IV, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

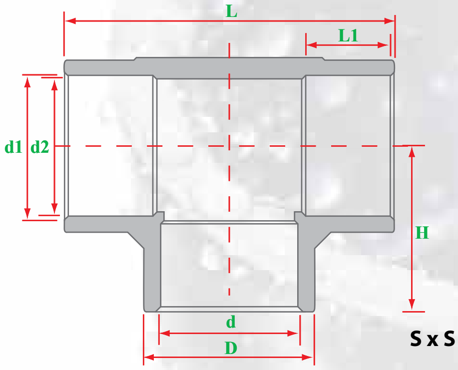
Dimensions

Physical dimensions and tolerances of CPVC Schedule 80 IPS (Iron Pipe Size) fittings meet the requirements of ASTM specification F-439 for socket type fittings and ASTM F-437 for threaded fittings. Threaded fittings have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

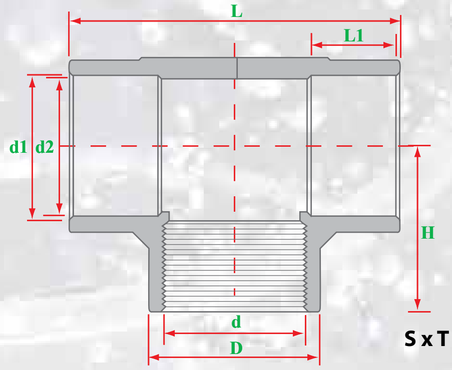
Marking

CPVC Schedule 80 fittings are marked as prescribed in ASTM F-439 and F-437 to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation F-439 (socket) or F-437 (threaded).

Tees



S x S



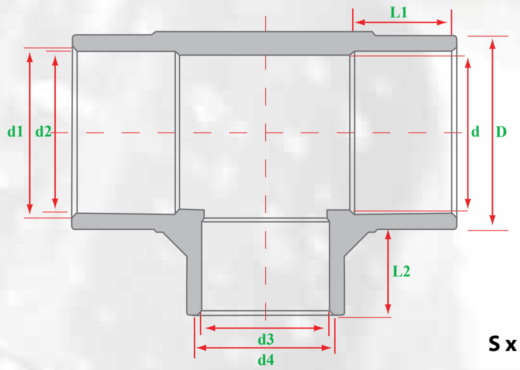
S x T

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM						
		D	d	d1	d2	L	L1	H	APPROX. WT.
26216	1/2"	29.5	19.00	21.54	21.23	70.00	22.50	35.00	0.05
26217	3/4"	35.0	24.00	26.87	26.57	80.00	25.50	40.00	0.07
26218	1"	43.0	31.00	33.65	33.27	95.00	29.00	47.50	0.11
26219	1 1/4"	52.5	40.00	42.42	42.04	112.00	32.00	55.00	0.17
26220	1 1/2"	59.0	46.00	48.56	48.11	124.00	35.00	62.00	0.22
26221	2"	72.0	58.00	60.63	60.17	143.00	38.50	71.50	0.34
26222	2 1/2"	87.5	70.00	73.38	72.85	167.00	44.50	83.50	0.58
26223	3"	105.0	86.00	89.31	88.70	190.00	48.00	95.00	0.86
26224	4"	132.0	110.00	114.76	114.07	235.00	57.50	117.50	1.48
26226	5"	-	-	-	-		-	-	3.20
26227	6"	193.0	164.00	168.83	168.00	334.00	77.00	167.00	4.30
26229	8"	245.0	214.00	219.84	218.70	448.00	100.00	224.00	8.00
26231	10"	318.0	-	273.81	272.67	585.00	140.00	292.00	21.00
26233	12"	356.0	-	324.61	323.47	672.00	160.00	338.00	29.00
26234	14"	399.0	-	356.39	-	738.00	178.00	370.00	35.00
26235	16"	450.0	-	407.19	-	866.00	204.00	433.00	38.00
26236	18"	505.0	-	457.99	-	980.00	228.00	490.00	48.00
26237	20"	563.0	-	517.07	-	1022.00	254.00	510.00	56.00
26238	24"	674.0	-	611.58	-	1225.00	305.00	613.00	84.00

PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM						
		D	d	d1	d2	L	L1	H	APPROX. WT.
26113	1/2"	29.5	19.00	21.54	21.23	70.00	22.50	35.00	0.05
26114	3/4"	35.0	24.00	26.87	26.57	80.00	25.50	40.00	0.07
26115	1"	43.0	31.00	33.65	33.27	95.00	29.00	47.50	0.11
26116	1 1/4"	52.5	40.00	42.42	42.04	112.00	32.00	55.00	0.17
26117	1 1/2"	59.0	46.00	48.56	48.11	124.00	35.00	62.00	0.22
26118	2"	72.0	58.00	60.63	60.17	143.00	38.50	71.50	0.34
26119	2 1/2"	87.5	70.00	73.38	72.85	167.00	44.50	83.50	0.58
26120	3"	105.0	86.00	89.31	88.70	190.00	48.00	95.00	0.86
26121	4"	132.0	110.00	114.76	114.07	235.00	57.50	117.50	1.48

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Tees



S x S

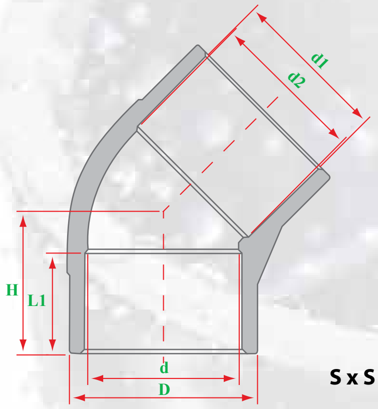
PART	NOMINAL SIZE	RED TEE - S x S	UNIT OF MEASURE: MM							
		D	d	d1	d2	d3	d4	L1	L2	APPROX. WT.
24551	3/4" > 1/2"	35.00	24.00	26.87	26.57	21.54	21.23	25.50	22.50	0.06
24554	1 > 1/2"	43.00	31.00	33.65	33.27	21.54	21.23	29.00	22.50	0.10
24555	1 > 3/4"	43.00	31.00	33.65	33.27	26.87	26.57	29.00	25.50	0.10
24558	1 1/4 > 1/2"	52.50	40.00	42.42	42.04	21.54	21.23	32.00	22.50	0.15
24559	1 1/4 > 3/4"	52.50	40.00	42.42	42.04	26.87	26.57	32.00	25.50	0.15
24560	1 1/4 > 1"	52.50	40.00	42.42	42.04	33.65	33.27	32.00	29.00	0.16
24563	1 1/2 > 1/2"	59.00	46.00	48.56	48.11	21.54	21.23	35.00	22.50	0.20
24564	1 1/2 > 3/4"	59.00	46.00	48.56	48.11	26.87	26.57	35.00	25.50	0.20
24565	1 1/2 > 1"	59.00	46.00	48.56	48.11	33.65	33.27	35.00	29.00	0.20
24566	1 1/2 > 1 1/4"	59.00	46.00	48.56	48.11	42.42	42.04	35.00	32.00	0.21
24569	2 > 1/2"	74.00	58.00	60.63	60.17	21.54	21.23	38.50	22.50	0.30
24570	2 > 3/4"	74.00	58.00	60.63	60.17	26.87	26.57	38.50	25.50	0.30
24571	2 > 1"	74.00	58.00	60.63	60.17	33.65	33.27	38.50	29.00	0.30
24572	2 > 1 1/4"	74.00	58.00	60.63	60.17	42.42	42.04	38.50	32.00	0.31
24573	2 > 1 1/2"	74.00	58.00	60.63	60.17	48.56	48.11	38.50	35.00	0.32
24578	2 1/2 > 1 1/2"	87.50	70.00	73.38	72.85	48.56	48.11	44.50	35.00	0.52
24579	2 1/2 > 2"	87.50	70.00	73.38	72.85	60.63	60.17	44.50	38.50	0.54
24582	3 > 1"	105.00	86.00	89.31	88.70	33.65	33.27	48.00	29.00	0.76
24584	3 > 1 1/2"	105.00	86.00	89.31	88.70	48.56	48.11	48.00	35.00	0.77
24585	3 > 2"	105.00	86.00	89.31	88.70	60.63	60.17	48.00	38.50	0.78
24586	3 > 2 1/2"	105.00	86.00	89.31	88.70	73.38	72.85	48.00	44.50	0.81
24592	4 > 2"	134.00	110.00	114.76	114.07	60.63	60.17	58.00	38.50	1.35
24593	4 > 2 1/2"	134.00	110.00	114.76	114.07	73.38	72.85	58.00	44.50	1.38
24594	4 > 3"	134.00	110.00	114.76	114.07	89.31	88.70	58.00	48.00	1.40
24620	6 > 3"	193.00	164.00	168.83	168.00	89.31	88.70	77.00	48.00	3.85
24621	6 > 4"	193.00	164.00	168.83	168.00	114.76	114.07	77.00	58.00	3.95
24637	8 > 6"	246.00	210.00	219.84	218.70	168.83	168.00	102.00	77.00	7.00
24650	10 > 8"	305.00	265.00	273.81	272.67	219.84	218.70	127.00	102.00	24.00
24660	12 > 10"	362.00	315.00	324.61	323.47	273.81	272.67	152.50	127.00	32.00

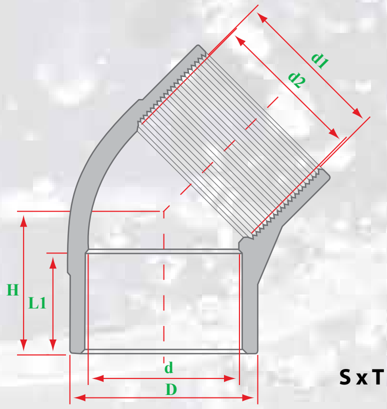
Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC SCHEDULE 80 FITTINGS

Weights, Dimensions and Tolerances

45° Elbows



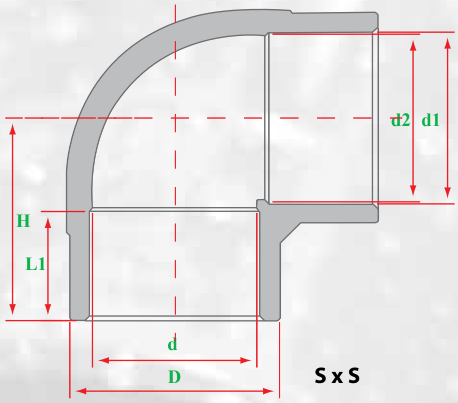


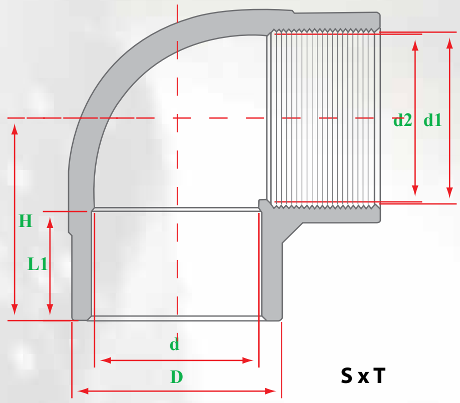
PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
26168	1/2"	29.5	19.00	21.54	21.23	22.50	29.50	0.03
26169	3/4"	35.0	24.00	26.87	26.57	25.50	33.00	0.04
26170	1"	43.0	31.00	33.65	33.27	29.00	38.50	0.07
26171	1 1/4"	52.5	40.00	42.42	42.04	32.00	44.00	0.11
26172	1 1/2"	59.0	46.00	48.56	48.11	35.00	48.50	0.14
26173	2"	72.0	58.00	60.63	60.17	38.50	54.50	0.21
26174	2 1/2"	87.5	70.00	73.38	72.85	44.50	63.00	0.36
26175	3"	105.0	86.00	89.31	88.70	48.00	70.00	0.55
26176	4"	132.0	110.00	114.76	114.07	57.50	85.00	0.90
26178	5"	-	-	-	-	-	-	1.67
26179	6"	193.0	164.00	168.83	168.00	77.00	119.50	2.65
26181	8"	245.0	214.00	219.84	218.70	100.00	153.90	7.00
26183	10"	318.0	-	273.81	272.67	140.00	206.30	11.00
26185	12"	356.0	-	324.61	323.47	160.00	271.40	15.00
26186	14"	399.0	-	356.39	-	178.00	298.60	21.00
26187	16"	450.0	-	407.19	-	204.00	345.00	24.00
26188	18"	505.0	-	457.99	-	228.00	381.00	32.00
26189	20"	563.0	-	517.07	-	254.00	405.00	38.00
26190	24"	674.0	-	611.58	-	305.00	478.00	53.00

PART	NOMINAL SIZE	45 ELL - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
27594	1/2"	29.5	19.00	21.54	21.23	22.50	29.50	0.03
27595	3/4"	35.0	24.00	26.87	26.57	25.50	33.00	0.04
27596	1"	43.0	31.00	33.65	33.27	29.00	38.50	0.07
27597	1 1/4"	52.5	40.00	42.42	42.04	32.00	44.00	0.11
27598	1 1/2"	59.0	46.00	48.56	48.11	35.00	48.50	0.14
27599	2"	72.0	58.00	60.63	60.17	38.50	54.50	0.21
27600	2 1/2"	87.5	70.00	73.38	72.85	44.50	63.00	0.36
27601	3"	105.0	86.00	89.31	88.70	48.00	70.00	0.55
27602	4"	132.0	110.00	114.76	114.07	57.50	85.00	0.90

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

90° Elbows



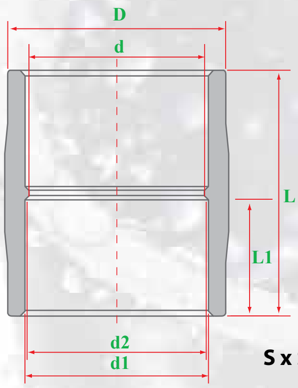


PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
26003	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.03
26004	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.05
26005	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.08
26006	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.13
26007	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.17
26008	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.26
26009	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.45
26010	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.70
26011	4"	132.0	110.00	114.76	114.07	57.50	117.50	1.17
26013	5"	-	-	-	-	-	-	1.94
26014	6"	193.0	164.00	168.83	168.00	77.00	167.00	3.03
26016	8"	246.0	214.00	219.84	218.70	100.00	224.00	7.80
26018	10"	314.0	-	273.81	272.67	140.00	340.00	13.00
26020	12"	362.0	-	324.61	323.47	160.00	338.00	23.00
26021	14"	397.0	-	356.39	-	178.00	369.00	27.00
26022	16"	450.0	-	407.19	-	204.00	427.00	29.00
26023	18"	505.0	-	457.99	-	228.00	490.00	38.00
26024	20"	563.0	-	517.07	-	254.00	510.00	47.00
26025	24"	674.0	-	611.58	-	305.00	617.00	63.00

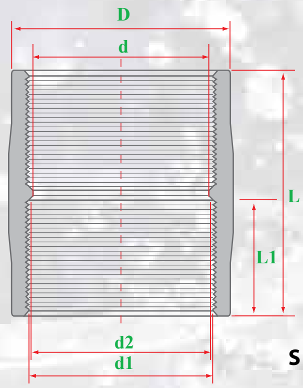
PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
26094	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.03
26095	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.05
26096	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.08
26097	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.13
26098	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.17
26099	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.26
26100	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.45
26101	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.70
26102	4"	134.0	110.00	114.76	114.07	57.50	117.50	1.17

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Couplings



S x S



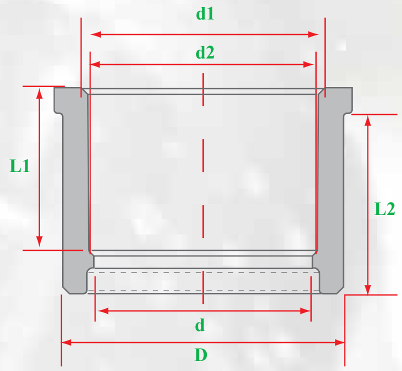
S x T

PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L	APPROX. WT.
26240	1/2"	29.5	19.00	21.54	21.23	22.50	48.00	0.02
26241	3/4"	35.0	24.00	26.87	26.57	25.50	54.00	0.03
26242	1"	43.0	31.00	33.65	33.27	29.00	61.00	0.05
26243	1 1/4"	52.5	40.00	42.42	42.04	32.00	68.00	0.08
26244	1 1/2"	59.0	46.00	48.56	48.11	35.00	74.00	0.10
26245	2"	72.0	58.00	60.63	60.17	38.50	81.00	0.14
26246	2 1/2"	87.5	70.00	73.38	72.85	44.50	93.00	0.26
26247	3"	105.0	86.00	89.31	88.70	48.00	100.00	0.38
26248	4"	132.0	110.00	114.76	114.07	57.50	120.00	0.58
26250	5"	-	-	-	-	-	-	1.06
26251	6"	193.0	164.00	168.83	168.00	77.00	162.00	1.62
26253	8"	246.0	214.00	219.84	218.70	100.00	216.00	3.17
26255	10"	305.0	-	273.81	272.67	140.00	270.00	6.00
26257	12"	370.0	-	324.61	323.47	160.00	338.00	10.00
26258	14"	393.0	-	356.39	-	178.00	406.00	14.00
26259	16"	450.0	-	407.19	-	204.00	439.00	18.00
26260	18"	505.0	-	457.99	-	228.00	496.00	22.00
26261	20"	563.0	-	517.07	-	254.00	522.00	27.00
26262	24"	674.0	-	611.58	-	305.00	652.00	34.00

PART	NOMINAL SIZE	COUPLING - T x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
27501	1/2"	29.5	19.00	21.54	21.23	22.50	35.00	0.02
27503	3/4"	35.0	24.00	26.87	26.57	25.50	40.00	0.03
27505	1"	43.0	31.00	33.65	33.27	29.00	47.50	0.05
27507	1 1/4"	52.5	40.00	42.42	42.04	32.00	55.00	0.08
27508	1 1/2"	59.0	46.00	48.56	48.11	35.00	62.00	0.10
27509	2"	72.0	58.00	60.63	60.17	38.50	71.50	0.14
27510	2 1/2"	87.5	70.00	73.38	72.85	44.50	83.50	0.26
27511	3"	105.0	86.00	89.31	88.70	48.00	95.00	0.38
27512	4"	132.0	110.00	114.76	114.07	57.50	117.50	0.58

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Bushes



S x S

PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
26819	3/4 > 1/2"	26.67	19.00	21.54	21.23	22.50	25.50	0.01
26822	1 > 1/2"	33.40	19.00	21.54	21.23	22.50	29.00	0.03
26823	1 > 3/4"	33.40	24.00	26.87	26.57	25.50	29.00	0.02
26826	1 1/4 > 1/2"	42.16	19.00	21.54	21.23	22.50	32.00	0.05
26827	1 1/4 > 3/4"	42.16	24.00	26.87	26.57	25.50	32.00	0.05
26828	1 1/4 > 1"	42.16	31.00	33.65	33.27	29.00	32.00	0.03
26831	1 1/2 > 1/2"	48.26	19.00	21.54	21.23	22.50	35.00	0.04
26832	1 1/2 > 3/4"	48.26	24.00	26.87	26.57	25.50	35.00	0.06
26833	1 1/2 > 1"	48.26	31.00	33.65	33.27	29.00	35.00	0.06
26834	1 1/2 > 1 1/4"	48.26	40.00	42.42	42.04	32.00	35.00	0.04
26837	2 > 1/2"	60.33	19.00	21.54	21.23	22.50	38.50	0.10
26838	2 > 3/4"	60.33	24.00	26.87	26.57	25.50	38.50	0.09
26839	2 > 1"	60.33	31.00	33.65	33.27	29.00	38.50	0.09
26840	2 > 1 1/4"	60.33	40.00	42.42	42.04	32.00	38.50	0.09
26841	2 > 1 1/2"	60.33	46.00	48.56	48.11	35.00	38.50	0.07
26846	2 1/2 > 1 1/2"	73.03	46.00	48.56	48.11	35.00	44.50	0.17
26847	2 1/2 > 2"	73.03	58.00	60.63	60.17	38.50	44.50	0.10
26850	3 > 1"	88.90	31.00	33.65	33.27	29.00	48.00	0.24
26852	3 > 1 1/2"	88.90	46.00	48.56	48.11	35.00	48.00	0.24
26853	3 > 2"	88.90	58.00	60.63	60.17	38.50	48.00	0.25
26854	3 > 2 1/2"	88.90	70.00	73.38	72.85	44.50	48.00	0.17
26860	4 > 2"	114.30	58.00	60.63	60.17	38.50	58.00	0.42
26861	4 > 2 1/2"	114.30	70.00	73.38	72.85	44.50	58.00	0.42
26862	4 > 3"	114.30	86.00	89.31	88.70	48.00	58.00	0.35
26863	5 > 4"	-	-	-	-	-	-	0.65
26886	6 > 2"	168.28	58.00	60.63	60.17	38.50	77.00	1.20
26888	6 > 3"	168.28	86.00	89.31	88.70	48.00	77.00	1.28
26889	6 > 4"	168.28	110.00	114.76	114.07	58.00	77.00	1.30
26900	8 > 2"	219.08	58.00	60.63	60.17	38.50	102.00	2.50
26902	8 > 3"	219.08	86.00	89.31	88.70	48.00	102.00	2.50
26903	8 > 4"	219.08	110.00	114.76	114.07	58.00	102.00	2.50
26905	8 > 6"	219.08	164.00	168.83	168.00	77.00	102.00	2.50
26913	10 > 4"	273.05	110.00	114.76	114.07	58.00	127.00	4.50
26916	10 > 6"	273.05	164.00	168.83	168.00	77.00	127.00	3.00
26918	10 > 8"	273.05	214.00	219.84	218.70	102.00	127.00	2.50
26926	12 > 8"	323.85	214.00	219.84	218.70	102.00	152.50	5.50
26928	12 > 10"	323.85	268.00	273.81	272.67	127.00	152.50	6.40
26934	14 > 12"	355.60	318.00	324.61	323.47	152.50	178.00	34.00
26940	16 > 14"	406.40	350.00	357.55	355.00	178.00	202.00	44.00
26943	18 > 16"	-	-	-	-	-	-	-
26946	20 > 16"	-	-	-	-	-	-	-
26947	20 > 18"	-	-	-	-	-	-	-
26948	24 > 20"	-	-	-	-	-	-	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
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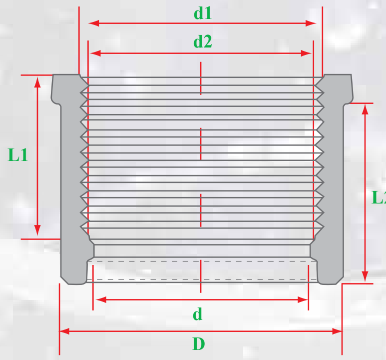
Female Reducing Bushes



PART	NOMINAL SIZE	REDUCER - S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
26999	1/2 > 3/8"	21.34	17.00	-	-	14.00	-	0.01
27000	1/2 > 1/4"	21.34	13.00	-	-	14.00	-	0.01
27001	3/4 > 1/4"	26.67	13.00	-	-	17.00	-	0.02
27002	3/4" > 1/2"	26.67	19.00	21.54	21.23	22.50	25.50	0.02
27005	1 > 1/2"	33.40	19.00	21.54	21.23	22.50	29.00	0.03
27006	1 > 3/4"	33.40	24.00	26.87	26.57	25.50	29.00	0.02
27009	1 1/4 > 1/2"	42.16	19.00	21.54	21.23	22.50	32.00	0.05
27010	1 1/4 > 3/4"	42.16	24.00	26.87	26.57	25.50	32.00	0.05
27011	1 1/4 > 1"	42.16	31.00	33.65	33.27	29.00	32.00	0.03
27014	1 1/2 > 1/2"	48.26	19.00	21.54	21.23	22.50	35.00	0.04
27015	1 1/2 > 3/4"	48.26	24.00	26.87	26.57	25.50	35.00	0.06
27016	1 1/2 > 1"	48.26	31.00	33.65	33.27	29.00	35.00	0.06
27017	1 1/2 > 1 1/4"	48.26	40.00	42.42	42.04	32.00	35.00	0.04
27020	2 > 1/2"	60.33	19.00	21.54	21.23	22.50	38.50	0.10
27021	2 > 3/4"	60.33	24.00	26.87	26.57	25.50	38.50	0.09
27022	2 > 1"	60.33	31.00	33.65	33.27	29.00	38.50	0.09
27023	2 > 1 1/4"	60.33	40.00	42.42	42.04	32.00	38.50	0.09
27024	2 > 1 1/2"	60.33	46.00	48.56	48.11	35.00	38.50	0.07
27036	3 > 2"	88.90	58.00	60.63	60.17	38.50	48.00	0.25
27043	4 > 2"	114.30	58.00	60.63	60.17	38.50	58.00	0.42
27045	4 > 3"	114.30	86.00	89.31	88.70	48.00	58.00	0.42

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
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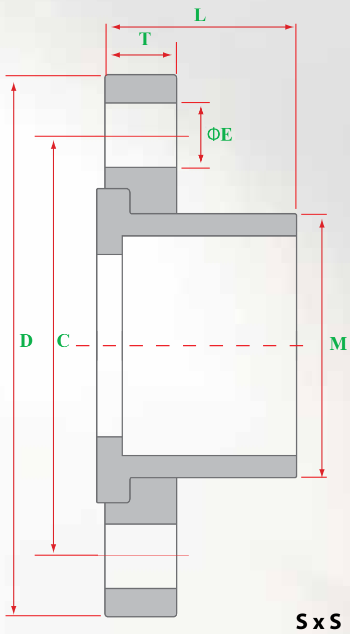
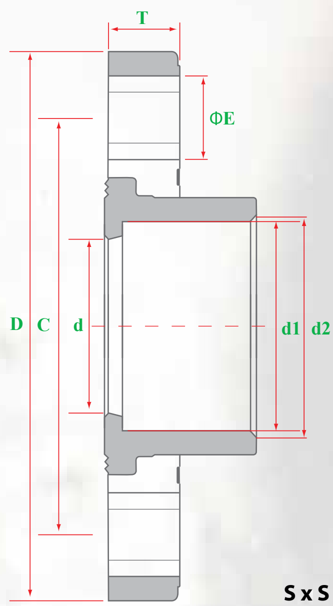
Van Stone Flanges

PART	NOMINAL SIZE	FLANGE S x S	UNIT OF MEASURE: MM					
		D	C	M	T	L	ΦE- N	APPROX. WT.
27291	1/2"	89.0	60.30	31.00	12.70	25.40	14.20	0.10
27292	3/4"	98.0	69.90	36.50	14.20	28.50	14.20	0.11
27293	1"	108.0	79.40	44.50	16.60	31.30	13.00	0.18
27294	1 1/4"	116.0	88.90	54.00	16.60	34.10	15.00	0.22
27295	1 1/2"	125.0	98.40	60.30	17.50	35.00	21.10	0.29
27296	2"	149.0	120.70	73.00	20.60	38.10	21.10	0.40
27297	2 1/2"	176.0	139.50	90.50	22.20	49.20	21.10	0.57
27298	3"	190.0	152.40	108.00	25.40	57.10	18.00	0.68
27299	4"	230.0	190.50	133.30	25.40	62.00	18.20	1.07
27301	5"	257.0	215.90	158.70	28.50	73.00	22.00	1.53
27302	6"	285.0	241.50	192.00	34.90	82.50	22.00	1.90
27304	8"	343.0	298.50	242.00	37.30	111.00	22.00	3.80
27306	10"	410.0	362.00	298.50	42.80	142.00	23.80	5.00
27308	12"	489.0	431.80	349.00	42.80	184.00	25.40	9.00
27309	14"	535.0	477.80	394.50	50.80	193.00	27.00	14.00
27310	16"	597.0	541.30	450.00	60.30	216.00	28.50	-
27311	18"	635.0	577.90	508.00	60.30	228.00	31.80	-
27312	20"	698.0	635.00	561.20	63.50	264.00	31.80	-
27313	24"	813.0	749.30	671.50	72.20	290.00	35.00	-



WTF Flanges

PART	NOMINAL SIZE	FLANGE S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	C	T	ΦE- N	APPROX. WT.
27318	1 1/2"	140.0	46.00	48.56	48.11	111.00	19.00	17 - 4	0.29
27319	2"	158.0	58.00	60.63	60.17	120.00	20.00	19 - 4	0.40
27320	2 1/2"	180.0	70.00	73.38	72.85	142.00	23.00	19 - 4	0.57
27321	3"	192.0	86.00	89.31	88.70	153.10	27.00	19 - 8	0.68
27322	4"	230.0	110.00	114.76	114.07	184.20	28.00	19 - 8	1.07
27325	6"	280.0	164.00	168.83	168.00	240.00	31.00	24 - 8	1.90
27327	8"	343.0	204.00	219.84	218.70	298.00	36.00	22 - 8	3.80
27328	10"	406.0	256.00	273.81	272.67	362.00	42.00	25 - 12	5.00
27329	12"	481.0	307.00	324.61	324.47	432.00	42.00	25 - 12	9.00



Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
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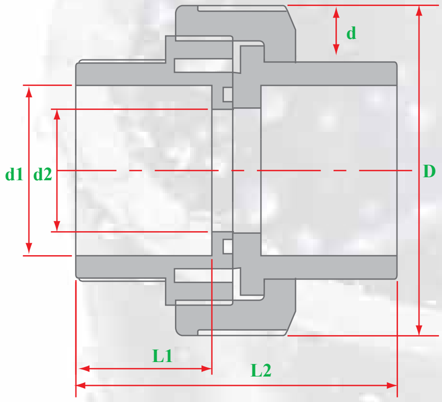
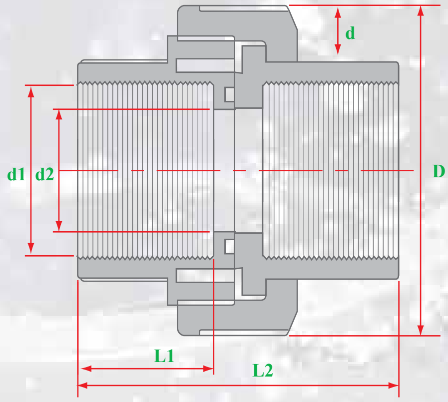
Unions



S x S



S x T

PART	NOMINAL SIZE	UNION - S x S	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
26124	1/2"	44.2	13.00	21.54	21.23	22.20	55.00	0.05
26125	3/4"	55.6	18.20	26.87	26.57	26.00	63.80	0.08
26126	1"	66.5	24.00	33.65	33.27	28.60	69.50	0.13
26127	1 1/4"	82.2	30.50	42.42	42.04	33.80	79.90	0.19
26128	1 1/2"	98.1	38.20	48.56	48.11	34.80	81.50	0.34
26129	2"	120.0	50.00	60.63	60.17	38.10	98.00	0.58
26130	2 1/2"	120.0	50.00	73.38	72.85	41.50	98.00	0.60
26131	3"	184.0	75.00	89.31	88.70	47.60	118.00	1.30
26132	4"	199.0	100.00	114.76	114.07	57.20	156.00	2.17

PART	NOMINAL SIZE	UNION - T x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	H	APPROX. WT.
26135	1/2"	44.2	13.00	21.54	21.23	22.20	55.00	0.05
26136	3/4"	55.6	18.20	26.87	26.57	26.00	63.80	0.08
26137	1"	66.5	24.00	33.65	33.27	28.60	69.50	0.13
26138	1 1/4"	82.2	30.50	42.42	42.04	33.80	79.90	0.19
26139	1 1/2"	98.1	38.20	48.56	48.11	34.80	81.50	0.34
26140	2"	120.0	50.00	60.63	60.17	38.10	98.00	0.58
26141	2 1/2"	120.0	50.00	73.38	72.85	41.50	98.00	0.60
26142	3"	184.0	75.00	89.31	88.70	47.60	118.00	1.30
26143	4"	199.0	100.00	114.76	114.07	57.20	156.00	2.17

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
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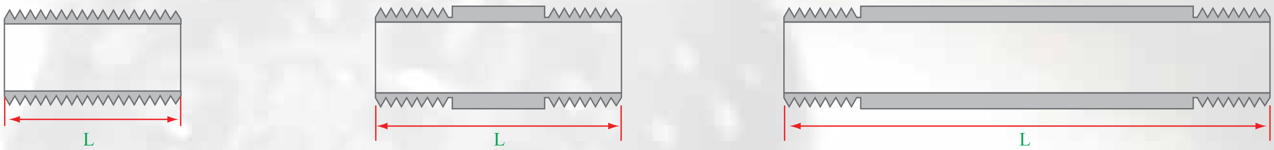
CPVC SCHEDULE 80 FITTINGS

Weights, Dimensions and Tolerances

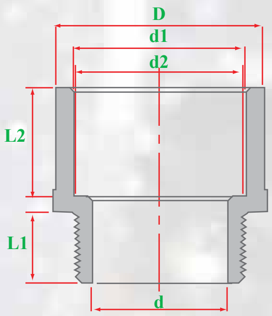
Nipples



CLOSE HEX LONG

NOM. PIPE SIZE	CLOSE		HEX		3"LONG	4"LONG	5"LONG	6"LONG	8"LONG	10"LONG	12"LONG
	PART NO.	L	PART NO.	L	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.
1/2"	25231	1 1/4"	27220	1 1/2"	25674	25688	25702	25716	25730	25744	25758
3/4"	25232	1 3/8"	27221	2"	25675	25689	25703	25717	25731	25745	25759
1"	25233	1 1/2"	27222	2"	25676	25690	25704	25718	25732	25746	25760
1 1/4"	25234	1 5/8"	27223	2 1/2"	25677	25691	25705	25719	25733	25747	25761
1 1/2"	25235	1 3/4"	27224	2 1/2"	25678	25692	25706	25720	25734	25748	25762
2"	25236	2"	27225	2 1/2"	25679	25693	25707	25721	25735	25749	25763
2 1/2"	25237	2 1/2"	25226	3"	-	25694	25708	25722	25736	25750	25764
3"	25238	2 5/8"	27227	3"	-	256t95	27709	25723	25737	25751	25765
4"	25239	2 7/8"	27228	4	-	-	27710	25724	25738	25752	25766

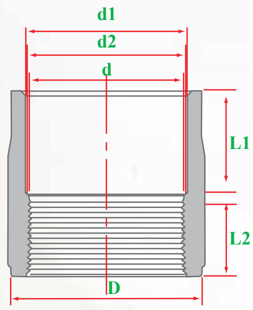
Male Adaptors



S x T

PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
27056	1/2"	29.5	15.00	21.54	21.23	22.50	18.00	0.02
27057	3/4"	35.0	20.00	26.87	26.57	25.50	18.00	0.03
27058	1"	43.0	25.00	33.65	33.27	29.00	20.00	0.04
27059	1 1/4"	52.5	32.00	42.42	42.04	32.00	22.00	0.07
27060	1 1/2"	59.0	38.00	48.56	48.11	35.00	22.00	0.09
27061	2"	72.0	48.00	60.63	60.17	38.50	25.00	0.12
27062	2 1/2"	87.5	60.00	73.38	72.85	44.50	32.00	0.24
27063	3"	105.0	75.00	89.31	88.70	48.00	33.00	0.32
27064	4"	132.0	100.00	114.76	114.07	57.50	36.00	0.55

Female Adaptors



S x T

PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM					
		D	d	d1	d2	L1	L2	APPROX. WT.
27107	1/2"	29.5	18.00	21.54	21.23	22.50	20.00	0.02
27108	3/4"	35.0	22.50	26.87	26.57	25.50	20.00	0.04
27109	1"	43.0	28.00	33.65	33.27	29.00	22.50	0.06
27110	1 1/4"	52.5	36.00	42.42	42.04	32.00	23.00	0.10
27111	1 1/2"	59.0	43.00	48.56	48.11	35.00	25.00	0.14
27112	2"	72.0	55.00	60.63	60.17	38.50	27.00	0.22
27113	2 1/2"	87.5	64.00	73.38	72.85	44.50	35.00	0.34
27114	3"	105.0	80.00	89.31	88.70	48.00	38.00	0.52
27115	4"	132.0	106.00	114.76	114.07	57.50	38.00	0.75

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
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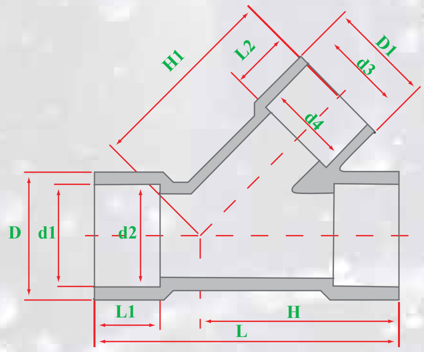
CPVC SCHEDULE 80 FITTINGS
Weights, Dimensions and Tolerances

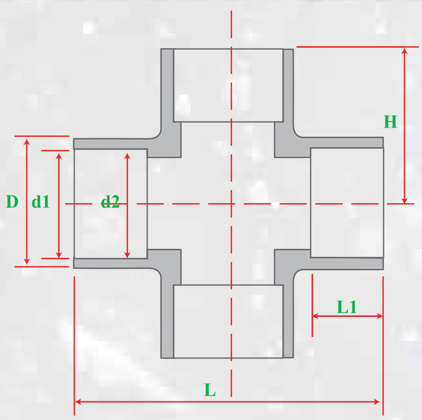
Wyes



S x S x S

PART	NOMINAL SIZE	WYE - S x S x S	UNIT OF MEASURE: MM					
		D	d1	d2	L1	L	H	APPROX. WT.
27661	1/2"	31.0	21.54	21.23	22.30	82.50	50.80	-
27662	3/4"	37.3	26.87	26.57	25.40	94.50	58.70	-
27663	1"	43.0	33.65	33.27	28.60	111.10	71.40	-
27664	1 1/4"	54.8	42.42	42.04	31.80	128.60	85.70	-
27665	1 1/2"	62.7	48.56	48.11	35.00	146.00	100.00	-
27666	2"	77.0	60.63	60.17	38.20	175.40	120.60	-
27667	2 1/2"	88.9	73.38	72.85	44.50	209.50	154.00	-
27668	3"	109.5	89.31	88.70	44.70	244.50	173.00	-
27669	4"	136.5	114.76	114.07	57.20	297.00	209.50	-
27671	6"	196.0	168.83	168.00	76.20	403.00	311.00	-
27673	8"	258.0	219.84	218.70	102.00	600.00	435.80	-

Crosses

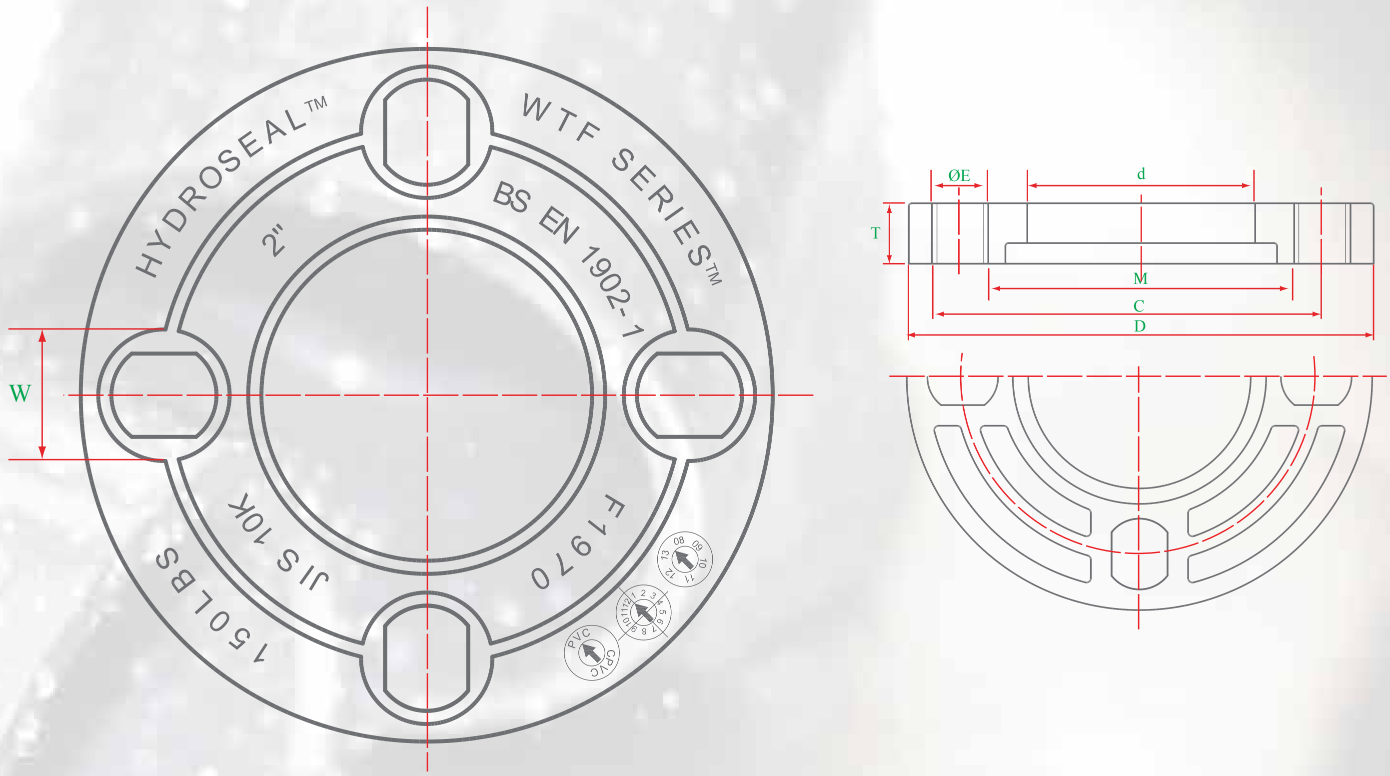


S x S x S x S

PART	NOMINAL SIZE	CROSS - S x S x S x S	UNIT OF MEASURE: MM					
		D	d1	d2	L	L1	H	APPROX. WT.
26196	1/2"	30.2	21.54	21.23	69	22.3	34.1	-
26197	3/4"	35	26.87	26.57	82.5	25.4	41.3	-
26198	1"	42.8	33.65	33.27	106.4	28.6	53.2	-
26199	1 1/4"	52.4	42.42	42.04	119	28.6	59.5	-
26200	1 1/2"	61.9	48.56	48.11	133.4	35	66.7	-
26201	2"	77.8	60.63	60.17	152.4	38.2	76.2	-
26202	2 1/2"	91.3	73.38	72.85	174.6	44.5	87.3	-
26203	3"	106.3	89.31	88.70	200	47.7	100	-
26204	4"	133.3	114.76	114.07	247.6	57.2	123.8	-
26206	6”	190.5	168.83	168.00	533.4	76.2	266.7	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

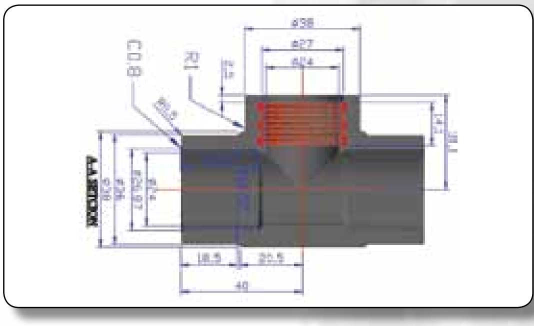
WTF™ Series Universal Van Stone Backing Rings

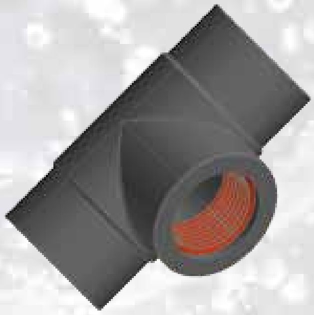


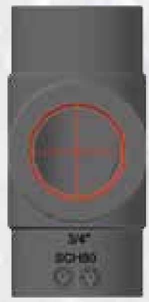
PART	NOMINAL SIZE	WTF FLANGE S x S	UNIT OF MEASURE: MM						
		d	M	C	D	T	ΦE-N	W	APPROX. WT.
27314	1/2"	31.50	37.00	64.76	95.00	12.00	20.5 - 4	16.00	0.09
27315	3/4"	36.50	42.50	71.80	100.00	13.50	18.0 - 4	16.00	0.11
27316	1"	44.50	51.00	85.20	118.00	15.50	21.8 - 4	17.00	0.18
27317	1 1/4"	53.00	61.50	95.00	128.00	17.00	22.0 - 4	17.00	0.22
27318	1 1/2"	62.00	71.50	105.00	140.00	18.50	22.0 - 4	17.00	0.29
27319	2"	75.50	86.00	120.00	158.00	20.00	24.0 - 4	19.00	0.40
27320	2 1/2"	92.00	100.00	137.00	180.00	23.00	26.0 - 4	19.00	0.58
27321	3"	109.00	119.00	153.10	192.00	27.00	24.0 - 8	19.00	0.75
27322	4"	135.00	151.00	184.20	230.00	28.00	24.0 - 8	19.00	1.10
27325	6"	195.00	206.00	240.00	280.00	31.00	24.0 - 8	24.00	1.80
27329	8"	-	-	-	-	-	-	-	-

Notes: Flange bolt hole patterns meet ANSI B16.5 as well as BS 4504.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Tees w/Brass

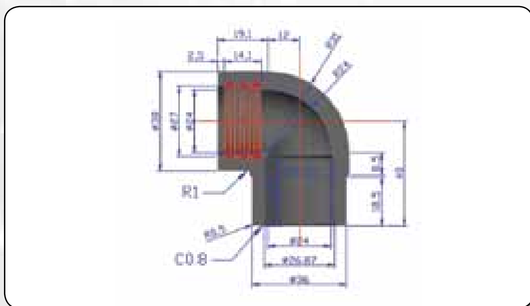






PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM			
		D	d	d1	L1	APPROX. WT.
27763	1/2"	COMING SOON				
27764	3/4 > 1/2"					
27765	3/4"					
27766	1"					
27768	1 1/2"					
27769	2"					

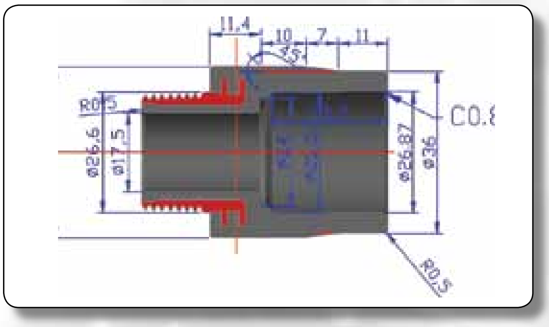
Elbows w/Brass



PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM			
		D	d	d1	L1	APPROX. WT.
27751	1/2"	COMING SOON				
27752	3/4 > 1/2"					
27758	3/4"					
27759	1"					
27761	1 1/2"					
27762	2"					

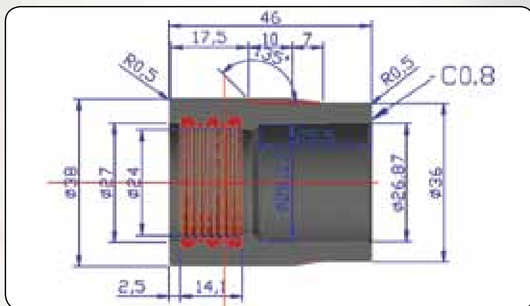
Notes: Physical dimensions and tolerances meet the requirements of ASTM Standards F-439 for socket type fittings and F-437 for threaded fittings.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Male Adaptors w/Brass



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM			
		D	d	d1	L1	APPROX. WT.
27770	1/2"	COMING SOON				
27771	3/4"					
27772	1"					
27773	1 1/4"					
27774	1 1/2"					
27775	2"					

Female Adaptors w/Brass



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM			
		D	d	d1	L1	APPROX. WT.
27744	1/2"	COMING SOON				
27745	3/4 > 1/2"					
27746	3/4"					
27747	1"					
27749	1 1/2"					
27750	2"					

Notes: Flange bolt hole patterns meet ANSI B16.5 as well as BS 4504.
CPVC material meets ASTM Standard D-1784.
Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC SCHEDULE 40 FITTINGS
Manufacturer's Product Specification

Scope
This specification sheet covers the manufacturer's requirements for PVC Schedule 40 pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

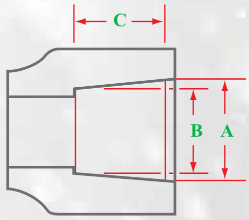
PVC Materials
Rigid PVC (polyvinyl chloride) used in the manufacture of Schedule 40 fittings is Type I, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions
Physical dimensions and tolerances of PVC Schedule 40 IPS (Iron Pipe Size) fittings meet the requirements of ASTM specification D-2466 for all fittings. Threaded fittings have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

Marking
PVC Schedule 40 fittings are marked as prescribed in ASTM D-2466 to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation D-2466.

PVC SCHEDULE 40 FITTINGS

Manufacturer's Product Specification

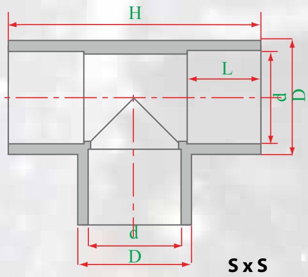


PVC SCHEDULE 40
TAPER SOCKET DIMENSIONS
(SOLVENT WELD TYPE)
ASTM D-2466 (PVC)

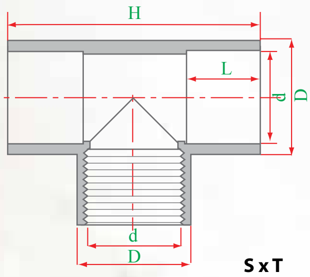
NOM. PIPE SIZE	PIPE O.D.	SOCKET ENTRANCE I.D.(A)		SOCKET BOTTOM I.D. (B)		MIN. SOCKET LENGTH (C)
		MIN.	MAX.	MIN.	MAX.	
1/2	0.840	0.844	0.852	0.832	0.840	0.688
3/4	1.050	1.054	1.062	1.042	1.050	0.719
1	1.315	1.320	1.330	1.305	1.315	0.875
1 1/4	1.660	1.665	1.675	1.650	1.660	0.938
1 1/2	1.900	1.906	1.918	1.888	1.900	1.094
2	2.375	2.381	2.393	2.363	2.375	1.156
2 1/2	2.875	2.882	2.896	2.861	2.875	1.750
3	3.500	3.508	3.524	3.484	3.500	1.875
4	4.500	4.509	4.527	4.482	4.500	2.000
6	6.625	6.636	6.658	6.603	6.625	3.000
8	8.625	8.640	8.670	8.595	8.625	4.000

For threaded female dimensions, see Schedule 80 Female Taper Threads on page 3.05.

Tees



S x S



S x T

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
20216	1/2"	27.9	21.34	19.00	63.70	0.03
26217	3/4"	33.5	26.67	26.00	83.10	0.05
26218	1"	40.8	33.40	27.50	92.10	0.08
26219	1 1/4"	50.1	42.16	29.00	104.00	0.10
26220	1 1/2"	56.6	48.26	34.00	120.00	0.16
26221	2"	69.0	60.33	40.00	143.50	0.20
26222	2 1/2"	84.4	73.03	45.00	168.20	0.43
26223	3"	100.9	88.90	48.00	190.00	0.60
26224	4"	127.3	114.30	54.00	230.50	0.95
20226	6"	183.6	168.30	76.70	332.00	2.30

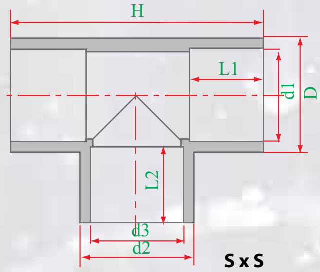
PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
20113	1/2"	27.9	21.34	19.00	63.30	0.03
20114	3/4"	33.5	26.67	26.00	83.00	0.05
20115	1"	40.8	33.40	27.50	92.10	0.08
20116	1 1/4"	50.1	42.16	29.00	101.40	0.10
20117	1 1/2"	56.6	48.26	34.00	117.50	0.16
20118	2"	69.0	60.33	40.00	142.00	0.20
20119	2 1/2"	84.4	73.03	45.00	165.00	0.43
20120	3"	100.9	88.90	48.00	180.00	0.60
20121	4"	127.3	114.30	54.00	220.50	0.95
20123	6"	183.6	168.30	76.70	318.00	2.30

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2466. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC SCHEDULE 40 FITTINGS

Weights, Dimensions and Tolerances

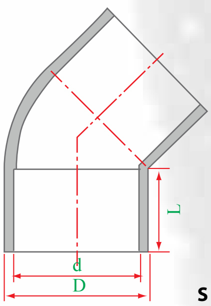
Reducing Tees



S x S

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM						
		D	d1	d2	d3	L1	L2	H	APPROX. WT.
20551	3/4 > 1/2"	33.8	26.67	28.00	21.34	26.00	19.00	77.80	0.05
20554	1 > 1/2"	40.9	33.40	27.50	21.34	27.50	19.00	80.30	0.06
20555	1 > 3/4"	40.9	33.40	33.50	26.67	27.50	26.00	86.00	0.06
20558	1 1/4 > 1/2"	50.1	42.16	27.50	21.34	29.00	19.00	83.30	0.08
20559	1 1/4 > 3/4"	50.1	42.16	33.50	26.67	29.00	26.00	88.60	0.08
20560	1 1/4 > 1"	50.1	42.16	40.90	33.40	29.00	27.50	95.60	0.08
20563	1 1/2 > 1/2"	56.6	48.26	27.50	21.34	34.00	19.00	93.30	0.10
20564	1 1/2 > 3/4"	56.6	48.26	33.50	26.67	34.00	26.00	99.00	0.10
20565	1 1/2 > 1"	56.6	48.26	40.90	33.40	34.00	27.50	105.10	0.10
20566	1 1/2 > 1 1/4"	56.6	48.26	50.10	42.16	34.00	29.00	114.00	0.10
20569	2 > 1/2"	69.0	60.33	27.50	21.34	40.00	19.00	105.30	0.40
20570	2 > 3/4"	69.0	60.33	33.50	26.67	40.00	26.00	110.60	0.16
20571	2 > 1"	69.0	60.33	40.90	33.40	40.00	27.50	117.50	0.16
20572	2 > 1 1/4"	69.0	60.33	50.10	42.16	40.00	29.00	125.80	0.16
20573	2 > 1 1/2"	69.0	60.33	56.60	48.26	40.00	34.00	131.90	0.16

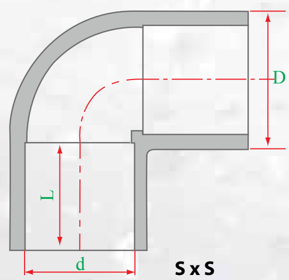
45° Elbows



S x S

PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM		
		D	d	L	APPROX. WT.
20168	1/2"	27.9	21.34	19.00	0.02
20169	3/4"	33.5	26.67	26.00	0.03
20170	1"	40.8	33.40	27.50	0.04
20171	1 1/4"	50.1	42.16	29.00	0.06
20172	1 1/2"	56.6	48.26	34.00	0.08
20173	2"	69.0	60.33	40.00	0.13
20174	2 1/2"	84.4	73.03	45.00	0.25
20175	3"	100.9	88.90	48.00	0.34
20176	4"	127.3	114.30	54.00	0.55
20178	6"	183.6	168.30	76.70	1.40

90° Elbows

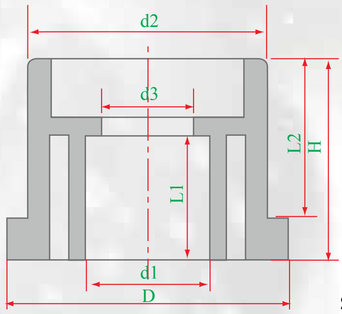


S x S

PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM		
		D	d	L	APPROX. WT.
20003	1/2"	27.9	21.34	19.00	0.02
20004	3/4"	33.5	26.67	26.00	0.04
20005	1"	40.8	33.40	27.50	0.05
20006	1 1/4"	50.1	42.16	29.00	0.08
20007	1 1/2"	56.6	48.26	34.00	0.11
20008	2"	69.0	60.33	40.00	0.18
20009	2 1/2"	84.4	73.03	45.00	0.33
20010	3"	100.9	88.90	48.00	0.44
20011	4"	127.3	114.30	54.00	0.78
20013	6"	183.6	168.30	76.70	1.90

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2466. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Bushes

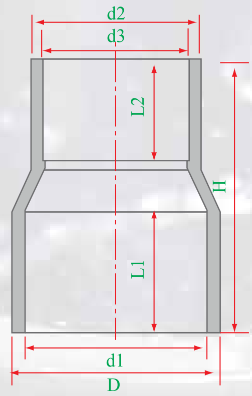


S x S

PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM						
		D	d1	d2	d3	H	L1	L2	APPROX. WT.
20819	3/4 > 1/2"	31.9	26.67	18.50	21.34	32.60	22.40	26.00	0.01
20822	1 > 1/2"	40.8	33.40	16.30	21.34	34.10	22.40	27.20	0.03
20823	1 > 3/4"	40.8	33.40	20.60	26.67	34.10	25.80	27.20	0.03
20826	1 1/4 > 1/2"	48.8	42.16	16.30	21.34	36.00	22.40	28.70	0.04
20827	1 1/4 > 3/4"	48.8	42.16	20.60	26.67	36.00	25.80	28.70	0.04
20828	1 1/4 > 1"	48.8	42.16	26.90	33.40	36.00	27.50	28.70	0.04
20831	1 1/2 > 1/2"	55.5	48.26	16.30	21.34	40.80	22.40	33.50	0.05
20832	1 1/2 > 3/4"	55.5	48.26	20.60	26.67	40.80	25.80	33.50	0.05
20833	1 1/2 > 1"	55.5	48.26	26.90	33.40	40.80	27.50	33.50	0.05
20834	1 1/2 > 1 1/4"	55.5	48.26	41.00	42.16	40.80	29.00	33.50	0.05
20837	2 > 1/2"	68.4	60.33	16.30	21.34	47.40	22.40	39.60	0.08
20838	2 > 3/4"	68.4	60.33	20.60	26.67	47.40	25.80	39.60	0.08
20839	2 > 1"	68.4	60.33	26.90	33.40	47.40	27.50	39.60	0.08
20840	2 > 1 1/4"	68.4	60.33	41.00	42.16	47.40	29.00	39.60	0.08
20841	2 > 1 1/2"	68.4	60.33	47.00	48.26	47.40	34.00	39.60	0.08
20852	3 > 1 1/2"	104.0	88.90	47.00	48.26	58.00	34.00	50.00	0.15
20853	3 > 2"	104.0	88.90	55.00	60.33	58.00	40.00	50.00	0.15
29860	4 > 2"	138.0	114.30	55.00	60.33	64.00	40.00	59.00	0.28
20889	6 > 4"	199.0	168.30	108.00	114.30	80.00	54.00	69.00	0.90

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2466. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Reducing Couplings



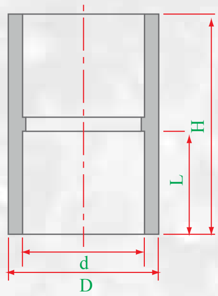
S x S

	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM						
		D	d1	d2	d3	H	L1	L2	APPROX. WT.
20685	3/4 > 1/2"	31.9	26.67	27.50	21.34	53.90	26.00	18.50	0.02
20688	1 > 1/2"	40.8	33.40	27.50	21.34	53.70	27.50	18.50	0.03
20689	1 > 3/4"	40.8	33.40	33.50	26.67	63.90	27.50	25.30	0.03
20692	1 1/4 > 1/2"	48.8	42.16	27.50	21.34	64.40	29.00	25.30	0.04
20693	1 1/4 > 3/4"	48.8	42.16	33.50	26.67	67.40	29.00	27.50	0.04
20694	1 1/4 > 1"	48.8	42.16	40.90	33.40	65.40	29.00	19.00	0.04
20697	1 1/2 > 1/2"	55.5	48.26	27.50	21.34	72.40	34.00	26.00	0.05
20698	1 1/2 > 3/4"	55.5	48.26	33.50	26.67	73.90	34.00	27.50	0.05
20699	1 1/2 > 1"	55.5	48.26	40.90	33.40	74.40	34.00	29.00	0.05
20700	1 1/2 > 1 1/4"	55.5	48.26	50.10	42.16	82.90	34.00	26.00	0.05
20703	2 > 1/2"	68.4	60.33	27.50	21.34	84.40	40.00	27.50	0.08
20704	2 > 3/4"	68.4	60.33	33.50	26.67	85.90	40.00	29.00	0.08
20705	2 > 1"	68.4	60.33	40.90	33.40	90.90	40.00	34.00	0.08
20706	2 > 1 1/4"	68.4	60.33	50.10	42.16	90.90	40.00	40.00	0.08
20707	2 > 1 1/2"	68.4	60.33	56.60	48.26	90.90	40.00	45.00	0.08

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2466. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

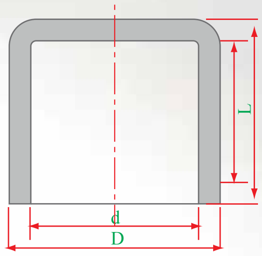
PVC SCHEDULE 40 FITTINGS
Weights, Dimensions and Tolerances

Couplings



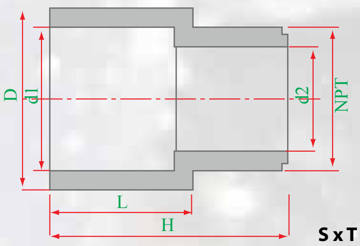
PART	NOMINAL SIZE	COUPLING S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
20240	1/2"	27.9	21.34	19.00	40.70	0.02
20241	3/4"	33.5	26.67	26.00	55.10	0.03
20242	1"	40.8	33.40	27.50	57.40	0.04
20243	1 1/4"	50.1	42.16	29.00	60.40	0.05
20244	1 1/2"	56.6	48.26	34.00	70.40	0.08
20245	2"	69.0	60.33	40.00	82.40	0.10
20246	2 1/2"	84.4	73.03	45.00	94.80	0.20
20247	3"	100.9	88.90	48.00	100.80	0.25
20248	4"	127.3	114.30	54.00	112.80	0.38
20251	6"	183.6	168.30	76.70	159.80	0.92

Caps



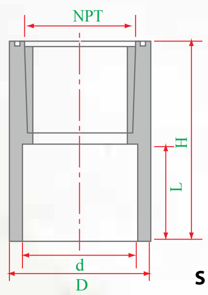
PART	NOMINAL SIZE	CAP P x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
20145	1/2"	27.9	21.34	19.00	22.00	0.01
20146	3/4"	33.5	26.67	26.00	30.00	0.02
20147	1"	40.8	33.40	27.50	31.00	0.02
20148	1 1/4"	50.1	42.16	29.00	33.40	0.03
20149	1 1/2"	56.6	48.26	34.00	38.60	0.04
20150	2"	69.0	60.33	40.00	44.50	0.06
20151	2 1/2"	84.4	73.03	45.00	57.20	0.19
20152	3"	100.9	88.90	48.00	61.60	0.22
20153	4"	127.3	114.30	54.00	89.00	0.30
20155	6"	183.6	168.30	76.70	102.00	0.60

Male Adaptors



PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
20240	1/2"	27.9	21.34	19.00	40.70	0.02
20241	3/4"	33.5	26.67	26.00	55.10	0.03
20242	1"	40.8	33.40	27.50	57.40	0.04
20243	1 1/4"	50.1	42.16	29.00	60.40	0.05
20244	1 1/2"	56.6	48.26	34.00	70.40	0.08
20245	2"	69.0	60.33	40.00	82.40	0.10
20246	2 1/2"	84.4	73.03	45.00	94.80	0.20
20247	3"	100.9	88.90	48.00	100.80	0.25
20248	4"	127.3	114.30	54.00	112.80	0.38
20251	6"	183.6	168.30	76.70	159.80	0.92

Female Adaptors



PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
21107	1/2"	27.9	21.34	19.00	40.40	0.02
21108	3/4"	33.5	26.67	26.00	49.90	0.03
21109	1"	40.8	33.40	27.50	57.40	0.04
21110	1 1/4"	50.1	42.16	29.00	60.40	0.06
21111	1 1/2"	56.6	48.26	34.00	64.40	0.07
21112	2"	69.0	60.33	40.00	71.10	0.10
21113	2 1/2"	84.4	73.03	45.00	82.80	0.20
21114	3"	100.9	88.90	48.00	95.40	0.25
21115	4"	127.3	114.30	54.00	103.30	0.38
21117	6"	183.6	168.30	76.70	131.10	0.80

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard D-2466. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC DIN PN16 FITTINGS

Manufacturer's Product Specification

Scope

This specification sheet covers the manufacturer's requirements for PVC DIN 8063 "PN16" pipe fittings. These fittings meet or exceed the standards set by German Industrial Norms.

PVC Materials

Rigid PVC (polyvinyl chloride) used in the manufacture of DIN 8063 fittings is Type I, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions

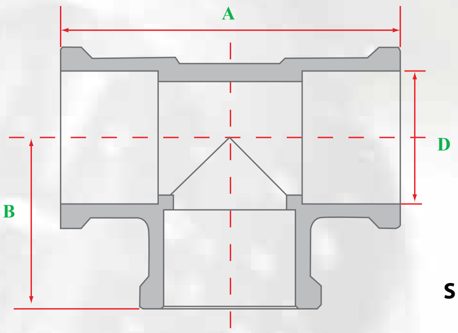
Physical dimensions and tolerances of PVC DIN fittings meet the requirements of DIN specification 8063 "PN16" for all fittings. Threaded fittings have tapered pipe threads in accordance with BSPF and BSPT tapered metric specifications.

Marking

PVC DIN fittings are marked as prescribed in DIN 8063 to indicate the manufacturer's name or trademark, size of fitting, and DIN designation 8063 "PN16" as well as corresponding DN references.

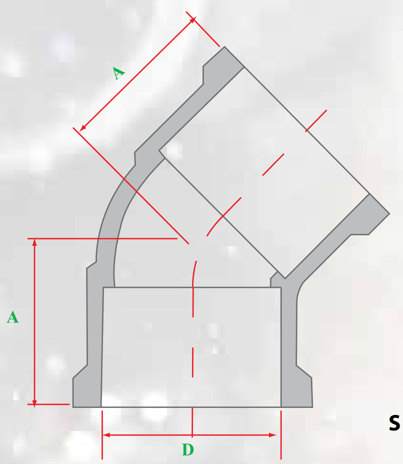
PVC DIN PN16 FITTINGS
Weights, Dimensions and Tolerances

Tees



PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM		
		D	A	B	APPROX. WT.
32216	DN 15	20.0	54.00	27.00	-
32217	DN 20	25.0	64.00	32.00	-
32218	DN 25	32.0	78.00	39.00	-
32219	DN 32	40.0	94.00	47.00	-
32220	DN 40	50.0	114.00	57.00	-
32221	DN 50	63.0	142.60	71.30	-
32222	DN 65	75.0	174.50	87.20	-
32223	DN 80	90.0	195.40	97.70	-
32224	DN 100	110.0	248.00	124.00	-
32226	DN 125	140.0	-	-	-
32227	DN 150	160.0	-	-	-

45° Elbows

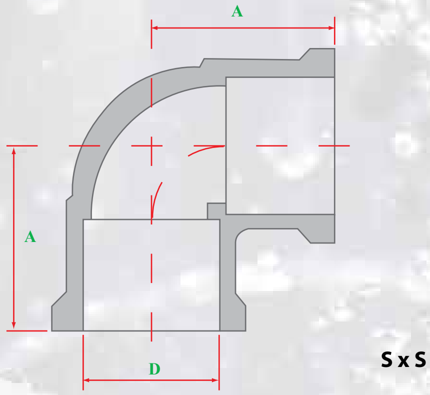


PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
32168	DN 15	20.0	22.30	-
32169	DN 20	25.0	24.50	-
32170	DN 25	32.0	29.50	-
32171	DN 32	40.0	35.50	-
32172	DN 40	50.0	42.50	-
32173	DN 50	63.0	49.50	-
32174	DN 65	75.0	60.00	-
32175	DN 80	90.0	67.50	-
32176	DN 100	110.0	85.50	-
32178	DN 125	140.0	-	-
32179	DN 150	160.0	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

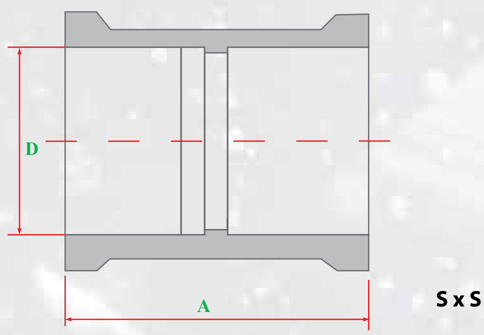
PVC DIN PN 16 FITTINGS
Weights, Dimensions and Tolerances

90° Elbows



PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
32003	DN 15	20.0	27.00	-
32004	DN 20	25.0	32.00	-
32005	DN 25	32.0	39.00	-
32006	DN 32	40.0	47.00	-
32007	DN 40	50.0	57.00	-
32008	DN 50	63.0	67.00	-
32009	DN 65	75.0	87.20	-
32010	DN 80	90.0	97.70	-
32011	DN 100	110.0	124.00	-
32013	DN 125	140.0	-	-
32014	DN 150	160.0	-	-

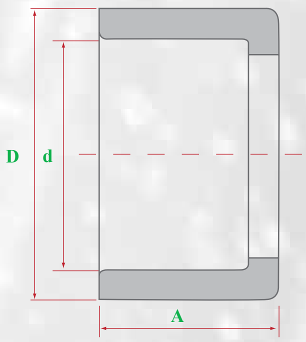
Couplings



PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
32240	DN 15	20.0	35.00	-
32241	DN 20	25.0	40.00	-
32242	DN 25	32.0	48.00	-
32243	DN 32	40.0	55.00	-
32244	DN 40	50.0	65.00	-
32245	DN 50	63.0	80.00	-
32246	DN 65	75.0	91.00	-
32247	DN 80	90.0	102.00	-
32248	DN 100	110.0	130.00	-
32250	DN 125	140.0	-	-
32251	DN 150	160.0	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

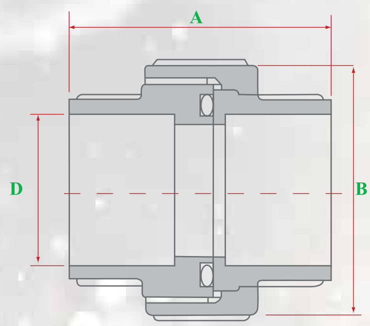
Reducing Bushes



S x S

PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM		
		D	A	d	APPROX. WT.
32819	DN 20 > 15	25.00	18.50	20.00	-
32823	DN 25 > 20	32.00	22.00	25.00	-
32828	DN 32 > 25	40.00	26.00	32.00	-
32834	DN 40 > 32	50.00	31.00	40.00	-
32841	DN 50 > 40	63.00	36.00	50.00	-
32847	DN 65 > 50	75.00	43.50	63.00	-
32854	DN 80 > 65	90.00	48.50	75.00	-
32862	DN 100 > 80	110.00	31.00	90.00	-
32889	DN 150 >100	160.00	-	-	-

Unions

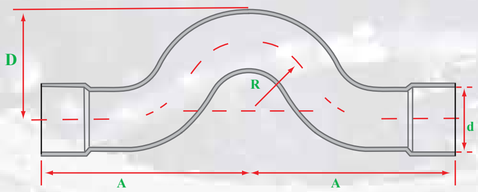


S x S

PART	NOMINAL SIZE	UNION - S x S	UNIT OF MEASURE: MM		
		D	A	B	APPROX. WT.
32124	DN 15	20.0	46.00	48.00	-
32125	DN 20	25.0	51.00	54.50	-
32126	DN 25	32.0	55.00	64.00	-
32127	DN 32	40.0	58.00	79.00	-
32128	DN 40	50.0	68.00	87.50	-
32129	DN 50	63.0	78.00	105.00	-
32130	DN 65	75.0	94.00	128.00	-
32131	DN 80	90.0	109.00	148.50	-
32132	DN 100	110.0	150.00	184.00	-

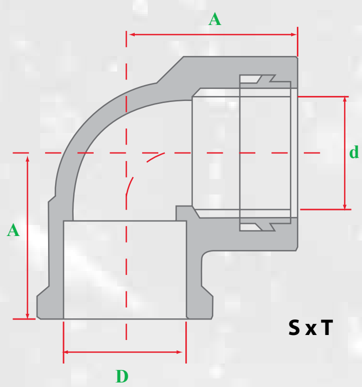
Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Crossovers



PART	NOMINAL SIZE	CROSSOVER S x S	UNIT OF MEASURE: MM		
		d	A	R	APPROX. WT.
32212	DN 15	20.0	68.00	12.50	-
32213	DN 20	25.0	84.00	16.00	-
32214	DN 25	32.0	105.50	20.00	-

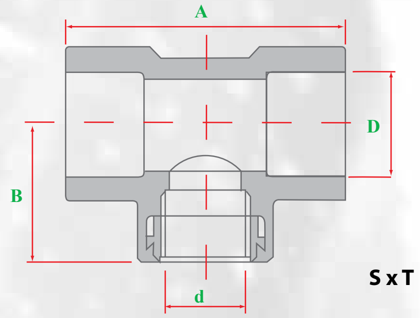
Female Elbows w/Brass



PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
33751	DN 15 x 1/2"	20.0	1/2"	27.00	-
33752	DN 20 x 1/2"	25.0	1/2"	31.00	-
33758	DN 20 x 3/4"	25.0	3/4"	31.00	-
33759	DN 25 > 1"	32.0	1"	37.00	-
33760	DN 32 > 1.25"	40.0	1.25"	-	-
33761	DN 40 > 1.5"	50.0	1.5"	-	-
33762	DN 50 > 2"	63.0	2"	-	-

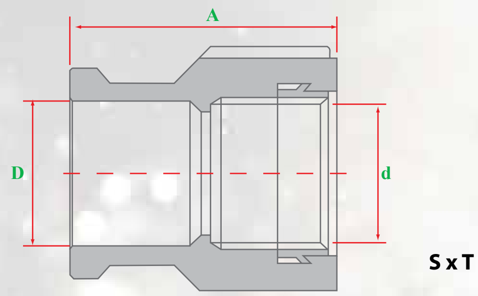
Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Female Tees w/Brass



PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM			
		D	d	A	B	APPROX. WT.
33763	DN 15 x 1/2"	20.0	1/2"	54.00	27.00	-
33764	DN 20 x 1/2"	25.0	1/2"	59.00	30.50	-
33765	DN 20 x 3/4"	25.0	3/4"	65.00	32.00	-
33766	DN 25 > 1"	32.0	1"	72.00	35.50	-
33674	DN 32 > 1.25"	40.0	1.25"	-	-	-
33675	DN 40 > 1.5"	50.0	1.5"	-	-	-
33676	DN 50 > 2"	63.0	2"	-	-	-

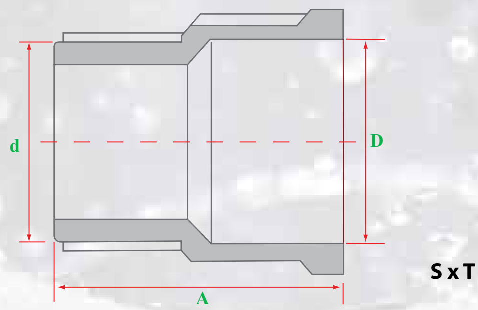
Female Adaptors w/Brass



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
33744	DN 15 x 1/2"	20.0	1/2"	31.00	-
33745	DN 20 x 1/2"	25.0	1/2"	36.00	-
33746	DN 20 x 3/4"	25.0	3/4"	36.00	-
33747	DN 25 > 1"	32.0	1"	47.60	-
33748	DN 32 > 1.25"	40.0	1.25"	-	-
33749	DN 40 > 1.5"	50.0	1.5"	-	-
33750	DN 50 > 2"	63.0	2"	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Male Adaptors



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
33056	DN 15	20.0	1/2"	37.10	-
33057	DN 20	25.0	3/4"	40.30	-
33058	DN 25	32.0	1"	50.70	-
33059	DN 32	40.0	1.25"	56.70	-
33060	DN 40	50.0	1.5"	63.00	-
33061	DN 50	63.0	2"	72.70	-
33062	DN 65	75.0	2.5"	86.30	-
33063	DN 80	90.0	3"	94.30	-
33064	DN 100	110.0	4"	115.90	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8063. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC DIN PN 16 FITTINGS
Manufacturer's Product Specification

Scope
This specification covers the manufacturer's requirements for CPVC DIN 8083 "PN16" pipe fittings. These fittings meet or exceed the standards set by the German Industrial Norms.

CPVC Materials
Rigid CPVC (chlorinated polyvinyl chloride) used in the manufacture of DIN 8083 fittings is Type IV, Grade I compound as stated in ASTM D-1784. Raw material used in the molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

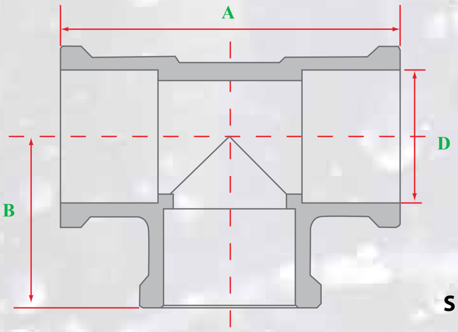
Dimensions
Physical dimensions and tolerances of CPVC DIN fittings meet the requirements of DIN specification 8083 "PN16" for all fittings. Threaded fittings have tapered pipe threads in accordance with BSPF and BSPT tapered metric specifications.

Marking
CPVC DIN fittings are marked as prescribed in DIN 8083 to indicate the manufacturer's name or trademark, size of fitting, and DIN designation 8083 "PN16" as well as corresponding DN references.

CPVC DIN PN 16 FITTINGS

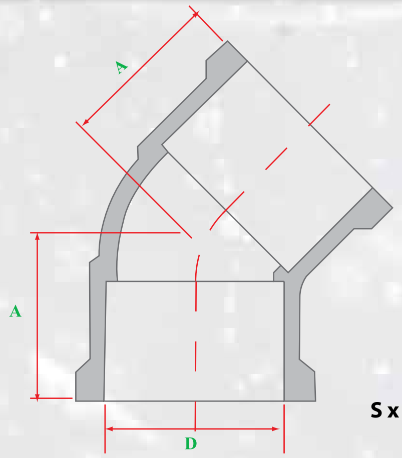
Weights, Dimensions and Tolerances

Tees



PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM		
		D	A	B	APPROX. WT.
34216	DN 15	20.0	54.00	27.00	-
34217	DN 20	25.0	64.00	32.00	-
34218	DN 25	32.0	78.00	39.00	-
34219	DN 32	40.0	94.00	47.00	-
34220	DN 40	50.0	114.00	57.00	-
34221	DN 50	63.0	142.60	71.30	-
34222	DN 65	75.0	174.50	87.20	-
34223	DN 80	90.0	195.40	97.70	-
34224	DN 100	110.0	248.00	124.00	-
34226	DN 125	140.0	-	-	-
34227	DN 150	160.0	-	-	-

45° Elbows



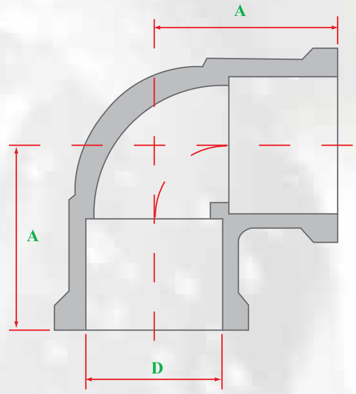
PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
34168	DN 15	20.0	22.30	-
34169	DN 20	25.0	24.50	-
34170	DN 25	32.0	29.50	-
34171	DN 32	40.0	35.50	-
34172	DN 40	50.0	42.50	-
34173	DN 50	63.0	49.50	-
34174	DN 65	75.0	60.00	-
34175	DN 80	90.0	67.50	-
34176	DN 100	110.0	85.50	-
34178	DN 125	140.0	-	-
34179	DN 150	160.0	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC DIN PN 16 FITTINGS

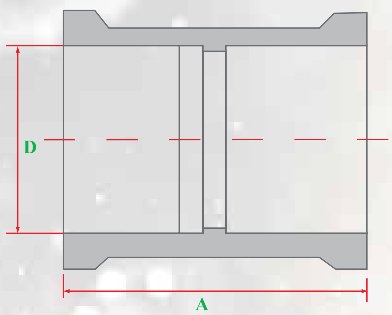
Weights, Dimensions and Tolerances

90° Elbows



PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
34003	DN 15	20.0	27.00	-
34004	DN 20	25.0	32.00	-
34005	DN 25	32.0	39.00	-
34006	DN 32	40.0	47.00	-
34007	DN 40	50.0	57.00	-
34008	DN 50	63.0	67.00	-
34009	DN 65	75.0	87.20	-
34010	DN 80	90.0	97.70	-
34011	DN 100	110.0	124.00	-
34013	DN 125	140.0	-	-
34014	DN 150	160.0	-	-

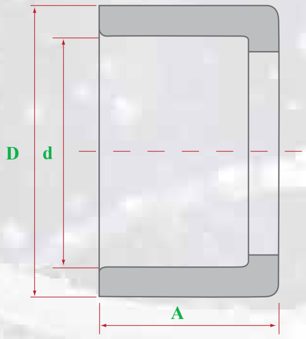
Couplings



PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM	
		D	A	APPROX. WT.
34240	DN 15	20.0	35.00	-
34241	DN 20	25.0	40.00	-
34242	DN 25	32.0	48.00	-
34243	DN 32	40.0	55.00	-
34244	DN 40	50.0	65.00	-
34245	DN 50	63.0	80.00	-
34246	DN 65	75.0	91.00	-
34247	DN 80	90.0	102.00	-
34248	DN 100	110.0	130.00	-
34250	DN 125	140.0	-	-
34251	DN 150	160.0	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

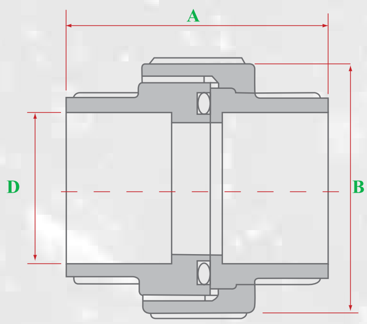
Reducing Bushes



S x S

PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM		
		D	A	d	APPROX. WT.
34819	DN 20 > 15	25.00	18.50	20.00	-
34823	DN 25 > 20	32.00	22.00	25.00	-
34828	DN 32 > 25	40.00	26.00	32.00	-
34834	DN 40 > 32	50.00	31.00	40.00	-
34841	DN 50 > 40	63.00	36.00	50.00	-
34847	DN 65 > 50	75.00	43.50	63.00	-
34854	DN 80 > 65	90.00	48.50	75.00	-
34862	DN 100 > 80	110.00	31.00	90.00	-
34889	DN 150 > 100	160.00	-	-	-

Unions



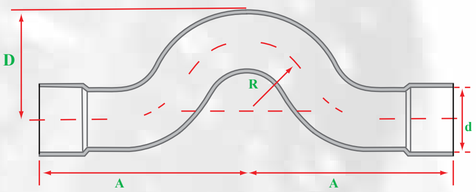
S x S

PART	NOMINAL SIZE	UNION - S x S	UNIT OF MEASURE: MM		
		D	A	d	APPROX. WT.
34124	DN 15	20.0	46.00	48.00	-
34125	DN 20	25.0	51.00	54.50	-
34126	DN 25	32.0	55.00	64.00	-
34127	DN 32	40.0	58.00	79.00	-
34128	DN 40	50.0	68.00	87.50	-
34129	DN 50	63.0	78.00	105.00	-
34130	DN 65	75.0	94.00	128.00	-
34131	DN 80	90.0	109.00	148.50	-
34132	DN 100	110.0	150.00	184.00	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC DIN PN 16 FITTINGS
Weights, Dimensions and Tolerances

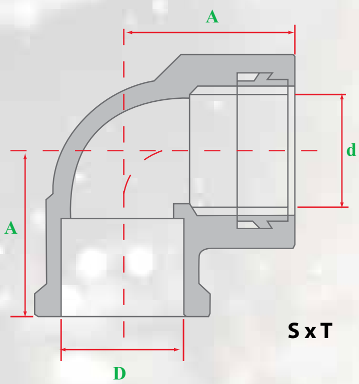
Crossovers



S x S

PART	NOMINAL SIZE	CROSSOVER - S x S	UNIT OF MEASURE: MM		
		d	A	R	APPROX. WT.
34212	DN 15	20.0	68.00	12.50	-
34213	DN 20	25.0	84.00	16.00	-
34214	DN 25	32.0	105.50	20.00	-

Female Elbows w/Brass

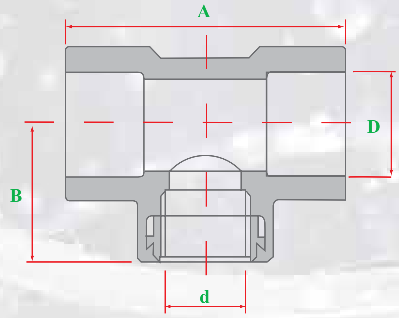


S x T

PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
35751	DN 15 x 1/2"	20.0	1/2"	27.00	-
35752	DN 20 x 1/2"	25.0	1/2"	31.00	-
35758	DN 20 x 3/4"	25.0	3/4"	31.00	-
35759	DN 25 > 1"	32.0	1"	37.00	-
35760	DN 32 > 1.25"	40.0	1.25"	-	-
35761	DN 40 > 1.5"	50.0	1.5"	-	-
35762	DN 50 > 2"	63.0	2"	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

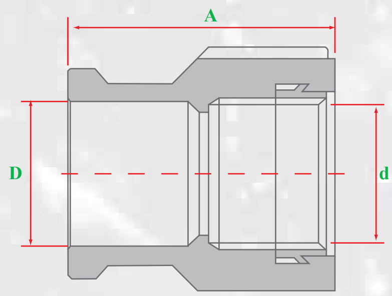
Female Tees w/Brass



S x T

PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM			
		D	d	A	B	APPROX. WT.
35763	DN 15 x 1/2"	20.0	1/2"	54.00	27.00	-
35764	DN 20 x 1/2"	25.0	1/2"	59.00	30.50	-
35765	DN 20 x 3/4"	25.0	3/4"	65.00	32.00	-
35766	DN 25 > 1"	32.0	1"	72.00	35.50	-
35674	DN 32 > 1.25"	40.0	1.25"	-		-
35675	DN 40 > 1.5"	50.0	1.5"	-		-
35676	DN 50 > 2"	63.0	2"	-		-

Female Adaptors w/Brass

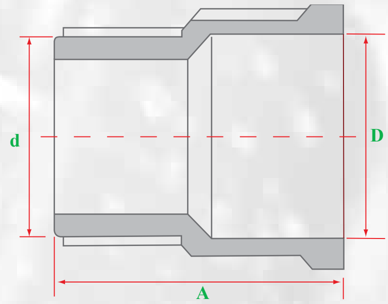


S x T

PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
35744	DN 15 x 1/2"	20.0	1/2"	31.00	-
35745	DN 20 x 1/2"	25.0	1/2"	36.00	-
35746	DN 20 x 3/4"	25.0	3/4"	36.00	-
35747	DN 25 > 1"	32.0	1"	47.60	-
35748	DN 32 > 1.25"	40.0	1.25"	-	-
35749	DN 40 > 1.5"	50.0	1.5"	-	-
35750	DN 50 > 2"	63.0	2"	-	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Male Adaptors w/Brass



S x T

PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM		
		D	d	A	APPROX. WT.
35056	DN 15	20.0	1/2"	37.10	-
35057	DN 20	25.0	3/4"	40.30	-
35058	DN 25	32.0	1"	50.70	-
35059	DN 32	40.0	1.25"	56.70	-
35060	DN 40	50.0	1.5"	63.00	-
35061	DN 50	63.0	2"	72.70	-
35062	DN 65	75.0	2.5"	86.30	-
35063	DN 80	90.0	3"	94.30	-
35064	DN 100	110.0	4"	115.90	-

Notes: Physical dimensions and tolerances meet the requirements of DIN Standard 8083. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC BS 4346E FITTINGS
Manufacturer's Product Specification

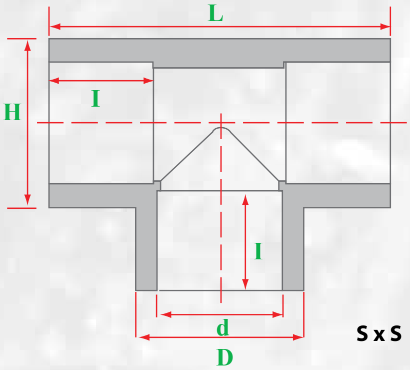
Scope
This specification covers the manufacturer's requirements for PVC BS 4346 "Class E" pipe fittings. These fittings meet or exceed the standards set by the British Standards Institute.

PVC Materials
Rigid PVC (polyvinyl chloride) used in the manufacture of BS Class E fittings is Type I, Grade I compound as stated in ASTM D-1784. Raw material used in the molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

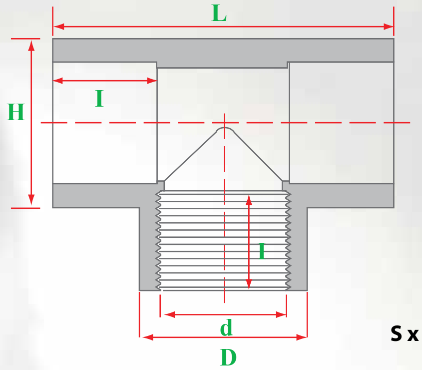
Dimensions
Physical dimensions and tolerances of PVC Class E fittings meet the requirements of BS specification 4346 "Class E" for all fittings. Threaded fittings have parallel pipe threads in accordance with BSPF and BSPT metric specifications.

Marking
PVC BS 4346 fittings are marked as prescribed in BS 4346 to indicate the manufacturer's name or trademark, size of fitting, and BS designation 4346 "E".

Tees



S x S

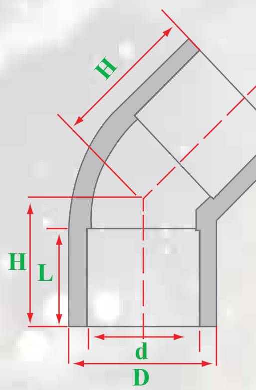


S x T

PART	NOMINAL SIZE	TEE S x S	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30216	1/2"	21.3	16.50	15	-
30217	3/4"	26.7	19.50	15	-
30218	1"	33.5	22.50	15	-
30219	1 1/4"	42.2	27.00	15	-
30220	1 1/2"	48.2	30.00	15	0.20
30221	2"	60.3	36.00	15	0.37
30222	2 1/2"	75.1	44.00	15	0.53
30223	3"	88.8	50.50	15	0.92
30224	4"	114.2	63.00	15	1.69
30227	6"	168.2	90.00	15	-

PART	NOMINAL SIZE	TEE S x T	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30113	1/2"	21.3	16.50	15	-
30114	3/4"	26.7	19.50	15	-
30115	1"	33.5	22.50	15	-
30116	1 1/4"	42.2	27.00	15	-
30117	1 1/2"	48.2	30.00	15	0.20
30118	2"	60.3	36.00	15	0.37
30119	2 1/2"	75.1	44.00	15	0.53
30120	3"	88.8	50.50	15	0.92
30121	4"	114.2	63.00	15	1.69

45° Elbows



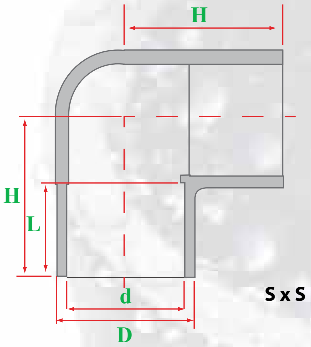
S x S

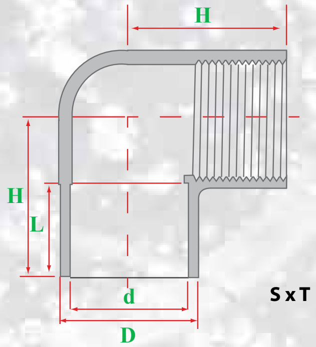
PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30168	1/2"	21.3	16.50	15	-
30169	3/4"	26.7	19.50	15	-
30170	1"	33.5	22.50	15	-
30171	1 1/4"	42.2	27.00	15	-
30172	1 1/2"	48.2	30.00	15	0.12
30173	2"	60.3	36.00	15	0.21
30174	2 1/2"	75.1	44.00	15	0.32
30175	3"	88.8	50.50	15	0.53
30176	4"	114.2	63.00	15	1.00
30179	6"	168.2	90.00	15	-

Notes: Physical dimensions and tolerances meet the requirements of BS Standard 4346. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

PVC BS 4346E FITTINGS
Manufacturer's Product Specification

90° Elbows

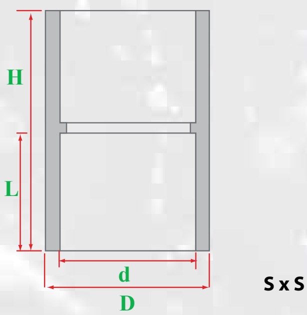




PART	NOMINAL SIZE	90 ELL S x S	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30003	1/2"	21.3	16.50	15	-
30004	3/4"	26.7	19.50	15	-
30005	1"	33.5	22.50	15	-
30006	1 1/4"	42.2	27.00	15	-
30007	1 1/2"	48.2	30.00	15	0.15
30008	2"	60.3	36.00	15	0.27
30009	2 1/2"	75.1	44.00	15	0.43
30010	3"	88.8	50.50	15	0.70
30011	4"	114.2	63.00	15	1.33
30014	6"	168.2	90.00	15	-

PART	NOMINAL SIZE	90 ELL S x T	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30094	1/2"	21.3	16.50	15	-
30095	3/4"	26.7	19.50	15	-
30096	1"	33.5	22.50	15	-
30097	1 1/4"	42.2	27.00	15	-
30098	1 1/2"	48.2	30.00	15	0.15
30099	2"	60.3	36.00	15	0.27
30100	2 1/2"	75.1	44.00	15	0.43
30101	3"	88.8	50.50	15	0.70
30102	4"	114.2	63.00	15	1.33

Couplings

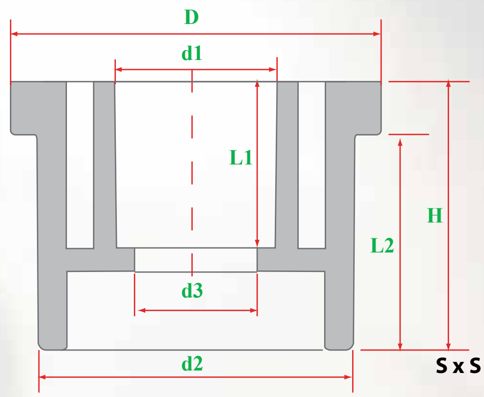


PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30240	1/2"	21.3	16.50	15	-
30241	3/4"	26.7	19.50	15	-
30242	1"	33.5	22.50	15	-
30243	1 1/4"	42.2	27.00	15	-
30244	1 1/2"	48.2	30.00	15	0.08
30245	2"	60.3	36.00	15	0.15
30246	2 1/2"	75.1	44.00	15	0.20
30247	3"	88.8	50.50	15	0.35
30248	4"	114.2	63.00	15	0.71
30251	6"	168.2	90.00	15	-

Notes: Physical dimensions and tolerances meet the requirements of BS Standard 4346. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

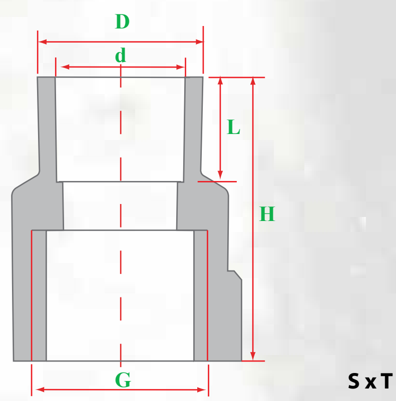
Reducing Bushes

PART	NOMINAL SIZE	REDUCER S x S	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
30819	3/4" > 1/2"	21.30	19.50	15	-
30822	1 > 1/2"	33.50	22.50	15	-
30823	1 > 3/4"	33.50	22.50	15	-
30826	1 1/4 > 1/2"	42.20	27.00	15	-
30827	1 1/4 > 3/4"	42.20	27.00	15	-
30828	1 1/4 > 1"	42.20	27.00	15	-
30831	1 1/2 > 1/2"	48.20	30.00	15	-
30832	1 1/2 > 3/4"	48.20	30.00	15	-
30833	1 1/2 > 1"	48.20	30.00	15	-
30834	1 1/2 > 1 1/4"	48.20	30.00	15	-
30837	2 > 1/2"	60.30	36.00	15	-
30838	2 > 3/4"	60.30	36.00	15	-
30839	2 > 1"	60.30	36.00	15	-
30840	2 > 1 1/4"	60.30	36.00	15	-
30841	2 > 1 1/2"	60.30	36.00	15	-
30846	2 1/2 > 1 1/2"	75.10	44.00	15	-
30847	2 1/2 > 2"	75.10	44.00	15	-
30852	3 > 1 1/2"	88.80	50.50	15	0.20
30853	3 > 2"	88.80	50.50	15	0.22
30854	3 > 2 1/2"	88.80	50.50	15	-
30860	4 > 2"	114.20	63.00	15	0.42
30862	4 > 3"	114.20	63.00	15	0.34
30888	6 > 3"	168.20	90.00	15	-
30889	6 > 4"	168.20	90.00	15	-



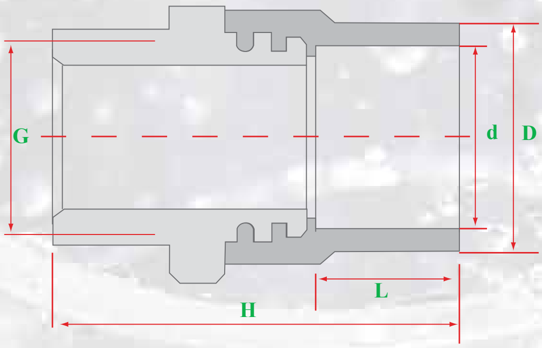
Female Adaptors

PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
31107	1/2"	21.3	16.50	15	-
31108	3/4"	26.7	19.50	15	-
31109	1"	33.5	22.50	15	0.04
31110	1 1/4"	42.2	27.00	15	-
31111	1 1/2"	48.2	30.00	15	0.10
31112	2"	60.3	36.00	15	0.19
31113	2 1/2"	75.1	44.00	15	0.20
31114	3"	88.8	50.50	15	0.37
31115	4"	114.2	63.00	15	0.76



Notes: Physical dimensions and tolerances meet the requirements of BS Standard 4346. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Male Adaptors



S x T

PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM		
		D	L	PN	APPROX. WT.
31056	1/2"	21.3	16.50	15	-
31057	3/4"	26.7	19.50	15	-
31058	1"	33.5	22.50	15	0.04
31059	1 1/4"	42.2	27.00	15	-
31060	1 1/2"	48.2	30.00	15	0.09
31061	2"	60.3	36.00	15	0.15
31062	2 1/2"	75.1	44.00	15	0.19
31063	3"	88.8	50.50	15	0.32
31064	4"	114.2	63.00	15	0.67

Notes: Physical dimensions and tolerances meet the requirements of BS Standard 4346. PVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Scope

This specification covers the manufacturer's requirements for CPVC ASTM 2846 pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

CPVC Materials

Rigid CPVC (chlorinated polyvinyl chloride) used in the manufacture of ASTM 2846 fittings is Type IV, Grade I compound as stated in ASTM D-1784. Raw material used in the molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions

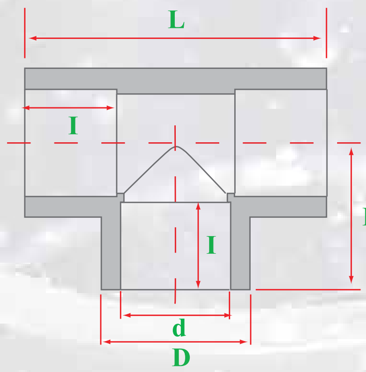
Physical dimensions and tolerances of CPVC ASTM 2846 fittings meet the requirements of ASTM specification 2846 for all fittings. Threaded fittings have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

Marking

CPVC ASTM 2846 fittings are marked as prescribed in ASTM 2846 to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation 2846.

CPVC ASTM 2846 FITTINGS
Weights, Dimensions and Tolerances

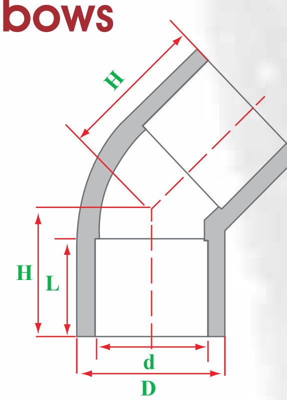
Tees



S x S

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM				
		D	d	I	L	H	APPROX. WT.
38216	1/2"	21.5	15.90	13.00	43.80	21.90	-
38217	3/4"	26.8	22.20	18.00	62.00	31.00	-
38218	1"	34.5	28.60	23.00	80.00	40.00	-
38219	1 1/4"	41.8	34.90	28.10	95.50	47.75	-
38220	1 1/2"	49.4	41.30	33.50	112.00	56.00	-
38221	2"	64.4	54.00	43.50	145.00	72.50	-

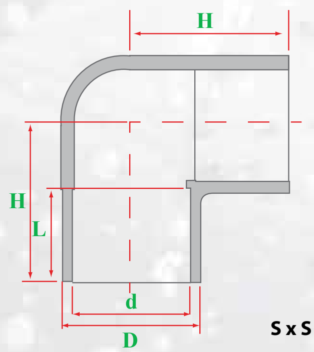
45° Elbows



S x S

PART	NOMNAL SIZE	45 ELL S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
38168	1/2"	21.5	15.90	13.00	18.80	-
38169	3/4"	26.8	22.20	18.00	24.30	-
38170	1"	34.5	28.60	23.00	30.90	-
38171	1 1/4"	41.8	34.90	28.10	-	-
38172	1 1/2"	49.4	41.30	33.50	-	-
38173	2"	64.4	54.00	43.50	-	-

90° Elbows



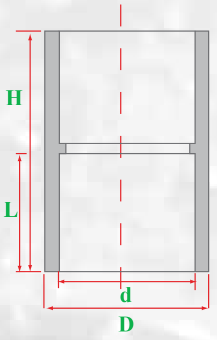
S x S

PART	NOMINAL SIZE	90 ELL S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
38003	1/2"	21.5	15.90	13.00	23.10	-
38004	3/4"	26.8	22.20	18.00	31.40	-
38005	1"	34.5	28.60	23.00	39.20	-
38006	1 1/4"	41.8	34.90	28.10	47.40	-
38007	1 1/2"	49.4	41.30	33.50	55.40	-
38008	2"	64.4	54.00	43.50	72.50	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard 2846. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

CPVC ASTM 2846 FITTINGS
Weights, Dimensions and Tolerances

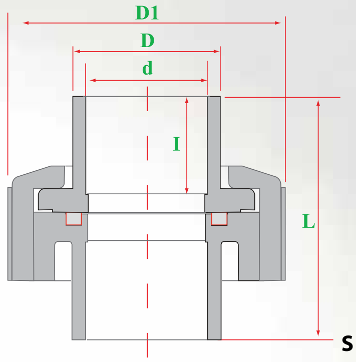
Couplings



S x S

PART	NOMINAL SIZE	COUPLING S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
38240	1/2"	21.5	15.90	13.00	28.90	-
38241	3/4"	26.8	22.20	18.00	39.50	-
38242	1"	34.5	28.60	23.00	50.00	-
38243	1 1/4"	41.8	34.90	28.10	60.00	-
38244	1 1/2"	49.4	41.30	33.50	70.50	-
38245	2"	64.4	54.00	43.50	90.50	-

Unions

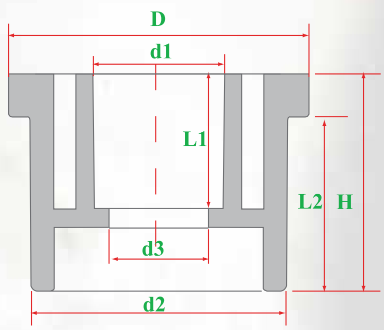


S x S

PART	NOMINAL SIZE	UNION S x S	UNIT OF MEASURE: MM				
		d	D	D1	I	L	APPROX. WT.
38124	1/2"	15.90	21.80	39.50	13.00	36.50	-
38125	3/4"	22.20	32.50	53.50	22.00	53.50	-
38126	1"	28.60	34.43	65.00	23.00	57.50	-
38127	1 1/4"	34.90	-	-	-	-	-
38128	1 1/2"	41.30	-	-	-	-	-
38129	2"	54.00	-	-	-	-	-

Reducing Bushes

PART	NOMINAL SIZE	REDUCER S x S	UNIT OF MEASURE: MM						
		D	d1	d2	d3	H	L1	L2	APPROX. WT.
38819	3/4 > 1/2"	26.80	15.90	22.10	14.72	21.20	13.00	18.00	-
38822	1 > 1/2"	34.50	15.90	28.47	14.72	26.40	13.00	23.00	-
38823	1 > 3/4"	34.50	22.20	28.47	21.10	26.40	18.00	23.00	-
38826	1 1/4 > 1/2"	41.80	15.90	34.85	14.72	31.00	13.00	28.10	-
38827	1 1/4 > 3/4"	41.80	22.20	34.85	21.10	31.00	18.00	28.10	-
38828	1 1/4 > 1"	41.80	28.60	34.85	27.47	31.00	23.00	28.10	-
38831	1 1/2 > 1/2"	49.50	15.90	41.20	14.72	36.30	13.00	33.50	-
38832	1 1/2 > 3/4"	49.50	22.20	41.20	21.10	36.30	18.00	33.50	-
38833	1 1/2 > 1"	49.50	28.60	41.20	27.47	36.30	23.00	33.50	-
38834	1 1/2 > 1 1/4"	49.50	34.90	41.20	33.85	36.30	28.10	33.50	-
38837	2 > 1/2"	-	-	-	-	-	-	-	-
38838	2 > 3/4"	-	-	-	-	-	-	-	-
38839	2 > 1"	-	-	-	-	-	-	-	-
38840	2 > 1 1/4"	-	-	-	-	-	-	-	-
38841	2 > 1 1/2"	-	-	-	-	-	-	-	-

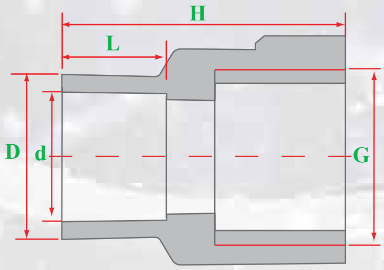


S x S

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard 2846. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

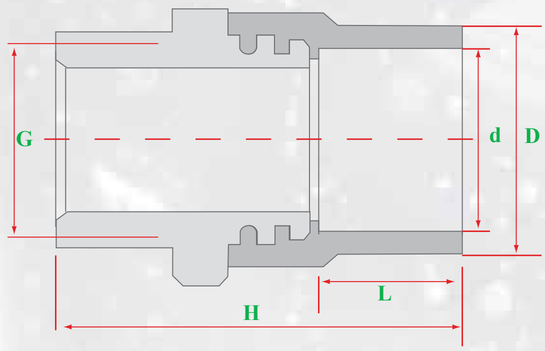
CPVC ASTM 2846 FITTINGS
Weights, Dimensions and Tolerances

Female Adaptors w/Brass



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM				
		D	d	H	L	G	APPROX. WT.
39744	1/2"	21.70	15.90	42.50	13.00	1/2"	-
39746	3/4"	28.50	22.20	50.00	18.00	3/4"	-
39747	1"	35.00	28.60	65.00	23.00	1"	-
39748	1 1/4"	44.00	34.90	77.00	28.10	1 1/4"	-
39749	1 1/2"	51.50	41.30	84.00	33.50	1 1/2"	-
39750	2"	64.40	54.00	94.00	43.50	2"	-

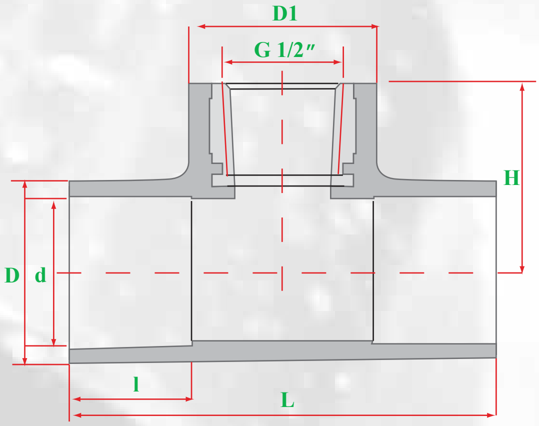
Male Adaptors w/Brass



PART	NOMINAL SIZE	ADAPTOR - S x T	UNIT OF MEASURE: MM				
		D	d	H	L	G	APPROX. WT.
39677	1/2"	21.70	15.90	48.00	13.00	1/2"	-
39678	3/4"	28.50	22.20	53.00	18.00	3/4"	-
39679	1"	35.00	28.60	71.00	23.00	1"	-
39680	1 1/4"	44.00	34.90	80.00	28.10	1 1/4"	-
39681	1 1/2"	51.50	41.30	88.00	33.50	1 1/2"	-
39682	2"	64.40	54.00	94.00	43.50	2"	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard 2846. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

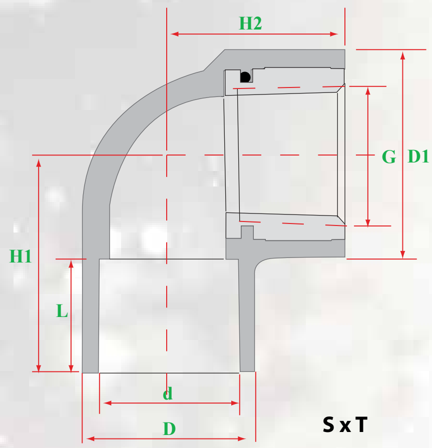
Female Tees w/Brass



S x T

PART	NOMINAL SIZE	TEE - S x T	UNIT OF MEASURE: MM						
		D1	D	d	L	G	H1	H2	APPROX. WT.
39763	1/2 x 1/2"	33.20	20.08	15.90	13.00	1/2"	52.00	39.00	-
39764	3/4" x 1/2"	33.20	26.85	22.20	18.00	1/2"	68.50	31.50	-

Female Elbows w/Brass



S x T

PART	NOMINAL SIZE	90 ELL - S x T	UNIT OF MEASURE: MM						
		D1	D	d	L	G	H1	H2	APPROX. WT.
39751	1/2 x 1/2"	33.20	20.08	15.90	13.00	1/2"	29.50	26.56	-
39752	3/4" x 1/2"	33.20	26.85	22.20	18.00	1/2"	34.50	28.35	-
39758	3/4"	39.00	26.85	22.20	18.00	3/4"	35.50	28.15	-

Notes: Physical dimensions and tolerances meet the requirements of ASTM Standard 2846. CPVC material meets ASTM Standard D-1784. Dimensions are subject to change without notice. Contact your HYDROSEAL representative for certification.

Hydroseal® Canada
re-engineering

SEWERAGE FITTINGS 4.00

PVC BS 5255 AND 4514 FITTINGS
Manufacturer's Product Specifications

Scope
This specification sheet covers the manufacturer's requirements for European PVC Drainage pipe fittings. These fittings meet or exceed the standards set by the British Standards Institute for solvent welded drainage fittings.

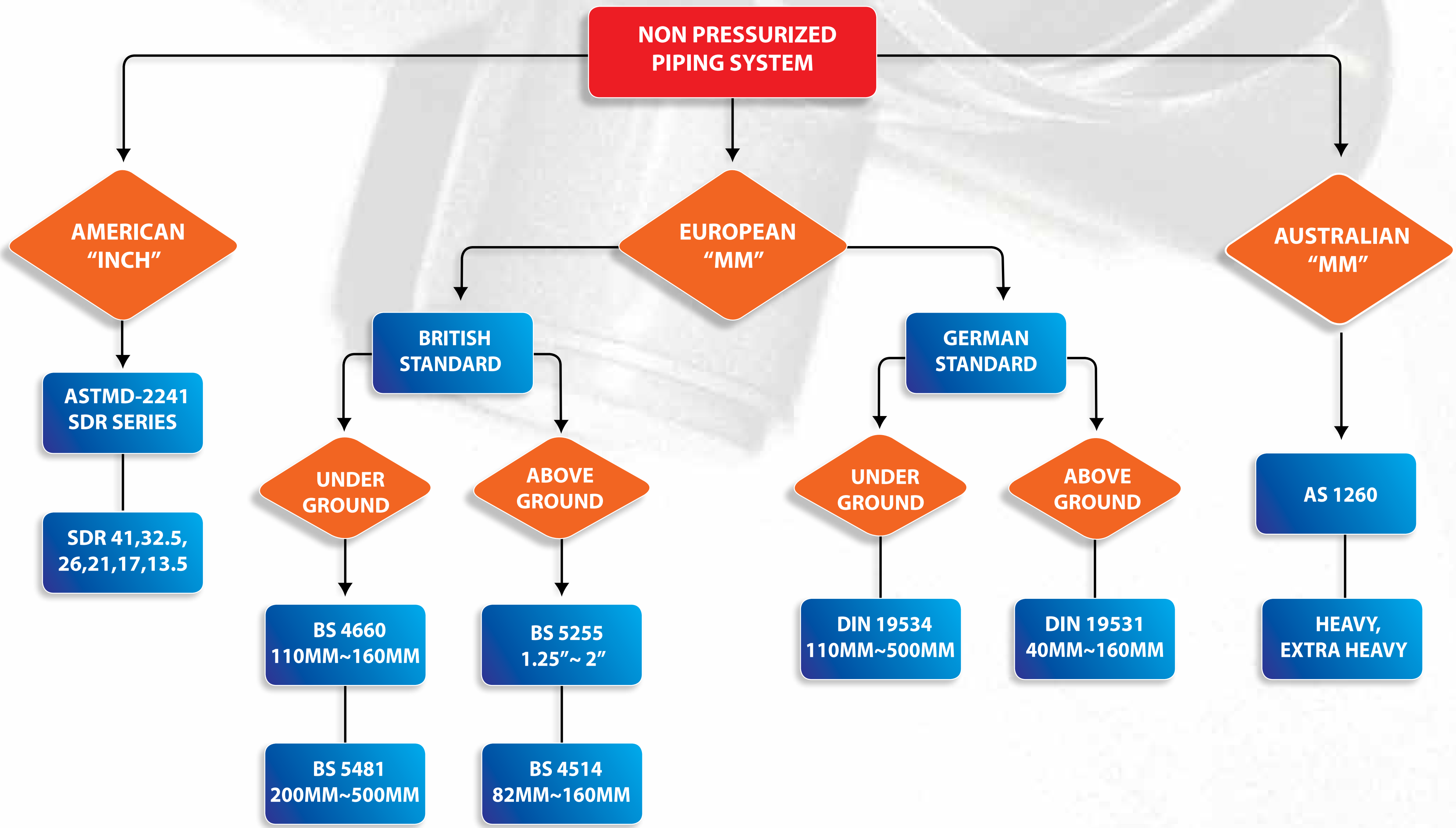
PVC Materials
Rigid PVC (polyvinyl chloride) used in the manufacture of PVC European drainage fittings is Type I, Grade 1 compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions
Physical dimensions and tolerances of PVC European drainage fittings meet the requirements of BS 5255 and BS 4514 specifications.

Marking
PVC BS 5255 and 4514 fittings are marked as prescribed in ASTM specifications to indicate the manufacturer's name or trademark, size of fitting, and respective BSI number.

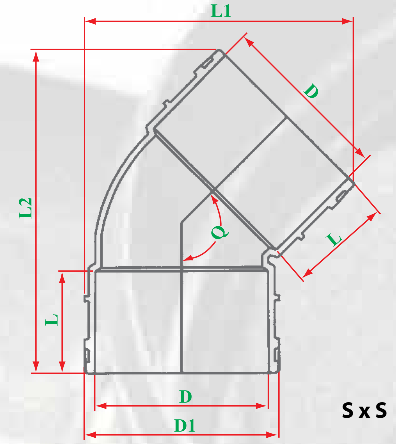
PVC SEWERAGE SYSTEMS

Selection Chart



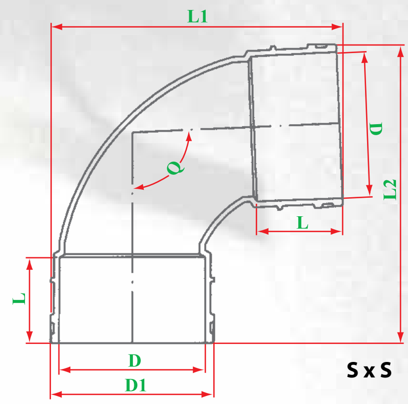
PVC BS 5255 AND 4514 FITTINGS
Weights, Dimensions and Tolerances

45° Bends



PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51063	1 1/4"	36.3	40.70	N/A	24.20	62	65	45	0.03
51064	1 1/2"	42.8	48.90	N/A	28.20	74	78	45	0.04
51065	2"	55.8	62.90	N/A	32.20	88	92	45	0.07
51066	82mm	82.6	92.60	N/A	39.50	119	122	45	0.15
51067	110mm	110.2	120.20	N/A	48.20	148	152	45	0.25
51068	160mm	160.2	170.20	N/A	60.10	192	201	45	0.60
51069	200mm	200.2	212.50	N/A	64.20	228	248	45	0.91

90° Bends

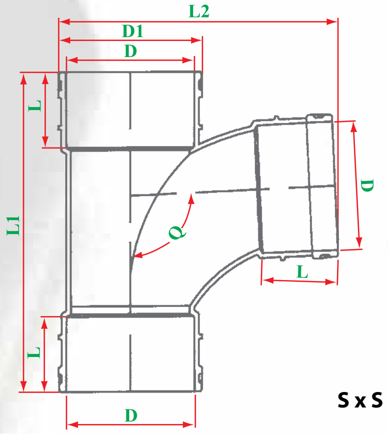


PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51001	1 1/4"	36.3	40.70	N/A	24.20	73	73	92.5	0.04
51002	1 1/2"	42.8	48.90	N/A	28.20	87	87	92.5	0.06
51003	2"	55.8	62.90	N/A	32.20	108	108	92.5	0.10
51004	82mm	82.6	92.60	N/A	39.50	150	150	92.5	0.25
51005	110mm	110.2	120.20	N/A	48.20	192	192	92.5	0.37
51006	160mm	160.2	170.20	N/A	60.10	260	260	92.5	0.82
51007	200mm	200.2	212.50	N/A	64.20	312	312	92.5	1.40

NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

Tees

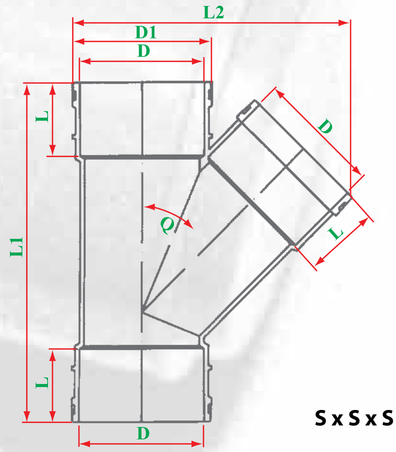
Also available: Reducing Tees and Cross Tees



PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51081	1 1/4"	36.3	40.70	N/A	24.20	93	73	92.5	0.05
51082	1 1/2"	42.8	48.90	N/A	28.20	114	87	92.5	0.09
51083	2"	55.8	62.90	N/A	32.20	133	108	92.5	0.13
51084	82mm	82.6	92.60	N/A	39.50	175	150	92.5	0.31
51085	110mm	110.2	120.20	N/A	48.20	223	192	92.5	0.36
51086	160mm	160.2	170.20	N/A	60.10	300	260	92.5	1.16
51087	200mm	200.2	212.50	N/A	64.20	348	312	92.5	1.73

Wyes

Also available: Reducing Wyes and Double Wyes



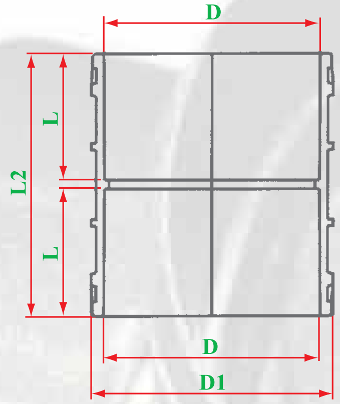
PART	NOMINAL SIZE	WYE - S x S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51244	1 1/4"	36.3	40.70	N/A	24.20	87	81	45	0.04
51245	1 1/2"	42.8	48.90	N/A	28.20	117	98	45	0.08
51246	2"	55.8	62.90	N/A	32.20	143	126	45	0.13
51247	82mm	82.6	92.60	N/A	39.50	196	185	45	0.34
51248	110mm	110.2	120.20	N/A	48.20	252	240	45	0.61
51249	160mm	160.2	170.20	N/A	60.10	347	340	45	1.42
51250	200mm	200.2	212.50	N/A	64.20	411	425	45	1.70

NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC BS 5255 AND 4514 FITTINGS

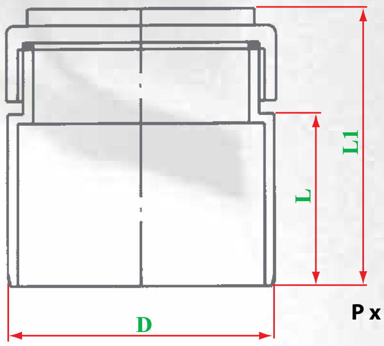
Weights, Dimensions and Tolerances

Couplings



PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51091	1 1/4"	36.3	40.70	N/A	24.20	N/A	51	N/A	0.02
51092	1 1/2"	42.8	48.90	N/A	28.20	N/A	60	N/A	0.03
51093	2"	55.8	62.90	N/A	32.20	N/A	69	N/A	0.05
51094	82mm	82.6	92.60	N/A	39.50	N/A	85	N/A	0.13
51095	110mm	110.2	120.20	N/A	48.20	N/A	100	N/A	0.20
51096	160mm	160.2	170.20	N/A	60.10	N/A	126	N/A	0.42
51097	200mm	200.2	212.50	N/A	64.20	N/A	135	N/A	0.60

Access Caps



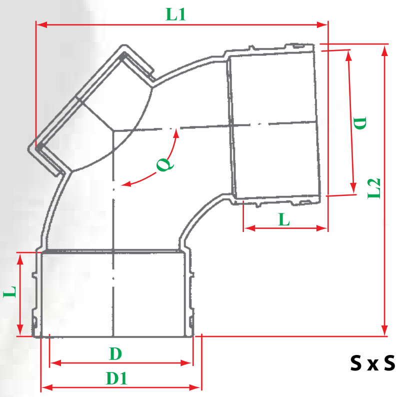
PART	NOMINAL SIZE	ACC - P x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
50155	1 1/4"	-	-	-	-	-	-	-	-
50156	1 1/2"	42.8	N/A	N/A	28.20	50	N/A	N/A	0.05
50157	2"	55.8	N/A	N/A	32.20	55	N/A	N/A	0.06
50158	82mm	82.6	N/A	N/A	39.50	64	N/A	N/A	0.10
50159	110mm	110.2	N/A	N/A	48.20	73	N/A	N/A	0.19
50160	160mm	160.2	N/A	N/A	60.10	85	N/A	N/A	0.31
50161	200mm	200.2	N/A	N/A	64.20	89	N/A	N/A	0.48

NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC BS 5255 AND 4514 FITTINGS

Weights, Dimensions and Tolerances

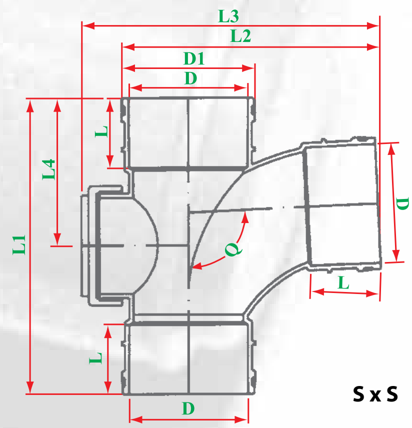
Access Bends



S x S

PART	NOMINAL SIZE	ACC - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51030	1 1/4"	-	-	-	-	-	-	-	-
51031	1 1/2"	-	-	-	-	-	-	-	-
51032	2"	-	-	-	-	-	-	-	-
51033	82mm	82.6	92.60	N/A	39.50	147	150	92.5	0.26
51034	110mm	110.2	120.20	N/A	48.20	185	189	92.5	0.41
51035	160mm	160.2	170.20	N/A	60.10	236	242	92.5	0.94
51036	200mm	-	-	-	-	-	-	-	-

Access Tees



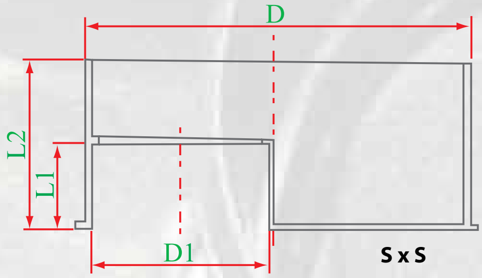
S x S

PART	NOMINAL SIZE	ACC - S x S	UNIT OF MEASURE: MM							
		D	D1	D2	L	L1	L2	L3	Q	APPROX. WT.
51046	1 1/4"	-	-	-	-	-	-		-	-
51047	1 1/2"	-	-	-	-	-	-		-	-
51048	2"	-	-	-	-	-	-		-	-
51049	82mm	82.6	92.60	N/A	39.50	175	152	172	92.5	0.30
51050	110mm	110.2	120.20	N/A	48.20	223	194	214	92.5	0.51
51051	160mm	160.2	170.20	N/A	60.10	300	247	267	92.5	1.10
51052	200mm	-	-	-	-	-	-		-	-

NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

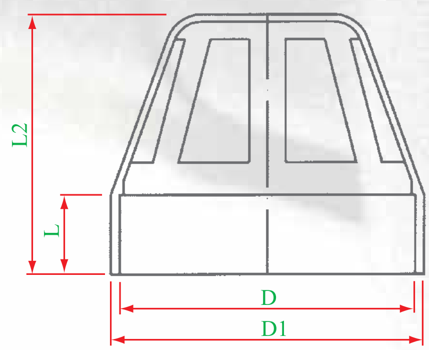
PVC BS 5255 AND 4514 FITTINGS
Weights, Dimensions and Tolerances

Reducing Bushes



PART	NOMINAL SIZE	REDUCER - S x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51204	1 1/2 x 1 1/4"	42.8	36.3	N/A	N/A	24.2	28.2	-	0.02
51206	2 x 1 1/2"	55.8	42.8	N/A	N/A	28.2	32.2	-	0.04
51209	82mm x 2"	82.6	55.8	N/A	N/A	32.2	42.0	-	0.08
51211	110mm x 2"	110.2	55.8	N/A	N/A	32.2	50.0	-	0.14
51212	110 x 82mm	110.2	82.60	N/A	N/A	39.5	50.0	-	0.15
51215	160 x 110mm	160.2	110.20	N/A	N/A	48.2	62.0	-	0.38
51217	200 x 160mm	200.2	160.2	N/A	N/A	60.1	66.0	-	0.50

Vent Cowls



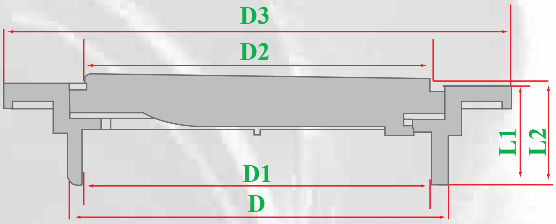
P x S

PART	NOMINAL SIZE	VENT COWL P x S	UNIT OF MEASURE: MM						
		D	D1	D2	L	L1	L2	Q	APPROX. WT.
51237	1 1/4"	-	-	-	-	-	-	-	-
51238	1 1/2"	42.8	42.80	47.90	20.00	N/A	38.00	N/A	0.02
51239	2"	55.8	55.80	60.90	26.00	N/A	52.00	N/A	0.03
51240	82mm	82.6	82.60	88.60	35.00	N/A	70.00	N/A	0.07
51241	110mm	110.2	110.20	116.80	60.00	N/A	114.00	N/A	0.13
51242	160mm	160.2	160.20	158.20	60.00	N/A	132.00	N/A	0.16
51243	200mm	-	-	-	-	-	-	-	-

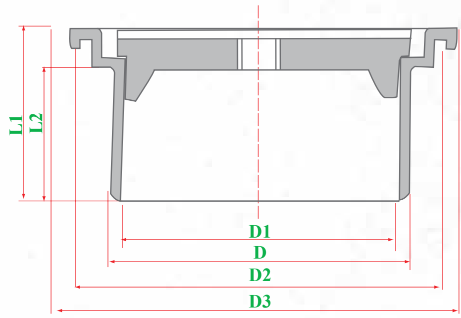
NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC BS 5255 AND 4514 FITTINGS

Weights, Dimensions and Tolerances

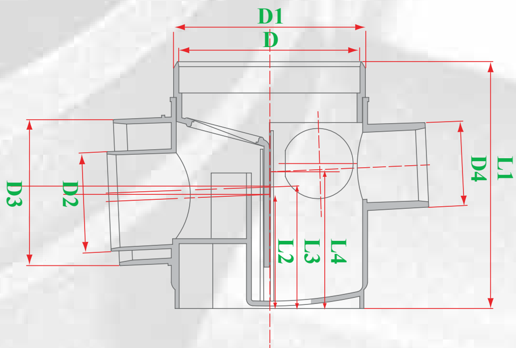


Cover - Type I

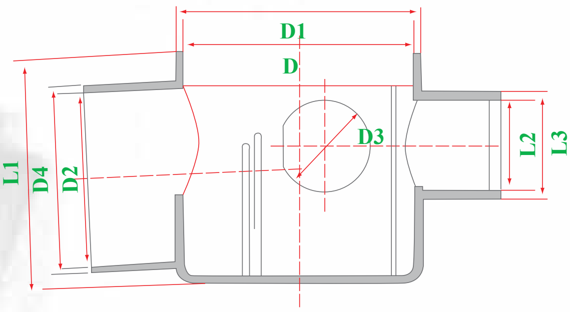


Cover - Type II

PART	NOMINAL SIZE	FLOOR TRAP COVER	UNIT OF MEASURE: MM								
		D	D1	D2	D3	D4	L1	L2	L3	L4	APPROX. WT.
51273-C	110mm	110.0	101.9	99.5	147.0	N/A	29.4	31.8	N/A	N/A	0.21
51273-D	110mm	110.0	101.9	130.0	145.6	N/A	62.0	48.0	N/A	N/A	0.74

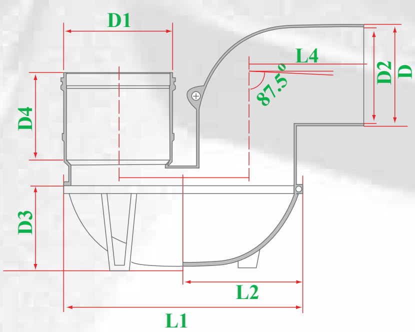


Floor Trap - Type I

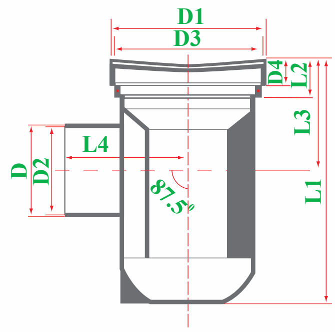


Floor Trap - Type II

PART	NOMINAL SIZE	FLOOR TRAP	UNIT OF MEASURE: MM								
		D	D1	D2	D3	D4	L1	L2	L3	L4	APPROX. WT.
51273	110mm	110.0	116.8	89.0	60.6	51.5	150.2	69.4	74.6	83.1	0.68
51274	110mm	110.0	116.8	89.0	43.2	82.9	109.8	43.2	51.5	-	0.47



P - Trap



G - Trap

PART	NOMINAL SIZE	P & GULLY TRAP	UNIT OF MEASURE: MM								
		D	D1	D2	D3	D4	L1	L2	L3	L4	APPROX. WT.
51768	110mm	110.0	116.8	103.0	85.5	94.7	262.0	127.0	140.0	130.0	1.10
51769	110mm	110.0	188.0	103.0	181.8	23.0	290.6	38.2	131.9	149.4	1.30

NOTES:
Physical dimensions and tolerances meet the requirements of BS 5255 and 4514. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC ASTM D2665 FITTINGS
Manufacturer's Product Specifications

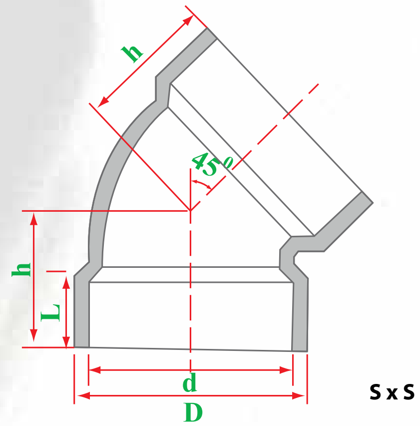
Scope
This specification covers the manufacturer's requirements for American PVC pipe fittings. These fittings meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation for solvent welded drainage fittings.

PVC Materials
Rigid PVC (polyvinyl chloride) used in the manufacture of PVC American drainage fittings is Type I, Grade I compound as stated in ASTM D-1784. Raw material used in the molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions
Physical dimensions and tolerances of PVC American drainage fittings meet the requirements of ASTM 2665 specification. Threaded fittings have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

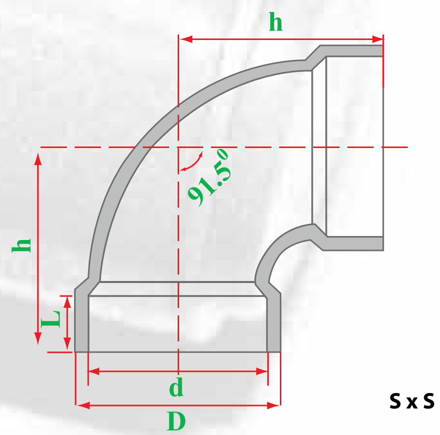
Marking
PVC ASTM 2665 fittings are marked as prescribed in ASTM specifications to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation.

45° Bends



PART	NOMINAL SIZE	45 ELL - S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
54064	1 1/2"	55.8	48.26	17.60	35.3	0.06
54065	2"	68.8	60.33	19.20	39.4	0.09
54066	3"	100.7	88.90	38.20	66.6	0.31
54067	4"	127.7	114.30	44.60	79.4	0.54
54068	6"	-	-	-	-	-
54069	8"	-	-	-	-	-

90° Bends



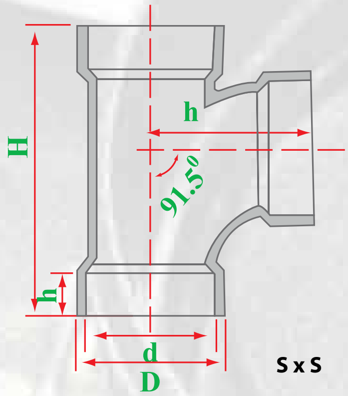
PART	NOMINAL SIZE	90 ELL - S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
54002	1 1/2"	55.8	48.26	17.60	35.3	0.09
54003	2"	68.8	60.33	19.20	39.4	0.14
54004	3"	100.7	88.90	38.20	66.6	0.43
54005	4"	127.7	114.30	44.60	79.4	0.74
54006	6"	-	-	-	-	-
54007	8"	-	-	-	-	-

NOTES:
Physical dimensions and tolerances meet the requirements of ASTM D2665. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC ASTM D2665 FITTINGS

Weights, Dimensions and Tolerances

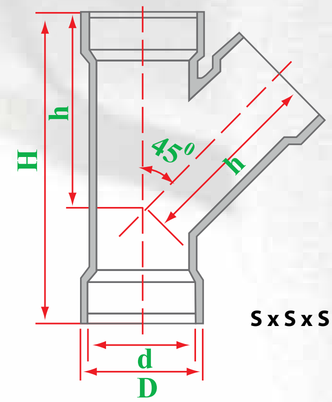
Tees



S x S

PART	NOMINAL SIZE	TEE - S x S	UNIT OF MEASURE: MM				
		D	d	L	H	h	APPROX. WT.
54082	1 1/2"	55.8	48.26	17.60	109.3	63.2	0.13
54083	2"	68.8	60.33	19.20	130.0	75.0	0.19
54084	3"	100.7	88.90	38.20	199.8	115.0	0.58
54085	4"	127.7	114.30	44.60	247.0	139.5	1.05
54086	6"	-	-	-	-	-	-
54087	8"	-	-	-	-	-	-

Wyes



S x S x S

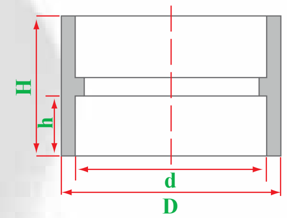
PART	NOMINAL SIZE	WYE - S x S x S	UNIT OF MEASURE: MM				
		D	d	L	H	h	APPROX. WT.
54245	1 1/2"	55.8	48.26	17.60	138.8	90.8	0.17
54246	2"	68.8	60.33	19.20	165.8	109.3	0.23
54247	3"	100.7	88.90	38.20	241.0	165.2	0.73
54248	4"	127.7	114.30	44.60	298.4	205.4	1.31
54249	6"	-	-	-	-		-
54250	8"	-	-	-	-		-

NOTES:
Physical dimensions and tolerances meet the requirements of ASTM D2665. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.

PVC ASTM D2665 FITTINGS

Weights, Dimensions and Tolerances

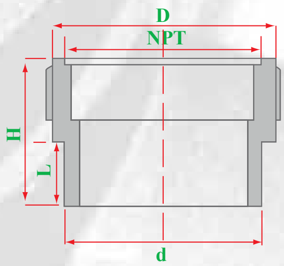
Couplings



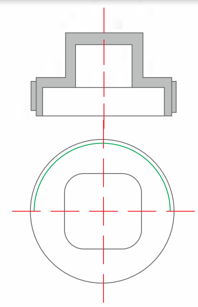
S x S

PART	NOMINAL SIZE	COUPLING - S x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
54092	1 1/2"	55.8	48.26	17.60	40.0	0.04
54093	2"	68.8	60.33	19.20	44.0	0.06
54094	3"	100.7	88.90	38.20	82.6	0.21
54095	4"	127.7	114.30	44.60	95.8	0.36
54096	6"	-	-	-	-	-
54097	8"	-	-	-	-	-

Plugs

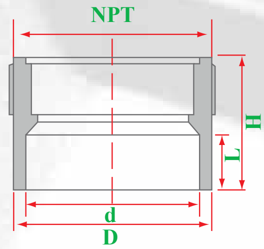


P x S

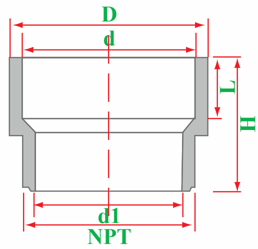


PART	NOMINAL SIZE	ACC - P x S	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
54055	1 1/2"	55.8	48.26	17.60	41.5	-
54056	2"	68.8	60.33	19.20	45.5	-
54057	3"	100.7	88.90	38.20	73.5	-
54058	4"	127.7	114.30	44.60	82.8	-
54059	6"	-	-	-	-	-
54060	8"	-	-	-	-	-

Adaptors



S x T

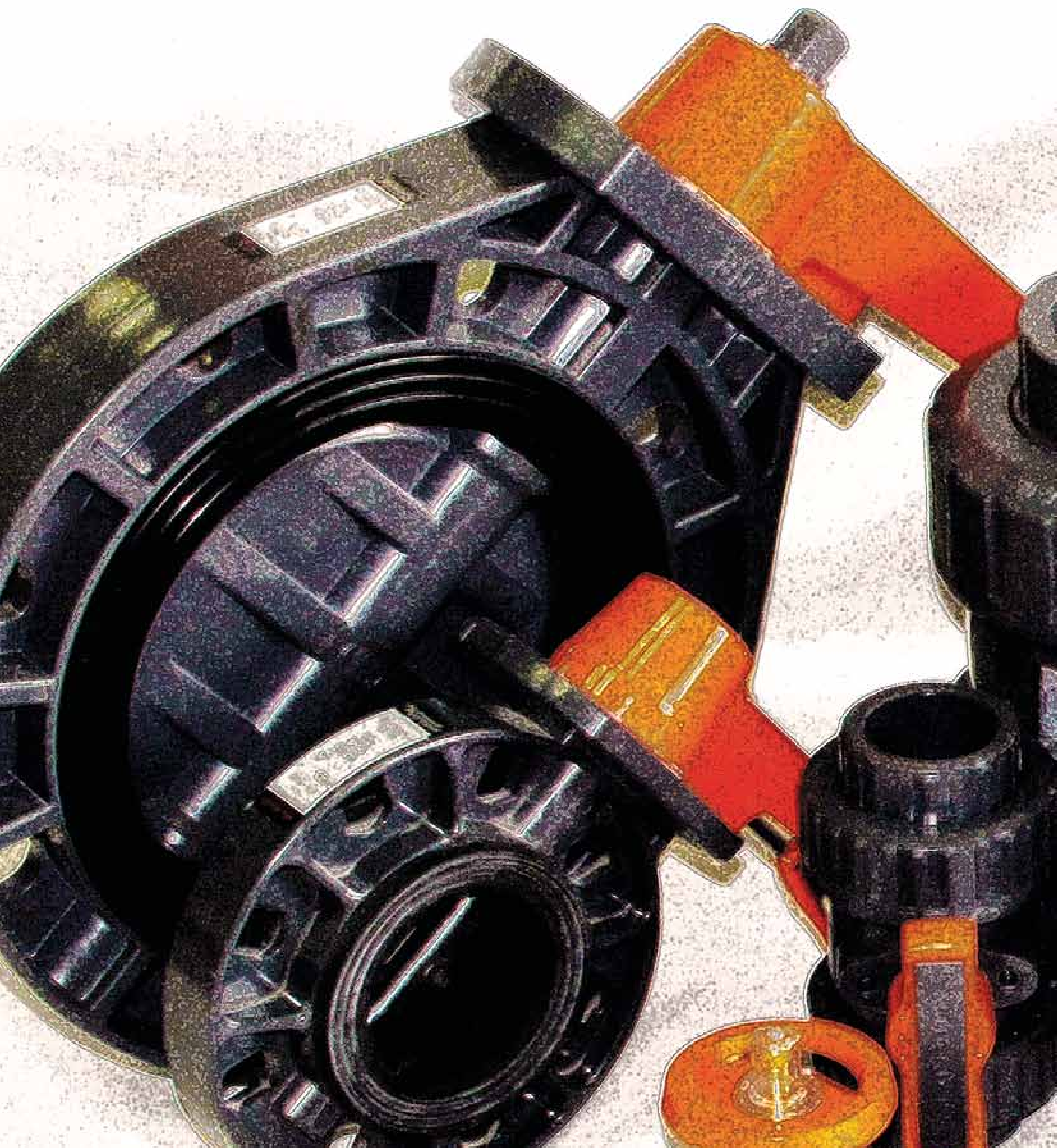


S x T

PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
54223	1 1/2"	55.8	48.26	17.60	42.3	-
54224	2"	68.8	60.33	19.20	45.2	-
54225	3"	100.7	88.90	38.20	76.4	-
54226	4"	127.7	114.30	44.60	85.2	-

PART	NOMINAL SIZE	ADAPTOR S x T	UNIT OF MEASURE: MM			
		D	d	L	H	APPROX. WT.
51228	1 1/2"	55.8	48.26	17.60	42.3	-
51229	2"	68.8	60.33	19.20	45.2	-
51230	3"	100.7	88.90	38.20	76.4	-
51231	4"	127.7	114.30	44.60	85.2	-

NOTES:
Physical dimensions and tolerances meet the requirements of ASTM D2665. PVC material meets ASTM Standard D-1784.
All dimensions are in millimeters unless otherwise specified.
Dimensions are subject to change without notice. Contact your Hydroseal representative for certification.




Hydroseal® Canada
re-engineering

VALVES AND ACTUATORS
Table of Contents

VALVES AND ACTUATORS 5.00

Scope

This specification sheet covers the manufacturer's requirements for PVC and CPVC F-1970 valves. These valves meet or exceed the standards set by the American Society for Testing and Materials and the National Sanitation Foundation.

PVC and CPVC Materials

Rigid PVC (polyvinyl chloride) and CPVC (chlorinated polyvinyl chloride) used in the manufacture of ASTM F-1970 valves is Type I, Grade 1 PVC compound, and Type IV, Grade 1 CPVC compound as stated in ASTM D-1784. Raw material used in molding shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Dimensions

Physical dimensions and tolerances of PVC and CPVC F-1970 products meet the requirements of ASTM specifications D-2467 and D-2466 for IPS (Iron Pipe Sizes) fittings. Threaded valves have tapered pipe threads in accordance with ANSI/ASME B1.20.1.

Marking

PVC and CPVC valves are marked as prescribed in ASTM F-1970 to indicate the manufacturer's name or trademark, size of fitting, and ASTM designation F-1970. There must be clear distinguishing on those products that are PVC and those products that are CPVC.

ISOLATION VALVES
Butterfly Valves - carrot top

Single Mold Body
Hydroseal Canada's 2" through 12" all-plastic carrot top Butterfly Valves are rated at a full 200 PSI. Hydroseal Canada valves are constructed from a one piece body that incorporates fully supported flanged bolt holes to prevent stressing of the mating pipe flanges. Their heavy duty construction stands up to the most demanding applications. The integral mounting pad ensures that the valve operator is used, lever handle, worm gear or actuator.

Advanced Design
Hydroseal Canada Butterfly Valves feature stainless steel stems and a unique, full body liner that has a V-notch retention design. This assures positive sealing of the liner to the valve body without the use of adhesives or thermal bonding. An integrally molded face seal provides positive sealing against the mating flange without the need for additional gaskets, and the lever handle has a built in lockout feature.

Easy Compatibility
Hydroseal Canada Butterfly Valves can be easily fitted into a metal piping system. All valve sizes meet industry face-to-face standards allowing simple retrofit.

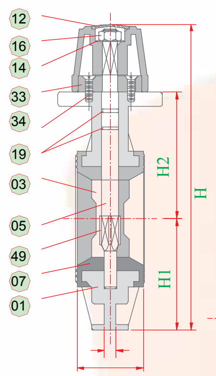
No Metal, No Corrosion
These valves have no metal in contact with the process media. They cannot corrode or rust, nor will they contaminate sensitive fluids flowing through them.

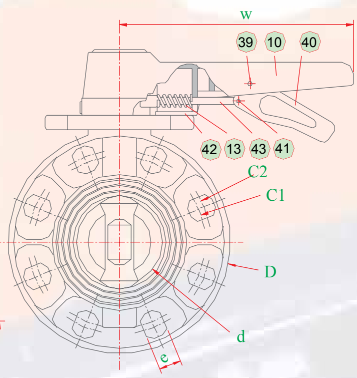
Features
- Rated at 200 PSI
- Stainless Steel Shaft
- Fully Supported Flange Bolt Holes
- Bolt Holes suitable for ASTM, DIN and JIS systems
- V-Notch Liner
- Viton, EPDM or Nitrile Liners

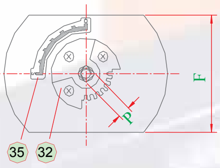
Options
- Lug Body Design
- Worm Gear Operators
- Electric Actuators
- Pneumatic Actuators
- PVC, PP or PVDF Discs

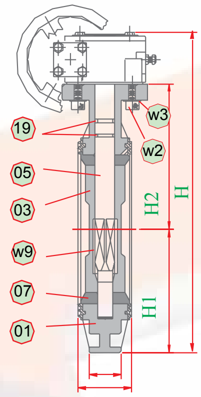
Technical Information

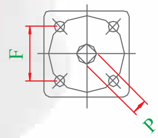
SIZE: 2″ ~ 8″
JOINT END: FLANGE TYPE - ANSI (150 LBS)
DIN (PN10) - JIS (10K)
WORKING PRESSURE: 200 PSI

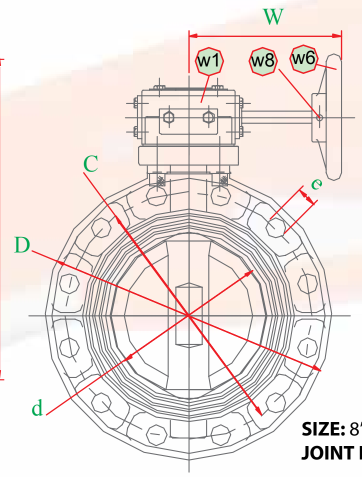












SIZE: 8″ ~ 12″
JOINT END: FLANGE TYPE
(ANSI.DIN.JIS)
WORKING PRESSURE: 200 PSI

CONSTRUCTION			
NO	PARTS	PCS	MATERIALS
13	SPRING	1	SUS316
14	HANDLE WASHER	1	SUS27
16	HANDLE NUT	1	SUS27
19	STEM O-RING	2	EPDM
32	LOCKING PLATE	1	SUS304
33	GEAR SEAT	1	ABS
34	BOLT	3	SUS27
35	LEVEL	1	ALUMINUM
39	PIN	1	SUS27
40	SMALL HANDLE	1	ABS
49	GATE BUSHING	1	SUS304

CONSTRUCTION			
NO	PARTS	PCS	MATERIALS
W1	WORM GEAR	1	FC20
W2	BOLT	4	SUS27
W3	WASHER	4	SUS27
W6	HANDLE	1	FC20
W8	PIN	1	SUS410
W9	GATE BUSHING	1	SUS410

CONSTRUCTION			
NO	PARTS	PCS	MATERIALS
1	BODY	1	PVC,PP
3	VALVE GATE	1	PP
5	VALVE STEM	1	SU410
7	SEAT	1	EPDM.NBR.BUNA
10	HANDLE	1	ABS
12	HANDLE CAP	1	ABS

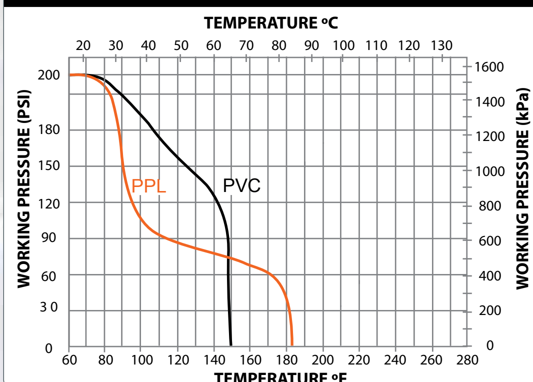
PART	NOMINAL SIZE	FLANGE TYPE	LEVER HANDLE TYPE							UNIT OF MEASURE:MM					
		DN	d	C1	C2	H	H1	H2	L	L1	D	F	W	e	P	"OPERATING TORQUE (LBF-IN)
60030	2″	DN 50	52.0	120.0	125.0	229.0	81.0	93.0	52.0	10.0	162.0	92.0	208.0	19.0	11.0	87.0
60031	2 1/2″	DN 65	66.0	140.0	145.0	248.0	89.0	104.0	43.0	10.0	179.0	92.0	208.0	19.0	11.0	104.0
60032	3″	DN 80	78.0	150.0	160.0	263.0	98.0	110.0	57.0	10.0	195.0	92.0	208.0	19.0	14.0	104.0
60033	4″	DN 100	100.0	175.0	190.5	296.0	112.0	128.0	60.0	10.0	225.0	92.0	208.0	19.0	14.0	130.0
60035	5″	DN 125	125.0	210.0	216.0	331.0	128.0	144.0	65.0	12.0	256.0	110.0	280.0	23.0	17.0	190.0
60036	6″	DN 150	143.0	240.0	240.0	358.0	140.0	158.0	70.0	12.0	282.0	110.0	280.0	23.0	17.0	217.0
60038	8″	DN 200	187.0	290.0	298.5	450.0	172.5	203.5	79.0	15.0	345.0	120.0	300.0	23.0	22.0	260.0

PART	NOMINAL SIZE	FLANGE TYPE	WORM GEAR TYPE							UNIT OF MEASURE:MM					
		DN	d	C	C	H	H1	H2	L	L1	D	F	W	e	P	"OPERATING TORQUE (LBF-IN)
60038	8″	DN 200	187.0	298.5	295.0	450.0	172.5	203.5	79.0	45.0	345.0	76.0	199.0	24.0	107.5	260.0
60040	10″	DN 250	236.0	362.0	350.0	523.0	206.5	241.5	97.0	55.0	413.0	76.0	199.0	25.0	107.5	303.0
60042	12″	DN 300	283.0	431.5	400.0	610.0	245.5	280.5	107.0	60.0	491.0	88.4	250.0	25.0	136.0	434.0

SELECTION CHART
Lever Handle Operator and Gear Box Operator

SIZE	BODY MATERIAL	DISC MATERIAL	SHAFT MATERIAL	LINER	OPERATOR	PRESSURE RATING
2″ to 8″	PVC	PP	SUS 410	Viton, EPDM or Nitrile	Lever or Gear Box	200 PSI @ 70F Non-Shock
		PVC or PVDF*	SUS 410			
10″ to 12″	PPL	PVC or PPL				

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
2″	125	6″	1100
3″	280	8″	2500
4″	375	10″	4700
5″	N/A	12″	7100

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

* PVDF not available in 2″

ISOLATION VALVES
Butterfly Valves - titan

Single Mold Body
Hydroseal Canada's 2" through 8" all plastic titan Butterfly valves are rated at a full 150 PSI. Hydroseal Canada valves are constructed from a one piece body that incorporates fully supported flanged bolt holes to prevent stressing of the mating pipe flanges. Their heavy duty, industrial, robust construction stands up to the most demanding applications. The integral mounting pad ensures that the valve operator is used, lever handle, worm gear or actuator.

Advanced and Tested Design
Hydroseal Canada Butterfly Valves feature stainless steel stems and a unique full body liner that has a V-notch retention design. This assures positive sealing of the liner to the valve body without the use of adhesives or thermal bonding. An integrally molded face seal provides positive sealing against the mating flange with the need for additional gaskets, and the lever handle has a built in lock out feature. The discs are also molded and re-engineered for precise flow control, with options available for PVC, CPVC , PP or PVDF.

Easy Compatibility
Hydroseal Canada Butterfly Valves can be easily fitted into a metal piping system. All valve sizes meet industry face-to-face standards allowing simple retrofit.

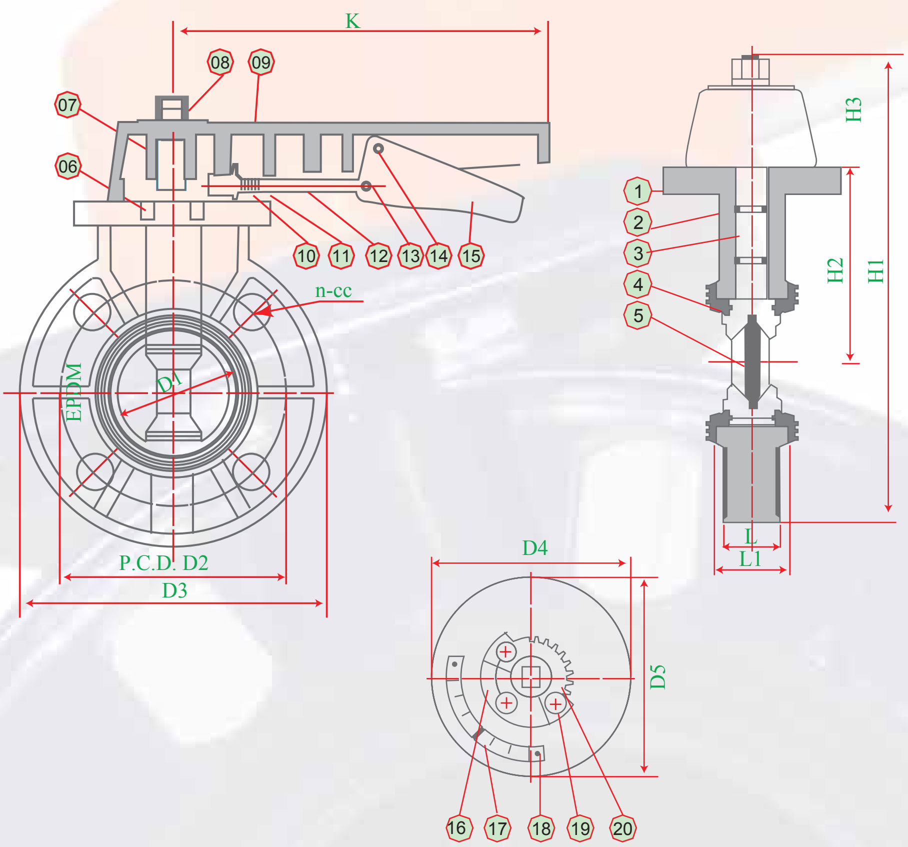
No Metal, No Corrosion
These valves have no metal in contact with the process media. They cannot corrode or rust, nor will they contaminate sensitive fluids flowing through them.

Features
- Rated at 150 PSI
- Stainless Steel Shaft
- Fully Supported Flange Bolt Holes
- Universal Bolt Holes suitable for ASTM, DIN and JIS systems
- V-Notch Liner

Options
- Lug Body Design
- Worm Gear Operators
- Electric Actuators
- Pneumatic Actuators
- PVC, CPVC, PP or PVDF discs
- Viton, EPDM or Nitrile Liners

Technical Information

SIZE: 2" ~ 8"
JOINT END: FLANGE TYPE - ANSI (150 LBS)
DIN (PN10) - JIS (10K)
WORKING PRESSURE: 150 PSI



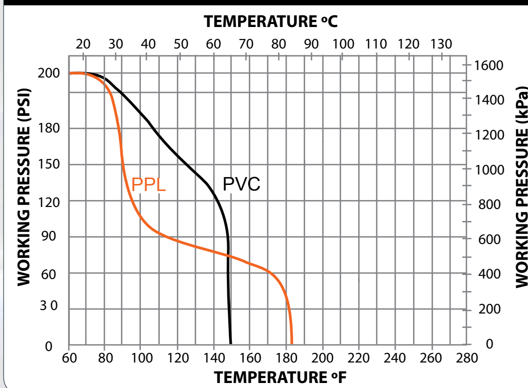
CONSTRUCTION			
NO	PARTS	PCS	MATERIALS
1	BODY	1	PVC,PP,CPVC,PVDF
2	STEM O-RING	2	EPDM,VITON
3	STEM	1	SUS 410, SUS 316
4	SEAT	1	EPDM,VITON,NBR
5	DISC	1	PVC,PP,CPVC,PVDF
6	BOLT	1	BRASS,SUS304
7	HANDLE INSERT	1	FC 0208
8	STEM BOLT	1	PVC, BRASS
9	HANDLE	1	ABS
10	HANDLE CAP	1	ABS
11	SPRING	1	SUS 304
12	LEVER	1	SUS 304
13	SET PIN(SHORT)	1	SUS 304
14	SET PIN(LONG)	1	SUS 304
15	LEVER	1	ABS
16	POSITIONER	1	PVC
17	INDICATOR	1	SUS 304
18	BOLT	2	SUS 304
19	BOLT	3	SUS 304
20	TEETH PLATE	1	SUS 304

PART	NOMINAL SIZE	FLANGE TYPE	LEVER HANDLE TYPE							UNIT OF MEASURE: MM					Torque at 100 PSI (kgf.m)	
		DN	D1	D2	D3	n	L	L1	D4	H1	H2	H3	I	K	D5	Open	Close
60030	2"	DN 50	55.0	123.0	164.0	4.0	38.0	41.0	105.0	82.0	107.0	63.0	252.0	204.0	93.0	0.80	1.00
60031	2 1/2"	DN 65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60032	3"	DN 80	78.0	151.8	196.0	8.0	42.0	45.0	127.0	98.0	123.0	63.0	284.0	204.0	95.0	2.50	2.50
60033	4"	DN 100	100.0	182.0	225.0	8.0	48.0	51.0	134.0	112.5	139.5	68.0	320.0	253.0	100.0	3.00	3.00
60035	5"	DN 125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60036	6"	DN 150	152.0	240.0	286.0	8.0	51.0	54.0	170.0	143.0	178.0	86.0	407.0	297.0	101.0	7.50	8.00
60038	8"	DN 200	200.0	290.0	344.0	12.0	61.0	64.0	191.0	172.0	212.0	86.0	470.0	297.0	110.0	10.15	10.50

SELECTION CHART
Lever Handle Operator and Gear Box Operator

SIZE	BODY MATERIAL	DISC MATERIAL	SHAFT MATERIAL	LINER	OPERA-TOR	PRESSURE RATING
2" to 8"	PVC	PP	SUS 410	Viton, EPDM or Nitrile	Lever or Gear Box	150 PSI @ 70F Non-Shock
		PVC or PVDF*	SUS 316			

OPERATING TEMPERATURE/PRESSURE



CV FACTORS

SIZE	FACTOR	SIZE	FACTOR
2"	125.0	6"	1100.0
3"	280.0	8"	2500.0
4"	375.0	-	-
5"	N/A	-	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES
Compact Ball Valves - quark

Rugged, Compact Design
Hydroseal Canada's rugged, compact all-plastic quark PVC Ball Valves incorporate many design features found only on higher cost ball valves. Features such as Teflon seats, full porting and a 150 PSI pressure rating are all standard on every size of Hydroseal Canada's range of Compact Ball Valves.

Cost-sensitive Applications
The Compact Ball Valve is perfect for applications that require a reliable ball valve at an economical price. The Compact valve has been designed and tested to make certain it will perform year in and year out in the most demanding applications without leakage or failure. The internal components of a Compact valve are completely encapsulated within the valve body in a one-step manufacturing process. There is absolutely no danger of leakage through assembled parts. This also means that the valve never requires adjustment since all internal components are sealed inside the one-piece valve body. The Compact valve is ready to be put into service right out of the box.

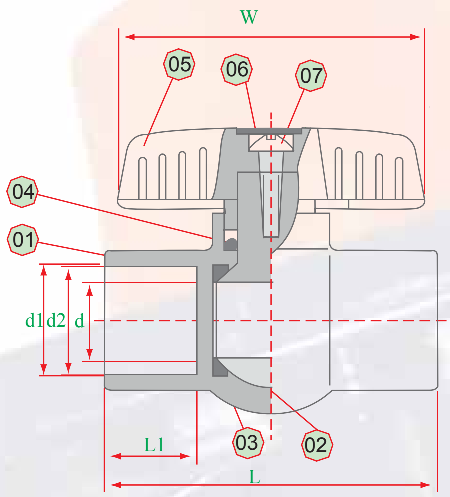
Lightweight and Compact
Hydroseal Canada Compact Ball Valves are designed to fit into space too small for other valves. They are about one-third the overall size of a plastic true union valve and they weigh an average of 50% less. This makes them ideal for skid-mounted and other applications where space and weight are critical considerations.

Can't Rust, Won't Corrode
The all-plastic construction means they will never fail, stick, or jam because of rusted or corroded parts - they will work in places and environments where metal valves must be painted or coated just to survive.

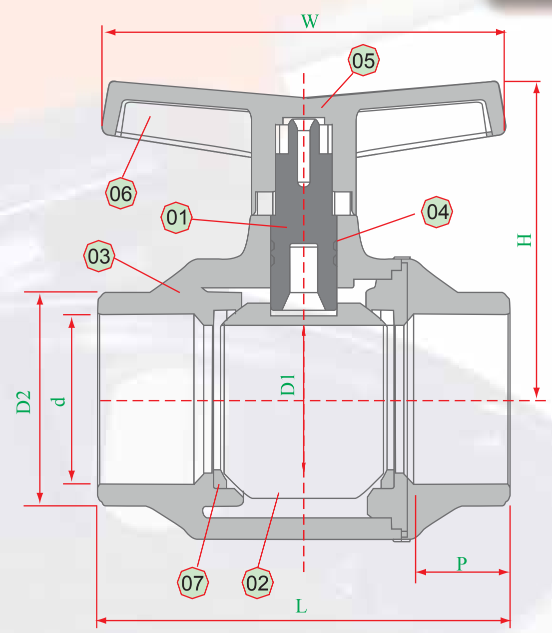
Features
- Rated at 150 PSI
- Teflon Seats
- EPDM Seals
- No Internal Parts to Replace
- Easy 1/4-Turn Operation
- NSF Listed
- Socket or Threaded Pipe Connections
- Suitable for ASTM, DIN, JIS systems

Technical Information

SIZE: 1/2" ~ 2"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE: 150 PSI



CONSTRUCTION			
NO	**PARTS**	**PCS**	**MATERIALS**
1	BODY	1	PVC, CPVC
2	STEM AND BALL	1	PVC, CPVC
3	SEAT	2	TEFLON
4	STEM O-RING	1	EPDM
5	HANDLE	1	ABS
6	CAP	1	ABS
7	BOLT	1	SUS304

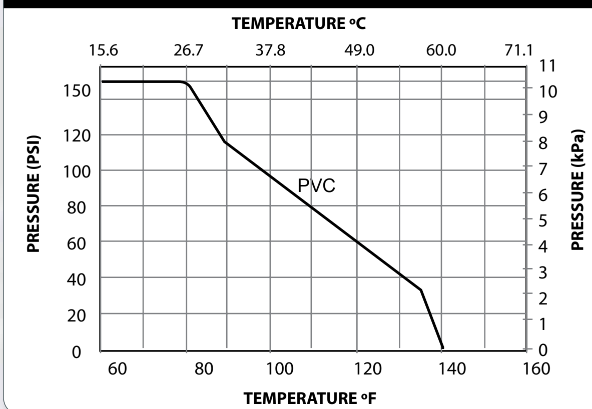


SIZE: 2 1/2" ~ 4"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSURE : 150 PSI

PART	NOMINAL SIZE	SOCKET. THREADED TYPE		ASTM	JIS	DIN	ASTM	JIS	DIN	UNIT OF MEASURE: MM		
		DN	D	d1	d1	d1	d2	d2	d2	L	W	H
60003	1/2"	DN15	29	21.33	20.30	22.30	22.22	16.00	22.20	79	70	47
60004	3/4"	DN20	37	31.75	25.30	26.30	25.40	18.50	25.40	91	77	57
60005	1"	DN25	43	33.40	32.30	32.33	28.58	22.00	28.60	107	89	61
60006	1 1/4"	DN32	53	42.16	40.30	38.43	31.75	26.00	31.80	123	89	66
60007	1 1/2"	DN40	61	48.26	50.30	48.46	34.93	31.00	34.90	129	111	74
60008	2"	DN50	73	60.32	63.30	60.56	38.10	37.50	38.10	151	139	80
60009	2 1/2"	DN65	96	73.03	75.30	68.07	44.45	43.50	44.50	194	190	141
60010	3"	DN80	110	88.90	90.30	77.98	47.63	51.00	47.60	233	230	154
60011	4"	DN100	136	114.30	110.30	100.07	57.15	61.00	57.60	280	274	170
60013	6"	DN150	196	168.83	160.30	148.08	89.94	90.00	90.00	376	323	182

SELECTION CHART				
SIZE	**MATERIAL**	**END CONN.**	**SEALS**	**PRESSURE RATING**
1/2" - 2"	PVC, CPVC	Socket or Threaded	EPDM	150 PSI @ 70F Non-Shock
2 1/2" - 4"	PVC, CPVC	Socket or Threaded		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	**FACTOR**	**SIZE**	**FACTOR**
1/4"	-	1 1/2"	110.0
3/8"	-	2"	217.0
1/2"	13.0	2 1/2"	304.0
3/4"	24.0	3"	452.0
1"	49.0	4"	510.0
1 1/4"	70.0	6"	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES

True Union Ball Valves - anthem (WTF™ Series)

Heavy Wall Plastic Construction

Stands up to the most aggressive of applications. Hydroseal Canada's anthem True Union Ball Valves can take the daily abuse of industrial service and continue to function.

True Union Functionality

This makes these valves very easy to maintain by allowing for easy removal from a piping system without breaking down pipe connections. Just unscrew the two assembly nuts and lift the valve body out of the line.

Advanced Design

Hydroseal Canada True Union Ball Valves are superior performers. A fine-pitch seal retainer thread allows for accurate compensation for seat wear. Reversible seats make it easy to get a damaged valve back in service. Should the seats become damaged they only need to be removed, turned over, and reinstalled to put the valve back on line. These valves feature a double o-ring stem seal for twice the leakage protection of valves with only a single stem seal.

Corrosion-free

This is because of anthem's all-plastic construction. Anthem will never rust or corrode, and can survive corrosive environments without the need for painting or expensive epoxy coatings.

Actuator-ready

Hydroseal Canada's manual True Union Ball Valves have been designed so that they can be easily converted to automated valves - in the field. To do this, just remove the compression-fit handle and install an actuator mounting bracket.

Features

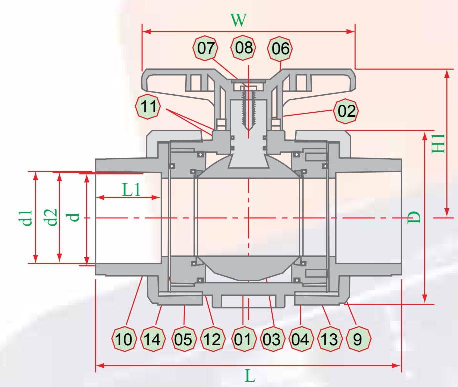
- Rated at 200 PSI
- Full Port Design
- Reversible PTFE Seats
- Easy Maintenance
- Viton or EPDM Seals
- Easily Automated
- Double O-Ring Stem Seals
- Adjustable Seat Retainer

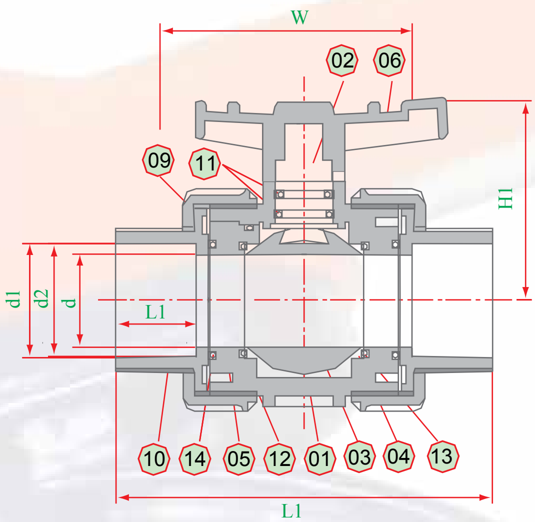
Options

- Stem Extensions
- Lockouts
- Spring Return Handle
- Pneumatic Actuators
- Electric Actuators
- 2" Square Operating Nuts
- Socket or Threaded Connectors
- Suitable for ASTM, DIN, JIS Systems

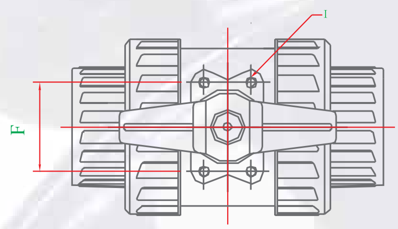
Technical Information

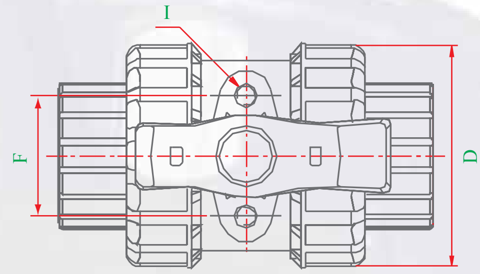
SIZE: 1/2" ~ 2"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE: 200 PSI





CONSTRUCTION			
NO ,	**PARTS**	**PCS**	**MATERIALS**
1	BODY	1	PVC , PP , CPVC
2	STEM	1	PVC , PP , CPVC
3	BALL	1	PVC , PP , CPVC
4	SEAT	2	TEFLON
5	THREADED SPACER	1	PVC , PP , CPVC
6	HANDLE	1	ABS
7	BOLT	1	SUS304
8	HANDLE CAP	1	ABS
9	UNION NUT	2	PVC , PP , CPVC
10	UNION SOCKET	2	PVC , PP , CPVC
11	STEM O-RING	2	EPDM
12	SPACER SEAL	2	EPDM
13	END SEAL	2	EPDM



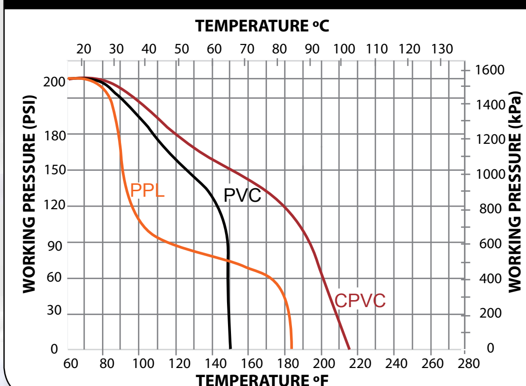


SIZE: 2 1/2" ~ 4"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSURE : 200 PSI

PART	NOMINAL SIZE	SOCKET,THREAD TYPE		UNIT OF MEASURE: MM											
	ND	DN	D	d1	d1	d1	d2	d2	d2	L	L1	W	F	H1	I
60017	1/2"	DN 15	53	21.54	20.30	22.30	21.23	19.90	21.78	104	23	66	31	49	M5
60018	3/4"	DN 20	61	26.87	25.30	26.30	26.57	24.90	25.70	115	26	79	33	60	M6
60019	1"	DN 25	71	33.66	32.30	32.33	33.27	31.90	31.67	131	30	87	40	68	M6
60020	11/4"	DN 32	83	42.42	40.30	38.43	42.04	39.80	37.57	147	32	97	52	76	M8
60021	11/2"	DN 40	96	48.56	50.30	48.46	48.10	49.80	47.54	164	35	109	52	85	M8
60022	2"	DN 50	116	60.63	63.30	60.56	60.17	62.80	59.44	210	40	132	70	97	M8
60023	21/2"	DN 65	146	73.38	75.30	76.60	72.85	74.80	75.87	265	49	205	83.6	133	M10
60024	3"	DN 80	162	89.31	90.40	89.60	88.70	89.80	88.83	290	63	205	83.6	144	M10
60025	4"	DN 100	206	114.76	110.40	114.70	114.07	109.80	113.98	366	87	250	121	170	M10

SELECTION CHART				
SIZE	**MATERIAL**	**END CONN.**	**SEALS**	**PRESSURE RATING**
1/2"~2"	CPVC	Socket or Threaded	Viton or EPDM	200 PSI @ 70F Non-Shock
1/2"~ 4"	PVC or CPVC	Socket, Threaded or Flanged		
1/2"~ 2"	PP	Socket or Threaded		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	**FACTOR**	**SIZE**	**FACTOR**
1/4"	-	1 1/2"	90.0
3/8"	-	2"	140.0
1/2"	8.0	2 1/2"	330.0
3/4"	15.0	3"	480.0
1"	29.0	4"	600.0
11/4"	75.0	6"	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES

True Union Ball Valves - fortis

Rugged Construction

Hydroseal Canada's fortis series True Union Ball Valves are cost effective, yet rugged enough to stand up to demanding industrial and commercial applications. The valves are assembled without any use of a silicon based lubricant and may be used for most forms of process media.

True Union Design

This makes valves very easy to maintain by allowing for easy removal from a piping system without breaking down piping connections. Just unscrew the two assembly nuts and lift the valve body out of the line.

Advanced Design Features

Hydroseal Canada True Union Ball Valves are superior performers. They have an adjustable seat carrier that allows the seat to be calibrated while maintaining downstream pressure. These valves feature a dovetail ball and stem, and a thick double o-ring stem steal for twice the leakage protection.

Actuator Mounting Design

For actuator mounting, the valve incorporates a unique design for glued or clamped on mounting pads. This assures proper alignment of the actuator to the valve body without creating damaging side loads to cause premature stem seal failure. Incorporating this design, the valve may be easily reverted back to manual operation, should the need arise.

Corrosion-free

This is because of Fortis's all-plastic construction. Fortis will never rust or corrode, and can survive corrosive environments without the need for painting or epoxy coatings.

Features

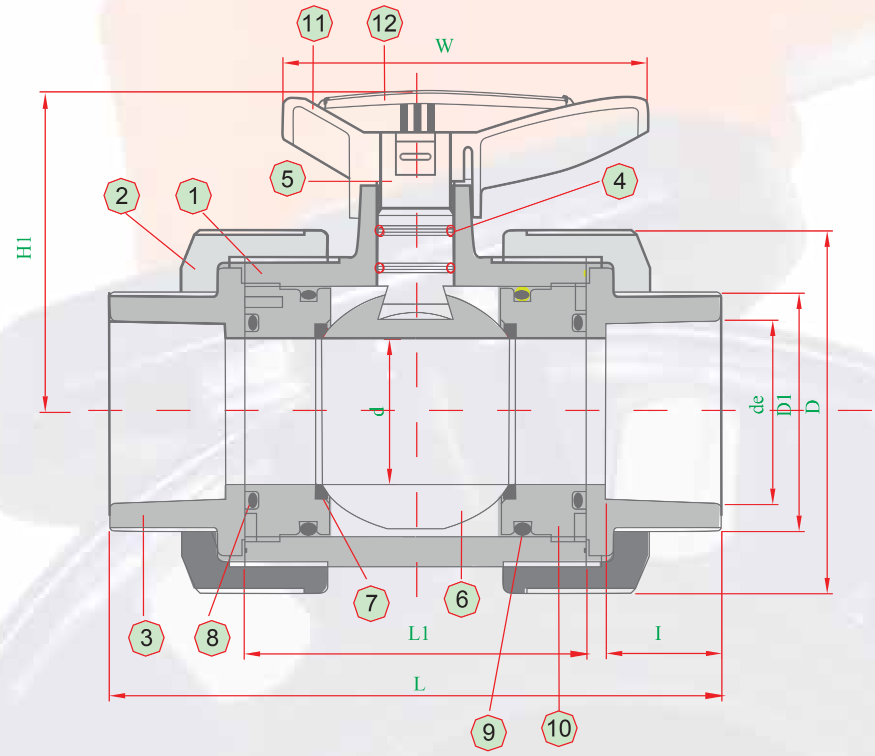
- Rated at 150 PSI
- Full Port Design
- Reversible PTFE Seats
- Easy Maintenance
- EPDM Seals
- Easily Automated
- Double O-Ring Steam Seals
- Adjustable Seat Retainer

Options

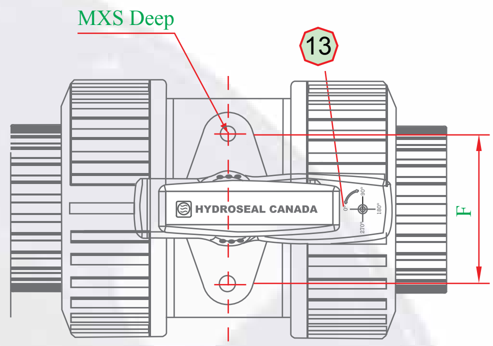
- Pneumatic Actuators
- Electric Actuators
- Socket or Threaded Connectors
- Suitable for ASTM, DIN, JIS Systems

Technical Information

SIZE: 1/2" ~ 2 1/2"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSURE: 150 PSI



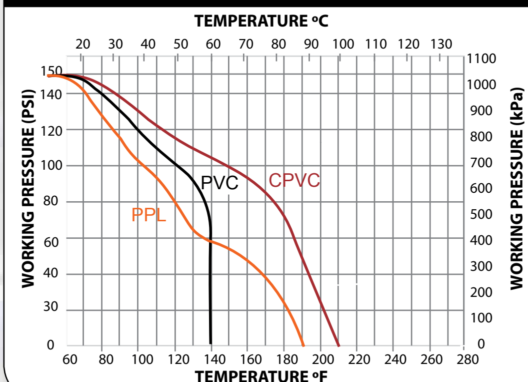
CONSTRUCTION			
NO.	PARTS	PCS	MATERIALS
1	BODY	1	PVC,CPVC, ABS
2	NUT	2	PVC,CPVC, ABS
3	END CONNECTOR	2	PVC,CPVC, ABS
4	STEM O-RING	2	EPDM, FPM
5	STEM	1	PVC,CPVC, ABS
6	BALL	1	PVC,CPVC, ABS
7	SEAT	2	PTFE
8	UNION O-RING	2	EPDM, FPM
9	CARRIER O-RING	1	EPDM, FPM
10	CARRIER	1	PVC,CPVC, ABS
11	HANDLE	1	ABS
12	HANDLE CAP	1	ABS
13	INSERTED NUT	2	C3602



PART	NOMINAL SIZE	SOCKET, THREAD TYPE							ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM	
		DN	D	D1	d	H1	L	L1	I	I	I	de	de	de	F	MXS
60017	1/2"	DN 15	45.8	32.0	13.0	48.5	115.4	62.0	22.6	17.0	22.6	21.3	22.5	22.0	30	M5
60018	3/4"	DN 20	55.8	38.0	18.0	60.0	133.0	72.9	25.5	20.0	25.5	26.7	25.5	26.0	33	M6
60019	1"	DN 25	67.0	45.0	24.0	67.0	148.0	79.9	28.6	23.0	28.6	33.4	29.0	32.0	40	M6
60020	1 1/4"	DN 32	82.0	55.2	31.0	76.0	169.0	88.0	31.9	27.0	31.9	42.2	32.0	38.0	47	M8
60021	1 1/2"	DN 40	98.0	67.0	38.5	89.0	174.0	93.0	35.1	32.0	35.1	48.3	35.0	48.0	52	M8
60022	2"	DN 50	119.5	80.3	50.0	108.3	204.0	112.7	38.2	37.5	38.2	60.3	38.5	60.0	70	M8
60023	2 1/2"	DN 65	119.5	80.3	50.0	108.3	210.0	112.7	41.4	41.5	41.2	73.0	44.5	76.0	70	M8

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
1/2"~ 2 1/2"	CPVC	Socket or Threaded	Viton or EPDM	150 PSI @ 70F Non-Shock
1/2"~ 2 1/2"	PVC	Socket or Threaded		
1/2"~ 2 1/2"	PP	Socket or Threaded		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/4"	-	1 1/2"	90.0
3/8"	-	2"	140.0
1/2"	8.0	2 1/2"	330.0
3/4"	15.0	3"	-
1"	29.0	4"	-
11/4"	75.0	6"	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES

True Union Ball Check Valves - kaplan

Completely Re-engineered

Twenty-five years of advanced experience in molding, manufacturing, logistics, transportation, materials, application have gone into Hydroseal Canada's kaplan True Union Ball Valves. This valve is completely designed to address today's fast-paced world and global trade.

True Union Functionality

Incorporating this tried-and-tested functionality, Hydroseal Canada has gone one step further. The kaplan valve may be retrofitted with spare parts from our unions, flanges and sharkfellow Ball Check Valve.

Durability

With a combination of sixteen seals and two sturdy teflon seats, this valve is designed for superior performance. The seats are reversible so damages will not result in costly down-time.

Actuator Ready

Similar to our other valves, kaplan may easily be converted to automated valves - in the field.

Features

- Rated at 200 PSI
- Full Port Design
- Reversible PTFE Seats
- Low Maintenance
- Viton or EPDM Seals.
- Easily Retrofitted with Parts from WTF Flanges, Unions and Sharkfellow Valves.

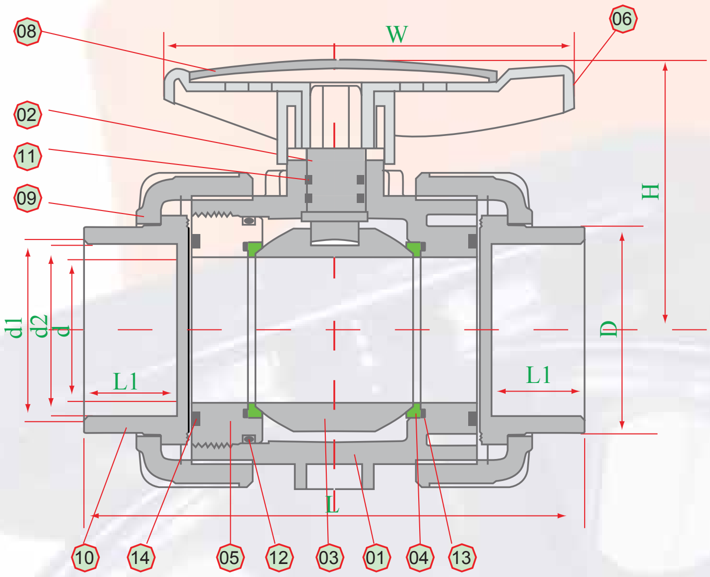
Options

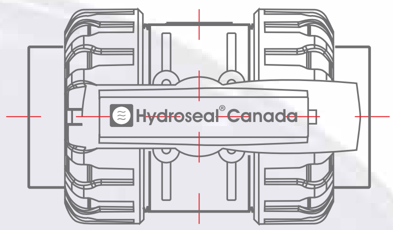
- Stem Extensions
- Lockouts (coming soon)
- Pneumatic Actuator Ready
- Electric Actuator Ready
- Socket or Threaded Connectors
- Suitable for ASTM, DIN, JIS Systems

Technical Information

SIZE: 1/2" ~ 4"
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSURE: 200 PSI

CONSTRUCTION			
NO.	PARTS	PCS	MATERIALS
1	BODY	1	PVC, CPVC
2	STEM	1	PVC, CPVC
3	BALL	1	PVC, CPVC
4	SEAT	2	TEFLON
5	THREADED SPACER	1	PVC, CPVC
6	HANDLE	1	ABS
7	HANDLE CAP	1	ABS
8	UNION NUT	2	PVC, CPVC
9	UNION SOCKET	2	PVC, CPVC
10	STEM O-RING	2	PVC, CPVC
11	SPACER SEAL	1	EPDM
12	END SEAL	2	EPDM
13	SPACER SEAL	2	EPDM

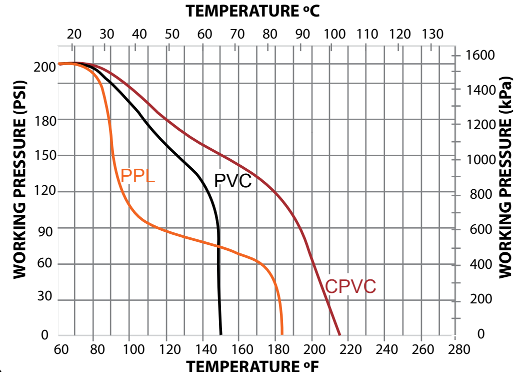




PART	NOMINAL SIZE	SOCKET, THREAD TYPE			ASTM	ASTM	DIN	DIN	JIS	UNIT OF MEASURE: MM					
		DN	D	d	d1	d2	d1	d2	d1	d2	L1	L	H	W	APPROX. WT.
60017	1/2"	DN 15	-	-	-	-	-	-			-	-	-	-	-
60018	3/4"	DN 20	-	-	-	-	-	-			-	-	-	-	-
60019	1"	DN 25	-	-	-	-	-	-			-	-	-	-	-
60020	1 1/4"	DN 32	-	-	-	-	-	-			-	-	-	-	-
60021	1 1/2"	DN 40	-	-	-	-	-	-			-	-	-	-	-
60022	2"	DN 50	-	-	-	-	-	-			-	-	-	-	-
60023	2 1/2"	DN 65	-	-	-	-	-	-			-	-	-	-	-
60024	3"	DN 80	162.00	75.00	89.31	88.70	90.40	90.10	89.60	88.83	48.00	258.00	138.00	210.00	3.70
60025	4"	DN 100	220.00	100.00	114.76	114.07	109.80	110.10	114.70	113.98	57.50	311.00	176.00	220.00	6.50

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
1/2"~2"	CPVC	Socket or Threaded	Viton or EPDM	200 PSI @ 70F Non-Shock
1/2"~ 4"	PVC or CPVC	Socket or Threaded		
1/2"~ 2"	PP	Socket or Threaded		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/4"	-	1 1/2"	90.0
3/8"	-	2"	140.0
1/2"	8.0	2 1/2"	330.0
3/4"	15.0	3"	480.0
1"	29.0	4"	600.0
11/4"	75.0	6"	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

Prevention of Backflow

Hydroseal Canada's minuteman Spring Check Valves prevent reversal of flow in piping systems using spring action. They are ideal for backflow prevention in certain applications such as swimming pools and irrigation. Spring action check valves can be used in both horizontal and vertical installations.

Trouble-free Operation

Hydroseal Canada Spring Check Valves operate especially well where large particles in water may adversely affect other types of valves. The default position of the valve is closed - line pressure moves the solid plastic seal off its EPDM gasket allowing water through the body of the valve. When the inlet flow stops, spring action moves the seal back onto the seat – effectively stopping the flow.

Cost-effective Functionality

These valves feature a single union design. This allows for easy removal from a piping system without breaking down piping connections. Just unscrew the union nut for easy installations.

Features

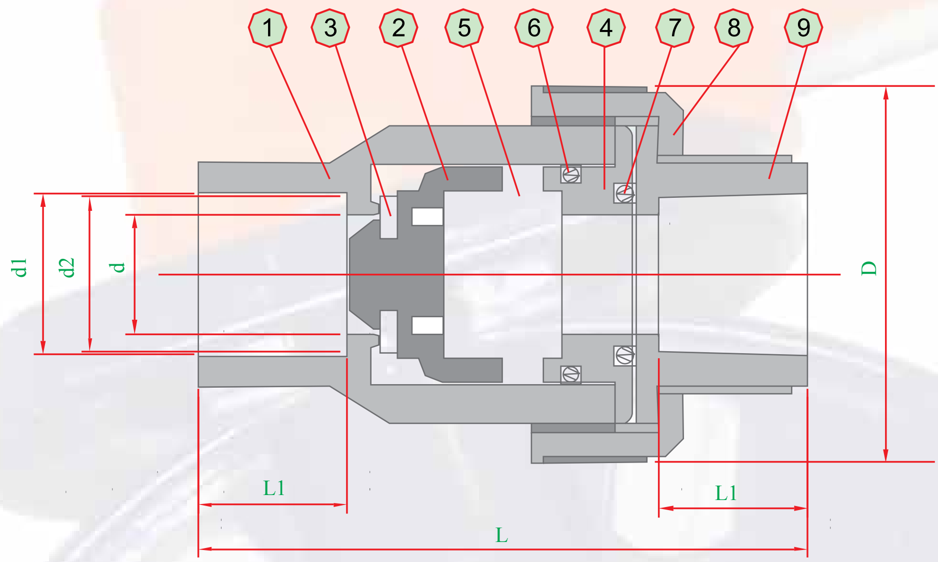
- Rated at 150 PSI
- Full Port Design to 2”
- Single Union Design
- Space Saving Design
- EPDM Seals
- Suitable for Vertical and Horizontal USE

Options

- Socket or Threaded Pipe Connectors
- Suitable for ASTM, DIN, JIS system

Technical Information

CONSTRUCTION			
NO.	PARTS	PCS	MATERIALS
1	BODY	1	PVC
2	SPIGOT	1	PVC
3	SEAT	2	EPDM
4	SPACER	1	PVC
5	SPRING	1	SUS304
6	SPACER SEAL	1	EPDM
7	END SEAL	1	EPDM
8	UNION NUT	1	PVC
9	UNION SOCKET	1	PVC

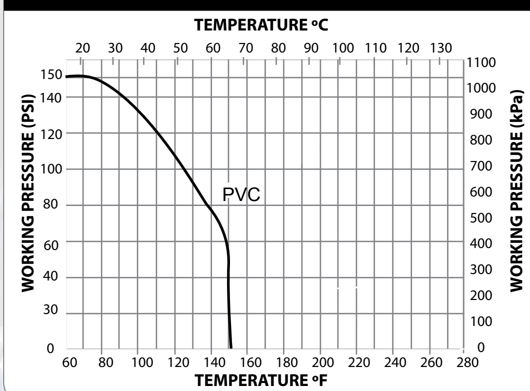


SIZE: 1/2″ ~ 2″
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE:150 PSI

PART	NOMINAL SIZE	SOCKET,THREAD TYPE		ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM		
		DN	d	d1	d1	d1	d2	d2	d2	L	L1	D
60130	1/2″	DN 15	15.4	21.54	20.30	22.30	21.23	19.90	21.78	92.00	22.00	53.50
60131	3/4″	DN 20	20.0	26.87	25.30	26.30	26.57	24.90	25.70	105.0	25.00	61.50
60132	1″	DN 25	25.1	33.66	32.30	32.33	33.27	31.90	31.67	121.00	30.00	69.50
60133	11/4″	DN 32	32.0	42.42	40.30	38.43	42.04	39.85	35.57	136.00	30.00	82.50
60134	11/2″	DN 40	40.0	48.56	50.30	48.46	48.11	49.85	47.54	150.00	35.50	93.50
60135	2″	DN 50	49.4	60.63	63.30	60.56	60.17	62.85	59.44	178.00	44.00	114.00

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
-	-	-	EPDM	150 PSI @ 70F Non-Shock
1/2″~ 2″	PVC	Socket or Threaded		
-	-	-		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/4″	-	1 1/2″	90.0
3/8″	-	2″	140.0
1/2″	8.0	2 1/2″	-
3/4″	15.0	3″	-
1″	29.0	4″	-
1 1/4″	75.0	6″	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES

True Union Ball Check Valves - sharkfellow

Prevention of Backflow

Hydroseal Canada's sharkfellow True Union Ball Check Valves prevent reversal of flow in piping systems. They are ideal where backflow could potentially cause damage to pumps, filters, or process equipment.

Service-free Operation

Hydroseal Canada True Union Ball Check Valves operate without the need for any adjustments or settings. Line pressure moves the solid plastic ball off the elastomer seat, opening the valve. When the inlet flow stops, back pressure moves the ball back onto the seat – stopping the flow.

True Union Functionality

These valves feature a true union design. This allows for easy removal from a piping system without breaking down piping connections. Just unscrew the two assembly nuts and lift the valve body out of the system.

Corrosion-free

Because of their all-plastic construction, these valves will never jam or sick as a result of rust or corrosion. Also they will not contaminate sensitive fluids that come into contact with them.

Features

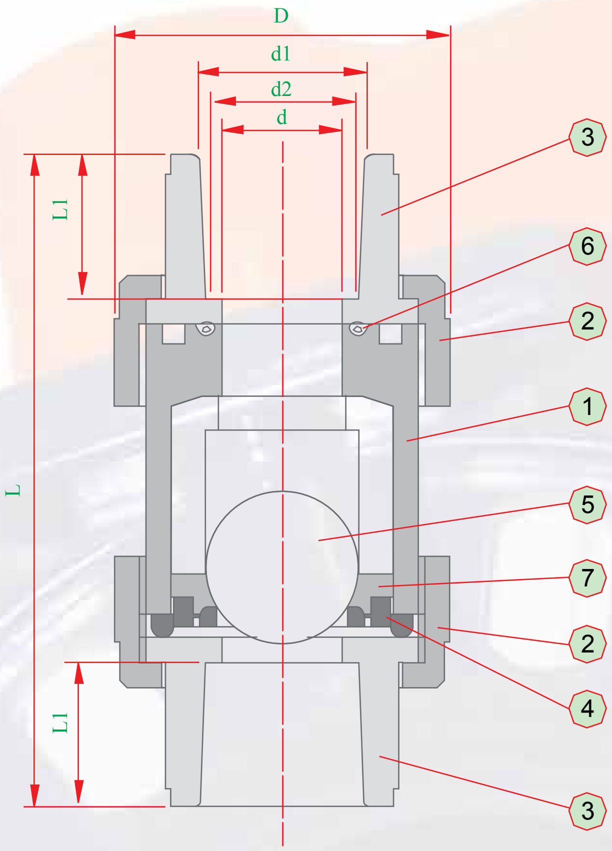
- Rated at 150 PSI
- Full Port Design to 2"
- True Union Design
- Easy Maintenance
- Viton or EPDM Seals
- Suitable for Vertical Use

Options

- Foot Valve Screens
- Viton or SBR Seats
- Teflon Ball
- Socket or Threaded Pipe Connectors
- Suitable for ASTM, DIN, JIS systems

Technical Information

CONSTRUCTION			
NO.	PARTS	PCS	MATERIALS
1	BODY	1	PVC,CPVC,PP
2	UNION NUT	2	PVC,CPVC,PP
3	UNION END	2	PVC,CPVC,PP
4	SEAT	1	EPDM,VITON,SBR
5	BALL	1	PVC OR TEFLON
6	SEALING O-RING	1	EPDM
7	GLAND	1	PVC.CPVC,PP

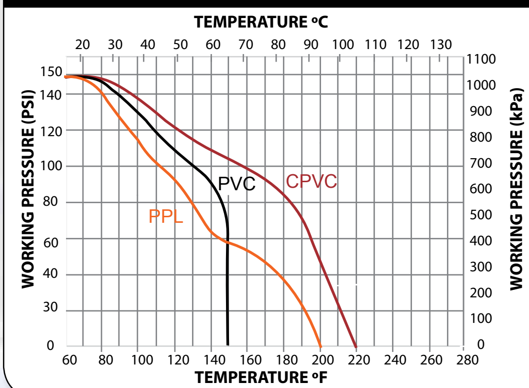


SIZE: 1/2″ ~ 2″
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE:150 PSI

PART	NOMINAL SIZE	SOCKET,THREAD TYPE		ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM		
		DN	d	d1	d1	d1	d2	d2	d2	L	L1	D
60049	1/2″	DN 15	15.4	21.54	20.30	22.30	21.23	19.90	21.78	97.30	22.30	53.80
60050	3/4″	DN 20	20.0	26.87	25.30	26.30	26.57	24.90	25.70	112.00	26.10	61.70
60051	1″	DN 25	25.1	33.66	32.30	32.33	33.27	31.90	31.67	132.20	30.10	69.60
60052	1 1/4″	DN 32	32.0	42.42	40.30	38.43	42.04	39.85	37.57	135.50	30.10	82.50
60053	1 1/2″	DN 40	40.0	48.56	50.30	48.46	48.11	49.85	47.54	160.60	36.00	93.80
60054	2″	DN 50	49.4	60.63	63.30	60.56	60.17	62.85	59.44	184.60	44.10	104.90

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
1/2″~ 2″	CPVC	Socket or Threaded	Viton or EPDM	150 PSI @ 70F Non-Shock
1/2″~ 2″	PVC	Socket or Threaded		
1/2″~ 2″	PP	Socket or Threaded		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/4″	-	1 1/2″	90.0
3/8″	-	2″	140.0
1/2″	8.0	2 1/2″	-
3/4″	15.0	3″	-
1″	29.0	4″	-
11/4″	75.0	6″	-

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES
Swing Check Valves - orca

Prevention of Backflow
Hydroseal Canada's orca Swing Check Valves prevent reversal of flow in larger sized piping systems using swing action. They are ideal for trouble-free backflow prevention in any application. Swing check valves can be used in both horizontal and vertical installations.

Trouble-free Operation
Hydroseal Canada Swing Check Valves operate especially well with viscous slurries that may adversely affect other types of check valves. The default position of the valve is closed - line pressure moves the solid wafer seal off its EPDM gasket allowing slurry through the body of the valve. When the inlet flow stops, swing action moves the seal back onto the seat – stopping the flow.

Cost-effective Simplicity
These valves feature a socket, threaded or flanged design. This allows for easy installation in piping systems with minimal cost. Adequate housing and simple operation ensures years of trouble free operation without any need for maintenance.

Corrosion-free
Because of their all-plastic construction, these valves will never jam or stick as a result of rust or corrosion. Also they will not contaminate sensitive fluids that come into contact with them.

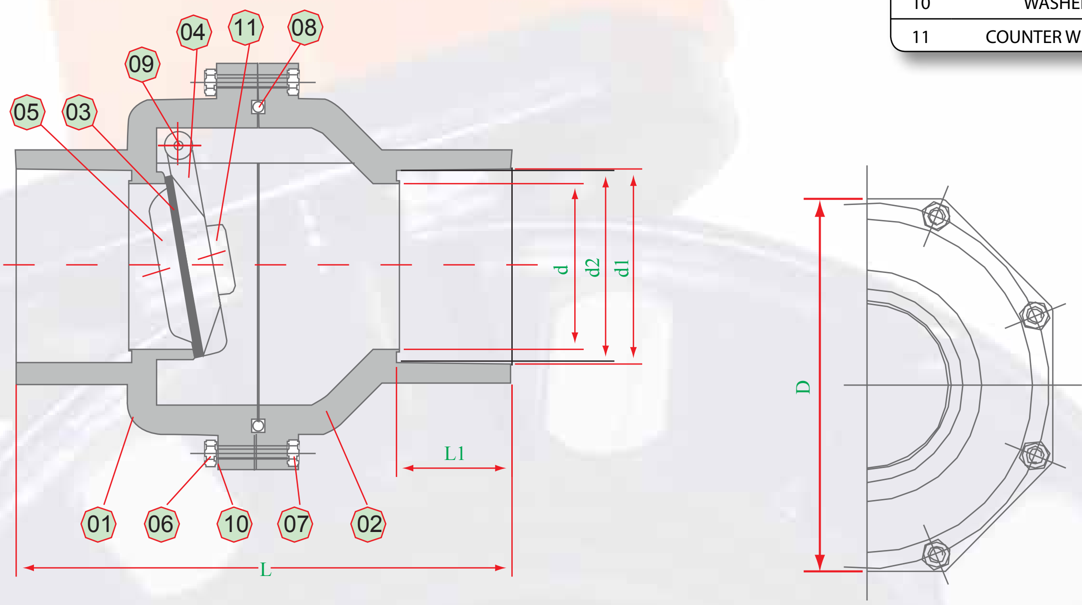
Features
- Rated at 200 PSI
- Full Port Design to 8"
- Only 3 PSI Backflow Required
- EPDM Seals
- Suitable for Vertical and Horizontal Use

Options
- Socket or Threaded Pipe Connectors
- Flanged Option Available
- Suitable for ASTM, DIN, JIS systems

Technical Information

CONSTRUCTION			
NO.	PARTS	PCS	MATERIALS
1	ENTRANCE BODY	1	PVC
2	EXIT BODY	1	PVC
3	SHEET GASKET	1	EPDM
4	DISK	1	PVC
5	SHEET GASKET HOLDER	1	PVC
6	NUT	8	SUS304
7	BOLT	8	SUS304
8	O-RING	1	EPDM
9	PIN	1	SUS304
10	WASHER	8	SUS304
11	COUNTER WEIGHT	1	PVC

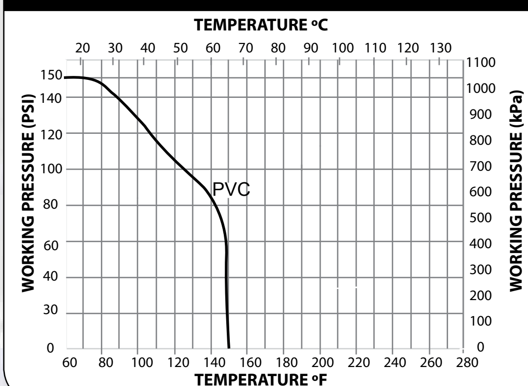
SIZE: 2 1/2" ~ 6" (8" FLANGED TYPE)
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE:150 PSI



PART	NOMINAL SIZE	SOCKET,THREAD TYPE		ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM		
		DN	d	d1	d1	d1	d2	d2	d2	L	L1	D
60077	2 1/2"	DN65	63.00	73.38	75.30	76.60	72.85	75.10	75.10	212.00	49.50	168.00
60078	3"	DN80	75.00	89.31	90.10	89.60	88.70	89.30	89.30	228.00	53.00	174.00
60079	4"	DN100	100.00	114.76	110.40	114.70	114.07	110.10	110.10	270.00	61.00	208.00
60082	6"	DN150	148.00	168.83	160.00	166.20	168.00	160.10	160.10	366.00	82.00	276.00
60084	8"	DN200	-	-	-	-	-	-	-	-	-	-

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
-	-	-	EPDM	150 PSI @ 70F NON-SHOCK
2 1/2"~ 6"	PVC	Socket or Threaded		
8"	PVC	Flanged		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/4"	-	2"	-
1/2"	-	2 1/2"	330.0
3/4"	-	3"	480.0
1"	-	4"	600.0
1 1/4"	-	6"	800.0
1 1/2"	-	8"	1000.0

Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

ISOLATION VALVES
Y Strainers - kiyo

Economical Protection
Hydroseal Canada's kiyo strainers protect piping system components from damage caused by dirt or debris in the process media. They cost less than other types of strainers and are light-weight and compact. Because they can often be supported by the pipeline alone, they work in applications where other types of strainers cannot.

Rugged Plastic Screens
Hydroseal Canada's Y strainers are supplied with a perforated plastic screen. This screen is ultrasonically welded, not glued, for superior performance and strength. Screens fabricated from type 316 stainless steel are also available in openings from 1/2" down to super-fine 325 mesh. All screens have an open area at least twice that of the equivalent pipe-size cross sectional area to minimize pressure drop.

Easy Clean Out
All sizes of Hydroseal Canada Y strainers feature heavy duty caps that permit quick and easy removal of the strainer screen when cleaning is necessary.

Adaptable Design
Hydroseal Canada's Y strainers will work equally well in horizontal and vertical installations, simplifying piping installations.

All Plastic Construction
Hydroseal Canada's Y strainers are all-plastic. They will never rust or corrode - and do not require painting or coating to operate in corrosive environments.

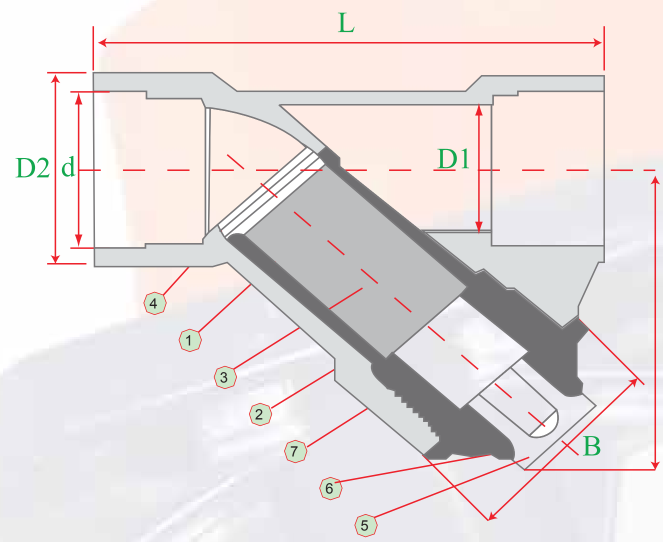
Features
- Rated to 150 PSI
- EPDM Seals
- All-plastic Construction
- Easy Screen Access
- Can be used Horizontally or Vertically

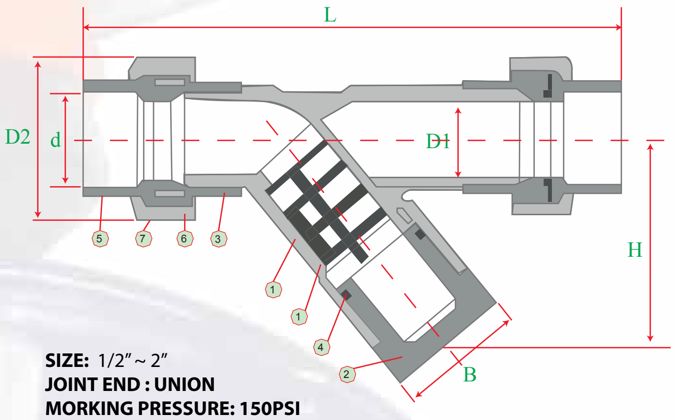
Options
- Stainless Steel screens
- True Union connections available

Technical Information

NO.	PARTS	PCS	MATERIALS
MATERIALS OF CONSTRUCTION			
1	BODY	1	PVC
2	LID	1	PVC
3	SCREEN	1	PVC
4	BODY O-RING	1	EPDM, VITON
5	CONNECTOR	2	PVC
6	UNION NUT	2	PVC
7	UNION O-RING	2	EPDM, VITON

SIZE: 2 1/2″ ~ 4″
JOINT END : SOKET (ASTM. DIN. JIS)
MORKING PRESSURE: 150PSI





SIZE: 1/2″ ~ 2″
JOINT END : UNION
MORKING PRESSURE: 150PSI

PART	NOMINAL SIZE	SOCKET, THREAD TYPE				ASTM	DIN	JIS	UNIT OF MEASURE: MM	
		DN	D1	D2	L	d	d	d	H	B
60115	1/2"	DN 15	15.0	46.0	205.0	21.54	20.3	22.30	70.0	35.0
60116	3/4"	DN 20	20.0	61.0	234.0	26.87	25.3	26.30	80.0	39.0
60117	1"	DN 25	26.0	70.0	250.0	33.66	32.3	32.36	95.0	47.0
60118	1 1/4"	DN 32	32.0	88.0	283.0	42.42	40.3	38.43	110.0	55.0
60119	1 1/2"	DN 40	40.0	88.0	312.0	48.56	50.3	48.46	132.0	70.0
60120	2"	DN 50	50.0	101.0	350.0	60.63	63.3	60.56	155.0	81.0
60121	2 1/2"	DN 65	61.0	90.0	209.5	73.78	75.3	76.60	137.1	89.5
60122	3"	DN 80	80.0	109.0	244.5	89.31	90.3	89.60	163.9	109.3
60123	4"	DN 100	100.0	138.0	297.0	114.76	110.3	114.70	199.3	136.2

SELECTION CHART

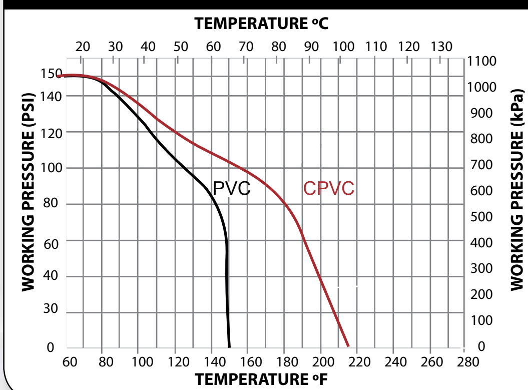
SIZE	MATERIAL	END CONN.	SEALS	RATING
1/2″~4″	PVC , CPVC	Thd, Skt, Flg.	EPDM/VITON	150 PSI @ 70°F

CV FACTORS

SIZE	FACTOR	SIZE	FACTOR
1/2″	4.0	2″	28.0
3/4″	6.8	2 1/2″	40.0
1″	9.0	3″	65.0
1 1/4″	12.0	4″	100.0
1 1/2″	28.0		

* With 1/32″ plastic screen

OPERATING TEMPERATURE/PRESSURE



Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

The pressure drop across the strainer, for water or fluids with a similar viscosity, can be calculated using this formula: the pressure loss across a valve or filter can be calculated using the system's flow rate and the Cv factor for that valve or filter.
For example, a 1″ strainer with a Cv factor of 8 will have a 4 PSI pressure loss in a system with a 16 gpm flow rate $(16 / 8)^2=4$

Strainer Screen Selection

- Y Strainers are furnished with a 1/32″ perf plastic screen.
- Stainless steel strainer screen are available in these perfs: 1/32″, 3/64″, 1/16″, 5/64″, 7/64″, 1/8″, 5/32″, 3/16″, 1/4″, 1/2″; and in mesh sizes: 20, 40, 60, 80, 100, 200, 325

ISOLATION VALVES
Manual Diaphragm Valves - aquaeduct

Overview
Hydroseal all-plastic diaphragm valves are engineered to provide superior handling of difficult media such as corrosive fluids, abrasives and slurries. They can also be used for high purity and sanitary applications.

Manual or automated
Available in manual or actuated (pneumatic or electric) models, the valves can be used for on/off and throttling service, and are self-draining on one side so that little to no dead volume remains in the valve. Standard material choices for the valve's body include PVC, CPVC, PVDF and PPL. Each is available with EPDM, Viton or PTFE diaphragms, allowing service in a wide range of applications.

Advanced Design
The valve controls flow by varying the space between a stationary weir and a moveable flexible diaphragm. By compressing the diaphragm against the weir, all flow is shut off. The only wetted components are the lower half of the valve body and the diaphragm. The diaphragm's stroke adjustment feature allows precise "tweaking" of diaphragm movement for very precise flow control. A large, sure-grip hand wheel makes it easy to open or close the valve, and a beacon-type indicator provides highly visible position indication at the top of the valve's rising stem.

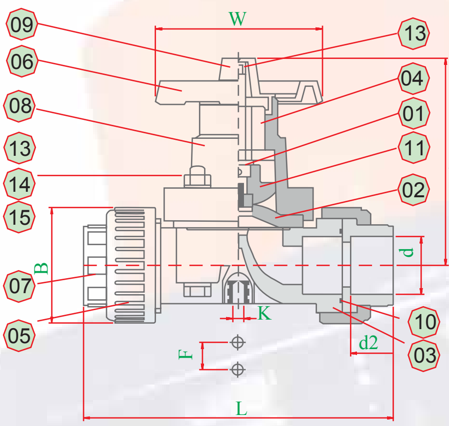
Connection Options
Options include ANSI/DIN/JIS flanges and true union socket end connections.

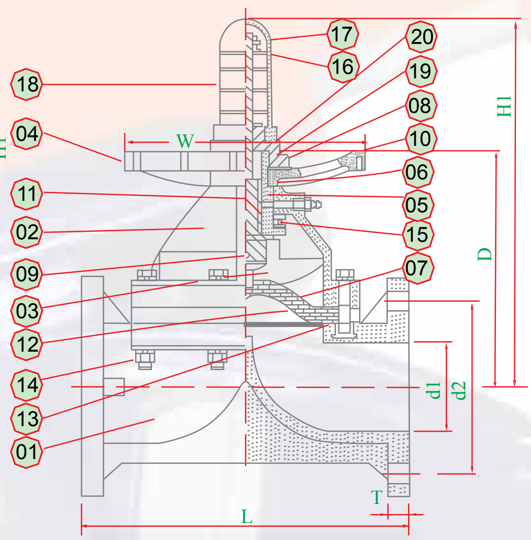
Features
- Rated at 150 PSI
- Position indicator
- Sure grip hand wheel
- Choice of EPDM, Viton, PTFE diaphragms
- Easily automated
- Choice of union or flanged connections for easy maintenance

Options
- Electric, Pneumatic Actuation to 4"
- PVDF vapor barrier

Technical Information

SIZE: 1″ ~ 2″
JOINT END: THREADED (PT.NPT.BSPF)
SOCKET (ASTM.DIN.JIS)
WORKING PRESSUREE:150 PSI





CONSTRUCTION			
NO	PARTS	PCS	MATERIALS
1	SHAFT	1	BRASS
2	DIAPHRAGM	1	EPDM, TEFLON
3	BODY	1	PVC, PPL, CPVC, PVDF
4	SLEEVE	1	BRASS
5	UNION NUT	2	PVC, PPL, CPVC, PVDF
6	HANDLE	1	ABS
7	END CONNECTOR	2	PVC, PPL, CPVC, PVDF
8	BONNET	1	PVC, PPL, CPVC, PVDF
9	GAUGE COVER	1	PVC
10	O - RING	2	EPDM, VITON
11	COMPRESSOR	1	15-A, 25-A, PVDF
12	INDICATOR	1	PE
13	BOLT	4	SUS304
14	NUT	4	SUS304
15	WASHER	4	SUS304
16	Stopper	1	SS-41, SUS-304
17	Nut	1	SS-41, SUS-304
18	Gauge Cover	1	PC
19	Sheet Ring	1	EPDM
20	Washer	1	SUS 304

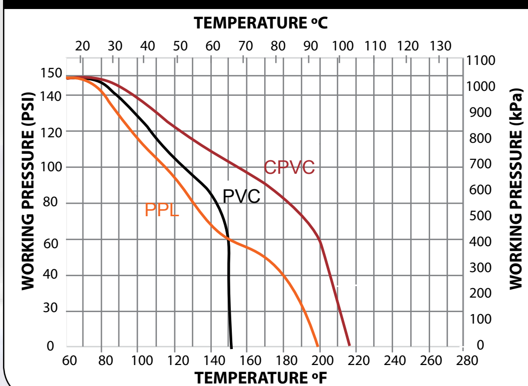
SIZE: 2 1/2″ ~ 12″
JOINT END: FLANGED
WORKING PRESSUREE:150 PSI

PART	NOMINAL SIZE	SOCKET,THREAD TYPE		ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM			
		DN	D	d1	d1	d1	d2	d2	d2	L	W	F	H1
60100	1/2″	DN 15	54	21.54	20.30	22.30	22.23	16,00	22,20	166	81	25	104
60101	3/4″	DN 20	54	26.87	25.30	26.30	25.40	18,50	25,40	166	81	25	104
60102	1″	DN 25	63	33.66	32.30	32.33	28.58	22,00	28,60	183	91	25	116
60103	11/4″	DN 32	89	42.42	40.30	38.43	31.75	26,00	31,80	238	117	45	142
60104	11/2″	DN 40	89	48.56	50.30	48.46	34.85	31,00	34,90	238	117	45	142
60105	2″	DN 50	101	60.63	63.30	60.56	38.10	37,50	38,10	273	150	45	176

PART	NOMINAL SIZE	SOCKET,		ASTM	DIN	JIS	ASTM	DIN	JIS	UNIT OF MEASURE: MM			
		DN	D	d1	d1	d1	d2	d2	d2	L	W	T	H1
60106	2 1/2″	DN 65	197	68,07	68,07	68,07	139,45	145,00	145,00	290	202	22	276
60107	3″	DN 90	218	77,98	77,98	77,98	152,40	160,00	160,00	310	202	22	293
60108	4″	DN 100	261	100,07	100,07	100,07	190,50	180,00	180,00	350	241	25	370
60109	6″	DN 150	334	148,08	148,08	148,08	241,55	240,00	240,00	480	395	30	471
60110	8″	DN 200	419	198,12	198,12	198,12	298,45	295,00	295,00	600	430	32	625
60111	10″	DN 250	510	248,41	248,41	248,41	285,75	350,00	350,00	680	540	32	750

SELECTION CHART				
SIZE	MATERIAL	END CONN.	SEALS	PRESSURE RATING
-	-	-	Viton or EPDM	150 PSI @ 70F Non-Shock
1/2″~ 2″	PVC, PPL CPVC, PVD	Socket Or Threaded		
2 1/2″ - 4	PVC, PPL CPVC, PVD	Flanged		

OPERATING TEMPERATURE/PRESSURE



CV FACTORS			
SIZE	FACTOR	SIZE	FACTOR
1/2″	3,27	2 1/2	90.68
3/4″	5,29	3″	116,79
1″	8,87	4″	186,78
1 1/4″	25,9	6″	345,26
1 1/2″	31,09	8″	-
2″	43,15	10″	-

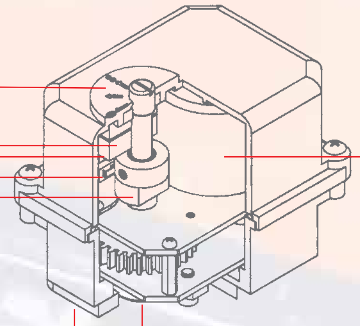
Pressure Loss Calculation Formula

$$\Delta P = \left[\frac{Q}{Cv}\right]^2$$

ΔP = Pressure Drop
Q = Flow in GPM
Cv = Flow Coefficient

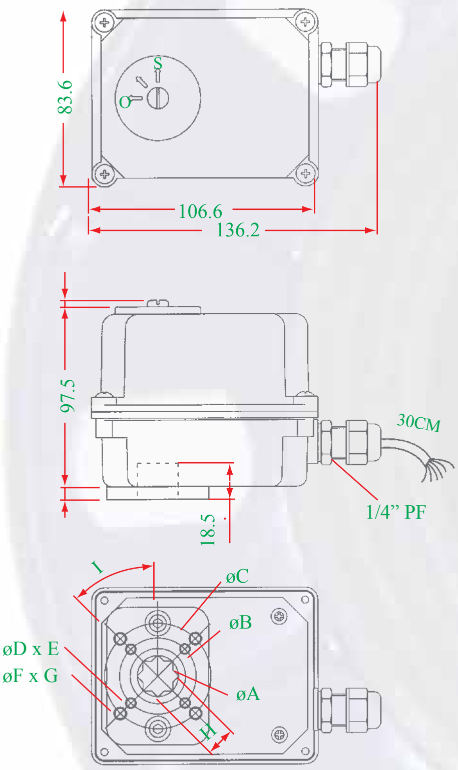
UMS

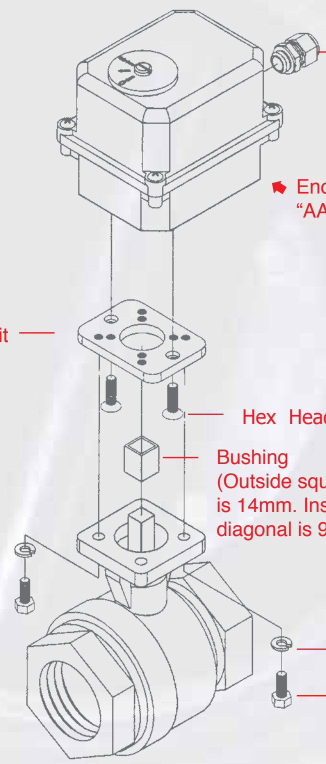
Weight : 2.2 lb



SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	24VAC	110VAC	220VAC	AC	DC	24VAC	110VAC	220VAC
3~4W	170 MA	33 MA	30 MA	23	N/A	130	130	130

SIZE OF VALVE		
SCREWED ENDS	3-WAY VALVE	TRUE UNION BALL VALVE (SWITCH KIT ONLY)
1/4"~ 1"	1/2" ~ 3/4"	1/2" ~ 1"





* Option : (1) H=9□, A=12 (2) H=11□, A=15

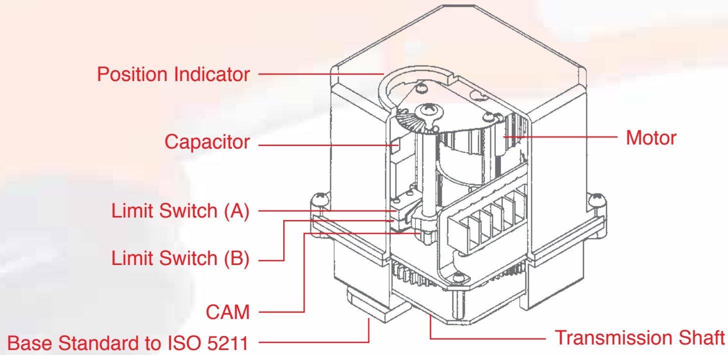
* F04/F07 D=M5, F=M8 Optional

DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H MAX	I	ISO5211
UMS	19	36	50	M5	4	M6	4	14	45°	F03/F05

MOUNTING PATTERN	BORE DISTANCE (PCD)	HEX HEAD BOLT SIZE
	Ø 36 (PCD)	M5 X P0.8 X 12L
	Ø 50 (PCD)	M6 X P1.0 X 15L

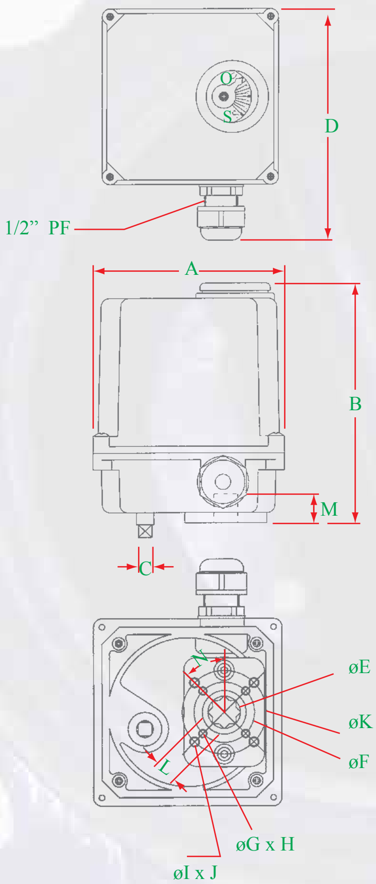
UM-1

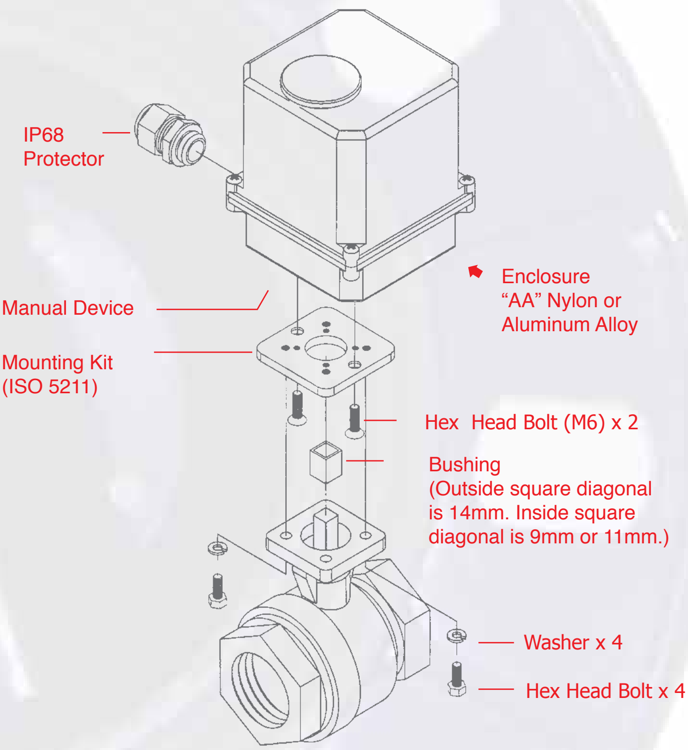
Weight : 3.5 lb



SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
10W	0.40A	0.25A	0.50A	10	15	303	314	380
15W	0.80A	050A	N/A	10	N/A	355	374	N/A

SIZE OF VALVE		
SCREWED ENDS	FLANGED ENDS	3-WAY VALVE
1/4"~ 1 1/2"	1/2" ~ 1"	1/2" ~ 1"



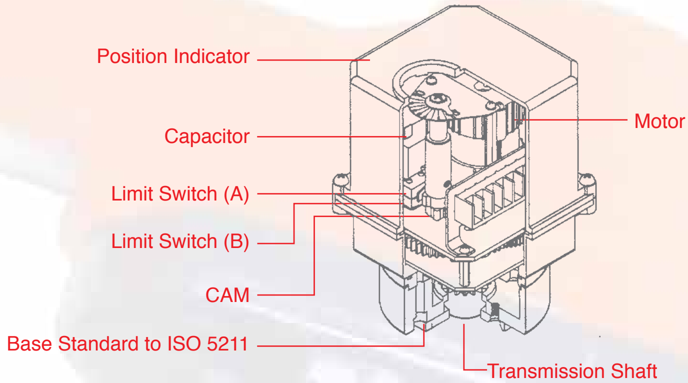


DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L Max	M	N	ISO 5211
UM-1	112	144	8	148	19	36	M5	4	M6	4	50	14	18.5	45º	F03/F05

MOUNTING AVPATTERN	BORE DISTANCE (PCD)	HEX HEAD BOLT SIZE
A	ø 36 (PCD)	M5 x P0.8 x 12L
	ø 50 (PCD)	M6 x P1.0 x 15L
B	ø 50 (PCD)	M5 x P0.8 x 12L
	ø 70 (PCD)	M6 x P1.2 x 15L

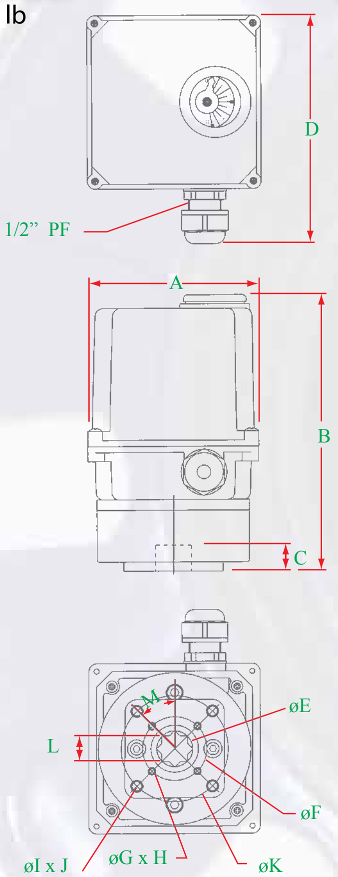
UM-2

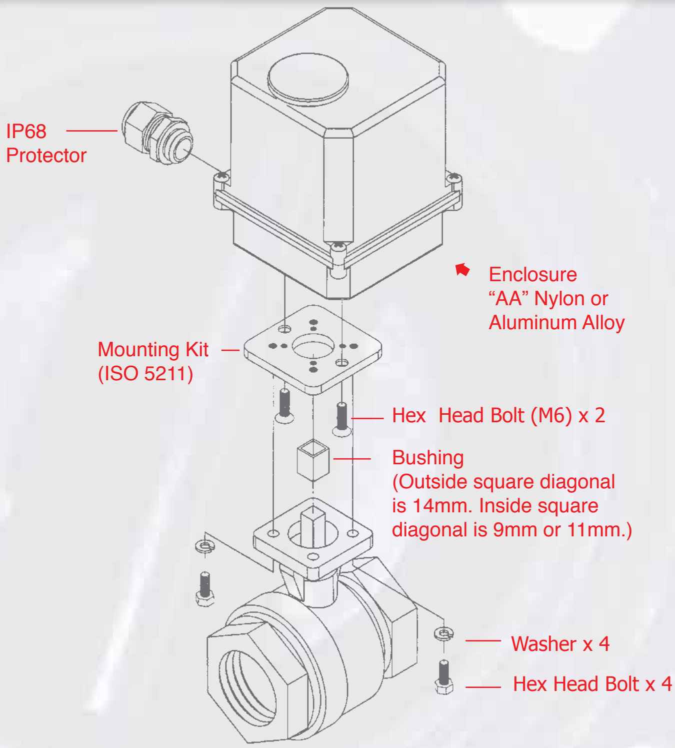
Weight : 5.1 lb



SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
10W	0.40A	0.25A	0.50A	20	30	416	435	539
15W	0.80A	050A	N/A	20	N/A	568	587	N/A

SIZE OF VALVE			
SCREWED ENDS	FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
1"~ 2"	1 1/4" ~ 2"	2"~3"	1 1/4" ~ 1 1/2"



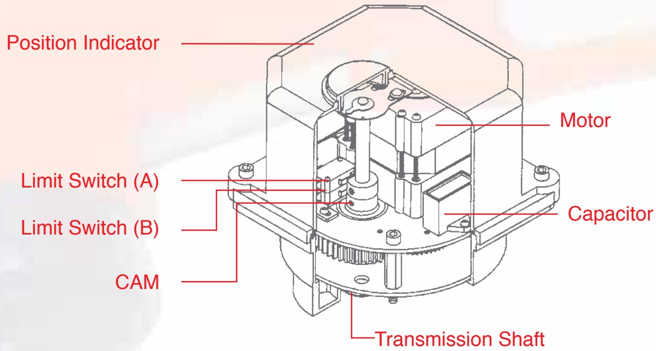


DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L Max	M	ISO 5211
UM-2	112	185	19.5	148	23.5	42	M5	4	M8	4	70	17	45°	F04/F07

MOUNTING PATTERN	BORE DISTANCE (PCD)	HEX HEAD BOLT SIZE
A	Ø 36 (PCD)	M5 X P0.8 X 12L
	Ø 50 (PCD)	M6 X P1.0 X 15L
B	Ø 42 (PCD)	M5 X P0.8 X 12L
	Ø 70 (PCD)	M8 X P1.2 X 15L

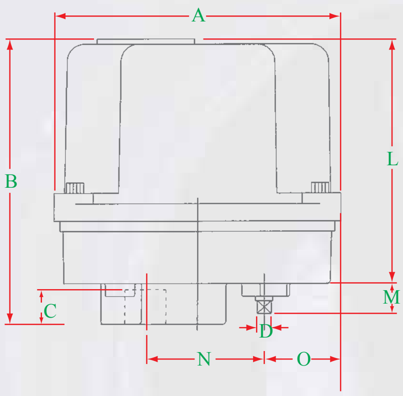
UM-3

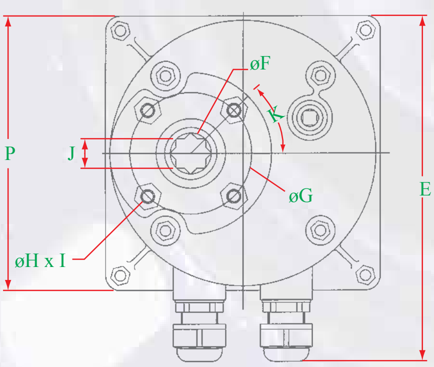
Weight : 9.3 lb

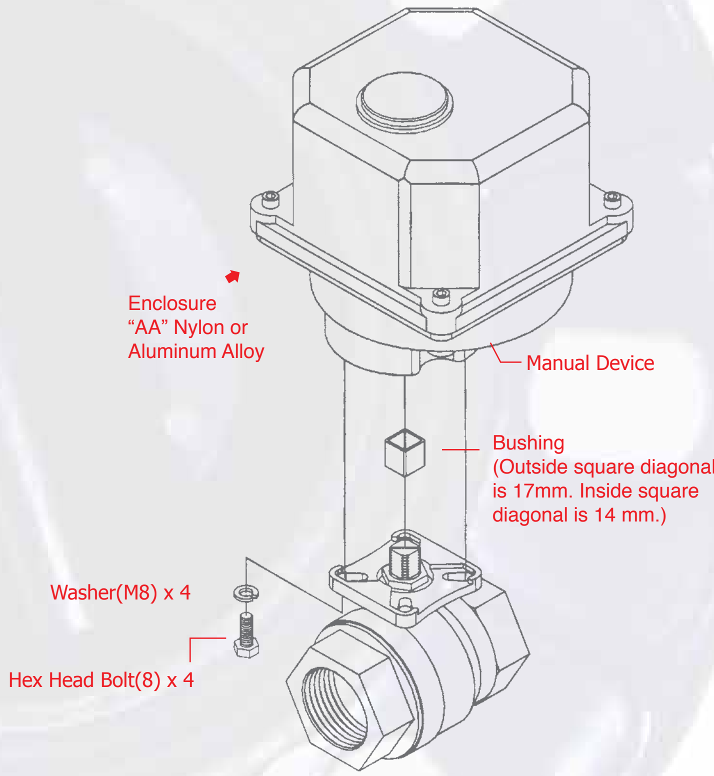


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	1	N/A	255	303	N/A
				8		1289	1355	
30W	N/A		0.50A	N/A	1	N/A		439
					8			1440

SIZE OF VALVE			
SCREWED ENDS	FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
1 1/4"~ 3"	1 1/4" ~ 3"	2"~4"	2 1/2"



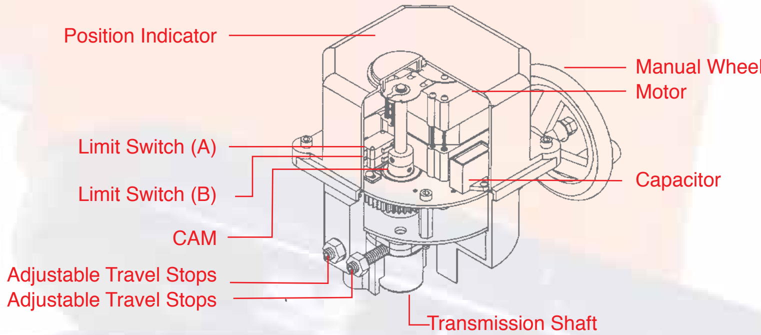




DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	ISO 5211
UM-3	165	165	20	8	200	23.5	70	M8	M6	17	45º	141	17.3	68.39	44.2	165	F07

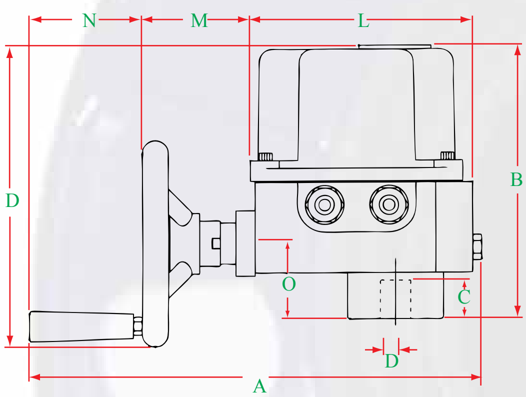
UM-3-1

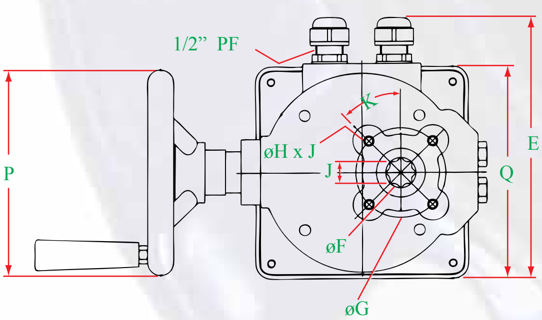
Weight : 15.4 lb

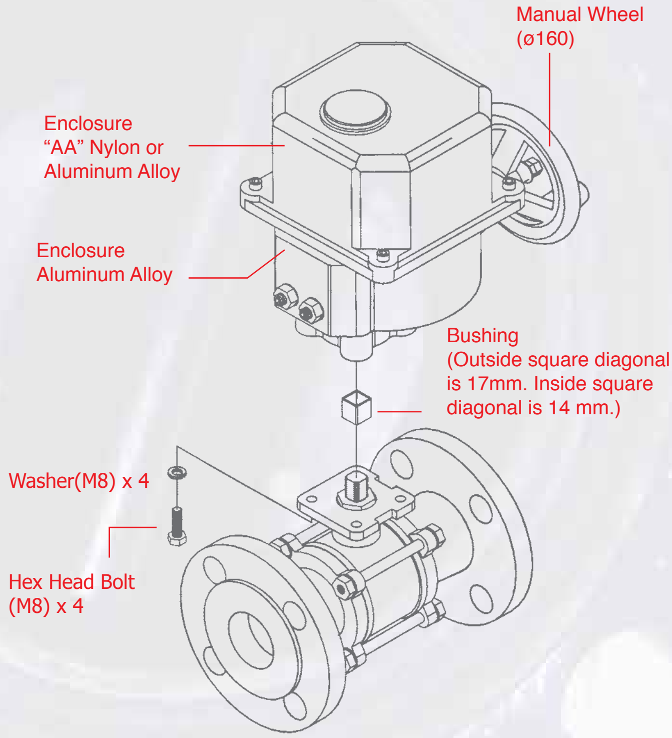


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	1	N/A	255	303	N/A
				8		1289	1355	
30W	N/A		0.50A	N/A	1	N/A		439
					8			1440

SIZE OF VALVE			
SCREWED ENDS	FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
1 1/2"~ 3"	1 1/4" ~ 3"	2"~4"	2 1/2"

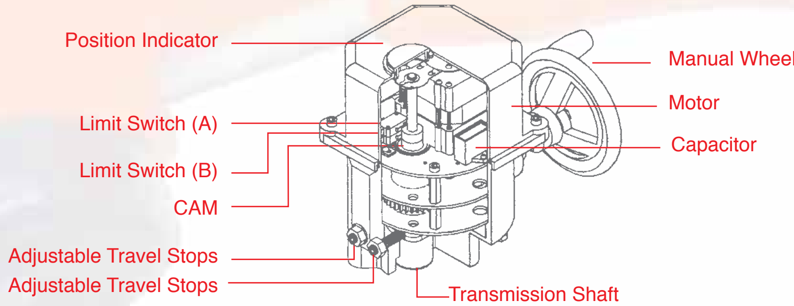






DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	ISO 5211
UM-3-1	350	215	30	235	203	23.5	70	M5	4	17	45°	173	84	87	59	160	165	F07

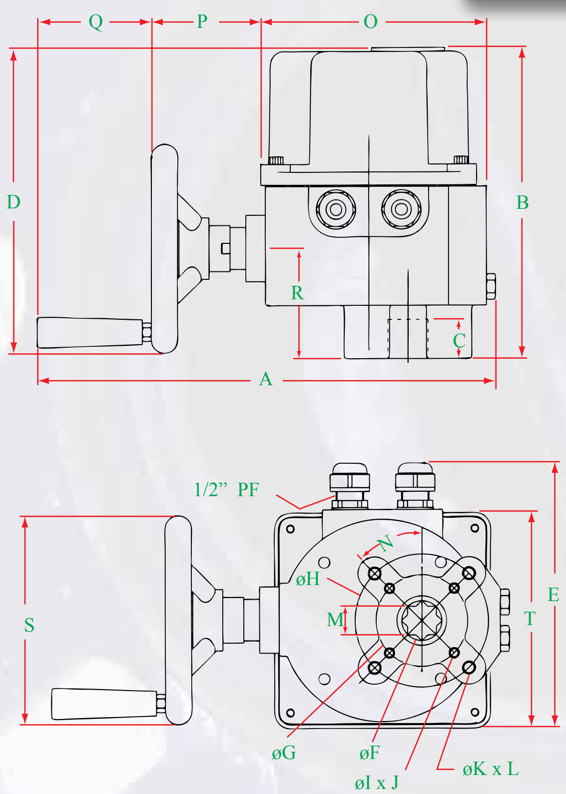
UM-4

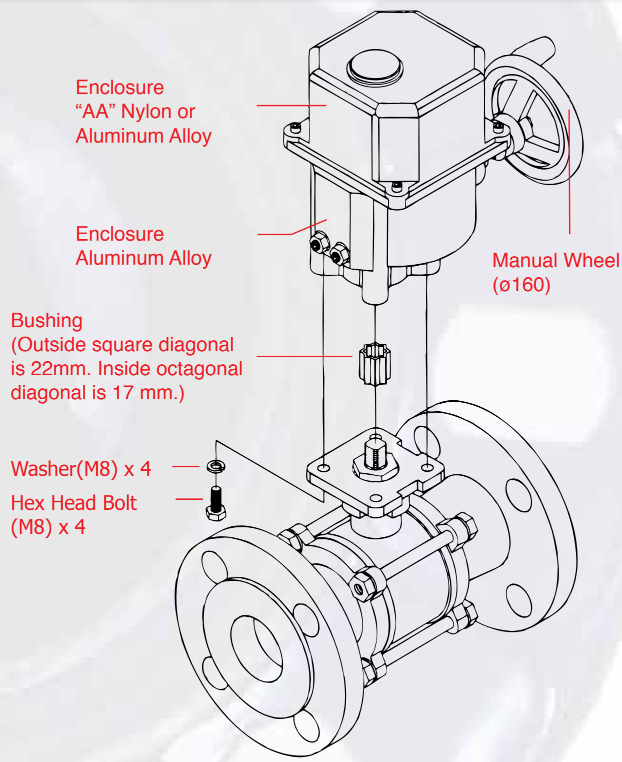


Weight : 18.7 lb

SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	20	N/A	2169	2169	N/A
				30		2706	2881	
30W	N/A		0.50A	N/A	20	N/A		2282
					30			2951

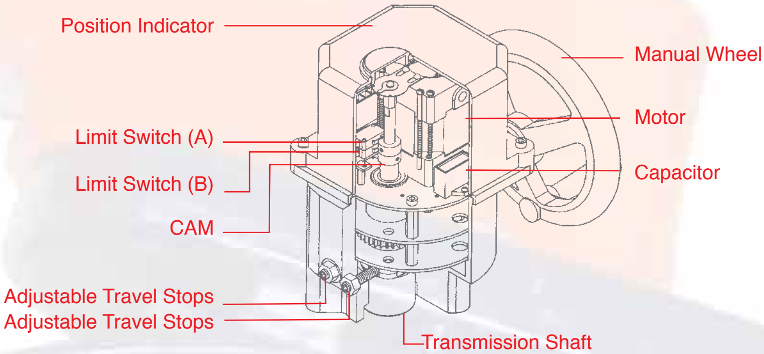
SIZE OF VALVE				
TIMES	SCREWED ENDS	FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
20SEC	2 1/2"~ 3"	2 1/2" ~ 3"	4"~5"	2 1/2"
30SEC	3"~4"	3"~4"	5"~8"	2 1/2"~3"





DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	ISO 5211
UM-4	350	240	30	235	203	30.6	70	102	M8	4	M10	4	22	45º	173	84	87	85	160	165	F07/F10

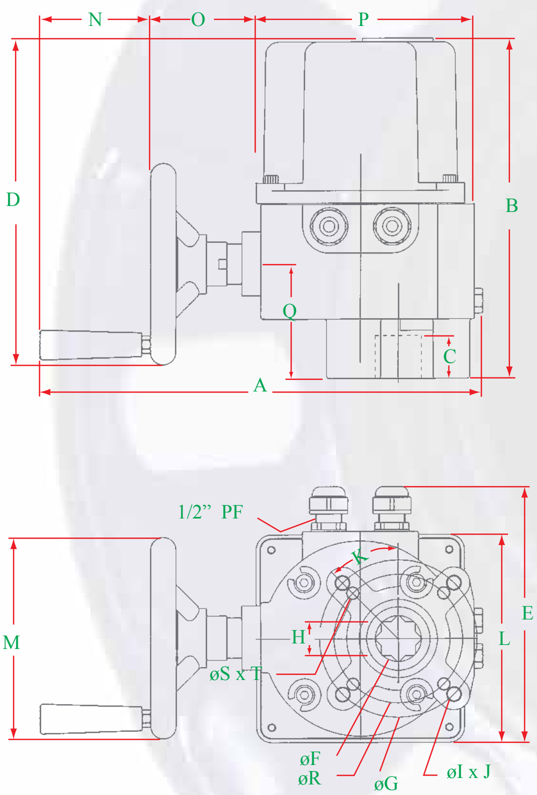
UM-5

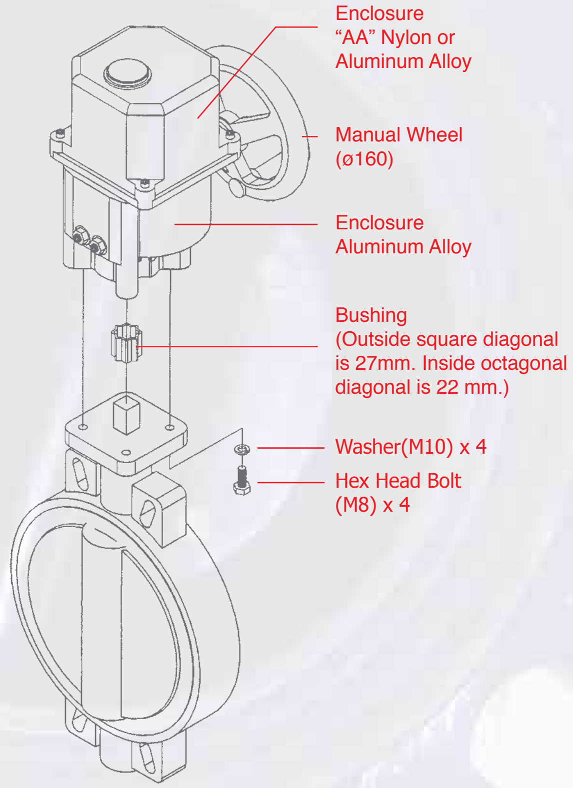


Weight : 19.6 lb

SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
40W	0.95A	0.58A	30	N/A	3702	4229	N/A

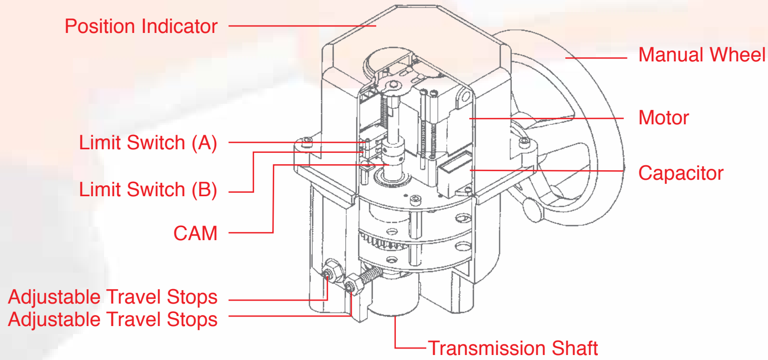
SIZE OF VALVE		
SCREWED ENDS	BUTTERFLY VALVE	3-WAY VALVE
4"~ 5"	8"~10"	3"~ 4"





DIMENSION (MM) / MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	ISO 5211
UM-5	350	272	34	260	203	36.6	125	27	M12	4	45°	165	200	87	84	173	92	102	M10	4	F10/F12

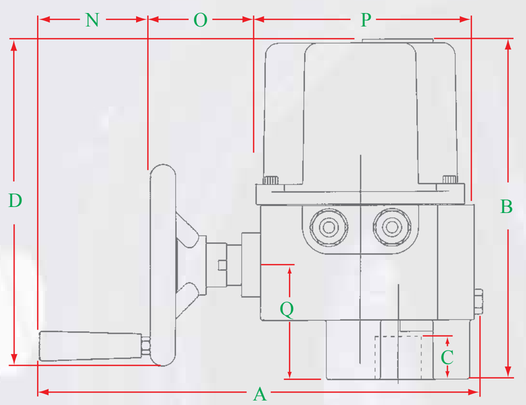
UM-6

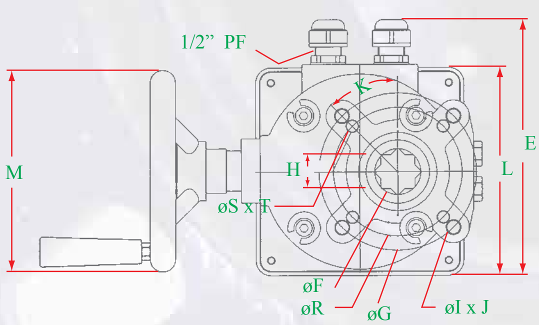


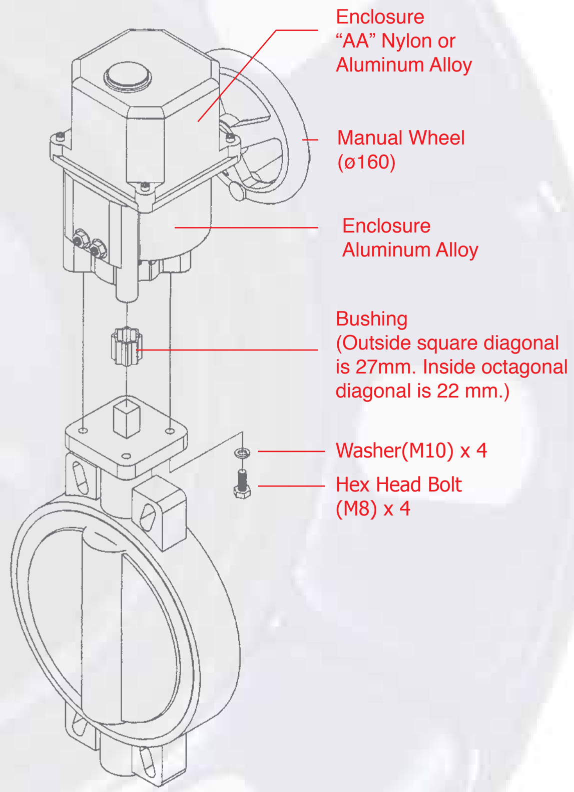
SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
60W	1.20A	0.66A	N/A	30	N/A	4937	5278	N/A
65W	N/A		1.5A	N/A	30	N/A		5409

SIZE OF VALVE		
FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
5"~ 6"	10"~12"	4"~ 5"

Weight : 19.6 lb







MODEL \ DIMENSION (MM)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	ISO 5211
UM-6	350	272	34	260	203	36.6	125	27	M12	4	45°	165	200	87	84	173	92	102	M10	4	F10/F12

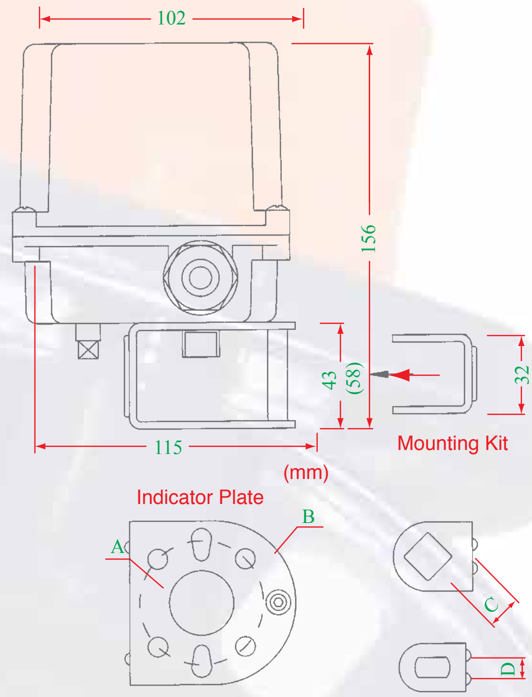
UM-1

Weight : 3.3 lb

A(PCD)	Ø 36	Ø 42	Ø 50
B	Ø 7	Ø 8	Ø 8
C	9□	11□	14□ (H43,H58)
		10□(H58)	12□(H58)
D	5	6	8

SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
10W	0.40A	0.25A	0.50A	1	2	65	355	86
				5		157	185	
				10	15		314	380
15W	0.80A	0.50A	N/A	1	N/A	110	114	439
				10		355	374	1440

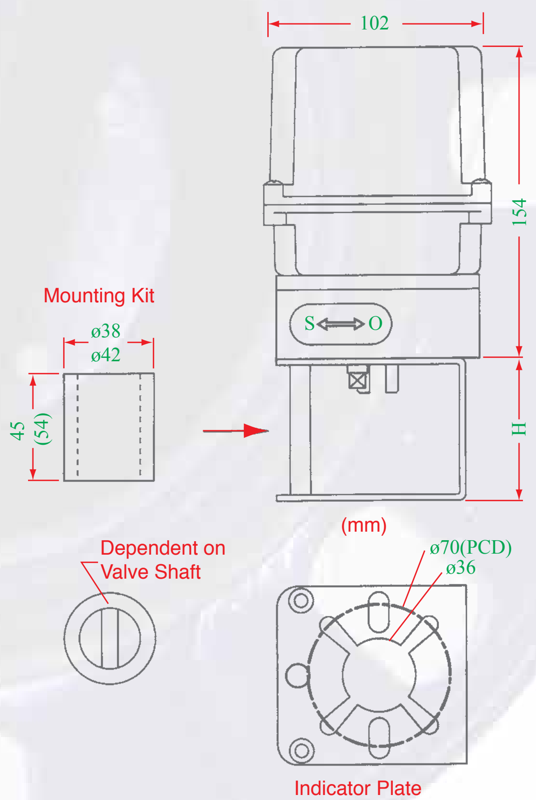
SIZE OF VALVE			
SCREWED ENDS	FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
1/4"~ 1 1/2"	1/2" ~ 1"	1/ 2"~1 1/2"	1/2"~1"



UM-2

Weight : 5.1 lb

H (MM)	60	70
SPECIFICATION	Butterfly Valve 2"~3"	Flange Ends 2"~3"
	Screwed Ends 1"~2"	

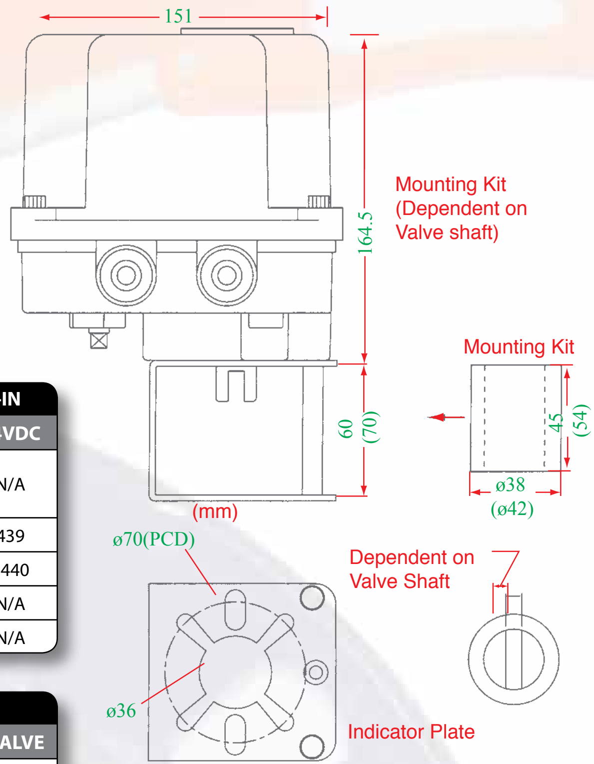


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
10W	0.40A	0.25A	0.50A	20	30	416	435	539
15W	0.80A	0.50A	N/A	20	N/A	568	587	N/A

SIZE OF VALVE				
SCREWED ENDS	FLANGED ENDS	TRUE UNION BALL VALVE	BUTTERFLY VALVE	3-WAY VALVE
1"~ 2"	1 1/4" ~ 1"	1 1/ 2"~2"	2"~3"	1 1/4" ~ 1 1/2"

UM-3


Weight : 13.2 lb

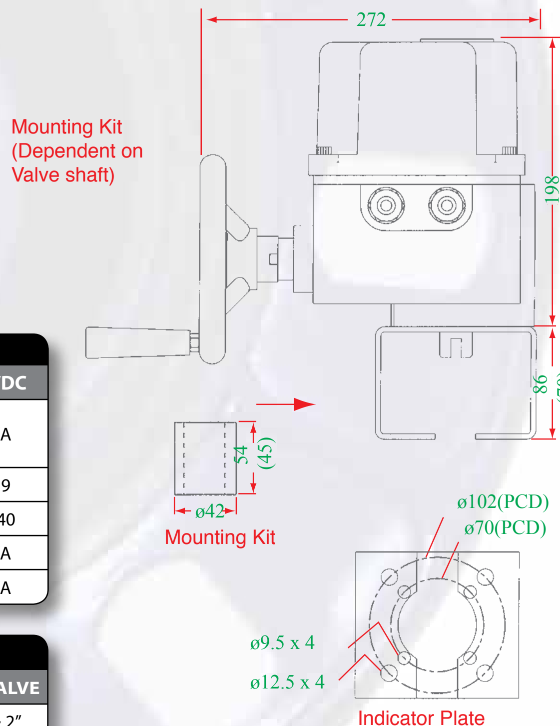


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	1	N/A	255	303	N/A
				8		1289	1355	
30W	N/A		0.50A	N/A	1	N/A		439
					8			1440
40W	0.95A	0.58A	N/A	1	N/A	320	351	N/A
60W	1.20A	0.66A	N/A	1	N/A	386	399	N/A

SEC	SIZE OF VALVE				
	SCREWED ENDS	FLANGED ENDS	THE UNION BALL VALVE	BUTTERFLY VALVE	3-WAY VALVE
8	1 1/4"~ 3"	1 1/4" ~ 3"	1 1/4" ~ 3"	2"~4"	1 1/4" ~ 2 1/2"
1	1 1/4"~2"	1 1/4"~2"	1 1/4" ~ 2"	2 1/2"	1 1/4" ~ 2"

UM-3-1


Weight : 16.5 lb

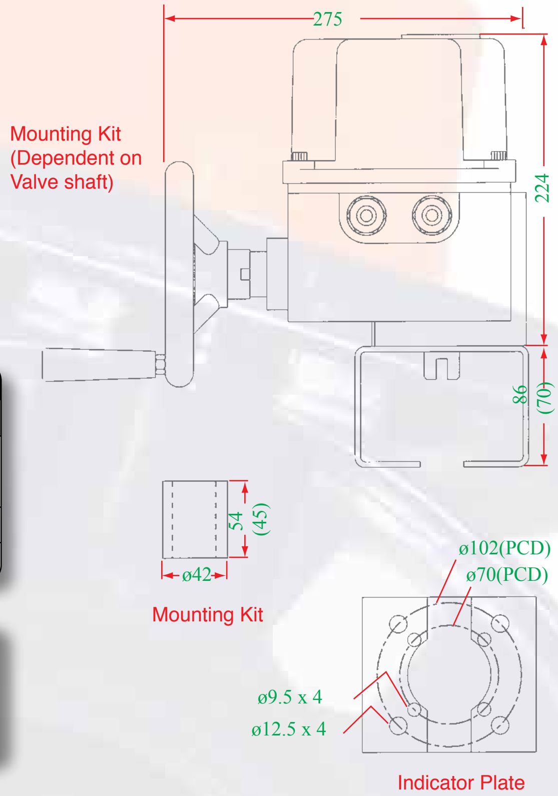


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	1	N/A	255	303	N/A
				8		1289	1355	
30W	N/A		0.50A	N/A	1	N/A		439
					8			1440
40W	0.95A	0.58A	N/A	1	N/A	320	351	N/A
60W	1.20A	0.66A	N/A	1	N/A	386	399	N/A

SEC	SIZE OF VALVE				
	SCREWED ENDS	FLANGED ENDS	THE UNION BALL VALVE	BUTTERFLY VALVE	3-WAY VALVE
1	1 1/4"~2"	1 1/4"~2"	1 1/4" ~ 2"	2"~2 1/2"	1 1/4" ~ 2"
8	1 1/4"~ 3"	1 1/4" ~ 3"	1 1/4" ~ 3"	2"~4"	1 1/4" ~ 2 1/2"

UM-4

Weight : 18.3 lb

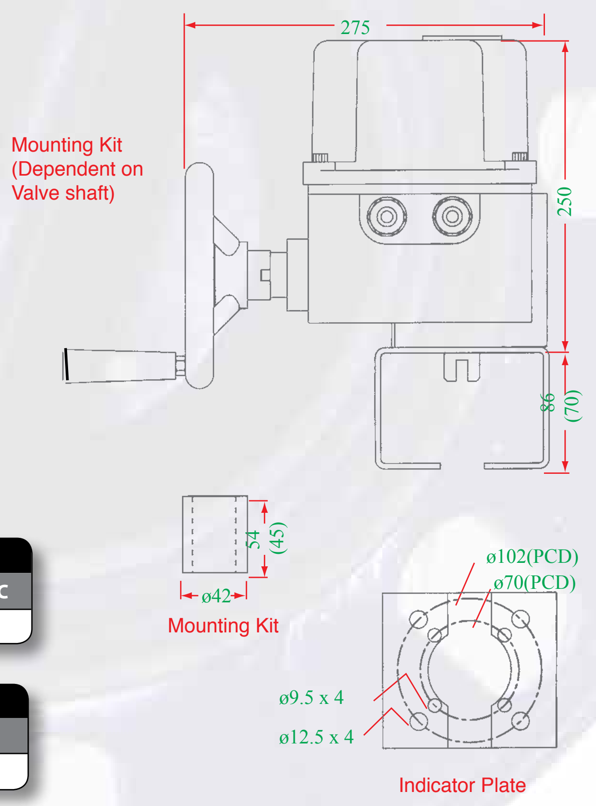


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
25W	0.76A	0.42A	N/A	20	N/A	2169	2169	N/A
				30		2706	2881	
30W	N/A		0.50A	N/A	20	N/A		2282
					30			2955

SEC	SIZE OF VALVE				
	SCREWED ENDS	FLANGED ENDS	THE UNION BALL VALVE	BUTTERFLY VALVE	3-WAY VALVE
20	1 1/4"~ 3"	1 1/4" ~ 3"	1 1/4" ~ 3"	2"~5"	1 1/4" ~ 2 1/2"
30	3"~4"	3"~4"	3" ~ 4"	5"~8"	2 1/2 "~3"

UM-5

Weight : 23.8 lb

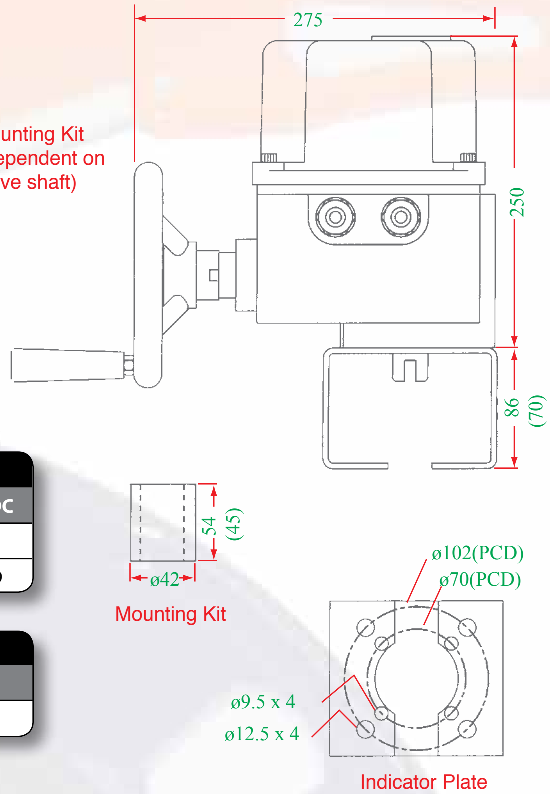


SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
40W	0.95A	0.58A	30	N/A	3702	4229	N/A

SIZE OF VALVE		
FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
4"~ 5"	8"~10"	3"~ 4"

UM-6

Weight : 24 lb

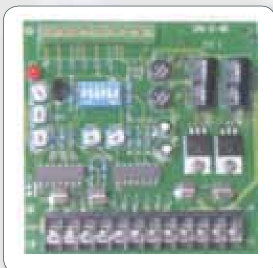


SPECIFICATION				SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	24VDC	AC	DC	110VAC	220VAC	24VDC
60W	1.20A	0.66A	N/A	30	N/A	4937	5278	N/A
65W	N/A		1.5A	N/A	30	N/A		5409

SIZE OF VALVE		
FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
4″~ 6″	10″~12″	5″

Position Control Systems

- Position control of output signal: five kinds of output signal (can be switched).
- 100~120VAC and 200~250VAC (can be switched).
- Option for flow rate position indicators.



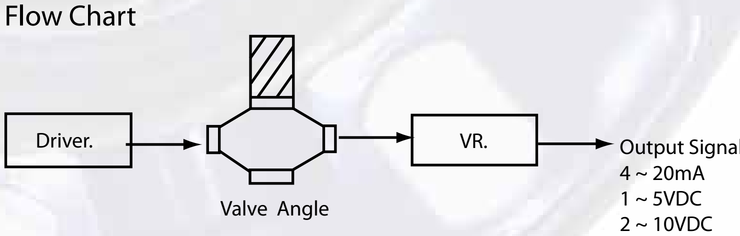
Position Control Panel2

Controller

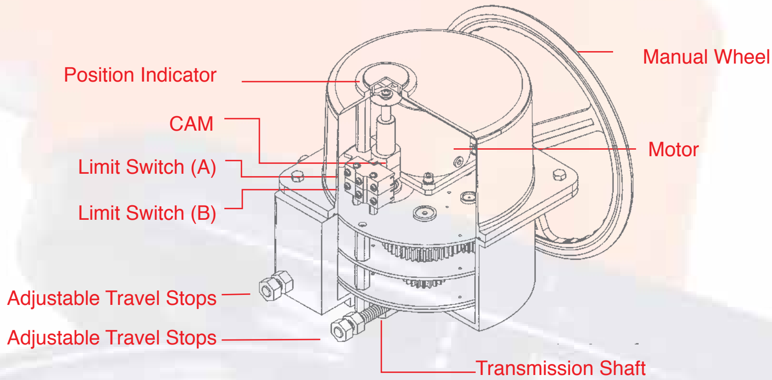
OUTPUT SIGNAL

- 4-20 mA
- 0 ~ 5VDC
- 1-5 VDC
- 0 ~ 10VDC
- 2-10 VDC

Flow Chart



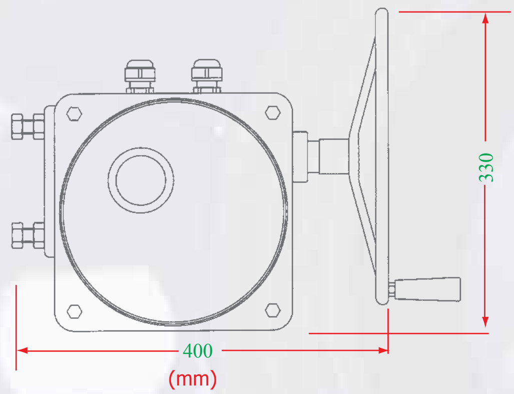
UM-8

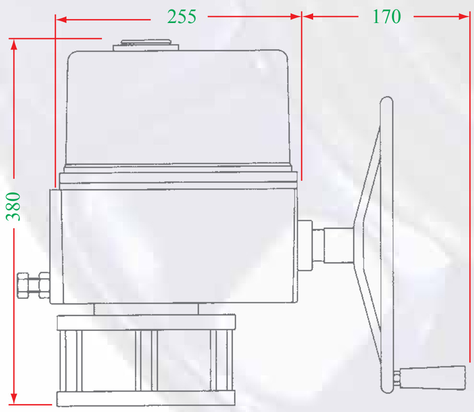


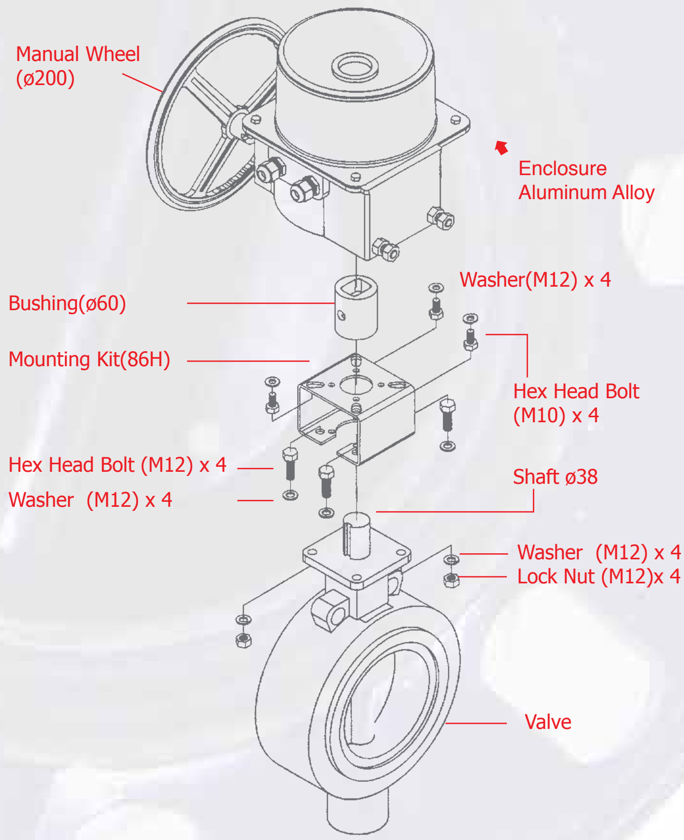
Weight : 70 lb

SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
100W	0.92A	0.34A	37	N/A	9580	8068	N/A

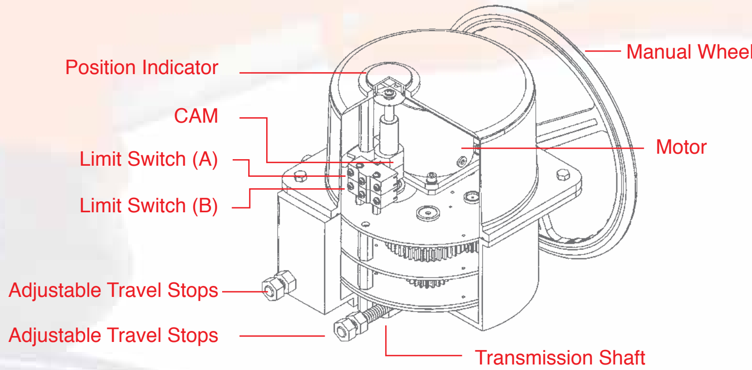
SIZE OF VALVE		
FLANGED ENDS	BUTTERFLY VALVE	3-WAY VALVE
6"~ 8"	12"~14"	5"~6"







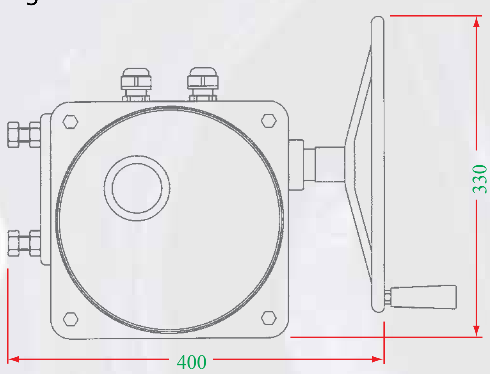
UM-10



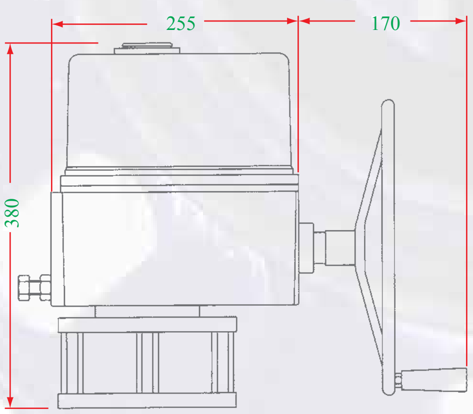
Weight : 75 lb

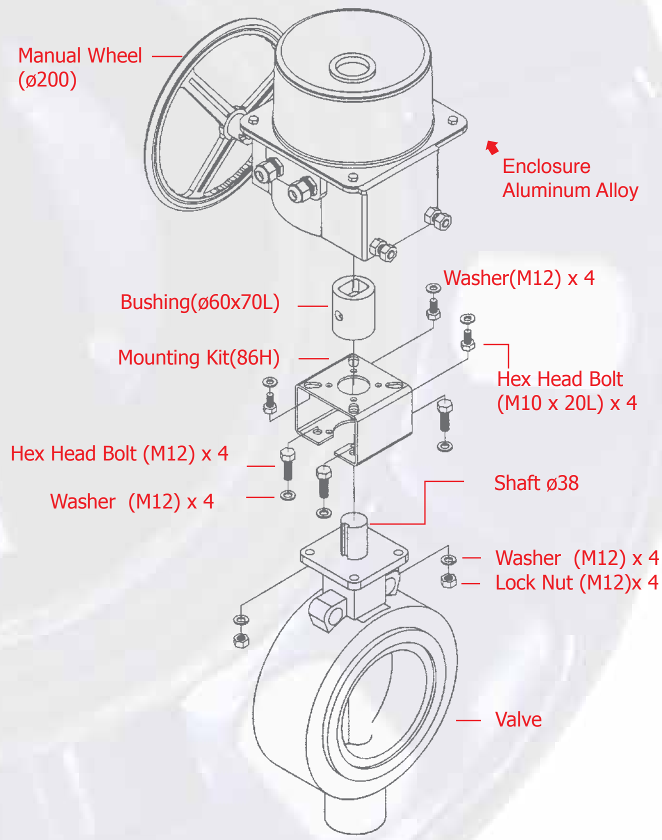
SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
100W	0.92A	0.34A	52	N/A	10467	11717	N/A

SIZE OF VALVE	
FLANGED ENDS	BUTTERFLY VALVE
8″~ 10″	14″~16″

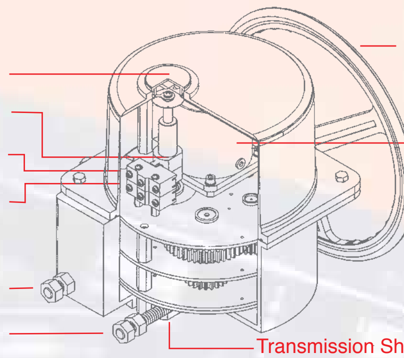


(mm)





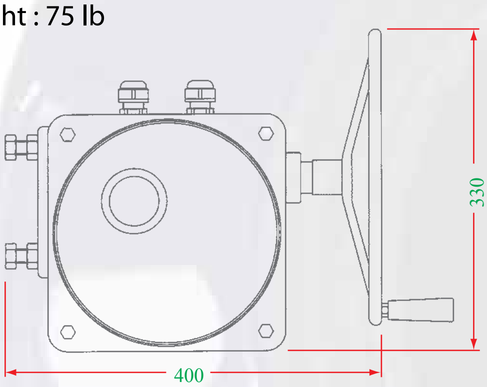
UM-11



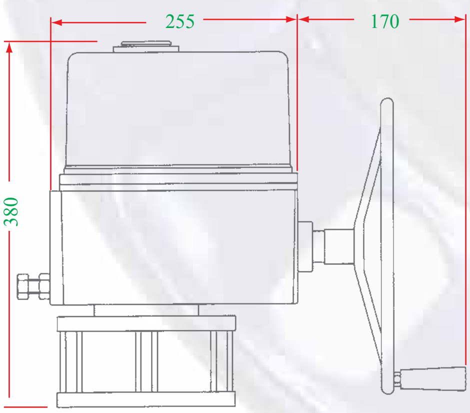
SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
100W	0.92A	0.34A	65	N/A	13019	12585	N/A

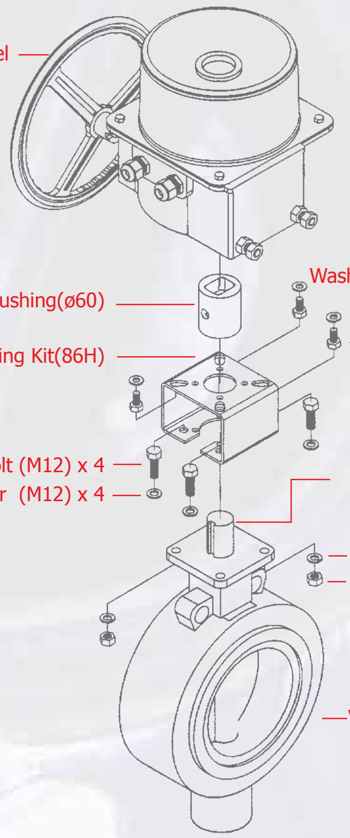
SIZE OF VALVE	
FLANGED ENDS	BUTTERFLY VALVE
10″~ 12″	16″~18″

Weight : 75 lb



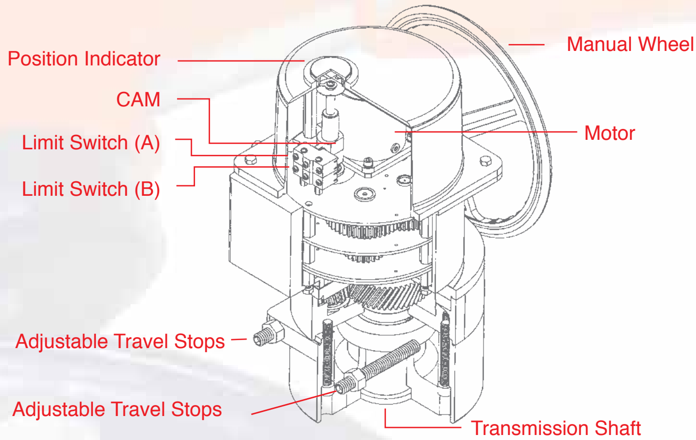
(mm)





Hydroseal® Canada re-engineering

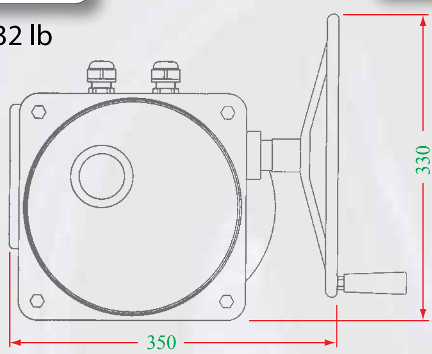
UM-12

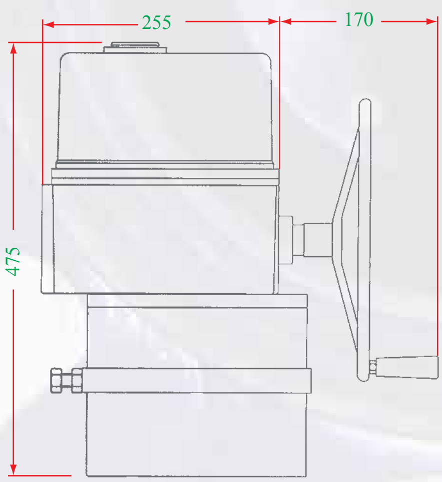


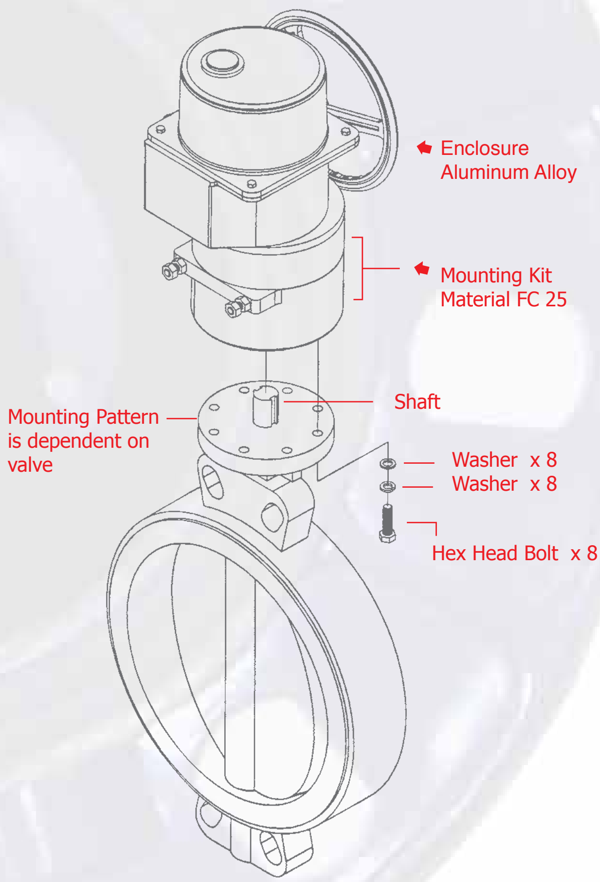
SPECIFICATION			SPEED (SEC)		OUTPUT TORQUE LBF-IN		
POWER	110VAC	220VAC	AC	DC	110VAC	220VAC	24VDC
100W	0.92A	0.34A	143	N/A	30378	30378	N/A

SIZE OF VALVE	
FLANGED ENDS	BUTTERFLY VALVE
12"~ 14"	20"~24"

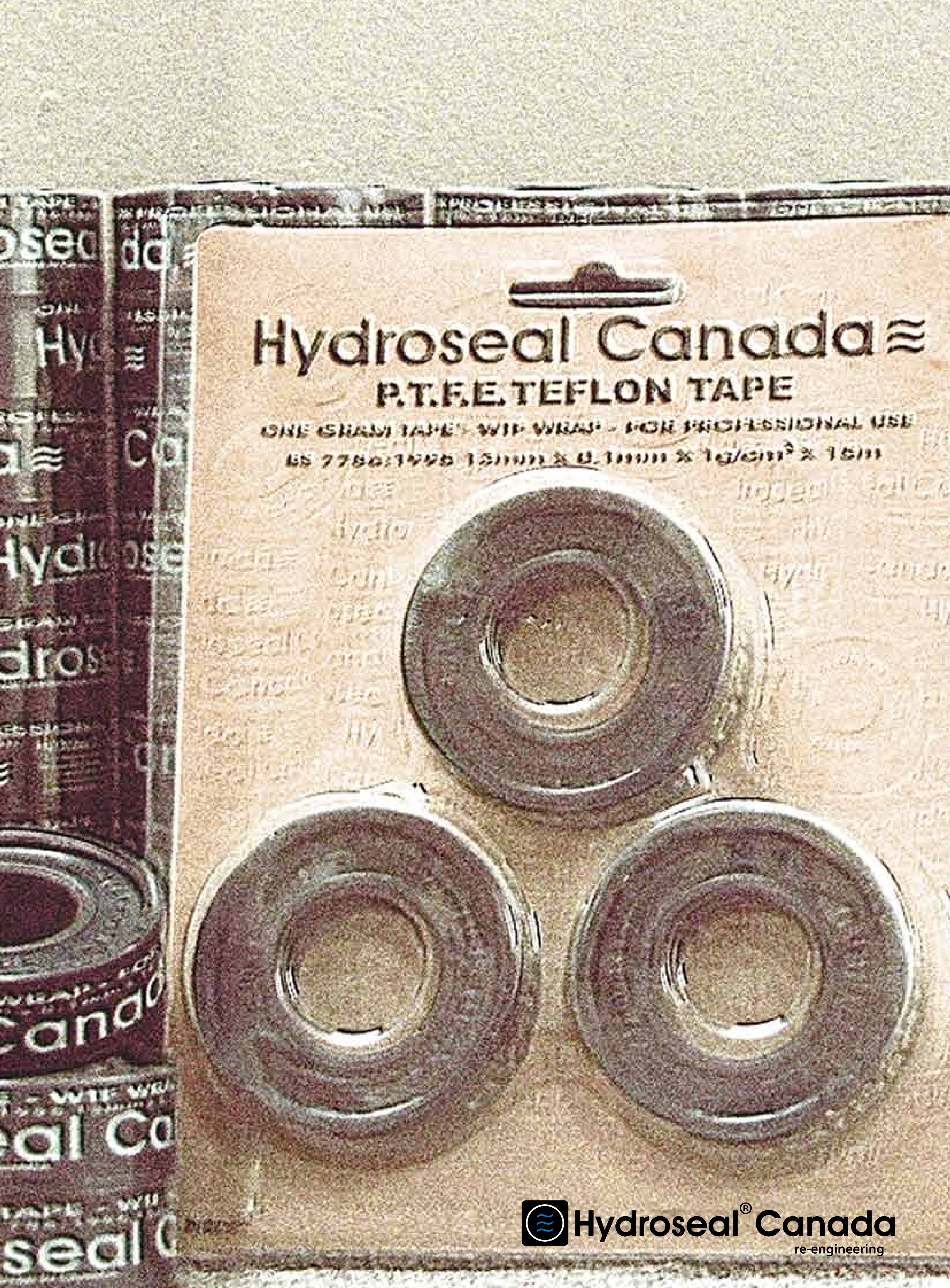
Weight : 132 lb








Hydroseal Canada≈
P.T.F.E.TEFLON TAPE



Hydroseal® Canada
re-engineering

ACCESSORIES 6.00

Jointing

Scope

This specification sheet covers the manufacturer's requirements for Solvent Cements, Primers, Cleaners and Thread Sealants. These products meet or exceed the standards set by the American Society for Testing and Materials, the National Sanitation Foundation and the British Standards Institute.

Solvent Cements/Primers/Thread Sealants

PVC (polyvinyl chloride) and CPVC (chlorinated polyvinyl chloride) cements meet or exceed ASTM D-2564 for PVC cement and F-493 for CPVC. Primers manufactured meet or exceed ASTM F-656. Material shall contain the specified amounts of color pigment, stabilizers, and other additives approved by the National Sanitation Foundation.

Marking

All products are marked as prescribed to indicate the manufacturer's name or trademark, size/length, and ASTM/BSE specifications. There must be clear distinguishing on those products that are required, all products shall be marked clearly with cautions and installation methods. Any expiry dates relevant shall clearly be marked on each product.

First Aid

All products which require careful handling shall also clearly be labeled with emergency First Aid directions.

ACCESSORIES
Cements - 22 Callibre PVC Cement

GENERAL DESCRIPTION:
Hydroseal® Canada 22 Callibre PVC Cement is a clear, regular bodied, quick setting, high strength PVC solvent cement for all classes and schedules of pipe and fittings with interference fit through 2 inch diameter.

APPLICATION:
Hydroseal® Canada 22 Callibre PVC Cement is for use on all types of PVC plastic pipe applications, Type I and Type II. It is suitable for use with potable water pressure systems, irrigation, turf, foam core, conduit, sewer, drain, waste and vent systems.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a PVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

NSF

- Meets ASTM D 2564 Standard.
- Listed by NSF International for compliance with ASTM D 2564, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR:	Clear
RESIN:	PVC
SPECIFIC GRAVITY:	0.920 ± 0.04
BROOKFIELD VISCOSITY:	Minimum 90 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:
3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:
Hydroseal® Canada 22 Callibre PVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	PVC	22 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W (KGS)	VOL (CU/FT)
72201	4 oz	22 CALLIBRE	CLEAR	24	1.90	2.80	0.29
72202	8 oz			24	3.80	5.80	0.41
72203	16 oz			12	4.30	5.30	0.42
72204	32 oz			12	8.10	11.00	0.78

GENERAL DESCRIPTION:

Hydroseal® Canada 40 Callibre PVC Cement is a clear, heavy bodied, mediium setting, high strength PVC solvent cement for all classes and schedules of pipe and fittings with interference fit through 8 inch diameter. Can be used without primer on non-pressure systems if local codes permit.

APPLICATION:

Hydroseal® Canada 40 Callibre PVC Cement is for use on all types of PVC plastic pipe applications, Type I and Type II. It is suitable for use with potable water pressure systems, irrigation, turf, foam core, conduit, sewer, drain, waste and vent systems.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a PVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

- Meets ASTM D 2564 Standard.
- Listed by NSF International for compliance with ASTM D 2564, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR:	Clear
RESIN:	PVC
SPECIFIC GRAVITY:	0.920 ± 0.04
BROOKFIELD VISCOSITY:	Minimum 500 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 40 Callibre PVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	PVC	40 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W (KGS)	VOL (CU/FT)
74001	4 oz	40 CALLIBRE	CLEAR	24	2.40	3.60	0.29
74002	8 oz	40 CALLIBRE	CLEAR	24	4.80	7.20	0.41
74003	16 oz	40 CALLIBRE	CLEAR	12	5.40	6.60	0.42
74004	32 oz	40 CALLIBRE	CLEAR	12	10.20	13.20	0.78

ACCESSORIES
Cements - 45 Callibre PVC Cement

GENERAL DESCRIPTION:

Hydroseal® Canada 45 Callibre PVC Cement is a clear or gray, extra heavy bodied, medium setting, high strength PVC solvent cement for all classes and schedules of pipe and fittings, including Schedule 80, with interference fit through 12 inch diameter and non-pressure applications up to 18 inch diameter. It has good gap filling properties and is recommended for solvent cementing joints where a sizable gap exists between pipe and fitting – e.g. large pipe sizes – and when more working time is required in warm weather.

APPLICATION:

Hydroseal® Canada 45 Callibre PVC Cement can be for use on all types of PVC plastic pipe applications, Type I and Type II. It is suitable for use with potable water pressure systems, irrigation, turf, conduit, industrial pipe applications, sewer, drain, waste and vent systems.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a PVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

NSF

- Meets ASTM D 2564 Standard.
- Listed by NSF International for compliance with ASTM D 2564, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR: Clear or Gray
RESIN: PVC
SPECIFIC GRAVITY: 0.947 ± 0.04
BROOKFIELD VISCOSITY: Clear: Minimum 1,600 CP@ 73 ± 2°F (23 ± 1°C)
Gray: Minimum 2,000 CP@ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 45 Callibre PVC Cement is evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	PVC	45 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W (KGS)	G.W (KGS)	VOL (CU/FT)
74501	4 oz	45 CALLIBRE	CLEAR	24	2.40	3.60	0.29
74502	8 oz			24	4.80	7.20	0.41
74503	16 oz			12	5.40	6.60	0.42
74504	32 oz			12	10.20	13.20	0.78

PART	SIZE	PVC	45 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W (KGS)	G.W (KGS)	VOL (CU/FT)
74506	4 oz	45 CALLIBRE	GREY	24	2.40	3.60	0.29
74507	8 oz			24	4.80	7.20	0.41
74508	16 oz			12	5.40	6.60	0.42
74509	32 oz			12	10.20	13.20	0.78

ACCESSORIES

Cements - 50 Callibre PVC Cement

GENERAL DESCRIPTION:

Hydroseal® Canada 50 Callibre PVC Cement is a gray super heavy bodied, slow setting, thixotropic (paste-like), high strength PVC solvent cement for all classes and schedules of pipe and fittings with interference fit through 24 inch diameter, including Schedule 80.

APPLICATION:

Hydroseal® Canada 50 Callibre PVC Cement is for use on all types of PVC plastic pipe applications, Type I and Type II. It is ideally suited for the fabrication of PVC fittings (particularly large diameter) as it has excellent gap filling properties. The slow set time also makes this cement outstanding for use with large diameter pipe in hot weather. **Hydroseal® Canada** 50 Callibre PVC Cement is suitable for use with potable water pressure systems, irrigation, conduit, industrial pipe applications, sewer, drain, waste and vent systems.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a PVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

- Meets ASTM D 2564 Standard.
- Listed by NSF International for compliance with ASTM D 2564, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR:	Gray
RESIN:	PVC
SPECIFIC GRAVITY:	0.984 ± 0.04
BROOKFIELD VISCOSITY:	Minimum 10,000 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 50 Callibre PVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	PVC	50 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G,W (KGS)	VOL (CU/FT)
75006	4 oz	50 CALLIBRE	GREY	24	2.70	4.00	0.29
75007	8 oz			24	5.40	8.00	0.41
75008	16 oz			12	6.00	7.30	0.42
75009	32 oz			12	11.30	14.60	0.78

ACCESSORIES

Cements - 40 Callibre PVC Cement (DO IT ALL JACK)

GENERAL DESCRIPTION:

Hydroseal® Canada 40 Callibre PVC Cement (DO IT ALL JACK) is a clear, medium bodied, fast setting, high strength, PVC to CPVC multi-purpose solvent cement. It is formulated for joining dissimilar plastic materials in all classes and schedules with interference fit through 6 inch diameter, Schedule 80 through 4 inch diameter. Although the cement appears to have a slight amber tint when viewed in the can, the usual thin layer on the pipe or fitting appears clear when dried.

APPLICATION:

Hydroseal® Canada 40 Callibre PVC Cement (DO IT ALL JACK) can be used on all types of PVC and CPVC, as well as on low-pressure ABS and Styrene systems. It is used for irrigation sprinklers, plumbing, conduit, etc. For pressure systems, it is always best to use cement specifically formulated for the type of plastic pipe used. **Do not use primer of any kind on the ABS side of the transition joint.**

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in PVC and CPVC systems using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

NSF®

- Meets the performance requirements of ASTM D 2564, D 2235 and F 493.

SPECIFICATIONS:

COLOR:	Clear
RESIN:	PVC
SPECIFIC GRAVITY:	0.935 ± 0.04
BROOKFIELD VISCOSITY:	Minimum 500 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 40 Callibre PVC Cement (DO IT ALL JACK) is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	MULTI PURPOSE	40 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W (KGS)	VOL (CU/FT)
84011	4 oz	40 CALLIBRE - DO IT ALL JACK	CLEAR	24	2.40	3.60	0.29
84012	8 oz			24	4.80	7.20	0.41
84013	16 oz			12	5.40	7.20	0.42
84014	32 oz			12	10.80	13.20	0.78

GENERAL DESCRIPTION:

Hydroseal® Canada 40 Callibre CPVC Cement is an orange, heavy bodied, medium setting, high strength CPVC solvent cement for all classes and schedules of CPVC pipe and fittings with interference fit through 8 inch diameter, including Schedule 80. It has good gap filling properties and its medium set allows more working time in warm weather.

APPLICATION:

Hydroseal® Canada 40 Callibre CPVC Cement is for use on cold and hot water systems up to 180°F (82°C) maximum, in industrial piping, residential, recreational vehicles and mobile homes plumbing. It can be used on copper tube size CPVC pipe and fittings.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a CPVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

- Meets ASTM D 2846 and F 493 Standard.
- Listed by NSF International for compliance with ASTM D 2846, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR:	Orange
RESIN:	CPVC
SPECIFIC GRAVITY:	0.972 ± 0.040
BROOKFIELD VISCOSITY:	Minimum 1,800 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

2 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 40 Callibre CPVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	CPVC	40 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G,W(KGS)	VOL (CU/FT)
84001	4 oz	40 CALLIBRE	ORANGE	24	2.40	3.60	0.29
84002	8 oz			24	4.80	7.20	0.41
84003	16 oz			12	5.40	6.60	0.42
84004	32 oz			12	10.20	13.20	0.78

ACCESSORIES
Cements - 45 Callibre CPVC Cement

GENERAL DESCRIPTION:
Hydroseal® Canada 45 Callibre CPVC Cement is gray, low VOC emissions extra heavy bodied, medium setting, high strength CPVC solvent cement for all classes and schedules of pipe and fittings with interference fit, including Schedule 80 through 12 inch diameter. Also recommended for PVC industrial piping systems for chemical applications.

APPLICATION:
Hydroseal® Canada 45 Callibre CPVC Cement is especially formulated for use on industrial piping systems (CPVC or PVC) requiring chemical resistance to caustics, including hypochlorite solutions, mineral acids, aggressive water and aqueous salt solutions. Approved for use with Corzan™ Industrial Piping Systems.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in CPVC and PVC systems using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:
- Meets ASTM F 493 Standard.
- Meets SCAQMD Rule 1168/316A.
- Compliant with LEED® (Leadership in Energy and Environmental Design). When using this **Hydroseal® Canada** low VOC product, credit can be claimed for LEED Green Building Rating System – Indoor Environmental Quality.
- Listed by NSF International for compliance with ASTM F 493, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:
COLOR: Gray
RESIN: CPVC
SPECIFIC GRAVITY: 0.984 ± 0.040
BROOKFIELD VISCOSITY: Minimum 2,000 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:
For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:
2 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:
Hydroseal® Canada 45 Callibre CPVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	CPVC	45 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W(KGS)	VOL (CU/FT)
84506	4 oz	45 CALLIBRE	GREY	24	2.40	3.60	0.29
84507	8 oz			24	4.80	7.20	0.41
84508	16 oz			12	5.40	6.60	0.42
84509	32 oz			12	10.20	13.20	0.78

GENERAL DESCRIPTION:

Hydroseal® Canada 50 Callibre CPVC Cement is a gray, low VOC emissions, super heavy bodied, slow setting, high strength CPVC solvent cement for all classes and schedules of industrial piping and duct with interference fit through 24 inch diameter.

APPLICATION:

Hydroseal® Canada 50 Callibre CPVC Cement is for use on CPVC industrial piping and duct applications. It has higher gap filling properties than **Hydroseal® Canada** 40 Callibre CPVC Cement or **Hydroseal® Canada** 45 Callibre CPVC Cement and is ideal for saddles and fabrication of large fittings.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a CPVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

NSF

- Meets ASTM F 493 Standard.
- Meets SCAQMD Rule 1168/316A.
- Compliant with LEED® (Leadership in Energy and Environmental Design). When using this **Hydroseal® Canada** low VOC product, credit can be claimed for LEED Green Building Rating System - Indoor Environmental Quality.

SPECIFICATIONS:

COLOR:	Gray
RESIN:	CPVC
SPECIFIC GRAVITY:	0.993 ± 0.04
BROOKFIELD VISCOSITY:	Minimum 10,000 CP @ 73 ± 2°F (23 ± 1°C)

SHIPPING:

For One Liter and Above
Proper Shipping Name: Adhesive
Hazard Class: 3
Identification Number: UN 1133
Packing Group: II
Label Required: Flammable Liquid

For Less than One Liter
Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

2 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Evaporation of solvent will cause the cement to thicken and reduce its effectiveness. Adding of thinners to change viscosity is not recommended and may significantly change the properties of the cement.

QUALITY ASSURANCE:

Hydroseal® Canada 50 Callibre CPVC Cement is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this solvent cement.

AVAILABILITY:

PART	SIZE	CPVC	50 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W (KGS)	VOL (CU/FT)
85006	4 oz	50 CALLIBRE	GREY	24	2.70	4.00	0.29
85007	8 oz			24	5.40	8.00	0.41
85008	16 oz			12	6.00	7.30	0.42
85009	32 oz			12	11.30	14.60	0.78

ACCESSORIES

Primer - 90 Callibre Primer

GENERAL DESCRIPTION:

Hydroseal® Canada 90 Callibre Primer is a low VOC emission, non-bodied, fast acting, primer. The strong, aggressive action of 90 Callibre Primer rapidly softens and dissolves the joining surfaces of PVC and CPVC pipe and fittings. The benefit of this priming action is especially noticeable on parts being joined together in cold weather. Available in clear and purple; the latter allows easy identification when used on the joining surfaces.

APPLICATION:

Hydroseal® Canada 90 Callibre Primer, when used in conjunction with appropriate **Hydroseal® Canada** solvent cements, will make consistently strong, wellfused joints. It is essential that the joining surfaces of pipe and fittings be softened and remains softened prior to assembly. The main function of the primer is to expedite the penetration and softening of the surfaces. Its rate of penetration into the joining surfaces is more rapid than that of solvent cement alone. 90 Callibre Primer is suitable for use with all types, classes and schedules of PVC and CPVC pipe and fittings.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

NOTE: Hydroseal® Canada solvent cements must never be used in a CPVC system using or being tested by compressed air or gases; including air-over-water booster.

STANDARDS AND CERTIFICATION LISTINGS:

NSF

- Meets ASTM F 656 Standard.
- Meets SCAQMD Rule 1168/316A.
- Compliant with LEED® (Leadership in Energy and Environmental Design). When using this **Hydroseal® Canada** low VOC product, credit can be claimed for LEED Green Building Rating System – Indoor Environmental Quality.
- Listed by NSF International for compliance with ASTM F 656, NSF/ANSI Standard 14 for use on potable water, drain, waste, vent and sewer applications.

SPECIFICATIONS:

COLOR:	Clear or Purple
SPECIFIC GRAVITY:	0.858 ± 0.040
BROOKFIELD VISCOSITY:	Water Thin

SHIPPING:

For One Liter and Above

Proper Shipping Name:	Flammable Liquid n.o.s. (Methyl Ethyl Ketone, Tetrahydrofuran)
Hazard Class:	3
Identification Number:	UN 1993
Packing Group:	II
Label Required:	Flammable Liquid

For Less than One Liter

Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

SHELF LIFE:

3 years in tightly sealed containers. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened. Adding of solvents is not recommended and may significantly change the properties of the primer.

QUALITY ASSURANCE:

Hydroseal® Canada 90 Callibre Primer is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this product.

AVAILABILITY:

PART	SIZE	PRIMER	90 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W (KGS)	G.W (KGS)	VOL (CU/FT)
99011	4 oz	90 CALLIBRE	CLEAR	24	2.20	3.40	0.29
99012	8 oz			24	4.80	7.20	0.41
99013	16 oz			12	4.80	6.60	0.42
99014	32 oz			12	9.60	12.00	0.78

PART	SIZE	PRIMER	90 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W (KGS)	G.W (KGS)	VOL (CU/FT)
99016	4 oz	90 CALLIBRE	PURPLE	24	2.20	3.40	0.29
99017	8 oz			24	4.80	7.20	0.41
99018	16 oz			12	4.80	6.60	0.42
99019	32 oz			12	9.60	12.00	0.78

ACCESSORIES
Cleaner - 22 Callibre Cleaner

GENERAL DESCRIPTION:
Hydroseal® Canada 22 Callibre Cleaner is a clear, low VOC emission, water-thin, solvent cleaner. It is specifically formulated to remove grease, oil and dirt from the bonding surfaces of PVC, CPVC, ABS and Styrene pipe and fittings. It is approved for Flowguard Gold® CTS plumbing systems.

APPLICATION:
Hydroseal® Canada 22 Callibre Cleaner is an all purpose cleaner and can be used on all sizes, classes and schedules of PVC, CPVC, ABS and Styrene pipe and fittings. It must be used only as a cleaner, in conjunction with the appropriate primer and/or cement combination. **Hydroseal® Canada** 22 Callibre Cleaner can also be used as a brush cleaner.

Detailed directions on making solvent cemented joints are printed on the container label. An installation DVD/CD covering solvent cementing is available. It not only describes the basic principles of solvent cementing, but also covers the handling, storage and use of our products. It is highly recommended that the installer review the instructions supplied by the pipe and fitting manufacturer.

STANDARDS AND CERTIFICATION LISTINGS:
- Meets SCAQMD Rule 1168/316A.
- Compliant with LEED® (Leadership in Energy and Environmental Design). When using this **Hydroseal® Canada** low VOC product, credit can be claimed for LEED Green Building Rating System – Indoor Environmental Quality.

SPECIFICATIONS:
COLOR:	Clear
SPECIFIC GRAVITY:	0.800 ± 0.040
BROOKFIELD VISCOSITY:	Water Thin

SHIPPING:
For One Liter and Above

Proper Shipping Name:	Flammable Liquid n.o.s. (Acetone, Methyl Ethyl Ketone)
Hazard Class:	3
Identification Number:	UN 1993
Packing Group:	II
Label Required:	Flammable Liquid

For Less than One Liter

Proper Shipping Name: Consumer Commodity
Hazard Class: ORM-D

DIRECTIONS FOR USE:
- Before using this cleaner, pipe and fittings should be cut square, deburred and checked for proper fit.
- Use an applicator (e.g. dauber, brush top applicator or paintbrush) at least ½ the size of the pipe diameter. Do not use a rag as repeated contact of cleaner-infused rag with skin may cause irritation or blistering.
- Apply 22 Callibre Cleaner freely to the socket keeping surface wet and applicator wet and in motion for 5 - 15 seconds. Be sure to use a scrubbing motion to clean off all grease, oil and dirt. Re-dip if necessary. Avoid puddling the socket.
- Apply 22 Callibre Cleaner to the pipe surface in the same manner equal to the depth of the socket.
- Repeat application to the fitting socket.
- Allow 22 Callibre Cleaner to dry and then apply appropriate **Hydroseal® Canada** primer and/or cement following instructions on the cans.

QUALITY ASSURANCE:
Hydroseal® Canada 22 Callibre Cleaner is carefully evaluated to assure that consistent high quality is maintained. Fourier transform infrared spectroscopy, gas chromatography, and additional in depth testing ensures each batch is manufactured to exacting standards. A batch identification code is stamped on each can and assures traceability of all materials and processes used in manufacturing this product. The date code of manufacture is stamped on the bottom of the container. Stability of the product is limited by the evaporation of the solvent when the container is opened and not contaminated. Adding of solvents is not recommended and may significantly change the properties of the cleaner.

AVAILABILITY:
PART	SIZE	CLEANER	22 CALLIBRE				
		DESCRIPTION	COLOR	CARTON	N.W(KGS)	G.W(KGS)	VOL (CU/FT)
92211	4 oz	22 CALLIBRE	CLEAR	24	2.10	3.20	0.29
92212	8 oz			24	4.80	6.00	0.41
92213	16 oz			12	4.80	6.60	0.42
92214	32 oz			12	9.00	12.00	0.78

GENERAL DESCRIPTION:

Polytetraflouroethylene (PTFE), is an engineering plastic known for its low coefficient of friction, inertness to chemicals, and resistance to heat. With a low friction surface, second only to ice, PTFE also boasts outstanding electrical, insulative and dielectric properties. When coated onto a fiber-glass fabric, it becomes dimensionally stable and durable. The addition of silicone or acrylic adhesive eliminates the need for mechanical fastening. This unique combination of materials, commonly referred to as "PTFE tape", is also resistant to tears, punctures, and abrasions. For these reasons, they are widely used in packaging, chemical processing, thread sealing and aerospace industries.

One of the defining characteristics of PTFE is how good it is at defeating friction. The use of PTFE tape in tapered pipe threads performs a lubricating function, which more easily allows the threads to be screwed together, to the point of deformation, which is what creates the majority, if not all, of the seal.

PTFE tape is appropriate for use on tapered threads, where the thread itself provides the surface seal. It is not required on parallel threads - parallel threads will not effectively seal themselves, even with tape. The sealing force on a tapered thread comes from the wedge action, that of a parallel thread is merely the axial force from the nut and is inadequate for a good seal. For this reason parallel threads are only to be used to mechanical clamp some other form of seal. Such seals do not require additional tape, and applying tape to their threads has no purpose.

STANDARDS

There are two US standards for determining the quality of any PTFE tape. MIL-T-27730A (an obsolete military specification still commonly used in industry in the US) requires a minimum thickness of 3.5 mils and a minimum PTFE purity of 99%. The second standard, A-A-58092, is a commercial grade which maintains the thickness requirement of MIL-T-27730A and adds a minimum density of 1.2 g/cc. Relevant standards may vary between industries; tape for gas fittings (to UK gas regulations) is required to be thicker than that for water. Although PTFE itself is suitable for use with high-pressure oxygen, the grade of tape must also be known to be free from grease.

PART	WIDTH	DESCRIPTION	USE	DENSITY	THICK	LENGTH	PACK
73800	12mm	PTFE Thread Sealing Tape	1/2">	0.20	0.075	15mtr	500
73801	12mm	PTFE Thread Sealing Tape	1">	0.35	0.075	15mtr	500
73802	12mm	PTFE Thread Sealing Tape	2">	0.40	0.100	15mtr	500
73803	13mm	PTFE Thread Sealing Tape (WTF™ Series)	8">	1.00	0.100	15mtr	500
73804	19mm	PTFE Thread Sealing Tape	4">	0.40	0.100	15mtr	500
73805	25mm	PTFE Thread Sealing Tape	4">	0.40	0.100	15mtr	500

SECTION I - IDENTIFICATION

TRADE NAME: HYDROSEAL 22, 40, 45 and 50 Callibre Cements for CPVC & PVC Systems.

SUPPLIER and MANUFACTURER: Hydroseal Canada Product Management Inc.
Waterpark Place, 20 Bay Street, 12th Floor Toronto, Ontario, M5J2N8 Canada
Phone: 1- 416 - 848 - 0899 Email: info@hydroseal.ca

EMERGENCY: Phone: 1- 703 - 527 - 3887 CHEMTREC (International)

SECTION 2 - CHEMICAL COMPOSITION

	CAS#	CONCENTRATION	SYMBOL	R phrases S	S phrases ExposureLimitValue
Synthetic Resin	NON-HAZ	15 -- 25%	N/A	N/A	N/A
Tetrahydrofuran (THF)**	109-99-9	30 -- 50%	F Xi	1-19-36/37/38 7-16-29-33	50 PPM# Skin
Methyl Ethyl Ketone (MEK)	78-93-3	25 -- 45%	F Xi	11-36-66-67 2-7-9-16-51	200 PPM
Cyclohexanone	108-94-1	1 -- 10%	Xn	10-20 7-29	20 PPM Skin
Toluene	108-88-3	0 -- 30%	F, T	11-23-24-25 16-25-29-33	100 PPM
Acetone	67-64-1	0 -- 25%	F Xi	11-36-37-38 23-26-33-39	500 PPM

All of the constituents of this adhesive product are listed on the TSCA inventory of chemical substances maintained by the US EPA, or are exempt from that listing.

SECTION 3 - RISK/HAZARD IDENTIFICATION

Human:
- Highly flammable; keep away from sources of ignition. Vapors are heavier than air and may travel to sources of ignition at or near ground or lower level(s) and flash back.
- Irritating, do not breathe vapours.
- See also section 11.

Environment:
- Emission of volatile organic compounds (VOC's).
- Spills or leaks can result in ground water contamination.

SECTION 4 - FIRST AID MEASURES

Contact with eyes: - Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.
Skin contact: - Remove contaminated clothing and shoes. Wash skin thoroughly with soap and water. If irritation develops, seek medical advice.
Inhalation: - Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice.
Ingestion: - Rinse mouth with water. Give 1 or 2 glasses of water or milk to dilute. Do not induce vomiting. Seek medical advice immediately.
Symptoms: - See section 11

SECTION 5 - FIREFIGHTING MEASURES

Suitable Extinguishing Media: - Dry chemical powder, carbon dioxide gas, foam, Halon, water fog.
Unsuitable Extinguishing Media: - Water spray or stream.
Exposure Hazards: - Carbon monoxide, carbon dioxide, hydrogen chloride and smoke
Combustion Products: - Carbon monoxide, carbon dioxide, hydrogen chloride and smoke
Protection for Firefighters: - Self-contained breathing apparatus or full-face positive pressure airline masks.

SECTION 6 - MEASURES FOR ACCIDENTAL RELEASE (LEAKS/SPILLAGE)

Personal precautions:
- Keep away from heat, sparks and open flame.
- Provide sufficient ventilation, use explosion
- proof exhaust ventilation equipment or wear suitable respiratory protective equipment.
- Prevent contact with skin or eyes (see section 8).

Environmental Precautions: - Prevent product or liquids contaminated with product from entering sewers, drains, soil or open water course.

Methods for Cleaning up:
- Clean up with sand or other inert absorbent material.
- Transfer to a closable vessel (Metal or polyethylene [PE])

Materials not to be used for clean up: - Liquid(s)

SECTION 7 - STORAGE AND HANDLING

Handling:
- Avoid breathing of vapor, avoid contact with eyes, skin and clothing.
- Keep away from ignition sources, use only electrically grounded handling equipment and ensure adequate ventilation/fume exhaust hoods.
- Do not eat; drink or smoke while handling.

Methods for Cleaning up:
- Store in ventilated room or shade between 5°C and 32.5°C (40°F - 90°F).
- Keep away from ignition sources and incompatible materials: caustics, ammonia, inorganic acids, chlorinated compounds, strong oxydizers and isocyanates.
- Keep container tightly closed when not in use.
- Follow all precautionary information on container label, product bulletins and solvent cementing literature.

SECTION 8 - PRECAUTIONS TO CONTROL EXPOSURE / PERSONAL PROTECTION

System Design: If ventilated cabinet, enclosure or fume hood is necessary, average airflow should be at least 100 FPM (50.8 cm/sec).

Monitoring: Maintain breathing zone airborne concentrations below exposure limits (see section 2).

Breathing Protection: Prevent inhalation of the solvents. Use in a well-ventilated room. Open doors and/or windows to ensure airflow and air changes. Use local exhaust ventilation to remove airborne contaminants from employee breathing zone and to keep contaminants below levels listed in section 2. With normal use, the Exposure Limit Value will not usually be reached. When limits approached, use respiratory protection equipment (filter)

Skin Protection: Prevent contact with the skin as much as possible. Polyethylene or PVA coated rubber gloves should be used for frequent dipping/immersion. Use of latex/nitrile surgical gloves or solvent-resistant barrier cream should provide adequate protection when normal solvent-cement welding practices and procedures are used for making plastic welded pipe joints.

Eye Protection: Avoid contact with eyes, wear splash-proof chemical goggles, face shield, safety glasses (spectacles) with brow guards and side shields,. etc. as may be appropriate for the exposure.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	40 Callibre - Orange, medium syrupy liquid; 45 Callibre - Gray, heavy syrupy liquid; 50 Callibre, paste-like				
Odour:	Etherial, similar to Acetone or ketone-like				
P.H.	N.A.P.				
Boiling Point:	57°C - 67°C (131°F - 151°F) Based on first boiling component:				
Flash Point:	-6°C (-20°F) T.C.C. based on Acetone				
Autoflammability:	321°C (609.8°F): THF				
Vapor Pressure:	143 mm Hg @ 20°C (68°F): THF				
Solubility:	Solvent portion completely soluble in water. Resin portion separates out				
Other Data:	Vapour Density:	2.49 (Air = 1)	Specific Gravity @23°C ± 2° (73°F ± 3.6°) : Variable by product 0.972 - 0.993 ± 0.040		
	Evaporation Rate:	> 1.0 (BUAC = 1)	Flammability Limits:	LEL: 1.8 - 2%	
	Viscosity:	Variable by product	(percent by volume)	UEL: 11.5 - 11.8%	

SECTION 10 - STABILITY AND REACTIVITY

Stability:	Stable
Conditions to avoid:	Keep away from heat, sparks, open flame and other ignition sources.
Effects:	When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.
Materials to avoid:	Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.
Hazardous decomposition products:	None in normal use. See item 10.2 for reactivity/combustion effects.

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute symptoms and effects:

Inhalation:	Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages.
Eye Contact:	Vapours slightly uncomfortable. Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid.
Skin Contact:	Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact.
Ingestion:	May cause nausea, vomiting, diarrhea and mental sluggishness.
Chronic (long-term) effects:	None known to humans

SECTION 13 - WASTE DISPOSAL CONSIDERATIONS

Follow local and national regulations. Consult disposal expert. Can be disposed of by controlled incineration. Excessive quantities should not be permitted to enter drains, sewers or water courses. Empty containers should be air dried before disposing.

SECTION 13 - WASTE DISPOSAL CONSIDERATIONS

DOT, IATA, ADR, IMO/IMDG SHIPPING INFORMATION

Proper Shipping Name:	Adhesives	EXCEPTION:	Case quantities of cement in containers of less than one liter may be shipped as LIMITED QUANTITY or CONSUMER COMMODITY, ORM-D
Hazard Class:	3		
Secondary Risk	None		
Identification Number:	UN 1133	TDG INFORMATION	
Packing Group:	II	TDG CLASS:	FLAMMABLE LIQUID 3
Label Required:	Flammable Liquid	SHIPPING NAME:	ADHESIVES (TETRAHYDROFURAN)
Marine Pollutant:	NO	UN NUMBER:	1133, PG II

SECTION 15 - REGULATORY INFORMATION

Precautionary Label Information: Highly Flammable, Irritant, possibly Toxic

Symbols: F, Xi, T

Risk Phrases:
- R-10 Flammable
- R-11 Highly Flammable
- R-23/24/25 Toxic by ingestion, inhalation or excessive contact with skin
- R-36/37/38 Irritating to eyes, respiratory system and skin

Advisory:
- R-20 Harmful by inhalation
- R-66 repeated exposure may cause skin dryness or cracking.
- R-67 Vapours may cause drowsiness and dizziness

Safety Phrases:
- S-7 Keep container tightly closed when not in use
- S-16 Keep away from sources of ignition.
- S-29 Do not empty into drains.
- S-39 Wear eye/face protection
- S-51 Use only in well ventilated areas.

No smoking. Advisory:
- S-2 Keep out of reach of children.
- S-9 Keep container in a well-ventilated place.
- S-23/24/25 Avoid inhalation and contact with skin and eyes.
- S-33 Take precautionary measures against static discharges.

SECTION 16 - OTHER INFORMATION

Specification Information:

Department issuing data sheet:	Safety Health & Environmental Affairs
Training necessary:	Yes, training in practices and procedures contained in solvent-cementing literature.
Reissue date / reason for reissue:	APR 2009 / New product in this Euro format
Intended Use of Product:	Bonding of rigid plastic joints between piping and fittings for CPVC plastic pipe

Not for use on piping systems tested with or using compressed gases. This product is intended for use by skilled individuals at their own risk. The information contained herein is based on data considered accurate based on current state of knowledge and experience. However, no warranty is expressed or implied regarding the accuracy of this data or the results to be obtained from the use thereof.

SAFETY DATA SHEET - HYDROSEAL® Primers & Cleaners for Plastic Systems

SECTION I - IDENTIFICATION

TRADE NAME: HYDROSEAL 22 Callibre and 90 Callibre Primers & Cleaners for Plastic Systems.

SUPPLIER and MANUFACTURER: Hydroseal Canada Product Management Inc.
Waterpark Place, 20 Bay Street, 12th Floor Toronto, Ontario, M5J2N8 Canada
Phone: 1 - 416 - 848 - 0899 Email: info@hydroseal.ca

EMERGENCY: Phone: 1 - 703 - 527 - 3887 CHEMTREC (International)

SECTION 2 - CHEMICAL COMPOSITION

	CAS#	CONCENTRATION	SYMBOL	R phrases S	S phrases ExposureLimitValue
Tetrahydrofuran (THF)**	109-99-9	30 -- 50%	F Xi	1-19-36/37/38 7-16-29-33	50 PPM# Skin
Methyl Ethyl Ketone (MEK)	78-93-3	25 -- 45%	F Xi	11-36-66-67 2-7-9-16-51	200 PPM
Cyclohexanone	108-94-1	1 -- 10%	Xn	10-20 7-29	20 PPM Skin
Acetone	67-64-1	0 -- 25%	F Xi	11-36-37-38 23-26-33-39	500 PPM

All of the constituents of this adhesive product are listed on the TSCA inventory of chemical substances maintained by the US EPA, or are exempt from that listing.

SECTION 3 - RISK/HAZARD IDENTIFICATION

Human:
- Highly flammable; keep away from sources of ignition. Vapors are heavier than air and may travel to sources of ignition at or near ground or lower level(s) and flash back.
- Irritating, do not breathe vapours.
- See also section 11.

Environment:
- Emission of volatile organic compounds (VOC's).
- Spills or leaks can result in ground water contamination.

SECTION 4 - FIRST AID MEASURES

Contact with eyes: - Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.

Skin contact: - Remove contaminated clothing and shoes. Wash skin thoroughly with soap and water. If irritation develops, seek medical advice.

Inhalation: - Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice.

Ingestion: - Rinse mouth with water. Give 1 or 2 glasses of water or milk to dilute. Do not induce vomiting. Seek medical advice immediately.

Symptoms: - See section 11

SECTION 5 - FIREFIGHTING MEASURES

Suitable Extinguishing Media: - Dry chemical powder, carbon dioxide gas, foam, Halon, water fog.

Unsuitable Extinguishing Media: - Water spray or stream.

Exposure Hazards: - Carbon monoxide, carbon dioxide, hydrogen chloride and smoke

Combustion Products: - Carbon monoxide, carbon dioxide, hydrogen chloride and smoke

Protection for Firefighters: - Self-contained breathing apparatus or full-face positive pressure airline masks.

SECTION 6 - MEASURES FOR ACCIDENTAL RELEASE (LEAKS/SPILLAGE)

Personal precautions:
- Keep away from heat, sparks and open flame.
- Provide sufficient ventilation, use explosion-proof exhaust ventilation equipment or wear suitable respiratory protective equipment.
- Prevent contact with skin or eyes (see section 8).

Environmental Precautions: - Prevent product or liquids contaminated with product from entering sewers, drains, soil or open water course.

Methods for Cleaning up:
- Clean up with sand or other inert absorbent material.
- Transfer to a closable vessel (Metal or polyethylene [PE])

Materials not to be used for clean up: - Liquid(s)

SECTION 7 - STORAGE AND HANDLING

Handling:
- Avoid breathing of vapor, avoid contact with eyes, skin and clothing.
- Keep away from ignition sources, use only electrically grounded handling equipment and ensure adequate ventilation/fume exhaust hoods.
- Do not eat; drink or smoke while handling.

Methods for Cleaning up:
- Store in ventilated room or shade between 5°C and 32.5°C (40°F - 90°F).
- Keep away from ignition sources and incompatible materials: caustics, ammonia, inorganic acids, chlorinated compounds, strong oxydizers and isocyanates.
- Keep container tightly closed when not in use.
- Follow all precautionary information on container label, product bulletins and solvent cementing literature.

SECTION 8 - PRECAUTIONS TO CONTROL EXPOSURE / PERSONAL PROTECTION

System Design: If ventilated cabinet, enclosure or fume hood is necessary, average airflow should be at least 100 FPM (50.8 cm/sec).
Monitoring: Maintain breathing zone airborne concentrations below exposure limits (see section 2).

Breathing Protection: Prevent inhalation of the solvents. Use in a well-ventilated room. Open doors and/or windows to ensure airflow and air changes. Use local exhaust ventilation to remove airborne contaminants from employee breathing zone and to keep contaminants below levels listed in section 2. With normal use, the Exposure Limit Value will not usually be reached. When limits approached, use respiratory protection equipment (filter)

Skin Protection: Prevent contact with the skin as much as possible. Polyethylene or PVA coated rubber gloves should be used for frequent dipping/immersion. Use of latex/nitrile surgical gloves or solvent-resistant barrier cream should provide adequate protection when normal solvent-cement welding practices and procedures are used for making plastic welded pipe joints.

Eye Protection: Avoid contact with eyes, wear splash-proof chemical goggles, face shield, safety glasses (spectacles) with brow guards and side shields,. etc. as may be appropriate for the exposure.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	22 Cal.- Clear, thin liquid, 90 Cal. - Clear or purple, thin liquid
Odour:	Etherial, similar to Acetone or ketone-like
P.H.	N.AP.
Boiling Point:	57°C - 67°C (131°F - 151°F) Based on first boiling component:
Flash Point:	-6°C (-20°F) T.C.C. based on Acetone
Autoflammability:	321°C (609.8°F): THF
Vapor Pressure:	143 mm Hg @ 20°C (68°F): THF
Solubility:	Completely soluble in water.
Other Data:	Vapour Density: 2.49 (Air = 1) — Specific Gravity @23°C ± 2° (73°F ± 3.6°) Variable by product 0.972 - 0.993 ± 0.040
	Evaporation Rate: > 1.0 (BUAC = 1) — Flammability Limits: LEL: 1.8 - 2%
	Viscosity: Water-thin — (percent by volume) UEL: 11.5 - 11.8%

SECTION 10 - STABILITY AND REACTIVITY

Stability:	Stable
Conditions to avoid:	Keep away from heat, sparks, open flame and other ignition sources.
Effects:	When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.
Materials to avoid:	Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.
Hazardous decomposition products:	None in normal use. See item 10.2 for reactivity/combustion effects.

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute symptoms and effects:

Inhalation:	Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages.
Eye Contact:	Vapours slightly uncomfortable. Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid.
Skin Contact:	Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact.
Ingestion:	May cause nausea, vomiting, diarrhea and mental sluggishness.
Chronic (long-term) effects:	None known to humans

SECTION 12 - ECOLOGICAL INFORMATION

Mobility:	In normal use, emission of volatile organic compounds (VOC's) to the air takes place. Typically at a rate of 490 Grams/Litre. Minimal other adverse effects include possible ground water contamination from release to soil, sewers, drains or water course.
Degradability:	Biodegradable.
Accumulation:	Minimal to none.

SECTION 13 - WASTE DISPOSAL CONSIDERATIONS

Follow local and national regulations. Consult disposal expert. Can be disposed of by controlled incineration. Excessive quantities should not be permitted to enter drains, sewers or water courses. Empty containers should be air dried before disposing.

SECTION 14 - TRANSPORT INFORMATION

DOT, IATA, ADR, IMO/IMDG SHIPPING INFORMATION

Proper Shipping Name:	Flammable Liquid, n.o.s. (Tetrahydrofuran, Methyl Ethyl Ketone)
Hazard Class:	3
Secondary Risk	None
Identification Number:	UN 1993 TDG INFORMATION
TDG CLASS:	FLAMMABLE LIQUID 3
SHIPPING NAME:	FLAMMABLE LIQUID, N.O.S.
UN NUMBER:	1993, PG II
Packing Group:	II
Label Required:	Flammable Liquid
Marine Pollutant:	NO

SECTION 15 - REGULATORY INFORMATION

Precautionary Label Information:	Highly Flammable, Irritant, possibly Toxic	
Symbols:	F, Xi, T	Advisory:
Risk Phrases:	R-10 Flammable R-11 Highly Flammable R-23/24/25 Toxic by ingestion, inhalation or excessive contact with skin R-36/37/38 Irritating to eyes, respiratory system and skin	R-20 Harmful by inhalation R-66 repeated exposure may cause skin dryness or cracking. R-67 Vapours may cause drowsiness and dizziness
Safety Phrases:	S-7 Keep container tightly closed when not in use S-16 Keep away from sources of ignition. S-29 Do not empty into drains. S-39 Wear eye/face protection S-51 Use only in well ventilated areas.	No smoking. Advisory: S-2 Keep out of reach of children. S-9 Keep container in a well-ventilated place. S-23/24/25 Avoid inhalation and contact with skin and eyes. S-33 Take precautionary measures against static discharges.

SECTION 16 - OTHER INFORMATION

Specification Information:	
Department issuing data sheet:	Safety Health & Environmental Affairs
Training necessary:	Yes, training in practices and procedures contained in solvent-cementing literature.
Reissue date / reason for reissue:	APR 2009 / New product in this Euro format
Intended Use of Product:	Cleaner or primer to enhance quality of bonded joint between plastic cement, piping and fittings.

Not for use on piping systems tested with or using compressed gases. This product is intended for use by skilled individuals at their own risk. The information contained herein is based on data considered accurate based on current state of knowledge and experience. However, no warranty is expressed or implied regarding the accuracy of this data or the results to be obtained from the use thereof.


Hydroseal
Hydroseal Canada
PTFE TEFLON TAPE
CANADA


Hydroseal® Canada
re-engineering

ENGINEERING 7.00

Buyer's Acceptance of Materials

The person responsible for receiving the product should always carefully inspect all materials immediately upon arrival. The ends of the pipe should be visually inspected for cracks or heavy deformations that could have occurred during shipment. Boxes should be checked for gouges or any signs of abuse. Inspection should be done in the presence of the shipper and any specific damage or shortages should be identified and documented for future settlements. Call your local Hydroseal representative immediately.

Unloading and Handling

Unloading of pipe and fittings should be handled with reasonable care and effort. Never push or drag a palletized load of pipe from a truck bed. Pipe should not come into severe contact with sharp objects such as corners of truck beds, loading docks and buildings, forks on forklift trucks, and rocks or other obstacles on the ground. Forklift forks must never be inserted into the ends of pipe as a means of lifting or moving.

Pipe Storage

Indoor storage of pipe is recommended but that is not always convenient. Therefore, when storing pipe outdoors, choose a flat, dry location to avoid bending and mud collection. Palletized pipes should be stacked with wooden pallet bracings touching each other.

The pipe must be protected from the sun and provided with adequate ventilation. When the pipe is not protected from the sun, extended exposure to ultraviolet rays may cause discoloration.

Fitting Storage

Store fittings in their original packaging. If they must be removed from their boxes, separate them by geometric type and size. Never combine your plastic fitting inventory with metallic materials. Avoid storing piping products near an open flame or source of extreme heat.

Maximum Operating Pressure - PSI (Water @ 73° F)

NOMINAL PIPE SIZE (IPS)	SCHEDULE 40 PVC AND CPVC	SCHEDULE 80 PVC			SCHEDULE 80 CPVC	SDR PRESSURE RATED PIPE FOR PVC PLAIN AND BELLED END		
	PLAIN & BELLED[1]	PLAIN END	THREADED[2]	ROLL GROOVED	PLAIN END[3]	SDR 26	SDR 21	SDR 13.5
1/4	NA	1130	NA	NA	NA	NA	NA	NA
1/2	600	850	420	NA	850	NA	NA	315
3/4	480	690	340	NA	690	NA	200	-
1	450	630	320	NA	630	NA	200	-
1 1/4	370	520	260	NA	520	160	200	-
1 1/2	330	470	240	NA	470	160	200	-
2	280	400	200	400	400	160	200	-
2 1/2	300	420	210	420	420	160	200	-
3	260	370	190	370	370	160	200	-
4	220	320	160	320	320	160	200	-
5	190	290	NR	290	290	160	200	-
6	180	280	NR	280	280	160	200	-
8	160	250	NR	250	250	160	200	-
10	140	230	NR	230	230	160	200	-
12	130	230	NR	230	230	160	200	-
14	130	220	NR	220	NA	160	200	-
16	130	220	NR	220	NA	160	200	-

(NR-Not Recommended)
(NA-Not Available)

1. Threading Schedule 40 and SDR/PR pipe is not recommended.
2. Threading Schedule 80 pipe above 4" is not recommended.
3. CPVC threaded connections should be avoided when possible at elevated temperatures and pressures. (Consult Hydroseal)
4. Standard dimensional ratio pipe will carry the same pressure rating for all diameters according to the SDR number.

The operating pressures listed above are based on the hydrostatic design of the product using water as a test medium at 73º F. Compounding nomenclature for Hydroseal Canada PVC is PVC 1120 with a cell class of 12454-B. For Hydroseal Canada CPVC pipe it is CPVC 4120 with a cell class of 23447-A.

For schedule-rated products and SDR/PR pipe, the following equation was used to determine operating pressures for outside diameter controlled pipe:

$$P = \frac{2ST}{D-T}$$

Where:
P = pressure (PSI)
D = average outside diameter
T = minimum wall thickness
S = hydrostatic design stress (HDS) for Hydroseal Canada PVC Type 1, Grade 1
HDS = 2,000 PSI
Hydroseal Canada CPVC also = 2,000 PSI

The following temperature corrections must be used to derate all PVC and CPVC pipe, valves and fittings when operating temperatures are expected to exceed 73º F.

The working pressure of PVC and CPVC pipe is directly affected by temperature changes. When the operating temperature of the pipe increases, the pipe loses its stiffness and tensile strength decreases. A drop in pressure capacity results. The drop can be calculated using this chart. Multiply the pipe's maximum working pressure by the temperature correction factor for a known temperature.

Example: For 2" Schedule 80 PVC pipe, the maximum working pressure is 400 PSI. If the operating temperature is known to be 110º F, the correction factor can be found on the chart to be 0.50. The adjusted pressure would then be 400 x 0.50 = 200 PSI.

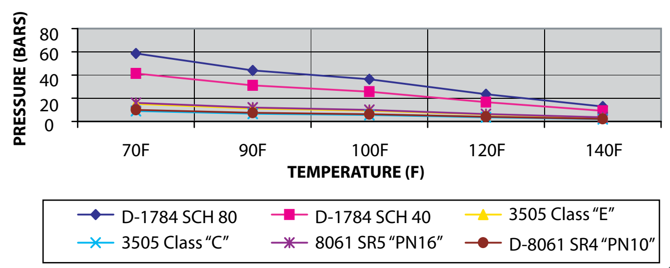
TEMPERATURE CORRECTION FACTORS

OPERATING TEMPERATURE (°F)	70	80	90	100	110	115	120	125	130	140	150	160	170	180	200
PVC 1120	1.00	0.88	0.75	0.62	0.50	0.45	0.40	0.35	0.30	0.22	NOT RECOMMENDED				
CPVC 4120	1.00	1.00	0.91	0.82	0.77	0.74	0.65	0.66	0.62	0.50	0.47	0.40	0.32	0.25	0.20

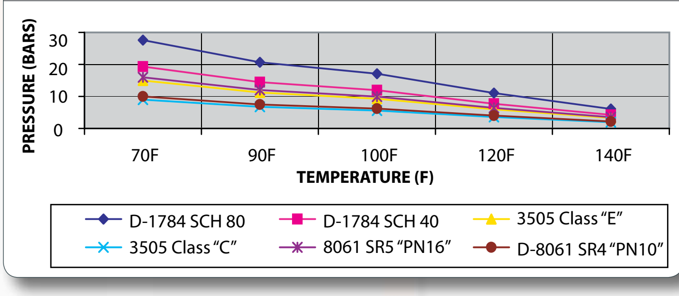
WARNING: Hydroseal Canada does not recommend its products for use in air or compressed gas systems.

NOTE: This data is based on information supplied by raw material manufacturers. It should be used as a general recommendation only and not as a guarantee of performance or longevity.

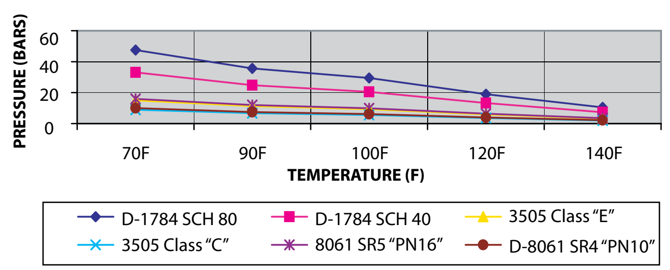
PVC PIPE COMPARISON - 1 /2”



PVC PIPE COMPARISON - 2”



PVC PIPE COMPARISON - 3 / 4”



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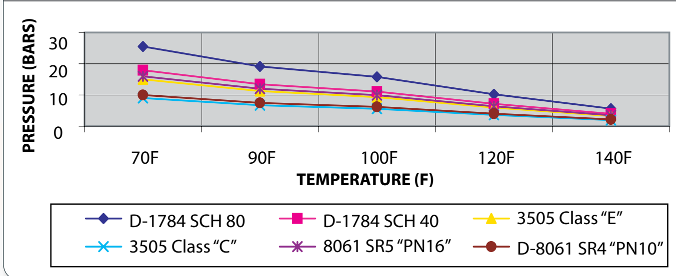

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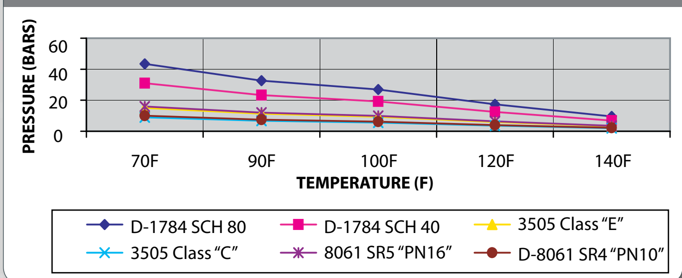
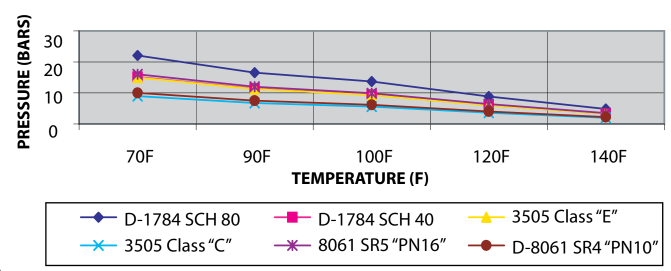
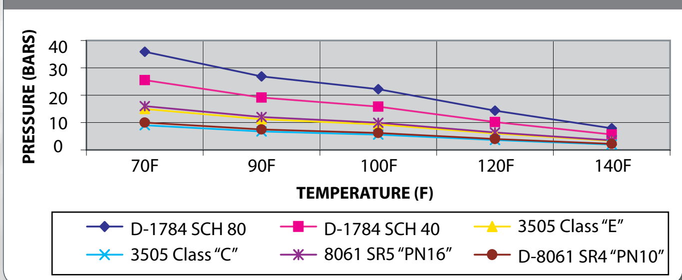


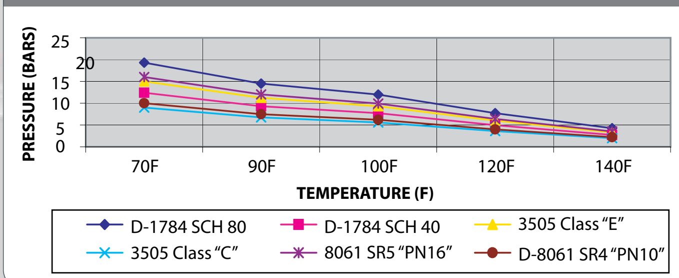
PVC PIPE COMPARISON - 4”



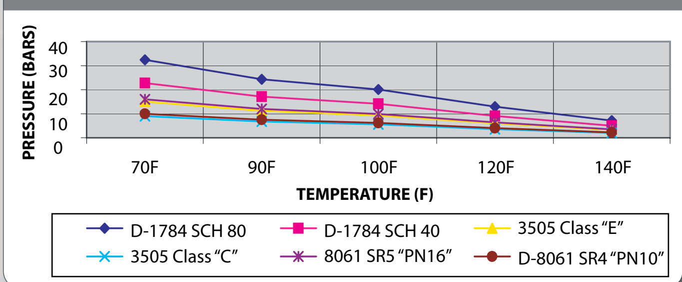
PVC PIPE COMPARISON - 1 1/4”



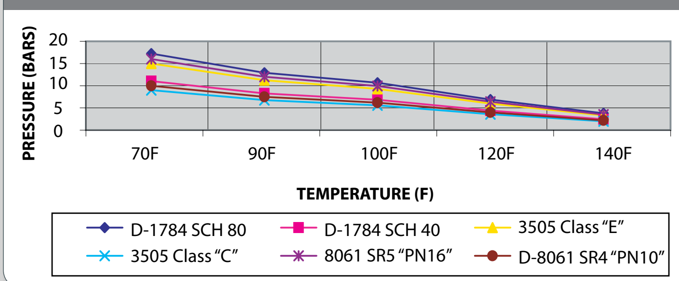
PVC PIPE COMPARISON - 6”



PVC PIPE COMPARISON - 11 /2”



PVC PIPE COMPARISON - 8”



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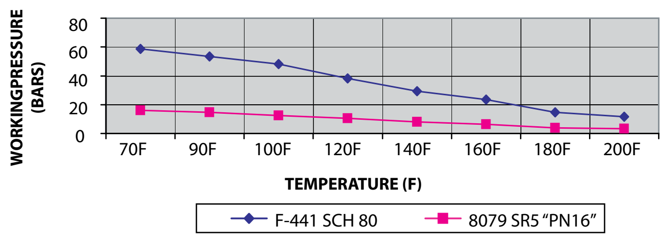

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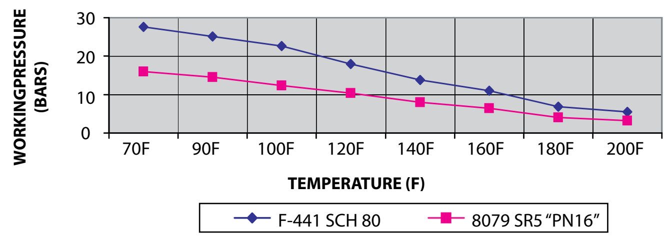

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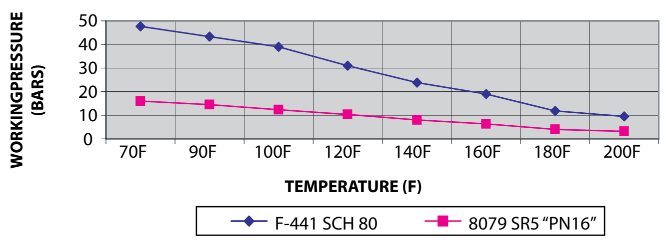

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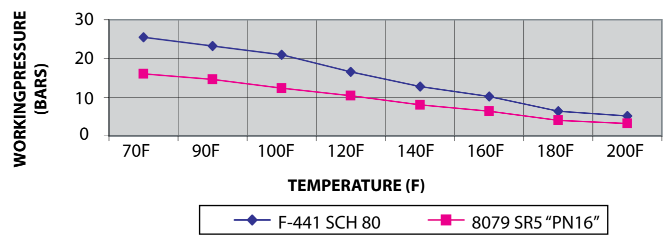
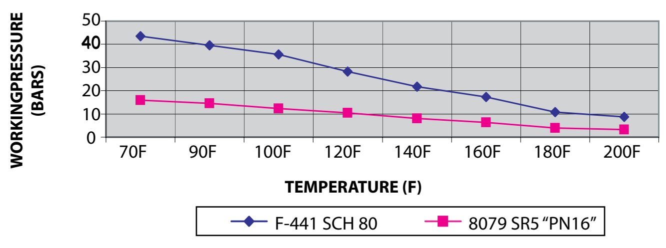


CPVC PIPE COMPARISON - 1 ”



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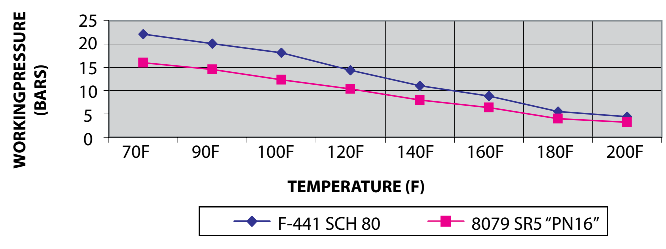
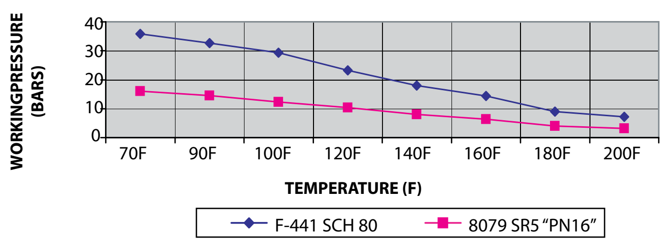
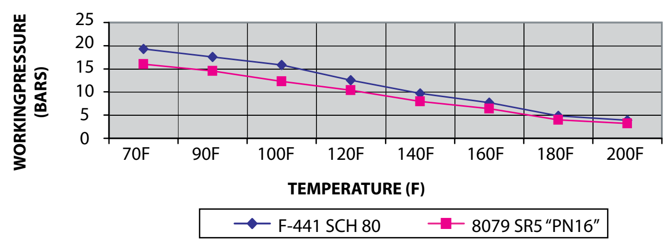


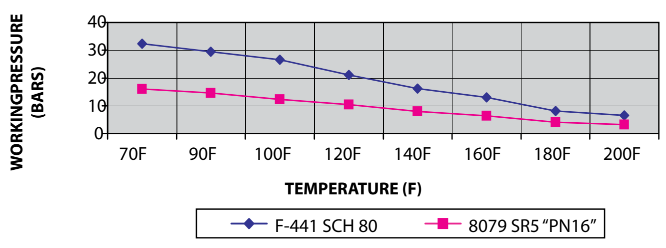
CPVC PIPE COMPARISON - 1 1 /4”



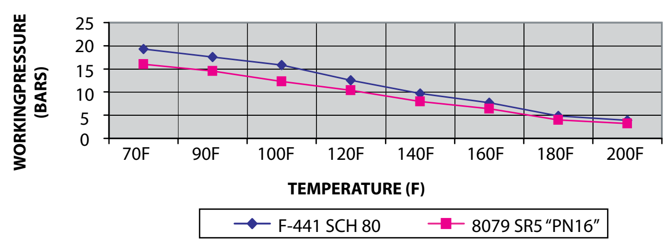
CPVC PIPE COMPARISON - 6”



CPVC PIPE COMPARISON - 1 1 /2”



CPVC PIPE COMPARISON - 8”



Friction Loss

The Friction loss in hydraulic flow can be evaluated through the use of various flow coefficients. One such coefficient is the Hazen - Williams C factor. This factor for PVC and CPVC plastic Piping systems has been set at C = 150. The following formula express the friction loss in feet of water and the water velocities in feet per second.

Friction loss is based on the Hazen Williams formula

$$f = 0.2083 \times \left(\frac{100}{c}\right)^{1.852} \times \frac{Q^{1.852}}{di^{4.8655}}$$

where

f = friction head loss in feet of water per 100 feet of pipe

C = constant for inside pipe roughness (C = 150 for extruded smooth wall thermoplastic pipe)

Q = flow in U.S. gallons per minute

di = inside diameter of pipe in inches

The value of C = 150 for thermoplastic pipe is based on engineering measurements made with new and used thermoplastic pipe in several laboratories. Thus, the value of C = 150 has a conservative bias. Using C = 150, the equation reduces to

$$f = 0.0983 \frac{Q^{1.852}}{di^{4.8655}}$$

Water velocities in feet per second V may be calculated as follows:

$$V = 0.408709 \frac{Q}{di^2}$$

TYPICAL VALUES OF THE HAZEN-WILLAMS COEFFICIENT

PIPE MATERIAL	C
Highly Smooth Pipes (all Metals)	130-140
Smooth Wood	120
Smooth Masonry	120
Vitrified Clay	110
Cast Iron (old)	100
Iron (worn/pitted)	60-80
Polyvinyl Chloride (PVC)	150
Brick	100

The tables on pages 7.08 - 7.11 will give quick, accurate values for friction heads in feet and friction losses in PSI. Also listed are carrying capacities in GPM at given velocities in feet per second for various pipe size diameters.

Friction Loss Through Fittings

A piping installation consists of pipe, fittings and valves. Normally loss through a fitting is described as being equivalent to loss through a certain number of linear feet of straight pipe. When calculating loss through a piping system, add together the number of feet represented by the fittings in the system. Data giving approximate friction losses in equivalent feet for a selection of PVC and CPVC pipe fittings in different pipe sizes are given here.

One additional flow coefficient worth mentioning is the Manning equation, based on the condition of steady flow and open channel flow. The Manning n factor, like the Hazen-Williams C factor, is an empirical number that defines the interior wall smoothness of a pipe. Laboratory studies have determined an "n" value that ranges from 0.008 to 0.012 for PVC pipe. The chart below illustrates the range of "n" values for other non-plastic piping materials.

RANGE OF "n" VALUES FOR VARIOUS PIPE MATERIALS

PIPE MATERIAL	"N" RANGE
Cast Iron	0.011-0.015
Wrought Iron (black)	0.012-0.015
Wrought Iron (galvanized)	0.013-0.017
Smooth Brass	0.009-0.013
Glass	0.009-0.013
Riveted and Spiral Steel	0.013-0.017
Clay Drainage Tile	0.011-0.017
Concrete	0.012-0.016
Concrete Lined	0.012-0.018
Concrete-Rubble Surface	0.017-0.030
PVC	0.008-0.012
Wood	0.010-0.013

Note:
For Relative Roughness (∈/D) of PVC Pipe, ∈= 0.000005 ft.

APPROXIMATE FRICTION LOSS IN PVC AND CPVC FITTINGS IN EQUIVALENT FEET OF STRAIGHT PIPE

NOMINAL PIPE SIZE (IN)		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
TEE	FLOW THRU RUN	1.00	1.40	1.70	2.30	2.70	4.30	5.10	6.30	8.30	12.5	16.5
	FLOW THRU BRANCH	4.00	5.00	6.00	7.00	8.00	12.0	15.0	16.0	22.0	32.0	38.0
90° ELBOW, STANDARD		1.50	2.00	2.25	4.00	4.00	6.00	8.00	8.00	12.0	18.0	22.0
45° ELBOW, STANDARD		0.75	1.00	1.40	1.75	2.00	2.50	3.00	4.00	5.00	8.00	10.0
INSERT COUPLING		0.50	0.75	1.00	1.25	1.50	2.00	3.00	3.00	4.00	6.25	-
MALE-FEMALE ADAPTORS		1.00	1.50	2.00	2.75	3.50	4.50	-	6.50	9.00	14.0	-

TABLE I - CARRYING CAPACITY AND FRICTION LOSS FOR SCHEDULE 80 THERMOPLASTIC PIPE

Independent variables: Gallons per minute and nominal pipe size O. D. Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth

1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
1	1.13	2.08	0.90
2	2.26	4.16	1.80
5	5.64	23.44	10.15
7	7.90	43.06	18.64
10	11.28	82.02	35.51

3/4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
1	0.63	0.51	0.22
2	1.26	1.02	0.44
5	3.16	5.73	2.48
7	4.43	10.52	4.56
10	6.32	20.04	8.68
15	9.48	42.46	18.39
20	12.65	72.34	31.32

1 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.77	0.55	0.24
5	1.93	1.72	0.75
7	2.72	3.17	1.37
10	3.86	6.02	2.61
15	5.79	12.77	5.53
20	7.72	21.75	9.42
25	9.65	32.88	14.22
30	11.58	46.08	19.95

1 1/4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.44	0.14	0.06
5	1.11	0.44	0.19
7	1.55	0.81	0.35
10	2.21	1.55	0.67
15	3.31	3.28	1.42
20	4.42	5.59	2.42
25	5.52	8.45	3.66
30	6.63	11.85	5.13
35	7.73	15.76	6.82
40	8.84	20.18	8.74
45	9.94	25.10	10.87
50	11.05	30.51	13.21

1 1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.33	0.07	0.03
5	0.81	0.22	0.09
7	1.13	0.38	0.17
10	1.62	0.72	0.31
15	2.42	1.53	0.66
20	3.23	2.61	1.13
25	4.04	3.95	1.71
30	4.85	5.53	2.39
35	5.66	7.36	3.19
40	6.47	9.43	4.08
45	7.27	11.73	5.08
50	8.08	14.25	6.17
60	9.70	19.98	8.65

2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
5	0.49	0.066	0.029
7	0.69	0.11	0.048
10	0.98	0.21	0.091
15	1.46	0.45	0.19
20	1.95	0.76	0.33
25	2.44	1.15	0.50
30	2.93	1.62	0.70
35	3.41	2.15	0.93
40	3.90	2.75	1.19
45	4.39	3.43	1.49
50	4.88	4.16	1.80
60	5.85	5.84	2.53
70	6.83	7.76	3.36
75	7.32	8.82	3.82
80	7.80	9.94	4.30
90	8.78	12.37	5.36
100	9.75	15.03	6.51

2 1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
5	0.30	0.038	0.016
7	0.49	0.051	0.023
10	0.68	0.09	0.039
15	1.03	0.19	0.082
20	1.37	0.32	0.14
25	1.71	0.49	0.21
30	2.05	0.68	0.29
35	2.39	0.91	0.39
40	2.73	1.16	0.50
45	3.08	1.44	0.62
50	3.42	1.75	0.76
60	4.10	2.46	1.07
70	4.79	3.27	1.42
75	5.13	3.71	1.61
80	5.47	4.19	1.81
90	6.15	5.21	2.26
100	6.84	6.33	2.74
125	8.55	9.58	4.15
150	10.26	13.41	5.81

3 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
5	0.22	0.015	0.007
7	0.31	0.021	0.009
10	0.44	0.03	0.013
15	0.66	0.07	0.030
20	0.88	0.11	0.048
25	1.10	0.17	0.074
30	1.33	0.23	0.10
35	1.55	0.31	0.13
40	1.77	0.40	0.17
45	1.99	0.50	0.22
50	2.21	0.60	0.26
60	2.65	0.85	0.37
70	3.09	1.13	0.49
75	3.31	1.28	0.55
80	3.53	1.44	0.62
90	3.98	1.80	0.78
100	4.42	2.18	0.94
125	5.52	3.31	1.43
150	6.63	4.63	2.00
175	7.73	6.16	2.67
200	8.83	7.88	3.41
250	11.04	11.93	5.17

4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
20	0.51	0.03	0.013
25	0.64	0.04	0.017
30	0.77	0.06	0.026
35	0.89	0.08	0.035
40	1.02	0.11	0.048
45	1.15	0.13	0.056
50	1.28	0.16	0.069
60	1.53	0.22	0.095
70	1.79	0.30	0.13
75	1.92	0.34	0.15
80	2.05	0.38	0.16
90	2.30	0.47	0.20
100	2.56	0.58	0.25
125	3.20	0.88	0.38
150	3.84	1.22	0.53
175	4.48	1.63	0.71
200	5.11	2.08	0.90
250	6.40	3.15	1.36
300	7.67	4.41	1.91
350	8.95	5.87	2.55
400	10.23	7.52	3.26

5 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
30	0.49	0.02	0.009
35	0.57	0.03	0.013
40	0.65	0.03	0.013
45	0.73	0.04	0.017
50	0.81	0.05	0.022
60	0.97	0.07	0.030
70	1.14	0.10	0.043
75	1.22	0.11	0.048
80	1.30	0.13	0.056
90	1.46	0.16	0.069
100	1.62	0.19	0.082
125	2.03	0.29	0.125
150	2.44	0.40	0.17
175	2.84	0.54	0.235
200	3.25	0.69	0.30
250	4.06	1.05	0.45
300	4.87	1.46	0.63
350	5.69	1.95	0.85
400	6.50	2.49	1.08
450	7.31	3.09	1.34
500	8.12	3.76	1.63

6 IN

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
50	0.56	0.02	0.009
60	0.67	0.03	0.013
70	0.79	0.04	0.017
75	0.84	0.05	0.022
80	0.9	0.05	0.022
90	1.01	0.06	0.026
100	1.12	0.08	0.035
125	1.41	0.12	0.052
150	1.69	0.16	0.069
175	1.97	0.22	0.096
200	2.25	0.28	0.12
250	2.81	0.43	0.19
300	3.37	0.60	0.26
350	3.94	0.79	0.34
400	4.49	1.01	0.44
450	5.06	1.26	0.55
500	5.62	1.53	0.66
750	8.43	3.25	1.41
1000	11.24	5.54	2.40

8 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
100	0.65	0.030	0.012
125	0.81	0.035	0.015
150	0.97	0.040	0.017
175	1.14	0.055	0.024
200	1.30	0.07	0.030
250	1.63	0.11	0.048
300	1.94	0.16	0.069
350	2.27	0.21	0.091
400	2.59	0.27	0.12
450	2.92	0.33	0.14
500	3.24	0.40	0.17
750	4.86	0.85	0.37
1000	6.48	1.45	0.63
1250	8.11	2.20	0.95
1500	9.72	3.07	1.33

10 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
200	0.82	0.027	0.012
250	1.03	0.035	0.015
300	1.23	0.05	0.022
350	1.44	0.065	0.028
400	1.64	0.09	0.039
450	1.85	0.11	0.048
500	2.05	0.13	0.056
750	3.08	0.28	0.12
1000	4.11	0.48	0.21
1250	5.14	0.73	0.32
1500	6.16	1.01	0.44
2000	8.21	1.72	0.74
2500	10.27	2.61	1.13

12 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
350	1.01	0.027	0.012
400	1.16	0.04	0.017
450	1.30	0.05	0.022
500	1.45	0.06	0.026
750	2.17	0.12	0.052
1000	2.89	0.20	0.087
1250	3.62	0.31	0.13
1500	4.34	0.43	0.19
2000	5.78	0.73	0.32
2500	7.23	1.11	0.49
3000	8.68	1.55	0.67
3500	10.12	2.07	0.90
4000	11.07	2.66	1.15

14 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
500	1.18	0.03	0.01
750	1.77	0.07	0.03
1000	2.37	0.12	0.05
1250	2.96	0.19	0.08
1500	3.56	0.27	0.12
2000	4.74	0.46	0.20
2500	5.93	0.70	0.30
3000	7.12	0.98	0.42
3500	8.30	1.30	0.56
4000	9.49	1.67	0.72
4500	10.68	2.08	0.90
5000	11.86	2.53	1.09
5500	13.05	3.02	1.31
6000	14.24	3.55	1.54
6500	15.42	4.11	1.78
7000	16.61	4.72	2.04
7500	17.79	5.36	2.32

16 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
500	0.91	0.02	0.01
750	1.36	0.04	0.02
1000	1.82	0.07	0.03
1250	2.27	0.10	0.04
1500	2.72	0.14	0.06
2000	3.63	0.24	0.10
2500	4.54	0.37	0.16
3000	5.45	0.51	0.22
3500	6.36	0.68	0.29
4000	7.26	0.87	0.38
4500	8.17	1.09	0.47
5000	9.08	1.32	0.57
5500	9.99	1.58	0.68
6000	10.90	1.85	0.80
6500	11.80	2.15	0.93
7000	12.71	2.46	1.06
7500	13.62	2.80	1.21
8000	14.53	3.15	1.37
8500	15.44	3.53	1.53
9000	16.35	3.92	1.69
9500	17.26	4.34	1.87
10000	18.16	4.77	2.06

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

TABLE II - CARRYING CAPACITY AND FRICTION LOSS FOR SCHEDULE 80 THERMOPLASTIC PIPE

Independent variables: Gallons per minute and nominal pipe size O. D. Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	1/2 IN.		
1	1.48	4.02	1.74
2	2.95	8.03	3.48
5	7.39	45.23	19.59
7	10.34	83.07	35.97
10			
15			
	4 IN.		
20	0.57	0.04	0.017
25	0.72	0.06	0.026
30	0.86	0.08	0.035
35	1.00	0.11	0.048
40	1.15	0.14	0.061
45	1.29	0.17	0.074
50	1.43	0.21	0.091
60	1.72	0.30	0.13
70	2.01	0.39	0.17
75	2.15	0.45	0.19
80	2.29	0.50	0.22
90	2.58	0.63	0.27
100	2.87	0.76	0.33
125	3.59	1.16	0.50
150	4.30	1.61	0.70
175	5.02	2.15	0.93
200	5.73	2.75	1.19
250	7.16	4.16	1.81
300	8.60	5.83	2.52
350	10.03	7.76	3.36
400	11.47	9.93	4.30
450			
500			
750			
1000			
1250			
1500			
2000			
2500			
3000			
3500			
4000			
4500			
5000			
5500			
6000			
6500			
7000			
7500			
8000			
8500			
9000			
9500			
10000			

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	3/4 IN.		
1	0.74	0.86	0.37
2	1.57	1.72	0.74
5	3.92	9.67	4.19
7	5.49	17.76	7.69
10	7.84	33.84	14.65
15	11.76	71.70	31.05
	5 IN.		
30	0.54	0.03	0.013
35	0.63	0.04	0.017
40	0.72	0.04	0.017
45	0.81	0.06	0.026
50	0.90	0.07	0.030
60	1.08	0.10	0.043
70	1.26	0.13	0.056
75	1.35	0.14	0.061
80	1.44	0.16	0.069
90	1.62	0.20	0.087
100	1.80	0.24	0.10
125	2.25	0.37	0.16
150	2.70	0.52	0.23
175	3.15	0.69	0.30
200	3.60	0.88	0.38
250	4.50	1.34	0.58
300	5.40	1.87	0.81
350	6.30	2.49	1.08
400	7.19	3.19	1.38
450	8.09	3.97	1.72
500	8.99	4.82	2.09

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	1 IN.		
2	0.94	0.88	0.38
5	2.34	2.75	1.19
7	3.28	5.04	2.19
10	4.68	9.61	4.16
15	7.01	20.36	8.82
20	9.35	34.68	15.02
25	11.69	52.43	22.70
30	14.03	73.48	31.82
	6 IN.		
50	0.63	0.03	0.013
60	0.75	0.04	0.017
70	0.88	0.05	0.022
75	0.94	0.06	0.026
80	1.00	0.07	0.030
90	1.13	0.08	0.035
100	1.25	0.10	0.043
125	1.57	0.16	0.068
150	1.88	0.22	0.095
175	2.20	0.29	0.12
200	2.51	0.37	0.16
250	3.14	0.56	0.24
300	3.76	0.78	0.34
350	4.39	1.04	0.45
400	5.02	1.33	0.58
450	5.64	1.65	0.71
500	6.27	2.00	0.87
750	9.40	4.25	1.84
1000	12.54	7.23	3.13

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	1 1/4 IN.		
2	0.52	0.21	0.09
5	1.30	0.66	0.29
7	1.82	1.21	0.53
10	2.60	2.30	1.00
15	3.90	4.87	2.11
20	5.20	8.30	3.59
25	6.50	12.55	5.43
30	7.80	17.59	7.62
35	9.10	23.40	10.13
40	10.40	29.97	12.98
45	11.70	37.27	16.14
50	13.00	45.30	19.61
	8 IN.		
125	0.90	0.045	0.019
150	1.07	0.050	0.022
175	1.25	0.075	0.033
200	1.43	0.09	0.039
250	1.79	0.14	0.610
300	2.14	0.20	0.087
350	2.50	0.27	0.12
400	2.86	0.34	0.15
450	3.21	0.42	0.18
500	3.57	0.51	0.22
750	5.36	1.08	0.47
1000	7.14	1.84	0.80
1250	8.93	2.78	1.20
1500	10.71	3.98	1.68

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	1 1/2 IN.		
2	0.38	0.10	0.041
5	0.94	0.30	0.126
7	1.32	0.55	0.24
10	1.88	1.04	0.45
15	2.81	2.20	0.95
20	3.75	3.75	1.62
25	4.69	5.67	2.46
30	5.63	7.95	3.44
35	6.57	10.58	4.58
40	7.50	13.55	5.87
45	8.44	16.85	7.30
50	9.38	20.48	8.87
60	11.26	28.70	12.43
	10 IN.		
200	0.90	0.036	0.015
250	1.14	0.045	0.02
300	1.36	0.070	0.03
350	1.59	0.085	0.037
400	1.81	0.11	0.048
450	2.04	0.14	0.061
500	2.27	0.17	0.074
750	3.40	0.36	0.16
1000	4.54	0.61	0.26
1250	5.67	0.92	0.40
1500	6.80	1.29	0.56
2000	9.07	2.19	0.95
2500	11.34	3.33	1.44

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	2 IN.		
5	0.56	0.10	0.040
7	0.78	0.15	0.065
10	1.12	0.29	0.13
15	1.68	0.62	0.27
20	2.23	1.06	0.46
25	2.79	1.60	0.69
30	3.35	2.25	0.97
35	3.91	2.99	1.29
40	4.47	3.83	1.66
45	5.03	4.76	2.07
50	5.58	5.79	2.51
60	6.70	8.12	3.52
70	7.82	10.80	4.68
75	8.38	12.27	5.31
80	8.93	13.83	5.99
90	10.05	17.20	7.45
100	11.17	20.90	9.05
	12 IN.		
350	1.12	0.037	0.016
400	1.28	0.05	0.022
450	1.44	0.06	0.026
500	1.60	0.07	0.030
750	2.40	0.15	0.065
1000	3.20	0.26	0.11
1250	4.01	0.40	0.17
1500	4.81	0.55	0.24
2000	6.41	0.94	0.41
2500	8.01	1.42	0.62
3000	9.61	1.99	0.86
3500	11.21	2.65	1.15
4000	12.82	3.41	1.48

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	2 1/2 IN.		
5	0.39	0.05	0.022
7	0.54	0.07	0.032
10	0.78	0.12	0.052
15	1.17	0.26	0.11
20	1.56	0.44	0.19
25	1.95	0.67	0.29
30	2.34	0.94	0.41
35	2.73	1.25	0.54
40	3.12	1.60	0.69
45	3.51	1.99	0.86
50	3.90	2.42	1.05
60	4.68	3.39	1.47
70	5.46	4.51	1.95
75	5.85	5.12	2.22
80	6.24	5.77	2.50
90	7.02	7.18	3.11
100	7.80	8.72	3.78
125	9.75	13.21	5.72
150	11.70	18.48	8.00
	14 IN.		
500	1.31	0.04	0.02
750	1.96	0.09	0.04
1000	2.62	0.16	0.07
1250	3.27	0.25	0.11
1500	3.92	0.34	0.15
2000	5.23	0.59	0.25
2500	6.54	0.88	0.38
3000	7.85	1.24	0.54
3500	9.16	1.66	0.72
4000	10.46	2.12	0.92
4500	11.77	2.64	1.14
5000	13.07	3.20	1.38
5500	14.39	3.83	1.66
6000	15.70	4.49	1.95
6500	17.00	5.21	2.26
7000	18.31	5.99	2.60

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
	3 IN		
5	0.25	0.02	0.009
7	0.35	0.03	0.012
10	0.50	0.04	0.017
15	0.75	0.09	0.039
20	1.00	0.15	0.065
25	1.25	0.22	0.095
30	1.49	0.31	0.13
35	1.74	0.42	0.18
40	1.99	0.54	0.23
45	2.24	0.67	0.29
50	2.49	0.81	0.35
60	2.99	1.14	0.49
70	3.49	1.51	0.65
75	3.74	1.72	0.74
80	3.99	1.94	0.84
90	4.48	2.41	1.04
100	4.98	2.93	1.27
125	6.23	4.43	1.92
150	7.47	6.20	2.68
175	8.72	8.26	3.58
200	9.97	10.57	4.58
250	12.46	16.00	6.93
	16 IN.		
500	0.99	0.02	0.01
750	1.49	0.05	0.02
1000	1.99	0.08	0.04
1250	2.49	0.13	0.05
1500	2.99	0.17	0.08
2000	3.99	0.30	0.13
2500	4.99	0.46	0.19
3000	5.98	0.64	0.28
3500	6.98	0.86	0.37
4000	7.98	1.09	0.48
4500	8.98	1.36	0.59
5000	9.97	1.66	0.72
5500	10.97	1.99	0.86
6000	11.97	2.32	1.00
6500	12.97	2.69	1.17
7000	13.96	3.09	1.33
7500	14.96	3.51	1.52
8000	15.96	3.96	1.71
8500	16.96	4.43	1.92
9000	17.95	4.93	2.13

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

TABLE III - CARRYING CAPACITY AND FRICTION LOSS FOR SCHEDULE 80 THERMOPLASTIC PIPE

Independent variables: Gallons per minute and nominal pipe size O. D. Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth

GALLONS PER MINUTE	1/2 IN.			3/4 IN.			1 IN.			1 1/4 IN.			1 1/2 "			2 IN.			2 1/2 IN.			3 IN.		
	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
1	0.84	1.00	0.43	0.50	0.28	0.12																		
2	1.67	2.00	0.86	0.99	0.56	0.24	0.59	0.29	0.13	0.36	0.085	0.037	0.27	0.02	0.0087	0.17	0.010	0.004						
5	4.17	11.25	4.87	2.47	3.14	1.36	1.48	0.91	0.39	0.90	0.27	0.117	0.68	0.14	0.059	0.44	0.045	0.020	0.30	0.025	0.011	0.20	0.010	0.0045
7	5.84	20.66	8.95	3.46	5.76	2.49	2.08	1.66	0.72	1.25	0.49	0.21	0.96	0.25	0.104	0.61	0.08	0.035	0.42	0.035	0.015	0.28	0.014	0.0063
10	8.34	39.34	17.03	4.94	10.96	4.74	2.96	3.16	1.37	1.79	0.92	0.40	1.36	0.47	0.20	0.87	0.16	0.069	0.59	0.06	0.026	0.40	0.02	0.009
15				7.40	23.23	10.06	4.44	6.69	2.90	2.68	1.96	0.85	2.04	1.00	0.43	1.30	0.33	0.14	0.88	0.13	0.056	0.59	0.05	0.022
20				9.87	39.57	17.13	5.92	11.40	4.94	3.58	3.34	1.45	2.72	1.71	0.74	1.73	0.57	0.25	1.18	0.22	0.095	0.79	0.09	0.039
25							7.40	17.23	7.46	4.47	5.04	2.18	3.40	2.59	1.12	2.16	0.86	0.37	1.47	0.34	0.15	0.99	0.13	0.056
30							8.88	24.15	10.46	5.36	7.07	3.06	4.08	3.63	1.57	2.60	1.21	0.52	1.77	0.47	0.20	1.19	0.18	0.078
35							10.36	32.13	13.91	6.26	9.41	4.07	4.76	4.83	2.09	3.03	1.61	0.70	2.06	0.63	0.27	1.39	0.24	0.10
40										7.15	12.05	5.22	5.44	6.18	2.68	3.46	2.06	0.89	2.35	0.81	0.35	1.59	0.31	0.13
45										8.04	14.98	6.49	6.12	7.69	3.33	3.90	2.56	1.11	2.65	1.00	0.43	1.78	0.38	0.16
50										8.94	18.21	7.88	6.80	9.34	4.04	4.33	3.11	1.35	2.94	1.22	0.53	1.98	0.47	0.20
60													8.16	13.10	5.67	5.19	4.36	1.89	3.53	1.71	0.74	2.38	0.65	0.28
70													9.52	17.42	7.54	6.06	5.80	2.51	4.12	2.27	0.98	2.78	0.87	0.38
75													10.19	19.80	8.57	6.49	6.60	2.86	4.41	2.58	1.12	2.97	0.99	0.43
80													10.87	22.31	9.66	6.92	7.43	3.22	4.71	2.91	1.26	3.17	1.11	0.48
90													12.23	27.75	12.02	7.79	9.25	4.01	5.30	3.62	1.57	3.57	1.38	0.60
100													13.59	33.73	14.61	8.66	11.24	4.87	5.89	4.39	1.90	3.97	1.68	0.73
125																			7.36	6.65	2.88	4.96	2.54	1.10
150																			8.83	9.31	4.03	5.95	3.56	1.54
175																			10.31	12.40	5.37	6.94	4.74	2.05
200																						7.93	6.07	2.63
250																						9.92	9.18	3.98

GALLONS PER MINUTE	4 IN.			5 IN.			6 IN.			8 IN.			10 IN.			12 IN.		
	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
20	0.48	0.02	0.009															
25	0.60	0.04	0.017															
30	0.72	0.05	0.022	0.47	0.02	0.009												
35	0.84	0.07	0.030	0.55	0.03	0.013												
40	0.96	0.09	0.039	0.63	0.03	0.013												
45	1.08	0.11	0.048	0.71	0.04	0.017												
50	1.20	0.14	0.061	0.78	0.05	0.022	0.55	0.02	0.009									
60	1.44	0.19	0.082	0.94	0.07	0.030	0.66	0.03	0.013									
70	1.67	0.25	0.11	1.10	0.09	0.039	0.77	0.04	0.017									
75	1.79	0.29	0.13	1.18	0.10	0.043	0.83	0.04	0.017									
80	1.91	0.32	0.14	1.25	0.12	0.052	0.88	0.05	0.022									
90	2.15	0.40	0.17	1.41	0.14	0.061	0.99	0.06	0.026									
100	2.39	0.49	0.21	1.57	0.18	0.078	1.10	0.07	0.030	0.66	0.030	0.012						
125	2.99	0.74	0.33	1.96	0.27	0.12	1.39	0.11	0.047	0.83	0.037	0.015						
150	3.59	1.04	0.45	2.35	0.37	0.16	1.66	0.16	0.069	0.98	0.04	0.017						
175	4.19	1.39	0.60	2.74	0.50	0.22	1.94	0.21	0.091	1.14	0.06	0.026						
200	4.79	1.77	0.77	3.13	0.63	0.27	2.21	0.27	0.12	1.30	0.07	0.030	0.83	0.027	0.012			
250	5.98	2.68	1.16	3.92	0.96	0.42	2.76	0.41	0.18	1.63	0.11	0.048	1.05	0.040	0.017			
300	7.18	3.75	1.62	4.70	1.34	0.58	3.31	0.57	0.25	1.95	0.16	0.069	1.26	0.050	0.022			
350	8.38	5.00	2.17	5.49	1.79	0.77	3.87	0.76	0.33	2.28	0.21	0.091	1.47	0.075	0.033	1.04	0.04	0.017
400	9.57	6.39	2.77	6.27	2.28	0.99	4.42	0.97	0.42	2.61	0.27	0.12	1.68	0.09	0.039	1.19	0.04	0.017
450	10.77	7.95	3.44	7.05	2.84	1.23	4.97	1.21	0.52	2.93	0.33	0.14	1.89	0.11	0.048	1.34	0.05	0.022
500	11.96	9.66	4.18	7.84	3.45	1.49	5.52	1.47	0.64	3.26	0.41	0.18	2.10	0.14	0.061	1.49	0.06	0.026
750				11.75	7.31	3.17	8.28	3.12	1.35	4.89	0.86	0.37	3.14	0.29	0.13	2.23	0.13	0.056
1000							11.05	5.31	2.30	6.51	1.47	0.64	4.19	0.50	0.22	2.98	0.22	0.095
1250										8.15	2.23	0.96	5.27	0.76	0.33	3.73	0.34	0.15
1500										9.77	3.11	1.35	6.29	1.06	0.46	4.47	0.46	0.20
2000										13.03	5.30	2.29	8.38	1.81	0.78	5.96	0.79	0.34
2500													10.48	2.74	1.19	7.45	1.20	0.52
3000													12.58	3.84	1.66	8.94	1.67	0.72
3500																10.43	2.22	0.96
4000																11.92	2.86	1.24
4500																13.41	3.54	1.53

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

TABLE IV - CARRYING CAPACITY AND FRICTION LOSS FOR SCHEDULE 80 THERMOPLASTIC PIPE

Independent variables: Gallons per minute and nominal pipe size O. D. Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth

1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
1	0.84	1.00	0.44
2	1.67	2.00	0.87
5	4.17	11.25	4.87
7	5.84	20.66	8.95
10	8.34	39.34	17.03

4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
20	0.50	0.03	0.013
25	0.62	0.04	0.017
30	0.75	0.06	0.026
35	0.87	0.08	0.035
40	1.00	0.10	0.043
45	1.12	0.12	0.052
50	1.25	0.15	0.065
60	1.50	0.21	0.091
70	1.75	0.28	0.12
75	1.87	0.32	0.14
80	2.00	0.36	0.16
90	2.25	0.45	0.19
100	2.50	0.54	0.23
125	3.13	0.82	0.36
150	3.75	1.15	0.50
175	4.37	1.54	0.67
200	4.99	1.96	0.85
250	6.24	2.97	1.29
300	7.49	4.16	1.80
350	8.74	5.54	2.40
400	9.99	7.09	3.07
450	11.24	8.82	3.82
500	12.48	10.72	4.64

3/4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
1	0.50	0.28	0.12
2	0.99	0.56	0.24
5	2.47	3.14	1.36
7	3.46	5.76	2.49
10	4.94	10.96	4.75
15	7.40	23.23	10.06
20	9.87	39.57	17.13

5 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
30	0.49	0.02	0.009
35	0.57	0.03	0.013
40	0.65	0.04	0.017
45	0.74	0.04	0.017
50	0.82	0.05	0.022
60	0.98	0.08	0.035
70	1.14	0.10	0.043
75	1.23	0.11	0.048
80	1.31	0.13	0.056
90	1.47	0.16	0.069
100	1.63	0.19	0.082
125	2.04	0.30	0.13
150	2.45	0.41	0.18
175	2.86	0.55	0.24
200	3.27	0.70	0.30
250	4.09	1.06	0.46
300	4.90	1.48	0.64
350	5.72	1.98	0.86
400	6.54	2.53	1.10
450	7.35	3.14	1.36
500	8.17	3.82	1.65
750	12.26	8.09	3.50

1 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.60	0.30	0.13
5	1.50	0.93	0.41
7	2.09	1.70	0.74
10	2.99	3.24	1.40
15	4.49	6.86	2.97
20	5.98	11.68	5.06
25	7.48	17.66	7.65
30	8.97	24.76	10.72
35	10.47	32.94	14.26

6 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
50	0.58	0.020	0.009
60	0.69	0.030	0.013
70	0.81	0.040	0.017
75	0.86	0.050	0.022
80	0.92	0.050	0.022
90	1.04	0.070	0.030
100	1.15	0.080	0.035
125	1.44	0.125	0.054
150	1.73	0.18	0.078
175	2.02	0.24	0.103
200	2.31	0.30	0.13
250	2.89	0.46	0.20
300	3.46	0.63	0.27
350	4.04	0.85	0.37
400	4.61	1.08	0.47
450	5.19	1.34	0.58
500	5.76	1.63	0.71
750	8.64	3.46	1.50
1000	11.53	5.89	2.55

1 1/4 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.37	0.095	0.04
5	0.93	0.30	0.13
7	1.31	0.54	0.23
10	1.86	1.02	0.44
15	2.79	2.16	0.94
20	3.72	3.68	1.59
25	4.65	5.56	2.41
30	5.58	7.80	3.38
35	6.51	10.37	4.49
40	7.44	13.28	5.75
45	8.37	16.52	7.15
50	9.30	20.08	8.69
60	11.17	28.14	12.18

8 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
100	0.67	0.030	0.012
125	0.85	0.037	0.015
150	1.02	0.050	0.022
175	1.19	0.065	0.028
200	1.36	0.080	0.035
250	1.70	0.125	0.054
300	2.04	0.18	0.078
350	2.38	0.24	0.103
400	2.72	0.30	0.13
450	3.06	0.37	0.16
500	3.40	0.45	0.19
750	5.10	0.96	0.42
1000	6.80	1.63	0.64
1250	8.50	2.47	1.07
1500	10.19	3.45	1.49
2000	13.59	5.87	2.54

1 1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.29	0.05	0.022
5	0.71	0.15	0.065
7	0.99	0.28	0.12
10	1.41	0.52	0.23
15	2.12	1.11	0.48
20	2.83	1.89	0.82
25	3.54	2.85	1.23
30	4.24	4.00	1.73
35	4.95	5.32	2.30
40	5.66	6.81	2.95
45	6.36	8.47	3.67
50	7.07	10.29	4.46
60	8.49	14.42	6.24
70	9.90	19.19	8.31
75	10.61	21.80	9.44

10 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
200	0.86	0.027	0.012
250	1.10	0.045	0.020
300	1.31	0.06	0.026
350	1.54	0.08	0.035
400	1.75	0.10	0.043
450	1.97	0.13	0.056
500	2.19	0.15	0.065
750	3.29	0.33	0.14
1000	4.38	0.56	0.24
1250	5.48	0.85	0.37
1500	6.57	1.18	0.51
2000	8.76	2.02	0.87
2500	10.96	3.06	1.33
3000	13.15	4.27	1.85

2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
2	0.18	0.023	0.010
5	0.45	0.060	0.025
7	0.63	0.081	0.035
10	0.90	0.17	0.074
15	1.35	0.37	0.16
20	1.80	0.63	0.27
25	2.25	0.95	0.41
30	2.71	1.34	0.58
35	3.16	1.78	0.77
40	3.61	2.27	0.98
45	4.06	2.83	1.23
50	4.51	3.44	1.49
60	5.41	4.82	2.09
70	6.31	6.41	2.78
75	6.76	7.29	3.16
80	7.21	8.21	3.55
90	8.12	10.21	4.42
100	9.02	12.41	5.37

12 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
350	1.08	0.036	0.016
400	1.24	0.04	0.017
450	1.40	0.06	0.026
500	1.55	0.07	0.030
750	2.33	0.14	0.061
1000	3.11	0.24	0.10
1250	3.89	0.37	0.16
1500	4.66	0.51	0.22
2000	6.22	0.87	0.38
2500	7.77	1.33	0.57
3000	9.33	1.85	0.80
3500	10.88	2.47	1.07
4000	12.44	3.17	1.37
4500	13.99	3.93	1.70

2 1/2 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
5	0.31	0.031	0.014
7	0.43	0.044	0.02
10	0.61	0.07	0.03
15	0.92	0.14	0.061
20	1.23	0.25	0.11
25	1.53	0.37	0.16
30	1.84	0.52	0.23
35	2.15	0.70	0.30
40	2.45	0.89	0.39
45	2.76	1.11	0.48
50	3.07	1.35	0.58
60	3.68	1.89	0.82
70	4.29	2.51	1.09
75	4.60	2.85	1.23
80	4.91	3.22	1.39
90	5.52	4.00	1.73
100	6.14	4.86	2.10
125	7.67	7.36	3.19
150	9.20	10.30	4.46
175	10.74	13.72	5.94

3 IN.

GALLONS PER MINUTE	VELOCITY FEET PER SECOND	FRICTION HEAD FEET	FRICTION LOSS POUNDS PER SQUARE INCH
5	0.20	0.015	0.006
7	0.29	0.021	0.009
10	0.41	0.03	0.013
15	0.62	0.06	0.026
20	0.83	0.09	0.039
25	1.03	0.14	0.061
30	1.24	0.20	0.087
35	1.45	0.27	0.12
40	1.65	0.34	0.15
45	1.86	0.42	0.18
50	2.06	0.51	0.22
60	2.48	0.72	0.31
70	2.89	0.96	0.42
75	3.10	1.09	0.47
80	3.30	1.23	0.53
90	3.72	1.52	0.66
100	4.13	1.85	0.80
125	5.17	2.81	1.22
150	6.19	3.93	1.70
175	7.23	5.23	2.26
200	8.26	6.69	2.90
250	10.33	10.13	4.39

CAUTION: Flow velocity should not exceed 5 feet per second. PVC and CPVC pipe cannot be used for compressed air service.

When a pipe contains a column of moving liquid, considerable kinetic energy is stored in the liquid by virtue of its mass and velocity. If the velocity is suddenly destroyed by the quick closing of a valve this energy cannot be absorbed because liquid is nearly incompressible. Therefore, an instantaneous shock is created which may represent excessively high pressures. Maximum pressure caused by water-hammer may be calculated with the following formulae:

$$a = \frac{4660}{\sqrt{1 + \frac{k\,d_i}{E\,t}}}$$ (wave velocity for water in PVC pipe)

$$p = \frac{aV}{2.31g}$$ (pressure surge)

Where:
- **p** = pressure surge, psi
- **a** = wave velocity, ft./sec.
- **V** = maximum velocity change, ft./sec.
- **g** = acceleration of gravity, 32.2 ft./sec.2
- **k** = fluid bulk modulus, 300,000 PSI for water
- **di** = pipe inside diameter, inches
- **E** = modulus of elasticity of the pipe, 420,000 PSI for PVC, 360,000 PSI for CPVC
- **t** = wall thickness, inches

Water-hammer calculated by the above formula is only about 1/3 of steel and cast iron pipe.

Water-hammer is a commonly used term for pressure surge in a piping system. One of the major causes of surge is a rapid change in velocity. The maximum safe velocity in a PVC or CPVC piping system depends on the specific details of the system and the operating conditions. In general, 5 feet per second is considered to be safe. Higher velocities may be considered where the operating characteristics of valves and pumps are known so that sudden changes in flow velocity can be controlled. The total pressure in the system at any one time (operating pressure + surge) should not exceed 150% of the pressure rating for the minimum-rated component (e.g., 150# flanges, unions, valves, and threaded parts) in the system.

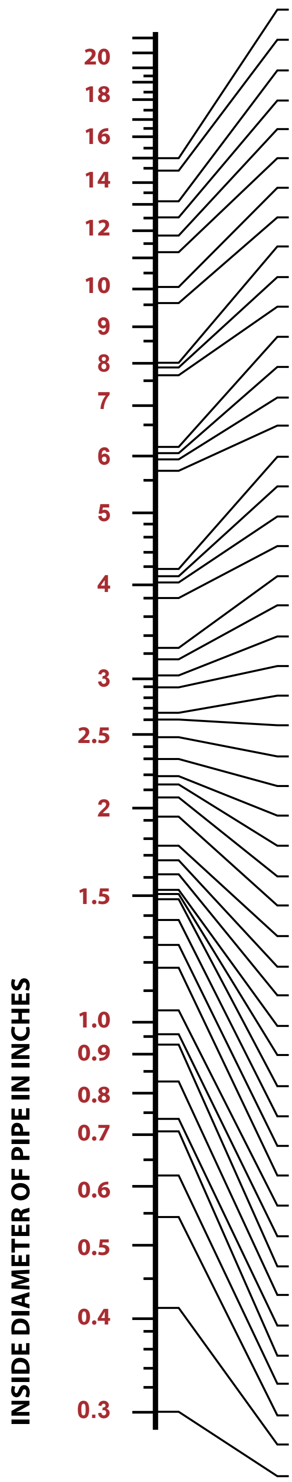
Causes
Here are some of the more common causes of pressure surge that should be reviewed when a plastic piping system is being considered.

- Speed of opening or closing of regulating type valves.
- Action of pumps starting or stopping.
- Movement of entrapped air through the system.
- Formation of vacuum and column separation.

Preventive Measures
Understanding the concept of water-hammer and designing the system to minimize it is the best possible preventive measure. A few tips to consider when attempting to reduce the causes of surge in a piping system are:

- Keep fluid velocities under 5 feet per second. (see pages 7.08 ~ 7.11)
- Check the cycling time of valves to prevent abrupt changes in flow. Both manual and actuated valves should be checked for specific closing times.
- Evaluate flow at pump start-up and during spin-down. Also determine how much air, if any, is introduced during pump start-up.
- Use surge control devices and standpipes wisely to give flow storage during surge and to minimize column separation. Check valves can be used near pumps to help keep lines full.
- Use properly sized vacuum breaker-air relief valves to control the amount of air that is admitted or exhausted throughout the system.

SPECIFIC INSIDE DIAMETERS OF PIPE



Specific	Inside Diameter
15.000	(16" SCH 40)
14.314	(16" SCH 80)
13.124	(14" SCH 40)
12.500	(14" SCH 80)
11.938	(12" SCH 40)
11.376	(12" SCH 80)
10.020	(10" SCH 40)
9.564	(10" SCH 80)
7.981	(8" SCH 40)
7.625	(8" PR 160)
6.115	(8" SCH 80)
6.065	(6" PR 160)
5.993	(6" SCH 40)
5.761	(6" PR 200)
4.154	(6" SCH 80)
4.072	(4" PR 160)
3.826	(4" PR 200)
3.230	(4" SCH 40)
3.166	(4" SCH 80)
3.230	(3" PR 160)
3.166	(3" PR 200)
3.068	(3" SCH 40)
2.900	(3" SCH 80)
2.655	(2 1/2" PR 160)
2.601	(2 1/2" PR 200)
2.469	(2 1/2" SCH 40)
2.323	(2 1/2" SCH 80)
2.193	(2" PR 160)
2.149	(2" PR 200)
2.067	(2" SCH 40)
1.939	(2" SCH 80)
1.754	(1 1/2" PR 160)
1.720	(1 1/2" PR 200)
1.610	(1 1/2" SCH 40)
1.532	(1 1/4" PR 160)
1.502	(1 1/4" PR 200)
1.500	(1 1/2" SCH 80)
1.380	(1 1/4" SCH 40)
1.278	(1 1/4" SCH 80)
1.189	(1" PR 200)
1.049	(1" SCH 40)
0.957	(1" SCH 80)
0.930	(3/4" PR 200)
0.824	(3/4" SCH 40)
0.742	(3/4" SCH 80)
0.716	(1/2" PR 315)
0.622	(1/2" SCH 40)
0.546	(1/2" SCH 80)
0.423	(3/8" SCH 80)
0.302	(1/4" SCH 80)

Thermal expansion and contraction is fairly common in most piping materials. The coefficient of linear expansion or expansivity for PVC and CPVC pipe is the ratio of the change in pipe length per degree change in temperature.

In the design of a piping system where runs are over 100 ft. in length, remember that PVC and CPVC expand roughly 4.5 to 5 times more than iron or steel. An allowance of about 1/3" of expansion or contraction should be calculated for every 100 feet of pipe run for each 10 degree change between ambient installation temperature and maximum operating temperature. The movement or growth in pipe length can be significant if the temperature variation between installation and operation is rather large. However, the resultant stresses generated by movement will be somewhat less for plastics than for steel. This is due to a higher modulus of elasticity for PVC and CPVC pipe in comparison to metallics; and, over time, some stress relaxation will occur.

The graph on page 7.14 illustrates the relationship between temperature change and growth in pipe length.

Adjustments for Above-Ground Thermal Expansion and Contraction

There are many different types of expansion joints available on the market. Each one is designed to compensate for excessive movement of pipe within the system. Every piping system is different. Many are above ground, but a large percentage also run underground. Pressure and temperature combinations can be very numerous and the possible combinations of corrosive and non-corrosive chemicals are limitless.

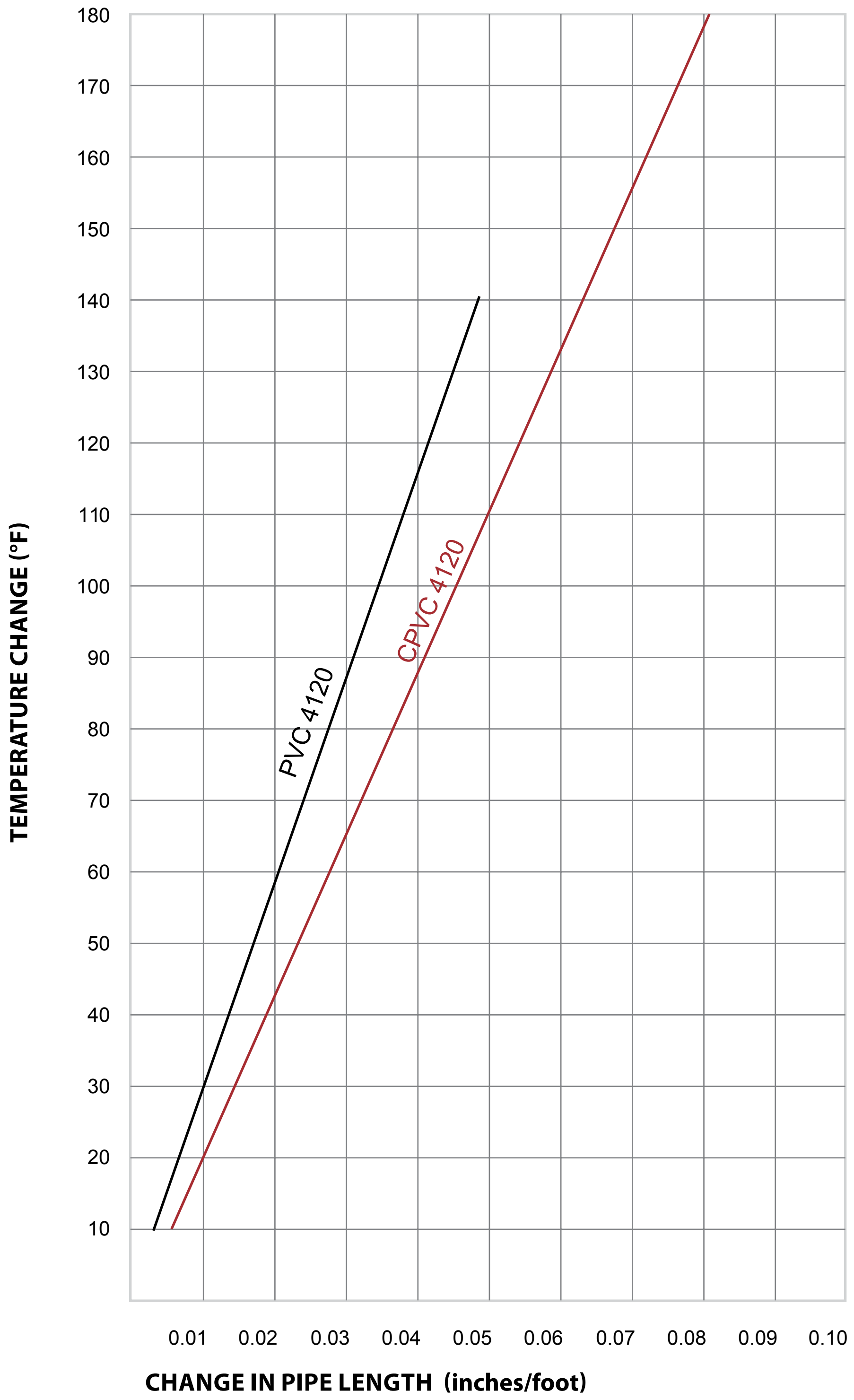
When designing for the use of any expansion joint, it should be remembered that this joint is usually considered to be the weakest link in the entire piping system. The responsible project engineer should determine the system requirements and then evaluate the design feasibility of each type of joint. To get an idea of what is available, here are some of the more common variations of joints:

Expansion Loop - A fairly simple but efficient method for growth control. Expansion loops generally contain no moving parts (o-ring seals or gaskets) and are easily fabricated from pipe and elbows. Their drawbacks are offset space requirements and limitations on large diameter pipe.

Flexible Bend - This type of joint (plastic or metallic) is available in many configurations. They absorb excessive vibration, allow multi-directional movement, and correct for mis-alignment or structural shift in the system. Negatives are pressure limitations and resistance to corrosive fluids in the case of 100% metallic bends.

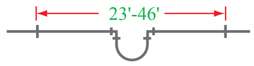
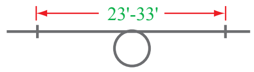
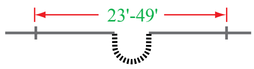
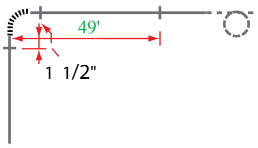
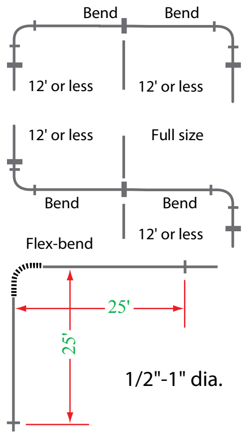
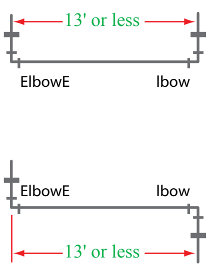
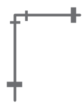
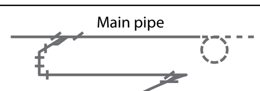
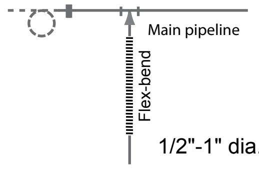
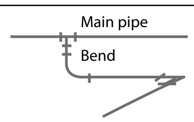
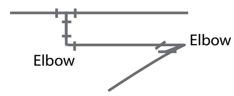
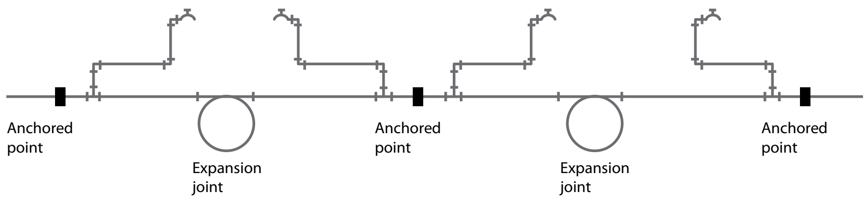
Plastic Piston Expansion Joint - Usually a fabricated device constructed by telescoping two pieces of pipe. They will allow for considerable movement in a linear direction only. For this reason, careful alignment is very necessary for smooth operation. The critical component in this device is the elastomeric o-ring seal, which must be evaluated for chemical and heat resistance as well as positive sealing characteristics during wear.

Bellows and Rubber Expansion Joints - these joints will absorb growth in the system due to thermal changes and will allow for dynamic movements of machinery, support structures, and buildings. Rubber expansion joints will allow for axial, lateral, angular and torsional movement. Both types are installed in-line and are fairly compact. The manufacturer of each should be consulted to determine specific design advantages and limitations

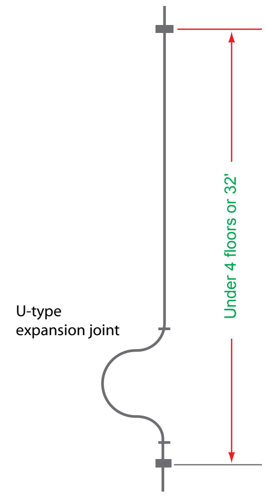
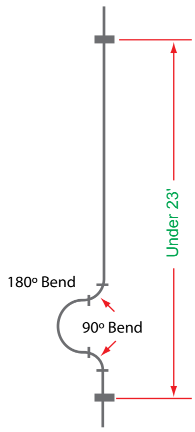
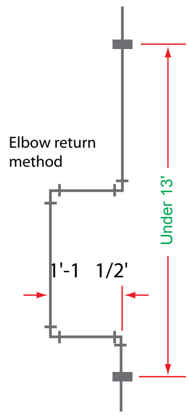
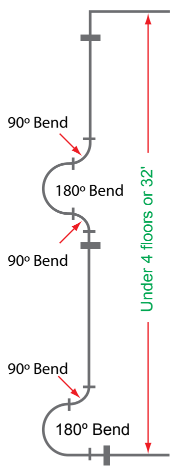
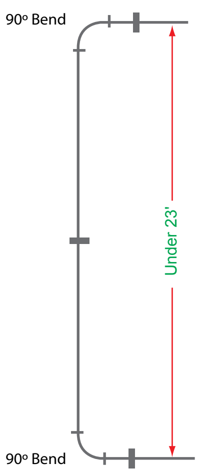
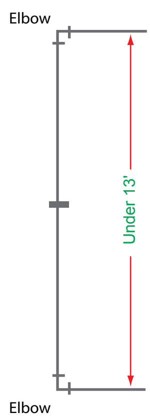
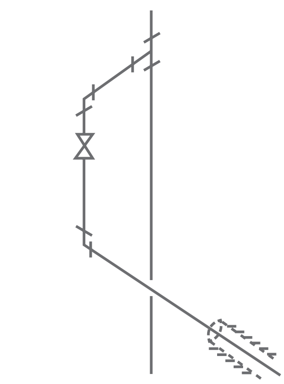
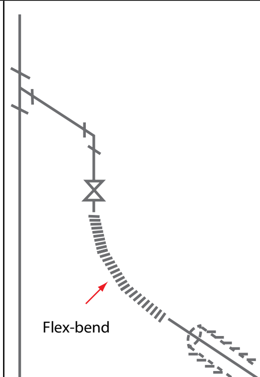


Coefficient of Thermal Linear Expansion

PVC 1120	= 2.8×10^{-5} in/in/°F
CPVC 4120	= 3.8×10^{-5} in/in/°F

	LONG STRAIGHT SECTIONS	STRAIGHT SECTIONS 13 TO 23 FEET LONG	STRAIGHT SECTIONS 7 TO 13 FEET LONG	STRAIGHT SECTIONS 7 FEET OR LESS
ABSORBING EXPANSION AND CONTRACTION IN STRAIGHT SECTIONS	U-type 2 1/2"-4" dia.  Loop-type 1/2"-2" dia.  Flex-bend 1/2"-1" dia. 	In accordance with the methods of absorbing expansion and contraction in bending sections.	In accordance with the methods of absorbing expansion and contraction in bending sections.	Adjusting for expansion and contraction is not necessary.
ABSORBING EXPANSION AND CONTRACTION IN BENDING SECTIONS	Flex-bend 1/2"-1" dia. 	 1/2"-1" dia.		Using an elbow 
LOCATING BRANCH POINTS ON THE MAIN PIPE AND ABSORBING EXPANSION AND CONTRACTION IN THE BRANCH SECTIONS	Long distance from anchored point to branch point	Distance of 13' to 23' from anchored point to branch point	Distance of 7' to 13' from anchored point to branch point	
	 Usage of 3 pcs of elbow  1/2"-1" dia.	 Usage of 1 pc. of bend and 1 pc. of elbow (Remarks) Be sure to use bend on the main pipe side	 Usage of 2 pcs of elbow	Adjusting for expansion and contraction is not necessary
LOCATION OF BRANCHING	 Branch as near as possible to anchored points.			

(Remarks) —▮— mark in the above table expresses "anchored supports".

SECTIONS TO ABSORB EXPANSION AND CONTRACTION	LONG VERTICAL PIPES	VERTICAL PIPES OF 13 TO 23 FEET LONG	VERTICAL PIPES OF 7 TO 13 FEET LONG	VERTICAL PIPES OF 7 FEET OR LESS
ABSORBING EXPANSION AND CONTRACTION IN STRAIGHT SECTIONS	 Application of 1 1/2" to 4" dia.	 Application of 1/2" to 2" dia.	 Application of full size	Adjusting for expansion and contraction is not necessary.
ABSORBING EXPANSION AND CONTRACTION IN STRAIGHT SECTIONS	 Flex-bend Application of 1/2 " to 1" dia.  Application of 1/2" to 2" dia.	 Application of full size	 Application of full size	Adjusting for expansion and contraction is not necessary.
BRANCHING ON VERTICAL PIPES				Adjusting for expansion and contraction is not necessary.

(Remarks) —▮— mark in the above table expresses "anchored supports".

PVC Pipe Snaking Procedure

Installation and operating temperatures for underground pipelines frequently vary. PVC expands under increasing temperatures and contracts with decreasing temperatures. Allowance for thermal expansion and contraction is easily made by snaking the pipe in the trench. Snaking is recommended for pipe using solvent cemented joints or other rigid couplings 1/2" through 2 1/2" nominal size.

When installation temperature is lower than the operating temperature, install the pipe in straight alignment and bring the pipe up to operating temperature after the joints are cured but before backfilling.

When installation temperature is considerably higher than the operating temperature, the pipe should be installed by "snaking" in the trench.

Recommended offsets and loop lengths for up to 2 1/2" nominal size are shown in the chart below.

For pipe diameters above 2 1/2", the pipe should be installed in a straight alignment. Before backfilling the trench, the temperature of pipe should be allowed to condition to within 15º F of the design operating temperature. When large swings in operating temperatures are expected, it may be necessary to consult your Hydroseal representative.

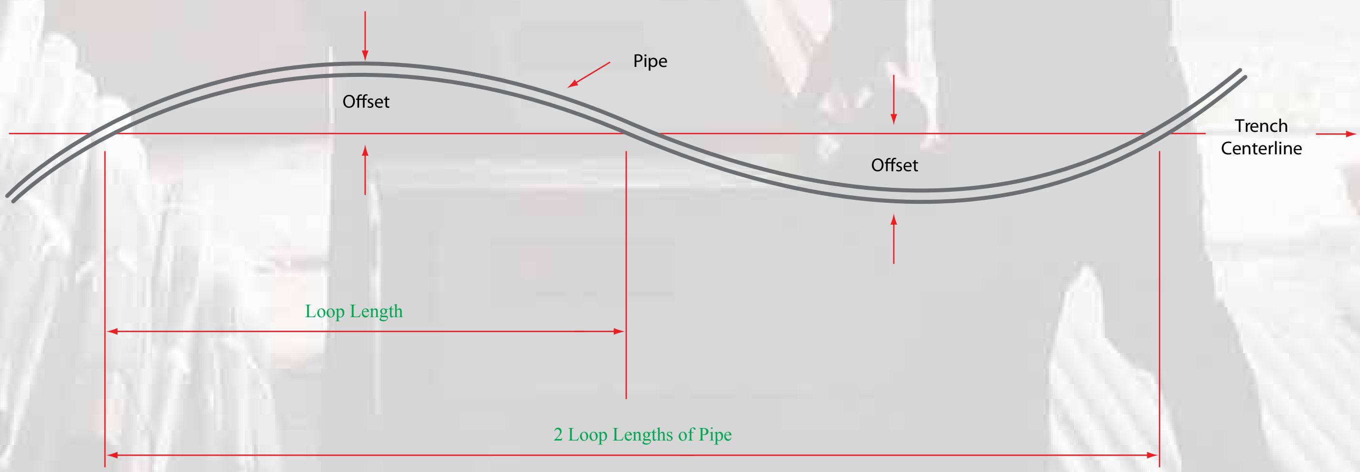
NOTE:
Piping must not be buried less than 24" in areas of heavy vehicular or construction equipment traffic. Fatigue of the pipe and joints will occur unless they are encased in a suitable metal conduit.

For additional information and data, please refer to ASTM specifications D2321, D2774, and F645.

Allowance for Underground Contraction

	MAX. TEMP. VARIATION ºF, BETWEEN INSTALLATION AND FINAL OPERATION									
	10º	20º	30º	40º	50º	60º	70º	80º	90º	100º
LOOP LENGTH (FEET)										
20	3.0	3.5	4.5	5.0	6.0	6.5	7.0	7.0	8.0	8.0
50	7.0	9.0	11.0	13.0	14.0	15.5	17.0	18.0	19.0	20.0
100	13.0	18.0	22.0	26.0	29.0	31.5	35.0	37.0	40.0	42.0

Pipe Snaking Diagram



Support and Spacing requirements for PVC and CPVC pipe, fittings, and valves should be designed into the system to allow for increased temperatures. As temperature increases, the tensile strength of PVC and CPVC decreases, so the pipe and associated fixtures must be well supported.

Horizontal piping systems should be supported on uniform centers which are determined by maximum operating temperatures. The following chart shows the recommended support spacing according to size, schedule, and operating temperatures when the transported liquid has a specific gravity of up to 1.35 with no concentrated loads (1.35 x 62.4 lbs. = 84 lbs./ft.3 of specific weight). These spacings apply to uninsulated lines, either in a building or exposed to the atmosphere. The formula used to determine the spacing data takes into account the heating effect of the sun on low temperature lines.

Adjustable clevis, ring, or roll hangers and roll stands with broad support surfaces are best for use with PVC and CPVC pipe. Other suitable types include: pipe clamps, straps, and riser clamps. The broader and flatter the support surfaces, the better. They should be filed smooth, taped, or padded to avoid the possibility of damaging the pipe. Also remove any sharp edges or burrs on the clamps, anchors, or any other supporting equipment that could frequently come in contact with the pipe.

Do not clamp or anchor the pipe so that it is held absolutely rigid or constricted. Some slight axial movement is necessary.

For vertical lines, it is recommended that the pipe be banded at intervals determined by the vertical load involved. Riser clamps are best utilized if they are supported on spring hangers. Short risers should include a saddle at the bottom and may require an additional hanger at the top. Longer risers may require oversized U-bolts or similar devices to prevent lateral motion.

All valves and points of concentrated loads such as tees and flanges should have support independent of normal span supports. Metallic or lined valves should be fully supported because of the increased weight. At higher temperatures or when the line is transporting hazardous liquids, it may be economically more practical to use a continuous support system.

When pipe clamps are used, they should not force the pipe and fittings into position. To remedy this, each section of the pipeline should be laid out and all connections, whether solvent cemented, screwed, or flanged should be made while the pipe is held in temporary support. Once the joints have been completed, the final clamping can be done. When correctly installed, a clamp, a holder, or a pipe connection can be loosened or removed without the pipeline shifting position.

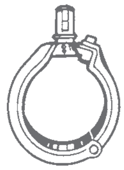
Recommended Support Spacing (feet)

NOM. PIPE SIZE (IN)	PVC PIPE														
	PR 160 & 200					SCHEDULE 40					SCHEDULE 80				
	TEMP. °F					TEMP. °F					TEMP. °F				
	60	80	100	120	160	60	80	100	120	140	60	80	100	120	140
1/2	3 1/2	3 1/2	3	2		4 1/2	4 1/2	4	2 1/2	2 1/2	5	4 1/2	4 1/2	3	2 1/2
3/4	4	3 1/2	3	2		5	4 1/2	4	2 1/2	2 1/2	5 1/2	5	4 1/2	3	2 1/2
1	4	4	3 1/2	2		5 1/2	5	4 1/2	3	2 1/2	6	5 1/2	5	3 1/2	3
1 1/4	4	4	3 1/2	2 1/2		51/2	5 1/2	5	3	3	6	6	5 1/2	3 1/2	3
1 1/2	4 1/2	4	4	2 1/2		6	5 1/2	5	3 1/2	3	6 1/2	6	5 1/2	3 1/2	3 1/2
2	4 1/2	4	4	3		6	5 1/2	5	3 1/2	7	7	6 1/2	6	4	3 1/2
2 1/2	5	5	4 1/2	3		7	6 1/2	6	4	3 1/2	7 1/2	7 1/2	6 1/2	4 1/2	4
3	5 1/2	5 1/2	4 1/2	3		7	7	6	4	3 1/2	8	7 1/2	7	4 1/2	4
4	6	5 1/2	5	3 1/2		7 1/2	7	6 1/2	4 1/2	4	9	8 1/2	7 1/2	5	4 1/2
6	6 1/2	6 1/2	5 1/2	4		8 1/2	8	7 1/2	5	4 1/2	10	9 1/2	9	6	5
8	7	6 1/2	6	5		9	8 1/2	8	5	4 1/2	11	10 1/2	9 1/2	6 1/2	5 1/2
10						10	9	8 1/2	5 1/2	5	12	11	10	7	6
12						11 1/2	10 1/2	9 1/2	6 1/2	5 1/2	12	11	10	7	6
14						12	11	10	7	6	13 1/2	13	11	8	7
16						12 1/2	11 1/2	10 1/2	7 1/2	6 1/2	14	13 1/2	11 1/2	8 1/2	7 1/2

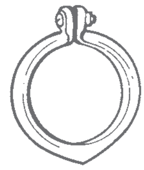
CPVC PIPE											
SCHEDULE 40						SCHEDULE 80					
TEMP. °F						TEMP. °F					
60	80	100	120	140	180	60	80	100	120	140	180
5	5	4 1/2	4 1/2	4	2 1/2	5	4 1/2	4 1/2	4	3 1/2	2 1/2
5 1/2	5	5	4 1/2	4	2 1/2	5 1/2	5	4 1/2	4	4	2 1/2
6	5 1/2	5 1/2	5	41/2	2 1/2	6	5 1/2	5	5	4 1/2	3
6	5 1/2	5 1/2	5 1/2	5	3	6	6	51/2	5	5	3
6 1/2	6 1/2	6 1/2	5 1/2	5	3	61 /2	6	6	51/2	5	3 1/2
6 1/2	6	6	5 1/2	5	3	7	6 1/2	6 1/2	6	5 1/2	3 1/2
7 1/2	7	7	6 1/2	6	3 1/2	7 1/2	7 1/2	7	7	6	4
8	7	7	7	6	3 1/2	8	8	7 1/2	7	7	4
8 1/2	7 1/2	7 1/2	7	61/2	4	9	9	8 1/2	8	7 1/2	4 1/2
9 1/2	8 1/2	8	71/2	7	4 1/2	11	11	10	9	8	5
9 1/2	8 1/2	8	7 1/2	7	5	12	12	11	10	9	5 1/2
10	9 1/2	9	8	7 1/2	5 1/2	13	13	12	10	9	5 1/2
10 1/2	10 1/2	10	9	8	6	14	14	13	10 1/2	9 1/2	7

NOTE:
This data is based on information supplied by raw material manufacturers. It should be used as a general recommendation only and not as a guarantee of performance or longevity.

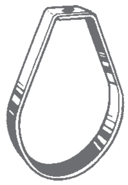
PIPE RINGS



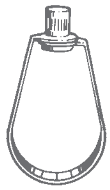
Adj. Swivel Ring
Split ring type
Fig. 1
3/4 to 8 in. pipe



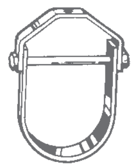
Split Ring
Fig. 2
3/8 to 8 in. pipe



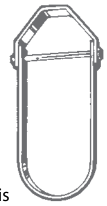
Adj. Ring
Fig. 6
1/2 to 8 in. pipe



Adj. Swivel Ring
Fig. 7
1/2 to 8 in. pipe

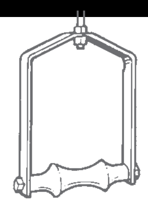


Adj. Clevis–Standard
Fig. 11
1/2 to 30 in. pipe

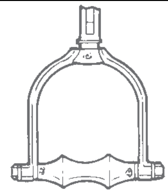


Adj. Clevis
For Insulated Lines
Fig. 12
3/4 to 12 in. pipe

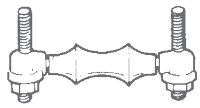
PIPE ROLLS



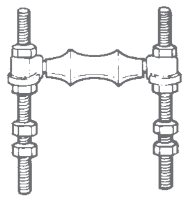
Adj. Steel Yoke
Pipe Roll
Fig. 3
21/2 to 20 in. pipe



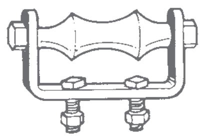
Adj. Swivel Pipe Roll
Fig. 4
21/2 to 12 in. pipe



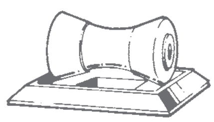
Single Pipe Ring
Fig. 8
1 to 30 in. pipe



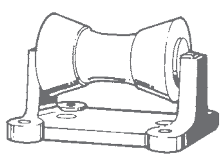
Adj. Pipe Roll Support
Fig. 9
1 to 30 in. pipe



Roller Chair
Fig. 13
2 to 12 in. pipe

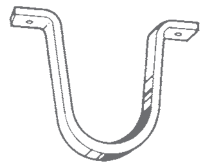


Pipe Roll and Plate
Fig. 14
2 to 24 in. pipe

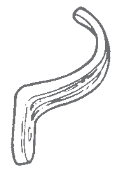


Pipe Roll Stand Complete
Fig. 16
2 to 24 in. pipe

STRAPS, HOOKS



Wrought Strap Short
Fig. 5
1/2 to 4 in. pipe

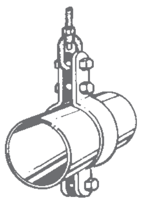


One Hole Clamp
Fig. 10
3/8 to 4 in. pipe

Flexi-Clip
Fig. 15
1/4 to 2 in. pipe

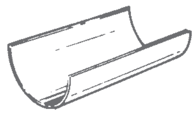
PIPE CLAMPS

Pipe Clamp Medium
Fig. 17
1/2 to 24 in. pipe



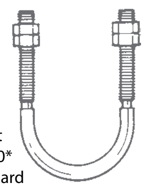
Double Bolt Pipe Clamp
Fig. 18
3/4 to 36 in. pipe

PIPE COVERING



Insulation Protection Shield
Fig. 19
1/2 to 24 in. pipe

U-BOLT



U Bolt
Fig. 20*
Standard
1/2 to 30 in. pipe
Light weight
1/2 to 10 in. pipe

*Also available plastic coated.

CAUTION:
Clamps used as anchors (such as U-bolts, etc.) if over-tightened, can produce a point-of-load stress on the pipe. This can result in cracking or premature burst failure. If U-bolts must be used, then a metal shield (Fig. 19) should be placed between the U-bolt and pipe surface. When anchoring plastic pipe, it is always desirable to spread the load over a wide area of contact.

1. Handling

Compared to steel, iron or copper pipe, PVC and CPVC pipe and fittings have a lower impact resistance (especially at low temperatures). Care should be exercised during transportation and installation of PVC and CPVC. Pipe installed in high impact areas should be protected accordingly.

2. Solvent Cement Welding

This method of joining is very simple and reliable if it is followed correctly, but any deviations from the recommended basic steps may reduce the strength and integrity of the joint. The procedures for preparation, insertion, and curing should be followed very carefully.

3. Expansion and Contraction

The coefficient of linear expansion of PVC and CPVC pipe is greater than that of metallic piping; therefore, take this factor into consideration when designing and installing a PVC and CPVC piping system. (see graph on page 7.14)

4. Hanging and Supporting

The modulus of elasticity of PVC and CPVC pipe is smaller than it is for metal pipes. Maximum working temperature and room temperature should be considered when determining the required support spacing. (see chart on page 7.18)

5. Trench Preparation

When laying PVC and CPVC pipe below the ground, care should be taken to remove all rocks, boards, empty primer and cement cans, brushes, bottles and other debris from the trench. Smaller diameters of pipe should be "snaked" in the trench to allow for expansion and contraction. If solvent cement welding is used for the method of joining, snaking, pressure testing, and pipe movement should not be done until after the joints have been given sufficient time to dry.

6. Temperature/Pressure

The working pressure of PVC and CPVC pipe and fittings varies with changes in temperature. Before putting a piping system into service, the maximum working temperature and the maximum working pressure should be verified. (see chart on page 7.04)

7. PVC and CPVC for Non-Liquid Transport

The manufacturer does not recommend its PVC or CPVC products for use in air or compressed gas systems. PVC and CPVC pipe and fittings are excellent products for the transport of water and corrosive chemicals, but there are a number of other piping products that are especially designed and suited for compressed air and gases.

8. Testing

Never use air or gas for pressure testing PVC or CPVC piping systems. Before water-testing a system, flush out all entrapped air. (see page 7.24)

A. Initial Preparation

1. Make sure the solvent cement you are planning to use is designed for the specific application you are attempting.
2. Know the physical and chemical characteristics and limitations of the PVC and CPVC piping materials that you are about to use.
3. Know the reputation of your manufacturer and their products.
4. Know your own qualifications or those of your contractor. The solvent welding technique of joining PVC and CPVC pipe is a specialized skill just as any other pipe fitting technique.
5. Closely supervise the installation and inspect the finished job before start-up.
6. Contact the manufacturer, supplier, or competent consulting agency if you have any questions about the application or installation of PVC and CPVC pipe.
7. Take the time and effort to do a professional job. Shortcuts will only cause you problems and delays in start-up. By far, the majority of failures in PVC and CPVC systems are the result of shortcuts and/or improper joining techniques.

B. Selection of Materials

- Cutting Device - Saw or Pipe Cutter
- Deburring Tool, Knife, File, or Beveling Machine (2" and above).
- Brush - Pure Bristle
- Rag - Cotton (not synthetic)
- Primer and Cleaner
- Solvent Cement - PVC for PVC Components and CPVC for CPVC Components. Use proper type and viscosity.
- Containers - Metal or Glass to hold Primer and Cement. Select the type of PVC or CPVC materials to be used on the basis of their application with respect to chemical resistance, pressure rating, temperature characteristics, etc.
- Insertion Tool - helpful for larger diameter pipe and fittings (6" and above).

Primer

It is recommended that Tetrahydrofuran (THF) be used to prepare the surfaces of pipe and fittings for solvent welding. Do not use water, rags, gasoline, or any other substitutes for cleaning PVC or CPVC surfaces. A chemical cleaner such as MEK may be used.

Cement

The cement should be a bodied cement of approximately 500 to 1600 centipoise viscosity containing 10 ~ 20% (by weight) virgin PVC material solvated with tetrahydrofuran (THF). Small quantities of dimethyl formamide (DMF) may be included to act as a retarding agent to extend curing time. Select the proper cement: Schedule 40 cement should be used for Schedule 40 and SDR pipe sizes 2" diameter or less. For Schedule 40 and SDR over 2" and all sizes of Schedule 80 pipe, Schedule 80 cement is recommended. Never use all-purpose cements, commercial glues and adhesives or ABS cement to join PVC or CPVC pipe and fittings.

SAFETY PRECAUTION: Primers and cements are extremely flammable, and must not be stored or used near heat or open flame.

Applicators

Select a suitable pure bristle type paint brush. Use a proper width brush or roller to apply the primer and cement (see chart below). Speedy application of cement is important due to its fast drying characteristics.

IMPORTANT NOTE:
A dauber type applicator should only be used on pipe sizes 2" and below. For larger diameter pipe, a brush or roller must be used.

RECOMMENDED BRUSH* SIZE FOR PRIMER AND CEMENT APPLICATION

NOMINAL PIPE SIZE (IPS)	BRUSH WIDTH (IN.)	NOMINAL PIPE SIZE (IPS)	BRUSH WIDTH (IN.)
1/2	1/2	3	1 1/2 - 2 1/2
3/4	1	4	2 - 3
1	1	6	3 - 5
1 1/4	1	8	4 - 6
1 1/2	1 - 1 1/2	10	6 - 8
2	1 - 1 1/2	12	6 - 8
2 1/2	1 1/2 - 2	14	6 - 8
		16	8+

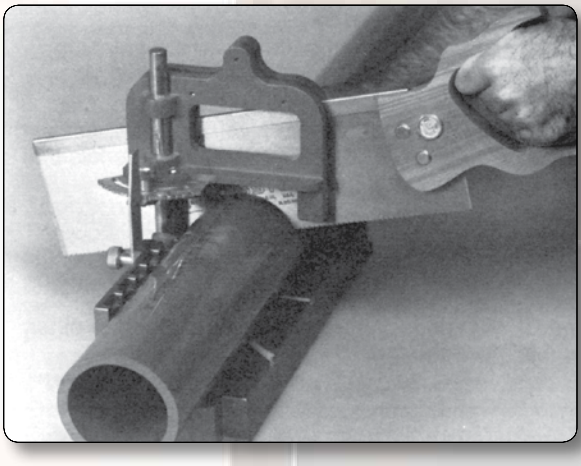
*Use Only Natural Bristle

C. Making the Joint

1. Cutting

Pipe must be squarely cut to allow for the proper interfacing of the pipe end and the fitting socket bottom. This can be accomplished with a miter box saw or wheel type cutter. Wheel type cutters are not generally recommended for larger diameters since they tend to flare the corner of the pipe end. If this type of cutter is used, the flare on the end must be completely removed.

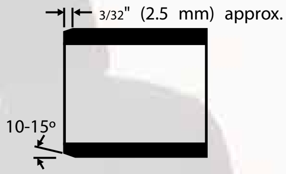
NOTE: Power saws should be specifically designed to cut plastic pipe.



STEP 1

2. Deburring

Use a knife, plastic pipe deburring tool, or file to remove burrs from the end of small diameter pipe. Be sure to remove all burrs from around the inside as well as the outside of the pipe. A slight chamfer (bevel) of about 10°-15° should be added to the end to permit easier insertion of the pipe into the fitting. Failure to chamfer the edge of the pipe may remove cement from the fitting socket, causing the joint to leak.
For pressure pipe systems of 2" and above, the pipe must be end-treated with a 15° chamfer cut to a depth of approx. 3/32". Commercial power bevelers are recommended



STEP 2

3. Test Dry Fit of the Joint

Tapered fitting sockets are designed so that an interference fit should occur when the pipe is inserted about 1/3 to 2/3 of the way into the socket. Occasionally, when pipe and fitting dimensions are at the tolerance extremes, it will be possible to fully insert dry pipe to the bottom of the fitting socket. When this happens, a sufficient quantity of cement must be applied to the joint to fill the gap between the pipe and fitting. The gap must be filled to obtain a strong, leak-free joint.

4. Inspection, Cleaning and Priming

Visually inspect the inside of the pipe and fitting sockets and remove all dirt, grease or moisture with a clean dry rag. If wiping fails to clean the surfaces, a chemical cleaner must be used. Check for possible damage such as splits or cracks and replace if necessary.

STEP 4

5. Depth-Of-Entry Mark

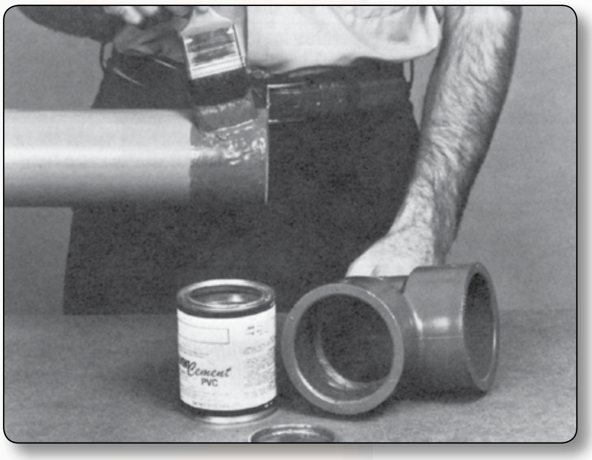
Marking the depth of entry is a way to check if the pipe has reached the bottom of the fitting socket in step #7. Measure the fitting socket depth and mark this distance on the pipe O.D. You may want to add several inches to the distance and make a second mark as the primer and cement will most likely destroy your first one.
Apply primer to the surface of the pipe and fitting socket with a natural bristle brush (see chart on page 7.21). This process softens and prepares the PVC or CPVC for the solvent cementing step. Move quickly without hesitation to the cementing procedure while surfaces are still wet with primer.

6. Application of solvent Cement

- Apply the solvent cement evenly and quickly around the outside of the pipe at a width a little greater than the depth of the fitting socket.
- Apply a light coat of cement evenly around the inside of the fitting socket. Avoid puddling.
- Apply a second coat of cement to the pipe end.

CAUTION:
When cementing bell-end pipe be careful not to apply an excessive amount of cement to the bell socket or spigot end. This will prevent solvent damage to the pipe. For buried pipe applications, do not throw empty primer or cement cans into the trench alongside the pipe.

NOTE:
Cans of cement and primer should be closed at all times when not in use to prevent evaporation of chemicals and hardening of cement. They are also very flammable and should be kept away from heat or flame.

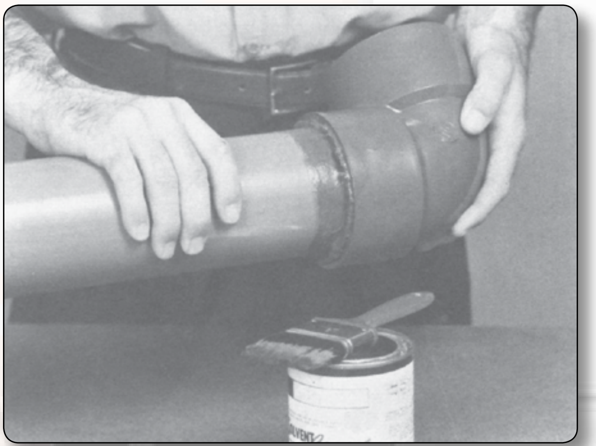


STEP 6

7. Joint Assembly

Working quickly, insert the pipe into the fitting socket bottom and give the pipe or fitting a 1/4" turn to evenly distribute the cement. Do not continue to rotate the pipe after it has hit the bottom of the fitting socket. A good joint will have sufficient cement to make a bead all the way around the outside of the fitting hub. The fitting will have a tendency to slide back on the pipe while the cement is wet so hold the joint tightly together for about 15 seconds. For pipe sizes 4" and above, greater axial forces are necessary for the assembly of interference fit joints. Mechanical forcing equipment may be needed to join the pipe and hold the joint until the cement "sets". The joint may have to be held together for up to 3 minutes. Consult your Hydroseal representative for specifics.

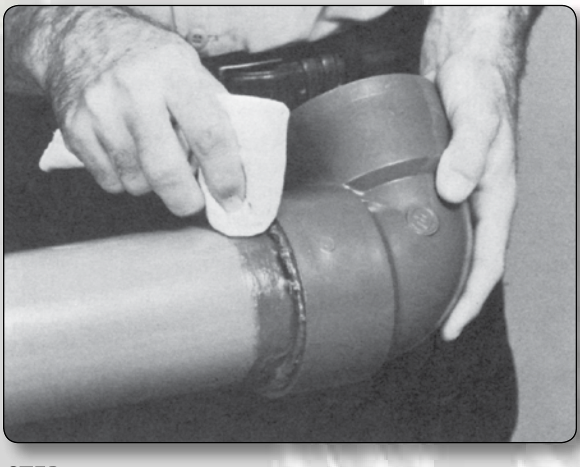
NOTE:
Always wait at least 24 hours before pressure testing a piping system to allow cemented joints to cure properly. For colder temperatures, it may be necessary to wait a longer period of time.



STEP 7

8. Cleanup and Joint Movement

Remove all excess cement from around the pipe and fitting with a dry cotton rag. This must be done while the cement is still soft. The joint should not be disturbed immediately after the cementing procedure and sufficient time should be allowed for proper curing of the joint. Exact drying time is difficult to predict because it depends on variables such as temperature, humidity and cement integrity. See the chart on page 7.24 for approximate joint movement times recommended by several pipe and solvent cement manufacturers. For more specific information, you should contact your HYDROSEAL representative.



STEP 8

RECOMMENDED JOINT CURING CHART

TEMPERATURE RANGE DURING CURE PERIOD	TEST PRESSURES FOR PIPE SIZES 1/2" TO 1 1/4"		TEST PRESSURES FOR PIPE SIZES 1 1/2" TO 3"		TEST PRESSURES FOR PIPE SIZES 4" TO 8"		TEST PRESSURES FOR PIPE SIZES 10" TO 16"
	UP TO 180 PSI	ABOVE 180 TO 370 PSI	UP TO 180 PSI	ABOVE 180 TO 315 PSI	UP TO 180 PSI	ABOVE 180 TO 315 PSI	UP TO 100 PSI
60°F-100°F	1 HR	6 HR	2 HR	12 HR	6 HR	24 HR	24 HR
40°F-60°F	2 HR	12 HR	4 HR	24 HR	12 HR	48 HR	48 HR
40°F	8 HR	48 HR	16 HR	96 HR	48 HR	8 DAYS	8 DAYS

Helpful Hints

1. Work quickly and carefully.
2. Use liberal amounts of fresh cement.
3. Do not attempt cementing in the rain or in the presence of moisture.
4. Do not cement when the temperature is below 40°F or above 100°F.
5. Do not take shortcuts or bypass recommended steps.
6. Do not weld steel piping that has been connected to freshly cemented PVC or CPVC pipe.
7. Keep primers and cements away from heat, sparks, and flame.
8. Provide good ventilation to reduce fire hazard and to minimize inhalation of solvent vapors.
9. Do not test with compressed air or gas, and bleed all entrapped air from the system before testing hydrostatically.
10. Consult your HYDROSEAL representative for specific questions or problems.

AVERAGE NUMBER OF JOINTS PER QUART OF CEMENT															
PIPE DIAMETER	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16
NUMBER OF JOINTS	300	200	125	120	90	60	45	40	30	10	5	2-3	1-2	3/4	1/2

APPLICABLE SPECIFICATIONS FOR SOLVENT WELDING	
ASTM D-2564	Solvent cements for PVC plastic pipe and fittings.
ASTM D-2855	Making solvent-cemented joints with PVC pipe and fittings.
ASTM F-493	Solvent cements for CPVC plastic pipe and fittings.
ASTM F-656	Primers for use in solvent cement joints of PVC plastic pipe and fittings.

Hydrostatic Pressure Testing

1. The last assembled joint should be fully cured before filling the system with water.

2. All valves and air relief mechanisms should be opened at the ends and elevations. The system should be filled slowly, flow velocities should not exceed 1 foot per second (Velocity-GPM charts pages 7.08 ~ 7.11). This will prevent surge, water hammer, and air entrapment.

3. Water flow should continue until all entrapped air is completely flushed out of every branch of the system. Maintain the 1 ft/s velocity until every valve is checked. A rapidly fluctuating gauge needle during pressure rise may be an indication that entrapped air still remains in the system.

   Systems should include the appropriate air relief and vacuum breaker valves to vent air during normal operation after installation. Entrapped air is major cause of surge and burst failure in plastic piping systems.

4. After filling the system, do not pressurize until the responsible engineer is present to witness the test. All personnel in the vicinity of the system should wear safety glasses and hard hats. High voltage electrical equipment should be shielded from a possible spray.

5. The piping system should be pressurized to 125% of its maximum design operating pressure. This pressure must not exceed the working pressure of the lowest rated component in the system, i.e. flanges, unions, thread parts, valves, etc.

6. The pressure test should not exceed 1 hour. This should provide enough time to inspect all joints for leaks. If leaks are found, pressure must be relieved and the leak repaired. The system should then be recharged and retested. Consult your Hydroseal representative if you have any questions concerning these steps.

DO NOT USE AIR OR INERT GAS TO TEST, THIS INCLUDES AIR-OVER-WATER BOOSTERS.

A. Characteristics

Threading of PVC or CPVC pipe is only recommended for Schedule 80. The wall thickness is diminished at the point of threading and thereby reduces the maximum working pressure by 50%. Because of this, threaded pipe should not be used in high pressure systems nor in areas where a leak might endanger personnel. Threaded joints will not withstand constant or extreme stress and strain and Threading must be supported or hung with this in mind. The threading of pipe sizes above 4" is not generally recommended.

CAUTION:
Using threaded PVC or CPVC products at or near the maximum temperature range should be avoided. Consult your Hydroseal representative for specific details.

B. Selection of Materials

- Power Threading Machine
- Threading Rachet and Pipe Vise (if hand pipe stock is used)
- Pipe Dies designed for plastic
- Threading Lubricant (optional)
- Strap Wrench
- Teflon* Tape or an approved Teflon Paste
- Cutting and Deburring Tool
- Ring Gauge (L-1)

*Trademark of E. I. Dupont

C. Making the Pipe Thread

1. Cutting and Deburring

PVC or CPVC pipe should be cut square and smooth for easy and accurate threading. A miter box or similar guide should be used when sawing is done by hand. Burrs should be removed inside and out using a knife or plastic pipe deburring tool.

2. Threading

Threading Schedule 80 PVC and CPVC pipe can easily be accomplished using either a standard hand pipe stock or a power operated tool. Cutting dies should be clean and sharp.

Power threading machines should be fitted with dies having a 5° negative front rake and ground especially for plastic pipe. Self-opening die heads, and a slight chamfer to lead the dies will speed the operation; however, dies should not be driven at high speeds or with heavy pressure.

When using a hand held cutter, the pipe should be held in a pipe vise. To prevent crushing or scoring of the pipe by the vise jaws, some type of protective wrap such as canvas, emery paper, rubber, or light metal sleeve should be used. For hand stocks, the dies should have a negative front rake angle of 5° to 10°.

A cutting lubricant such as a soap and water solution or a water soluble machine oil should be used while the threads are being cut. PVC and CPVC is readily threaded and caution should be taken not to over-thread.

3. Preparing the Threaded Pipe

A ring gauge should be used to check the accuracy of the threads. Tolerance = ± 11/2 turns.

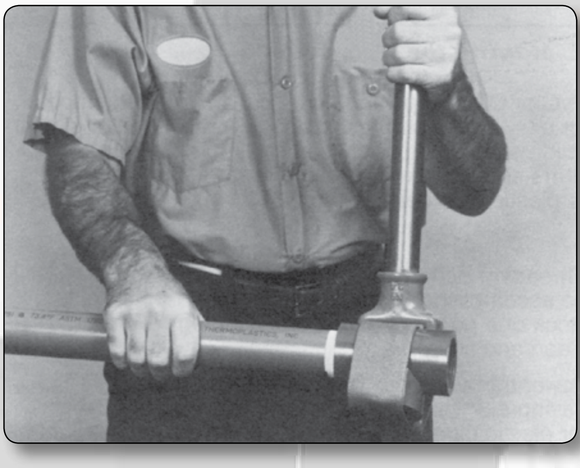
The threads should then be cleaned by brushing away cuttings and ribbons.

After cleaning, apply a thread lubricant such as Teflon* tape to the threaded portion of pipe. Wrap the tape around the entire length of threads beginning with number two thread from the end. The tape should slightly overlap itself going in the same direction as the threads. This will prevent the tape from unraveling when the fitting is tightened on the pipe. Overlapping in the wrong direction and the use of too much tape can affect tolerances between threads. This can generate stress in the wall of female fittings resulting in failure during operations.

STEP3

4. Assembly of Threaded Joints

After applying thread lubricant, screw the threaded fitting onto the pipe. Screwed fittings should be started carefully and hand tightened. Threads must be properly cut and a good quality thread lubricant/tape must be used. If desired, the joint may be tightened with a strap wrench. IN NO CASE SHOULD A STILLSON TYPE WRENCH BE USED. The jaws of this type of wrench will scar and damage the pipe wall. Fittings should be screwed on until hand tight with an additional 1 to 11/2 turn more. Avoid stretching or distorting the pipe, fittings or threads by over tightening.



STEP4

CAUTIONS:

1. Never apply solvent cement to threaded pipe or threaded fittings.

2. Some Teflon* pastes contain chemicals that may be harmful to the pipe and fittings. You should consult the supplier or manufacturer of the paste before use.

3. Avoid screwing metallic male threads into plastic female threads. If connections to metal threads have to be made, the preferred method is to screw a plastic male thread into a metallic female thread.

There are a variety of plastic fittings that are molded with metallic male or female NPT threaded inserts. The corrosion resistance of the metal insert will have to be taken into consideration. Consult your Hydroseal representative for the availability of these metal insert fittings.

*Trademark of E. I. Dupont

Flanged PVC and CPVC pipe has an advantage when used in a system where there is need to dismantle the pipe occasionally or when the system is temporary and mobility is required. Flanging can also be used when it is environmentally impossible to make solvent cemented joints on location.

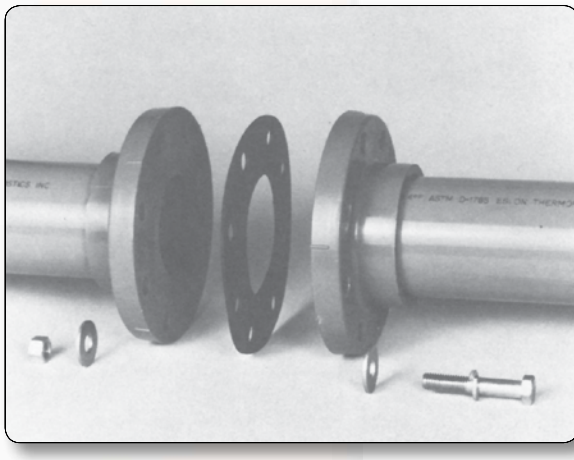
A. Selection of Materials

- Gasket - full faced elastomeric, (Durometer "A" scale of 55 to 80, usually 1/8" thick). Must be resistant to chemicals flowing through the line.
- Fasteners - bolts, nuts, and washers, also resistant to the chemical environment. (Threads should be well lubricated.)
- Torque Wrench - a necessity for tightening bolts in a manner that guards against excessive torque.

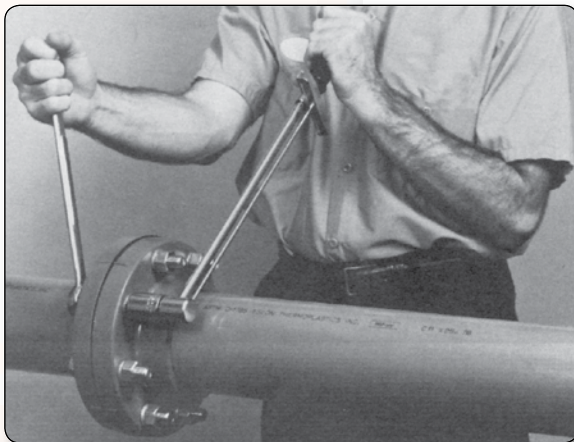
B. Flange Assembly

1. Join the flange to the pipe as outlined in the solvent cementing section or in the threading section depending on the joining method desired.
2. Align the flanges and gasket by inserting all of the bolts through the matching bolt holes. Proper mating of flanges and gaskets is very important for a positive seal.
3. Using a torque wrench, tighten each bolt in a gradual sequence as outlined by the flange sketch. For final tightening of all bolts, find the recommended torque value in the chart below.

CAUTIONS:
1. Do not over-torque flange bolts.
2. Use the proper bolt tightening sequence.
3. Make sure the system is in proper alignment.
4. Flanges should not be used to "cold-spring" the system
5. Flat washers must be used under every nut and bolt head



STEP A



STEP B

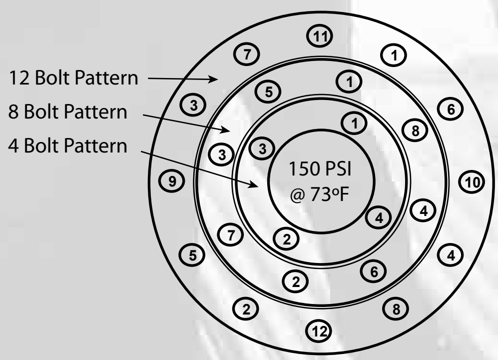
RECOMMENDED TORQUE

PIPE SIZE (IPS)	NO. BOLT HOLES	BOLT DIAMETER	APPROX. BOLT LENGTH*	RECOMMENDED TORQUE FT/LBS
1/2	4	1/2	2 1/2	10-15
3/4	4	1/2	2 1/2	10-15
1	4	1/2	2 1/2	10-15
1 1/4	4	1/2	3	10-15
1 1/2	4	1/2	3	10-15
2	4	5/8	3	20-30
2 1/2	4	5/8	3	20-30
3	4	5/8	3 1/2	20-30
4	8	5/8	4	20-30
6	8	3/4	4	33-50
8	8	7/8	5	33-50
10	12	7/8	5	53-75
12	12	1	5	53-75

*Bolt lengths were calculated using two Hydroseal flanges. Additional accessories or different mating surfaces will alter these numbers.

NOTE. Flange bolt hole pattern meets ANSI B16.5.

FLANGE BOLT TIGHTENING PATTERN
(Tighten bolts evenly; follow numerical sequence)

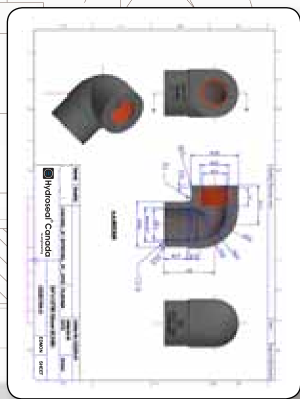


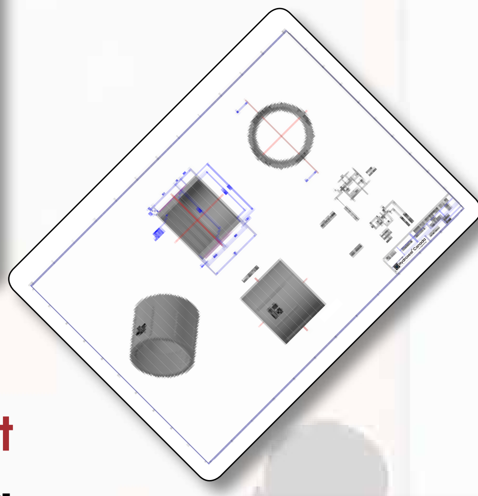
Hydroseal® Canada laboratories

ask your representative about

Hydroseal Laboratories

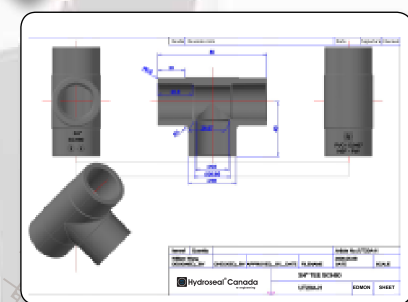
Hydroseal® Canada re-engineering

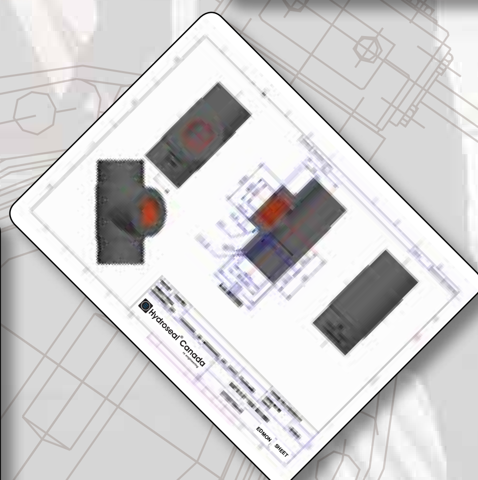


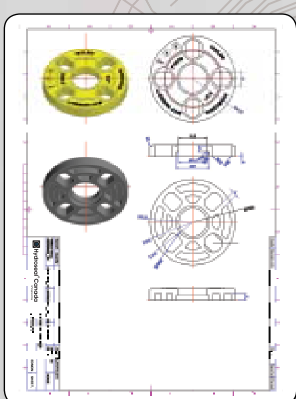


ask your representative about

Hydroseal Engineering







The data in the following tables was obtained from numerous sources in our industry. The information is based primarily on the immersion of unstressed strips in the chemicals at ambient temperature and, to a lesser degree, on field experience. The end user should be aware of the fact that actual service conditions will affect the chemical resistance. It should be noted in the following charts that the "A" rating does not mean or imply that material will perform within original specification. The Chemical Resistance Chart should be used for reference only. It is the ultimate responsibility of the end user to determine the compatibility of the chemical being used in his or her particular application.

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
ACETALDEHYDE		X	X	B	C	X	A	X	B	X	A	A	A
ACETALDEHYDE, AQ.	A	X	X	A	X	X	A	B	A				
ACETAMIDE	A			A			A	C	A	A	A		
ACETATE SOLV., CRUDE		X	X	X	A	X							
ACETATE SOLV., PURE		X	X	X	A	X	A	X	C	X	A	A	
ACETIC ACID 5%	A						A	A	A	B			
ACETIC ACID 10%	A	A	A	A	A	A	A	X	B	B	A	A	B
ACETIC ACID 20%	A	A	B	A	A	A	A	C	B	B	A	B	A
ACETIC ACID 30%	A					A	A	C	A	B			
ACETIC ACID 50%	A	A	A	A	A	A	A	C	B	A	A	C	
ACETIC ACID 60%	A	A		B	A	A	A	C	C		A	X	
ACETIC ACID 80%	A	B	B	C	A	C	A	C	B	C	A	X	
ACETIC ACID, GLACIAL	C	X	X	B	B	C	A	X	B	X	A	X	B
ACETIC ALDEHYDE							A	X	A	X			
ACETIC ANHYDRIDE		X	C	B	B	X	A	X	C	C	A	X	B
ACETIC ESTER							A	X	B	X			
ACETIC ETHER							A	X	B	X			
ACETOL							A						
ACETONE	C	X	X	B	X	X	A	X	A	C	A	A	A
ACETONITRILE	C	X		B	A	X	A	C	A	C	A		
ACETOPHENONE				A	A		A	X	A	C	A		
ACETYL ACETONE		X	X		X	X	A	X	A	X			
ACETAL BENZENE							A	X	A	X			
ACETYL BROMIDE					A		A						
ACETYL CHLORIDE		X	X	A	A	X	A	C	X	C	A		
ACETAL OXIDE							A	X	B	C			
ACETYL PROPANE							A	X	B	X			
ACETYLENE		C	C	A	A	C	A	A	A	A	A	A	
ACETYLENE DICHL.							A	A			X		
ACETYLENE TETRACHL.							A	A	X	X			
ACID MINE WATER		A	A	B	A	A	A	A					

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
ACRYLIC ACID		X	X		A	X	A						
ACRYLIC EMULSIONS				X									
ACRYLONITRILE		X	X	B	A	X	A	X	X	C	C		
ADIPIC ACID, AQ.		A	A	A	A	A	A	A	A	A			
AIR	A	A	A	A	A	A	A	A	A	A			
ALCOHOL							A	B	A	A			
ALCOHOL, ALLYL		X	X	A	A	C	A	B	A	A		A	
ALCOHOL, AMYL		C	B	A	A	C	A	A	A	A	A		A
ALCOHOL, BENZYL		X	X	A	A	X		A	C	X	A		A
ALCOHOL, BUTYL		C	A	A	A	C	A	A	A	A	A	A	A
ALCOHOL, DIACETONE		X		C	B	X	A	X	A	C	A		A
ALCOHOL, ETHER							A	B	A	C			
ALCOHOL, ETHYL	A	A	A	A	A	A	A	B	A	A	A	B	A
ALCOHOL, HEXYL		A		A		A	A	A	A	A	A		A
ALCOHOL, ISOBUTYL					A		A	A	A	B	A		A
ALCOHOL, ISOPROPYL		A	A	A	B	A	A	A	A	B	A		A
ALCOHOL, METHYL		A	X	A	A	A	A	X	A	A	A		A
ALCOHOL, OCTYL								A		B	A		A
ALCOHOL, POLYVINYL		A	A	A		A	A	A	A				
ALCOHOL, PROPARGYL		A											
ALCOHOL, PROPYL		A	A	A	A	A	A	A	A	A	A		A
ALDEHYDE							A	X	A	X			
ALKANES							A	A	X	A			
ALKAZENE							A	B	X	X			
ALLYL ALDEHYDE							A	A		B			
ALLYL BROMIDE							A	B		X			
ALLYL CHLORIDE		X			A	X	B	B	X	X	A		A
ALLYL TRICHLORIDE							A	A		X			
ALUM		A	A	A	A	A	A	A	A	A	A		A
ALUM, AMMONIUM		X	X	A	A	C		A	A	A			
ALUM, CHROME		A	A	A		A		A		A			

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Customer should test to determine application suitability.

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
ALUM, POTASSIUM		A	A	A	A	A	A	A	A	A			
ALUM, ACETATE							A	C	A	B			
ALUM, AMMONIUM				A	A		A	A	A	B			
ALUM, BROMIDE							A	A	A	A			
ALUM, CHLORIDE	A	A	A	A	A	A	A	A	A	A	C	X	C
ALUM, CHLOROHYDR.							A						
ALUM, CITRATE													
ALUM, FLUORIDE		A	A		A	C		A	A	A	C	X	C
ALUM, FORMATE							A	X		X			
ALUM, HYDROXIDE	A	A	A	A	A	C	A	C	A	A	A	A	A
ALUM, NITRATE		A	A	A	A	A	A	B	A	A		A	
ALUM, OXYCHLORIDE		A	A	A	A	A		X					
ALUM, PHOSPHATE							A	A	A	A			
ALUM, POTASSIUM		A	A	A	A	A	A	A	A	A		X	
ALUM, SALTS		A		A	A	A	A	A	A	A	X	X	
ALUM, SULFATE		A	A	A	A	A	A	A	A	A	B	X	A
AMBER ACID		A	A	A	A	A	A	A	A				
AMINES		C			B	C	A	X		X	A	A	B
AMMONIA 10%		A		A		A	A	A		X	A	A	A
AMMONIA, ANHYDROUS		X	X	A	B	X	A	X	A	C	A	A	B
AMMONIA, AQ. 25%		A	A	A	A	A						B	
AMMONIA, DRY GAS		A	A	A		A	A	X	A	A		A	A
AMMONIA, LIQUID	C	X		A	A	X	A	X	A	B	A	A	
AMMONIA, NITRATE		B	B	A	A	C		A	A	B	A	A	
AMMONIUM, PH. MONO		A		A		A	A	A	A	A	A	A	A
AMMONIUM, PH. TRI.		A		A		A	A	A	A	A	A	B	A
AMMONIUM, ACETATE		A	A	A		A	A	A	A	A			
AMMONIUM, ALUM							A			B			
AMMONIUM, BICHROM.							A		A	A			
AMMONIUM, BIFLUORIDE		A	A	A	A	A	A	A	A	B	A		
AMMONIUM, BISULFIDE		A			A	A							
AMMONIUM, CARBONATE		A	A	A	A	A	A	A	A	C	B	B	A
AMMONIUM, CASENITE											A		
AMMONIUM, CHLORIDE		A	A	A	A	A	A	A	A	B	B	C	A
AMMONIUM, DICHROMATE		A				A	A		A	A			
AMMONIUM, FLUORIDE							A			B			
AMMONIUM, FLUORIDE 10%		A	A	A	A	C	A	A	A				
AMMONIUM, FLUORIDE 20%		A		A	A	C	A	A	A				
AMMONIUM, FLUORIDE 25%		X	X	A	A	X							
AMMONIUM, HYDROXIDE	X	A	X	A	A	A	A	B	A	B	A	A	A
AMMON. METAPHOSPH.		A	A	A	A	A	A	A	A	A			

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
AMMONIUM, NITRATE		B	B	A	A	A		A	A	A	A	A	
AMMONIUM, OXALATE										A	A		
AMMONIUM, PERSULFATE		A	A	C	A	A	A	C	B	C	A	A	A
AMMONIUM, PHOSPHATE	A	A	A	A	A	A	A	A	A	A		A	
AMMONIUM, PH. DI BASIC		A	A	A		A	A	A	A	A	A	A	A
AMMONIUM, PH. MONO.			A	A		A		A		A	C	B	A
AMMONIUM, PH. TRI.			A	A		A		A		A	A	A	A
AMMONIUM, SALTS		A		A	A	A	A	C	A	A	X		
AMMONIUM, SULFATE	A	A	A	A	A	A	A	C	A	B	B	B	A
AMMONIUM, SULFIDE		A	A	A	A	A	A	C	A	A			
AMMONIUM, THIOCYAN.		A	A	A		A	A	A	A	A			
AMMONIUM, THIOSULF.							A	A	A	A	A		A
AMYL ACETATE		X	X	X	C	X	A	X	A	X	A		X
AMYL ALCOHOL		C	B	A		C	A	A	A	A	A		C
AMYL BORATE					A		A	A	X	A			
AMYL BROMIDE							A	B	X	X			
AMYL CHLORIDE		X	X	X	A	X	A	A	X	X	B	C	C
ANILINE		X	X	A	C	X	A	B	B	X	A	B	B
ANILINE CHLOROHYDRATE		X				X							
ANILINE HYDROCHLORIDE		X	X	A	A	X	A	B	B	C		X	
ANTHRAQUINONE SULF. AC.		A	A	A	A	A		A					
ANTI-FREEZE	C	A		A		A	A	A	A	A	A		
ANTICHLOR							A	A	A	A			
ANTIMONY CHLORIDE				A	A		A	A		X			
ANTIMONY PENTACHLORIDE							A			X			
ANTIMONY TRICHLORIDE		A		A	A		A	A	A	A		X	
AQUA REGIA		X	X	X	A		A	C	C	C	X	X	B
ARGON							A	A	A	C			
AROCHLOR								A		X			
AROMATIC HYDROCARBONS		X	X			X		A	X	X	A		
ARSENIC ACID		A	A	A	A	A	A	A	A	B	B	B	
ARSENOUS ACID													
ARYL SUPFONIC ACID		X	X	X	X								
ASPHALT		X	X	A	A	X	A	A	X	B	A	B	
AVIATION FUEL							A						
AVIATION TURBINE FUEL							A						
BAKING SODA							A	A	A	A		A	
BARIUM ACETATE													
BARIUM CARBONATE		A	A	A	A	A	A	A	A	A	B	B	A
BARIUM CHLORIDE		A	A	A	A	A	A	A	A	A	B	B	A
BARIUM CYANIDE							A			C	A		

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Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
BARIUM HYDRATE							A	A	A	A			
BARIUM HYDROXIDE		A	A	A	A	A	A	A	A	A	A	B	B
BARIUM NITRATE		A	A	A		A	A	A		A	A	A	A
BARIUM SALTS		A		A	A	A	A	A	A	A	A		
BARIUM SULFATE		A	A	A	A	A	A	A		A	A	B	A
BARIUM SULFIDE		A	A	A	A	A	A	A	A	A	A	B	
BEER		A	A	A	A	A	A	A	A	C	A	A	A
BEET SUGAR LIQUID		A	A	A		A	A	A	A	A	A	A	
BEET SUGAR LIQUORS		A	A	A	A	A	A	A	A	A		B	
BENZALDEHYDE		X	X	C	C	X		C	C	X	A		A
BENZALKONIUM CHL.		A											
BENZENE	C	X	X	C	B	X	A	B	X	C	B	B	A
BENZENE SULF. AC.		X	X	X	B	X	A	A	X	C			
BENZENE SULF. AC. 10%		X	X	X	B	X	A	A					
BENZIL CHLORIDE							A	A	X	X			
BENZOIC ACID		A	A	A	A	A	A	A	B	X	B	B	A
BENZYL ALCOHOL	X			A			A	A	B	C			
BENZYL BENZOATE							A	A	C	X			
BENZYL CHLORIDE				A	X		A	X	X	X			
BISMUTH CARBONATE		A	A	A	A	A	A	A	A	A			
BLACK LIQUOR		A	A	A	A	A	A	A	B	A			
BLEACH		A	A	A	A	A	A	A	A	X			
BORAX		A	A	A	A	A	A	A	A	A	A	A	A
BORIC ACID		A	A	A	A	A	A	A	A	B	B	B	A
BRAKE FLUID	C						A	X	A	C			
BREWERY SLOP								A		A	A		
BRINE		A	A	A	A	A	A	A	A	A			
BRINE ACID		A	A	A	A	A	A	A	A	A			
BROMIC ACID		A	A	X	A	A	A	A	B				
BROMINE DRY							A	A	X	X		X	
BROMINE GAS		C		X	A	C	A	A	X	X		X	
BROMINE LIQUID, BR		X	X	X	A	X	A	A	X	X		X	
BROMINE WATER		X	C	C	A	X	A	A	X	X		X	
BROMOBENZENE		X				X	A	A	X	C			
BROMOTOLUENE		X		X		X							
BUTADIENE GAS		B	A	A	A	C	A	A	X	X	A	A	
BUTANE		A	A	A	A	A	A	A	X	A	A	A	
BUTANEDIOL		A	B		A	A		A	X				
BUTANOL							A				A		
BUTTER							A	A		A	A	A	
BUTTERMILK							A	A		A	A	A	

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
BUTYL ACETATE	C	X	X	C	B	X	A	X	B	C	C	B	
BUTYL ACRYLATE PURE		X	X	X	A	X	A	X	A				
BUTYL ACRYLATE SATUR.								X	A				
BUTYL AMINE		X	X	X	B	X	A	X	X	C			
BUTYLBENZENE							A	A		X			
BUTYL BENZOATE							A	A	A	X			
BUTYL BROMIDE					A		A	B		X			
BUTYL BUTYRATE							A	C	B	X			
BUTYL CARBITOL							A	A	A	C			
BUTYL CELLOSOLVE		A	X		A	A	A	X	B	C			
BUFYL CHLORIDE					A		A	A		X			
BUTYL DIOL		B	A	A	A	C	A	A	A				
BUTYL ETHER		X	X	X	A	X	A	X	X	B			
BUTYL FORMATE							A			X			
BUTYL HYDRATE							A	A	B	A			
BUTYL HYDRIDE							A	A	X	A			
BUTYL HYDROXIDE							A	A	B	A			
BUTYL MERCAPTAN		X			A	X	A						
BUTYL PHENOL		C	A	A	A	C							
BUTYL PHTHALATE		X	X	A	A	X	A	C	B	X			
BUTYL STEARATE					A		A	A	B	B			
BUTYLENE		A	A	X	A	A	A	A	X	B	A		
BUTYRALDEHYDE							A	X	B	X			
BUTYRIC ACID		X	B	A	A		A	B	B	X	B	C	A
CADMIUM CYANIDE		A	A			A		A					
CADMIUM SALTS				A	A		A	A					
CAFFEINE CITRATE		A			A		A						
CALAMINE							A	A		B			
CALCIUM ACETATE		A	A	A	A	A	A	X	A	B			
CALCIUM BISULFIDE		A	A	A	A	A	A	A	X	A	B		A
CALCIUM BISULFITE		A	A	A	A	A	A	A	X	A		X	
CALCIUM CARBONATE		A	A	A	A	A	A	A	A	A	A	A	A
CALCIUM CHLORATE		A	A	A	A	A	A	A	A	A	A		
CALCIUM CHLORIDE		A	A	A	A	A	A	A	A	A	B	B	A
CALCIUM CYANIDE							A		A	A			
CALCIUM HYDROXIDE	A	A	A	A	A	A	A	A	A	A	A		A
CALCIUM HYPOCHLORIDE								A	A	A	X		
CALCIUM HYPOCHLORITE	A	A	A	B	A	A	A	A	A	B	X	X	B
CALCIUM NITRATE		A	A	A	A	A	A	A	A	B			
CALCIUM OXIDE		A			A	A	A		A	A			
CALCIUM PHOSPHATE							A	A	A	A			

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Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
CALCIUM SULFATE		A	A	A	A	A	A	A	A	A	A	B	A
CALCIUM SULFIDE		A	A	A	A	A	A	A	A	A			
CALCIUM THIOSULFATE							A	A	A	B			
CALGON				C	A		A	A		A	A		
CANE SUGAR LIQUORS		A	A	A	A	A	A	A	A	A	A		
CAPRYLIC ACID					A		A			C			
CARBINOL							A	X	A	A			
CARBOLIC ACID			A	A						C	A		B
CARBON BISULFIDE		X	X	X	A	X	A	A		X	C		
CARBON DIOXIDE		A	A	A	A	A	A	A	B	A	A	A	A
CARBON DISULFIDE		X	X	X	A	X	A	A	X	C	A	B	
CARBON MONOXIDE		A	A	A		A	A	A	A	A	A	A	
CARBON TETRACHLORIDE	A	X	X	X	A	X	A	B	X	C	A	A	A
CARBONIC ACID		A	A	A	A	A	A	A	A	B	B	B	
CASEIN					A		A	A	A	A			
CASTOR OIL		A	C	A	A	A	A	A	B	A			
CATSUP		A	A	A		A		A		A	A		
CAUSTIC LIME							A	B	A	A			
CAUSTIC POTASH		A	A	A	A	A	A	X	A	A		B	
CAUSTIC SODA		A	A	A	A	A	A	B	A	C		C	
CELLOSOLVE	C	B		A	A		A	C	B	C			
CHLORAL HYDRATE		A	A	A	A	A		A		C			
CHLORASETIC ACID		A		X			A	X	B	X	X	X	A
CHLORIC ACID		A			A		A			X	X	X	
CHLORIC ACID 20%		A	A	X	A	A							
CHLORINATED GLUE								A	B	C	A		
CHLORINE DIOXIDE		A	A	C	A	A	A	A	X				
CHLORINE, DRY							A	C	B	X	A		X
CHLORINE GAS, DRY	A	X	X	X	A	X	A	B	X	C			
CHLORINE GAS, WET	C	X	X	X	A	X	A	C	X	C			
CHLORINE, LIQUID		X	X	X	A	X	C			C			
CHLORINATED WATER		A	A	C	A	A	A	A	B	C	X	X	A
CHLOROSULFONIC, ACID		X	X	X	C	X	A	X	X	X	X	X	A
CHLOROX BLEACH 5.5%	A	A	A	C	A	A	A	A	B	C	A		
CHOCOLATE SYRUP				A				A		A	A	A	
CHRESYLIC ACID 50%		A			B			A		X	A		
CHROME ALUM		A	A	A	A	A		A		A			
CHROMIC ACID 5%	A	A		X		A		A	A	X	A		A
CHROMIC ACID 10%	A	A	A	B	A	A	A	A	B	X			A
CHROMIC ACID 20%		B	B	X	A	C	A	B	B	C			A
CHROMIC ACID 30%		B	B	X	A	C	A	A		X			A
CHROMIC ACID 50%	C	X	X	X	A	X	A	A	B	X	X		A
CHROMIUM ALUM		A	A	A	A	A	A	A	A				
CITRIC ACID	A	A	A	A	A	A	A	A	A	B	A		A
CITRIC OILS				A			A	A	B	A	A		
COBALT CHLORIDE							A	A	A	A			
COCONUT OIL		A	A	A	A	A	A	A	B	A			
COD LIVER OIL							A	A	A	B			
COFFEE			A	A			A	A	A	A			
COKE OVEN GAS		X	A	A	A	X	A	A	A	X			
COLA CONCENTRATES				A									
COPPER ACETATE		A	A	A	A	A	A	X	A	B			
COPPER BOROFLUORIDE		A	A	A	A	A	A	A	A				
COPPER CARBONATE		A	A	A	A	A	A	A	A	X			
COPPER CHLORIDE		A	A	A	A	A	A	A	A	A	B	B	A
COPPER CYANIDE		A	A	A	A	A	A	A	A	B	A	B	A
COPPER FLUOBORATE		A				A	A	A		B	X		
COPPER FLUORIDE		A	A	A	A	A	A	A	A				
COPPER NITRATE		A	A	A	A	A	A	A	A	A	A	B	A
COPPER SALTS		A	A	A	A	A	A	A	A	A			
COPPER SULFATE		A	A	A	A	A	A	B	A	B	A		A
COPPER SULFATE 5%		A		A		A	A	A		A	A	B	A
CORN OIL		A	A	A		A	A	A	B	A			
CORN SYRUP		A	A	A	A	A	A	A	B	A			
COTTONSEED OIL		A	A	A	A	A	A	A	B	B			
CREAM			A	A				A		A	A		
CREOSOL		X	X	C	C	X	A	A	X	X	A		
CREOSOTE		X	X			X	A	A	X	B			
CRESOLS		X	X	C	C	X	A	A	X	X	A		
CRESYLIC ACID		C	C	A	A		A	A	X	X	A	A	A
CROTON ALDEHYDE		X	X	A	C	X	A	A	B				
CRUDE OIL		A	A	A	A	A	A	A	X	X	A	B	
CRYOLITE		B	B	A	A		A	A	A	B			
CUPRIC CYANIDE													
CUPRIC FLUORIDE		A	A	A	A	A	A	A	A				
CUPRIC NITRATE							A	A	A	A			
CUPRIC SALTS		A		A	A	A	A	A	A		X		
CUPRIC SULFATE		A	A	A	A	A	A	A	A	A			
CUTTING OIL							A	A	X	A			
CYANIC ACID							A		A	A			
CYCLOHEXANE	A	X	X	X	A	X	A	A	X	C			A
CYCLOHEXANOL		X	X	A	C	X	A	A	B	B			

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Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
CYCLOHEXANONE		X	X	B	C	X	A	X	C	C			
DECALIN		X	X	A	A	X	A	A	X	X			
DECANAL							A	X		X			
DECANE					A		A	A	X	B			
DETERGENTS		A	A	B	A	A	A	A	A	A	A		
DETERGENTS, HEAVY DUTY		A	A	A	A	A							
DEVELOPERS							A			A			A
DEXTRIN		A	A	A	A	A	A	A	A				
DEXTROSE		A	A	A	A	A	A	A	A	A			
DIACETONE ALCOHOL		X	X	A	B	X	A	X	A	X			
DIALLYL PHTHALATE													
DIAZO SALTS		A	A	A	A	A							
DIBENZYL ETHER					A		A		C				
DIBUTYL AMINE					A		A	C	X	C			
DIBUTYL ETHER					A		A	C	C	C			
DIBUTYL PHTHALATE		X	X	B	A	X	A	B	A	X			
DIBUTYL SEBACATE		B			A		A	C	B				
DICALCIUM PHOSPHATE													
DICHLORETHANE	X	X				X	A	C			A		
DICHLORO BENZENE		X				X	A	B	X	X			
DICHLOROBENZENE	X	X	X		A	X	A	A	X	X			
DICHLOROETHYLENE		X		X	A	X	A	A	X	X			
DICHLOROISOPROPYL ETHER					A								
DICHLOROMETHANE	X						A	B	X	X			
DIEMETHYL PHTHALATE													
DIESEL FUEL	A	A	A	B	A	A	A	A	X	A	A		
DIETHANOLAMINE													
DIETHYL CELLOSOLVE					A				X				
DIETHYL ETHER		X	X	B	A	X	A	C	C	X		A	
DIETHYL KETONE							A	X	B	X			
DIETHYL OXIDE							A	X	X	B			
DIETHYLAMINE		X	X	A	C	X	A	X	B	B			
DIETHYLBENZENE							A	A	X	X			
DIETHYLENE GLYCOL	A		A	A			A	A		A	A		
DIETHYLENETRIAMINE					A		A			B			
DIGLYCOLIC ACID		A	A	A	A	A	A	A	A				
DIISOBUTYL KETONE					A			X	X				
DIISOBUTYLENE					A		A	A	X				
DIISOOCTYL PHTHALATE	A						A	B	B				
DIISOPROPYL KETONE					B		A	X	B				
DIMETHYL AMINE		X	X	A	B	X	A	X	C	B			

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
DIMETHYL BENZENE							A	A	X	X			
DIMETHYL ETHER							A	B	B	B			
DIMETHYL FORMAMIDE	X	X	X	A	A	X	A	C	B	B			
DIMETHYL KETONE							A	X	A	X			
DIMETHYL PHTHALATE					B		A	B	B	X			
DIMETHYLAMINE		X	X	A	X	X		X	X				
DIOCTYL PHTHALATE		X	X	X	A	X	A	A	B	X			
DIOXANE	X	X	X	B	X	X	A	X	B	X			
DIOXOLANE					X			X	X				
DIPHENYL							A	A	X	X			
DIPHENYL ETHER													
DIPHENYL OXIDE								A	X	X			
DIPROPYLENE GLYCOL							A	A		A			
DISOD.METHYLARSONATE													
DISODIUM PHOSPHATE		A	A	A	A	A	A		A	A			
DISTILLED WATER		A	A	A	A	A							
DIVINYLBENZENE		X	X	X	X	X							
DOLOMITE							A	A	B	A			
DOWTHERM													
DRY CLEANING SOLVENTS						X	A	A	X	A			
EPICHLOROHYDRIN		X	X	A	A		A	X	X				
EPSOM SALT		A		A	A	A	A	A	A	A	A		A
ESTERS		X	X	C	A	X	A						
ETHANE							A	A	X	A	A		A
ETHANOL	A	A	A	A	A	A	A	B	A	A	A	B	A
ETHANOLAMINE		X	X	X	X	X	A	X	A	B	A	A	
ETHERS		X	X	C		X	A	C	C	X	A	B	
ETHYL ACETATE	C	X	X	C	A	X	A	X	B	X	A	B	
ETHYL ACETOACETATE		X	X		A	X	A	X	A	X			
ETHYL ACRYLATE	C	X	X	X	A	X	A	X	B	X			
ETHYL ALCOHOL		A	A	A	A	A	A	B	A	A	A	B	A
ETHYL BENZENE					A		A	A	X	X			
ETHYL BENZENE					A		A	A	X	X			
ETHYL BROMIDE				X									
ETHYL BUTYRATE													
ETHYL CELLOSOLVE													
ETHYL CHLORIDE		X	X	X	A	X	A	A	A	B	A	A	A
ETHYL ETHER	A	X	X	B	A	X	A	C	X	X			
ETHYL FORMATE							A	B	B	X			
ETHYL HEXANOL					A		A	A	A	B			
ETHYL SULFATE							A	X		C	X		

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X = Not recommended. Ratings are based on testing at an ambient temperature of 70° F.

Customer should test to determine application suitability.

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
ETHYLCELLULOSE													
ETHYLENE BROMIDE		X	X	C	A	X	A	B	C	X			
ETHYLENE CHLORIDE		X	X	C	A	X	A	A	C	X	A	A	B
ETHYLENE CHLOROHYDRIN		X	X	A	A	X	A	A	A	X			
ETHYLENE DIAMINE	X	X	X	A	C	X	A	X	A	A			
ETHYLENE DICHLORIDE		X	X	C	A	X	A	A	X	X	A	A	A
ETHYLENE GLYCOL	A	A	C	A	X	A	A	A	A	A	A	B	
ETHYLENE OXIDE		X	X	X	A	X	A	X	X	X	A		
EXTRIN		A	A	A	A		A	A	A				
FATTY ACIDS		A	B	A	A	A	A	A	X	B	A	B	A
FERRIC ACETATE		B				B	A	X		X			
FERRIC CHL. ANHYDROUS		A	A	A	A	A	A	A	A	B	X	X	A
FERRIC HYDROXIDE		A	A	A		A	A	C	A				
FERRIC NITRATE		A	A	A	A	A	A	A	A	A	B	B	A
FERRIC SULFATE		A	A	A	A	A		A	A	B	B	B	A
FERROUS CHLORIDE		A	A	A	A	A	A	A	A	B	X	X	A
FERROUS NITRATE		A	A	A	A	A	A	A	B	A			
FERROUS SULFATE		A	A	A	A	A	A	A	A	A	C	B	A
FISH SOLUBLES		A	A	B		A							
FLUOBORIC ACID	B	A	A	A	A	A		A	A	B	B		X
FLUORINE GAS (WET)		A	A	B	A	C	A	A	A	X			
FLUORINE LIQUID		C		X	A	X	B	B	C	X	X		X
FLUOSILICIC ACID 25%		A	A	A	A		A	A	A	A	B	C	X
FORMALDEHYDE	A	X	A	A	A	B	A	B	B	B	A	B	A
FORMALDEHYDE 35%		A	A	A	A	A	A	A	A			B	
FORMALDEHYDE 50%		A	A	A	A	A	A	B	X				
FORMIC ACID	B	A	A	A	A	A	A	X	A	C	B	B	C
FREON 11		X	A	A	A	X	A	B	X	B	A	A	
FREON 113		A			A	A	A	B	X	A	A	A	
FREON 114		A			A	A	A	A	C	A			
FREON 12		C	A	A	A	C	A	B	A	B	A	A	
FREON 12 (WET)		B		A		C	A	A	B	A	X	A	
FREON 22		X	X	A	A	X	A	X	B	X	A	A	
FREON TF	A	B	B	X		C	A	B	X	A	A	A	
FRUCTOSE		A	A	A	A	A	A	A	A	A	A		
FRUIT JUICE		A	A	A	A	A	A	A		A	A		
FRUIT PULP		A	A	A	A	A		A					
FUEL OIL		B		B	A	C	A	A	X	A	A		A
FUMARIC ACID							A	A		A			
FURAN							A	X	X				
FURFURAL (ANT OIL)		X	X	C	B	X	A	X	B	X	A	A	
FURFURAL ALCOHOL					B		A	X	C				
GALLIC ACID		A	A	A	A	A	A	A	A	A	A	B	
GAS, NATURAL		A	A	A	A	A		A	X	A			
GASOLINE, LEADED	A	A	X	X	A	A	A	B	X	A	A	A	X
GASOLINE, SOUR		A	B	X	A	A	A	A	X	A	A	A	X
GASOLINE, UNLEADED	A	C	X	X	A	C	A	B	X	A	A	A	X
GELATIN		A	A	A	A	A	A	A	A	A	A	A	
GIN		A	A	A	A	A	A	A	A				
GLUCONIC ACID 50%													
GLUCOSE		A	A	A	A	A	A	A	A	A	A	A	
GLUE		A	A	A	A	A	A	A	B	A	A	A	A
GLYCERINE	A	A	A	A	A	A	A	A	A	A	A	A	A
GLYCEROL		A	A	A	A	A	A	A	A	A	A		
GLYCOLIC ACID		A	A	A	A	A	A	A	A	A			
GLYCOLS		A	A	A	A	A	A	A	A	A			
GLYOXAL								A					
GOLD MONOCYANIDE								A		A	A		
GRAPE JUICE		A	A			A		A		A	A		
GRAPE SUGAR		A	A	A	A	A	A	A	A	A			
GREASE		A		A	A	A	A	A	X	B	A		
GREEN LIQUOR		A	A	A	A	A	A	A	A	B			
HELIUM							A	A	A	A			
HEPTANE		A	A	B	A	A	A	A	X	A	A		
HEXANE	A	X	A	B	A	X	A	A	X	A	A		
HEXENE							A	A	X	A			
HEXYL ALCOHOL		A	A	A	A	A	A	A	B				
HONEY		A		A	A	A	A	A		A	A		
HYDRAULIC OIL	A						A	A	X	X			
HYDRAULIC OIL (SYNTH.)				X		C		A		C	A		
HYDRAZINE		X	X	X	X	X	A	X	A	C	A		
HYDROBROMIC ACID		A	A	B	A	A	A	A	A	X	X	X	A
HYDROBROMIC ACID 20%		A	A	A	A	A	A	A	A	X	X	X	A
HYDROBROMIC ACID 50%		A	A	B	A	A	A	A	A	X	C	X	X
HYDROCHLORIC ACID	A	A					A		A		A		
HYDROCHLORIC ACID 10%	A	A	A	A	A	A	A	A	A	B		X	C
HYDROCHLORIC ACID 20%	A	A	A	A	A	A	A	A	A	B	X	X	C
HYDROCHLORIC ACID 25%	A	A	A	A	A	A	A	A	A	C		X	
HYDROCHLORIC ACID 37%	A	A	A	A	A	A	A	A	C	C	X	X	C
HYDROCYANIC ACID		A	A	A	A	A	A	A	A	B	A	B	A
HYDROCYANIC ACID 10%		A	A	A	A	A	A	A	A	B	X	X	
HYDROFLUORIC ACID 10%		A	A	A	A	C	A	A	A	B		X	

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Customer should test to determine application suitability.

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
HYDROFLUORIC ACID 20%		A		A		C	A	A	A	X	X	X	X
HYDROFLUORIC ACID 30%		A	A	A	A	C	A	A	A			X	
HYDROFLUORIC ACID 40%		B	X	A	A	C	A	A	A			X	
HVDROFLUORIC ACID 50%	A	X	X	A	B	X	A	A	A	C	X	X	X
HYDROFLUORIC ACID 65%							A	A	B	X		X	
HYDROFLUORIC ACID 75%		X	C	A	A	X	A	A	X	X	X	X	
HYDROFLUOSILIC ACID		A	A	A	A	A	A	A	A	A	X	X	A
HYDROFLUOSILIC ACID 20%		A	A	A		A	A	A	A	B	X	X	X
HYDROGEN		A	A	A	A	A	A	A	A	A	A	A	
HYDROGEN CHL. GAS DRY				A	A							X	
HYDROGEN CYANIDE		A	A	A	A	A	A	A	A	B		C	
HYDROGEN FLUORIDE		X	X	A	A	X						C	
HYDROGEN PEROXIDE 5%		A	X	A	A	A	A	A	A			B	
HYDROGEN PEROXIDE 10%		A	A	A	A	A	A			A	C	B	C
HYDROGEN PEROXIDE 30%	A	A	X	C		A	A	A	B	X	B	B	B
HYDROGEN PEROXIDE 50%		B	B	A	A	C	A	A	C	X		C	
HYDROGEN PEROXIDE 90%		X	X	X	A	C	A	B	C	X		X	
HYDROGEN PEROXIDE		A		A	A	A	A	A	B	C	B	B	B
HYDROGEN PHOSPHIDE		X	A	A	A	C				C			
HYDROGEN SULFIDE		A		A	A	A	A	A	A			C	
HYDROGEN SULF. (AQ. SOL.)		A	A	A		A	A	C	A	C	A	C	A
HYDROGEN SULFIDE (DRY)		A	A	A	A	A	A	A	A	A	A	C	
HYDROQUINONE		A	A	A	A	A	A	A	A	X			
HYDROXYACETIC ACID			A					A		A			A
HYDROXYACETIC ACID 70%		A	A			A		A	A	A			B
HYDROXYLAMINE SULFATE		A	A	A	A	A			A				
HYPOCHLOROUS ACID		A	A	A	A	A	A	B	B	X	X		
INK				A	A					A	A		
IODINE SOLUTION	A	X	A	C	A	X	A	A	A	C	X	X	A
ISOBUTYL ALCOHOL	A				A		A	A	A				
ISOOCTANE		A	A	A	A	A	A	A	A	A			
LSOPHORONE		X	X			X		X	X				
ISOPROPYL ACETATE							A	X	B	X	B		
ISOPROPYL ALCOHOL		A	A	A	B	A	A	A	A	B	A		A
ISOPROPYL ETHER		X	X	C	A	X	A	X	X	B	A		
JET FUEL JP-3				A			A	A	X	A	A	A	
JET FUEL JP-4		A	A	C	A	A	A	A	X	B	A	A	
JET FUEL JP-5	A	A	A	C	A	A	A	A	X	A	A	A	
KEROSENE	A	A	A	A	A	A	A	A	X	A	A	A	A
KETONES		X	X	A	A	X	A	X	C	X	A		A
KRAFT LIQUOR		A	A	A	A	A							

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
LACQUER				A			A	X	X	X	A		
LACQUER THINNER		C		B		C	A		A	X	A		A
LACTIC ACID	A	A	A	A	A	A	A	B	B	B	A	C	B
LARD	A	A	A	A	A	A	A	A	C	A	A	A	
LARD OIL		A	A	A	A	A	A	A	A				
LATEX				A			A	A	B	B	A	A	
LAURIC ACID		A	A	A	A	A	A						
LAURYL CHLORIDE		A	A	A	A	A	A						
LEAD ACETATE		A	A	A	A	A	A	C	A	B	B	B	A
LEAD CHLORIDE		A	A	A	A	A	A	A	A				
LEAD NITRATE		A	A	A		A	A	A	A	A		B	
LEAD SULFATE		A	A	A	A	A	A	A	A	A			
LEMON OIL		A	A	X	A	A	X						
LEVULINIC ACID													
LIGROIN		X	X	C	A	X		A	C	A	A		
LIME (CALCIUM OXIDE)		A		A		A	A	A	C	A	A		A
LIME - SULFUR SOLUTION		A	A	A	A	A				X		B	
LINOLEIC ACID		B	A	A	A	C	A	B	X	B		A	
LINSEED OIL		A	A	A	A	A	A	A	B	A		A	
LITHIUM BROMIDE		A			A	A	A	A		A			
LITHIUM CHLORIDE						A						X	
LPG							A						
LUBRICANTS		A		A		A	A	A		A	A	A	A
LUBRICATING OIL		A	A	A	A	A	A	A				A	
LYE SOLUTION													
MACHINE OIL		A	A	A	A	A	A	A					
MAGNESIUM ACETATE							A	X		X			
MAGNESIUM CARBONATE		A	A	A	A	A	A	A	B	A	A	A	
MAGNESIUM CHLORIDE		A	A	A	A	A	A	A	A	A	B	B	A
MAGNESIUM CITRATE		A	A	A	A	A	A	A	A				
MAGNESIUM HYDROXIDE		A	A	A	A	A	A	A	A				
MAGNESIUM NITRATE		A	A	A	A	A	A	A	B	A	A	A	A
MAGNESIUM OXIDE							A	A	A	A	A	B	
MAGNESIUM SULFATE		A	A	A	A	A	A	A	C	A	A	A	A
MALEIC ACID		A	A	A	A	A	A	A	C	X	A	A	A
MALEIC ANHYDRIDE								A		X			
MALIC ACID		A	A	A	A	A	A	A	X	A	A	B	A
MANGANESE SULFATE		A	A	A		A	A	A	A	A			
MASH										A	A		
MAYONNAISE				A			A	A		A	A		
MELAMINE										C	X		

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Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
MERCURIC CHLORIDE		A	A	A	A	A	A	A	A	A	X	X	A
MERCURIC CYANIDE		A	A	A	A	A	A	A	B	A	A	X	A
MERCURIC NITRATE							A	A	A			A	
MERCURIC SULFATE		A	A	A	A	A	A	A	A	A			
MERCUROUS CHLORIDE													
MERCUROUS NITRATE		A	A	A	A	A	A	A	A				
MERCURY		A	A	A	A	A	A	A	A	A	A	A	B
METHACRYLIC AC. GLACIAL		X											
METHANE		A	A	A	A	A	A	A	C	A		A	
METHANE SULFONIC AC.					A		A						
METHANOL	A	A	X	A	A	A	A	X	A	A	A		A
METHOXYETHYL OLEATE		A				A							
METHYI ”CELLOSOLVE”		X	X	A	A	X		X	B	X			
METHYL ACETATE		X	X	B	A	X	A	X	B	X	A		
METHYL ACETONE							A	X		X	A		
METHYL ACRYLATE					A		A	X	B	X	A		
METHYL ALCOHOL		A	A	A	A	A	A	C	A	A		B	
METHYL BENZENE							A	A	X	X			
METHYL BROMIDE		X	X	X	A	X	A	A	C	X			
METHYL BUTANOL							A	B		A			
METHYL BUTYL KETONE							A	X	B	X	A		
METHYL CHLORIDE		X	X	X	A	X	A	C	C	C	A	B	A
METHYL CHLOROFORM		X	X	C	A	X	A	B	X				
METHYL ETHER							A	C	C	B			
METHYL ETHYL KETONE	C	X	X	C	X	X	A	X	A	X	A		A
METHYL FORMATE								X	A				
METHYL ISOBUTYL ALCOHOL										X			
METHYL ISOBUTYL CARBINOL							A	A	A				
METHYL ISOBUTYL KETONE		X	X	C	A	X	A	X	B	X	A		A
METHYL ISOPROPYL KETONE		X	X	B	A	X	A	X	C	X	A		
METHYL METHACRYLATE	C	A					A	X	X	X			
METHYL PROPANOL							A	A	B	A			
METHYL SALICYLATE		A	A	A	A	A							
METHYL SULFATE		B	A	A	A	C							
METHYLAMINE		X	X	X	C	X	A		A	B	A		
METHYLENE BROMIDE		X			X	X							
METHYLENE CHLORIDE		X	X	X	C	X	A	B	X	X	A	B	A
METHYLENE IODINE		X			C	X	A	A					
METHYLHEXANE							A	A	X	A			
METHYLISOBUTYL CARB.		A	A	A	A	A		A	A				
METHYLMETHACRYLATE					A		A	X	X				

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
METHYLSULFURIC ACID		A	A	A	A	A	A						
MILK	B	A	A	A	A	A	A	A	A	A	A	A	
MINERAL OIL	A	B	A	A	A	A	A	A	X	A		A	
MOLASSES		A	A	A		A	A	A	C	A	A	A	
MONOCHLOROACETIC ACID		A	A	B	A	A	A	B	C			X	
MONOCHLOROBENZENE				B	A		A	A	X				
MONOETHANOLAMINE		X			X	X	A	A	A	A		A	
MORPHOLINE							A				A		
MOTOR OIL	A	A	A	C	A	A	A	A	X	A			
MUSTARD		A	A	A		A		A		B	A		
NAPHTHA	A	A	A	A	A	A	A	A	X	B	A	A	A
NAPHTHALENE		X	X	B	A	X	A	B	X	X	B	A	A
NATURAL GAS		A	A	A	A	A		A	X	A			
NEON							A	A	A	A			
NICKEL		A	A	A		A	A	A	A	A			
NICKEL ACETATE		A	A	A	A	A	A	X	A	B			
NICKEL CHLORIDE		A	A	A	A	A	A	A	A	B	B	X	A
NICKEL CYANIDE		A	A			A							
NICKEL NITRATE		A	A	A	A	A	A	A	B	A		B	
NICKEL SULFATE		A	A	A	A	A	A	A	A	A	C	B	
NICOTINE		A	A	X	C	A	A						
NICOTINE ACID		A	A	A	A	A	A		A				
NITRIC ACID 10%	A	A	A	A	A	A	A	A	B	X	A	B	A
NITRIC ACID 20%	A	A		A		A	A	A	X	X		B	
NITRIC ACID 30%	A	A	A	A	B	A	A	A	B	X		B	
NITRIC ACID 40%	A	A	A	C	B	A		A	X	X		C	
NITRIC ACID 50%		A	A	C	B	A	A	A	X	X		X	
NITRIC ACID 70%	A	X	X	X	X	X	A	C	X	X		X	
NITRIC ACID CONCENTR.		X	X	X	X	X	A	C	X	X		C	
NITRIC ACID FUMING		X	X	X	X	X						C	
NITROBENZENE	C	X	X	C	A	X	A	C	C	C	B	B	A
NITROETHANE					A		A	X	A				
NITROGEN							A	A	A	A		A	
NITROGEN DIOXIDE					A		A						
NITROGEN SOLUTIONS													
NITROGLYCERINE		X							A				
NITROMETHANE					A		A		B				
NITROUS OXIDE		A	A	A	A	A	A	A	A	A			
OCENOL		A	A	X	A	A							
OCTANE					A		A	A	X				
OCTYL ACID					A		A			C			

A = Excellent, no effect • B = Good, minor effect • C = Fair, data not conclusive, testing recommended

X = Not recommended. Ratings are based on testing at an ambient temperature of 70º F.

Customer should test to determine application suitability.

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
OCTYLAMINE							A	X		C			
OILS		A	A	A	A	A							
OILS, ANILINE		X		A		X	A	A	B	X	A		A
OILS, ANISE			X								A		
OILS, BAY			X					A			A		
OILS, BONE								A		A	A		
OILS, CASTOR		A	C					A	B	A	A		
OILS, CINNAMON		A	X					A			A		
OILS, CITRIC			X	A				A		A	A		
OILS, CLOVE			X	B						A	A		
OILS, COCONUT			C	A				A	A	A	A		
OILS, COD LIVER			C	A				A	A	A	A		
OILS, CORN			C	A				A	C	A	A		
OILS, COTTON SEED		A	C	A		A	A	A	C	A	A		
OILS, CREOSOTE				X		X		A	X	B	A		
0IIS, CRUDE SOUR												C	
OILS, DIESEL FUEL			A	A		A		A	X	A	A		
OILS, FUEL		A				A	A	A	X	B	A		A
OILS, LINSEED		A	C	A		A		A	X	A	A		
OILS, MINERAL		A	A	A		A		A	X	A	A	A	
OILS, OLIVE		A	C	A		A	A	A	B	A	A	A	
OILS, PINE		A	X				A	A	A		C	A	
OILS, SILICONE			A	A		A		A		A	A		
OILS, VEGETABLE		A	C	A	A	A		A		A		A	
OLEIC ACID	A	A	B	A	A	A	A	B	C	B	A	B	
OLEUM		X	X	X	X	X	A	X	X	X	A		
ORANGE EXTRACT			X	A	A		A						
OXALIC ACID		A	A	A	A	A	A	A	A	B	B	C	C
OXYGEN GAS		A	A	A	A	A	A	A	A	C			
OZONE		B	B	C	A	B		A	A	X			
PALMITIC ACID 10%		A	A	A	A	A	A	A	B	A			
PALMITIC ACID 70%		X	A	A			A	A	B	A			
PARAFFIN		A	A	A	A	A	A	B	X	A	A	A	
PENTANE							A	A	X	A	C		
PERACETIC ACID 40%		X	X	X	A	X	A	A	B				
PERCHLORLC ACID 10%		A	A	A	A	A	A	A	B	X		B	
PERCHLORLC ACID 70%	X	X	X	A	A	X	A	A	A	X		X	
PERCHLOROETHYLENE		X	X	C	A	X	A	A	X	X	A		
PERPHOSPHATE		A	A	A		A	A	A	A				
PETROLATUM		A	A	A	A	A	A	A	C	A	A		
PETROLEUM (SOUR)		A				A		A	X	A		C	

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
PETROLEUM OILS		A	A	B	A	A	A	A	X	A		A	
PHENOLS 100%	X	X	A	A	A	X	A	B	C	X	A		C
PHENYLACETATE							A	X	B	X			
PHENYLHYDRAZINE		X	X	X	A	X	A	C	C	X			
PHENYLHYDRAZINE HYDROCHL		X	A	X	A	X							
PHOSGENE GAS		X	X	C	A	X		X	A	X			
PHOSGENE LIQUID		X	X	X	C	X		X	A	X			
PHOSPHORIC ACID 10%	A	A	A	A	A	A	A	A	A	C	A		B
PHOSPHORIC ACID 20%	A	A	A	A	A	A	A	A	A	C			
PHOSPHORIC ACID 40%	A	A		A		A	A	A	B	X	A		A
PHOSPHORIC ACID 50%	A	A	A	A	A	A	A	A	A	C	B		B
PHOSPHORIC ACID 80%	A	A	A	A	A	A	A	A	A				
PHOSPHORIC ACID 85%	A	A	A	A	B	A	A	A	A	C	B		C
PHOSPHORIC ACID 100%		A		A		A	A	A	B	X	B		B
PHOSPHORIC ACID CRUDE							A	A	B	C	C		C
PHOSPHOROUS OXYCHLORIDE							A						
PHOSPHOROUS RED		A	A	A	A	A	A						
PHOSPHOROUS TRICHLORIDE		X	X	C	A	X	A	C	C	X	A		
PHOSPHOROUS YELLOW		A	A	A	A	A	A						
PHOTOGRAPHIC DEVELOPER		A	A	A	A	A		A		A	A		A
PHOTOGRAPHIC SOLUTIONS		A	A	A	A	A	A	A		A			
PHTHALIC ACID		X	X	X	A	X	A	A	A			B	
PHTHALIC ANHYDRIDE		X	X	X		X	A	A	A	C	B	A	
PICKLE BRINE		A	A	A	A	A							
PICKLING SOLUTIONS		A	A	A	A	A	A	B	C	X			
PICRIC ACID		X	C	A	A	X	A	A	C	B	A	B	
PINE OIL						A	A	A	X	B			
PLATING SOL. ANTIMONY		A	A	A		A	A	A		A	A		A
PIATING SOL. ARSENIC		A	A	A		A		A		A	A		A
PLATING SOLUTIONS, BRASS		A	A	A	A	A	A	A	A	A	A		A
PLATING SOLUTIONS, BRONZE		A	A	A		A	A	A		A	A		A
PLATING SOL. CADMIUM		A	A	C	A	A	A	A	A	A	A		A
PLATING SOLUTIONS, CHROME		A	A	C	A	A	A	C	B	X	C	A	A
PLATING SOLUTIONS, COPPER		A	A	A	A	A	A	A	A	A	X		A
PLATING SOLUTIONS, GOLD		A	A	C	A	A	A	A	A	A	C		A
PLATING SOLUTIONS, LNDIUM		A	A	A		A	A	A		A	C		A
PLATING SOLUTIONS, IRON		X	A	C		X	A	A		A	C		A
PLATING SOLUTIONS, LEAD		A	A	A	A	A	A	A	A	B	C		X
PLATING SOLUTIONS, NICKEL		A	A	A	A	A	A	A	A	A	C		A
PLATING SOL. RHODIUM		A	A	A	A	A	A	A	A	A	X		X
PLATING SOLUTIONS, SILVER		A	A	A	A	A	A	A	A	A	A		A

A = Excellent, no effect • B = Good, minor effect • C = Fair, data not conclusive, testing recommended

X = Not recommended. Ratings are based on testing at an ambient temperature of 70º F.

Customer should test to determine application suitability.

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
PLATING SOLUTIONS, TIN		A	A	A	A	A	A	A	A	B	C		X
PLATING SOLUTIONS, ZINC		A	A	A	A	A	A	A	A	A	X		A
POLYETHYLENE GLYCOL		A	A	A	A	A	A	A	A	A			
POLYVINYL ACETATE EMUL					A		A	A	A				
POLYVINYL ALCOHOL		A	X	A	A	A	A	A	A				
POTASH		A	A	A	A	A	A	C	B	C	A		
POTASSIUM ACETATE		A	A	A	A	A	A	X	A	B			
POTASSIUM ALUM		A	A	A	A	A	A	A	A	A		B	
POTASSIUM BICARBONATE		A	A	A	A	A	A	A	A	A	B	B	A
POTASSIUM BICHROMATE		A	A	A	A	A	A	A	A	A		B	
POTASSIUM BISULFATE		A	A	A	A	A	A	A	A	A			
POTASSIUM BROMATE		A	A	A	A	A	A	A	A	A			
POTASSIUM BROMIDE		A	A	A	A	A	A	A	A	A	B	B	A
POTASSIUM CARBONATE	A	A	A	A	A	A	A	A	A	B	A	B	A
POTASSIUM CHLORATE		A	A	A	A	A	A	A	A	A	A	B	A
POTASSIUM CHLORIDE		A	A	A	A	A	A	A	A	A	A	B	A
POTASSIUM CHROMATE		A	A	A	A	A	A	A	A	A	B	B	
POTASS. COPPERCYANIDE		A	A	A	A	A	A	A	A				
POTASSIUM CYANIDE		A	A	A	A	A	A	B	A	A	B	B	A
POTASSIUM DICHROMATE		A	A	A	A	A	A	A	A	A	A	B	A
POTASSIUM FERRICYANIDE		A	A	A	A	A	A	A	A	A		A	
POTASSIUM FERROCYANIDE		A	A	A	A	A	A	A	A	C		A	
POTASSIUM FLUORIDE		A	A	A	A	A	A	A	A	A			
POTASSIUM HYDROXIDE	A	A	A	A	A	A	A	C	B	C	C	A	C
POTASSIUM HYDROXIDE 25%						A							
POTASSIUM HYDROXIDE 50%		A	A	A	B	A							
POTASSIUM HYPOCHLORITE		A	A	A	A	A	A	A	A	X		X	
POTASSIUM IODIDE		A	A	A	A	A	A	A	A	A		A	
POTASSIUM NITRATE		A	A	A	A	A	A	B	A	A	B	B	A
POTASSIUM PERBORATE		A	A	A	A	A	A						
POTASSIUM PERCHLORATE		A	A	A		A	A		A				
POTASSIUM PERMANGAN.		A	A	B	A	A	A	B	A	C	B	B	B
POTASSIUM PERSULFATE		A	A	A	A	A	A		A				
POTASSIUM PHOSPHATE										A			
POTASSIUM SALTS				A	A		A	A	A				
POTASSIUM SULFATE		A	A	A	A	A	A	A	A	A	B	B	A
POTASSIUM SULFIDE		A				A	A	A	A	A		B	
POTASSIUM THIOSULFATE							A	A		A			
PROPANE		A	A	B	A	A	A	A	X	A	A	A	
PROPANOL							A	A	A	A		A	
PROPARGYL ALCOHOL		A	A	A	A	A							

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
PROPYL ACETATE					A		A	X	B	X			
PROPYL ALCOHOL		A	A	A	A	A	A	A	A	A		A	
PROPYLENE							A	A	X	X			
PROPYLENE DICHLORIDE		X	X	C	A	X	A	B	X	X			
PROPYLENE GLYCOL	A		C				A	A	A	A	A		
PYRIDINE	X	X	X	C	C	X	B	X	C	X	C	B	
PYROGALLIC ACID		B			X	C	A	A		A	A	B	
QUATERNARY AMM. SALTS													
RAYON COAGULATING BATH		A	A	A	A	A							
RHODAN SALTS		A	A	A	A	A	A	A	A				
ROSINS				A			A	A		A	A	B	
RUM		A		A		A	A	B	A	A			
RUST INHIBITORS				A				A		A	A		
SALAD DRESSINGS		A		A		A		A		A	A		
SALICYLALDEHYDE	X	X			C	X	A	A	A				
SALICYLIC ACID	A	A			A	A	A	A	A	C		B	
SALINE SOLUTIONS		A	A	A	A	A							
SALT BRINE		A	A	A	A	A	A	A	A	A			
SEA WATER		A	A	A	A	A	A	A	A	A	C	C	A
SELENIC ACID		A	A	A	A	A							
SEWAGE		A	A	A	A	A	A	A	A	A			
SHELLAC BLEACHED				A			A			A	A	A	
SHELLAC ORANGE				A			A			A			
SILICIC ACID		A	A	A	A	A	A	A	A				
SILICONE OIL		A	A	A		A	A	A	A	A	A		
SILVER BROMIDE											C	X	
SILVER CYANIDE		A	A	A	A	A	A	A	A			A	
SILVER NITRATE		A	A	A	A	A	A	A	C	C	B	B	A
SILVER SALTS		A		A	A	A	A	A	A		A		
SILVER SULFATE		A	A	A	A	A	A	A	A	C			A
SOAP SOLUTIONS		A	A	A	A	A	A	A	A	A	A	A	A
SODA ASH							A	A	A	A			
SODIUM		A	A	A	A	A	A	A	A				
SODIUM ACETATE		A	A	A	A	A	A	C	A	C	B	B	A
SODIUM ALUM		A	A	A	A	A	A	A	A	A			
SODIUM ALUMINATE							A	A	A	A	A	C	B
SODIUM BENZOATE		A	A	A	A	A	A						
SODIUM BICARBONATE		A	A	A	A	A	A	A	A	A	A	A	A
SODIUM BICHROMATE		A	A	A	A	A	A	A	A			B	
SODIUM BISULFATE		A	A	A	A	A	A	A	A	B	A	A	A
SODIUM BISULFITE		A	A	A	A	A	A	A	A	A	A	C	A

A = Excellent, no effect • B = Good, minor effect • C = Fair, data not conclusive, testing recommended

X = Not recommended. Ratings are based on testing at an ambient temperature of 70° F.

Customer should test to determine application suitability.

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
SODIUM BORATE		C	A	A	A	C	A	A	A	A		A	
SODIUM BROMATE													
SODIUM BROMIDE		A	A	A	A	A	A	A	A			C	
SODIUM CARBONATE		A	A	A	A	A	A	A	A	A	A		A
SODIUM CHLORATE		A	A	A	A	A	A	A	A	C	B	B	A
SODIUM CHLORIDE		A	A	A	A	A	A	A	A	A	C	B	A
SODIUM CHLORITE		X	X	X		X	B	X	X				
SODIUM CHROMATE				A			A	B		A	A	B	
SODIUM CYANIDE		A	A	A	A	A	A	A	A	A	A	A	A
SODIUM DICHROMATE		A	A	A	A	A	A	A	A				
SODIUM FERRICYANIDE		A	A	A	A	A	A	A	A			B	
SODIUM FERROCYANIDE		A	A	A	A	A	A	A	A				
SODIUM FLUORIDE		A	A	A	A	A	A	B	A	C		C	A
SODIUM HYDROSULFIDE													
SODIUM HYDROSULFITE		C					A	A					
SOD. HYDROXIDE 15%	A	A	A	A	A	A	A	C	A	A	B	B	A
SODIUM HYDROXIDE 20%		A	A	A	A	A	A	C	A	A	B	B	A
SODIUM HYDROXIDE 30%		A	A	A	A	A	A	C	A		B	B	
SODIUM HYDROXIDE 50%		A	A	A	A	A	A	C	A	X	B	C	A
SODIUM HYDROXIDE 70%		A	A	B	B	A	A	X	A	X		X	A
SOD. HYDROXIDE CONC.		A	A	A	A	A	A	B	A	X		C	
SOD. HYPOCHLORITE 20%		A	A	A	A	A	A	A	B	C	C		A
SODIUM HYPOCHLORITE	A	A	A	B	A	A	A	X	X	X			
SODIUM HYPOSULFATE							A				A		
SODIUM METAPHOSPHATE		A	A	C	A	A	A	A	A	A	A		
SODIUM METASILICATE		A	A	A	A	A	A	A	A	A	A	A	
SODIUM NITRATE		A	A	A	A	A	A	B	A	C	B	B	A
SODIUM NITRITE		A	A	A	A	A	A	A	A		B		
SODIUM PALMITRATE		A	A	A	A	A	A						
SODIUM PERBORATE		A	A	A	A	A	A	A	A	C	C	B	
SODIUM PERCHLORATE		A	A	A	A	A	A						
SODIUM PEROXIDE		A	A	A	A	A	A	A	B	C	A	A	
SODIUM PHOSPHATE AC.		A	A	A	A	A	A	A	A	A			
SODIUM PHOSPH. ALKAL.		A	A	A	A	A	A	A	A	A			
SODIUM PHOSPH. NEUTR.		A	A	A	A	A	A	A	A	A			
SODIUM POLYPHOSPH.							A	A	A	B	A		A
SODIUM SILICATE		A	A	A	A	A		A	A	A	B	B	A
SODIUM SULFATE		A	A	A	A	A	A	A	A	A	B	B	A
SODIUM SULFIDE		A	A	A	A	A	A	A	A	C	B	X	A
SODIUM SULFITE		A	A	A	A	A	A	A	A	A	C	B	A
SODIUM TETRABORATE		A						A		A	A	A	

Chemicals

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
SODIUM THIOCYANATE		A	A	A	A	A	A	A	A				
SODIUM THIOSULPHATE		A	A	A	A	A	A	A	A	B	A	A	
SORGHUM								A		A	A		
SOY SAUCE								A		A	A		
SOYBEAN OIL		A	A	A	A	A	A	A	A				
STANNIC CHLORIDE		A	A	A	A	A	A	A	A	A	A	X	A
STANNIC SALTS		A		A	A	A	A	A	A				
STANNOUS CHLORIDE		A	A	A	A	A	A	B	B	C	C	C	A
STARCH		A	A	A		A	A	A	A	A	A		
STEARIC ACID		A	A	B	A	A	A	A	C	B	B	B	A
STODDARD'S SOLVENT		X	X	C	A	X	A	A	X	B	A		A
STRONTIUM CARBONATE													
STYRENE					A		A	C	X	X	A		
SUCCINIC ACID		A	A	A	A	A	A	A	A				
SUGAR SOLUTIONS				A			A	A		A	A	A	
SULFAMIC ACID		X	X	X	X	X							
SULFATE LIQUORS		A	A	A	A	A		A	A	A	C	A	
SULFATED DETERGENTS		A	A	A	A	A							
SULFER 10%		A		A		A	A	A	X	C	C		A
SULFER DIOXIDE		X		X		C	A	C	A	X	A		A
SULFITE LIQUOR		A	A	A	A	A	A	A	A	B		X	
SULFUR		A	A	X	A	A	A	A	C	C		A	
SULFUR CHLORIDE		A	A	C	A	A	A	A	X	X	X	C	
SULFUR DIOXIDE DRY		A	A	A	A	A	A	A	A	X	B	B	
SULFUR DIOXIDE WET		X	A	A	A	X	A	A	A	X		B	
SULFUR SLURRIES		A	A	A	A	A							
SULFUR TRIOXIDE DRY		C	C	X	X	C	B	C	C	C	C	B	
SULFURIC ACID 10%	A	A	A	A	A	A	A	A	B	C	C	X	A
SULFURIC ACID 30%		A	A	A	A	A	A	A	A	C	X	X	C
SULFURIC ACID 50%		A	A	A	A	A	A	A	B	C	X	X	C
SULFURIC ACID 60%		A	A	A	B	A	A	A	B	X	X	X	C
SULFURIC ACID 70%		A	A	C	A	A	A	A	A	C	X	X	X
SULFURIC ACID 80%		X	A	A	A	X	A	A	A	C	X	X	X
SULFURIC ACID 90%		X	A	C	A	X	A	A	A	C	X	X	X
SULFURIC ACID 95%	X	X	C	X	A	X	A	A	X	X	X	X	X
SULFURIC ACID 98%		X	X	X	A	X	B	X	X		X	X	
SULFURIC ACID 100%		X	X	X	C	X	B	C	X	X	C	C	X
SULFUROUS ACID		A	A	A	A	A	A	A	C	X	B	C	A
SULFURYL CHLORIDE		A					A						
SYRUP		A		A		A	A	A		A	A		
TALL OIL		A	A	A	A	A	A	A	A	A		X	

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Customer should test to determine application suitability.

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
TALLOW				A	A		A	A	A	A	A		
TANNIC ACID		A	A	A	A	A	A	A	B	C	C	B	A
TANNING LIQUORS		A	A	A	A	A	A	A	B	C	A		A
TAR		X	X	B	A	X	A	A	X	C		B	
TARTARIC ACID		A	A	A	A	A	A	A	B	C	B	B	A
TERTIARY BUTYL ALCOHOL		A	A	A	A	A	A	A	B				
TETRACHLORETHANE		X		A		X	A	A	X	X	A		A
TETRACHLOROETHANE					A	X	A	A	X				
TETRAETHYL LEAD		B	A	A	A	C	A	B	X	C			
TETRAHYDROFURAN	X	X	X	B	B	X	A	X	X	X	A		
TETRALIN		X	X	X	A	X	A	A	X	X			
THIONYL CHLORIDE		X	X	X	X	X	A						
THREAD CUTTING OILS		A	A	A	A	A			X				
TITANIUM TETRACHLORIDE		X	X	X	X	X	A	A	X	C			
TITANOUS SULFATE		A	A	A	A	A	A						
TOLUENE	C	X	X	C	A	X	A	B	X		A	A	
TOLUENE TOLUOL		X	X	C	B	X	A	C	X	X	A	A	A
TOMATO JUICE		A	A	C	A	A	A		A	A	A	C	
TOXAPHENE-XYLENE		X	X	X	A	X							
TRANSFORMER OIL		A	A	A	A	A	A	A	X	A			
TRIBUTYL PHOSPHATE		X	X	C	A	X	A	X	A	X			
TRICHLOROACETIC ACID		A	A	C	A	A	A	X	X	X	X	X	
TRICHLOROETHANE	X					X	A	A	X	X	A		A
TRICHLOROETHYLENE	X	X	X	B	A	X	A	A	X	C	A	A	B
TRICHLOROPROPANE						X	A	A		A	A	A	
TRICRESYL PHOSPHATE		X				X	A	B	A	X	A		B
TRIETHANOLAMINE		B		C	C	C		X	A				
TRIETHYL PHOSPHATE	C	A	A	A	A	A	A	A	A		A		
TRIETHYLAMINE	A	A	A	X	C	A		A		A			
TRIMETHYLPROPANE		A	A	A	A	A	A						
TRISODIUN PHOSPHATE		A	A	A	A	A	A	A	A	A	A	B	
TURBINE OIL		A	A	B		A	A	A	X	B			
TURPENTINE	A	X	A	B	A		A	A	C	C	A	B	
UREA	A	A	A	A	A	A	A	A	A	C			
URINE		A	A	A	A	A	A	A	A	A	A		

Chemicals	Ultem (GF 40%)	PVC	CPVC	PPL	PVDF	PVCGF (Fiberloc)	Teflon	Viton	EPDM	Nitrile (Buna N)	316 SS	416 SS	Titanium
VANILLA EXTRACT				A		A	A						
VARNISH				A	A		A	A	X	B	A	A	
VASELINE		X	A	A	A	X	A	A	X	A			
VEGETABLE OIL		A	C	A	A	A	A	A	A	A	A		
VINEGAR	A	A	A	A	A	A	A	A	A	C	A	A	A
VINYL ACETATE	X	X	X		A	X	A	X	B	X			
VINYL CHLORIDE							A	A	C	X		A	
VINYL ETHER							A	X		B			
WATER ACID MINE		A	A	A	A	A	A	A	A	A	A	C	
WATER DEIONIZED		A	A	A	A	A	A	B	A	A	A		
WATER DEMINERALIZED		A	A	A	A	A		A	A	A			
WATER DISTILLED		A	A	A	A	A	A	A	A	A	A	A	
WATER POTABLE		A	A	A	A	A	A	A	A	A	A	A	
WATER SALT		A	A	A	A	A	A	A	A	A	A	C	
WATER SEWAGE		A	A	A	A	A	A	A	A	A			
WEED KILLERS								A		B	A		
WHEY								A		A	A		
WHISKEY		A	A	A	A	A	A	A	A	A	A		
WHITE ACID					A		A						
WHITE LIQUOR		A	A	A	A	A	A	A	A	B	A		
WINES		A	A	A	A	A	A	A	A	A	A	C	
XENON							A	A	A	A			
XYLENE	X	X	X	X	A	X	A	B	X	X	A		
XYLOL		X	X	X	A	X	A	A	X	C			
YEAST				A	A		A	A	A				
ZEOLITE							A	A	A	B			
ZINC ACETATE		A	A	A	A	A	A	C	A	B			
ZINC CARBONATE							A	A		A		B	
ZINC CHLORIDE	A	A	A	A	A	A	A	A	A	A	B	C	A
ZINC CHROMATE							A						
ZINC NITRATE		A	A	A	A	A	A	A					
ZINC PHOSPHATE													
ZINC SALTS				A	A	A	A	A	A	A			
ZINC SULFATE		A	A	A	A	A	A	A	A	A	A	A	A
ZIRILITE							A	C	A	B			

A = Excellent, no effect • B = Good, minor effect • C = Fair, data not conclusive, testing recommended

X = Not recommended. Ratings are based on testing at an ambient temperature of 70º F.

Customer should test to determine application suitability.

TABLE A-1 WATER PRESSURE, FEET HEAD AND PSI

WATER PRESSURE TO FEET HEAD			
IBS./SQ. IN.	FEET HEAD	IBS./SQ. IN.	FEET HEAD
1	2.31	100	230.90
2	4.62	110	253.98
3	6.93	120	277.07
4	9.24	130	300.16
5	11.54	140	323.25
6	13.85	150	346.34
7	16.16	160	369.43
8	18.47	170	392.52
9	20.78	180	415.61
10	23.09	200	461.78
15	34.63	250	577.24
20	46.18	300	692.69
25	57.72	350	808.13
30	69.27	400	922.58
40	92.36	500	1154.48
50	115.45	600	1385.39
60	138.54	700	1616.30
70	161.63	800	1847.20
80	184.72	900	2078.10
90	207.81	1000	2309.00

NOTE:
One pound of pressure per square inch of water equals 2.309 feet of water at 62°F. Therefore, to find the feet head of water for any pressure not given in the table above, multiply the pressure pounds per square inch by 2.309.

WATER PRESSURE TO FEET HEAD			
IBS./SQ. IN.	FEET HEAD	IBS./SQ. IN.	FEET HEAD
1	0.43	100	43.31
2	0.87	110	47.64
3	1.30	120	51.97
4	1.73	130	56.30
5	2.17	140	60.63
6	2.60	150	64.96
7	3.03	160	69.29
8	3.46	170	73.63
9	3.90	180	77.96
10	4.33	200	86.62
15	6.50	250	108.27
20	8.66	300	129.93
25	10.83	350	151.58
30	12.99	400	173.24
40	17.32	500	216.55
50	21.65	600	259.85
60	25.99	700	303.16
70	30.32	800	346.47
80	34.65	900	389.78
90	38.98	1000	433.00

NOTE:
One foot of water at 62°F. equals .433 pound pressure per square inch. To find the pressure per square inch for any feet head not given in the table above, multiply the feet head by .433.

TABLE A-2. CONVERSION FACTORS

UNITS OF LENGTH	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW							
	IN.	FT.	YD.	MILE	MM.	CM.	M.	KM.
1 INCH	1	0.0833	0.0278	-	25.40	2.540	0.0254	-
1 FOOT	12	1	0.3333	-	304.8	30.48	0.3048	-
1 YARD	36	3	1	-	914.4	91.44	0.9144	-
1 MILE	-	5280	1760	1	-	-	1609.3	1.609
1 MILLIMETER	0.0394	0.0033	-	-	1	0.100	0.001	-
1 CENTIMETER	0.3937	0.0328	0.0109	-	10	1	0.01	-
1 METER	39.37	3.281	1.094	-	1000	100	1	0.001
1 KILOMETER	-	3281	1094	0.6214	-	-	1000	1

(1 micron = 0.001 millimeter)

TABLE A-2 (CONTINUED). CONVERSION FACTORS

UNITS OF WEIGHT	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW						
	GRAIN	OZ.	LB.	TON	GRAM	KG.	METRIC TON
1 GRAIN	1	-	-	-	0.0648	-	-
1 OUNCE	437.5	1	0.0625	-	28.35	0.0283	-
1 POUND	7000	16	1	0.0005	453.6	0.4536	-
1 TON	-	32,000	2000	1	-	907.2	0.9072
1 GRAM	15.43	0.0353	-	-	1	0.001	-
1 KILOGRAM	-	35.27	2.205	-	1000	1	0.001
1 METRIC TON	-	35,274	2205	1.1023	-	1000	1

UNITS OF DENSITY	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW				
	LB./CU. IN.	LB./CU. FT.	LB./GAL.	G/CU. CM.	G/LITER
1 POUND/CU. IN.	1	1728	231.0	27.68	27,680
1 POUND/CU. FT.	-	1	0.1337	0.0160	16.019
1 POUND/GAL.	0.00433	7.481	1	0.1198	119.83
1 GRAM/CU. CM.	0.0361	62.43	8.345	1	1000.0
1 GRAM/LITER	-	0.0624	0.00835	0.001	1

UNITS OF AREA	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW						
	SQ. IN.	SQ. FT.	ACRE	SQ. MILE	SQ. CM.	SQ. M.	HECTARE
1 SQ. INCH	1	0.0069	-	-	6.452	-	-
1 SQ. FOOT	144	1	-	-	929.0	0.0929	-
1 ACRE	-	43,560	1	0.0016	-	4047	0.4047
1 SQ. MILE	-	-	640	1	-	-	259.0
1 SQ. CENTIMETER	0.1550	-	-	-	1	0.0001	-
1 SQ. METER	1550	10.76	-	-	10,000	1	-
1 HECTARE	-	-	2.471	-	-	10,000	1

UNITS OF VOLUME	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW							
	CU. IN.	CU. FT.	CU. YD.	CU. CM.	CU. METER	LITER	U.S. GAL.	IMP. GAL.
1 CU. INCH	1	-	-	16.387	-	0.0164	-	-
1 CU. FOOT	1728	1	0.0370	28,317	0.0283	28.32	7.481	6.229
1 CU. YARD	46,656	27	1	-	0.7646	764.5	202.0	168.2
1 CU. CENTIMETER	0.0610	-	-	1	-	0.0010	-	-
1 CU. METER	61,023	35.31	1.308	1,000,000	1	999.97	264.2	220.0
1 LITER	61.025	0.0353	-	1000.028	0.0010	1	0.2642	0.2200
1 U.S. GALLON	231	0.1337	-	3785.4	-	3.785	1	0.8327
1 IMPERIAL GALLON	277.4	0.1605	-	4546.1	-	4.546	1.201	1

TABLE A-2 (CONTINUED). CONVERSION FACTORS

UNITS OF PRESSURE	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW						
	LB./SQ. IN.	LB./SQ. FT.	INT. ETC.	KG/CM2	MM HG AT 32°F	IN. HG AT 32°F	FT. WATER AT 39.2°F
1 POUND/SQ. IN.	1	144	-	0.0703	51.713	2.0359	2.307
1 POUND/SQ. FT.	0.00694	1	-	-	0.3591	0.01414	0.01602
1 IN/CM. ATMOSPHERE	14.696	2116.2	1	1.0333	760	29.921	33.90
1 KILOGRAM/SQ. CM.	14.223	2048.1	0.9678	1	735.56	28.958	32.81
1 MILLIMETER-MERCURY-1 TORR (TORRICELLI)	0.0193	2.785	-	-	1	0.0394	0.0446
1 INCH MERCURY	0.4912	70.73	0.0334	0.0345	25.400	1	1.133
1 FOOT WATER	0.4335	62.42	-	0.0305	22.418	0.8826	1

UNITS OF ENERGY	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW					
	FT.-IB.	BTU	G. CAL.	JOULE	KW-HR.	HP-HR.
1 FOOT-POUND	1	0.001285	0.3240	1.3556	-	-
1 BTU	778.2	1	252.16	1054.9	-	-
1 GRAM CALORIE	3.0860	0.003966	1	4.1833	-	-
1 INT. JOULE	0.7377	0.000948	0.2390	1	-	-
1 INT. KILOWATT-HOUR	2,655,656	3412.8	860,563	-	1	1.3412
1 HORSEPOWER-HOUR	1,980,000	2544.5	641,617	-	0.7456	1

UNITS OF SPECIFIC ENERGY	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW				
	ABSOLUTE JOULE/G	INT. JOULE/G	CAL/G	INT. CAL/G	BTU/LB.
1 ABSOLUTE JOULE/GRAM	1	0.99984	0.23901	0.23885	0.42993
1 INT. JOULE/GRAM	1.000165	1	0.23904	0.23892	0.43000
1 CALORIE/GRAM	4.1840	4.1833	1	0.99935	1.7988
1 INT. CALORIE/GRAM	4.1867	4.1860	1.00065	1	1.8000
1 BTU/LB.	2.3260	2.3256	0.55592	0.55556	1

UNITS OF POWER (rates of energy use)	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW								
	HP	WATT	KW	BTU/MIN.	BTU/HR.	FT-IB/SEC.	FT-IB/MIN.	G. CAL/SEC.	METRIC HP
1 HORSEPOWER	1	745.7	0.7475	42.41	2544.5	550	33.000	178.2	1.014
1 WATT	-	1	0.001	0.0569	3.413	0.7376	44.25	0.2390	0.00136
1 KILOWATT	1.3410	1000	1	56.88	3412.8	737.6	44,254	239.0	1.360
1 BTU PER MINUTE	-	-	-	1	60	12.97	778.2	4.203	0.0239
1 METRIC HP	0.9863	735.5	0.7355	41.83	2509.6	542.5	32.550	175.7	1

UNITS OF REFRIGERATION	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW					
	BTU(IT) / MIN.	BTU(IT) / HR.	KG CAL / HR.	TON (U.S.) / COMM.	TON (BRIT.) / COMM.	FRIGORIE / HR.
1 TON (U.S.) COMM.	200	12,000	3025.9	1	0.8965	3025.9
1 TON (BRIT.) COMM.	223.08	13,385	3375.2	1.1154	1	3375.2
1 FRIGORIE/HR.	0.06609	3.9657	1	0.0003305	0.0002963	1

1 frigorie = 1 kg cal. (IT) **Note:** Btu is International Steam Table Btu (IT)

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UNITS OF TORQUE	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW												
	DYN-CM	GF-CM	KGF-M	KN-M	KP-M	MN-M	MN-M	MN-M	N-M	OZF-FT	OZF-IN	LBF-FT	LBF-IN
1 DYNE CENTIMETER	1	0.001	-	-	-	-	0.100	-	-	-	-	-	-
1 GRAM-FORCE CENTIMETER	980.665	1	-	-	-	-	98.067	0.098	-	0.001	0.014	-	0.001
1 KILOGRAM-FORCE METER	98066500	100000	1	0.010	1	-	9806650	9806.650	9.807	115.728	1388.739	7.233	86.796
1 KILONEWTON METER	-	-	101.972	1	101.972	0.001	-	1000000	1000	11800.971	141611.97	737.561	8850.748
1 KILOPOND METER	98066500	100000	1	0.010	1	-	9806650	9806.650	9.807	115.728	1388.739	7.233	86.796
1 MEGANEWTON METER	-	-	101971.62	1000.000	101971.62	1	-	-	-	-	-	-	-
1 MICRONEWTON METER	10	0.010	-	-	-	-	1	0.001	-	-	-	-	-
1 MILLINEWTON METER	10000.00	10.197	-	-	-	-	1000	1	0.001	0.012	0.142	0.001	0.009
1 NEWTON METER	-	10197.162	0.102	0.001	0.102	-	1000000	1000	1	11.801	141.612	0.738	8.851
1 OUNCE-FORCE FOOT	847387.9	864.095	0.009	-	0.009	-	84738.790	84.739	0.085	1	12	0.063	0.750
1 OUNCE-FORCE INCH	70615.500	72.008	0.001	-	0.001	-	7061.550	7.062	0.007	0.083	1	0.005	0.063
1 POUND-FORCE FOOT	13558200	13825.516	0.138	0.001	0.138	-	1355820	1355.820	1.356	16	192	1	12.000
1 POUND-FORCE INCH	1129848	1152.124	0.012	-	0.012	-	112984.80	112.985	0.113	1.333	16	0.083	1

UNITS OF SPEED	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW																
	CM/H	CM/M	CM/S	FT/H	FT/M	FT/S	KM/H	KM/M	KM/S	KNOT	MACH	M/H	M/M	M/S	MP/H	MP/M	MP/S
1 CENTIMETER/HOUR	1	0.017	-	0.033	0.001	-	-	-	-	-	-	0.010	-	-	-	-	-
1 CENTIMETER/MINUTE	60	1	0.017	1.969	0.033	0.001	0.001	-	-	-	-	0.600	0.010	-	-	-	-
1 CENTIMETER/SECOND	3600	60	1	118.110	1.969	0.033	0.036	0.001	-	0.019	-	36	0.600	0.010	0.022	-	-
1 FOOT/HOUR	30.480	0.508	0.008	1	0.017	-	-	-	-	-	-	0.305	0.005	-	-	-	-
1 FOOT/MINUTE	1828.80	30.480	0.508	60	1	0.017	0.018	-	-	0.010	-	18.288	0.305	0.005	0.011	-	-
1 FOOT/SECOND	109728	1828.800	30.48	3600	60	1	1.097	0.018	-	0.592	0.001	1097.280	18.280	0.305	0.682	0.011	-
1 KILOMETER/HOUR	100000	1666.667	27.778	3280.840	54.680	0.911	1	0.017	-	0.540	0.001	1000	16.667	0.278	0.621	0.010	-
1 KILOMETER/MINUTE	6000000	100000	1666.667	196850.39	3280.840	54.681	60	1	0.017	32.397	0.050	60000	1000	16.667	37.282	0.621	0.010
1 KILOMETER/SECOND	360000000	6000000	100000	-	196850.39	3280.840	3600	60	1	1943.844	3.017	3600000	60000	1000	2236.936	37.282	0.621
1 KNOT	185200.00	3086.667	51.444	6076.115	101.269	1.688	1.852	0.031	0.001	1	0.002	1852	30.867	0.514	1.151	0.019	-
1 MACH	119325600	1988760	33146.000	3914881	65248.030	1087.467	1193.256	19.888	0.331	644.307	1	1193286	19887.600	331.460	741.555	12.358	0.206
1 METER/HOUR	100	1.667	0.028	3.281	0.055	0.001	0.001	-	-	0.001	-	1	0.017	-	0.001	-	-
1 METER/MINUTE	6000	100	1.667	196.850	3.281	0.055	0.060	0.001	-	0.032	-	60	1	0.017	0.037	0.001	-
1 METER/SECOND	360000	6000	100	11811.024	196.85	3.281	3.600	0.06	0.001	1.944	0.003	3600	60	1	2.237	0.037	0.001
1 MILE/HOUR	160934.40	2682.240	44.704	5280	88	1.467	1.609	0.027	-	0.869	0.001	1069.344	26.822	0.447	1	0.017	-
1 MILE/MINUTE	9656064	160934.4	2682.24	316800	5280	88	96.561	1.069	0.027	52.139	0.081	96560.64	1609.344	26.822	60.000	1	0.017
1 MILE/SECOND	579363840	9656064	160934.4	19008000	316800	5280	5793.638	95.561	1.609	3128.314	4.855	5793638.4	96560.640	1609.344	3600.000	60.000	1

UNITS OF FORCE	MULTIPLY UNITS IN LEFT COLUMN BY PROPER FACTOR BELOW							
	DYN	GF	KGF	KN	MN	N	OZF	LBF
1 DYNE	1	0.001	-	-	0.010	-	-	-
1 GRAM-FORCE	980.665	1	0.001	-	9.807	0.010	0.035	0.002
1 KILOGRAM-FORCE	980665	1000	1	0.010	9806.650	9.807	35.274	2.205
1 KILONEWTON	100000000	101971.6	101.972	1	1000000	1000	3596.942	224.809
1 MILLINEWTON	100	0.102	-	-	1	0.001	0.004	-
1 NEWTON	100000	101.972	0.102	0.001	1000	1	3.597	0.225
1 OUNCE-FORCE	27801.4	28.350	0.028	-	278.014	0.278	1	0.063
1 POUND-FORCE	444822	453.592	0.454	0.004	4448.222	4.448	16	1

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TABLE A-3 PRESSURE CONVERSION

BY FACTOR TO OBTAIN →

GIVEN	LB/IN2	IN H20 AT + 39.2°F	CM H20 AT + 4°C	IN HG AT + 32°F	MM HG (TORR) T(AT 0°C)	DYNE/CM2 1M BAR	NEWTON/M2 (PASCAL)	KGM/CM2	BAR	ATM. (AN)	LB/FT2	FT H2O (AT + 39.2°F)
LB/IN2	1.0000	2.7680×10^{1}	7.0308×10^{1}	2.0360	5.1715×10^{1}	6.8948×10^{4}	6.8948×10^{3}	7.0306×10^{-2}	6.8947×10^{-2}	6.8045×10^{-2}	1.4400×10^{2}	2.3067
IN H2O (AT + 39.2°F)	3.6127×10^{-2}	1.0000	2.5400	7.3554×10^{-2}	1.8683	2.4908×10^{3}	2.4908×10^{2}	2.5399×10^{-3}	2.4908×10^{-3}	2.4582×10^{-3}	5.2022	8.3333×10^{-2}
CM H2O (AT + 4°C)	1.4223×10^{-2}	0.3937	1.0000	2.8958×10^{-2}	0.7355	9.8064×10^{2}	9.8064×10^{1}	9.9997×10^{-4}	9.8064×10^{-4}	9.6781×10^{-4}	2.0481	3.2808×10^{-2}
IN HG (AT + 32°F)	4.9116×10^{-1}	1.3596×10^{1}	3.4532×10^{1}	1.0000	2.5400×10^{1}	3.3864×10^{4}	3.3864×10^{3}	3.4532×10^{-2}	3.3864×10^{-2}	3.3421×10^{-2}	7.0727×10^{1}	1.1330
MM HG (TORR) (AT 0°C)	1.9337×10^{-2}	5.3525×10^{-1}	1.3595	3.9370×10^{-2}	1.0000	1.3332×10^{3}	1.3332×10^{2}	1.3595×10^{-3}	1.3332×10^{-3}	1.3158×10^{-3}	2.7845	4.4605×10^{-2}
DYNE/CM2 (1M BAR)	1.4504×10^{5}	4.0147×10^{-4}	1.0197×10^{-3}	2.9530×10^{-5}	7.5006×10^{-4}	1.0000	1.0000×10^{-1}	1.0197×10^{-6}	1.0000×10^{-6}	9.8692×10^{-7}	2.0886×10^{-3}	3.3456×10^{-5}
NEWTON/M2 (PASCAL)	1.4504×10^{-4}	4.0147×10^{-3}	1.0197×10^{-2}	2.9530×10^{-4}	7.5006×10^{-3}	1.0000×10^{1}	1.0000	1.0197×10^{-5}	1.0000×10^{-5}	9.8692×10^{-6}	2.0885×10^{-2}	3.3456×10^{-4}
KGM/CM2	1.4224×10^{1}	3.9371×10^{2}	1.00003×10^{3}	2.8959×10^{1}	7.3556×10^{2}	9.8060×10^{5}	9.8060×10^{4}	1.0000	9.8060×10^{-1}	9.678×10^{-1}	2.0482×10^{3}	3.2809×10^{1}
BAR	1.4504×10^{1}	4.0147×10^{2}	1.0197×10^{3}	2.9530×10^{1}	7.5006×10^{2}	1.0000×10^{6}	1.0000×10^{5}	1.0197	1.0000	9.8692×10^{-1}	2.0885×10^{3}	3.3456×10^{1}
ATM. (AN)	1.4696×10^{1}	4.0679×10^{2}	1.0333×10^{3}	2.9921×10^{1}	7.6000×10^{2}	1.0133×10^{6}	1.0133×10^{5}	1.0332	1.0133	1.0000	2.1162×10^{3}	3.3900×10^{1}
LB/FT2	6.9445×10^{-3}	1.9223×10^{-1}	4.882×10^{-1}	1.4139×10^{-2}	3.591×10^{-1}	4.7880×10^{2}	4.7880×10^{1}	4.8824×10^{-4}	4.7880×10^{-4}	4.7254×10^{-4}	1.0000	1.6019×10^{-2}
FT H2O (AT + 39.2°F)	4.3352×10^{-1}	1.2000×10^{1}	3.0480×10^{1}	8.826×10^{-1}	2.2419×10^{1}	2.9890×10^{4}	2.9890×10^{3}	3.0479×10^{-2}	2.9890×10^{-2}	2.9499×10^{-2}	6.2427×10^{1}	1.0000

↑ MULTIPLY GIVEN NUMBER OF

TABLE A-4 DECIMAL AND MILLIMETER EQUIVALENTS OF FRACTIONS

INCHES: FRACTIONS	INCHES: DECIMALS	MILLIMETERS
1/64	0.015625	0.397
1/32	0.031250	0.794
3/64	0.046875	1.191
1/16	0.062500	1.588
5/64	0.078125	1.984
3/32	0.093750	2.381
7/64	0.109375	2.778
1/8	0.125000	3.175
9/64	0.140625	3.572
5/32	0.156250	3.969
11/64	0.171875	4.366
3/16	0.187500	4.763
13/64	0.203125	5.159
7/32	0.218750	5.556
15/64	0.234375	5.953
1/4	0.250000	6.350

INCHES: FRACTIONS	INCHES: DECIMALS	MILLIMETERS
17/64	0.265625	6.747
9/32	0.281250	7.144
19/64	0.296875	7.541
5/16	0.312500	7.938
21/64	0.328125	8.334
11/32	0.343750	8.731
23/64	0.359375	9.128
3/8	0.375000	9.525
25/64	0.390625	9.922
13/32	0.406250	10.319
27/64	0.421875	10.716
7/16	0.437500	11.113
29/64	0.453125	11.509
15/32	0.468750	11.906
31/64	0.484375	12.303
1/2	0.500000	12.700

INCHES: FRACTIONS	INCHES: DECIMALS	MILLIMETERS
33/64	0.515625	13.097
17/32	0.531250	13.494
35/64	0.546875	13.891
9/16	0.562500	14.288
37/64	0.578125	14.684
19/32	0.593750	15.081
39/64	0.609375	15.478
5/8	0.625000	15.875
41/64	0.640625	16.272
21/32	0.656250	16.669
43/64	0.671875	17.066
11/16	0.687500	17.463
45/64	0.703125	17.859
23/32	0.718750	18.256
47/64	0.734375	18.653
3/4	0.750000	19.050

INCHES: FRACTIONS	INCHES: DECIMALS	MILLIMETERS
49/64	0.765625	19.447
25/32	0.781250	19.844
51/64	0.796875	20.241
13/16	0.812500	20.638
53/64	0.828125	21.034
27/32	0.834750	21.431
55/64	0.859375	21.828
7/8	0.875000	22.225
57/64	0.890625	22.622
29/32	0.906250	23.019
59/64	0.921875	23.416
15/16	0.937500	23.813
61/64	0.953125	24.209
31/32	0.968750	24.606
63/64	0.984375	25.003
1	1.000000	25.400

TABLE A-5 TEMPERATURE CONVERSION

NOTE: For convenience in making actual temperature degrees scale conversions, the center column in orange typeface refers to the known temperature in degrees, either Centigrade or Fahrenheit. If converting. from Fahrenheit to Centigrade the equivalent temperature will be found in the left column, while if converting from degrees Centigrade to degrees Fahrenheit, the answer will be found in the column on the right.

CENTIGRADE		FAHRENHEIT	CENTIGRADE		FAHRENHEIT	CENTIGRADE		FAHRENHEIT	CENTIGRADE		FAHRENHEIT
-273	-459		-17.8	0	32.0	12.8	55	131.0	65.6	150	302
-268	-450		-17.2	1	33.8	13.3	56	132.8	68.3	155	311
-262	-440		-16.7	2	35.6	13.9	57	134.6	71.1	160	320
-257	-430		-16.1	3	37.4	14.4	58	136.4	73.9	165	329
-251	-420		-15.6	4	39.2	15.0	59	138.2	76.7	170	338
-246	-410		-15.0	5	41.0	15.6	60	140.0	79.4	175	347
-240	-400		-14.4	6	42.8	16.1	61	141.8	82.2	180	356
-234	-390		-13.9	7	44.6	16.7	62	143.6	85.0	185	365
-229	-380		-13.3	8	46.4	17.2	63	145.4	87.8	190	374
-223	-370		-12.8	9	48.2	17.8	64	147.2	90.6	195	383
-218	-360		-12.2	10	50.0	18.3	65	149.0	93.3	200	392
-212	-350		-11.7	11	51.8	18.9	66	150.8	96.1	205	401
-207	-340		-11.1	12	53.6	19.4	67	152.6	98.9	210	410
-201	-330		-10.6	13	55.4	20.0	68	154.4	100	212	414
-196	-320		-10.0	14	57.2	20.6	69	156.2	102	215	419
-190	-310		-9.4	15	59.0	21.1	70	158.0	104	220	428
-184	-300		-8.9	16	60.8	21.7	71	159.8	107	225	437
-179	-290		-8.3	17	62.6	22.2	72	161.6	110	230	446
-173	-280		-7.8	18	64.4	22.8	73	163.4	113	235	455
-169	-273	-459	-7.2	19	66.2	23.3	74	165.2	116	240	464
-168	-270	-454	-6.7	20	68.0	23.9	75	167.0	118	245	473
-162	-260	-436	-6.1	21	69.8	24.4	76	168.8	121	250	482
-157	-250	-418	-5.6	22	71.6	25.0	77	170.6	124	255	491
-151	-240	-400	-5.0	23	73.4	25.6	78	172.4	127	260	500
-146	-230	-382	-4.4	24	75.2	26.1	79	174.2	129	265	509
-140	-220	-364	-3.9	25	77.0	26.7	80	176.0	132	270	518
-134	-210	-346	-3.3	26	78.8	27.2	81	177.8	135	275	527
-129 .	-200	-328	-2.8	27	80.6	27.8	82	179.6	138	280	536
-123	-190	-310	-2.2	28	82.4	28.3	83	181.4	141	285	545
-118	-180	-292	-1.7	29	84.2	28.9	84	183.2	143	290	554
-112	-170	-274	-1.1	30	86.0	29.4	85	185.0	146	295	563
-107	-160	-256	-0.6	31	87.8	30.0	86	186.8	149	300	572
-101	-150	-238	0.0	32	89.6	30.6	87	188.6	154	310	590
-96.0	-140	-220	0.6	33	91.4	31.1	88	190.4	160	320	608
-90.0	-130	-202	1.1	34	93.2	31.7	89	192.2	166	330	626
-84.0	-120	-184	1.7	35	95.0	32.2	90	194.0	171	340	644
-79.0	-110	-166	2.2	36	96.8	32.8	91	195.8	177	350	662
-73.3	-100	-148	2.8	37	98.6	33.3	92	197.6	182	360	680
-67.8	-90	-130	3.3	38	100.4	33.9	93	199.4	188	370	698
-62.2	-80	-112	3.9	39	102.2	34.4	94	201.2	193	380	716
-59.4	-75	-103	4.4	40	104.0	35.0	95	203.0	199	390	734
-56.7	-70	-94	5.0	41	105.8	35.6	96	204.8	204	400	752
-53.9	-65	-85	5.6	42	107.6	36.1	97	206.6	210	410	770
-51.1	-60	-76	6.1	43	109.4	36.7	98	208.4	216	420	788
-48.3	-55	-67	6.7	44	111.2	37.2	99	210.2	221	430	806
-45.6	-50	-58	7.2	45	113.0	37.8	100	212.0	227	440	824
-42.8	-45	-49	7.8	46	114.8	40.6	105	221.0	232	450	842
-40.0	-40	-40	8.3	47	116.6	43.3	110	230.0	238	460	860
-37.2	-35	-31	8.9	48	118.4	46.1	115	239.0	243	470	878
-34.4	-30	-22	9.4	49	120.2	48.9	120	248.0	249	480	896
-31.7	-25	-13	10.0	50	122.0	51.7	125	257.0	254	490	914
-28.9	-20	-4	10.6	51	123.8	54.4	130	266.0	260	500	932
-26.1	-15	5	11.1	52	125.6	57.2	135	275.0			
-23.3	-10	4	11.7	53	127.4	60.0	140	284.0			
-20.6	-5	23	12.2	54	129.2	62.8	145	293.0			

The formulas at the right may also be used for converting Centigrade or Fahrenheit degrees into the other scales.

Degrees Cent., $°C = \frac{5}{9}(°F - 32)$

Degrees Fahr., $°F = \frac{9}{5}°C + 32$

Degrees Kelvin, $°T = °C + 273.2$

Degrees Rankine, $°R = °F + 459.7$

Abrasion

Abrasion is mechanical erosion, e. g. of the inside of a plastic pipe by solids, in the medium flowing through it. The abrasion can be reduced by using pipe materials with softer particles, e. g. —> Blends of —> Elastomers.

Absorption of water and moisture

The absorption of water by polymers is a form of diffusion. The amount of water taken up depends on the surface area.

The amount also depends on the sorts and quantities of additives, fillers and strengthening agents contained in the polymer.

In addition, the absorption of moisture by a polymer is determined by its chemical composition, i. e. by the presence of certain —> Functional groups. Water (chemically a highly polar compound) can have a considerable influence on a plastic's mechanical properties, its dimensions, electrical insulation, dielectric-loss factor and appearance. Polyamides, for instance, can take up large quantities of water (up to 10 % of their weight), and the impact resistance can be 20 times higher in the saturated than in the unsaturated state.

The precise determination of the absorption of water and moisture has to be performed on a sample of a given shape. The graph of the sample's weight is traced as a function of time, until there is no longer any increase in weight. It is advisable to use a logarithmic scale for the time axis.

If necessary, the weight reduction experienced by the sample in yielding some of its material to the water (—> Migration) should be examined. The absorption of water is assessed in conformity with the standard EN ISO 62.

Annealing

In the manufacture of amorphous and semi-crystalline plastic products, the cooling process (—> Shrinkage) involved in shaping the components leads to—> Internal stress (i. e. molecular stress). Annealing is a subsequent heat treatment which produces the following improvements:

a) Removal of internal stress in amorphous thermoplastics when annealing near the —> Glass transition temperature. In the case of semi-crystalline thermoplastics, a reduction of stress can often be achieved if the annealing is performed at temperatures below the melting range. By doing this, the susceptibility to —> Formation of stress-induced hairlines can be reduced considerably. Examples: PSU.

b) Increase of the crystalline proportion in semi-crystalline thermoplastics (post-crystallisation). This is associated with increased rigidity, hardness, abrasion resistance, a better dimensional stability under heat, etc. Examples: PPS
See —> Physical ageing.

Apparent density

The apparent density is the quotient obtained by dividing the mass of a powder or granulated substance used in moulding, by its volume. It is given in g/ml (=g/cm^3) and is measured by letting the substance trickle freely through a standardised funnel into a beaker of a given diameter. It is used to control the structure of powder or granulated moulding compounds.

Barrier properties

Barrier properties are a variety of properties concerning a plastic's ability to resist —> Permeation and —> Diffusion against gases and liquids. They are determined by the plastic's molecular structure and its processing.

BgVV/BGA

BgVV: The German "Federal Institute for Health Protection of Cosumers and Veterinary Medicine" (Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin).

BGA: The German "Federal Health Office" (Bundesgesundheitsamt)

The BgVV is one of three independent national authorities which in 1994 replaced the Federal Health Office(BGA). It is subdivided into eight departments and two special units (ZEBS and ZEBET).
The BGA has published in about 40 recommendations detailed regulations for plastics and other materials employed in the manufacture of articles used with foodstuffs. The recommendations complement the conditions given the German law (Sect. 31, Par., 1 LMBG Lebensmittel- und Bedarfsgegenständegesetz) concerning the use of articles made of high polymers, with foodstuffs. The law has been made more specific in the German BGV (Bedarfsgegenstände Verordnung).
The substances used in such articles may not impair the foodstuffs in smell or taste. The recommendations consist largely of lists of —> Monomers, substances used in manufacturing processes, and of —> Additives, i. e. substances from which the articles may be made ("positive lists"). Although the recommendations are legally nothing more than the name says, in practice they are adhered to as if they were legally binding.

Bursting pressure

Bursting pressure is the absolute pressure at the moment in which a test object breaks. —> Stress-rupture test (creep strength).

Chemical resistance factor fCR/Reciprocal chemical resistance factor

The chemical resistance factor can be regarded as a measure of the resistance to damage sustained by piping used to transmit aggressive substances. In the course of time, the damage (always compared to that produced by water) leads to changes in the physical properties of the piping, such as reduced compressive strength. The factors are strongly temperature dependent. Relevant information can be found in the —> DVS guidelines 2205, Part 1 and in the DIN standards of the raw materials used for the piping

Chromic acid test

If needed, our company performs chromic acid tests on PP pipes (—> Polypropylene) to ascertain whether the pipes are subject to internal strain. If PP pipes with an unacceptable level of internal stress are immersed in 60 % chromic acid for 24 hours, clearly visible hairlines and cracks are produced. Polypropylene pipes are manufactured with only slight internal stress, and must pass the test without difficulty.

Creep

As plastics are viscoelastic, they show both an immediate (elastic) and a delayed (viscous) reaction to mechanical loads. (The latter is due to flow processes involving individual molecules).

In this way, thermoplastic components can change their shape. They "creep", i. e. they slowly give way to the load. Creep in plastics is strongly influenced by temperature.

Creep modulus

In a substance under —> Creep (—> Stress-rupture test), the ratio of a constant stress to its time-dependant elongation is called "creep modulus"

$$E_c(t) = \frac{\sigma}{\varepsilon(t)}$$

E_c= creep modulus; σ = stress; ε(t) = elongation (temperature dependent)

Density, measurement of

The density ρ of a substance is defined as the quotient of the mass m and its volume V.

$$\rho = \frac{m}{V}$$

For example the density of a substance is its mass per unit volume. Commonly used units are g/cm^3 and kg/m^3. One differentiates, as needed, between bulk density (taking for example, pores and enclosed air into account) and the density of the pure substance.The density of a substance is measured

- to characterise materials
- in quality controls
- to monitor the substance's production and processing, and
- to calculate the weight (mass) of given quantities of the substances

Densities of some materials used for pipes

MATERIAL	DENSITY (g/cm^3)
PVC	1.38
CPVC	1.50
PE	0.95
PP	0.91
ABS	1.03
PVDF	1.78

DIBT

German Institute for Structural Engineering (Deutsches Institut für Bautechnik)

The DIBT is a public institution with its administrative centre in Berlin. The institute is legally charged with ensuring the uniform implementation of construction techniques in public building projects. In particular, its responsibilities include:

- the authorisation of general supervisory powers concerning building commodities and types of buildings on the basis of the building regulations of the federal states within Germany.
- the coordination of national, European and international cooperation in the formulation of technical (particularly standardised) regulations.
- the preparation of laws concerning technical matters for the federal states within Germany, and the publication of the so-called lists A, B and C of building rules ("Bauregellisten") in conformity with the building regulations of those states.
- the approval of bodies involved in testing, supervision and certification.
- encouraging building surveys and awarding research contracts, as well as advising, controlling and judging these activities.
- commissioning experts' reports on constructional matters for the parties (the German federal state and its constituent parts) involved in settlements.

Dielectric strength

Break-down strength; rupture strength; disruptive discharge voltage. The dielectric strength is the minimum potential difference which has to be applied to an electrical insulator (most plastics are nomally insulators) for it to become conductive (—> Conductivity).

Diffusion

The molecules of a gas or liquid are in motion. This makes them fill the space available to them and is the underlying cause of diffusion. The amount of a substance which diffuses in a given time through an area, can be determined by Fick's First Law. Gases and liquids can diffuse through pits and cavities in molecular structures as well as through porous films. A semi-permeable membrane (i.e. one which lets molecules up to a certain maximum size pass through) which separates two solutions of different concentrations, will let molecules of the solvent diffuse through, but not out of the solute (—> Osmosis).

DIN 4102

In the German standard DIN 4102, building materials are divided into combustible and incombustible categories. The combustible materials are subdivided into those with low, normal and high combustibility. According to the standard, PVC is categorised as "B1" and PP as "B2". The classifications are, however, also dependent on the shape and the thickness of the materials used. The exact requirements for categorisation are specified in the standard.

CATEGORY OF BUILDING MATERIAL		SUB-CATEGORY (WITH OFFICIAL GERMAN DESIGNATION)	
A	incombustible	A1	
		A2	
		B1	flame retardant (schwerentflammbar)
B	combustible	B2	normal combustibility (normalentflammbare)
		B3	high combustibility (leichtentflammbare)

DVGW
German Technical and Scientific Association on Gas and Water (Deutscher Verein des Gas- und Wasserfaches e.V.)
The association (administrative centre in Bonn) has the purpose of promoting technically and scientifically aspects involving gas and water in particular with reference to safety, environmental concerns and hygiene.
The aims of the association are
- setting of authorised standards
- testing and certification
- research and development
- vocational training
- provision of information
- advisory services.

Plastic pipes, piping components and adhesives are controlled and tested in the DVGW's Water Technology Centre (TZW: Technologiezentrum Wasser) in Karlsruhe.

DVS
The German Association for Welding Technology (DVS = Deutscher Verein für Schweisstechnik), has published guidelines on various aspects of welding.

Dynamic loading
The dynamic loading of pipes (in this case by oscillation in a certain range of frequencies) is a complex subject. Special care has to be taken that pipes connected to pumps are not under dynamic load. On occasion it may be necessary to use axial compensators in order to remove oscillations caused by pumps. Neglecting this can quickly lead to breakage of the piping.

Elastic modulus, tensile modulus and flexural modulus
The e-modulus is the constant ratio of the mechanical tension in a body to the corresponding deformation. One differentiates between tensile and flexural moduli. The moduli define a plastic's degree of stiffness. They can be derived from the initial parts (corresponding to the ideally elastic state) of the graphs showing extension as a function of stress. They are given in N/mm^2(=MPa). The higher the numerical values, the stiffer the material is.

Elasticity
Elasticity is the property of a substance to return itself to its original shape or volume after deformation by external forces or torques. If the forces exceed the yield point, and the material does not snap, it begins to be deformed irreversibly, i. e. in a plastic way. Plasticity is the opposite of elasticity.

Explosion areas
So-called "explosion areas" are rooms and premises (e. g. factory areas) in which electrostatic discharges can damage sensitive eletronic systems or even lead to explosions.

FAR
Federal Aviation Regulations These are globally valid regulations (from the USA) concerning the protection against fire in aircraft. FAR §25.851 defines fire protection generally. §§25.853, 25.855, 25.855F contain specifications for (and ways of grading) the materials, fittings and items of equipment in cockpit and fuselage, as well as in the compartments for supply, luggage and freight.

FDA
Food and Drug Administration The FDA can be regarded as the USA equivalent of the BGA in Germany. FDA authorisation is needed for many export arrangements involving pharmaceutical goods and food.

Fire characteristics
The way a substance behaves in a fire is complicated. When assessing fire hazards, many isolated insights complement each other. Besides the flammability of the substance or of the component, the following factors are of importance:
- position in a room
- combination with other substances
- intensity of the igniting source
- heat radiation
- ventilation conditions
- degree of dispersal (fine-coarse)
- thickness
- colour
- surface area
- shape

These factors affect the fire characteristics by influencing the production of smoke (its composition and density) and the flame temperature. The fire characteristics of a substance can therefore only be assessed in the context of a given application. Indications like "fire-resistant" etc. should no longer be used. Instead, statements such as conforms to —> DIN 4102 or —> UL-94 class are more convenient.

Flame retardants
Flame retardants are additives which reduce the combustibility and the inflammability of plastics. They have their effect physically (by cooling, covering or diluting) or chemically (in the gaseous state by removing those energetic radicals which promote combustion, in the solid state by providing a protective layer of carbon or ashes). The most important flame retardants are named under the heading —> Flammability.
Flame retardants are not able to prevent burning. They only reduce the combustibility. Without flame contact, they cause the fire to die out.

Flammability
A plastic's flammability depends strongly on its chemical structure, fillers, additives (e.g. softening agents) and shape. Some plastics burn very easily, others are flame retardant (as defined in —> DIN 4102, B1) or stop burning after removal of the heat source. Fire resistance in equipment is often achieved by incorporating hydrated alumina, antimony oxide or compounds containing halogens, phosphorus, boron or nitrogen (—> Flame retardants). Numerous testing procedures using heat radiators, incandescent filaments or naked flames are determined by the applications and produce correspondingly restricted results. Investigations are carried out, as needed, on
- how long combustion lasts
- how quickly flames spread

- ignition temperature (ignition point)
- temperature of fumes produced
- concentration and composition of fumes produced (smoke density, toxicity) and
- drops produced by burning substances.

The results are only valid if the testing procedure and, if necessary, the thickness of the test sample are specified. (—> DIN 4102, —> UL 94)

Formation of corrosion by stress-induced hairlines and cracks; Crazing

In a way these phenomena, which are observed in metals and in plastics, represent physico-chemical action. In many cases, the inducing chemical reagent is simply moisture.

For the phenomena to occur, stress (—> Internal stress) has to be present. It is of no consequence whether they are caused by the manufacturing process, or by external influences (which are somewhat under the usual limits of tensile strength). Hairlines and cracks appear perpendicular to the direction of tensile stress. In many plastics the effects are worsened by the substances with which they are used, particularly by surface-active substances. The effect of these substances may be due to impurities, or to constituents with low molecular weight being dissolved out of the plastic. They could be due to gradual swelling processes which enable the relaxation of locally frozen (internal) stress, resulting in the formation of the observed hairlines/crazes.

It is certain, however, that the formation of stress-induced hairlines and cracks is accelerated considerably by raising the temperature. If damaging (surface-active) substances act for longer periods of time (and possibly with internal or external stresses), hairlines can penetrate through the walls becoming cracks which lead to the complete destruction of the pipe. Example: This effect can be seen very nicely if a piece of unannealed PSU piping is put into acetone. Even after a short time, hairlines followed by strong cracking can be observed.

Note: The expressions "stress-induced corrosion", "stress-induced cracking"and "crazes" are sometimes used interchangeably. "Stress-induced corrosion" is, however, usually the designation for the formation of hairlines on account of the chemical attack of a flow medium on a pipe (i. e. it is a process involving both the production of new and the breaking of old chemical bonds).

Free-fall experiment/Falling ball test

There are two different ways of performing the free-fall experiment: In type A) the test specimen is dropped (either by hand or with the help of a frame) from a predetermined height onto the floor. In type B) a standardized body (such as a ball, a falling block or dart) is dropped from a predetermined height onto the specimen.

FRP pipes (fibre-reinforced plastic pipes; fibreglass pipes)

FRP pipes are made by wrapping glass fibres around and into a sleeve made of unsaturated polyester (UP) and epoxy (EP) resins. (DIN 16965, Part 1, Type A). The pipes are characterised by high mechanical strength and good heat resistance.

Harmonisation of tolerances; Calibrated connectors

On account of our experience (gathered over decades) on pipes made of PVC and CPVC, we know that such pipes have to be jointed together with particular care. The points of contact are especially at risk when using aggressive media (—> Cementing/jointing technology).

The parts being jointed together are affected chemically most strongly on both sides of the gap between them. We have therefore decided to extrude (the sizes in question) using stricter tolerances than those prescribed by DIN. The reduced tolerances in a pipe's outer diameter lead to gaps which are smaller, and thus minimal chemical attack.

The same effect is achieved by using normal, but subsequently calibrated connecting parts. As this method is complex, it is no longer used. Naturally, the stricter tolerances also have to be applied to all the fittings used, i.e. there has to be a harmonisation of the tolerances.

Hoop stress (circumferential stress)

If every point of an elastic hoop (e. g. of an O-ring) is pressed uniformly in an outward direction, the hoop becomes larger and its material is put under stress. In analogy, a plastic pipe expands (at least very slightly) when subjected to inside pressure. Its circumference becomes enlarged, causing a so-called hoop (or circumferential) stress in the pipe material. This stress is an important means of quantifying a pipe's state of tension. The relationship between the inside pressure and the pipe material's hoop stress is given by the —> Vessel formula.

Impact resistance (impact strength)
Notched impact resistance

In the impact test, the energy needed to break or deform a sample is measured by letting a pendulum with known kinetic energy (calculated from the corresponding potential energy = weight x distance fallen) collide against the sample. The impact resistance is the work (energy) per unit area of the critical cross-section (kJ/m^2) needed to break the sample. It is determined, for example, in the flexural impact test, which can be performed in two different ways:

1. Charpy's method: The impact occurs at the centre of the sample, which stands on two supports.
2. Izod's method: The sample is held at one end while the impact occurs at the other end.

The notch impact resistance is measured using a sample with notches.

Internal stress; Frozen stress

This stress arises by reciprocal action between parts of a work piece or test sample, e.g. in chains of molecules. Essentially, it is the result of small differences in density or of sterically adverse conformations. (—> Glass). If they were cut up in an appropriate way, they would cause deformations in the work piece. (cf. Janson test with pipes made of polypropylene). Internal stress can arise because of:

- uneven contraction of a melted charge in cooling,
- uneven pressure during injection moulding or die-casting, and/or
- uneven cooling within the work piece.

Internal stress can be detrimental to the mechanical properties of the substance. (—> Formation of / corrosion by stress-induced hairlines and cracks)

KTW
German Plastic and Drinking Water Recommendations (Kunststoff-Trinkwasser-Empfehlungen)
The recommendations were published by the BGA in Berlin. Every ready-made utensil made of plastic or other non-metallic materials for use in connection with drinking water, has to satisfy fundamental requirements concerning its effects on the water. These requirements are tested by placing the utensil in contact with water for 72 hours. The test is repeated twice.

The aims of the tests are
(i) to gain information about the amounts of the materials from the utensil (e. g. from a PVC pipe for drinking water) which migrate into the drinking water,

(ii) to ascertain that they are —> physiologically harmless, and inoffensive in smell and taste,

(iii) to find out which quantities of these materials can be tolerated. The DVGW's Water Technology Centre in Karlsruhe, Germany, performs such tests on pipes used for drinking water. (—> TOC)

K-value
The K-value, a dimensionless parameter derived from measurements of solution viscosity, is used for the approximate determination of the —> Molecular weight of a polymer. It is extrapolated from a series of measurements of the time needed for polymer solutions, of varying concentration, to flow through the capillary tube of a so-called viscometer. The conditions under which the measurements are made (the temperature, the solvent used and the structure of the polymer) are always the same.

The K-value obtained is close to the weight average MW (—> Distribution of molecular mass) of the distribution of molecular weights. The molecular weight of PVC is usually found by determining its K-value. Normal values for the material qualities used in the extrusion of PVC-U pipes are between 60 and 70.

There are conversion tables for the coefficient of viscosity and the K-value in EN ISO 1628-2.

Linear expansion, coefficient of
Plastics and metals differ fundamentally in their atomic and molecular composition and in the nature of their chemical bonds. This is illustrated, for example, by observing that thermal expansion in plastics is about ten times greater than in metals. The coefficient of linear expansion represents a material's degree of thermal expansion and is measured in compliance with DIN 53752.
It denotes the extension per unit length of a plastic component for 1 K (= 1 °C) rise in temperature. The thermal expansion (or contraction) of piping can be calculated using the formula:

$\Delta l = L \cdot \Delta T \cdot \alpha$

Δl = thermal expansion (or contraction) in mm
L = length of piping in m
ΔT = difference in K (= °C) between reference temperature of piping (e. g. at installation) and temperature in use

POLYMER	A IN MM/M K
ABS	0.1
PA	0.1
PE	0.15-0.20
PP	0.16-0.18
PPS	0.15
PVC	0.07-0.08
CPVC	0.06-0.07
PVDF	0.12-0.18

α = coefficient of linear expansion in mm/m K (= mm $m^{-1}K^{-1}$)
Coefficient of expansion of selected polymers

Liner pipes
Liner pipes are composite pipes made of a thermoplastic (PE, PP, PVC, CPVC, PVDF and PPS) inside and —> FRP outside. The so-called inliner (the thermoplastic inner part) makes the pipe chemically resistant,the outer FRP composite provides mechanical strength.

Because the FRP withstands a large pressure, the load on the inliner is small. This leads to longer life and higher standards of safety. The production of liner pipes has to conform (inter alia) to special KRV criteria (of the Plastic Pipe Federation - "Kunststoff-Rohr-Verband" - in Bonn, Germany) as well as to ISO and DIN standards.

Long-term characteristics
The long-term characteristics of plastic pipes are determined by many factors. There are the operating conditions such as flow medium, temperature, operating pressure, and external factors, as well as the pressure for which the pipes have been designed. Of course, it is very important that the right piping material is chosen for the given operating conditions. In the applicable lists of standards - e. g. under the heading "permitted pressure". one can find details of the long-term characteristics of pipes.

Long-term regression curves
—> Stress-rupture test (Creep strength)

MC Test
In our company the dichloromethane test (MC test) is used in the production of PVC pipes as a quick check on if the material used is homogeneous and has been treated with due care.

In this test, sections of pipes are left in dichloromethane (a solvent) at 23 °C for 30 minutes. One can then assess the quality of the plasticization (gelation) in the extrusion process by observing the degree and shape of the swelling.

The plasticization was good if the surface is not attacked. Any indication to the contrary means that the plasticization was (in various degrees) unsatisfactory, i.e. the extrusion process was performed at a too low temperature.

Melt Flow Index (MFI)/Melt Flow Rate (MFR)

A thermoplastic material is melted in a cylinder and then pressed through a die using the pressure exerted by a piston. The MFI / MFR is the amount of material (in grams) pressed through a standardized die by a given force in 10 minutes.

This single-point measurement characterises the flow of melted thermoplastics under certain conditions of pressure and temperature. It gives an approximate indication of the material's processing (i. e. flow) properties and thus provides information on the influence that working the material - or its thermal decomposition - can have. In this respect, it is particularly significant for polyolefins.

Microscopy

Microscopy is performed to observe the condition or structure of a plastic's surface. By using polarization techniques, the crystalline structure or states of orientation can also be examined in more detail. (—> Microtome sections, —> Scanning electron micrograph) Depending on its thickness, a sample can be viewed using transmitted or reflected light.

Microtome section

Microtome sections are thin cuts (only a few µm thick) used in microscopic examinations. They are particularly suitable for viewing by transmitted light. In our company, this form of examination is used as a matter of routine. Microtome sections allow assessing if a polymer has been processed in a homogeneous way. It is also possible to detect foreign parts (contaminants), voids, cracks, etc. In addition, microtome sections facilitate the appraisal of the crystalline structure of a polymer.
Example: Observation of —>Spherulites in PP pipes.

MRS (Minimum Required Strength)

The MRS is used as a measure of a pipe material's —> Pressure stability. The material's —> Hoop stress σ (in N/mm^2= MPa) for the temperature 20 ºC (water) and for the time 50 years is read from its long-term regression curves (—> Stress-rupture test). One obtains the MRS by rounding down to the highest Renard number which is smaller than, or equal to the hoop stress.
Example: $\sigma_{(50a, 20°C, water)}$ = 10.58 N/mm^2, i. e. MRS10
Examples: PP-H and PE100 pipes are graded MRS10.
Some sorts of PE (PE80) and PP-copolymers (PP-R, PP-B) are graded MRS8.

Optical properties of polymers

The optical properties of a material depend on its interaction with light. "Normal", i. e. visible light consists of electromagnetic waves with wavelengths between 400 nm and 800 nm. A frequency can be assigned to each wavelength.

In substances which are neither magnetic nor electrically conductive, i. e. in nearly all polymers, the interaction between the material and visible light is reduced approximately to an interaction between an electromagnetic field and the electrons in the material. As a result, we obtain a number of fundamental, physical phenomena which characterise the optical properties of the material.

Refraction of light

Light incident on a transparent substance is bent, according to certain laws, when it enters or leaves the substance. Examples of this phenomenon are the use of a prism to break up white light into its component colours, or a rainbow. A so-called refractive index n of the substance has been defined (which depends to some extent on the wavelength). Complex electrodynamical considerations show the refractive index of most polymers to be n = 1.5 ± 0.2, a value which, on account of the similar structures of all polymers (long chains of carbon atoms), does not vary much. Large lateral units and in particular —> Functional groups do, however, lead to deviations from the value. The refractive index also becomes larger with higher degrees of crystallization.

Reflection of light

At the boundaries of a polymer (e. g. at its surfaces), light is reflected. An example of this phenomenon is the total internal reflection of light in fibre-optic cables. Otherwise, more light is reflected and less refracted when the angle of incidence of the light becomes greater, and when the substance has a higher refractive index.

- A material's gloss (sheen) arises as a consequence of a substance's ability to reflect light. It is the ratio of the reflection by a sample of the material to that (under identical conditions of light incidence) by a standardised material.
- A material's glitter originates in its gloss and arises from the presence of stronger light reflections for particular incident angles and/or particular contrasts in colour and intensity.
- Dependent on the refractive index, up to 95 % of perpendicularly incident light (minimum reflection) can enter a polymer sample. Such a degree of transparencis, however, seldom reached because of additional scattering and —> Absorption, both of which weaken the intensity of the light on its way through the polymer. For a given sample, the so-called transmission is the ratio of the intensity of the transmitted light to that of the incident light. One differentiates between transparent bodies (transmission > 90 %) and translucent bodies (transmission < 90 %). In the latter case, thin bodies appear transparent.

Scattering of light

The above is valid for optically homogeneous systems. Inhomogeneities (such as impurities - and in emulsions) lead to further effects in the interaction with light.

- Among these are light-scattering phenomena in which a part of the light is dispersed in all directions. An example of this phenomenon is the weakening of the light from automobile headlights in fog. In this case, light is scattered by tiny drops of water. The scattering of light in crystal lattices make crystalline and partly crystalline polymers appear to be not transparent - as in polyethylene, polypropylene and polyphenyl sulphide. Amorphous polymers, on the other hand, are transparent (provided they contain no colouring), for example polycarbonate, polyvinyl chloride, polymethy lmethacrylate (Plexiglas) and polysulfone. The phenomena can be illustrated very nicely by stretching an amorphous sample (e. g. of polystyrene) to reorientate its molecules (—> Stress-whitening).

- A body which scatters light appears to be opaque if there are localised variations of the refractive index and/or variations in the molecular orientation (in nonisotropic structures) - and if the inhomogeneous parts are larger than the wavelength of the light used.

OSU (Ohio State University)

The heat release (HR) and the heat-release rate (HRR) of plastics are measured in the OSU's combustion chamber. The respective quantities may not exceed values of 65kW/m^2 and 65 kW/m^2 per minute when applied to the interiors of those aircraft taken into service after July 1990. (The upper limits OSU 65/65 replaced OSU 100/100 which had been valid up to that time).

Oxygen index (LOI, limiting oxygen index)

A substance's oxygen index is the minimum concentration of O_2 in a mixture of oxygen and nitrogen which just sustains its combustion. The higher the need of oxygen is, the lower should the combustibility be. Use of the index in judging fire hazards is a matter of controvers.

Paint-impairment-free; Silicone-free

Plastic pipes and moulded parts which are paint-impairment-free are employed in surface-coating installations (here specifically the paint shops in the automobile industry). It is important that these parts do not contain certain substances or come into contact with them when being processed. The substances include silicone, fats, waxes and PTFE.

Details are obtainable from automobile manufacturers. In this context silicone is particularly noteworthy. Components which contain silicone, or components using silicone-based mould-release agents during production, can cause unevenness in the wetting characteristics of the paint, leading to severe difficulties and financial losses.

Permeability to water vapour

This a special case of general permeability and is important for the application of plastics as packaging material and as a basic material for cable sleeving. The permeability to water vapour depends on the material's thickness. The unit used is grams per m^2 and day.

Permeation/Permeability

The permeability of a substance is a measure of its "leakiness", i.e. its ability to let a specific medium pass through. Example: A piping system's permeability to oxygen is often of critical importance. A substance's permeability depends on the sizes of its microscopic gaps and spaces. The permeation of plastics by water vapour and gases is of interest for packaging, coverings, barrier films, gaskets and seals, pipes, containers, etc. Diffusion and —> Absorption or —> Desorption of substances of low molecular weight, e. g. of the water in or from polymers oftening agents are also of importance. If a substance of low molecular weight, the permeator, penetrates into a polymer, its coefficient of permeation P is defined as the product of the coefficient of diffusion D and the coefficient of solubility S ("solubility"), i. e. $P = D \cdot S$

For the given system and at a given temperature, the coefficient of permeation P is an important parameter. It is defined by the equation:

$Q = P \cdot A \cdot t \cdot \Delta p/d$

Q is the quantity of gas or vapour, which in the time t (and on account of the permeator's pressure difference p between the front and the back of the layer), permeates through a polymer layer of area A and thickness d.

COEFFICIENTS OF PERMEATION OF DIFFERENT POLYMER MATERIALS

MATERIAL	O_2 (OXYGEN)	N_2 (NITROGEN)	H_2 (HYDRGEN)	CO_2 (CARBON DIOXIDE)	H_2O (WATER VAPOUR)
PE	8 - 19	2 - 6	25 - 55	32 - 75	0.5 - 1.5
PP	5	2	65	25	1.1
PVC	0.4	0.04	10	0.9	6.5
PVDF	0.7	0.2	3	<1.0	5.2

Pipe series S

The number S of a pipe series is a parameter which can be used to calculate (ISO 4065) the wall thickness e of a pipe of given outer diameter d.

$S \approx 0.5 \cdot (d/e - 1)$ i. e. $e \approx d/(2 \cdot S + 1)$

Pipes from a given series S and of a given material quality all withstand the same pressure. However, the number S is defined purely geometrically and it is often used as a measure of pressure resistance. [—> Nominal Pressure (PN), —> SDR = Standard Dimension Ratio] Positive list —> BGA, —> FDA

Pressure impulses (water hammer; surge pressure)

Pressure impulses often occur in piping when valves or taps are suddenly closed. If large enough, the resulting pressure peaks produce extra strains which can be detrimental after a time. Piping should therefore be installed in such a way that, wherever possible, pressure impulses are avoided. For example, fast-closing valves in compressed-air pipelines can cause peak pressures which are 2½ times higher than the normal operating pressure. PVC pipes do not withstand such pressure impulses over a long period and are therefore not recommended in compressed-air systems. They can splinter and be hazardous.

Pressure rating (PN, Nominal Pressure)

In order to choose pipes and fittings which are compatible in their —> Pressure stability, they are assigned to various standardised pressure categories. The pressure rating (PN) of these has been widely accepted. Unlike the —> SDR or —> Pipe series S, this categorisation does not depend primarily on size or shape, but on the pipe material's behaviour in the —> Stress-rupture test, and on the applicable —> Safety factor. The pressure rating can be regarded as a value of the pressure (in bar) which the pipe can certainly withstand, at 20 °C for the duration of 50 years, with water as the flow medium.

$$PN \triangleq P\ max_{(50a\ /\ 20\ °C\ /\ water)}$$

Pipes of a given pressure rate (like those of a given—> Pipe series S) can withstand the same pressure - regardless of their dimensions. There is, however, only an approximate relationship between the pressure rating PN and the Pipe series number S, which is given by the following formula:

$S \approx \sigma\ per_{(50a,\ 20\ °C,\ water)}$ / PN ≈ 0.5(d/e - 1)

σ_{per} = permissible hoop stress

d = outer diameter of pipe

e = wall thickness of pipe

Radiation, resistance to

The depth to which radiation penetrates depends on its type, its energy and on the resulting excitation —> Absorption. In certain cases, ultraviolet radiation can break chemical bonds, thereby splitting molecules. Generally, the changes which radiation causes in a polymer depend on various external factors. They depend, in particular, on the radiation's energy dose. Many plastics are hardly influenced by radiation and are finding increasing use in equipment which has to withstand strong and energy-intensive radiation. UV radiation is applied commercially in the photochemical cross-linking of PE to PE-X. Pipes made of PE-X are frequently used in sanitary installations for hot and cold water.

RAL colours

Colour standards which conform to the register of colours (colour charts) issued by the German Association for Quality and Labelling (RAL).

Rigidity

The rigidity of a pipe is determined mainly by its elastic modulus and its flexural strength. Both provide information on the deformations produced by certain loads. The suitability of a part for an application in which rigidity is important is generally determined using a bending test in which the influence of its material and shape are examined. The high value of ca. 3000 N/mm² for the elastic modulus of PVC leads to high rigidity in pipes, even if the walls are thin. The pipes have excellent properties even under the long-term effect of stresses produced by extension, compression, bending and shearing. The modulus of elasticity should be taken into consideration when assessing the rigidity of pipes made of other materials.

Rupture stress

—> Tensile test

Safety factor (SF)

Safety factors are important, for example, in determining a pipe's required dimensions, its pressure rating or its anticipated service life.

The —> Hoop stress σ read from a long-term regression curve (—> Stress-rupture test) is taken to be a measure of a pipe material's maximum pressure stability under the given conditions. To ensure absolute safety in practice, this stress is divided by a safety factor SF to give the value of the permissible stress σ_{per}.

σ_{per} (T, t, medium) = σ (T, t, water) / SF

A high value safety factor, value therefore inevitably leads to a low classification of a pipe's —> Pressure stability. Safety factors depend on a variety of circumstances (according to the pipe's application), for example:

- variations in strength, possibly dependent on the raw material or manufacturing process
- impact stress caused by pressure impulses or external influences
- safety margins for the uncertainties of practical use
- thermal stresses due to temperature changes
- flexural stresses produced by expansion or by ground settling
- flow medium

More details on the relationship between chemical resistance and safety factors can be found in the —> DVS guidelines 2205, Part 1. The —> Chemical resistance factor f CR for each of the various substances is given in the —> DIBT list of media (German: Medienliste). Of course, very important safety factors (some of them temperature dependent) are those for the various pipe materials with water as the flow medium. Because of the ongoing development of pipe materials, safety factors are subject to variations, which are partly due to the establishment of new and different standards. The standards evolve under the influence of considerations which are not only scientific and technical, but also commercial and strategic. This is well illustrated by the fact that for a given material, different safety factors are used in different countries.

Please consult us if you have any questions concerning safety factors!

Scanning electron micrographs

In a scanning electron microscope, electromagnetic lenses focus the electrons reflected from the surface of the specimen being viewed to produce an image of the surface on a screen or on a photographic plate. Scanning electron micrographs are used by our company in the assessment of the inside surfaces of pipes and of fracture surfaces.

SDR (Standard Dimension Ratio)

The SDR is the ratio d/e of a pipe's outer diameter d to its wall thickness e. Besides this, other classifications are the —> Pressure rating (PN) and the —> Pipe series S. The definitions of the SDR and the pipes series number S depend exclusively on pipe dimensions. This is not the case with the pressure rating (PN):

SDR = 2S + 1 = d/e

S = (d/e - 1)/2

Service life

A pipe's service life depends on the pipe material, dimensions, flow medium, temperature, etc. For the determination of the anticipated service life of a given pipe, or the use of the intended service life in the determination of other parameters, see —> Stress-rupture test.

Shear strength

Shear strength is the ability of a substance to withstand the stress as a result of two parts of a body being pushed or pulled in such a way that they slide relative to one another. The shear strength is of particular interest in parts which have been cemented together. It is determined by increasing the shear force applied to a simple overlapping joint until it breaks. According to EN ISO 9311-2, the shearing strength is a quantity applicable to the entire joint.

Shore hardness

The Shore hardness is a way of quantifying hardness. Two methods (Shore A and Shore D) are used in measurements - mainly on rubber-like, but also on soft and elastic-loamed plastics. The measurements are of little practical importance for the plastics used in piping. Measurements of the Shore hardness are performed according to DIN 53505.

A spring presses a needle (a truncated cone for "Shore A", a cone for "Shore D") with constant force onto the sample. The depth to which the needle sinks into the sample is a measure of the hardness. (The scale ranges from 0 to 100 - without units.) Methods A and D are used in different ranges of hardness.

Shrinkage

Melted thermoplastics which are cooled contract on solidification. The contraction can be explained by the plastic's crystallization. Further shrinkage may arise after reheating polymer pipes which have been manufactured to have anisotropically orientated molecules. (—> Internal stress)

One distinguishes between:

- contraction in length
- contraction in volume
- contraction due to processing
- delayed contraction

All these types of contraction are dependent on the substance used in the moulding, the processes carried out, the shape of the tooling (e. g. of the dies), and on the molecular orientation (anisotropy). Delayed contraction also depends on outside influences.

Sieve analysis

Sieve analysis is used to determine the distribution of grain or particle sizes, and to determine the proportions by weight of different particle size ranges. Each category is determined by two consecutive sieve-mesh sizes.

Granulated substances used in moulding are analysed with the help of machines which contain sieves positioned above each other.

These oscillate horizontally in a circle movement. According to DIN standards, sieve-mesh sizes are classified by standardised numbers. The classification is the same as that recommended by the ISO. In processing PVC , sieve analysis of the pure PVC powder is a powerful tool in maintaining the constant quality of the required PVC formula.

Stress crack-inducing media

These are substances which cause an inhomogeneous softening or a swelling of a plastic product. Hairlines and cracks in pipes have a variety of causes. They are the physical and/or chemical effects due to the flow medium (—> Swelling, —> Solution) in combination with internal stress. The effects are accompanied by a partial extension, a crazing, of the hairlines and cracks. When plastic articles are immersed in the substances in question, hairlines and cracks are produced which depend on internal strains and on external forces. The following table shows some of the substances which are particularly likely to produce hairlines and cracks. The combinations of raw material and medium are frequently used for testing purposes, i. e. for determining the level of internal stress in products made of the given plastics. It is important that the suitability of a planned plastic piping system for use with various substances is discussed with the manufacturers - particularly if the piping is to transport surfactants Plastic Substance

The presence in pressurised pipes (e. g. those made of PVC, PE or PP) of substances which are surface active (surfactants) can reduce their durability quite considerably and lead to premature failure.

PLASTIC	SUBSTANCE
PP	chromic acid
PVC	methanol
PSU	acetone
PS	petroleum/crude oil
PC	carbon tetrachloride
ABS	toluol, n-propanol

Stress-rupture test

Stress-rupture tests are used to examine a polymer's —> Creep behaviour and are the basis on which the —> Pressure rating, required dimensions or anticipated—> Service life of pipes (made of the polymer) can be determined.

In the tests, pipe samples filled with a test fluid (usually water) and held at constant temperature in a water bath or a hot-air oven, are subjected to constant inside pressure causing a three-axial stress. The pipes are tested until they fail (i. e. break, rupture, burst). The—> Vessel formula is used to calculate the —> Hoop stress resulting from the internally applied pressure in a pipe of given dimensions.

There are different types of stress-rupture tests:

a) Short-time burst-pressure tests

These tests are performed by applying the highest pressure possible. Failure results even after a few seconds. Such tests give important information about the pressure resistance of new products under the respective conditions.

b) Long-term stress-rupture tests

Long-term tests on pipe samples are performed (in compliance with DIN 53759) to obtain the data presented in long-term regression curves. Each curve is a double logarithmic plot of the time after which the pipe samples (of given material at a given temperature) fail, against the corresponding, applied —>Hoop stress. Using standardised statistical algorithms, the curves can be extrapolated to predict a material's creep behaviour even for very long periods of time. (The tests on the commonly used pipe materials PE, PP and PVC have been running for well over 30 years!) The use of hoop stress instead of pressure makes the curves independent of pipe dimensions, i. e. it makes them a representation of a property of the given pipe material. This accounts for the extraordinary importance of the long-term regression curves.

c) Spot tests:

Long experience has shown that stress-rupture tests can be carried out in a comparatively short time if performed at higher temperatures than those found in practical working use (principle of time-temperature superposition). Such tests are used, for example, in the quality control of batches of manufactured goods (as demanded in the applicable DIN specifications and —> DVGW guidelines). Examples of the hoop stress $\sigma 0$ prescribed (in DIN) for such tests are given in the following table.

TEMPERATURE IN °C	MATERIAL	σ_0 in N/mm²
60	PVC	10
80	PE	4
95	PP- H	3.5

Shortened tests should only be applied if the long-term creep behaviour of the given material is already known.

Stress-whitening

Stress-whitening is a light-scattering phenomenon which can be seen in parts of a stretched plastic sample (transparent or coloured). It is often accompanied by the formation of crazes (—> Formation of / corrosion by stress-induced hairlines and cracks; crazing), i. e. by the formation of microscopic, usually lenticular areas, the boundaries of which are bridged by individual, extremely strong strands of the material. Stress-whitening is a sign of overloading. (—> Optical properties of polymers)

Surface properties

When plastics are used, not only their volume-related, mechanical properties (such as firmness and stiffness) are important, but also the properties relating to the surface topography. Included in the latter are surface hardness, frictional and abrasive properties, certain reactions of polymer materials to aggressive substances and in particular, their tendency to develop hairlines and cracks.

Our company aims to produce pipes with inner surfaces so smooth that a Ra value of less than 1 µm is achieved. Ra (the average value of surface roughness) is the arithmetic mean of the distances between protrusions and a line through the middle of the surface profile. Rt (the maximum roughness) is the vertical distance between the highest and lowest points of the surface profile in the section measured.

Surface resistance

The resistance of the surfaces of raw materials and finished products is an important parameter for plastic pipes installed in so-called —> Explosion areas. The surface resistance of such pipes has to be ≤ 10^9 Ω. As plastics have very good innate electrical insulation characteristics. the pipes have to incorporate conductive fillers such as carbon black, carbon fibres or conductive polymers.

The surface resistance of pipes depends (among other things) on the surrounding conditions. High humidity, for example, reduces the surface resistance slightly.

Categories of conductivity:

SURFACE RESISTANCE (R)	CATEGORY
R >1012 Ω	insulating
109 Ω < R ≤ 1012 Ω	antistatic
104 Ω < R ≤ 109 Ω	statically conductive
R ≤ 104 Ω	conductive

Surface treatment

The surfaces of certain components are treated not only to protect and improve them, but also for decorative purposes. Fine films with good physical and chemical stability can easily be formed on plastics. Metallization by electrolytic deposition or by other means gives plastic the metallic appearance occasionally required. Thicker coatings are made by electroplating. For the most part, the plastic PS, ABS, PMMA cellulose, polyvinyl derivatives and thermosetting materials are metallised. In processes using electrolytic deposition, it is necessary (after cleaning and roughening) to provide the plastic with a conductive coating. Components made of ABS are particularly good for metallization using electrolytic deposition.

Tensile test

In the tensile test, a sample (or component) is forcefully extended, in the direction of its longitudinal axis until it reaks. The following values can be obtained from the curve of tensile stress plotted against elongation:

- tensile strength at maximum load = greatest stress sustained (N/mm²)
- tensile strength at break = stress at breaking point (N/mm²)
- tensile strength at yield = first relative maximum(N/mm²) of the curve
- percentage extensions correspond to the named stresses.

Thermal conductivity

There is a time-dependent transfer of heat (Q) between two points of a body which have different temperatures. Considering a wall of cross-sectional area A and thickness e, the heat conducted from one side to the other is directly proportional to the (maintained) temperature difference between the sides, to the area A and to the time t. It is inversely proportional to the thickness e:
$Q = \lambda \cdot A{\cdot}t \cdot \Delta T/e$

The constant of proportionality k depends on the wall's material and is called its coefficient of thermal conductivity.
$[\lambda] = W / (m\ K) = Wm^{-1}\ K^{-1}$
W = watt, m = metre, K = Kelvin (= °C).

In general plastics have very low values of thermal conductivity compared with other materials such as metals. For this reason they are often used for thermal insulation.

SUBSTANCE	COEFFICIENT OF THERMAL CONDUCTIVITY (WM- 1K- 1)
Foam Plastics	0.02-0.05
PVC	0.16
CPVC	0.17
PP-H	0.22
PE-HD	0.41
Copper	400
Water	0.61
Air	0.023

Thermal stability

Thermal stability is a moulding compound's durability in processing to thermal degradation, e.g. thermal oxidation. (—>Pyrolysis; —> Chemical ageing) One possibility of assessing the thermal stability is to perform a time-trial by exposing the compound to a constant, predetermined test temperature in order to age it thermally.

In polymers a depolymerisation or dissociation (e. g. of HCl from PVC) can occur. According to EN 728 the so-called Oxidation Induction Time (OIT), the time which passes before oxidation begins, is used to characterise the thermal stability of polymer compounds.

Thermoanalytical measurements using DSC and DTA

The following thermoanalytical methods are used in investigations of the structures of polymers:

- differential thermoanalysis (DTA)
- differential scanning calorimetry (DSC)
- thermogravimetric analysis (TGA)
- dynamic mechanical analysis (DMA)
- dilatometry

Differential thermoanalysis (DTA) and differential scanning calorimetry (DSC) are based on the same principle. In both methods the test sample and a reference sample are heated (or cooled) simultaneously. By doing this, the temperature difference between the samples (DTA) and the difference between the specific temperatures (DSC) are measured.

Because the DTA graphs are, ultimately, used to calculate the specific heats, and because all normally obtainable, modern equipment is of the DSC type, we will only discuss the DSC method. Thermograms are obtained which show at which temperatures the processes are endothermic (energy absorbing) or exothermic (energy releasing). The processes can, for example, be the formation or the melting of crystals respectively. They can also be —> Glass transitions in which overheating or undercooling is observed. Further examples of the application of DSC to polymers are the analysis of impurities, the determination of the degree of cross-linkage, and the examination of thermal stability. If a semicrystalline sample with unknown structure is melted in a DSC apparatus, the resulting thermogram gives information on its crystalline structure and its degree of crystallinity before treatment.

DSC examinations of amorphous polymers enable an analysis of their behaviour at —> Glass transition. They also reveal equilibrium disturbances such as the quenching of amorphous thermoplastic material. Both DSC and DTA are very important polymer material tests, which give the user a good general view of the polymer's structure and condition. Hence, DSC is a valuable tool for quality assurance and for polymer research and development.

In TGA a polymer sample's change in mass is determined resulting from the application of a given temperature programme in a given gas atmosphere (N2, O2, air). The graph of the experimental results reveals the reduction in weight when the temperature is raised.
Using DMA, it is possible to determine both storage and loss moduli (E', E") of a polymer sample for a given temperature and at a given frequency of an applied sinusoidal vibration. The —> Relaxation modes(e. g. —> Glass transition point) of various polymers can be analysed using this technique.

UL94 inflammability

Standard 94 of the Underwriters' Laboratories (UL 94) has established itself as the globally accepted norm for the classification of a plastic's fire resistance. UL 94 prescribes how a material's ability to stop burning is to be tested.

In the classification, the rate of burning, the time after which burning stops, any drops produced, and the time in which smouldering continues are all taken into account. For each material, many categories are possible (depending on wall thickness). The correct categorisation of a material corresponds to the component's thinnest wall cross-section. UL 94 categories are only comparable and meaningful if the applicable wall thicknesses are given.
UL 94 prescribes the following groups - in which the best category is the last:

- UL 94 HB
- UL 94 V-2
- UL 94 V-1
- UL 94 V-0
- UL 94 5V
- UL 94 5VB
- UL 94 5VA

Vessel formula

A pipe's—> Hoop stress σ depends on the operating pressure p, on the wall thickness e and on the diameter d. The so-called vessel formula gives the relationship between these quantities.

$\sigma = (p/10)(d0 - e)/2e$

σ = hoop stress in N/mm^2

p= inside pressure in bar

d0 = outer diameter

e = wall thickness

Vicat softening point

In the Vicat test, measurements of a plastic's softening temperature are made. The flattened end of a round needle of area 1 mm^2 is pressed (with predetermined force and at steadily increasing ambient temperature) onto the surface of a sample of the material. The softening point (VST = Vicat Softening Temperature) is reached when the needle penetrates 1mm into the sample. Practicable alternatives are:

- Method A with an applied force of 10N .
- Method B with an applied force of 50N (ISO 306)

In each case the temperature can be raised by 50 °C or by 120 °C per hour. The test conditions are called A50, A120, B50 or B120.

Volatiles

A volatile or "volatile component" is the "dampness" or "water content" of plastics, and is released when the plastics are dried or worked on. In most cases, other volatile substances (e. g. water) are also released.

Weathering; UV stability; Atmospheric exposure

These headings cover the resistance of a material to atmospheric exposure, e. g. to temperature and temperature fluctuations, atmospheric oxygen, ozone, humidity, UV radiation, environmental pollution (sulphur dioxide, nitrogen oxides) and impact by hailstones. These factors can lead to a radical change in a polymer's basic properties, including its colour stability. Only some polymers are sufficiently resistant to degradation by light and by weathering. Many products (e. g. PE-HD black) have to be mixed with active carbon black - which still has the best stabilising effect against light and weathering. Quantities of 2 % to 4 % are usual. Atmospheric exposure can cause changes in a plastic's appearance (sheen, colour, hairlines), chemical composition and handling properties. —> Chemical ageing, —> Radiation, resistance to

Absorption

Broadly speaking, absorption is a “sucking-up” or “taking-in” process. Examples: Plastics can absorb solvents which cause —> Swelling. Electromagnetic energy (e. g. visible light) can be absorbed by a material and be changed to heat, or give rise to effects such as fluorescence, splitting of molecules, and potential differences due to the separation of electric charges (solar cells).

Acid/alkali solution (alkali = base)

In chemistry there are different interpretations of the concepts ‘acid’ and ‘alkaline’. We restrict ourselves to simple but narrow definitions - those based on the Arrhenius model. In an aqueous solution, an acid produces so-called hydroniums (= H_3O+), a base produces hydroxyl (= OH-) ions.
Examples:
(i) Acids: sulphuric acid, carboxylic acid (e. g. acetic acid), all halogen hydracids (e. g. HCl), oxalic acid, hydrocyanic acid.
(ii) Bases: caustic soda (sodium hydroxide), caustic potash (potassium hydroxide), ammonia solution, amines. Plastics consist of molecules which are organic chains. In the case of some polymers, acids and caustic solutions can assist reactions which lead to the destruction of the chains, or in which certain —> Additives are attacked. This is of particular significance when acids and caustic solutions flow through plastic pipes. In these cases, the pipe material has to be chosen carefully, taking the conditions of use into consideration. See also —> pH; —> Chemical resistance.

Active carbon (activated charcoal)

Active carbon is a collective term for various forms of microcrystalline carbon. These forms differ in the size of their pores. By using the active carbon’s —> Adsorption, substantial quantities of organic substances can be removed from a liquid or gas phase. Examples: Active carbon is used in kitchen ventilator units to remove odours and vapours (as in cooker hoods or stove vents), in the filters of gas masks, and in filters used to purify water. In the polymer industry, carbon black is used to stabilise polyolefins against UV radiation. Special grades of carbon black are used to make polymers electrically conductive.

Additives

In the context of polymer technology, ‘additive’ is the collective term for auxiliary materials which are mixed with a polymer to effect a change in its behaviour or properties. There are two categories of additives, i. e. those which:

1. enable a proper processing. Examples: stabilisers, lubricants.

2. change the properties of the polymer to achieve longterm use. Examples: UV stabilisers, softening agents, fillers, pigments, flame retardants and, sometimes, other polymers (—> Blends).

Adhesion (= adsorption)

This is the sticking-together of two different phases (i. e. media) at their common boundary. It is due to the attraction (the so-called adhesive forces) which exist between the molecules of one medium and those of the other.
Examples: adhesion is what causes a drop of liquid to wet a surface (as opposed to the surface tension of the liquid, which tends to hold the drop together). Adhesion is what causes chalk to stick to a blackboard. The opposite of adsorption is called desorption.

Aerosol

An aerosol is a homogeneous distribution of fine liquid droplets in a gas.

Aliphatic compounds

The molecules of this class of substances contain linear and branched chains of carbon atoms. Aliphatic compounds contain only C-C or C-H bonds and are therefore relatively unpolar (—> Polarity), chemically rather inactive or even inert. Examples: polyolefins like PP or PE are good examples of this class, as well as countless compounds of low molecular weight, such as benzine, butane and paraffin.

Amorphous/semi-crystalline

When thermoplastic polymers solidify, their molecular chains are more or less of an even structure. The molecules of a crystalline substance are spatially ordered in a large volume. The spatial arrangement of the chains in amorphous polymers (the arrangement of the elements of the chains and of their bonding angles) leads these polymers to set in a disorderly fashion. In the solid state, the chains of amorphous polymers are disorientated or, at best, only locally ordered. In a semi-crystalline polymer’s solid state, the amorphous parts are surrounded by crystalline parts. Examples: PPS, PP, PE. For thermodynamic reasons, a purely crystalline polymer, i. e. a “polymer monocrystal”, is strictly speaking not possible.

Annealing processes

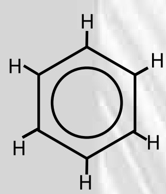
The molecular strains which inevitably arise when an amorphous polymer is cooled below its glass transition temperature TG can be greatly reduced by storing the material (for a “reasonable” time) at temperatures around TG or, depending on the polymer, slightly below TG . (The glass state should be regarded as a non-equilibrium state.) Example: —> Annealing of pipes made, for example, of PSU or PE.

AOX (adsorbable organic halogen compound)

This is the sum parameter of the halogenated hydrocarbons in water.

Aromatic compounds

Aromatic compounds are a large category of organic substances. They have flat, ring-shaped structures with a characteristic distribution of electrons, behave in a particular way in reactions, and are chemically very stable. Benzene (benzol) is an important member of this category. The name “aromatic” stems from those substances which were once largely extracted from plants and which had an “aromatic” smell. Examples: aromatic polymers include almost all plastics, e. g. PPS and PEI.



Benzene

Atom

The continued division of a material leads to the smallest particles which can exist alone and independent from each other. These are the material's atoms. Nowadays about 300 different variants (so-called nuclides) are known. Each atom contains a characteristic number of electrons (carriers of negative electrical charge) and a nucleus. The electrons surround the nucleus like a shell or cloud and are found at different distances from the nucleus. They are, therefore, not all equally easy to remove. In most chemical reactions, only the atom's electrons are involved - usually the outer ones, i. e. those electrons at the greatest distance from the nucleus.

The nucleus contains protons, each of which is nearly 2000 times as heavy as an electron, and carries as much positive electricity as an electron's negative elementary charge. As all atoms contain the same number of electrons as protons, they are electrically neutral.

This number is characteristic of what is called an element. Example: the element oxygen has 8 protons and therefore also 8 electrons. The elements are listed systematically in the so-called periodic table of the elements. Besides the protons, the nucleus of an atom contains other elementary particles, i. e. neutrons. These have no electrical charge, are about as heavy as protons and function like a "glue", which holds the protons together. The atoms of a given element can differ in the number of neutrons, in this case we say that the element has different isotopes.

Atomic weight/Relative atomic mass

All substances consist of atoms. Each element has a characteristic mean "weight". Because the weights of the atoms are so minute, a scale using grams gives values which are far too small for practical use. Instead, a scale based on the unified atomic mass constant u, i. e. 1/12th of the mass of a (particular sort of) carbon atom is used. The relationship 1 u = 1.6605 x 10-27 kg gives an idea of the difference between the scales. An atom's so called atomic weight is its relative atomic mass, i.e. the ratio of the atom's mass to the unified atomic mass constant.
An atom's gram-atomic weight (or gram-atom) is the mass (in grams) of one —> Mole of the atoms.

Example: for neon gas (Ne):

atomic weight = relative atomic mass	= 20
gram-atomic weight = gram-atom	= 20 g
molar mass (i.e. mass per mole)	= 20 g/mole
mass of neon atom	= 20 u

(u = unified atomic mass constant. —> Atomic weight)

Blend

In the context of this book, a blend is a homogeneous mixture of polymers (analogous to alloys of metals). Alloys are mixed to produce a given combination of properties. Blends of polymers, however, are often highly complicated and unstable systems. This is due to a lack of "compatibility" of certain polymers. In polymer technology, blends are of immense importance when achieving the required balance of material properties.

BOD (Biological Oxygen Demand; Biochemical Oxygen Demand)

The BOD (German: BSB = Biologischer Sauerstoff-Bedarf) is the mass of oxygen used by micro-organisms to oxidise an organic substance in a unit volume of water at 20 °C. Measurements usually take 5 days to complete(BOD_5).

Carbon

The element carbon, chemical symbol C, has the allotropes, diamond, graphite, and so-called "amorphous" forms (like soot and active carbon). Each variety of these forms consists of finely crystalline graphite. Carbon atoms, unlike other atoms, are able to combine with each other in practically limitless ways to form chains and rings. The resulting multitude of compounds is the
subject matter of -->**Organic chemistry**.

Carbon atoms each have four valency electrons, i. e. electrons which participate in chemical bonding. Examples: a carbon atom can have four single bonds (as in chloroform CCl_4). It can have a double bond and two single bonds (as in ethylene $CH_2 = CH_2$). It can have a triple bond and one single bond (as in acetyleneHC=HC).

Catalyst

A catalyst is a substance which apparently takes no part in chemical reactions, but does accelerate them. A more accurate analysis of such reactions shows that the catalyst is indeed chemically changed, but is re-formed in the end. Its participation in the reaction is therefore not evident.

Chemical ageing

Chemical ageing is the collective name for all those processes which cause a chemical degradation of or a change in a polymer's molecules. The most important of these causes are:

(i) Photochemical reactions:
Radiation incident on the polymer causes chemical bonds to break. (—> UV-stability, —> Radiation, resistance to)
(ii) Thermally induced chemical ageing:
Higher temperatures make it possible for certain degradation processes to occur.
(iii) Contact with flow media:
A polymer's limited —> Chemical resistance to certain categories of media can lead to degradation and to noticeable damage. Examples: sensitivity of PP to oxidizing agents, such as chromic acid. PVDF is sensitive to caustic solutions.

Chemical resistance

The chemical resistance of a substance is a complex property which depends (inter alia) on its chemical composition and on the way it has been processed / manufactured. The chemical resistance of a polymer pipe depends predominantly on its chemical structure, on additives, on its crystalline structure and on the condition of its surfaces. As chemical resistance depends, ultimately, on the possibility of chemical reactions occurring (reaction kinetics), the conditions under which they take place (pressure, temperature, radiation, mechanical loads, concentration of chemicals and the duration of contact with them, etc.) are also decisive. According to the existing standards (DIN 16888, Parts 1 and 2), there are three categories for a thermoplastic pipe's behaviour under chemical attack: "resistant" (+), "conditionally resistant" (0) and "not resistant" (-).
The following table lists synonyms and logograms:

DIN 16888 -1, -2	DIN SUPPLEMENTS TO 8061/8075/8078	LISTS OF CHEMICAL RESISTANCE	ISO 4433
W	resistant	A	satisfactory (S)
BW	conditionally resistant	B	limited (L)
NW	not resistant	X	not satisfactory (NS)

—> Chemical stability; —> Corrosion; —> Swelling; —> Physically active substances;—> Chemically active substances.

Chemical active substances

In this context, chemically active substances are those which attack or change the material of which a pipe is made.
Example: PP can be chemically degraded by having its molecules (its carbon chains) broken by strongly oxidizing agents.

Chlorine, chemistry of:

Because of the large number of customers' questions concerning the—> Chemical resistance of HYDROSEAL plastic pipes to substances containing chlorine, a summary of the most important facts is given here.
Chlorine (chemical formula Cl_2) is one of the most important primary products of modern chemistry. In spite of heated discussion in the last few years, it still has to be regarded as a necessary and ecologically viable basic chemical for use in many large-scale industrial processes (e. g. in the production of sodium hydroxide).

On a large scale it is usually manufactured by the electrolysis of alkali-metal chlorides. Chlorine and sodium hydroxide (caustic soda) are produced in an electrochemical redox reaction from a concentrated common salt solution. One distinguishes between the diaphragm, the amalgam (mercury) and, more recently, the membrane processes.

Note: Reinforced PVC has been used on the "chlorine side", i.e. on the side of the anode, and proved itself to be an excellent material. In this application, our customers (world-wide) rely on the extraordinarily good quality of components made of PVC .

On the cathode side and for brine feed ducts, polypropylene pipes have proved to be the best in their resistance to highly concentrated caustic soda. This is an important application of PP components summary of the most important aspects of chlorine chemistry: Chlorine is a very versatile —> Element. Via —> Reduction, its atoms each take up an electron, and a so-called "chloride" (= Cl-) is produced - such as gaseous hydrogen chloride (HCl - its solution in water is called hydrochloric acid) and common salt (NaCl). Chlorine can also be oxidized, in which case each chlorine atom can lose up to seven electrons from its outer shell. This unusually large number of electrons has the effect that several different chlorine compounds can result, the most important of which are given in the following table.
Important notes:

- All chlorine compounds with positive oxidation states (oxidation numbers) are, to a greater or lesser degree, strongly oxidizing agents (e. g. hypochlorites, chlorites). The use, for example, of the polyolefins (PP and PE) as piping for these substances must always be discussed carefully with our customers. At our company, we have considerable expertise in dealing with these and similar matters. Our long, unusually comprehensive experience in the planning and installation of chemical plants makes us confident that we can solve your problems in such matters - in consultation with you.

- When chlorine is passed through water, it is partly changed into chlorides and hypochlorites. The latter decompose slowly, releasing oxygen. This, in part, is how swimming pools are disinfected. At higher temperatures, hypochlorites decompose into chlorides and chlorates.

COD (Chemical Oxygen Demand)

The COD (German: CSB = Chemischer Sauerstoffbedarf) this value quantifies the oxidizable substances contained in water. It indicates a volume-related measure of oxygen which is equivalent to this oxidant potassium dichromate for the oxidative breakdown of organic substances.

Cohesion

Cohesive forces are forces which attract between the molecules of a —> Phase. In the solid state, they determine the strength and mechanical stability of a material. Cf. —> Adhesion.

Compatibility

In polymer technology this concept describes how well polymers blend. "Compatible" polymer mixtures are those which permanently retain their homogeneous structure. "Non-compatible" mixtures separate out in the course of time. Cf. —> High-impact polymers.

Compounding

This is the concept of putting —> Additives into polymers. It includes making the component parts of the necessary mixtures homogeneous. Example: some polymer mixtures are compounded at our company using our own, well-established formulas for the manufacture of pipes.

Concentration

The concentration of a component substance (in a mixture, solution, etc.) is its quantity per unit volume or mass ("weight") of the total. Common units of concentration are percent by volume, percent by mass (by "weight"), g/l and mol/l.

NUMBER OF ELECTRONS LOST (+) OR GAINED (-) (OXIDATION STATE)	FORMULA OF ACID	NAME OF ACID	FORMULA AFTER REMOVAL OF WATER (ANHYDRIDE)	NAME OF CORRESPONDING SALT
- 1	HCl	Hydrogen chloride (solution in water is known as hydrochloric acid)		chlorite
+ 1	HCl		Cl_2O	hypoclorite
+ 3	$HClO_2$	chlorous acid	-	chlorite
+ 5	$HClO_3$	chloric acid - chlorate	-	chlorite
+ 7	$HClO_4$	perchloric acid	Cl_2O_7	perchlorate

Conductivity (electrical)

Conductivity is a measure of a substance's ability to conduct electricity (It is the reciprocal of the substance's resistivity. —> Resistance, electrical). The conductivity of solutions in water (these are of interest here) is determined by the —> Dissociation of the dissolved compounds. Salts in water, for example, divide into —> Ions. Similarly, acids and bases dissociate into their component parts. Conductivity is strongly temperature dependent (25 °C is the usual reference temperature).

A commonly used unit of conductivity is µS/cm, S being the symbol for the unit "siemens" (i. e. the reciprocal 1/Ω of the unit "ohm" Ω). In practice, the conductivity is measured in order to assess the amount of material dissolved in water. E. g. 30 µS/cm corresponds to approximately 1" total salt content. At 25 °C the intrinsic conductivity of purest water (at its dissociation equilibrium) sets a lower limit of 0.055 µS/cm to the conductivity of water (i. e. an upper limit of 18.2 MΩcm to its resistivity).

Copolymer

A copolymer results from a —> Polymer synthesis using many monomers, without regard to the method used. The individual monomers are combined on the basis of chemical criteria which can be described using so-called copolymerization parameters. Copolymers are subdivided into:

(i) statistical copolymers (random copolymers): the different monomers are united unsystematically, but in proportion to their relative amounts. Examples: PP-R, Type 3, has up to 6 % of ethylene (by weight) as comonomer. SAN is a copolymer made of styrene and acrylonitrile.

(ii) block copolymers: these can be imagined as having normal polymer chains (of monomer A) in which complete sections ("blocks") consist of chains of a second polymer (monomer B). Example: PP-B (Type 2) is a block copolymer made of propylene and 8 % to 10 % (by weight) of ethylene (PE blocks).

(iii) graft copolymers: in a chemical reaction, chains of a polymer B are "grafted" as side chains onto chains of a main polymer A.

Corrosion

Corrosion can be described, quite generally, as the chemical change on the surface of a solid body. Example: damage done by certain substances to the surfaces of plastic pipes.

More colloquially, corrosion is taken to be the electrochemical degradation caused by the presence of an electrolyte (e. g. drinking water or salt solutions) at a point where two different metals come into contact.

Cross-linking

Cross-linking is the process in which linear macromolecules are joined together to make elastomers or thermosetting plastics. It can be achieved by mixing in appropriate monomers during polymerization, or (subsequently, in chemically suited polymers) by the addition of hardeners (e. g. in dual-component adhesives), by heating (e. g. in curing processes with PPS), or by irradiation (e. g. photoresist).

Crystal

Crystals are the stable structures which arise when atoms, ions or molecules come together in a spatially ordered way (i. e. in regularly repeated units). The crystals are held together by electrostatic or other intermolecular forces. The smallest part of a crystal which is repeated regularly by parallel translation is called the crystal's unit cell. The various classes of external crystal symmetry are determined by the symmetry of their unit cells. A crystal's lattice is the geometrical arrangement of its unit cells. The crystalline structure of a substance can be determined by X-ray crystallography. (—> Glass, —> Amorphous/semi-crystalline)

Crystalline melting range

When a crystalline or semi-crystalline polymer is heated, there might be additional phase changes other than the —> Glass transition. Between the (semi-)crystalline phase and the liquid (melted) phase, there can be intermediate phases - depending on the rate of heating - such as a liquid crystal phase or other crystalline allotropes.

The phase transitions can be examined by using X-ray crystallography, differential calorimetry (DSC) or differential thermal analysis (DTA). (—> Thermoanalytical measurements using DSC and DTA)

CSB —> COD

DAB

Abbreviation for "Deutsches Arzneibuch" (= German Pharmaceutical Codex)

Disinfectant

Disinfectants are a category of substances which, on account of their chemical composition, harm germs. Their effect can, for example, be due to damage done to the micro-organism's protein structure. (Protein is found, for example in a cell's DNS and DNA). Disinfection can be achieved by retarding or stopping the microoganism's growth, or by radically killing it off. Important factors are the concentration of the disinfectant, the length of time it is used, and its temperature. It is often possible to disinfect using heat alone (pasteurization).

Examples of disinfectants are: acids, caustic solutions, —> Oxidizing agents, halogens (e. g. iodine, chlorine), certain compounds of heavy metals, alcohols, aldehydes (e. g. formaldehyde), and ethylene oxide (for sterilization at room temperature). In piping systems disinfectants need to be given particular attention. They are often used with surface active solutions (—> Surfactants), which are known to frequently trigger off stress-induced cracks in polymers.(—> Formation of / corrosion by stress-induced hairlines and cracks; crazing)

Disinfection

Disinfection is the elimination of pathogenic (i. e. disease-causing) micro-organisms in certain situations (e. g. the removal of one particular type of germ). Disinfection, in contrast to —> Sterilisation, is a partial, not an absolute process.

Dissociation

The breaking up of substances, in melts or in solutions, into more or less freely moving —> Ions is called (electrolytic) dissociation.

Distribution of molecular mass

Because of the way in which a polymer is manufactured, it never has molecular chains of the same length and therefore of constant —> Molecular weight. Instead, it has a statistical distribution of molecular weights (mass) which is typical of the reaction conditions under which the polymer is made (—> Polymer synthesis). Every polymer can be characterised by the following statistical formulae:

Number average of molecular weight:

$$M_n = \frac{i(n_i M_i)}{i n_i}$$

Weight average of molecular weight:

$$M_w = \frac{i(n_i M_i^2)}{i(n_i M_i)}$$

Mi = mass of each molecule of fraction (i)
ni= number of molecules in the fraction (i)

The distribution of molecular mass has an enormous influence on the mechanical properties of a polymer. The graph of the molecular weight distribution function, i.e. of Mi plotted against ni has a shape which can be described numerically by using statistical methods. For example, the so-called "nonuniformity", i. e. the value of M_w/M_n- 1, characterises the width of the distribution. Example: Polymers used for pipes usually have higher molecular weights than those used in injection moulding. The distribution of mass can be determined by using gel-permeation chromatography (GPC). In practice, however, worthwhile information about a polymer can be obtained by measurements of its viscosity, or by determination of its —> Melt flow index MFI.

Dry-blend powder mixture

This concept arises in connection with —> Compounding and is the name of a particular quality of mixtures of plastics and additives. Dry blends are so well mixed (homogenized) that the mixture can be used directly in an extruder or in an injection-moulding machine.

Elastomers

Elastomers consist of molecules with a relatively small degree of cross-linking. The segments of the mesh are assembled spatially in a relatively simple way, making these parts able to move relative to each other even at lower temperatures. This means that the glass transition temperature TG is usually observed at negative temperatures (e. g. for polyisobutane at TG= -70 °C). Above TG these polymers are rubber-elastic. They are only moderately deformable because of counteracting forces which arise within the mesh. Examples: all sorts of rubber. —> Thermoplastics, —> Thermosetting plastics (Thermosets).

Electrolytes

Electrolyte is the collective term for chemical compounds which, in solution or in the melted state, conduct electricity. One distinguishes between strong and weak electrolytes.

Enzymes

Enzymes are proteins which function as —> Catalysts, i. e. they facilitate chemical reactions without undergoing any permanent chemical change themselves. Each enzyme catalyses specific biochemical reactions.

Fillers

Fillers are special —> Additives. They are additional materials which increase the mass or volume of a polymer (making it cheaper), or produce a desired change of properties.

Examples: added glass fibres (GF) or synthetic and carbon fibres (CF) improve a plastic's mechanical properties. Added chalk, quartz and mica are used, for example, to increase a polymer's density and to improve its handling properties in an extruder. Note the difference between glass fibres (GF) and glass-reinforced plastics (—> FRP), between carbon fibres (CF) and carbon fibre-reinforced plastics (CFP)!

Flame retardants

Protection from flames can be improved by using shielding layers or by the admixture of flame retardants (as —>Additives or in the monomer). The way in which the latter work is only known in a few cases. The choice of retardant is, therefore, usually empirically based.
Underlying effects:
(i) oxygen is excluded by the production of non-flammable gases, and
(ii) the flames are "poisoned" by —> Radicals.
Examples: when a polycarbonate, PEEK or PEI decomposes, it gives off carbon dioxide and water, which smother flames. Flame retardants containing halogens (bromine or chlorine) decompose in heat, producing halogen radicals. These combine with the radicals produced by the combustion (of the polymer) poisoning the flames (halon fire extinguishers). In a similar way, antimony
(iii) oxide (Sb_4O_6) functions as a "radical grabber" by reacting with halogen compounds. (This antimony oxide is the flame retardant in PP-s and in PSU "UDEL 1725".) Note the difference between combustion inhibitors [effect (i)] and flame-retardants [effect (ii)].

Fluorinated hydrocarbons

If fluorine is introduced into a compound, it is said to be fluorinated. Important fluorinated hydrocarbons are the chlorofluorocarbons (CFCs). Of these, the so-called Freons have properties (low boiling points and high chemical stability) which have made them useful as refrigerants in air-conditioning systems and in refrigerators. They are also used as propellant gases in aerosol dispensers and in the manufacture of foamed (or expanded) plastics. Each FreonXYZ is classified with the help of a three-digit number:

X number of carbon atoms per molecule minus one (For molecules with only one carbon atom, i. e. for methane derivatives, X = 0. In this case the first digit is omitted.)

Y number of hydrogen atoms per molecule plus one

Z number of fluorine atoms per molecule (Allother atoms are chlorine).

Examples:
Fluorotrichloromethane CCl_3F = Freon 11
Chlorodifluoromethane $CHClF_2$ = Freon 22
When Freons are used in fire extinguishers, they are called halons ABCD (A, B, C and D being the number of carbon, fluorine, chlorine and bromine atoms respectively.)
Because of their volatility and high chemical stability, Freons of low

molecular weight reach the upper atmosphere, where they cause decomposition of the ozone layer. For this reason the use of Freons has been progressively reduced world-wide, or even forbidden.

Fluoropolymers

Fluoropolymers are the whole range of plastics in which the monomers, in some way or other, contain the element fluorine. Depending on the polymer structure and the types of monomers or comonomers, one distinguishes between:

(i) completely fluorinated polymers: polymers which only contain carbon and fluorine (PTFE, FEP or PFA/TFA) and

(ii) partly fluorinated polymers: polymers which contain fluorine, carbon and hydrogen (PVDF, PVF, ETFE).

Fluoropolymers have very good chemical stability. Physically, they have relatively good temperature stability as well as good mechanical and electrical properties. They have particularly good sliding characteristics and withstand adhesives. (This is because a fluoropolymer's secondary structure causes a negatively charged surface layer of fluorine, leading to repulsive forces between molecules.)

Functional groups

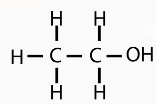
Almost all reactions in organic chemistry (—> Organic / organic chemistry) depend on the presence of parts of molecules with an electron density that is either relatively low (electrophilic parts) or relatively high (nucleophilic parts). These "reactive centres" arise through the insertion of functional groups, the most important of which are to be found in the following short survey. The particular significance of the groups is that they each have their own characteristic combination of properties. If these properties are known, most of the properties of a molecule (even of a macromolecule) in which a functional group is present can be approximately predicted. This is very useful e. g. in assessing the —> Chemical resistance of plastic piping systems to certain media. (R = univalent group or—> Radical in an organic molecule)

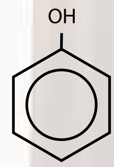
1) Halides (organohalogen compounds):

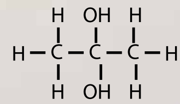
Structure: R-X, where X = halogen atom (F, Cl, Br or I). Properties: the halogen atom is easily replaced (by other atoms or groups of atoms). It causes an electron deficit in the atom to which it is bonded (usually carbon). In many cases its presence in a molecule makes the entire molecule polar.
Examples: all halogenated hydrocarbons such as chloroform($CHCl_3$), vinyl chloride, chlorofluorocarbons (CFC), —> Polyvinyl chloride (PVC), —> Fluoropolymers.

2) Alcohols:

Structure: R-OH
Properties: the properties are similar to those of the structure element R-X. Under certain conditions the -OH group can be replaced by a halogen. The group often functions like an acid.—> Acid / alkali (= base) Alcohols often react with carboxylic acids to produce esters and water. Being polar, they have particular properties in relation to solvents. All alcohols of low molecular weight (e. g. methanol, ethanol) are more soluble in water than in their respective hydrocarbons. Depending on their structure, alcohols can be oxidised to aldehydes, ketones or carboxylic acids.
Examples:

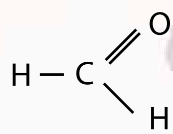

Ethanol


Phenol


Isopropanol

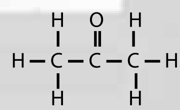
3) Aldehydes

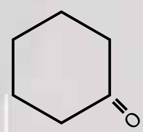
Structure:
Properties: aldehydes are relatively reactive. Important reactions are those with alcohols and those which take place due to the ease with which aldehydes can be oxidised. The aldehyde group gives the molecule polar properties.
Example:


Formaldehyde

4) Ketones

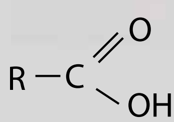
Structure:
Properties: the polarity is similar to that of the aldehydes for equal lengths of the —> Radical R. Ketones are, however, much less easily oxidised. Some ketones of low molecular weight are widely used solvents.
Examples:


Acetone


Cyclohexanone

5) Carboxylic acids:

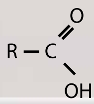
Structure:

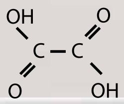


Properties: the combination of the -OH and -C = O groups in one functional group, the carboxyl group, lowers the electron density (—> Polarity) of its carbon atom, thereby increasing its reactivity. Carboxylic acids have acidic properties (e. g. they form salts when added to alkali solutions or to certain metals). In condensation reactions with alcohols, they form esters; with amines, they form amides. These reactions are utilized in polymerisation [polyesters, polyamides (e. g. nylon)].

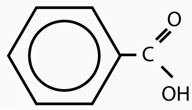
Modifications of the carboxyl group with higher reactivity are to be found in the corresponding carboxylic acid anhydrides and carboxylic acid chlorides.

Examples:





OXALIC ACID



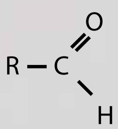
BENZOIC ACID

R = H
(formic acid)
R = CH_3
(acetic acid)

With long-chained, unpolar, univalent groups R, socalled fatty acids are formed. Example: R = CH_3-(CH_2)16- yields stearic acid. The metallic salts of this acid (stearates) are used widely and in different ways as —> Additives in polymers. Fatty acids have surface-active properties. Soaps are the salts of such acids.

6) Esters

Structure:



Properties: in the simplest case, esters are formed by the reaction of acids with alcohols. The ester group is somewhat sensitive to acids, to alkali solutions and to water. Esters find diverse chemical applications - as basic, intermediate and final products.
Examples: depending on the length of their molecules, esters are called fats or oils. Waxes are the esters of alcohols and carboxylic acids with longer chains. Esters of low molecular weight are known as fruit flavouring.

Glass

Glass is the name given to a large class of substances which retain their disordered molecular arrangement on being cooled out of the liquid phase. There is no crystallisation and no constant temperature at which solidification occurs. These so-called "amorphous" substances can be viewed as supercooled liquids. They have a high viscosity and there is no symmetry in the way the molecules are arranged or aligned. They do not, therefore, conform to the familiar "gas-liquid-solid" scheme. Examples: polystyrol, PMMA and PC (polymers); amorphous silicone (semiconductors); many proteins and alcohols.

Glass transition

The transformation of a glass-forming substance from its liquid to its glass (amorphous) state does not take place (as with a crystal) at a definite melting point, but in a temperature range of some (degrees) Kelvin. It proves to be the case that the so-called glass transition temperature (TG) depends on the speed with which the substance is heated or cooled. If an amorphous plastic is heated to its glass transition temperature, the chain segments of its molecules are "animated".
Above TG its mechanical properties worsen drastically on account of the molecular motion (—> Relaxation) which is then possible. The glass transition temperature signifies an upper limit at which an amorphous material can be worked or used. It is determined experimentally and routinely, e. g. by calorimetric measurements (—> Thermoanalytical measurements using DSC and DTA) or by mechanical and dielectric relaxation spectroscopy.

Examples: PMMA, TG ≈ 90 °C; PC, TG ≈ 145 °C; rubber, TG ≈ 70 °C.

Hardness of water

Water's hardness is its total amount of hardening agents (alkaline-earth metals, e. g. Ca^2+, Mg^2+, Sr^2+), i. e. of those substances which in the presence of carbonate and sulphate ions produce sparingly soluble precipitates. The total hardness has two components: the temporary hardness due to hydrogen carbonates and the permanent (noncarbonate) hardness due to chlorides, sulphates etc. The temporary hardness can be removed by boiling, which leads to the precipitation of carbonates. The amount of hardness is given in °dH (Deutsche Härtegrade = "German degrees of hardness") or in mmol/l. Soft and hard water can have a hardness of 3°dH and 22°dH respectively.

Examples:
a) Limescale ("fur") in water pipes arising from temporary hardness.
b) Precipitation of surfactants due to hardening agents. With surfactants, Mg^2+ or Ca^2+ form a sparingly soluble precipitate (of a calcium or magnesium "soap"). This increases the amount of detergents which are used. Ion exchangers or special compounds can remove the hardening agents from the water - leaving "soft" water.

High-impact polymers

Mixing —> Rubbers and —> Elastomers to polymers (usually brittle) increases their impact resistance. The energy released at impact is taken up by the elastomer component, sustaining its molecular motion (—> Relaxation).
Basically, there are two ways of improving the impact resistance of polymers:

(i) by copolymerization of the base polymer with an elastomer component. Example: the block copolymerization of styrene and butadiene to produce polystyrene (SB).

(ii) by blending the base polymer with an elastomer component (—> Blend). In order to fix such a blend permanently as a stable, homogeneous mixture, the —> Compatibility of the two components has to be ascertained.

Example: the well-known material ABS is usually a blend of the copolymer polyacrylonitrile polystyrene (= SAN) with polybutadiene (PB) as its elastomer component. The compatibility between SAN and PB is achieved chemically by placing a covering of SAN over the SB molecules.

The maintenance of a fine, homogeneous distribution of impact modifier is of decisive importance when processing the polymer. Phase separation and coagulation of the impact modifier have to be avoided.

Homogeneous

"Homogeneous" is synonymous with "uniform" - the opposite of "heterogeneous".

Homopolymer

In contrast to a copolymer, a homopolymer is a "pure" polymer, i. e. one made of a single —> Monomer. Example: PP-H, Type 1, has only propylene as a monomer.

Hydrocarbons

Collective term for those organic compounds which only contain carbon and hydrogen.

Hydrolysis

There are salts which, dissolved in water, react not in a neutral but in an acidic or alkaline way (—> pH Value). The cause of this effect is hydrolysis, i. e. nothing more than the effect of water splitting salts into acids and bases. Hydrolysis, the opposite of neutralisation, is only observed with salts which are made from so-called "weak" acids and/or "weak" bases.

Hydrophobic

"Hydrophobic" is the opposite of "hydrophilic". (—> Surfactants)
A substance, usually organic, is said to be hydrophobic if it is water repellent, if it does not dissolve in polar solvents (such as water) or if it does not mix with polar materials. The substance's hydrophobic property is usually associated with the presence of unpolar aliphatic chains (-[CH_2]-) in its molecules. Example: one end of a —> Surfactant molecule is hydrophobic. The other end is hydrophilic.

Hygroscopicity

Hygroscopicity is a substance's ability to take up water, either chemically (e. g. as with concentrated sulphuric acid) or physically. (—> Solvation)

Inorganic/ Inorganic chemistry

Inorganic chemistry deals with all the elements and their compounds, except for carbon, of which only the oxides, cyanides and carbides are covered.

Ion

A positively charged ion (cation) is obtained if one or several electrons are removed from an atom or molecule. (—> Oxidation) Similarly, a negatively charged ion (anion) is obtained when (additional) electrons are incorporated into the atom or molecule. (—> Reduction) Cations and anions are the two possible sorts of ions. Example: common salt (sodium chloride, NaCl) consists of the cations Na^+ (sodium atoms, each with one electron removed) and of the anions Cl^- (chlorine atoms, each with one extra electron). The salt's electrical neutrality shows that both types of ions are numerically present in the ratio 1: 1.

Ion exchanger

An ion exchanger is an important device used in chemical processes such as various chromatography procedures and in demineralizing water. It consists of a specially prepared synthetic resin, e. g. one based on polystyrol. The resin contains —> Functional groups which (depending on their type) exchange either their positive or negative ions with those of a medium flowing past.

KBE (Colony-Building Unit)

The KBE (German: Koloniebildende Einheit) is a quantity used in counting bacteria, particularly in certain methods of producing cultures.

Legionnaire's disease

This disease is caused by a new type of very large, rod-shaped bacteria, the most important of which is Legionella pneumophilia - known only for some twenty years. The bacteria are 0.3 µm to 0.9 µm in diameter and between 2 µm and 20 µm long. The optimum temperature for their proliferation is between 30 °C and 45 °C.
In many cases to date, infections have been traced back to piping systems used for water and for ventilation (inhalation of contaminated aerosols). Nowadays, with pipes of quality, certain minimum requirements have been specified to reduce surface roughness and therefore also the risk of bacterial infestation.

Lubricants

Lubricants are a processing aid. They are —>Additives used to reduce a plastic melt's internal and external friction.

(i) Internal lubricants allow a polymer's chains to slide past one another. As with softening agents, they reduce the melt's viscosity. They are partially soluble in polymers. Usually compounds are used which have a low molecular weight and —> Surfactant properties, e. g. modified esters from long chained fatty acids.

(ii) External lubricants should not have much —> Affinity with the plastic. In processing they have to leave the body of the polymer, moving towards the boundary surfaces, where they build a slippery film between the machine and the polymer melt. However, a certain affinity is indeed required so that the lubricants are not deposited permanently on the tools used. Examples: waxes and long-chained fatty acids.

Macromolecules

Macromolecules are —>Molecules consisting of a great number of —>Atoms. They are produced naturally (e.g. cellulose, enzymes and natural rubber) and synthetically (e. g. all plastics and silicon resins).

MAK

MAK is an abbreviation for the German term "Maximale Arbeitsplatzkonzentration", i. e. for the maximum permissible concentration of a substance in the occupational environment. It signifies a concept devised to quantify occupational hazards, safety at work and matters of —> Toxicology. It is defined in the TRG 900 (German: Technische Regeln für Gefahrstoffe = Technical Regulations for Dangerous Materials) and legally authenticated in the GefStoffV (German: Gefahrstoffverordnung = Ordinance on Dangerous Materials).

The MAK is the highest concentration of a processed substance

allowed (in the form of gases, vapours or suspended particles) in the air at a place of work - according to the current state of knowledge. It takes repeated and long-term exposure to the substance (normally 8-hour periods) into account, so that the health of those concerned is neither impaired nor endangered.
There are also other important parameters concerning safety at the workplace, for example the "Biological Tolerances for Safety at Work" (German: BAT = Biologische- Arbeitsplatz-Toleranz) and, for particularly dangerous materials, the "Technical Concentration Standards" (German: TRK = Technische Richtkonzentrationen).

Master batch

A master batch consists of —> Additives mixed with a small quantity of the polymer material to be treated, making it a concentrated form of the additives. In practice, the additives are mixed into a polymer by insertion of a calculated quantity of the master batch. The method also makes the application of small quantities of additives easier.

Medium

The expression "medium" is synonymous with "chemical", i. e. a substance which takes part in physical and chemical processes. The flow medium in a pipe is the substance flowing through the pipe.

Membrane processes

These are methods used on a microscopic scale in separation processes, refining and purification. Membranes with different pore sizes are utilised to achieve various degrees of selectivity.
Important methods:

- Microfiltration: this method is used to isolate microscopic particles with sizes between (0.06 µm (activecarbon dust) and 100 µm (human hair)). Microfiltration can be regarded as the intermediate between conventional filtering and the following.

- Ultrafiltration: This method is used to isolate particles with sizes between (0.001 µm (the smallest viruses) and 0.05 µm (wavelength of high-energy UV radiation)). Ultrafiltration, as opposed to reverse osmosis (see below), cannot isolate salts. It works on the so-called cross-flow principle in which the substances to be separated flow tangentially over the membrane.

- Nanofiltration: this method uses membranes to filter out particles at the lower limits of ultrafiltration and at the upper limits of reverse osmosis.

- Reverse osmosis (RO): this method is used to isolate salts and particles with sizes between 0.0003 µm and 0.001 µm (approximate size of small organic molecules like ethylene).

- Electrodialysis: this method covers the same particle sizes as the last two methods mentioned above.

Micro-organisms (pathogenic)

Micro-organism is the collective term for a multitude of tiny living entities and of structures like fungi, bacteria and viruses. They differ greatly in size, structure and in their effect on the human organism.
In practice, the inside surfaces of plastic pipes used in sanitary applications and in ventilation systems are of particular importance when considering the possibilities of infestation by micro-organisms. Here, it is also of significance that additives of low molecular weight can serve as a micro-organism's source of nourishment. Important example: because of the presence of softening agents, soft PVC (PVC-P) is much more susceptible to certain microbiological infestations than hard PVC (PVC contains no softening agents).

Migration

In the context of polymers, migration is the diffusion of additives of low molecular weight, i. e. their ability to move around inside the polymer.

Mole

Mole (mol) is the globally used base unit of the amount of a pure substance. It is defined as a constant number (6.022 x 1023) of atoms, ions or molecules. One mole of a substance has a mass (in g) numerically equal to its —> Molecular weight.

Molecular chains

—> Macromolecules

Molecular weight/ Relative molecular mass

The so-called molecular weight, MW (or formula weight, FW) of a molecule is its relative molecular mass, i. e. the sum of its atoms' —> Atomic weights (relative atomic masses).
A compound's gram-molecular weight (or gram-molecule) is the mass (in grams) of one mole of the compound. A gram-formula is the mass of one mole of formula unit.
A compound's molar mass is its mass per mole. All these quantities are important characteristics of a given compound. Example: for oxygen in its molecular form (O_2):
molecular weight = formula weight = relative molecular mass = 32
gram-molecular weight = gram-molecule = gram-formula = 32 g
molar mass = 32 g/mole
mass of oxygen molecule = 32 u
(u = unified atomic mass constant. —> Atomic weight)

Molecule

Two or more —> Atoms joined together are called a molecule. The strength of the bonds between the atoms of a molecule is al ways greater than the attracting forces, the —> Cohesion, between individual molecules.
Examples: two atoms of hydrogen and one atom of oxygen combine to form a molecule (H_2O) of water. Two atoms of chlorine combine to create a chlorine molecule (Cl_2), the stable form of the element. Many - often several thousand - carbon atoms combine with more than double the number of hydrogen atoms to make a polyethylene —> Macromolecule.

Monomers

Monomers are the units of which —> Oligomers and —> Polymers are made.

Nucleation/ Nucleating agents

Nucleating agents are —> Additives which are mixed into certain —>Semi-crystalline polymers to act as nuclei around which crystals (possibly with modified symmetry) can form. They can also influence the kinetics of the production of crystals. The agents foster the growth of small-grained crystallites and prevent that of large —> Spherulites. They accelerate solidification and can improve the properties of semicrystalline polymers considerably. Nucleation can have different causes. Important factors are how easily the polymer melt wets the nucleation agent or dissolves it. Under certain circumstances, particular properties of the agents (e. g. their sterical structure) can be used to encourage the development of particular crystal modifications. Example: the PP-H components are made of a specially nucleated PP-H raw material (DAPLEN BE60). This (together with special processing techniques) gives them a particularly good combination of properties.

Oligomers

Oligomers have short polymer chains consisting of only a few (n <10) monomer units. A high proportion of oligomers in a polymer material worsens its mechanical properties.

Organic chemistry

Organic chemistry is the chemistry of carbon compounds (apart from a few of the very simplest compounds which are covered in —> inorganic chemistry). The division of chemistry into organic and inorganic parts has historical roots. Organic compounds always contain carbon, nearly always contain hydrogen and often contain oxygen, nitrogen, phosphorus or sulphur.

Osmosis

Osmosis, a process observed in solutions, is a physical and chemical phenomenon of a so-called colligative sort, i.e. one which depends on the number of dissolved particles and not on their exact nature.

Imagine the following: an U-tube is divided in the middle by a membrane. On one side the tube is filled with a solvent, and on the other side (up to the same height) with a concentrated solution based on the same solvent. If the membrane is only permeable to the solvent, then a so-called "osmotic pressure" causes the solvent to pass through the me brane into the concentrated solution. This results in the solution rising in the U-tube. The process ends when the hydrostatic pressure caused by the transferred solvent is equal to the osmotic pressure.

If one applies external pressure to the side with the concentrated solution, the equilibrium is disturbed, and the reverse process starts. Solvent from the solution then flows back into the side which only contains solvent. Examples: this effect, reverse osmosis, is often utilised in facilities built to desalinate sea water (which can be viewed as a concentrated solution of salts in water). The same effect is used medically in dialysis equipment, i. e. to purify blood. The production of ultrapure water (—> Water quality) can also be based on the effect.

Oxidation

In very many chemical reactions, electrons are transferred between the reactants. Oxidation is the process in which electrons are removed from an —> Atom, an—> Ion, or a—> Molecule. Reduction is the opposite process, i.e. one in which electrons are taken up. Because the electrons (and their electric charges) do not just appear or disappear, both processes are inseparably linked - in so-called redox reactions.

The concept of oxidation (as defined above) is widely applicable. This means that it is not necessarily dependent on the presence of oxygen. Oxidizing agents oxidize (another substance) and are thereby reduced. Reducing agents reduce (another substance) and are thereby oxidized. Example: chromic acid (aqueous CrO_3 solution) is a strong oxidizing agent which also oxidizes PP.
The chrome ions of the acid are themselves reduced by taking up electrons which the PP (the reducing agent) gives up.

pH

The pH of a substance is one of its important properties, i. e. a measure of its acidity or alkalinity (—> Acid / Alkali). Its name is derived from the Latin expression pondus hydrogenii (= weight of hydrogen). The pH is the negative common logarithm of the concentration [H+] of hydrogen ions (pH = -log[H+]).
Note: Acid solutions have pH < 7. Alkaline solutions have pH > 7. The pH of a neutral solution is 7.

Phase

A phase is a homogeneous, physically distinct portion of matter present in a non-homogeneous system. Examples: undissolved common salt (solid phase) in contact with its saturated aqueous solution (liquid phase) .

Physical ageing

When an amorphous polymer is cooled rapidly from a viscoelastic state to a temperature under its —>Glass transition temperature (and maintained at that temperature), one can imagine that the molecules "freeze" into a non-ideal conformation. The process is always associated with strains in the material. There is a tendency for the resulting —> Glass to fall into its so-called thermodynamic equilibrium by various, slow movements of its chain segments.

This kind of ageing should not be confused with —> Chemical ageing which is defined as a splitting of molecules, or as some kind of chemical change of the molecules themselves. In the course of time, both sorts of ageing lead to changes in the properties of the materials involved.

Physically active substances

In this context, substances are called physically active if they interact physically (i. e. without any new compounds arising) with the materials of which pipes are made.
Example: the —>Swelling of the inside surfaces of pipes in contact with certain liquids.

Physiologically harmless

In Germany, the expression "physiologically harmless" is assigned to materials which pass certain tests. It is the most stringent of the criteria to be fulfilled when using the materials with foodstuffs. The materials comply with EU requirements and with the —>BgVV recommendations.
With a high degree of certainty, any deterioration of foodstuffs due to contact with the materials can be excluded.
DEKAPROP PP-H-L-HP and DEKADUR-L-HP pipes have been tested by the German Federal Institute for Material Research and Testing (BAM), Berlin, and declared to be physiologically harmless.

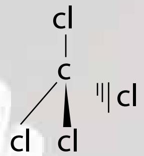
(Physiology is the science which deals with the fundamentals of life and of living matter, in particular with the functions and activities of the human organism.) Cf. —>MAK —> Toxicology.

Pigment

Pigments are indissoluble dyes which, like soluble dyes, are particular —> Additives. They are used, for example, to colour plastics. Pigments usually have a particle size between 0.01 µm and 1 µm. There are —> Organic and —> Inorganic pigments. On account of their molecular structure, inorganic pigments do not usually colour very intensely. However, they do have good covering properties, are usually very temperature-insensitive and colour-fast. Examples: carbon black, titanium white (= TiO_2).
Organic pigments usually have an intense colour, but their covering properties are not so good. They consist of complicated organic molecules which, understandably enough, are not very stable at higher temperatures.

Polarity

Polarity is a concept used in physical chemistry. Ultimately, the polarity of a compound depends on the spatial distribution of electrons (relative to the nuclei of the atoms) in the compound's molecules. Whenever two—> Atoms combine, the distribution of electrons between their nuclei ceases to be symmetrical, leading to a polarization of the bond. The distribution of the polarized bonds within a molecule determines whether or not the whole molecule appears to be polarized.
The polarity of a compound is one of its most important characteristics, determining almost all of its properties, both physical and chemical. Example: the well-known solvent carbon tetrachloride (CCl_4) has four polar, carbon-chlorine bonds which are symmetrically so positioned (tetrahedrally) that the molecule displays no external polarity.

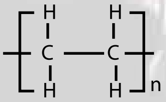


Carbon tetrachloride CCl_4

Polyethylene (PE)

Polyethylene is a widely used plastic. It is a pure hydrocarbon and is used for technical piping systems in many areas, e. g. in sanitary installations (for drinking water and drainage) and in industrial applications (for gas pipes, for the protective sleeving of cables, and for various ducts).

Important basic properties of PE are its high impact resistance (the amorphous state of PE has a glass transition temperature TG between -120 °C and 110 °C) and, due to its simple molecular structure, a chemical resistance better than other polyolefins. Crystalline PE has a melting point between 115 °C and 135 °C.



Nowadays, all sorts of PE materials can be produced (depending on the choice of catalysts and on the processing conditions):

- PE-HD: this abbreviation is used for a PE which is obtained by the controlled polymerization of ethylene under very moderate processing conditions ("low-pressure PE"). It is a linear polymer and has, therefore, a comparatively high density. It has a crystalline content, of up to 85 %.

- PE-MD: this medium density PE is formed at temperatures of about 160 °C and at pressures of about 50 bar. It has a crystalline content of up to 70 %.

- PE-LD: this PE is produced at temperatures of about 300 °C and at high pressure ("high-pressure PE"). Highly reactive, intermediate reactants cause a branching of the molecular chains. The material has a lower density than the grades mentioned above. Its long-term stability is not as good. It has a crystalline content of about 50 %.

- PE-X: this material is a PE which has been crosslinked in subsequent reactions. The properties of PE can be influenced in a controlled way, by incorporating comonomers (—> Monomers) with butene as a C_4 unit. This changes the PE's crystallinity and density. It also improves its resistance to stress-induced hairlines and cracks. (—> Formation of / corrosion by stress-induced hairlines and cracks; crazing)

- PE80: this is a polyethylene which, according to an extrapolation of the results of the long-term —> Stressrupture test (DIN 8075, at 20 °C), has a —> MRS (minimum required strength) of 8 MPa. There are diverse sorts of PE in this group, depending on the pipe manufacturer. The name PE80 says nothing about the material's —> Distribution of molecular mass or about the branching of its molecular chains.

- PE100: this is a new PE quality, in which a —> MRS ≥ 10 MPa (20 °C; 50 years) is achieved. PE100 contains both short linear and longer, branched PE molecular chains (achieved by employing butene comonomers). It therefore has two peaks (so-called bimodality) in its —> Distribution of molecular mass. In spite of a branching of its long chains, a high density is achieved as well as a favourable resistance to cracks and a high degree of stiffness.

Polymer structure

This concept is used for the systematic description of the spatial structure of the molecules of a polymer. The following categories are used:

- Primary structure: Which chemical configuration does the polymer have? In which sequence are the atoms to be found?

- Secondary structure: Which shape do the individual polymer chains have? Are they, for example, parts of disordered bundles or are they spirally formed (as in PTFE)?

- Tertiary structure: Which spatial distribution do the molecular chains in the bulk of the polymer have? What interactions are there between the chains?

- Polymer synthesis

Polymer synthesis is the name given to those reactions in which —> Polymers are produced. Reactions to start the synthesis, to affect the growth of polymer chains, and to terminate the chains are involved. There are the following categories of polymer synthesis:

1. Polymerization
   Many identical or similar small molecules (or chain segments = monomers) react together to form longer molecular chains. One distinguishes between —> Radical and ionic (anionic or cationic) polymerization according to the type of the ends of the growing molecular chains, or the active species. Polyolefins like PP and PE, for example, are normally polymerized by using highly efficient organo-metallic catalytic systems (so-called Ziegler-Natta catalysts or, more recently, metalocen catalysts).

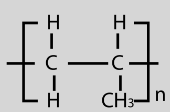
2. Condensation polymerization (polycondensation) The monomers are usually made of two different classes of substances which have reactive groups at their ends. Reactive groups at the ends of one of the monomers react with groups at the ends of the other.
A "condensate" is produced, i. e. small molecules - mostly water molecules - which have to be removed continuously. Examples: manufacture of all polyesters (PET, PC, PMMA), of phenolformaldelhyde resins, of polyamides (all of which are sorts of nylon), or of PEI and PAI.

3. Addition polymerization
   As with condensation polymerization, molecules from two monomer systems, each with a reactive group at its end, combine to form macromolecules. Unlike condensation polymerization, there are no reaction products of low molecular weight. Groups at the ends of one monomer are "added" to groups at the ends of the other monomer. Examples: production of polyurethane from di-isocyanates and alcohols. Epoxy resins.

Polymers
Polymers are substances consisting of —> Macromolecules.

Polypropylene (PP)
Polypropylene is a thermoplastic material with a comparatively low density. The combination of its excellent mechanical properties, its enormous chemical resistance and its heat resistance for temperatures up to about 90 °C, make it a widely used material in industrial piping systems. Nowadays, PP industrial pipes are an integral part of countless installations, of the most diverse sorts all over the world. The pipes are routinely butt welded instead of being cemented together. PP is being increasingly favoured for applications with materials of the highest purity and at temperatures up to 90°C.
Special catalytic systems have turned the production of isotactic PP (—> Tacticity) into a standardised process. There are two categories of PP used in piping systems —> Homopolymer(PP-H) and —> Copolymer.

For this reason, PP copolymers have slightly different mechanical properties such as a higher impact resistance at low temperatures. (Note: The glass transition temperature of amorphous PP is about -5 °C.) Note that the various PP materials also differ in their so-called —>Nucle-ation.

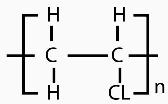


Polypropylene

The latter, which contains ethylene as comonomer (typically up to 12 % by weight), can be obtained as a block copolymer (PP-C) and as a statistical (= random) copolymer (PPR).

The crystallization characteristics of a given PP type can be influenced by using additives to change the nucleation. The melting point of crystalline PP lies between 155 °C (β-form) and 165 °C (α-form) depending on the nature of the nucleation (α or β). Polypropylenes are one of our main fields of research and development. If needed, we can send you more detailed information in the form of pamphlets and specialist papers.

Polyvinyl chloride (PVC)
PVC is the one of the oldest polymer materials available. World-wide, it is the second most commonly used of all plastics. Because it consists of up to 57 % chlorine, its production demands relatively little crude oil. It is manufactured on an industrial scale in one of three processes:
- Emulsion polymerization (PVC-E)
- Suspension polymerization (PVC-S)
- Bulk polymerization (PVC-M)



PVC

In the polymer structure, the chlorine atoms are distributed statistically, i. e. in a tactic way. PVC is an amorphous material of 5 % crystallinity. Its glass transition temperature lies between 75 °C and 85 °C, and it has a density of 1.4 g/cm^3. It can be processed without difficulty by extrusion, calendering, blow forming, spread coating, dip coating and injection moulding.
PVCs differ not only in the way they are manufactured, but also in the many modified forms which arise from the use of different additives. For example:
- PVC-U (unplasticized = hard PVC)
- PVC-P (plasticized = soft PVC)
  PVC has the following characteristic properties:
- high mechanical stability, stiffness and hardness
- high resistance to attack by chemicals intrinsic flame resistance (because of the high halogen content) —>Flame retardants
- easily cemented and welded together

PVC pipes are usually extruded using the type S-PVC which has a —> K-value between 65 and 68. An extrudable mixture is made by blending the initial S-PVC material with additives and other —> Processing aids. A high K-value is needed in the manufacture of pressure pipes. In contrast to extrusion, injection moulding needs a K-value below 60.

Pipes made of PVC have been used for decades with great success in the following areas: piping and equipment in the chemical industry pipes for drinking water, for drainage and sewage.

Post-chlorinated polyvinyl chloride
PVC is photochemically post-chlorinated PVC . In the post-chlorination reaction, there is a further exchange of chlorine for hydrogen in the PVC chain molecules. The exchange is more likely to occur at

already chlorinated carbon atoms of the PVC (-CClH-). In this way, the chlorine content of a polymer can be raised from 57 up to 65 % by weight. The interactions between the polymer's molecules are increased. The polymer' molecular chains then interact more strongly with each other. This leads to an increased heat resistance, some 30 K higher than in PVC (the glass transition temperature TG being raised to about 130 °C), and to a distinctly higher chemical resistance. The main application of the moderately priced material is for chemical equipment used with very aggressive substances and at higher temperatures (up to T = 90 °C, e. g. in the electrolytic production of chlorine and caustic soda).
Post-chlorination makes a material's extrusion more difficult. This is because the temperature "gap" between plastic behaviour and the point of thermal decomposition is narrowed. Welding is also made more difficult. Up to OD 160 mm adhesion therefore produces the most durable joints in CPVC pipes.

Post-crystallization
Many semi-crystalline polymers have a larger proportion of amorphous material if they are cooled from their melt in quick successive steps - even though a larger proportion of crystalline material could be expected on the basis of the actual energy equilibrium. Because the molecular motion is "frozen", a change in crystalline order is hardly attainable at ambient temperatures and in a finite time span. Moderate heating ($T < T_{melt}$) of a given polymer considerably accelerates the formation of crystals.
Example: PPS.
Post-crystallization in polymers can also be achieved locally by mechanical stretching. This can be the cause for example, of white "kinks" in small polystyrene plates.

ppm (parts per million), ppb (parts per billion)
ppm ($=10^{-6}$) and ppb ($=10^{-9}$) are very common expressions used for values of concentration.
Note the confusing difference in usage!
A US (and French) billion is 109 (German: Milliarde). German Billion is 10^{12}. In the UK there is often the ambiguity of whether the term billion means 10^{12} (older usage) or 10^9.

Processing aids
Processing aids are particular —> Additives.

Pyrolysis
Pyrolysis is defined as the irreversible chemical decomposition of a substance (without —> Oxidization taking place) brought about by the action of heat.
Example: the unwanted pyrolysis of a polymer granulate in an extruder.

Radical
A radical is a highly reactive, intermediate product in a chemical reaction - particularly in organic chemistry. Radicals arise in the uniform break-up (= homolytic fission) of simple chemical bonds as schematized in A - B —> A* + B* (in which "*" signifies an unpaired electron).
The break-up can be caused by heat, by radiation or by chemical means. Every organic oxidation depends on the existence of radicals. They are of great importance in many polymerization processes, and are the central factor in the discussion of colour retention by plastics and dyes.

Reduction
—> Oxidation

Relaxation
Various molecular motions are possible in a polymer material. Their analysis in so-called relaxation spectroscopy, makes it possible to classify the motions, which are often highly complex, into certain classes - the α, β, γ classes etc. The aim is to correlate the relaxation observed in a given polymer with certain molecular motions.
Example: a relaxation is always a motion which, in amorphous and semi-crystalline polymers, leads to the —> Glass transition. At a given temperature, a relaxation is always associated with a fixed frequency.

Rubber (Caoutchouc)
Rubber is the generic term for largely —> Amorphous polymers, with a glass transition temperature below the temperature of use. Depending on the way they are produced, one distinguishes between natural and synthetic rubbers. A rubber which has been loosely cross-linked (chemically) is called soft rubber (or simply "rubber") and is an elastomer. A rubber which has been highly cross-linked (chemically) is called hard rubber. Crude rubbers (caoutchouc) are important raw materials for elastomers. Note the difference between —> elastomers and —> thermoplastic elastomers.

Silicic Acid
Silicic acid is the collective name of a large number of silicon compounds which are obtained from the condensation of so-called orthosilicic acid H_2SiO_4. Molecular networks are produced which can adsorb a large quantity of water. Further condensation leads to their becoming ever more viscous. Finally, they coagulate (gelatinous silica). If the resulting gel yields more water, it becomes silica gel which, like —> Active carbon, is a good adsorbing agent. Heating silica gel to incandescence produces quartz.
Example: these substances are used to give the required degree of viscosity in many plastic adhesives.

Softening agents
Softening agents are an important group of additives which increase a polymer's plasticity. The effect can be understood by imagining the softening agent to penetrate into the polymer structure like a multitude of tiny "wedges". These place themselves between the polymer chains creating extra so-called "free volume". The increased mean distance between the polymer chains reduces their forces of —> Cohesion and facilitates the microscopic motion of the chains, enabling them to slide past each other more easily. Macroscopically (i. e. on a much larger scale) one observes a reduction of the glass transition temperature. The material is more easily formed - it is "softer". One distinguishes between softening agents with molecules of low molecular weight and those highly viscous agents which have much larger molecules. One also differentiates between primary and secondary softening agents. The latter function effectively as solvents of the primary agents. The choice of a softening agent is dictated by a number of factors, for example the ease with which the agent can diffuse out of the polymer (—> Migration,—>Toxicity), and its solvation.

Example: the most important use of softening agents, particularly in piping systems, is in PVC-P. (Between 80% and 85 % of all softening agents are used in PVC.) Phthalate is an agent often used here. Hard PVC pipes (PVC-U) differ from PVC-P products by containing no softening agents at all. Note: PVC-P pipes and moulded components are never to be used together with PVC-U There could be a damaging —> Migration of the softening agent from the PVC-P into the PVC-U.

Solution

Solutions are homogeneous mixtures. Colloquially, the expression is usually only used for liquid solutions, although alloys and gaseous mixtures also fall into the category. A solution's major component, quantitatively, is the—> Solvent. The minor component is the solute. Important: there are degrees of solubility in all such systems, i.e. one can make solutions dilute, concentrated or saturated solvation (Hydration): —> Solvent.

Solvation (Hydration)

—> Solvent

Solvent

Matter is held together by forces which have different causes. Here, one distinguishes among other things between (simple) electrostatic forces and interactions between dipoles. Such forces have to be overcome by the solution in order for it to be able to solvate part of the substance being dissolved. —> Solvation can be envisaged as placing a solvent covering over each particle of the solute. Here too, there are attracting interactions between the solvent and solute. A substance's solubility in a given solvent depends finally on the relative energies of the components of the system. For this reason the temperature always has to be taken into consideration.
According to their possible interactions, solvents can be divided, very roughly, into polar and unpolar groups. The polar solvents can be subdivided into socalled protical and aprotical solvents.
The theory of what dissolves in what has been popularized in the slogan "same in same, like in like". Examples: polar substances such as common salt, dissolve well in apolar (protical) solvents such as water. Unpolar substances such as fats, dissolve in unpolar solvents such as dry-cleaning spirit.
The slogan is generally valid for polymers and their solubility.
The polymer molecules' great size and their entanglement are, however, additional factors which should be taken into account. Here, theories of very much greater complexity are needed, e. g. to explain other but similar phenomena, like that of —> Swelling.

Spherulite

A spherulite is one possible form of a polycrystalline macrostructure to be found in semi-crystalline polymers such as PP. The spherulites in a polymer strongly affect its morphology (i. e. the shape to which small crystalline parts of the polymer join together). As a result of three dimensional, uniform growth, the spherulites are spherically symmetrical. They have particular optical properties, which are easily recognised in —> Microtome sections (illuminated by linearly polarized light) by a characteristic Maltese cross-like interference effect. The sizes and types of the spherulites in a polymer can be strongly influenced by the addition of special —> Nucleating agents, by the way in which the polymer is processed, and by heat treatment.
In PP, the sizes and types of spherulites have a critical influence on almost all the material's properties (e. g. on its impact resistance and chemical stability).

Stabilizers

Stabilizers are additives which, by causing certain chemical reactions, give a polymer additional resistance to heat, to radiation (e. g. UV light), to atmospheric oxygen and to humidity. They help the polymer to retain its properties when being processed, handled or used. Usually, combinations of stabilizers are used which protect simultaneously against heat, light and oxidation. Important groups of stabilizers are, for example, compounds of lead, and of calcium with zinc (in —> Polyvinyl chloride, PVC), organo-zinc compounds, epoxides, UV absorbers, substances which impede oxidation (—> Antioxidants, e. g. in PP) and co-stabilizers (cf. —>Radicals). Example: at high temperatures, HCl is easily released from unstabilized PVC. Double (C=C) bonds arise at those points of the PVC chains involved, making them susceptible (by breakage) to oxidation by atmospheric oxygen. In this case, stabilizers stop the reaction producing HCl, or take up the HCl immediately after it has been produced.

Sterilisation

Sterilisation is the complete extermination of micro-organisms (e. g. fungi, bacteria, spores, viruses). The word "sterile" is synonymous with "free of all living material". Sterility is therefore an absolute condition. It can be produced by heat, sophisticated filtration, oxidation and UV radiation. A medium which is sterilised is always disinfected at the same time. A disinfected medium does not have to be sterile. (—> Disinfection).

Surfactants (detergents, surface-active agents, tensides)

Surfactants are a whole class of organic compounds used as washing agents, wetting agents or emulsifiers. On account of its molecular structure, a surfactant accumulates on surfaces and at the boundaries of two phases making them easier to wet; i. e. it reduces the surface and interfacial tension. This is the principle behind washing, wetting, cleaning, emulsifying, and the effect of dispersants.
A surfactant's particular properties are determined by the presence of two molecular groups:

- a —> Hydrophobic group (usually an —> Aliphatic residue)

- a —> Hydrophilic group which gives rise to the surfactant's solubility in water and which can contain a negative electric charge (anionic surfactant), a positive charge (cationic surfactant) or only certain dipolar groups (nonionic surfactant)

The wetting properties of surfactants —> Stress crack inducing media) are of enormous importance when considering the—> Chemical resistance of polymer piping.

Swelling

Swelling is the name given to the penetration of certain liquids (usually —> Solvents) or gases into a polymer. The molecules of the polymer are, however, not dissolved out, but remain as part of the polymer structure. The liquid taken up makes the polymer expand and become heavier.
The marked swelling of a cross-linked polymer is called gelling. For a given polymer material, swelling phenomena are dependent in

particular on the molecular size and chemical structure of the solvent or gellant, on the time in which these substances act, and on the temperature. Swelling causes a softening of the polymer material, the structure of which can be permanently damaged. For example, new cavities can be formed, i. e. the so called "free volume" increases. It is possible, too, that additives are more easily leached out after swelling. Swelling in plastic pipes is of immense importance, particularly with regard to their —> Chemical resistance, or when using adhesives to connect piping elements.

Tacticity

Tacticity is the spatial distribution of side groups on polymer chains (e. g. the CH_3 groups in PP).

- syndiotactic: The side groups are arranged alternately on one and then on the other side of the chains.

- isotactic: All the side groups are on one side of the polymer chains.

- atactic: There is no regular arrangement of the side groups.

The tacticity of a material influences the ease with which discrete crystalline domains can be produced. It has an enormous influence on the material's—> Glass transition temperature and on the melting points of its crystallites.

Thermal decomposition

—> Pyrolysis

Thermoplastic elastomers

This is the name given to polymers which (due to forces of —> Cohesion) are physically cross-linked at ambient temperatures. At higher temperatures, the cross-linking is undermined by thermal motion, making the material easily processable - as with a thermoplastic.

Thermoplastics

This name has its origin in the classification of plastics according to their behaviour when heated or processed, and in their capability to be reused. Thermoplastics consist of macromolecules which are not (or only slightly) cross-linked. It is easier for these molecules to slip past each other when the thermoplastic is heated. Above the glass transition and/or the melting temperature, a thermoplastic material can be re-formed - reversibly and as often as needed. —> Elastomers and —> Thermosetting plastics are polymers with similar characteristics.

Thermosetting plastics (thermosets)

The polymer chains of thermosetting plastics are so strongly cross-linked, that thermal deformation (below the decomposition temperature) is often impossible. Moulded parts and semi-finished products can only be manufactured using the "precursor" plastic, i. e. before cross-linking takes place. The parts and products are then hardened thermally or photochemically (possibly by adding cross-linking agents or hardeners).

Examples: bakelite, many dual-component adhesives, PAI, curing of PPS, manufacture of polyimides, thermal cyclization of polyacrylonitrile (PAN) to graphite and to carbon fibres. (Cf. —> Thermoplastics, —>Elastomers)

TOC (Total Organic Carbon)

The TOC is a measure of the organic contamination of water. When applied to ultrapure water, its value is often identical with the DOC (Dissolved Organic Carbon). The TOC is almost always found either by oxidizing the organic materials and by determining the total amount of CO_2 formed, or by measuring the increase in conductivity which is caused by the carbonic acid produced by dissolved CO_2.
Example: a plastic pipe's suitability for use with ultrapure water depends (among other things) strongly on the proportion of organic substances of low molecular weight (e. g. —> Additives, —> Oligomers) which, under working conditions, are leached, or migrate, out of the pipe.

The TOC is an important part of the so-called "leach-out values". PP-H Daplen BE60 components have extremely low TOC values compared with other PP pipes. They open new possibilities for the application of the material PP-H in the transport of ultrapure substances.

Toxicology

Toxicology is defined as the scientific study of the harmful effects of chemicals on living organisms.
Note: Because pharmacology is the study of the interaction between any chemicals and living organisms, it follows that toxicology is only one part of pharmacology.

Voids

Voids are unwanted cavities which arise during the extrusion/ moulding of polymer products. Air bubbles, a granulate which is too damp, or impurities are possible causes.

Water quality

Water can contain very many substances and has to be processed or purified according to its proposed use. The results are a variety of degrees of purity which can be characterised according to diverse criteria. [e. g. measurements of —> Conductivity (electrical); determination of the amount of specific types of ion.]

Process water

Water with different qualitative features (its suitability as —> Drinking water could be included) for business, industrial and agricultural purposes

Brackish water

Water with medium salt content, e. g. the mixture of fresh and salt water which is found at the mouths of rivers. The specific conductivity at 25 °C lies between 0.05 S/cm and 1 S/cm.

Drinking water

Water of a quality which conforms to the TVO (Trinkwasserverordnung = German Drinking Water Ordinance) regarding, for example, the maximum amount of pollutants. Drinking water has to maintained at a temperature below 25 °C. Its specific conductivity at 25 °C lies between 50 µS/cm and 5000 µS/cm.

Pure water

Water which has been produced using —> **Ion exchangers**, reverse osmosis or distillation, but which still contains a residue of certain ions. Purified water ("aqua purificata") prepared according to the —> **DAB** (and used in many pharmaceutical products) belongs to this category. Its specific conductivity at 25 °C lies between 1 µS/cm and 50 µS/cm. Water for injection ("aqua ad injectabilia") used in hypodermic syringes is categorised in the —> **DBA** as a "cleaner" pure water. It is used as a solvent and as a fluid for diluting those medicines which can be applied by injection or by infusion. Sterility is a prerequisite.

Deionized water

Water which is fully salt-free (deionized). It is produced by the use of ion exchangers or by distillation. The quality of the resulting product is codified by various standards (e. g. DIN, ISO 3696). No ionogenic contents (= anions and cations) may be present. The specific conductivity at 25 °C lies between 0.1 µS/cm and 1 µS/cm.

Ultrapure water

Water of the very highest purity. It is made from distilled water using supplementary ion-exchange techniques, —> **Active carbon** and other absorbing materials. It contains only the slightest traces of organic compounds, micro-organisms and electrolytes. The specific conductivity at 25 °C is less than 0.1 µS/cm.

For those unfamiliar with the difference between metric and inch sizes the following note may be helpful. In imperial systems, the sizes of pipes, fittings and other components such as valves are identified by reference to the nominal size of the bore of the pipe expressed in inches and fractions of an inch.

In metric systems, however, sizes are identified by references to the outside diameter of the pipe expressed in millimetres.

The table below shows the metric sizes which are regarded for practical purposes as being generally equivalent to imperial sizes. It should, however, be understood that metric sizes are not simply inch sizes which have been converted into millimetres and called metric. Their actual dimensions are slightly different and they are with the exception of 2½ " (75 mm) and 5" (140 mm) not interchangeable.

IMPERIAL SIZES		METRIC SIZES	
NOMINAL BORE DN (INCH)	PIPE OUTSIDE DIAMETER D (MM)	PIPE OUTSIDE DIAMETER D (MM)	NOMINAL BORE DN (MM)
1/8	10.4	10	6
1/4	13.7	12	8
3/8	17.2	16	10
1/2	21.3	20	15
3/4	26.7	25	20
1	33.4	32	25
1 1/4	42.2	40	32
1 1/2	48.3	50	40
2	60.3	63	50
2 1/2	73.0	75	65
3	88.9	90	80
3 1/2	101.6	-	-
4	114.3	110	100
-	-	125 1)	100
-	-	125 2)	125
5	141.3	140	125
6	168.3	160	150
-	-	180 1)	150
7	193.7	180 2)	175

1) only butt fusion systems
2) only cementing socket systems

IMPERIAL SIZES		METRIC SIZES	
NOMINAL BORE DN (INCH)	PIPE OUTSIDE DIAMETER D (MM)	PIPE OUTSIDE DIAMETER D (MM)	NOMINAL BORE DN (MM)
8	219.1	200	200
8	219.1	225	200
9	244.5	250	250
10	273.0	280	250
12	323.9	315	300
14	355.6	355	350
16	406.4	400	400
18	457.2	450	450
20	508.0	500	500
22	558.2	560	600
24	609.6	630	600
26	660.4	-	-
28	711.2	710	700
30	762.0	-	-
32	812.8	800	800
34	863.6	-	-
36	914.4	900	900
40	1016.0	1000	1000

Acceptance test — an investigation performed on an individual lot of a previously qualified product, by, or under the observation of, the purchaser to establish conformity with a purchase agreement.

Acetal plastics — plastics based on resins having a predominance of acetal linkages in the main chain.

Acrylonitrile-butadiene-styrene (ABS) pipe and fitting plastics — plastics containing polymers and/or blends of polymers, in which the minimum butadiene content is 6 percent, the minimum acrylonitrile content is 15 percent, the minimum styrene and/or substituted styrene content is 15 percent, and the maximum content of all other monomers is not more than 5 percent, and lubricants, stabilizers and colorants.

Adhesive — a substance capable of holding materials together by surface attachment.

Adhesive, solvent — an adhesive having a volatile organic liquid as a vehicle. See Solvent Cement.

Aging, n. — (1) the effect on materials of exposure to an environment for an interval of time.

— (2) the process of exposing materials to an environment for an interval of time.

Antioxidant — a compounding ingredient added to a plastic composition to retard possible degradation from contact with oxygen (air), particularly in processing at or exposures to high temperatures.

Artificial weathering — the exposure of plastics to cyclic laboratory conditions involving changes in temperature, relative humidity, and ultraviolet radiant energy, with or without direct water spray, in an attempt to produce changes in the material similar to those observed after long-term continuous outdoor exposure.

NOTE — The laboratory exposure conditions are usually intensified beyond those encountered in actual outdoor exposure in an attempt to achieve an accelerated effect. This definition does not involve exposure to special conditions such as ozone, salt spray, industrial gases, etc.

Beam loading — the application of a load to a pipe between two points of support, usually expressed in pounds and the distance between the centers of the supports.

Bell end — the enlarged portion of a pipe that resembles the socket portion of a fitting and that is intended to be used to make a joint by inserting a piece of pipe into it. Joining may be accomplished by solvent cements, adhesives, or mechanical techniques.

Burst strength — the internal pressure required to break a pipe or fitting. This pressure will vary with the rate of buildup of the pressure and the time during which the pressure is held. See NOTE A.

Butylene plastics — plastics based on resins made by the polymerization of butene or copolymerization of butene with one or more unsaturated compounds, the butene being in greatest amount by weight.

Cellulose acetate butyrate plastics — plastic made by compounding a cellulose acetate butyrate ester with plasticizers and other ingredients. Cellulose acetate butyrate ester is a derivative of cellulose (obtained from cotton and/or wood pulp) made by converting some of the hydroxyl groups in cellulose to acetate and butyrate groups with chemicals.

Cement — See Adhesive and Solvent, cement.

Chemical resistance — (1) the effect of specific chemicals on the properties of plastic piping with respect to concentration, temperature and time of exposure.

— (2) the ability of a specific plastic pipe to render service for a useful period in the transport of a specific chemical at a specified concentration and temperature.

Cold flow — See Creep.

Compound — the intimate admixture of a polymer or polymers with other ingredients such as fillers, softeners, plasticizers, catalysts, pigments, dyes, curing agents, stabilizers, antioxidants, etc.

Copolymer — See Polymer.

Creep, n. — the time-dependent part of strain resulting from stress, that is, the dimensional change caused by the application of load over and above the elastic deformation and with respect to time.

Cure, v. — to change the properties of a polymeric system into a final, more stable, usable condition by the use of heat, radiation, or reaction with chemical additives.

Deflection temperature — the temperature at which a specimen will deflect a given distance at a given load under prescribed conditions of test. See ASTM D-648. Formerly called heat distortion.

Degradation, n. — a deleterious change in the chemical structure of a plastic. See also Deterioration.

Deterioration — a permanent change in the physical properties of a plastic evidenced by impairment of these properties.

Diffusion, n. — the movement of a material, such as a gas or liquid, in the body of a plastic. If the gas or liquid is absorbed on one side of a piece of plastic and given off on the other side, the phenomenon is called permeability. Diffusion and permeability are not due to holes or pores in the plastic but are caused and controlled by chemical mechanisms.

Dimension ratio — the diameter of a pipe divided by the wall thickness. Each pipe can have two dimension ratios depending on whether the outside or inside diameter is used. In practice, the outside diameter is used if the standards requirement and manufacturing control are based on this diameter. The inside diameter is used when this measurement is the controlling one.

Dry-Blend — a free-flowing dry compound prepared without fluxing or addition of solvent.

NOTE A — Burst strength, fiber stress, hot stress, hydrostatic design stress, long-term hydrostatic strength, hydrostatic strength (quick), long-term burst, ISO equation, pressure, pressure rating, quick burst, service factor, strength, stress, and sustained pressure test are related terms.

Elasticity — that property of plastic materials by virtue of which they tend to recover their original size and shape after deformation.

NOTE — If the strain is proportional to the applied stress, the material is said to exhibit Hookean or ideal elasticity.

Elastomer — a material which at room temperature can be stretched repeatedly to at least twice its original length and, upon immediate release of the stress, will return with force to its approximate original length.

Elevated temperature testing — tests on plastic pipe above 23C (73F).

Environmental stress cracking — cracks that develop when the material is subjected to stress in the presence of specific chemicals.

Ethylene plastics — plastics based on resins made by the polymerization of ethylene or copolymerization of ethylene with one or more other unsaturated compounds, the ethylene being in greatest amount by weight.

Extrusion — a method whereby heated or unheated plastic forced through a shaping orifice becomes one continuously formed piece.

Failure, adhesive — rupture of an adhesive bond, such that the place of separation appears to be at the adhesive-adherent interface.

Fiber stress — the unit stress, usually in pound per square inch (psi), in a piece of material that is subjected to an external load. See NOTE A, page 7.76.

Filler — a relatively inert material added to a plastic to modify its strength, permanence, working properties, or other qualities, or to lower costs. See also Reinforced plastic.

Forming — a process in which the shape of plastic pieces such as sheets, rods, or tubes is changed to a desired configuration. See also Thermoforming.

NOTE — The use of the term "forming" in plastics technology does not include such operations as molding, casting, or extrusion, in which shapes or pieces are made from molding materials or liquids.

Fungi resistance — the ability of plastic pipe to withstand fungi growth and/or their metabolic products under normal conditions of service or laboratory tests simulating such conditions.

Heat distortion — See Deflection temperature.

Heat forming — See Thermoforming.

Heat joining — making a pipe joint by heating the edges of the parts to be joined so that they fuse and become essentially one piece with or without the use of additional material.

Hoop stress — the tensile stress, usually in pounds per square inch (psi), in the circumferential orientation in the wall of the pipe when the pipe contains a gas or liquid under pressure. See NOTE A, page 7.76.

Hydrostatic design stress — the estimated maximum tensile stress in the wall of pipe in the circumferential orientation due to internal hydrostatic pressure that can be applied continuously with a high degree of certainty that failure of the pipe will not occur. See NOTE A, page 7.76.

Hydrostatic strength (quick) — the hoop stress calculated by means of the ISO equation at which the pipe breaks due to an internal pressure build-up, usually within 60 to 90 seconds. See NOTE A, page 7.76.

Long-term burst — the internal pressure at which a pipe or fitting will break due to a constant internal pressure held for 100,000 hours (11.43 years). See NOTE A, page 7.76.

Impact, Izod — a specific type of impact test made with a pendulum type machine. The specimens are molded or extruded with a machined notch in the center. See ASTM D-256.

Impact, Tup — a falling weight (tup) impact test developed specifically for pipe and fittings. There are several variables that can be selected. See ASTM D-2444.

ISO equation — an equation showing the interrelations between stress, pressure and dimensions in pipe, namely

$$S = \frac{P(ID + t)}{2t} \text{ or } \frac{P(OD - t)}{2t}$$

where
- **S** = stress
- **P** = pressure
- **ID** = average inside diameter
- **OD** = average outside diameter
- **t** = minimum wall thickness (Note A, page 7.76)

Reference: ISO R161-1960 Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part I, Metric Series.

Joint — the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by an adhesive, a solvent-cement or a mechanical device such as threads or a ring seal.

Long-term hydrostatic strength — the estimated tensile stress in the wall of the pipe in the circumferential orientation (hoop stress) that when applied continuously will cause failure of the pipe at 100,000 hours (11.43 years). These strengths are usually obtained by extrapolation of log-log regression equations or plots. See NOTE A, page 7.76.

Molding, compression — a method of forming objects from plastics by placing the material in a confining mold cavity and applying pressure and usually heat.

Molding, injection — a method of forming plastic objects from granular or powdered plastics by the fusing of plastic in a chamber with heat and pressure and then forcing part of the mass into a cooler chamber where it solidifies.

NOTE — This method is commonly used to form objects from thermoplastics.

Monomer — a relatively simple chemical which can react to form a polymer. See also Polymer.

Nylon plastics — plastics based on resins composed principally of a long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain.

Olefin plastics — plastics based on resins made by the polymerization of olefins or copolymerization of olefins with other unsaturated compounds, the olefins being in greatest amount by weight. Polyethylene, polypropylene and polybutylene are the most common olefin plastics encountered in pipe.

Outdoor exposure — plastic pipe placed in service or stored so that it is not protected from the elements of normal weather conditions, i.e., the sun's rays, rain, air and wind. Exposure to industrial and waste gases, chemicals, engine exhausts, etc. are not considered normal "outdoor exposure".

Permanence — the property of a plastic which describes its resistance to appreciable changes in characteristics with time and environment.

Permeability — See Diffusion.

Plastic, n. — a material that contains as an essential ingredient an organic substance of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or in its processing into finished articles, can be shaped by flow.

Plastic, adj. — the adjective plastic indicates that the noun modified is made of, consists of, or pertains to plastic.

NOTE 1 — The above definitions may be used as a separate meaning to the definitions contained in the dictionary for the adjective "plastic".

NOTE 2 — The plural form may be used to refer to two or more plastic materials, for example, plastics industry. However, when the intent is to distinguish "plastic products" from "wood products" or "glass products", the singular form should be used. As a general rule, if the adjective is to restrict the noun modified with respect to type of material, "plastic" should be used; if the adjective is to indicate that more than one type of plastic material is or may be involved, "plastics" is permissible.

Plastic conduit — plastic pipe or tubing used as an enclosure for electrical wiring.

Plastic pipe — a hollow cylinder of plastic material in which the wall thicknesses are usually small when compared to the diameter and in which the inside and outside walls are essentially concentric. See Plastic tubing.

Plastic tubing — a particular size of plastics pipe in which the outside diameter is essentially the same as that of copper tubing. See Plastic pipe.

Plasticizer — a material incorporated in a plastic to increase its workability and its flexibility or distensibility.

NOTE — The addition of the plasticizer may lower the melt viscosity, the temperature of the second-order transition, or the elastic modulus of the plastic.

Polybutylene, n. — a polymer prepared by the polymerization of butene-1 as the sole monomer. See Polybutylene plastics and Butylene plastics.

Polybutylene plastics — plastics based on polymers made with butene-1 as essentially the sole monomer.

Polyethylene, n. — a polymer prepared by the polymerization of ethylene as the sole monomer. See Polyethylene plastics and Ethylene plastics.

Polyethylene plastics — plastics based on polymers made with ethylene as essentially the sole monomer. NOTE — In common usage for this plastic, essentially means no less that 85% ethylene and no less than 95% total olefins.

Polymer — a compound formed by the reaction of simple molecules having functional groups that permit their combination to proceed to high molecular weights under suitable conditions. Polymers may be formed by polymerization (addition polymer) or polycondensation (condensation polymer). When two or more monomers are involved, the product is called a copolymer.

Polymerization — a chemical reaction in which the molecules of a monomer are linked together to form large molecules whose molecular weights is a multiple of that of the original substance. When two or more monomers are involved, the process is called copolymerization or heteropolymerization.

Polyolefin, n. — a polymer prepared by the polymerization of an olefin(s) as the sole monomer(s). See Polyolefin plastics and Olefin plastics.

Polyolefin plastics — plastics based on polymers made with an olefin(s) as essentially the sole monomer(s).

Polypropylene, n. — a polymer prepared by the polymerization of propylene as the sole monomer. See Polypropylene plastics and Propylene plastics.

Polypropylene plastics — plastics based on polymers made with propylene as essentially the sole monomer.

Polystyrene — a plastic based on a resin made by polymerization of styrene as the sole monomer. See Styrene plastics.

NOTE — Polystyrene may contain minor proportions of lubricants, stabilizers, fillers, pigments, and dyes.

Poly (vinyl chloride) — a resin prepared by the polymerization of vinyl chloride with or without the addition of small amounts of other monomers.

Poly (vinyl chloride) plastics — plastics made by combining poly (vinyl chloride) with colorants, fillers, plasticizers, stabilizers, lubricants, other polymers, and other compounding ingredients. Not all of these modifiers are used in pipe compounds.

Powder blend — See Dry-Blend.

Pressure — when expressed with reference to pipe the force per unit area exerted by the medium in the pipe. See NOTE A, page 7.76.

Pressure rating — the estimated maximum pressure that the medium in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur. See NOTE A, page 7.76.

Propylene plastics — plastics based on resins made by the polymerization of propylene or copolymerization of propylene with one or more other unsaturated compounds, the propylene being in greatest amount by weight.

Qualification test — an investigation, independent of a procurement action, performed on a product to determine whether or not the product conforms to all requirements of the applicable specification.

NOTE — The examination is usually conducted by the agency responsible for the specification, the purchaser, or by a facility approved by the purchaser, at the request of the supplier seeking inclusion of his product on a qualified products list.

Quick burst — the internal pressure required to burst a pipe or fitting due to an internal pressure build-up, usually within 60 to 70 seconds. See NOTE A, page 7.76.

Reinforced plastic — a plastic with some strength properties greatly superior to those of the base resin, resulting from the presence of high strength fillers imbedded in the composition. See also Filler.

Resin — a solid, semisolid, or pseudosolid organic material which has an indefinite and often high molecular weight, exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally.

Reworked material (thermoplastic) — a plastic material that has been reprocessed, after having been previously processed by molding, extrusion, etc. in a fabricator's plant.

Rubber — a material that is capable of recovering from large deformations quickly and forcibly. See Elastomer.

Sample — a small part or portion of a plastic material or product intended to be representative of the whole.

Saran plastics — plastics based on resins made by the polymerization of vinylidene chloride or copolymerization of vinylidene chloride with other unsaturated compounds, the vinylidene chloride being in greatest amount of weight.

Schedule — a pipe size system (outside diameters and wall thickness) originated by the iron pipe industry.

Self-extinguishing — the ability of a plastic to resist burning when the source of heat or flame that ignited it is removed.

Service factor — a factor which is used to reduce a strength value to obtain an engineering design stress. The factor may vary depending on the service conditions, the hazard, the length of service desired, and the properties of the pipe. See NOTE A, page 7.76.

Set — to convert an adhesive into a fixed or hardened state by chemical or physical action, such as condensation, polymerization, oxidation, vulcanization, gelation, hydration, or evaporation of volatile constituents. See also Cure.

Softening range — the range of temperature in which a plastic changes from a rigid to a soft nature.

NOTE — Actual values will depend on the method of test. Sometimes referred to as softening point.

Solvent cement — in the plastic piping field, a solvent adhesive that contains a solvent that dissolves or softens the surfaces being bounded so that the bonded assembly becomes essentially one piece of the same type of plastic.

Solvent cementing — making a pipe joint with a solvent cement. See Solvent cement.

Specimen — an individual piece or portion of a sample used to make a specific test. Specific tests usually require specimens of specific shape and dimensions.

Stabilizer — a compounding ingredient added to a plastic composition to retard possible degradation on exposure to high temperatures, particularly in processing. An antioxidant is a specific kind of stabilizer.

Standard dimension ratio — a selected series of numbers in which the dimension ratios are constants for all size of pipe for each standard dimension ratio and which are the USASI Preferred Number Series 10 modified by +1 or –1. If the outside diameter (OD) is used the modifier is +1. If the inside diameter (ID) is used the modifier is –1.

Standard thermoplastic pipe materials designation code — a means for easily identifying a thermoplastic pipe material by means of three elements. The first element is the abbreviation for the chemical type of the plastic in accordance with ASTM D-1600. The second is the type and grade (based on properties in accordance with the ASTM materials specification): in the case of ASTM specifications which have no types and grades or those in the cell structure system, two digit numbers are assigned by the PPI that are used in place of the larger numbers. The third is the recommended hydrostatic design stress (RHDS) for water at 23C (73F) in pounds per square inch divided by 100 and with decimals dropped, e.g. PVC 1120 indicates that the plastic in poly (vinyl chloride), Type I Grade 1 according to ASTM D-1784 with a RHDS of 2000 psi for water at 73F. PE 3306 indicates that the plastic is polyethylene. Type III Grade 3 according to ASTM D-1248 with a RHDS of 630 psi for water at 73F. PP 1208 is polypropylene. Class I-19509 in accordance with ASTM D-2146 with a RHDS of 800 psi for water at 73F; the designation of PP 12 for polypropylene Class I-19509 will be covered in the ASTM and Product Standards for polypropylene pipe when they are issued.

Stiffness factor — a physical property of plastic pipe that indicates the degree of flexibility of the pipe when subjected to external loads. See ASTM D-2413.

Strain — the ratio of the amount of deformation to the length being deformed caused by the application of a load on a piece of material.

Strength — the stress required to break, rupture, or cause a failure. See NOTE A, page 7.76.

Stress — when expressed with reference to pipe the force per unit area in the wall of the pipe in the circumferential orientation due to internal hydrostatic pressure. See NOTE A, page 7.76.

Stress-crack — external or internal cracks in a plastic caused by tensile stresses less than that of its short-term mechanical strength.

NOTE — The development of such cracks is frequently accelerated by the environment to which the plastic is exposed. The stresses which cause cracking may be present internally or externally or may be combinations of these stresses. The appearance of a network of fine cracks is called crazing.

Stress relaxation — the decrease of stress with respect to time in a piece of plastic that is subject to an external load.

Styrene plastics — plastics based on resins made by the polymerization of styrene or copolymerization of styrene with other unsaturated compounds, the styrene being in greatest amount by weight.

Styrene-rubber (SR) pipe and fitting plastics — plastics containing at least 50 percent styrene plastics combined with rubbers and other compounding materials, but not more than 15 percent acrylonitrile.

Styrene-rubber plastics — compositions based on rubbers and styrene plastics, the styrene plastics being in greatest amount by weight.

Sustained pressure test — a constant internal pressure test for 1000 hours. See NOTE A, page 7.76.

Thermoforming — forming with the aid of heat. See also Forming.

Thermoplastic, n. — a plastic which is thermoplastic in behavior.

Thermoplastic, adj. — capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

NOTE — Thermoplastic applies to those materials whose change upon heating is substantially physical.

Thermoset, n. — a plastic which, when cured by application of heat or chemical means, changes into a substantially infusible and in-soluble product.

Thermoset, adj. — pertaining to the state of a resin in which it is relatively infusible.

Thermosetting — capable of being changed into a substantially infusible or insoluble product when cured under application of heat or chemical means.

Vinyl Chloride plastic — plastics based on resins made by the polymerization of vinyl chloride or copolymerization of vinyl chloride with other unsaturated compounds, the vinyl chloride being in greatest amount by weight.

Virgin material — plastic material in the form of pellets, granules, powder, floc, or liquid that has not been subjected to use or processing other than that required for its original manufacture.

Weld- or Knit-line — a mark on a molded plastic formed by the union of two or more streams of plastic flowing together.

Abbreviations

AGA	American Gas Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BOCA	Building Officials and Code Administrators
BS	British Standards Institution
CPVC	Chlorinated poly (vinyl chloride) plastic or resin
CS	Commercial Standard, see Product Standard
DIN	German Industrial Norms
FHA	Federal Housing Administration or Farmers Home Administration
HDS	Hydrostatic Design Stress
IAPD	International Association of Plastics Distributors
IAPMO	International Association of Plumbing and Mechanical Officials
ISO	International Standards Organization
JIS	Japanese Industrial Standards
NSF	National Sanitary Foundation
PPI	Plastics Pipe Institute
PS	Product Standard when in reference to a specification for plastic pipe and fittings. These specifications are promulgated by the U.S. Department of Commerce and were formerly known as Commercial Standards.
PSI	Pounds per Square Inch
PSIG	Gage Pressure in Pounds per Square Inch
PVC	Poly (Vinyl Chloride) plastic or resin
RHDS	Recommended Hydrostatic Design Stress
RVCM	Residual Vinyl Chloride Monomer
SCS	Soil Conservation Service
SDR	Standard Dimension Ratio
SI	International System of Units
SPI	The Society of the Plastics Industry, Inc.
USASI	United States of America Standards Institute (formerly American Standards Association)
WOG	Water, Oil, Gas

PVC and UPVC – is there any difference?

Yes, of course there is. PVC (polyvinyl chloride) is a petroleum by-product and can be used in various applications and forms. Think of PVC clothing apparel, PVC tiles, PVC fasteners, PVC pipes. There are numerous types of PVC.

I'm looking for UPVC – can I use Hydroseal PVC products?

Yes, absolutely. In the context of our industry, UPVC is normally referred to as PVC. The "U" is commonly dropped from references to avoid confusion with other forms of PVC used in the industry such as CPVC.

What is CPVC – is CPVC any different to PVC?

CPVC (chlorinated polyvinyl chloride) while having the properties of PVC, has a better temperature tolerance than PVC (refer to pages 7.04 ~ 7.06). It also offers greater chemical resistance than ordinary PVC (refer to pages 7.30 ~ 7.41).

What is the expected service life of PVC and CPVC piping systems?

With proper installation and application in accordance with their designed operation, the expected service life of PVC and CPVC systems is 50 years. The primary cause for reduced service life is the lack of factoring of temperature effects on PVC and CPVC systems (refer to pressure / temperature relationship on page 7.04). If properly used, PVC and CPVC piping systems will last a lifetime.

What are some causes for PVC and CPVC failures?

Incorrect installation, including using the wrong grade of jointing cement, will result in immediate problems within any PVC and CPVC piping system. It is necessary that threads are jointed with a good quality thread sealant or joint leakage will almost certainly occur. Once installed, at least 24 hours should be allowed before any pressure testing is done.

Installation – do PVC/CPVC require the same process?

Yes, both PVC and CPVC have the same process of installation – with the only exception being the type of cement used in making joints. We have a complete line of PVC and CPVC cements that may be used for jointing (refer to section 6.00). For detailed installation (refer to pages 7.21 ~ 7.24).

Cleaner and Primer – is there any difference?

Yes, cleaner will remove excess dirt and oils on the surface, while primer will soften the surface for better interference fit. Keep in mind that PVC and CPVC are both thermoplastic (affected by temperature) materials, and often you may find a minimal difference in the dimensions of pipes and fittings that have been stored for prolonged periods. This difference may be amplified further when using parts from different manufacturers. Using primers before applying cements in jointing systems will vastly correct any minor differences between pipes and fittings.

Who is that guy in the installation pictures that looks like a leftover from the 70's?

Believe it or not, that's our most valuable asset T.J. Sharkfellow, who aside from being the most experienced and informed technician in the industry, also has a valve named after him! Caution: Becomes extremely volatile when reminded that Elvis Presley is dead – best to avoid such touchy subjects.

FREQUENTLY ASKED QUESTIONS
General Concerns

Many options, what should I use – North American or European PVC systems?

All our PVC systems are manufactured from the same raw material grade – the characteristics remain the same. The difference is in how the North American and European specifications are set up. For climates where temperatures extend beyond 105F, North American PVC specifications consistently outperform their European counterparts for most sizes (refer to Pipe Specification Comparative on page 2.07). European PVC specifications should be used in climates where maximum temperatures do not generally go beyond 100F or the life of the system is severely reduced. Hydroseal Canada's warranty on European PVC systems cannot be extended to regions where temperatures are above 105F for more than 2 months per year.

Are PVC and CPVC systems safe to use outdoors in direct sunlight?

Absolutely, PVC 1120 and CPVC 4120 raw materials will suffer no chemical or structural changes aside from a minor discoloration when installed outdoors in direct sunlight. Caution: Prolonged exposure to temperatures above 140F will likely cause deformity in PVC fittings – care must be taken in such States like Nevada, California, Texas and New Mexico during summer months.

I want Schedule 80 valves – I don't see them anywhere in your catalogue?

It's a common misconception that valves are "Schedule 80". The ASTM specification covering PVC and CPVC valves is F-1970. All valves should have a minimum working pressure rating of 150 PSI@73F. Working pressure is different to test pressure, which will be much higher. Refer to Section 5.00 for further details on valves available within our range.

What is ASTM F-1970, and what does it cover?

ASTM F-1970 covers PVC and CPVC unions, flanges and valves. These products fall outside of normal PVC and CPVC molded fittings and pipes because they are designed to withstand tightening, torque and entirely different pressure ratings than those outlined by Schedule 40 and Schedule 80 specifications.

Spring type, Ball type, Swing type – which check valve should I use?

It depends on the design and purity of your system. Generally, our philosophy is that no metallic parts should come into contact with the process media. True Union ball check valves offer the best service where no large particles are flowing through them – there are absolutely no metallic parts contained in them. For larger sized valves (2"+), swing check valves offer the most reliable functionality – and they can be used both horizontally and vertically. For installations where there are large particles (such as sand), spring check valves are very practical – but keep in mind that the spring will eventually lose its tension and will hasten scale formation over time. We recommend that all check valves only be used after large, heavy particles are strained out of the system.

Ball valves and Butterfly valves – which valve offers the best flow control?

For sizes below 2", ball valves offer better functionality and are more cost efficient. Larger sized ball valves can sometimes be affected by improper storage and handling because of their numerous moving parts. Our recommendation to all clients is that for sizes above 2", butterfly valves offer the best functionality.

I notice options for seals – what are "EPDM" and "Viton" seals?

EPDM (Ethylene Propylene Rubber) seals provide good ozone and chemical resistance but are comparatively less resistant against ketone and ester. Viton or FPM (Flourorubber) seals offer superb chemical resistance against strong oxidizing and concentrated agents such as hydrochloric or sulfuric acid. Additionally, Viton seals offer a greater operating temperature range.

FREQUENTLY ASKED QUESTIONS
General Concerns

Why are Hydroseal Canada valves more expensive than many other brands?

Good question. Our valves are calibrated and tested beyond the methods outlined by the National Sanitation Foundation. Every valve is tested a minimum of 6 times before passing through quality control (if you've ever received any valves that have water droplets on them now you know why). It is not the manufacturing or raw material costs, but the testing of our valves that govern pricing. We have an entire department – Hydroseal Labs – that we urge all our clients to get familiar with.

What are "Van Stone" flanges?

"Van Stone" is a North American industrial term for a two-piece flange system that has locking mechanisms for the backing rings and stubs to fit into place. All Van Stone flanges are designed with flat even surfaces for successful usage with gaskets. Refer to page 3.14 for detailed information on Van Stone flanges.

… and "WTF" flanges?

"WTF" flanges are patented and uniquely designed Van Stone flanges that have universal hole patterns suitable for mating with North American, European or Asian standards. Refer to page 3.18 for detailed information on WTF™ flanges.

I notice thin lines on some of your fittings – what are these?

The process of injection molding used in the manufacture of PVC and CPVC fittings involves hot, liquefied raw material to be injected into a steel mold that has been crafted in the shape of the required fitting. Upon entering the mold, liquefied material will flow in one or more (dependent on the item being manufactured) directions and eventually fill the mold. On larger fittings where liquefied material fills the mold from two or more directions, the point of contact where the directions of flow meet will have cooled slightly. The lines created as a result of this are referred to as flow lines. Generally, flow lines may be observed on the opposite side of the injection point. Flow lines are not unique to Hydroseal Canada fittings and valves – they can be observed in every brand where the injection process is employed for the manufacture of PVC and CPVC fittings and valves.

What is "Hydroseal Labs" and how does it benefit me?

We believe that questions and concerns ought to be addressed immediately as much as is possible. While every manufacturer is equipped with a laboratory, we open our facilities to all our clients for their use. Come in, ask questions, learn how we test products and bring any samples you'd like tested. See for yourself and be 100% certain before you spend a single dollar. If visiting our labs is not convenient, then we've got all our documentation available online. We are not looking for clients to purchase our products, but rather to believe that they're getting the best and most valuable return on their investment.

WTF™ Series – can you tell me more?

In a nutshell, wherever you notice "WTF" it entails that Hydroseal Canada has gone the distance on creative and qualitative thinking to make life much easier for our clients. We've invested in the technology and study of common problems in the industry and come up with solutions, products and information to address these grey areas. We haven't just familiarized ourselves with North American specifications and engineering, but have versed ourselves with European and Asian methods and combined the best of all three! This figuratively means that there will be no confusion or concern when combining equipment and technology from all over the world. For more detailed information on WTF™ Series, refer to page 1.01.

Why isn't Hydroseal Canada certified by the International Standards Organization (ISO)?

We believe that we have a clearer understanding of how to service our clients than any outside regulatory authority could possibly have. ISO management standards are more about getting your own house in order than product quality, service or dependability. We're NSF certified, have an unblemished track record and have loyal clients which have nothing to do with ISO. Perhaps at some point in the future we may consider ISO management models beneficial, but currently such systems would be counterproductive.

What is NSF?

National Sanitation Foundation (NSF) is the global authority on potable (drinking) water systems. For more on NSF directly visit their website (www.nsf.org) to find out for yourself. Verify whether the products being used in your systems are certified by the NSF. Certification by the NSF means that everything from raw material through packaging and advertising (what you can and cannot say on your products) are carefully screened in accordance with their rigid standards for consumer protection.

Pipe sizes – I'm lost, how do I make sense of all these numbers?

Don't worry, it's a very confusing issue but we're here to help.

Firstly, keep in mind that a pipe will ALWAYS fit INTO a fitting/valve – which also means that a fitting is designed to ALWAYS fit ON TOP of the pipe (except in certain special cases such as spigot flanges).

Secondly, when designing any system, it is crucial to determine what size pipe is needed to achieve the required flow rate. This can only be done by knowing the INSIDE diameter of the pipes. In North American systems, all sizes refer to the inside or NOMINAL diameter of pipes and fittings. In European DIN systems, it is important to establish whether one is referring to the outside diameter or the nominal diameter (usually denoted by DN numbers).

Thirdly, and perhaps most importantly, an inch is not an inch is not an inch. When referring to a 1/2" pipe (for example), it is important to understand; a) that 1/2" is the nominal diameter of the pipe and b) 1/2" is the approximate size closest to the standard set by ASTM or BSI because it would be terribly inconvenient to go around calling it 0.5488 inch (example for ASTM Schedule 80).

Sounds like a lot to digest, but luckily over the years standardization has set into the industry so planning, ordering and maintaining systems today is generally an easy task if one is slightly familiar with the above and asks simple questions.

For your ease, below is a chart of standard Nominal Diameter (DN) references and their corresponding Outside Diameters (O.D.).

North American, British and DIN Pressure Pipes

DN	DIN	
	O.D. (IN.)	O.D. (MM)
15	0.787	20.00
20	0.984	25.00
25	1.260	32.00
32	1.575	40.00
40	1.969	50.00
50	2.480	63.00
65	2.953	75.00
80	3.543	90.00
100	4.331	110.00
100	4.921	125.00
125	5.512	140.00
150	6.299	160.00
175	7.087	180.00
180	7.874	200.00

DN	ASTM AND BS	
	O.D. (IN.)	O.D. (MM)
1/2	0.840	21.34
3/4	1.050	26.67
1	1.315	33.40
1 1/4	1.660	42.16
1 1/2	1.900	48.26
2	2.375	60.33
2 1/2	2.875	73.03
2 1/2	2.953	75.00
3	3.500	88.90
4	4.500	114.30
5	5.512	140.00
5	5.563	141.30
6	6.625	168.28
8	8.625	219.08

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