SecuraGold™

WATER TIGHT PLUMBING SYSTEMS

Technical Manual

Version 1

STANDARDS COMPLIANCE

All materials and components used in the SecuraGold™ range are sourced and produced in ISO 9000 accredited facilities and hold the **Australian Watermark** registration number **WMK 1289 from SAI Global** as well as the prestigious **Germanischer Lloyd Society** for marine applications on certificate no. **13 659 – 98 HH**.

The SecuraGold™ piping system complies with all relevant requirements of the following standards:

- AS/NZS3500 Parts 1, 4 & 5
- AS/NZS2642 Parts 1, 2 & 3
- C35200
- AS/NZS 1567
- AS/NZS 1568
- AS 2345

Durability

Installed correctly SecuraGold™ can be expected to meet the requirements of both the Australian and New Zealand Building Codes.

CERTIFICATE OF CONFORMITY

SAI Global hereby grants:

Dux Industries Limited

ABN 1787959

32 Mahia Road,, MANUREWA AUCKLAND, New Zealand

WaterMark Certificate of Conformity – Level 1

Evaluated to:

AS/NZS 2642.3:2008 - Polybutylene (PB) plumbing pipe systems - Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications

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Certificate No: WMKA1289-1

Issued : 1 April 2011
Expires : 31 March 2016

Originally Certified : 1 April 2011
Current Certification : 1 April 2011

Duncan Lilley
Global Head – Assurance Services

Alex Ezrakhovich
General Manager – Certification Services

WaterMark

JAS-ANZ

* For details of manufacture, refer to the licensee

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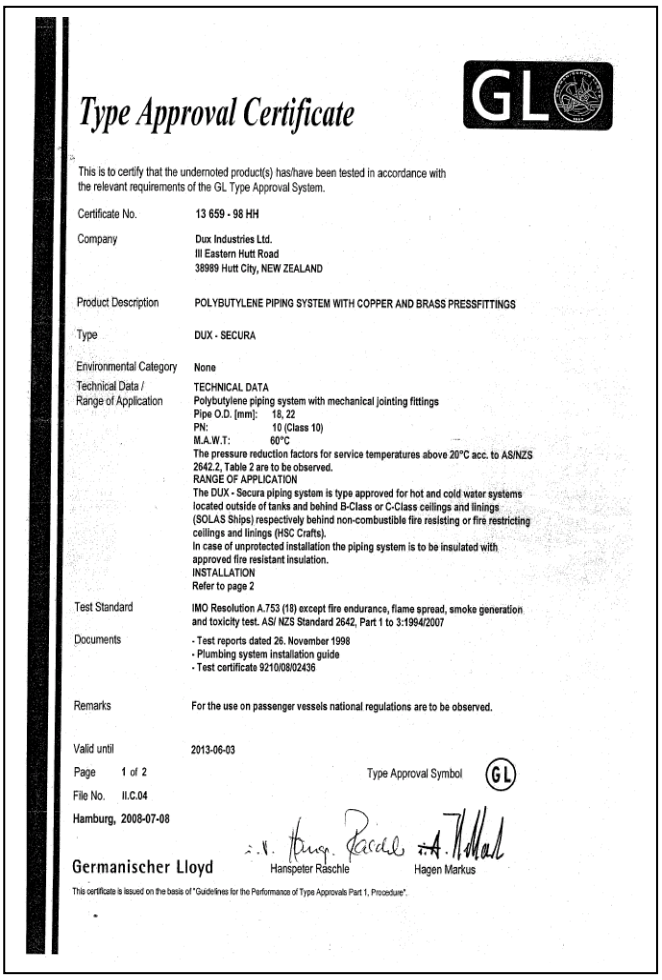
SAI GLOBAL

AI Global Certificate



Type Approval Certificate

GL

This is to certify that the undernoted product(s) has/have been tested in accordance with the relevant requirements of the GL Type Approval System.

Certificate No.	13 659 - 98 HH
Company	Dux Industries Ltd. III Eastern Hutt Road 38989 Hutt City, NEW ZEALAND
Product Description	POLYBUTYLENE PIPING SYSTEM WITH COPPER AND BRASS PRESSFITTINGS
Type	DUX - SECURA
Environmental Category	None
Technical Data / Range of Application	TECHNICAL DATA Polybutylene piping system with mechanical jointing fittings Pipe O.D. [mm]: 18, 22 PN: 10 (Class 10) M.A.W.T: 60°C The pressure reduction factors for service temperatures above 20°C acc. to AS/NZS 2642.2, Table 2 are to be observed. RANGE OF APPLICATION The DUX - Secura piping system is type approved for hot and cold water systems located outside of tanks and behind B-Class or C-Class ceilings and linings (SOLAS Ships) respectively behind non-combustible fire resisting or fire restricting ceilings and linings (HSC Crafts). In case of unprotected installation the piping system is to be insulated with approved fire resistant insulation. INSTALLATION Refer to page 2
Test Standard	IMO Resolution A.753 (18) except fire endurance, flame spread, smoke generation and toxicity test. AS/ NZS Standard 2642, Part 1 to 3:1994/2007
Documents	- Test reports dated 26. November 1998 - Plumbing system installation guide - Test certificate 9210/08/02436
Remarks	For the use on passenger vessels national regulations are to be observed.
Valid until	2013-06-03
Page	1 of 2
File No.	II.C.04

Type Approval Symbol GL

Hamburg, 2008-07-08

Germanischer Lloyd

Hanspeter Raschle

Hagen Markus

This certificate is issued on the basis of "Guidelines for the Performance of Type Approvals Part 1, Procedure".

CONTENTS

INTRODUCTION

Dux Industries Limited has been and remains synonymous with plumbing in New Zealand. Starting from humble beginnings as a small engineering firm based out of Wellington in 1936 it has grown into a competitive force able to offer the plumbing industry of New Zealand a large selection of plumbing solutions. Dux Industries Limited moved to the forefront of the plumbing industry in New Zealand by pioneering the use of plastics in the plumbing industry and has become known for innovative design solutions to the problems faced by professional plumbers today.

Dux revolutionised the plumbing market in the 1990's introducing the Secura Polybutene -1 Plumbing System for Hot and Cold Potable Water reticulation. These early encapsulated copper fittings combined with PB-1, a highly flexible, lightweight but tough pipe, proved to be very popular with plumbers due to their ease of installation.

From this early start SecuraGold™ has evolved into the premium product available today. Manufactured from high grade Dezincification Resistant (DR) brass combined with Polybutene-1 pipe and available in four sizes ranges with over 90 fittings to choose from, SecuraGold™ is the most complete hot and cold water reticulation system available in New Zealand.

The SecuraGold™ range of products are the market leaders and continues to be the first choice for professional plumbers and designers in New Zealand.

SECTION 1 – Polybutene-1 The Secura Pipe

POLYBUTENE-1 PIPE PROPERTIES

Polybutene – 1 (PB-1) resins are high molecular weight isotactic, semi-crystalline thermoplastic polyolefin's produced through the polymerisation of Butene-1 and Ethylene, and/or Propylene co monomers.

PB-1 combines the typical characteristics of Polyolefin's with a unique property mix of high flexibility and outstanding creep resistance over a wide temperature range. Due to a similar molecular structure, PB-1 is very compatible with PP and Propylene based thermoplastic elastomers. It is easily dispersible in PE notwithstanding its limited molecular compatibility. Secura PB-1 is extruded from grade 4267 PB-1 resin manufactured by Lyondell Basell.

Temperature	Polybutene -1 will withstand all temperatures found in a normal hot and cold water reticulation system. It is capable of handling temperature variations from -50°C up to 99°C.
Mechanical	Polybutene-1 is a strong, robust material. Its strength is not significantly affected by temperatures and pressures normally encountered in hot and cold water reticulation systems. It exhibits the highest creep resistance of any of the polyolefin's and as a result retains its strength even under long term stress. It also has an exceptional resistance to stress cracking.
Bending and Flexing	Polybutene-1 can be repeatedly flexed without harm. The recommended minimum bending radius is eight times the pipe outside diameter. At this diameter it is recommended to use either a Dux Centipede or ensure that the pipe is well supported with pipe clips to prevent undue stress. This reduces the requirement for elbows, thereby minimising frictional loss. Where tighter bends are required elbows are necessary.
Chemical Resistance	Polybutene-1 is resistant to soaps, detergents, most acids and alkalis below 96°C and many solvents at room temperatures. Because it is so inert, it is immune to attack from most common chemicals. For a list of chemical resistances please refer to the Chemical Resistance Charts on the Dux website. Do not allow Polybutene-1 to come into contact with building product adhesives, sealers, solvent cements, lubricants or any oxidising agent such as household bleach.
Pressure	Polybutene-1 has the highest pressure rating of any flexible thermoplastic. It is capable of withstanding pressures up to 6.90Mpa.
Thermal	As Polybutene-1 has a high thermal insulation value water will not cool as quickly when laying in the pipe resulting in hot water being delivered more quickly. Also the expansion rate is unusual for a plastic as it is only 1.3×10^{4} m/m/°C. The thermal conductivity being 0.22 W/(m.k).
VOC Rating	Polybutene-1 has been tested for the release of VOC's (Volatile Organic Compounds) in compliance with the test specifications of EN852-1, ISO 4120 and ISO 5495. Polybutene-1 has a VOC rating <0.02 mg C/l and <0.02 mg C/m² /day.
Electrical	Polybutene-1 has good di-electric properties over a wide range of ambient conditions. **WARNING** – because of its good insulation qualities Polybutene-1 cannot be used for electrical earthing. Where it forms a break between existing metal pipe that is being used for earthing or bonding, then a bonding lead should be connected to both ends of the existing metal pipe work.
Anti-Fouling	Because of its relatively high thermal insulation value, exceptionally smooth bore and high abrasion resistance, build ups of pipe scale or mineral deposits do not occur.
Compatibility	Polybutene-1 is chemically inert so it can be connected safely to any other type of pipe system without danger of corrosive action.
Water Hammer and Surge	Polybutene-1 can easily withstand the effects of water hammer because of its high elastic modulus. It dampens rather than propagates pressure waves and the associated pipe noise. Under extreme conditions of service water hammer arrestors may be advisable provided the installation has been

	completed correctly.
Freezing	Ice formation causes no damage as the pipe's flexibility accommodates expansion. The pipe will return to its original state upon thawing. It must be pointed out however that a small section of Polybutene-1 in an otherwise rigid system cannot protect the pipe system from the effects of freezing. Only where a significant proportion of Polybutene-1 is used will the effects of freezing be minimised. ***Always check with your local council for any specific requirements for lagging in freezing conditions.***
Fire Resistance	Polybutene-1 is not highly flammable but it will burn. By-products of combustion are not toxic or harmful should they be inhaled.

PERFORMANCE CHARACTERISTICS

Polybutene-1 exhibits a unique morphology and crystallisation behaviour which, combined with careful control of molecular parameters, gives Polybutene-1 a profile of properties unrivalled in piping systems manufacture.

Table A – Performance Characteristics of PB-1, PEX & PP

	PB-1	PEX	PP	VALUES		PB-1	PEX	PP-R
Density	0.93	0.94	0.90	g/cm³	**Impact Toughness**	Good	Good	Average
Melt Range	122	130		°C	**Chemical Resistance**	Good	Good	Good
Thermal Conductivity @20°C	0.22	0.41	0.24	W/Mk	**Flexibility**	Excellent	Good	Average
Internal Surface Resistance	0.007			W	**Creep Resistance**	Excellent	Good	Good
Linear Expansion Rate	0.13	0.20	0.18	mm/M/°C	**Thermal Pressure Resistance**	Excellent	Good	Average
Impact Value @ 0°C	4.7		3.7	kJ/mm²	**CLTE Induced Stress**	Excellent	Good	Average
Elastic Modulus	350	600	800	Mpa (N/mm²)	**Pipe Weight**	Excellent	Good	Poor
Expansion Contraction	0.13	0.2	0.18	mm/M/°C				
Yield Stress @ 23°C	28		25	N/mm²				

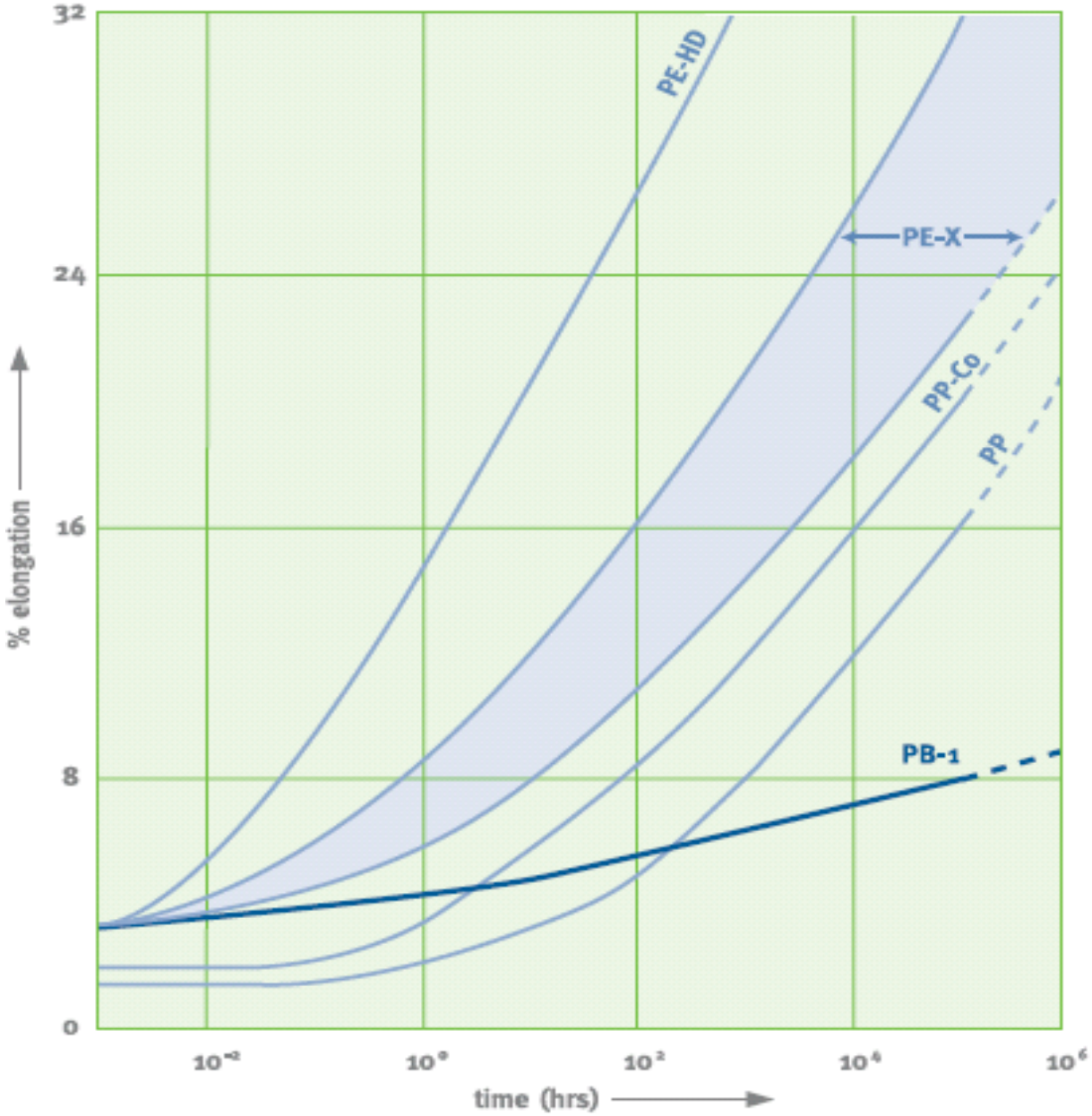
COMPARISON OF CREEP RESISTANCE

Creep is the amount of stretch or give in a material under a given load over a set period of time. In pipe systems internal and external pressure works to stretch, expand, pull and push material away from the point load of a joint or seal.

The most important property or characteristic which sets PB-1 apart from competitive products is the combination of high flexibility and outstanding resistance to internal pressure creep over a wide range of hot and cold temperatures.

All Polyolefinic materials tend to creep when exposed to continually applied stresses over a long period of time. This cold flow behaviour can be suppressed by creating a three dimensional network in the polymer structure by either physical or chemical cross linking as is the case in the manufacture of cross linked Polyethylene (PEX). PB-1 pipe displays superior inherent creep resistance without the application of any cross linking, co-polymerisation or compounding modification as illustrated by Figure 1. In its simplest homopolymer form, its property profiles are ideal for satisfying the demands of pressure piping applications.

Figure 1 – Creep behaviour of Polyolefin's at room temperature (8 Mpa)



ACOUSTIC CHARACTERISTICS

Due to the flexibility of PB-1 and its low density and low thermal expansion, PB-1 pipes have superior acoustic behaviour. Water hammer or hydraulic noise is absorbed with no damage to the pipe.

Table B – Acoustic Properties of Various Pipe Materials

	Density (g/cm³)	**Elastic Modulus** (Mpa)	**Sound Velocity** (m/s)
Copper	7.2	110,000	3.900
PB-1	0.94	450	620
CPVC	1.56	3,500	2,350
PEX	0.95	600	800
Soft Rubber	0.90	90	320

BENDING AND FLEXING POLYBUTENE-1

Secura PB-1 is extremely flexible and can be repeatedly flexed without harm however minimum radii bends should be adhered to in order to avoid kinking of the pipe. This radius is measured by multiplying the outside diameter of the pipe by a factor of eight. Maintaining this dimension as your minimum radius will prevent the possibility of damage to the pipe during installation. At this radius it is recommended that the pipe is well supported through the use of either pipe clips or a Dux Centipede to prevent undue stress on the pipe or fittings.

Table C – Bending Radii for Various Pipe Diameters (PB-1)

Pipe Designation	Mean O.D. of Pipe	Minimum Radii
12mm	12.93mm	103.44mm
15mm	16.31mm	130.48mm
20mm	22.84mm	182.72mm
28mm	25.50mm	204.00mm

Figure 2 – Pipe Failure due to Kinking

Figure 3 – Small radius bend using Dux Centipede

Where tighter bends are required the pipe must be supported by a bend support such as the **Dux Centipede (Dux Code: DCS751501)** At this point in time only the 15mm Centipede support is available. For other sizes of pipe it is recommended that pipe clips be used to support the pipe and prevent stress being placed on nearby fittings.

Alternatively within the SecuraGold™ range there are 45° and 90° Elbows available as well as a multitude of further fittings that will be able to accommodate and overcome any problem installation facing a professional plumber.

NOTE: If a pipe is kinked during installation that portion of the pipe must be cut out and replaced. If the damaged section of pipe is not removed a pipe failure will occur.

CHANGES OF DIRECTION

It is important to install pipes and fittings with as little stress as possible on the joints particularly at changes of direction.

When a pipe is being bent after a fitting it must be supported sufficiently to reduce stress. This is carried out by fitting Dux pipe clips to support and stabilize the fitting. When installing through framing this problem is less obvious but care should still be taken to reduce the stress on fittings.

'STRAIGHT' COILS'

A feature offered by Dux Industries Limited within our pipe range is the 25m 'Straight' Coils. These coils are processed with a reduced memory so that when they are used the pipe behaves more like a straight length. The coil is wrapped in an outer dispenser wrap that is left in place while the pipe is drawn from the centre.

Figure 4 – 25m Lay Straight Coil

Figure 5 – 25m Lay Straight coil laid out

Benefits of the straight coils are:

- Easier to Handle
- Easier to store and transport
- Fewer joints
- No 'Bird Nesting'
- Reduces wastage

SecuraGold™ Lay Straight Coils effectively give a plumber the advantage of a 25m straight length with little or no curve and no bird nesting. These straight coils are currently available in three sizes: 15mm, 20mm and 28mm each with a standard length of 25m.

CHEMICAL AND CORROSION RESISTANCE

The SecuraGold™ system is designed specifically for potable hot and cold water reticulation systems with PB-1 and DR Brass fittings being perfectly matched for this purpose.
The system is unaffected by the chemicals, compounds and minerals normally found in potable water supplies and a wide range of ground conditions. SecuraGold™ will not pit, rot, rust or corrode and the exceptionally smooth bore of the PB-1 pipe will not allow internal mineral build up, maintaining a consistent flow throughout its life.

PRESSURE VS TEMPERATURE

The temperature of the liquid passing through the pipe affects the ability of PB-1 to withstand pressure. As the temperature rises the supplied pressure must reduce. Temperature and pressure are relative. AS/NZS 2642.2 sets out the parameters as follows:

Table D: Continuous Working Pressure

Working Temperature	20°C	40°C	60°C	70°C	80°C
Max. Working Pressure kPa	1600	1370	1050	880	740

Max. Working Pressure PSI	230	200	160	130	110

NOTE: The above temperature pressure combinations are maxima and should under no circumstances be exceeded.

SECURAGOLD™ the 'Green' Solution

Polybutene-1 is a single process material that is pure, inert and food safe. It is also the most environmentally friendly plastic available, using far fewer resources and less energy to produce than other plastic materials used in hot and cold water reticulation.

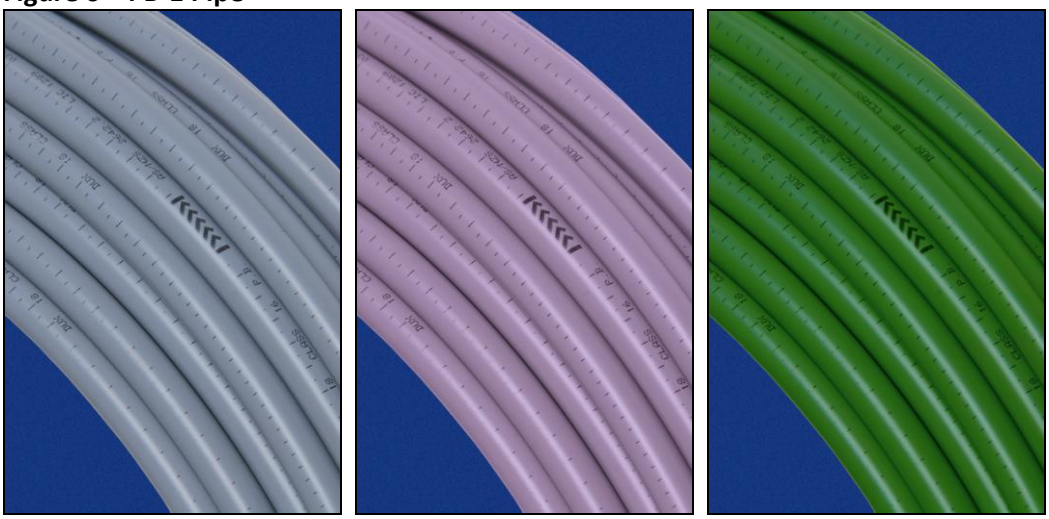
Each part of the SecuraGold™ range, from the individual fitting components to the lengths of pipe are 100% recyclable. The SecuraGold™ system is truly a **'Green'** Product.

STORAGE & HANDLING

Although PB-1 is a very tough and rugged pipe there are a number of factors that should be taken into account when storing and handling the pipe.

- PB-1 is not resistant to Ultra Violet light and should be kept away from sunlight as much as possible. The UV rays will degrade and limit the life of PB-1.
- Avoid placing heavy loads or sharp objects on top of the pipe.
- Do not drag or roll coils across the ground or rough surfaces such as tarmac or concrete, this will scratch or cut the material and could cause leaks.
- Avoid applying direct heat or naked flame to the pipe.
- Coils can be stacked up to a maximum of 10 coils high
- When storing 5m straights for any length of time, lay them flat. No heavy objects should be placed on top of the lengths.
-

Figure 6 – PB-1 Pipe



POTABLE WATER RECYCLED WATER RAINWATER

SECTION 2 – SecuraGold™ Water Tight Plumbing System

The SecuraGold™ system is available in four sizes: 12mm, 15mm, 20mm and 28mm. The standard **Grey** - Potable Hot and Cold plumbing pipe is the flagship of the range. The pipe is also available in **Lilac** - Recycled or Reclaimed Non-Potable Water and **Green** - Rainwater.
With over ninety fittings, six crimping tools, two pipe cutters, four pipe clips and other accessories available to choose from, the SecuraGold™ range is the most comprehensive Hot & Cold domestic/light commercial plumbing system in New Zealand today.

All SecuraGold™ fittings are engineered and manufactured to exacting standards with all fittings except for the Brazing Tails comprising of four basic components:

1) Dezincification resistant (DR) brass body
2) Copper crimp ring
3) EVA retaining ring (Not required with Brazing Tails)
4) LDPE protective cap

Dezincification Resistant (DR) Brass

Every SecuraGold™ fitting is manufactured using DR Brass. Dux Industries Limited selected this material based on its historical performance in the water industry and because its physical performance is completely compatible with PB-1 pipe.

Material: Dezincification resistant brass is principally a mixture of copper, lead and zinc. The exact proportions of each component are detailed in AS/NZS 1567 and AS 2345 DR brass is recognised and adopted worldwide as a premium alloy suitable for water fittings.

Mechanical: DR Brass is a strong, durable material that has excellent forging and machining properties and gives exceptional resistance to temperature, pressure and impact damage across a wide range.

Durability: DR Brass is a strong durable material able to withstand the rigors of installation and deliver years of uninterrupted service under a variety of installation and operating conditions.

Corrosion: DR Brass is perfectly suited to potable water usage. Its resistance to a wide range of varying water and ground conditions also makes it suitable for other applications such as heating and compressed air.

Temperature / Pressure: DR Brass gives exceptional resistance to varying operating temperatures and pressures and will exceed the temperature and pressures required of PB-1 pipe.

Electrical: DR Brass will conduct electrical energy, however as the fittings are installed as part of a non conductive plastic piping system SecuraGold fittings must never be used for earthing purposes.

Environmental: DR Brass is 100% recyclable.

SecuraGold™ fittings are extensively tested ensuring the highest quality of fitting is made available to the professional plumber.

The Tools

Dux Industries Limited currently offers 2 types of crimping tools for use with the SecuraGold™ system. These are the **Magnum** Compact tool and the **Alba** Tool. The **Pipe Cutter SGPC0V2** is able to cut 12mm – 28mm comfortably.

The Magnum

The Magnum compact tool has been developed by Dux Industries Limited after requests for a crimping tool that is easy to use and is particularly suited for the confined spaces found in modern houses. It has been precision engineered from stainless steel to resist corrosion and withstand the rigours of everyday use.
Unlike 'bolt action' crimp tools the handles of the Magnum do not open wide allowing it to be used in very confined spaces.
The Magnum tool operates with a pull back action to open the jaws that are held open by one hand.
The jaws are then positioned on the crimp ring and when the grip on the handles is relaxed the spring loaded jaws close around the crimp ring and the handles are compressed fully to complete the joint.

Figure 7 – The Magnum is available in three sizes:

CCT2 – 12mm (Green Handle)

CCT3 – 15mm (Blue Handle)

CCT4 – 20mm (Red Handle)

The Alba

The Alba crimp tool is light weight, robust and durable with an easy adjustment mode and requires little maintenance. The jaws are high grade cast tempered steel fitted with tubular handles and comfortable grips. The tool uses a patented offset roller cam combined with a broken arm lever action that gives an easy action and reduces operational force, giving reasonable access to confined spaces.

The Alba is available in three sizes:

SCT3 – 15mm

SCT4 – 20mm

SCT5 – 28mm

Figure 8 – The Alba Tool

The Pipe Cutters

Figure 9 – SGPC026 Pipe Cutter

Figure 10 – SGPC0V2 Pipe Cutter

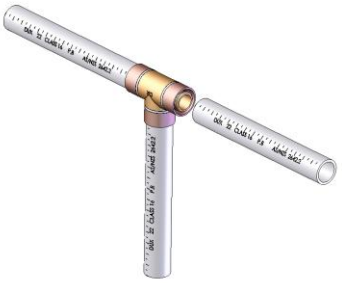
Successfully cutting a section of pipe using the SGPC026 pipe cutter is best achieved by applying pressure then giving a quarter turn until the blade cuts through the first wall of the pipe.
The SGPC0V2 EX-TEC pipe cutter does not require this action and will cut through PB-1 smoothly. As with any blade consistent use will dull the edge and it will require sharpening from time to time.
These cutters are designed to be used only with PB-1.

Making a SecuraGold™ Crimp Joint

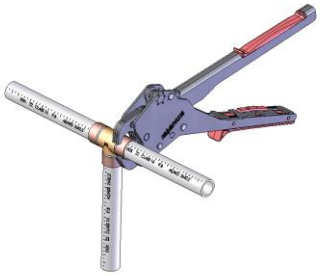
There are four easy steps required to successfully crimp a SecuraGold™ Joint.

Step One:
Cut the pipe making sure the end is square and free from dirt or burrs. Check the pipe has no scores or kinks. (Cut out and replace if necessary).

Step Two:
Select the required fitting, remove the protective cap/s from the joint end and insert the pipe fully into the fitting up to the shoulder so pipe is clearly visible through the inspection holes.



Step Three:
Position the crimp tool jaws centrally over the crimp ring at 90° to the pipe. Check the pipe and fitting are aligned correctly then close the handles of the tool to the stop point.



Step Four:
Check the completed crimp joint with the crimp gauge, the gauge must fit over the crimped area of the ring without using **<u>any</u>** force.

If the joint does not pass this test

1. Check the joint has been crimped
2. Remove fitting and replace
3. Adjust the crimping tool until the joints gauge correctly

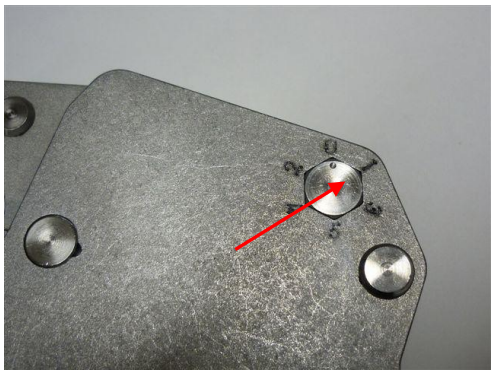
Note: Under-crimped joints must be replaced as joints should not be double crimped. Double crimping can lead to work hardening of the copper crimp ring and may cause future stress failures.

Tool Maintenance

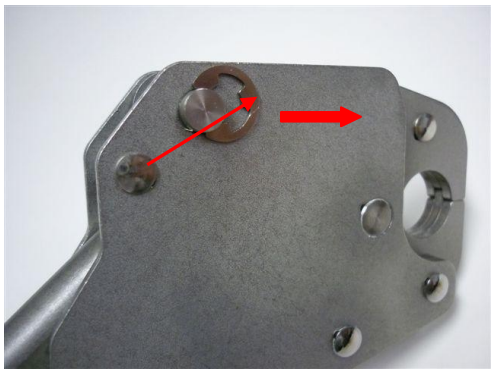
It is important to maintain and check your tool regularly as all mechanical devices wear with use. Unless it is adjusted to compensate the tool will not perform correctly which could lead to crimp failures.

Adjusting the Magnum Tool

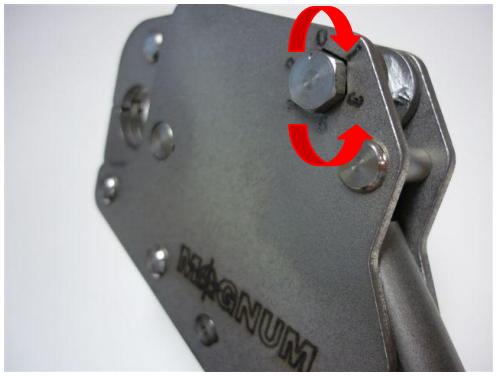
1. Note the position of the dot on the hex adjustment bolt head in relation to the increments on the tool body.



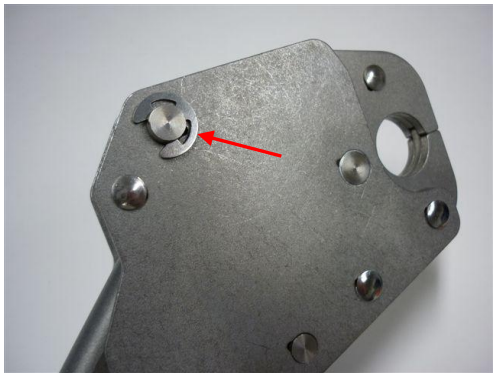
2. Remove the circlip that holds the adjusting nut in place. (take care not to lose the clip)



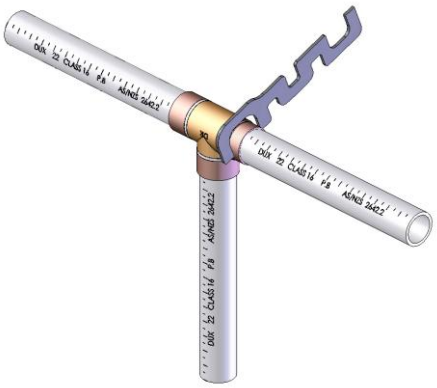
3. Gently tap the adjusting bolt enough to clear the hex head from the body. (Take care not to push the bolt completely out). Turn the adjustment bolt to the next sequential number and push the bolt back into position in the tool body. (Do not turn more than one increment at a time).
   Note: The positions of the numbers.



4. Refit the circlip.



5. Check the tool is now correctly adjusted by crimping and gauging a joint. The gauge must pass freely over the crimp ring where it has been crimped. If this does not occur repeat the above steps or contact your local Dux representative.

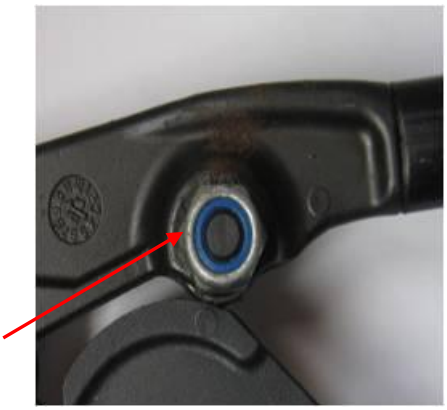


Adjusting the Alba Tool

1. Close the handles fully.

2. Note the position of the alignment mark on the hex bolt head marked ‘ALBA’ in relation to the increment marks on the tool.

3. Loosen the Nylock nut.



4. Turn the hex adjusting bolt head one increment towards the + mark. (Clockwise to tighten, anti-clockwise - to loosen).

5. Hold the adjustment bolt head at its new position and re-tighten the Nylock nut.

6. Make a crimp joint and check that the joint gauge passes freely over the crimped area of the crimp ring. If the gauge does not fit repeat the above steps.

SECTION 3 - Installing SecuraGold™

The SecuraGold™ piping system is ideally suited to New Zealand building systems. Its flexibility enables long lengths to be quickly and easily manipulated through framing systems, under floors and in ceiling spaces with minimal joints.

Installation Guide

Site Preparation

a) Pre-plan the route you will take when laying the PB-1 pipe, a well set out installation will reduce wastage and time.
b) If possible mark and pre-drill holes in timber
c) Ensure you have the tools and product you will require during the installation, Cutters, crimping tool, gauge tool, pipe, fittings and pipe clips etc if required pipe bend assistors such as the Dux Centipede should be at hand.

Pipe Preparation

a) Only use an approved pipe cutter to cut PB-1, using other utensils can result in poor and erratic cuts.
b) Do not pull pipe tight during the installation, it is good practice to allow enough for expansion and contraction and generally 10mm per metre length would be adequate.
c) Check the condition of the pipe prior to installation, any cuts or damage to a pipe may result in premature pipe failure.

Installation

a) PB-1 pipe should not be kinked or buckled during installation; if this occurs the section affected should be cut out and removed.
b) When inserting pipe into a fitting push in fully and check that pipe can be seen in the two spy holes of the crimp ring.
c) Once crimped check the gauge of the crimp with the supplied gauge tool if it is correct carry on with the installation otherwise replace the fitting and re-calibrate your tool before any further fittings are crimped.
d) Fit pipe clips to support the PB-1 pipe at the recommended intervals.
e) At the end of the installation pressure test the installation as per AS/NZS 3500 standard.

Code of Practice and Local Authority Approvals

Dux SecuraGold™ has the Australian Standards Water Mark and complies with all necessary standards and therefore is approved by local authorities. However, special conditions may apply to some areas. Always check with your local authority before installation.

System Identification

All pipes and fittings are identified with the Dux name. Ensure that only pipe and fittings marked in this way are used to guarantee satisfactory performance and a long working life.

Electrical Earthing

Polybutene -1 is an insulator and must NOT be used for the earthing of electrical equipment.

Storage and Handling

Polybutene -1 is not UV resistant and should be stored under cover. In installations exposed to direct sunlight pipe work must be covered with a protective sleeve or painted to avoid exposure. Its flexibility permits considerable freedom of handling, but care should be taken not to cut abrade or crush the pipe. All fittings should be treated in a similar manner.

Cutting

It is important to ensure cut ends are square and clean. Rotate the pipe cutter while cutting pipe to avoid distortion. Remove any burrs.

Do not use a hacksaw to cut the pipe.

Bending

Polybutene -1 pipe can be repeatedly flexed without harm. The recommended minimum bending radius is eight times the diameter of the pipe. Where tighter bends are required, elbows or pipe supports must be used. Care should be taken to avoid over bending and buckling the pipe. If the pipe is accidentally 'Kinked' the damaged section must be replaced.

Timber Framework

Polybutene -1 may be installed in the traditional manner by running notches or chases, or by surface mounting. However the preferred method is to run the pipe through holes drilled through the neutral axis (centre) of studs, dwangs (noggings) or joists. The holes must be a minimum of 3mm larger than the pipes outside diameter as per the following table. To prevent rubbing or chafing of the pipe, neutral cure silicon can be used to fill the hole.

Table E: Recommended Hole Sizes PB-1 Pipe

Pipe Designation	Mean OD	Recommended Minimum Hole Size
12mm	12.93mm	16.00mm
15mm	16.31mm	19.50mm
20mm	22.84mm	26.00mm
28mm	28.50mm	31.50mm

Metal Framework

Polybutene -1 can be installed in metal framework but protection must be provided where the pipe passes through holes in the frame using a suitable sleeve or grommet to prevent any chafing or rubbing against the metal edges.

Under Concrete

Polybutene -1 can be installed under concrete in accordance with AS 3500 or to local authority requirements. Where pipe work enters or leaves a concrete slab it must be sleeved or passed through ducting to permit free movement for expansion and contraction to the full depth of the slab penetration.

Joints under Concrete: are not recommended and should be avoided where possible. However where joints are unavoidable they should be kept to a minimum and pressure tested before backfilling, all joints should be wrapped in an impermeable flexible material for protection and their positions noted accurately on 'As Built' drawings.

Concrete Walls: Polybutene -1 should be placed in a formed chase and wrapped with an impermeable flexible material. Joints should be avoided where possible.

Supports (Pipe Clips)

Where not fully supported Secura PB -1 piping needs to be clipped to avoid stress damage and for aesthetic reasons Dux Industries Limited recommend proprietary plastic clips that permit free thermal movement. The use of metal pipe clips is not recommended.

Support spacing must meet the requirements of AS/NZS 3500.

Figure11 – Dux Pipe Clips

Table F: Pipe Clip Spacing

Pipe Size	Horizontal Clip Distance		Vertical Clip Distance
	Hot	Cold	
12mm (Type 15)	500mm	600mm	1200mm
15mm (Type 18)	500mm	600mm	1200mm
20mm (Type 22)	600mm	700mm	1400mm
28mm	600mm	750mm	1500mm
Continuous Support Tray	2.5m		

Tension

Do not pull the pipe tight during installation as this will restrict pipe movement during expansion and contraction.

Expansion

The linear expansion rate for polybutene -1 is approximately 13mm per 10°C temperature change for every 10m of pipe. Make allowance for expansion based on this value. For most installations this low expansion rate combined with the pipe's inherent flexibility eliminates the need to allow for expansion so long as the pipes are not anchored rigidly or pulled tight between fixed points.

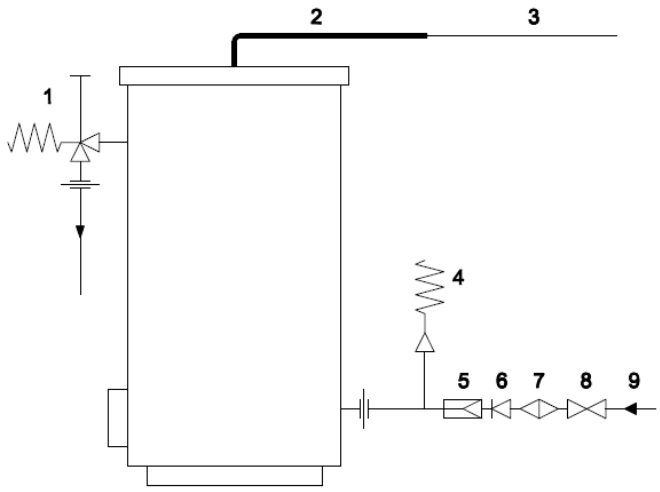
Testing

In accordance with AS/NZS 3500.1.2, the installation must be pressure tested after installation to a hydrostatic pressure of 1500 kPa for a period of not less than 30 minutes using cold water only.

Pressure testing before wall lining is good trade practice and is strongly recommended.

Note: When pressure testing additions to an existing installation it is advisable to cap the addition and test independently as the existing pipe work and fixtures may be damaged by the high test pressure.

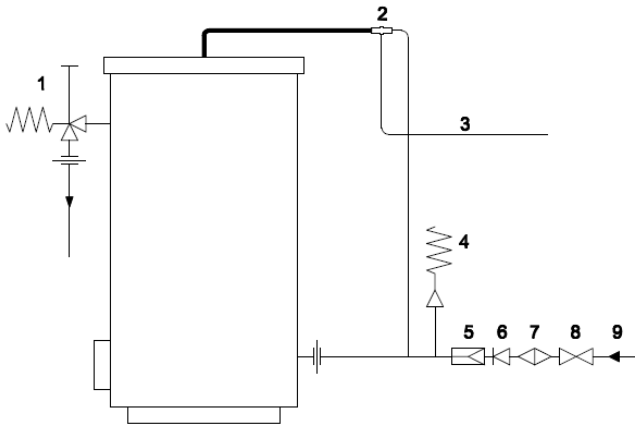
Hot Water Cylinders Typical Installations



Typical Industrial High Pressure System
Potable Water – Not Personal Hygiene

1. Temperature Pressure Relief Valve
2. One Metre Copper Pipe
3. Hot Water Supply PB-1 Pipe
4. Pressure Limiting Valve 350kPa
5. Expansion Control Valve 550kPa
6. Non Return Valve
7. Line Strainer (Where required)
8. Isolating Valve
9. Mains Water Supply PB-1 Pipe

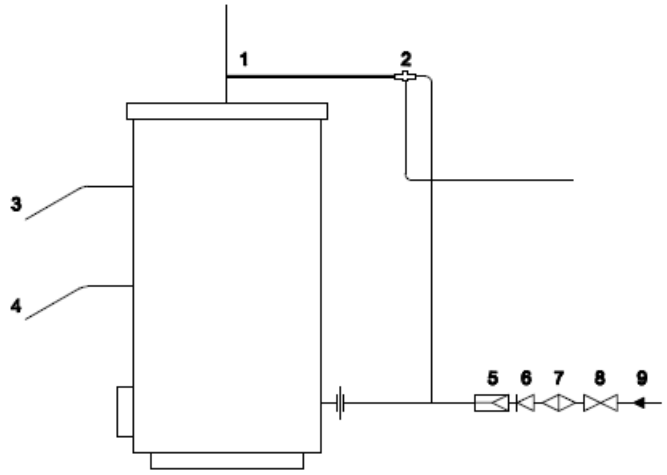
Figure 12



High Pressure Valve Sequence Potable Hot Water – For Personal Hygiene

1. Temperature Pressure Relief Valve 700kPa
2. Tempering Valve
3. Hot Water Supply PB-1 Pipe
4. Expansion Valve
5. Limiting Valve
6. Non Return Valve
7. Line Strainer (Where Required)
8. Isolating Valve
9. Mains Water Supply Pb-1 Pipe

Figure 13



Low Pressure Valve Sequence Potable Hot Water – For Personal Hygiene

1. Header Pipe and Vent
2. Tempering Valve
3. Return From “Wetback” (Back Boiler) If Required
4. To “Wetback” If Required
5. Pressure Reducing Valve
6. Non Return Valve
7. Line Strainer (Where Required)
8. Isolating Valve
9. Mains Water Supply PB-1 Pipe

Figure 14

Section 4 SecuraGold™ – The Range

Dux Industries Limited supplies the largest range of Polybutene -1 pipe coupled with the largest range of fittings available in New Zealand.

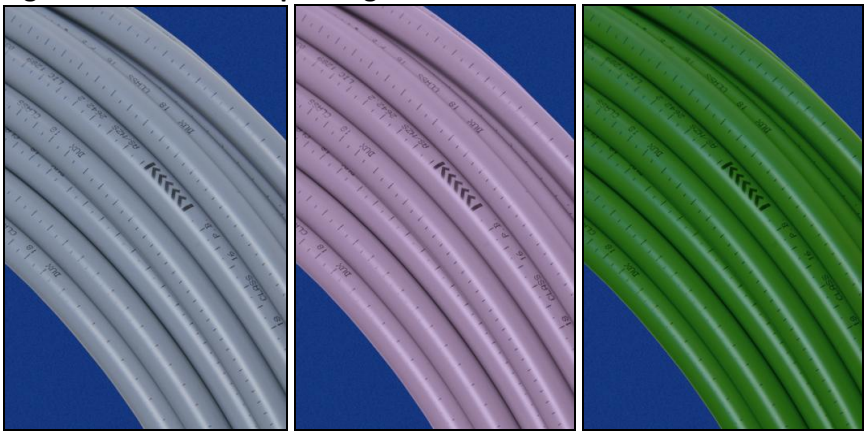
The newest addition to the SecuraGold™ range maximises water saving while delivering excellent flow rates.

High volume supply this pipe will give you the volume you require but also gives you flexibility during installation

The industry standard giving high volume supply in a flexible easy to handle size

Maximum supply with minimum pressure drop, when you need volume this large bore pipe will deliver, ideal for a ring main situation

Figure 15 – The PB-1 Pipe Range



POTABLE WATER **RECYCLED WATER** **NON-POTABLE RAINWATER**

PIPE CODES

PIPE	GREY (Potable Water)	LILAC (Recycled Water)	GREEN (Rainwater)
12mm x 5m	N2PS5		
12mm x 100m	N2PC100		
12mm x 50m	N2PC50		
15mm x 5m	N3PS5	N3PS5L	N3PS5G
15mm x 25m*	N3PC25	N3PC25L	N3PC25G
15mm x 50m	N3PC50	N3PC50L	
15mm x 100m	N3PC100		
20mm x 5m	N4PS5	N4PS5L	N4PS5G
20mm x 25m*	N4PC25	N4PC25L	N4PC25G
20mm x 50m	N4PC50	N4PC50L	
28mm x 5m	N5PC5		
28mm x 25m*	N5PC25		

***Lay Straight Coil**

THE SECURAGOLD™ FITTINGS

	**COUPLINGS**
SC2 – 12mm	**SC24 – 20mm x 12mm (Reducing)**
SC3 – 15mm	**SC32 – 15mm x 12mm (Reducing)**
SC4 – 20mm	**SC43 – 20mm x 15mm (Reducing)**
SC5 – 28mm	**SC54 – 28mm x 20mm (Reducing)**

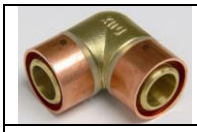
	**BRASS MALE ADAPTORS**
SAM3 – 15mm x ½" BSP	**SAM23 – 12mm x ½" BSP**
SAM4 – 20mm x ¾" BSP	**SAM43 – 15mm x ¾" BSP**
SAM5 – 28mm x 1" BSP	

	**REDUCING TEES**
ST223 – 12mm x 12mm x 15mm	**ST434 – 20mm x 15mm x 20mm**
ST224 – 12mm x 12mm x 20mm	**ST442 – 20mm x 20mm x 12mm**
ST332 – 15mm x 15mm x 12mm	**ST443 – 20mm x 20mm x 15mm**
ST334 – 15mm x 15mm x 20mm	**ST553 – 28mm x 28mm x 15mm**
ST433 – 20mm x 15mm x 15mm	**ST554 – 28mm x 28mm x 20mm**

	**TEES**
ST2 – 12mm	**ST4 – 20mm**
ST3 – 15mm	**ST5 – 28mm**

	**FEMALE LUGGED TEES**
SWT3 – 15mm x ½" BSP	

	**CROX TEE ADAPTORS**
SXT3 – 15mm x ½" BSP	

	**ELBOWS 90°**
SE2 – 12mm	**SE5 – 28mm**
SE3 – 15mm	**SE43 – 20mm x 15mm (Reducing)**
SE4 – 20mm	**SE54 – 28mm x 20mm (Reducing)**

	**ELBOWS 45°**
SE3045 – 15mm	**SE5045 – 28mm**
SE4045 – 20mm	

	**WINGBACK ELBOW MALE**
SWM3 – 15mm x ½" BSP (65mm L)	**SWM3100 – 15mm x ½" BSP (100mm L)**
SWM4 – 20mm x ¾" BSP (75mm L)	**SWM4100 – 20mm x ¾" BSP (100mm L)**

	**WINGBACK ELBOW FEMALE**
SW3 – 15mm x ½" BSP	**SW34 – 15mm x ¾" BSP**
SW4 – 20mm x ¾" BSP	**SW43 – 20mm x ½" BSP**
SW23 – 12mm x ½" BSP	

	**DOUBLE FIX WINGBACK MALE**
SDWM3100 – 15mm x 100mm x ½" BSP	**SDWM4100 – 15mm x 100mm x ¾" BSP**

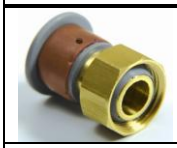
	**DOUBLE FIX WINGBACK FEMALE**
SDW3 – 15mm x ½" BSP	**SDW34 – 15mm x ¾" BSP**

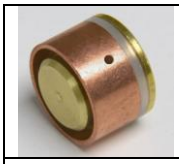
SDW4 – 20mm x ¾" BSP	**SDW43 – 20mm x ½" BSP**
SDW5 – 28mm x 1" BSP	**SDW53 – 28mm x ½" BSP**

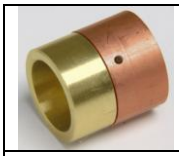
	**MANIFOLD**
SMF4203 – 20mm x 3 – 12mm Outlet	**SMF4303 – 20mm x 3 – 15mm Outlet**
SMF4204 – 20mm x 4 – 12mm Outlet	**SMF4304 – 20mm x 4 – 15mm Outlet**

	**THREADED ELBOWS MALE**
SEM3 – 15mm x ½" BSP	**SEM5 – 28mm x 1" BSP**
SEM4 – 20mm x ¾" BSP	

	**HOSEPLATE FEMALE**
SH3 – 15mm x ½" BSP	**SH53 – 28mm x ½" BSP**
SH4 – 20mm x ¾" BSP	

	**BSP SWIVEL ELBOW**
SXE23 – 12mm x ½" BSP	**SXE43 – 20mm x ½" BSP**
SXE24 – 12mm x ¾" BSP	**SXE4 – 20mm x ¾" BSP**
SXE3 – 15mm x ½" BSP	**SXE5 – 28mm x 1" BSP**
SXE34 – 15mm x ¾" BSP	
	**BSP SWIVEL CONNECTORS**
SXC23 – 12mm x ½" BSP	**SXC43 – 20mm x ½" BSP (Reducing)**
SXC3 – 15mm x ½" BSP	**SXC5 – 28mm x 1" BSP**
SXC4 – 20mm x ¾" BSP	**SXC54 – 28mm x ¾" BSP (Reducing)**

	**BLANK PLUGS**
SBP2 – 12mm	**SBP4 – 20mm**
SBP3 – 15mm	**SBP5 – 28mm**

	**BRAZING TAIL**
SBT3 – 15mm	**SBT4 – 20mm**

	**PLUGGED NIPPLE**
NPN3 – 15mm	**NPN4 – 20mm**

	**CRIMP RINGS (COPPER)**
SR2 – 12mm	**SR4 – 20mm**
SR3 – 15mm	**SR5 – 28mm**

	**PIPE CLIPS (SINGLE NAIL)**
PS2 – 12mm (Grey)	**PS4 – 20mm (Grey)**
PS3 – 15mm (Grey)	**PS5 – 28mm (Grey)**

Chemical Resistance of Polybutene -1 *KEY: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Acetaldehyde	L	U	Ammonium Metaphosphate	E	E
Acetate Solvents - Crude	E	L	Ammonium Nitrate	E	E
Acetate Solvents - Pure	E	L	Ammonium Persulphate	E	E
Acetic Acid 0 – 10%	E	E	Ammonium Phosphate (Ammoniacal)	E	E
Acetic Acid 10 – 20%	E	E	Ammonium Phosphate (Neutral)	E	E
Acetic Acid 20 – 30%	E	G	Ammonium Sulphate	E	E
Acetic Acid 30 – 60%	E	L	Ammonium Sulphide	E	E
Acetic Acid 80%	E	E	Ammonium Thiocyanate	E	E
Acetic Acid - Glacial	U	U	Amyl Alcohol	E	E
Acetic Acid Vapours	E	L	Aniline	L	L
Acetic Anhydride	U	U	Aniline Chlorohydrate	U	U
Acetone	E	G	Aniline Hydrochloride	U	U
Acetylene	L	U	Anthraquinone	L	U
Adipic Acid	E	L	Anthraquinone Sulphonic Acid	L	U
Allyl Alcohol 96%	E	G	Antimony Trichloride	E	E
Allyl Chloride	E	G	Aqua Regia	U	U
Alum	L	U	Arsenic Acid 60%	E	E
Aluminium Chloride	E	E	Asphalt	E	G
Aluminium Fluoride	E	E	Barium Carbonate	E	E
Aluminium Hydroxide	E	E	Barium Chloride	E	E
Aluminium Oxychloride	E	E	Barium Hydroxide	E	E
Aluminium Nitrate	E	E	Barium Sulphate	E	E
Aluminium Sulphate	L	U	Barium Sulphide	E	E
Ammonia – Dry Gas	E	E	Beer	E	E
Ammonia - Liquid	G	L	Beet – Sugar Liquor	E	E
Ammonium Biflouride	E	E	Benzaldehyde	L	U
Ammonium Carbonate	E	E	Benzene	U	U
Ammonium Chloride	E	E	Benzoic Acid	E	E
Ammonium Fluoride 25%	E	L	Benzol	U	U
Ammonium Hydroxide 28%	E	E	Bismouth Carbonate	E	E

Chemical Resistance of Polybutene-1 *Key: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Black Liquor (Paper Industry)	E	E	Castor Oil	E	E
Bleach – 12.5% Active CL	G	G	Caustic Potash	G	L
Borax	E	E	Caustic Soda	G	L
Boric Acid	E	E	Cellosolve	E	G
Boron Trifluoride	E	E	Chloracetic Acid	U	U
Breeder Pellets – Deriv. Fish	E	E	Chloral Hydrate	U	U
Brine	E	E	Chlorine Gas (Dry)	U	U
Bromic Acid	E	E	Chlorine Gas (Moist)	U	U
Bromine - Liquid	U	U	Chlorine Water	E	G
Bromine - Water	L	U	Chlorobenzene	U	U
Butane	U	U	Chloroform	L	U
Butanol - Primary	E	-	Chlorosulphonic Acid	-	U
Butanol - Secondary	E	-	Chrome Alum	E	E
Butyl Acetate	L	U	Chromic Acid 10%	E	E
Butyl Alcohol	E	E	Chromic Acid 25%	E	E
Butyric Acid 20%	E	L	Chromic Acid 30%	E	E
Calcium Bisulphite	E	E	Chromic Acid 40%	E	-
Calcium Carbonate	E	E	Chromic Acid 50%	G	-
Calcium Chlorate	E	E	Citric Acid	E	E
Calcium Chloride	E	E	Coconut Oil	G	G
Calcium Hydroxide	E	E	Copper Chloride	E	E
Calcium Hypochlorite	E	E	Copper Cyanide	E	E
Calcium Nitrate	E	E	Copper Fluoride 2%	E	E
Calcium Sulphate	E	E	Copper Nitrate	E	E
Cane Sugar Liquors	E	E	Copper Sulphate	E	E
Carbon Bisulphide	U	U	Core Oils	E	E
Carbon Dioxide (Aqueous Solution)	E	E	Cottonseed Oil	E	E
Carbon Dioxide Gas (Wet)	E	E	Cresol	U	U
Carbon Monoxide	E	E	Cresylic Acid 50%	U	U
Carbon Tetrachloride	U	U	Crude Oil - Sour	L	U
Carbonic Acid	E	E	Crude Oil - Sweet	L	U
Casein	E	E	Cyclohexanol	G	L

Chemical Resistance of Polybutene-1 *Key: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Cyclohexanon	U	U	Formaldehyde	E	E
Demineralised Water	E	E	Formic Acid	E	E
Dextrin	E	E	Freon - 12	E	G
Dextrose	E	E	Fructose	E	E
Diazo Salts	E	E	Fruit Pulps and Juices	E	E
Diglycolic Acid	E	E	Fuel Oil (Containing H2S04)	U	U
Dimethylamine	U	U	Gallic Acid	E	E
Dioctylpthalate	L	U	Gas – Coke Oven	E	L
Disodium Phosphate	E	E	Gas - Manufactured	E	L
Distilled Water	E	E	Gas – Natural (Dry)	E	L
Ethers	U	U	Gas – Natural (Wet)	E	L
Ethyl Acetate	L	U	Gasoline - Refined	U	U
Ethyl Alcohol 0- 50%	E	E	Gasoline - Sour	U	U
Ethyl Alcohol 50 – 98%	E	E	Gelatine	E	E
Ethyl Ether	L	U	Glucose	E	E
Ethylene Bromide	U	U	Glycerine (Glycerol)	E	E
Ethylene Chlorohydrin	U	U	Glycol	E	E
Ethylene Dichloride	G	G	Glycolic Acid 30%	E	E
Ethylene Glycol	E	E	Green Liquor (Paper Industry)	U	U
Fatty Acids	E	G	Heptane	U	U
Ferric Chloride	E	E	Hexme	E	G
Ferric Nitrate	E	E	Hexanol, Tertiary	E	E
Ferric Sulphate	E	E	Hydrobromic Acid 20%	E	E
Ferrous Chloride	E	E	Hydrochloric Acid 0 – 25%	E	E
Ferrous Sulphate	E	E	Hydrochloric Acid 25 – 40%	E	E
Fish Solubles	E	E	Hydrocyanic Acid or Hydrogeo Cyanide	E	E
Fluorine Gas - Dry	L	U	Hydrofluoric Acid 10%	E	E
Fluorine Gas - Wet	L	U	Hydrofluoric Acid 48%	E	E
Fluoroboric Acid	E	E	Hydrofluoric Acid 60%	E	E
Fluorosilicic Acid	E	E	Hydrogen	E	E
Food Products such as Milk, Buttermilk, Molasses, Salad Oils, Fruit	E	E	Hydrogen Peroxide 30%	E	G

Chemical Resistance of Polybutene-1 *Key: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Hydrogen Peroxide 50%	U	U	Methyl Chloride	U	U
Hydrogen Peroxide 90%	U	U	Methyl Ethyl Ketone	E	L
Hydrogen Phosphide	E	E	Methyl Sulphuric Acid	E	E
Hydrogen Sulphide Aqueous Solution	E	E	Methylene Chloride	G	L
Hydrogen Sulphide - Dry	E	E	Milk	E	E
Hydroquinone	E	E	Mineral Oils	L	U
Hypochlorous Acid	E	E	Molasses	E	E
Iodine (In Alcohol)	U	U	Naphthalene	G	U
Isopropylalcohol	E	E	Nickel Acetate	E	E
Kerosene	L	U	Nickel Chloride	E	E
Kraft Liquor (Paper Industry)	E	E	Nickel Nitrate	E	E
Lactic Acid 28%	E	E	Nickel Sulphate	E	E
Lard Oil	G	L	Nicotine	E	E
Lauryl Chloride	G	L	Nicotine Acid	E	E
Lead Acetate	E	E	Nitric Acid 10%	L	U
Lime Sulphur	E	E	Nitric Acid 20%	U	U
Linoleic Acid	E	E	Nitric Acid 35%	U	U
Linseed Oil	E	E	Nitric Acid 40%	U	U
Liquors	E	E	Nitric Acid 60%	U	U
Lubricating Oils	E	E	Nitric Acid 68%	U	U
Magnesium Carbonate	E	E	Oils and Fats	E	E
Magnesium Chloride	E	E	Oleum	U	U
Magnesium Hydroxide	E	E	Oxalic Acid	E	G
Magnesium Nitrate	E	E	Perchloric Acid 10%	L	U
Magnesium Sulphate	E	E	Perchloric Acid 70%	U	U
Maleic Acid	E	E	Phenol	E	L
Malic Acid	E	E	Phosphoric Acid 0 – 25%	E	E
Mercuric Chloride	E	E	Phosphoric Acid 25 – 50%	E	G
Mercuric Cyanide	E	E	Phosphoric Acid 50 – 75%	G	L
Mercurous Nitrate	E	E	Photographic Chemicals	E	E
Mercury	E	E	Picric Acid	E	E
Methyl Alcohol	E	E	Potassium Acid Sulphate	E	E

Chemical Resistance of Polybutene-1 *Key: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Potassium Bicarbonate	E	E	Silver Plating Solutions	E	G
Potassium Bichromate	L	U	Soaps	E	E
Potassium Borate 1%	E	E	Sodium Acetate	E	E
Potassium Borate 10%	E	E	Sodium Acid Sulphate	E	E
Potassium Bromide	E	E	Sodium Antimonate	E	E
Potassium Carbonate	E	E	Sodium Arsenite	E	E
Potassium Chlorate	E	E	Sodium Benzoate	E	E
Potassium Chloride	E	E	Sodium Bicarbonate	E	E
Potassium Chromate 40%	E	E	Sodium Bisulphate	E	E
Potassium Cuprocyanide	E	E	Sodium Bisulphite	E	E
Potassium Cyanide	E	E	Sodium Bromide	E	E
Potassium Dichromate 40%	E	E	Sodium Carbonate (Soda Ash)	E	E
Potassium Ferricyanide	E	E	Sodium Chlorate	E	E
Potassium Fluoride	E	E	Sodium Chloride	E	E
Potassium Hydroxide 10%	E	E	Sodium Cyanide	E	E
Potassium Hydroxide 20%	E	E	Sodium Dichromate	E	E
Potassium Nitrate	E	E	Sodium Ferricyanide	E	E
Potassium Perborate	E	E	Sodium Ferrocyanide	E	E
Potassium Perchlorate	E	E	Sodium Fluoride	E	E
Potassium Permanganate 10%	E	E	Sodium Hydroxide 10%	E	E
Potassium Persulphate	E	E	Sodium Hydroxide 35%	E	E
Potassium Sulphate	E	E	Sodium Hydroxide Saturated	E	E
Potassium Sulphide	E	E	Sodium Hypochlorite	E	E
Potassium Thiosulphate	E	E	Sodium Nitrate	E	E
Propane	E	-	Sodium Nitrite	E	E
Propyl Alcohol	E	E	Sodium Phosphate - Acid	E	E
Rayon Coagulating Bath	E	E	Sodium Silicate	E	E
Salt Water	E	E	Sodium Sulphate	E	E
Selenic Acid	E	G	Sodium Sulphide	E	E
Silicic Acid	E	G	Sodium Sulphate	E	E
Silver Cyanide	E	E	Sodium Thiosulphate (Hypo)	E	E
Silver Nitrate	L	U	Stannic Chloride	E	E

Chemical Resistance of Polybutene-1 *Key: E = Excellent, G = Good, L = Limited, U = Unsuitable*

	Temperature			Temperature	
	22°C	66°C		22°C	66°C
Stannous Chloride	E	E	Trichloroethylene	U	U
Stoddards Solvent	E	E	Triethanolamine	E	L
Stearic Acid	E	E	Trisodium Phosphate	E	E
Sulphur	E	E	Turpentine	U	U
Sulphur Dioxide Gas - Wet	E	L	Urea	E	E
Sulphuric Acid 0 – 1%	E	E	Urine	E	E
Sulphuric Acid 10 – 30%	E	E	Vinegar	E	E
Sulphuric Acid 30 – 50%	E	E	Water – Acid Mine Water	E	E
Sulphuric Acid 50 – 75%	L	U	Water - Distilled	E	E
Sulphuric Acid 75 – 90%	L	U	Water - Fresh	E	E
Sulphuric Acid 95%	U	U	Water - Salt	E	E
Sulphurous Acid	E	E	Whiskey	E	E
Sulphur Trioxide	L	U	White Gasoline	U	U
Tannic Acid	E	E	Wines (Still)	E	E
Tanning Liquors	E	G	Xylene or Xylol	U	U
Tattaric Acid	E	E	Zinc Chromate	E	E
Tetrahydrofurane	L	U	Zinc Cyanide	E	E
Thionyl Chloride	E	E	Zinc Nitrate	E	E
Toluol or Toluene	U	U	Zinc Sulphate	E	E

FLOW RATE CALCULATIONS

There are a number of factors involved with the calculation of friction loss through pipes and fittings that need to be taken into account, these being Velocity, Reynolds number (roughness of the pipe bore), Temperature and Density of the water, the length of pipe and finally the Head Pressure. Below is an example of the calculations required to determine the pressure drop in a 15mm PB-1 pipe.

To calculate the velocity of water through a 15mm pipe: **$v = Q \times 21.22/D^2$**

Pipe Ø	Flow Rate l/min (Q)	Constant	D^2	m/second
15mm	12	21.22	169.2601	1.50

At a flow rate of 12 litres per minute the velocity of water through the pipe would be 1.5 m/sec

To calculate the Reynolds number (Re): **Re=1000 x v x D/kv**

Pipe Ø	Constant	Velocity (m/sec)	Diameter of Bore in mm	Kinematic Velocity (kv)	Reynolds number (Re)
15mm	1000	V = 1.50	D = 13.01	Kv = 1.004	Re = 19494.66

The Reynolds number is 19494.66, this number determines the type of flow characteristic passing through the pipe. Flow can be either Laminar or Turbulent when passing through a pipe and this during the calculations can be determined if the Reynolds number is less or greater than 2300. A number <2300 is Laminar while >2300 the flow is deemed to be Turbulent. Flows through average household plumbing systems would be deemed Turbulent.

Turbulent flow **$f=0.3164 \times Re^{-0.25}$**

0.3164	Constant number
0.084629368	$0.3164 \times 19494.66^{-0.25}$
0.026776732	**Total Friction Factor**

This number is the friction factor in relation to the flow, the Reynolds number and the Kinematic Velocity @ 20°C

The final calculation for the expected pressure drop is: **$\Delta p = v^2 \times f \times L \times p/2D$**

Velocity $(v)^2$	Friction Factor (f)	(L) Length of Pipe (m)	(p) Density kg/m^3	2 x Diameter in Meters	Δp (Pascal)	kPa
2.2633	0.026776732	10	998.21	0.02602	23249.64	23.250

The expected pressure drop for a 10m length of 15mm PB-1 pipe at a flow rate of 12 l/min would be 23.250 kPa or 3.372 PSI

The two factors that have not as yet been explained are Kinematic velocity and density. The following tables show their relationship to water temperature.

Kinematic velocity relates to the movement or flow of water through a pipe and the interaction of the water with the wall of the pipe. This acts very much in the favour of PB-1 pipe as the wall surface is very smooth in comparison to steel. Velocity is affected by changes in temperature as shown in Table G.

Density is also affected by temperature and will change as the temperature increases or decreases as is shown in Table H.

Temperature – Kinematic Velocity @ °C			
°C	Centistokes (cSt)	°C	Centistokes (cSt)
20	**1.004**	**70**	**0.413**
30	**0.801**	**80**	**0.365**
40	**0.658**	**90**	**0.326**
50	**0.553**	**100**	**0.294**
60	**0.475**		

Table G

Viscosity – Density of Water @°C			
°C	Kg/m^3	°C	Kg/m^3
20	**998.21**	**70**	**977.77**
30	**995.65**	**80**	**971.80**
40	**992.22**	**90**	**965.32**
50	**988.04**	**100**	**958.37**
60	**983.20**		

Table H

A further factor to take into account is head pressure when lifting pipes up into an attic space or second storey. Each metre rise is equivalent to approximately 10 kPa lost pressure so this should be factored into the final calculation.

Fittings affect pressure loss and can either be calculated to each fitting configuration or allocated an equivalent pipe length in metres.

The equivalent pipe lengths in Table I are an estimate and slight variations would be seen with differing flow rates and temperatures but have been designed to accommodate these changes as far as possible.

Fitting Description	Code	Line Flow (m)	Branch Flow (m)		Fitting Description	Code	Line Flow (m)	Branch Flow (m)
Coupling	SC2	0.4			BSP Swivel Elbow	SXE23	0.9	
Coupling	SC3	0.5			BSP Swivel Elbow	SXE24	0.9	
Coupling	SC4	0.7			BSP Swivel Elbow	SXE34	1.1	
Coupling	SC5	1			BSP Swivel Elbow	SXE43	1.6	
Coupling	SC24	0.8						
Coupling	SC32	0.7			Elbow 90°	SE4	1.3	
Coupling	SC43	1			Elbow 90°	SE5	1.6	
Coupling	SC54	1.3			Elbow 90°	SE43	1.5	
					Elbow 90°	SE54	1.8	
Male Adaptor	SAM3	0.5						
Male Adaptor	SAM4	0.7			Elbow 45°	SE3045	0.2	
Male Adaptor	SAM5	1			Elbow 45°	SE4045	0.3	
Male Adaptor	SAM23	0.4			Elbow 45°	SE5045	0.4	
Male Adaptor	SAM43	0.5						
					Wingback Elbow (M)	SWM3	1.3	
Reducing Tee	ST223	0.4	1.1		Wingback Elbow (M)	SWM4	1.5	
Reducing Tee	ST224	0.4	1.1		Wingback Elbow (M)	SWM3100	1.5	
Reducing Tee	ST332	0.5	1.3		Wingback Elbow (M)	SWM4100	1.7	
Reducing Tee	ST334	0.5	1.3					
Reducing Tee	ST433	0.6	1.3		Wingback Elbow (F)	SW3	1.1	
Reducing Tee	ST434	0.8	1.6		Wingback Elbow (F)	SW4	1.3	
Reducing Tee	ST442	0.7	1.6		Wingback Elbow (F)	SW23	0.9	
Reducing Tee	ST443	0.7	1.6		Wingback Elbow (F)	SW34	1.1	
Reducing Tee	ST553	1	2		Wingback Elbow (F)	SW43	1.5	
Reducing Tee	ST554	1	2					
					Double Fix Wingback (M)	SDWM3100	1.5	
Equal Tee	ST2	0.4	1.1		Double Fix Wingback (M)	SDWM4100	1.7	
Equal Tee	ST3	0.5	1.3					
Equal Tee	ST4	0.7	1.6		Double Fix Wingback (F)	SDW3	1.1	
Equal Tee	ST5	1	2		Double Fix Wingback (F)	SDW4	1.3	
					Double Fix Wingback (F)	SDW5	1.6	
Female Lugged Tee	SWT3	0.5	1.3		Double Fix Wingback (F)	SDW34	1.1	
					Double Fix Wingback (F)	SDW43	1.5	
Crox Tee Adaptor	SXT3	0.5	1.3		Double Fix Wingback (F)	SDW53	1.8	
Elbow 90°	SE2	0.9			Manifold	SMF4203		1.3
Elbow 90°	SE3	1.1			Manifold	SMF4204		1.6
					Manifold	SMF4303		1.3
Threaded Elbow (M)	SEM3	1.1			Manifold	SMF4304		1.6
Threaded Elbow (M)	SEM4	1.3						
Threaded Elbow (M)	SEM5	1.6			BSP Swivel Connector	SXC3	0.5	
					BSP Swivel Connector	SXC4	0.7	
Hose Plate (F)	SH3	0.5			BSP Swivel Connector	SXC5	1	
Hose Plate (F)	SH4	0.7			BSP Swivel Connector	SXC23	0.5	
Hose Plate (F)	SH53	1			BSP Swivel Connector	SXC43	0.5	
					BSP Swivel Connector	SXC54	1.3	
BSP Swivel Elbow	SXE3	1.1						
BSP Swivel Elbow	SXE4	1.3						
BSP Swivel Elbow	SXE5	1.6						

Table I

Once the fittings have been added together this metre length can then be added to the total overall length to complete the calculation.

Table J - Acceptable flow rates to sanitary fixtures in NZBC G12/AS1

Appliance	Flow Litre/Sec	Flow Litre/Min	Requirement
Bath	0.3l/s at 45°C	18 l/min	Mix hot and cold water to achieve 45°C
Sink	0.2 l/s at 60°C	12 l/min	Flow rates required at both hot and cold taps but not simultaneously
Laundry Tub	0.2 l/s at 60°C	12 l/min	Flow rates required at both hot and cold taps but not simultaneously
Basin	01 l/s at 45°C	6 l/min	Mix hot and cold water to achieve 45°C
Shower	01 l/s at 45°C	6 l/min	Mix hot and cold water to achieve 42°C

The tables below show examples of pipe length calculations at varying flow rates, length and temperatures.

Table k – 12mm PB-1 Pipe

12mm PB-1 kPa Pressure Drop at 6 l/min				12mm PB-1 kPa Pressure Drop at 12 l/min			12mm PB-1 kPa Pressure Drop at 18 l/min		
Length (m)	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**
1	2.9	2.3	2.2	9.7	8.0	7.4	19.7	16.1	14.9
5	14.4	11.7	10.9	48.7	39.8	36.8	98.7	80.6	74.6
10	28.7	23.5	21.7	97.3	79.5	73.6	197.4	161.3	149.3
20	57.5	46.9	43.4	194.7	159.0	147.2	394.9	322.6	298.5
25	71.8	58.7	54.3	243.4	198.8	184.0	493.6	403.2	373.1

Table L – 15mm PB-1 Pipe

15mm PB-1 kPa Pressure Drop at 6 l/min				15mm PB-1 kPa Pressure Drop at 12 l/min			15mm PB-1 kPa Pressure Drop at 18 l/min		
Length (m)	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**
1	0.7	0.6	0.5	2.3	1.9	1.7	4.7	3.9	3.6
5	3.4	2.8	2.6	11.6	9.4	8.7	23.7	19.4	17.9
10	6.9	5.6	5.2	23.1	18.9	17.5	47.4	38.7	35.8
20	13.7	11.2	10.4	46.2	37.8	34.9	94.8	77.5	71.7
25	17.2	14.0	13.0	57.8	47.2	43.7	118.5	96.8	89.6

Table M – 20mm PB-1 Pipe

20mm PB-1 kPa Pressure Drop at 6 l/min				20mm PB-1 kPa Pressure Drop at 12 l/min			20mm PB-1 kPa Pressure Drop at 18 l/min		
Length (m)	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**
1	0.1	0.1	0.1	0.4	0.4	0.3	0.9	0.7	0.7
5	0.6	0.5	0.5	2.2	1.8	1.7	4.5	3.7	3.4
10	1.3	1.1	1.0	4.4	3.6	3.4	9.0	7.3	6.8
20	2.6	2.1	1.9	8.9	7.3	6.7	17.9	14.6	13.5
25	3.2	2.6	2.4	11.1	9.1	8.4	22.4	18.3	16.9

Table N – 28mm PB-1 Pipe

28mm PB-1 kPa Pressure Drop at 6 l/min				28mm PB-1 kPa Pressure Drop at 12 l/min			28mm PB-1 kPa Pressure Drop at 18 l/min		
Length (m)	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**	**20°C**	**60°C**	**80°C**
1	0.1	0.0	0.0	0.2	0.1	0.1	0.3	0.3	0.3
5	0.3	0.2	0.2	0.8	0.7	0.6	1.7	1.4	1.3
10	0.5	0.4	0.4	1.6	1.3	1.2	3.3	2.7	2.5
20	1.0	0.8	0.8	3.2	2.7	2.5	6.7	5.5	5.1
25	1.3	1.0	0.9	4.1	3.3	3.1	8.4	6.8	6.3

The above calculations have been independently verified by:
Professor Bruce Melville, FRSNZ, FIPENZ
Professor and Head of Department
Department of Civil and Environmental Engineering
The University of Auckland

Please refer to the New Dux website: www.dux.co.nz for an easy to use Flow Rate Calculator.

Water and Energy Conservation

Energy and Water efficiency concerns determine a set volume of hot water to be held in a pipe length feeding from a hot water heater to a fixture such as a kitchen tap.
Table O calculates the volume held by PB-1 pipe at varying lengths in all of the pipe diameters available in the SecuraGold™ range. 12mm PB-1 pipe is eminently suited to carrying hot water to a fixture and at 25 metres it will hold 1.825 litres of water ensuring a fast and efficient supply of hot water when required.

Table O – Pipe Volumes

PB-1 Pipe Volume in Litres				
Length (m)	**12mm**	**15mm**	**20mm**	**28mm**
1	0.073	0.133	0.269	0.408
5	0.365	0.665	1.345	2.04
10	0.73	1.33	2.69	4.08
15	1.095	1.995	4.035	6.12
20	1.46	2.66	5.38	8.16
25	1.825	3.325	6.725	10.2

Table O outlines the volume of water held in a PB-1 pipe per meter length, for further sizing multiply the length of the pipe run by the one metre volume.

Table P – Pressure Conversion

kPa	Bar	P.S.I.	Mpa	Metre Head
5	0.05	0.72	0.005	0.5
10	0.1	1.45	0.01	1
20	0.2	2.90	0.02	2
30	0.3	4.35	0.03	3
40	0.4	5.80	0.04	4
50	0.5	7.25	0.05	5
60	0.6	8.70	0.06	6
70	0.7	10.15	0.07	7
80	0.8	11.60	0.08	8
90	0.9	13.05	0.09	9
100	1.0	14.50	0.10	10
150	1.5	21.76	0.15	15
200	2.0	29.00	0.20	20
250	2.5	36.26	0.25	25
300	3.0	43.50	0.30	30
350	3.5	50.76	0.35	35
400	4.0	58.00	0.40	40
450	4.5	65.27	0.45	45
500	5.0	72.50	0.50	50
1000	10.0	145.00	1.00	100

Definition of Terms

Dezincification	Dezincification of brass is a form of selective corrosion that happens when Zinc is leached out of the alloy leaving a porous copper fitting.
Dezincification Resistant (DZR/DR)	Dezincification Resistant brass is a specifically modified brass alloy purposefully made to be suitable for potable water reticulation.
Elastic Modulus	Elastic Modulus or Modulus of Elasticity is the mathematical description of an object or substance's tendency to be deformed elastically (i.e. non-permanently) when a force is applied to it.
EVA	Ethylene Vinyl Acetate is the co polymer of Ethylene and Vinyl Acetate. It is a polymer that approaches elastomeric materials in softness and flexibility but can be processed like other thermoplastics.
Hydrostatic Pressure	The pressure exerted by a fluid at equilibrium at a given point within the fluid, due to the force of gravity. Hydrostatic pressure increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.
Isotactic	A type of polymeric molecular structure containing a sequence of regularly spaced, asymmetric atoms arranged in like configuration in a polymer chain.
Kinematic Velocity	A measure of the resistance to flow of a fluid, equal to its absolute viscosity divided by its density, usually measured in stokes.
Laminar Flow	Sometimes known as streamline flow, occurs when a fluid flows in parallel layers, with no disruption between the layers. At low velocities the fluid tends to flow without lateral mixing and adjacent layers slide past one another like playing cards.
LDPE	Low Density Polyethylene is a thermoplastic made from petroleum and has the distinction of being the first grade of polyethylene produced in 1933.
Potable	Drinking water or potable water is water pure enough to be consumed or used with low risk of immediate or long term harm.
Thermal Conductivity	The property of a material to conduct heat, materials with a high level of thermal conductivity allows heat to transfer at a faster rate than those with a low thermal conductivity.
Thermoplastic	Also known as thermosoftening plastic is a polymer that turns to a liquid when heated and freezes to a very glassy state when cooled sufficiently. Most thermoplastics are high molecular weight polymers.
Turbulent Flow	Movement of a fluid in which subcurrents in the fluid display turbulence, moving in irregular patterns, while the overall flow is in one direction. Turbulent flow is common in non-viscous fluids moving at high velocities.
Viscosity	Viscosity is a measure of the resistance of a fluid which is being deformed by either shear stress or tensile stress.
Volatile Organic Compounds (VOC)	Volatile Organic Compounds are emitted as gases from certain solids or liquids. VOC's include a variety of chemicals, some of which may have short or long term adverse health risks.

Compatibility of PB-1 Systems

Dux SecuraGold™ fittings and pipe are manufactured to the AS/NZS 2642.1, 2 and 3 standards and as such any compatible competitor's pipe made to the same standard would be suitable for use with SecuraGold™ fittings. If the pipe specifications are correct to the AS/NZS 2642.2 standard and the crimped fitting gauges appropriately Dux will guarantee the connection.

The SecuraGold™ Guarantee

SecuraGold Hot and cold water piping system

Dux Industries Ltd 25 year performance warrantee (limited)

Dux Industries is committed to providing quality products to customers that meet or exceed the requirements of relevant current AS/NZ standards and the New Zealand Building Code. This warrantee covers the Dux SecuraGold fittings and Secura PB-1 pipe only, against material or manufacturing defects during normal operation from the date of manufacture for a period of 25 years.

(This warrantee does not apply to the tools used to install the SecuraGold system)

All products are to have been stored, handled and installed in strict accordance with the manufacturer's installation manuals and instruction leaflets.