HOT AND COLD WATER AND CENTRAL HEATING PLASTIC PIPE SYSTEMS

INTRODUCTION
Plastic pipe systems are available in a wide variety of materials. The most common are Polybutylene (PB) and Cross Linked Polyethylene (PEX), including barrier pipe that incorporates an oxygen barrier, and multi-layer composite pipes (MLC). These pipe systems can be used in hot and cold water supply and central heating installations; in fact in most areas where traditional piping materials are used.

The flexibility of the pipes, particularly those manufactured in PB or PEX, provides easy handling and installation. They are available in both straight lengths and coils, which enables 'threading' around obstructions and through joists etc., reducing the number of joints required. MLC pipes retain their formed shape.

In service the systems have many benefits over traditional materials. These include reduction in mechanical noise, no scale build up (as the smooth internal bore reduces the accumulation of limescale), and lack of corrosion. No solder is required (which complies with Water Supply (Water Fittings) Regulations 1999). The pipes do not easily fracture when frozen as thermal expansion is accommodated within the length of a pipe run. Finally, low thermal conductivity means that pipes carrying hot water are cooler to the touch.

The extensive range of fittings available for each pipe system enables reliable, watertight joints to be made quickly and easily in a wide variety of domestic and commercial systems.

APPLICATIONS
Plastic pipe systems manufactured from PB and PEX are available Kitemarked to class 'S' of BS 7291-1 (Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings-Part 1: General requirements) – which ensures that they are safe for all classes of service conditions shown in table 1. The current edition of the standard is dated 2010.

Table 1 – Classification of Service Conditions

<table>
<thead>
<tr>
<th>APPLICATION**</th>
<th>Nominal System Flow Temperature (Tf) °C</th>
<th>Maximum System Service Temperature (Ts) °C</th>
<th>System Malfunction Temperature (Tm) °C</th>
<th>System Maximum Working Pressure BAR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect cold water systems</td>
<td>20</td>
<td>20</td>
<td>-</td>
<td>3½</td>
</tr>
<tr>
<td>Direct mains-fed cold water systems</td>
<td>20</td>
<td>20</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Subsurface heating systems</td>
<td>60</td>
<td>83</td>
<td>100</td>
<td>3½</td>
</tr>
<tr>
<td>Vented hot water systems(1)</td>
<td>65</td>
<td>83</td>
<td>100</td>
<td>3½</td>
</tr>
<tr>
<td>Unvented hot water systems including instantaneous heaters and/or incorporating storage(2)</td>
<td>65</td>
<td>95</td>
<td>100</td>
<td>6</td>
</tr>
<tr>
<td>Vented central heating systems and indirect hot water primary circuits</td>
<td>82</td>
<td>95</td>
<td>100</td>
<td>3½</td>
</tr>
<tr>
<td>Sealed central heating systems and indirect hot water primary circuits</td>
<td>82</td>
<td>105</td>
<td>114</td>
<td>3</td>
</tr>
</tbody>
</table>

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(1) Continuously operated re-circulating systems are excluded from these applications – see page 10 for further details.
CODES OF PRACTICE
Plastic pipe systems should be designed and installed in accordance with the following standards and guides:

BS 5449:1990
Specification for forced circulation hot water central heating systems for domestic premises.

BS EN 12828:2003
Heating systems in buildings. Design for water-based heating systems.

BS EN 12831:2003

BS 5955-8 :2001

BS 6700:2006
Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.

BS 8000-15:1990
Workmanship on building sites. Code of practice for hot and cold water services (domestic scale).

PAS 33
Specification for the design, installation and commissioning of gas fired central heating systems in domestic premises.

Water Industry Act 1991

The Building Regulations 2000
(approved documents A, G and L).

PRODUCT RANGES
Plastic pipe systems come in a wide variety of types. Those Kitemarked to Class ‘S’ of BS 7291 are suitable for the applications described previously.

The following information provides an outline of the wide choice available in plastic pipe systems. Care should be taken to ensure that the jointing mechanism and fittings used are those recommended by the manufacturer for the system.

Plastic pipe systems are available in a range of plastic materials including polybutylene, PPSU and cross-linked polyethylene.

Barrier pipes generally have an intermediate polymeric layer bonded to the pipe wall on either side by an adhesive layer that forms a barrier to the passage of oxygen. In MLC systems an intermediate layer of metal, such as aluminium is bonded between the two plastic layers.

Pipes are available in nominal diameters of 10 to 110mm to cover a wide range of applications. Different manufacturers’ supply different size ranges.

Pipes are available as straight lengths or coils. Coiled pipes are supplied in longer lengths, which can be threaded in continuous runs through the fabric of a building reducing the number of joints required.

A wide variety of fittings are available to cater for all installation requirements. Manufacturers also offer their own range of accessories such as conduit pipe, pipe clips, pipe clip spacers, cold forming bends, pipe cutters etc.

The manufacturers’ brochures should be consulted for the full range of fittings available for each system and their compatibility with other systems.
JOINTING SYSTEMS
A variety of jointing systems are available for plastic pipe systems. Care should be taken to ensure that the correct jointing mechanism for the system is used. To ensure the jointing system is compatible, the relevant manufacturer’s literature should be consulted. The most common jointing system in the UK for domestic applications is the push-fit. A support sleeve is inserted into the pipe end and the pipe simply pushed firmly into the fitting to an insertion mark or specified depth. A quick tug back on the pipe ensures the joint is secure. Push-fit joints incorporate a rubber seal and a gripping mechanism to provide a secure mechanical connection. They are generally ‘demountable’ either by unscrewing or by using a special tool.

Other systems include
- Mechanical compression jointing
  the fitting compresses the pipe ensuring the tightness of the joint without the use of any sealing material. Special tools are sometimes required and a support sleeve should always be used.
- Press fit jointing
  incorporating a metal outer sleeve and plastic or metal body with integral inserts.
  Using a special power tool the outer sleeve is pressed to grip the pipe to the fitting body.
- Fusion jointing
  the pipe and fitting are heated until their surfaces melt. The two molten surfaces are brought together and joined. As they cool the two surfaces fuse together. Special tools are required.
- Electrofusion
  similar to the above but electrofusion is used to melt the surfaces.

INSTALLATION
General
General information on installing plastic pipe systems is given below. However, the manufacturer’s installation instructions should always be followed for each specific system. Many manufacturers run their own training schemes, and information on these can be obtained direct from the manufacturer.

Pipe Cutting
Pipes should be cut using the manufacturer’s recommended pipe cutter. A hacksaw or craft knife should never be used since this can leave a roughened or out-of-square end. The cut pipe should be checked for burrs or scoring and any roughness, grit, dirt or swarf should be removed prior to jointing.

Jointing
The widely used push fit joints are made by first inserting a pipe support sleeve into the pipe. It is essential to use a support sleeve in order to make a good joint. The support sleeve must be pushed fully into the pipe end. The pipe is then pushed firmly into the fitting. To ensure the pipe has been pushed to the full socket depth, ensure the insertion depth marks on the pipe align with the outer end of the fitting.

If insertion marks are not marked on the pipe or the pipe is being installed in an area where the marks are not clearly visible then the insertion depth can be marked on the pipe in advance of jointing using a suitable marker. Manufacturer’s literature should be consulted for the correct insertion depths. Most push fit joints are capable of being rotated and dismantled. This enables the joints to be re-aligned or dismantled after installation and some or all of the components may be re-used in re-assembly. The manufacturer’s instructions should be followed and in some cases a special tool may be required.

For other jointing techniques the manufacturer’s literature should be consulted.
Connection to Other Systems

Many plastic pipe systems, especially the push fit ranges, can be connected to other pipe materials.

Copper Pipe

The copper pipe should be cut square, using a wheel cutter. Before jointing ensure the pipe ends are free from burrs or swarf and undamaged or dented. Where specified by the manufacturer an appropriate copper pipe end-protector should be inserted. Connection to metric copper pipe to BS EN 1057 (Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications) can be made using most push fit connectors. Connection to other copper pipe sizes will require a change of ring seal in the fitting or use of an appropriate adaptor. Where flexible pipe is suitable for jointing to compression fittings a pipe support sleeve should always be used in the flexible pipe.

Chrome Plated Copper and Stainless Steel Pipe

Push fit fittings are not suitable for use with chrome plated copper pipe or stainless steel pipe due to the differences in surface hardness of the materials. Compression fittings or suitable adaptors should be used.

Incoming Service Pipes

The manufacturer’s recommendations as to the correct method of jointing to incoming service pipes should be followed.

Appliances, Taps, Ancillaries, Storage Vessels, Radiators etc.

The manufacturer’s advice should be sought. Most systems will include a suitable adaptor or connector fitting for any required connection.

Connection to Boilers and Heaters

Direct connections to BS 7291 Class ‘S’ pipes can be made where boilers incorporate a high limit cut out thermostat and a pump overrun device and have connections outside the boiler casing 350mm from the heat source. If any of the above criteria for direct connection to a boiler cannot be met a minimum one metre run of copper pipe should be installed between the boiler and the start of the plastic pipe system. In all cases (including instantaneous water heaters, caravan heaters etc.) care should be taken to ensure that the appliances have the appropriate thermostatic controls and cut outs to ensure that operating conditions do not exceed the temperature and pressure limits laid down for Class ‘S’ pipes.

For any type of back boiler, all water connections should be extended from the appliance to the outside of the fireplace opening in copper tube. In instances where the heat output may be uncontrolled a minimum one metre run of copper pipe should be used between the boiler and the start of the Class ‘S’ plastic pipe system.

Any gravity circuit of a solid fuel boiler should always be installed in copper.

Bending

A bend is made by installing a fixing at one end and gently curving the pipe by hand (using an appropriate tool where necessary) to the required shape, and then installing a second fixing at the other end. Alternatively, bends can be supported with an appropriate bend former. Care should be taken not to bend the pipe beyond its recommended bending radius as this can cause kinking. Pipes that have been damaged during bending should not be used. Details of the bending radius can be obtained from the manufacturer’s literature. It is generally 12 times the pipe diameter for unsupported pipe and 8 times the pipe diameter for supported pipe.
Fixing
Plastic pipe systems manufactured in PB or PEX in diameters less than 32mm are not self-supporting and must be adequately supported in accordance with the support centres detailed in BS 5955:Part 8:2001.

Where piping is adequately supported or is run within concealed spaces (e.g. through suspended timber floors), clips can be reduced or omitted provided that:

• The pipe will not be subjected to vigorous movement.
• The pipe does not form part of an open vent provided for safe operation of a heat source, boiler or hot water vessel.
• The pipe does not form a distribution pipe or circuit where effective air venting might be impaired by poor pipe alignment.
• Hot pipes will not touch cold pipe or vice versa.
• There is no risk pipe will come into contact with sharp, abrasive or other potentially damaging surfaces.
• There is no risk pipe will come into contact with hot surfaces or transmitted heat that may melt the pipe e.g. inset lighting.
• There is no risk the pipe will come in contact with materials that may suffer damage or discoloration from transmitted heat.

The inherent flexibility of plastic pipe systems means that there is generally no need to make any special provision for thermal expansion. Each manufacturer supplies the appropriate fixings for their pipe and these should be installed in-line with each individual manufacturer’s guidelines.

The screw-in type fixing may be used with a spacer, which provides a greater spacing between the pipe and the fixing background. This allows for different pipe fixing centres, which can be used to enable pipe cross-overs or the installation of thermal insulation.

For other pipe materials, including MLC’s, and larger diameters the manufacturer’s literature should be consulted.

Pipe routing
The flexibility of these systems allows pipes to be threaded through the fabric of the building – through stud partitions, dry walling, steel structural members and drilled holes in joists.

Threading through joists
Pipe systems using traditional materials are installed by notching joists, which means that pipes are located very close to the underside of floorboards. This can result in damage to pipe during subsequent floor laying or partition wall fixing. The thermal movement of pipe against notched joists gives rise to noise and difficulties in fitting insulation where required.

Flexible pipe can be threaded through holes drilled in the joists allowing pipework to be installed from below, after the flooring has been laid. This has important health and safety advantages enabling more accurate setting out for ‘second fix’ connections to appliances and easier insulation.
Traditional timber joists

Holes must be located in the correct zones of the joist span, which is different from the notching zone. The permitted zone for holes is between 0.25 and 0.4 of the joist span (see diagram above).

Within the drilling zone, the holes must be located on the central axis of the joist, with the centre lines spaced no closer than three times the largest diameter apart. The maximum size of hole must not exceed one quarter of the joist height.

Once the drill positions have been determined and marked on the first joist, a batten can be used as a quick measuring template to transfer the position of the hole to other joists.

Holes can be drilled by using a drill with an angle chuck (suitable eye protection should be worn). When the holes have been drilled, the flexible pipe can be threaded into position.

When pipework is installed in notches in the joists, structural timbers should be notched only with the permission of the architect or a structural engineer and should be in accordance with BS 6700:2006.

Threading through engineered joists

Plastic pipe systems are ideal in buildings incorporating engineered 'I' section composite timber joists. The piping can be installed through holes in the web section without damaging flange members.

Threading through steel structural members

In fabricated steel framing systems, plastic pipes can be simply threaded through the open webs of the framework. Some mechanical protection should be provided to prevent chaffing of the pipe walls where these rest on the steel members.

Laying pipes in concrete floors

Unlike metal pipes, plastics are not affected by cement, limes, mortars, concrete and general corrosion. They can therefore be installed directly in screeded floors. However, account should be taken of the requirements of the Water Regulations, which require distribution pipework to be accessible to facilitate its repair and replacement. The pipe-in-conduit systems supplied by many manufacturers are ideal for installation directly into concrete floors.

They consist of a flexible plastic pipe run inside a slightly larger conduit pipe. This prevents the need for expensive pipe ducting systems that require continuous timber access boarding.

The conduit system should be installed so that the pipe within the conduit may be removed for replacement, by disconnecting the exposed ends and withdrawing it through the conduit. For further installation recommendations refer to the manufacturer. The system should be pressure tested before the screed is laid. The thickness of the screed will depend upon the loading requirements of the floor and the screed should be laid in accordance with the relevant requirements of BS 8204-1:2003 (screeds, bases and in-situ floorings. Concrete bases and cement sand leveling screeds to receive floorings. Code of Practice.)
Installing pipes in walls

10mm plastic pipe systems can be accommodated behind ‘dot and dab’ plasterboard walls to give a pipe free appearance within the room. When installing pipes in dry lined walls care should be taken to avoid running the pipework along any obvious fixing zone i.e. at skirting level or where curtain rails may be fixed. Lateral pipes should be run horizontally in line with plasterboard penetrations and radiator drops should be run vertically, side by side, at one end of the radiator position.

Plastic pipe systems can be easily threaded through studwork and within wall systems during construction. This method is often used for running feeds to radiators or where concealed plumbing is required. Unlike pipe systems that use traditional materials, plastic pipe systems can be easily withdrawn, in-line with Building Regulations.

Wall and floor penetrations

Pipes which pass through blockwork, brickwork, solid floors, concrete, steelwork and similar abrasive constructional elements should be protected from mechanical damage by the use of a plastic sleeve. This sleeve should project at least 3mm beyond the wall etc. at either end. The use of a protective sleeve is particularly important if there is any likelihood of structural movement.

Whenever the pipe passes through a firewall or floor where firestopping is required, the fireseal should be wrapped in foil or otherwise prevented from contact with the pipe. Proprietary foil clad intumescent products are available from a number of manufacturers.

Electrical bonding

There is no risk of electric shock from plastic pipes, as they do not conduct electricity. (see www.plasticpipesgroup.com Bulletins Index - earthbonding)

Where the pipe forms a break in the continuity of existing metal pipe, which may have been used for earthing or bonding, the electrical continuity should be reinstated. The bonding lead should be fixed permanently to both ends of the existing metal pipework.

Insulation

The inherent resilience and flexibility of plastic pipes offer considerably increased resistance to damage from freezing.

The pipe walls are able to deform under pressure from the internal expansion and will resume their original shape without damage after thawing.

However, plastic pipes do not provide any resistance to freezing which may prevent the system from functioning and can cause damage to metallic parts of the system. Therefore it is always advisable to provide insulation in accordance with the Building Regulations in situations where there is any likelihood of freezing.

Painting

Most plastic pipe systems can be painted if required. It is preferable to use emulsion paints but oil based gloss paints in conjunction with an undercoat can be used. Cellulose paints, or other coatings which contain solvents, should never be used. Before painting ensure the surface of the pipe is clean, dry and free from grease and silicone compounds.

If repainting is required, chemical paint strippers and hot air guns should not be used.

Woodworm/Timber Treatment

Aqueous based solutions are generally acceptable when treating timber for woodworm or timber rot. However, care should be taken to protect and cover the pipes and fittings before spraying. It is preferable to carry out any spraying prior to installation of the pipework. Solvent based treatments should not be used.
**Pressure testing**

When the installation is complete, pressure testing of the pipework and fittings in accordance with the guidelines laid down by the Water Supply (Water Fittings) Regulations 1999 and as recommended in BS 6700:2006 must be carried out. This should always be carried out before the next building process covers the pipes e.g. screeding of floors or laying of floorboards. These regulations stipulate a minimum pressure condition for testing that may be below individual manufacturer recommendations.

Care should be taken to ensure that the pressure used does not exceed the figures recommended by the manufacturers for other components of the system such as pumps, cylinders etc.

**Corrosion Inhibitors**

Corrosion Inhibitors should be used in all heating circuits in the normal way to prevent corrosion of steel radiators and other vulnerable components. Most proprietary anti-corrosion compounds and central heating anti-freeze admixtures used at the normal recommended levels do not affect the majority of plastic pipe systems.

**Flushing**

Once a central heating system installation is complete it should be flushed and filled in accordance with BS 7593:1992 (Code of practice for the treatment of water in domestic hot water central heating systems).

**Disinfecting**

Once the system has been tested and approved the potable system should be disinfected in accordance with BS 6700:2006.

**SYSTEM DESIGN**

The use of plastic pipe systems does not impose any constraint on the design of hot and cold water or central heating systems.

Plastic pipe systems can be used in exactly the same way as those utilising traditional materials, however the flexibility of most plastic pipe provides a wider and more flexible range of design options.

Many manufacturers supply manifolds for use on central heating systems. These provide an opportunity for modular system design. One manifold is used in the flow pipework, and a second, matching unit, is provided in the return line. Individual manifolds can be joined together to provide multiple flow/return circuits.

**Pipe Sizing**

In small, simple installations such as those in single dwellings, pipes can be sized on the basis of experience and convention. In these cases it should be noted that although the nominal internal diameters of plastics pipe systems are often slightly less than that of the equivalent traditional material, this slight reduction has no significant effect on capacity. The plastic pipe systems will maintain their internal diameter throughout their working life, whilst traditional metal systems are susceptible to deposits of fur and scale. Similarly, the smooth internal surface of the plastic pipe systems and the ease with which they can be formed into long radius bends reduces frictional losses.

In all other cases the probable flow rates and pipe sizes required should be calculated using a recognized method such as that in BS 6700:2006, Annex D and BS 5955:Part 8:1990.

The Plumbing Engineering Services Design Guide published by the Institute of Plumbing provides guidance on pipe sizing.

**Heating Design**

Domestic central heating systems should be designed in line with conventional practice. The heating demands for particular rooms can be calculated as detailed in the CIBSE (Chartered Institute of Building Service Engineers) Guide Part A. To calculate the pressure drop in the pipes connected to each radiator, the total length of pipe is defined as the sum of the lengths of flow and return pipes from the manifold to the radiator.

**Expansion Control**

In typical domestic applications, special provision for thermal movement is not normally required, as expansion is absorbed by the natural flexibility of the pipe. However, reference should always be made to individual manufacturer’s instructions.

Where long runs of pipe are to be installed, provisions are required to control thermal movement and retain the proper alignment of the system. It is important to assess the amount of thermal movement on each pipe run or pipe section.

*Proprietary guide brackets, which allow the pipe to slide within them during thermal movement, and anchor points are required to control thermal movement. Anchor points should be formed at couplings or tees. An anchor point can be formed by locating two guide brackets directly against the opposing socket face of the fitting. Where expansion movement on a pipe section is only acting in one direction, a single guide bracket may be used to form an anchor point. The maximum distance between anchor points should not exceed 6m. If it is necessary to form an anchor point near an elbow, then an additional coupling should be installed.*
Health and Safety

Prior to installing plastic pipe systems, it is important to read the relevant manufacturer’s health and safety and installation guidelines.

Limitations

In general, plastic pipe systems should not be used for pipelines carrying steam, gases, fuel oil, petroleum or water containing high levels of chlorine such as swimming pool installations. When in doubt or for particular requirements, the advice of the manufacturer should be sought.

Plastic pipe systems should not be used for the primary circuit of solar heating systems where the temperature cannot be thermostatically controlled.

In general, plastic pipe systems should not be installed in locations where they are likely to be exposed to excessive levels of ultra violet light, such as in direct sunlight or where artificial sources of UV are in use. If such exposure is unavoidable, the pipes should be encased in a protective ducting or similar.

Continuously operated re-circulating systems (Secondary hot water circulation/Ring main installations)

A continuously operated re-circulating system is a water-replenished circulating system which is maintained at a constant high temperature to provide a constant source of hot water. Continuously operated re-circulating systems are used to distribute constant hot water to draw off points that may be distant from the heat source or hot water storage vessel. Continuously operated re-circulating systems are very different from conventional hot water supply and central heating systems found in domestic properties, for which our products have been tested to, under either BS 7291 2010 Class S or WRAS approval standards, and for this reason these products must not be used on any continuously operated re-circulating systems as they are not approved under the current version of these standards.

Manufacturers own technical information should always be consulted as specific product limitations may apply.

Expansion loop

Where a cold water pipe is installed in high ambient temperature conditions, provision for thermal movement due to contraction should also be considered.

Sound

Problems with noise are frequently experienced with systems incorporating rigid metal pipes. These include water hammer and ‘ticking’ during expansion and contraction of the metal pipe. Plastic pipe systems do not transmit noise and with careful installation can be installed to run almost silently.

Provision for pipe expansion should be incorporated between each anchor point. There are two ways of allowing for pipe expansion - Flexible arm or Expansion loop.

Flexible arm: this needs to be long enough to allow the pipe to flex naturally without causing any damage.

Expansion loop: this is a method of allowing for pipe expansion in the middle of a pipe section. Pipes can also be laid on a continuous support such as a cable tray. The thermal movement can then be accommodated by the ‘snaking’ of the pipe. It is necessary to prevent upward movement to stop the pipe coming into contact with pipe at a different temperature or electrical wiring.

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ADVANTAGES OVER TRADITIONAL METAL SYSTEMS

Material benefits of high performance engineered polymers

Physical
- Lower weight
- Reduced risk of theft: lower scrap value
- Impact resistant
- Reduced risk of freeze-bursting

Performance in service
- Smoother bore: improved flow/velocity
- Extra resistant to corrosion
- No scale build-up
- Lower thermal conductivity
  - Cooler to touch/safer
- Lower noise transmission: quieter
- Extended service life:
  - Class ‘S’ pipes: 50 years design life
- Lower environmental impact:
  - Reduced energy values

Flexibility benefits
- Available in coils up to 63mm dia.
- Longer pipe runs: fewer joints
- Can be run round obstructions
- Faster installation
- Absorbs thermal expansion

Jointing benefits
- Choice of jointing options
  - Push-fit
  - Crimped
  - Electro-fusion
- No naked flames required
- Can be jointed to existing metal systems

Applications
Plastic plumbing systems are suitable for:
- Domestic, industrial, commercial projects and for the following functions:
- Hot water supply
  - excluding re-circulating systems
- Cold water supply
  - including drinking water, chilled water
- Heating:
  - radiators, underfloor, district

Other applications
The flexibility and low weight of these pipes make them ideal for use in a variety of other applications:

Boats
- can be easily threaded around the interior cavities and hidden behind bulkheads.

Caravans
- can be fitted in confined spaces without damage to the fabric of the vehicle or adding undue weight.

Exhibitions
- the demountable joints available with many flexible systems make them ideal for the temporary nature of exhibitions.

Portable buildings
- plastic pipe systems comply with Water Supply (Water Fittings) Regulations 1999 and allow the building to be moved with minimum disruption to internal systems.

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