PRESS RELEASE

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TESTING OF PLASTICS PIPING SYSTEMS FOR A LIFETIME OF CONFIDENCE FOR DOMESTIC APPLICATIONS

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The service life of plastics is generally determined by a combination of three factors; temperature, stress (pressure) and aggressive chemicals. Members of the BPF Pipes Group have piping products which undertake extensive testing at the extreme limits of these factors to ensure that they will give excellent performance in water systems.

In the UK, the service conditions for standard domestic applications can be found in BS 7291 "Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings." These conditions are called 'Class S' and are as follows (Table 1 taken from BS 7291-1: 2010):

Application	**Nominal system flow temperature** T_f °C	**Maximum system service temperature** T_s °C	**System malfunction temperature** T_m °C	**System maximum working pressure** [A] Bar [B]
Indirect cold water systems	20	20	-	3½
Direct mains-fed cold water systems	20	20	-	12½
Subsurface heating systems	60	83	100	3½
Vented hot water supply systems	65	83	100	3½
Unvented hot water supply systems including Instantaneous heaters and/or incorporating storage	65	95	100	6
Vented central heating systems and indirect hot water primary circuits	82	95	100	3½
Sealed central heating systems and indirect hot water primary circuits	82	105	114	3
Continuously operated re-circulating systems are excluded from these applications				

A) Where a nominal working pressure does not comprise an integer value, the mantissa is expressed in a fractional format. This is done to reduce the possibility of misinterpretation or obscurity that could cause a system to be subjected to an excessive pressure.
B) 1 bar = 10^5N/mm^2 = 10^5Pa

This standard (in common with the European Standards for plastics piping systems for hot and cold water installations) includes many tests which prove suitability for these applications. The tests are designed to replicate the conditions experienced by the pipe system in use at the limits of performance. These include:

- **Confirmation of dimensions** – the first and most important guarantee of the performance of a plastic pipe is sufficient wall thickness to resist pressure at temperature. The dimensions of outside diameter and wall thickness are specified in BS 7291 and are measured on a routine basis by pipe manufacturers.
- **Long-term hydrostatic strength of pipes** – it is essential to confirm the performance of the pipe over its whole design life. Holding samples of pipe at raised pressures at various temperatures for long periods of time generates data on times to failure. Pipes at higher pressures will burst sooner than those at lower pressures. Statistical analysis of the times to failure allows a robust prediction of the maximum pressure resistance of the pipe at over 50 years or beyond.
- **Hydrostatic pressure resistance of assembled pipes and fittings** – the strength of the joint between a pipe and fitting is critical to the lifetime success of a system. Pressurising samples of pipes and fittings together for 1,000 hours at pressures well above the Class S rating will verify this joint strength.
- **Resistance to thermal cycling of assembled pipes and fittings** – the temperature fluctuations and rapid thermal expansion and contraction encountered by a domestic hot water system or central heating system can induce stress in the pipework. This has the potential to damage or age the plastics being used. Subjecting pipe samples to thermal cycle testing involves creating a closed loop system which is repeatedly cycled with cold and hot water over three consecutive stages for approximately 7½ months. The test verifies the resistance of the system to this fluctuating stress.
- **Resistance to cyclic pressure shock** – pressure shocks can be experienced in water systems due to the rapid closing of valves or shutting down of pumps. Testing samples of pipe at 93°C and subjecting them to a 9-bar pressure shock every two seconds (30 cycles per minute), repeated 10,000 times, will rigorously confirm the resistance of pipes to these pressure shock conditions.

- **Oxygen permeability (barrier pipe)** – like metals, plastics can suffer oxidation in the presence of high levels of oxygen. Plastic pipes can be tailored to provide a barrier layer to oxygen permeability. This test confirms that the barrier is effective. The level of oxygen in a closed loop recirculating system is measured at very sensitive levels to ensure it is sufficiently low to prevent oxidation of the pipe or other system components (e.g. iron radiators).

Other short-term tests are designed to give manufacturers confidence that their piping system continues to meet the requirements on a day-to-day basis. These are basic pressure tests (at raised temperatures) over a short timeframe.

Factors in installation which can affect the lifetime of a plastics piping system

All members of the BPF Pipes Group provide extensive technical assistance on the correct installation of their systems. This information will help installers and end users maintain a correctly functioning system that will give many years of satisfactory service. Further assistance can also be found in Building Regulations and installation standards BS EN 806 "*Specification for installations inside buildings conveying water for human consumption*" and BS 8558 "*Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – complementary guidance to BS EN 806.*"

Summary

In summary, the main advice points from manufacturers are:

DESIGN

- Use the piping system in applications for which it is designed
- Use connectors (and pipe inserts) compatible with the pipe
- Consult pipe sizing guides to guarantee sufficient flow
- Do not exceed the specified temperatures and pressures for the application ("Class S" BS 7291-1)
- Design the system to expand and contract freely during heating and cooling cycles
- Design the system to accommodate hot water expansion
- Do not put mechanical strain on a piping system
- Carefully follow manufacturer's guidance when connecting to a boiler
- Protect from direct sunlight
- Do not bury pipe and fittings directly in concrete (except for underfloor heating pipe)

INSTALLATION

- Protect pipework during installation from damage such as scratching, chemical attack by unsuitable substances (e.g. solder flux) or heat (e.g. blow torches)
- Do not use components that are obviously damaged
- Protect the pipework during service from freezing, direct mechanical abuse or attack by rodents
- Comply with electrical continuity requirements
- Do not bend pipework excessively, twist joints or apply side load
- Correctly support the pipe (consult manufacturer instructions on clipping)

TESTING AND COMMISSIONING

- Ensure unvented hot water cylinders are functioning correctly
- Always pressure test systems before commissioning
- Always disinfect hot and cold water domestic systems before commissioning.

When these sensible precautions are considered, plastics piping systems provide excellent performance in water systems over a long lifetime.