Viega White Paper

Design Considerations For Potable Water Pipework

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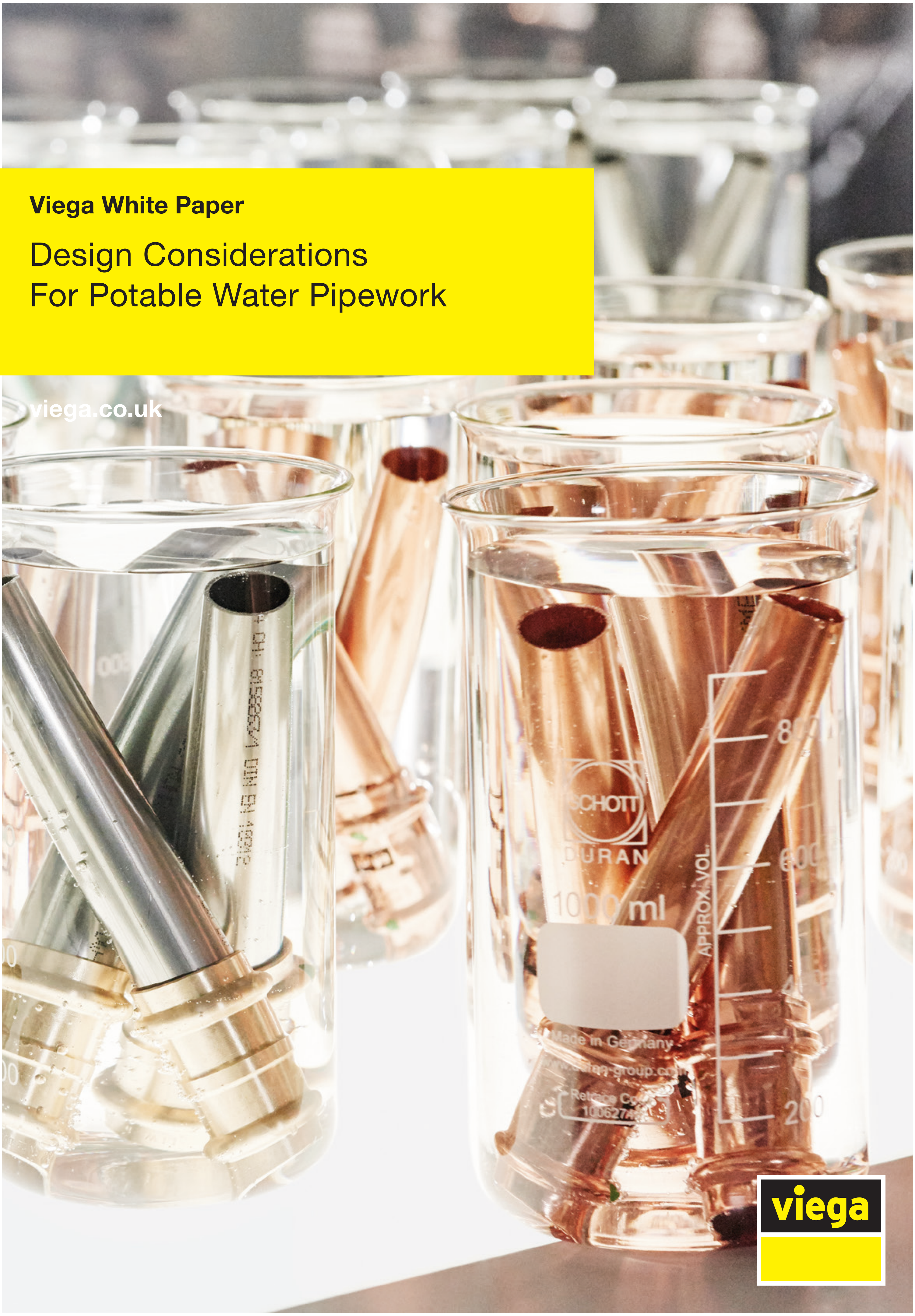

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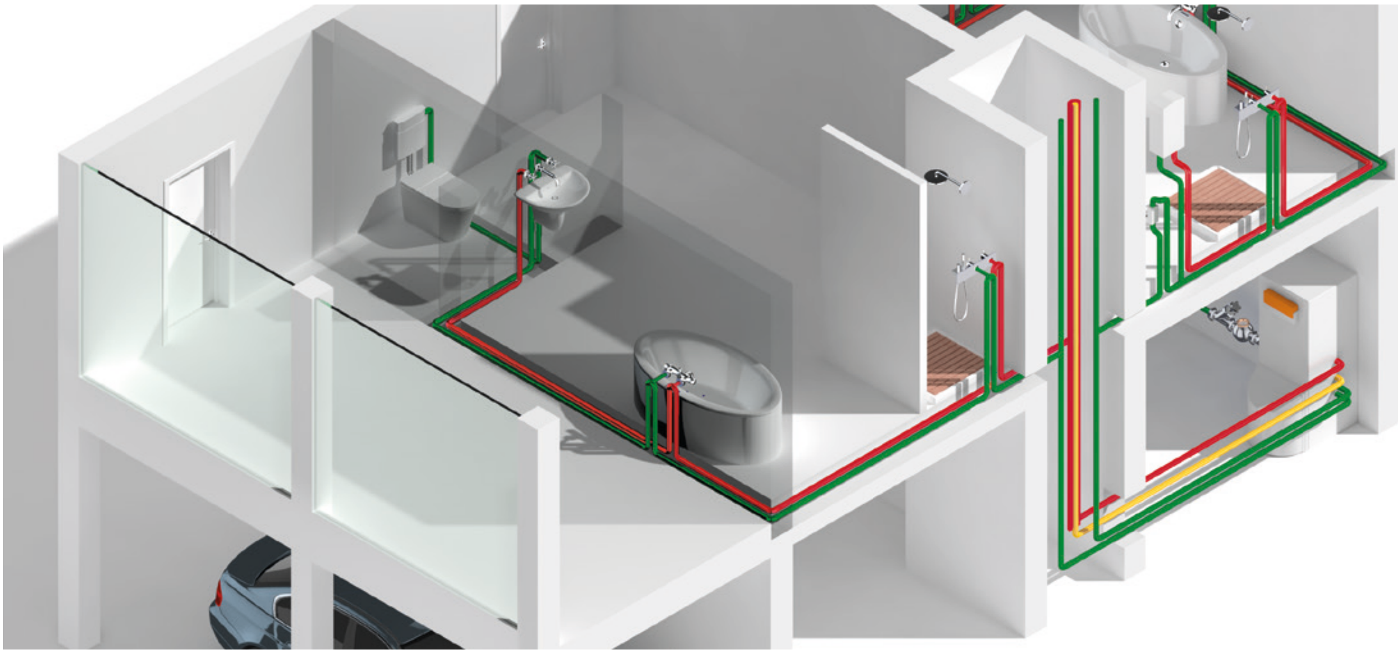
DESIGN CONSIDERATIONS FOR POTABLE WATER PIPEWORK

There are a number of key factors and issues that surround the successful supply of potable water to new and existing buildings. The materials, systems and design of the water distribution system will have an effect on the quality of the water.



Ensuring a supply of potable water for drinking and food preparation is vital for maintaining the health of building occupants and users. All installations must comply with current UK and European Union (EU) regulations that provide minimum standards for drinking water quality. The EU standards, from which the UK regulations are derived, are closely linked to the regularly updated guidance from the World Health Organization (WHO).

The WHO document ‘Guidelines for Drinking-water Quality’, now in its fourth edition, asserts that there should be a base standard for potable water and provides acceptable limits for microbial, chemical and radiological elements that would impact human health. It also sets out ‘acceptability aspects’ such as taste, odour and appearance that may affect consumer confidence in the quality of the water. It also defines the roles and responsibilities of those involved in the supply of drinking water from storage and distribution to use and consumption in both private and public buildings. It gives a detailed framework for the correct management of the water at each stage of the supply chain to the end consumer.

While much of the safety of water depends on the water suppliers to correctly maintain, store and distribute water, the ultimate safety of the water supply within individual buildings will depend on the quality of the pipework between the mains supply and the point of consumption. As such the WHO guidance states that ‘significant adverse health effects have been associated with inadequate plumbing systems within public and private buildings, arising from poor design, incorrect installation, alterations and inadequate maintenance’.
The 1998 European drinking water directive, which sets the minimum standard for water for human use across all EU countries requires that quality level must be achieved at all hot and cold water delivery points.
In addition, the UK water system and pipework designs must comply with the minimum requirements of British Standards, Building Regulations (Building Standards in Scotland), the Water Supply Regulations 1999, and the Water Supply (Water Quality) Regulations 2000.

For more information about legislation, standards and codes refer to CIBSE Guide G Public Health & Plumbing Engineering.

Sources of contamination

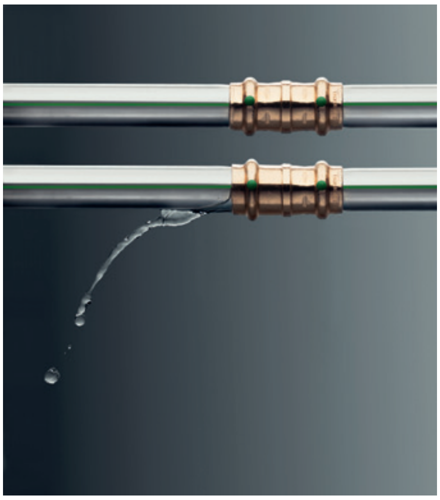
The main aim of the UK water regulations is the prevention of contamination, which can occur in many ways – for example, by:

- Ingress into the systems, such as from bird droppings in uncovered storage cisterns or bacteria introduced during installation, repair or addition to the system.
- Use of unsuitable materials during construction – for example, lead-based solder in copper pipe joints.
- Cross-connection with non-potable water – such as recycled greywater or rainwater.
- Backflow of contaminated fluids drawn back into drinking-water systems from other pipework or outlets. This can occur as a result of high pressure within equipment attached to the pipework or inadequate pressure in the system as a whole.

Preventing contamination

All components of a drinking-water installation must be supplied to the building site in a hygienic state. This means that at each stage of the supply chain, steps must be taken to reduce the risk of contamination.

Manufacture
If not managed correctly, bacteria can be introduced during the manufacture of components. Any water left in the product after wet leakage tests will encourage the growth of micro-organisms during the potentially long storage times – particularly if the materials are kept in warm conditions. For this reason dry leakage tests are preferred to prevent the microbial risk developing. Once bacteria are established in the system it can be difficult to remove. An example of this is a clinic where the drinking-water installation has had to be continually disinfected with chemicals since 2006, because the newly installed pressure-booster system was contaminated with Pseudomonas aeruginosa bacteria when it was supplied and commissioned. The contamination is thought to have been caused by a wet leakage test in the factory.



Construction
The storage of pipes and fittings should always be carried out in a way that excludes any penetration of dirt and contaminated water. As building phases often last for long periods of time, there is a great risk of contamination occurring in the components, even before the system is commissioned. Pipes can be supplied fitted with end stoppers, so that hygienic transportation can be guaranteed. Similarly, protective caps to seal riser pipes during assembly will reduce the risk of contamination from dust and chemicals. Although such contamination is normally not considered critical in terms of microbiology, it may require a significant flushing effort to clean such deposits from the network of pipes before operation.

The connection method and materials used is also a potential source of contamination if not selected correctly. For example, using lead based solders on copper pipe can pollute the potable water.

Testing and commissioning
To reduce the risk of contamination after testing, it is recommended that dry leakage tests are employed to check the system following installation, using dry, oil-free air. For systems where higher levels of hygiene must be maintained, for example in hospitals, inert gases can be used. This is especially important on large scale projects where there may be an extended period of time between completion of the pipework installation and the handover of the building.

To dry test a system, the pipework is pressurised with air up to 110 millibar (mbar) for a defined time. The length of the test depends on the volume of the pipework. For 100 litres of capacity the test should last at least 30 minutes and increased by 10 minutes for every additional 100 litres. If there is a leak a recordable drop in pressure will occur across the system.

Leak testing with water should only be considered if the system will be made operational immediately afterwards, for example in individual residential properties. Furthermore, any flushing of the installation required should take place as close to hand over as possible. This will prevent the type of microbial contamination that would compromise the quality of the drinking water.

Repair
A further possible source of contamination is any repair works or additions to existing systems. The risks to drinking-water quality should be considered just as carefully during work on older systems or addressing operational breakdowns as on new installations. For example, those carrying out the work should be careful to ensure they wash their hands thoroughly after working with contamination before continuing work on potable water pipework.

Here too, ensuring any new components are kept contaminant free from the point of manufacture to commissioning is vital. Some fittings manufacturers supply their products in individually controlled packaging, and the fitting should only be removed directly before use.

Pipe material

The choice of the material for an installation is made using technical and economic aspects. Materials and products must meet the particular requirements, as determined by local needs and the properties of the water. CIBSE Guide G provides factors that should be considered when choosing the material for the piping. These include:

- Characteristics of the water supply – the air, carbon dioxide and mineral content as well as the alkalinity or acidity.
- Relative, installed cost of suitable materials – including requirements for bracketing.
- Ease of replacement.
- Inside dimensions - the actual inside dimensions of pipes and fittings of different materials may differ despite the same nominal size.
- Coefficient of friction of materials - the roughness or smoothness of interior surface of the pipe.

Materials typically used for potable water supply pipework include copper, stainless steel and various plastics, including cross-link polyethylene (PE-X), thermoplastic (ABS), medium-density and barrier polyethylene (MDPE), polybutylene and multilayer composite pipe (MLCP).

There are applications for which a particular material may be the preferred option. Metal pipe may be chosen where fewer fixing points along the pipe length is beneficial, where space for pipework expansion is limited or where improved resistance to fire is an advantage. In contrast Multilayer Composite Pipe (MLCP) may be chosen where the flexibility is an advantage for installing in tight spaces. There can also be benefits to combining two systems – using copper or stainless steel for the underfloor and riser pipes and then employing plastic or MLCP for distribution pipes on the final pipework to outlets.

Designing systems to maintain flow

The correct sizing of pipework and reducing friction within the system will ensure optimum system pressure and flow velocity. This will prevent unnecessary stagnation and backflow into the system occurring.

The fittings, pipe and design of the system will all contribute to the friction in the pipework and reduce the flow. However, oversized pipe negatively affects the pressure that can be maintained. Not only will users of the building experience low water pressure but there is also increased risk of backflow from equipment on the system that creates a higher pressure. Many pipe and fittings manufacturers will provide tools to help designers and contractors calculate the correct sizing and pressure for the system.

Building type and usage

A further factor that should be considered when designing a potable water system is the predicted usage pattern of the building. While this cannot be fully calculated before the building is occupied, the intended use will provide indications. For example, usage of a school, college or university building will fluctuate considerably throughout the year from intensive activity during term time to being empty for weeks during school holidays – see Fredenberg Vocational Schools case study.

CASE STUDY: FREDENBERG VOCATIONAL SCHOOLS IN SALZGITTER, GERMANY

The renovation of Fredenberg Vocational Schools in Salzgitter included the replacement of the 40 year old sanitary facilities and installation of new drinking water pipework.

A school environment presents several specific challenges including the changing usage levels not only throughout the day but across the school year. The system must have sufficient capacity to cope with peaks in demand during breaktimes. The design of the system also needed to address the long usage interruptions during the holidays when stagnation increases the risk of microbiological contamination of the potable water.

To ensure the quality of the drinking water, the old pipelines were replaced using Viega's Sanpress Inox stainless steel piping system, which is tested and certified for potable water applications. To prevent stagnation, at the end of each stub line, a flushing station was installed that included Viega's Hygiene+ function. It detects critical usage interruptions and triggers flushing operations as required to clear the system.

For the purposes of potable water system design there are four types of usage pattern:

Rarely interrupted
Where the systems are in constant use. For example, residential buildings where usage is only interrupted for brief periods each year when occupants go on holiday. Here stagnation can be addressed through manual flushing when the owner or tenant returns.

Interruption on a room or apartment basis
Where longer unoccupied periods are likely and stagnation will occur in specific areas. For example, seasonal hotels where a smaller proportion of the rooms will be occupied at certain times of the year. Stagnation in areas of the building can have an effect of the quality of water in the whole building.

Interruption in use on a storey basis
Buildings, such as serviced offices, where a floor of the building may be unoccupied for an extended time.

Interruption in use on a building basis
This category includes educational facilities as well as sports and hospitality venues where the building may not be used for weeks or even months at a time.

For buildings where interruption and stagnation is expected, automatic and manually activated flushing systems should be considered to prevent the build up of contamination in the stagnated pipework.

Press connections for potable water pipework

There are several specific advantages to using press connection technology for drinking water installations. The cold applied system does not require the use of chemicals and lubricants that could contaminate the system or cause swarf that would need to be flushed out. Press connections can be used on a wide range of materials including copper, stainless steel and MLCP. For applications where two different pipe materials are used, press connection technology provides a single installation method and a reliable way to connect the two materials. Further, by selecting a product designed and certified for potable water the specifier can be sure that the fittings and pipe materials will not affect the water.

Through careful selection of materials and considered design of the system, factoring in any building specific contamination risk, the integrity of the drinking water within a building can be secured.

To find out more about the Viega range of products suitable for potable water and system flushing solutions visit **www.viega.co.uk**

References

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