Water Regulations Tutorial # 3
Filling Heating Systems

Updated 23/06/14

There are two types of heating system – vented and unvented. Vented means the primary system is pressurised by gravity. Filling and expansion is normally accommodated with a primary feed and expansion cistern. Backflow prevention is afforded by an appropriate air gap in the cistern.

Unvented systems – often termed "sealed" - are becoming increasing popular since they do not need a cistern at high level. A higher system pressure reduces pump cavitation and has many technical advantages. Traditional backflow protection is normally provided by a mechanical device during filling and an air gap or disconnection during operation.

FLUID CATEGORY

The fluid in a heating system is often contaminated with dissolved metals, flux and some form of chemical inhibitor. Whilst the chemicals and concentration in a house primary circuit may be similar to those in a non-house (commercial) system, the quantity is likely to be substantially more in the latter case. The overall risk in a "non-house" situation is therefore considered higher. The industry considers a primary circuit in a house to be Fluid Category 3. A non-house system is considered Fluid Category 4 by default, however there is an option to ask the local water company to risk asses the heating system and potentially downgrade it to Fluid Category 3 (this is based on the size of the system and the type of chemicals used).

Previous UK Classification	European/New UK Classification	Backflow Prevention Examples (Used in Building Services)
Class 1 Schedule A Risk	Fluid Category 5	Air Gap – **AA AB** Pipe Interrupter – **DC**
	Fluid Category 4	RPZ – **BA** Pipe Interrupter – **DB**
Class 2 Schedule B Risk	Fluid Category 3	Double Check – **ED**
Class 3 Schedule C Risk	Fluid Category 2	Single Check - **EB**
Wholesome Water	Fluid Category 1	No Protection Required (Except whole site, at times)

***Topic B22* states -**

"The categorisation of non-domestic primary circuits or heating systems is given in guidance as fluid category 4. Water suppliers do however adopt a risk based approach to enforcement and where a risk assessment indicates that the risk associated with a primary circuit or heating system is lower than a fluid category 4 risk they will accept alternative approaches. Factors taken into consideration when risk assessing non-domestic primary circuits or heating systems include, but are not restricted to:

- *The type and use of chemical inhibitors; and*
- *The size and type of system i.e. whether it is a vented (open to atmosphere a vented system would be deemed to be a higher risk) or unvented (sealed) system".*

The idealistic concept of first identifying the Fluid Category and then choosing an appropriate device has its limitations. Whilst a house primary circuit is Fluid Category 3, it is **not** acceptable to protect with a Double Check Valve on a permanent basis.

HOUSE BACKFLOW PROTECTION – VENTED PRIMARY

The feed and expansion cistern in a house should have a type AG air gap (formerly known as Type B). In practical terms this is achieved with a BS1212 part 2 float valve. ½" BS1212 part 1 float valves are **not** allowed in any application because the close level cannot be adjusted (G16.1d). BS1212 part 2 valves have a brass body, level adjustment and an "up & over discharge". The warning pipe (overflow) should have a 19 mm minimum bore and be positioned below the supply pipe to the float valve.

NON-HOUSE BACKFLOW PROTECTION – VENTED PRIMARY

Guidance for non-household heating systems is Fluid Category 4 (Table G6.1d) which makes no distinction between sealed and cistern fed systems. However, the recently updated B22 WRAS advice (see above) states "a vented system **would** be deemed to be of a higher risk" and therefore should be classed as Fluid Category 5.

Whilst a sealed non-house system is Category 4, the cistern would not normally exclude insects through the overflow. Schedule 2, paragraph 16 requires every storage cistern to have a lid and this means it is impossible to provide a type AA air gap. Fluid Category 5 protection should therefore be accomplished with a type AB air gap. This has a weir slot arrangement to BS EN 13077. The float valve opening level should be towards the bottom of the cistern in order to leave capacity for expansion. When fully expanded, the fluid should be at least 25 mm below the overflowing level of the warning pipe (G21.1). To allow at least 4% system capacity for expansion means the opening level could be 1 m or more below the float valve. Clearly a 300 mm "drop arm" fitted to a float valve is of little benefit; besides this is mechanically unwise and further degrades an already unreliable device. A better solution is to use solid-state electrodes and a level controller operating a solenoid valve - as supplied by Arrow Valves.

If there is insufficient expansion volume available – e.g. using a conventional float valve, the fluid will overflow through the warning pipe. This is an offence under regulation 2 (waste), contravenes clause G21.1 and will lead to rapid corrosion and scaling of the system. Having expelled the fluid – together with its inhibitor - the float valve will open upon contraction and admit raw water with its dissolved calcium carbonate (scale). The resulting damage can be phenomenally expensive and disruptive. This problem is all too common.

The Water Regulations are not retrospective providing the installation took place before the 1st July 1999 **and it conformed to the Byelaws**. The Byelaws had the same requirements as the new regulations for an industrial feed and expansion cistern (old type A air gap) so every **existing** system must be altered if necessary to comply with the Water Regulations. Furthermore it is an offence to contaminate the supply pipe **at any time**.

HOUSE BACKFLOW PROTECTION – UNVENTED (SEALED) PRIMARY

CA15C297PRV - Filling valve assembly comprising of – inlet Servicing Valve c/w serviceable strainer, CA Device, Pressure Reducing Valve (PRV) and Servicing (isolating) Valve. Normally set to 1.5 bar

Many houses and **individually** occupied flats have a sealed heating system, e.g. “combi” boiler. G17.1b shows a diagram where the Double Check Valve is now upstream of the **temporary** filling loop. The filling loop **must** be disconnected after filling or replenishing. This method ensures protection should the flexible hose be used for other purposes.

There are two alternatives to a removable filling loop for a house – CA and BA devices.

The CA device offers Fluid Category 3 protection – available from Arrow Valves model CA297. Unlike a filling loop with Double Check Valve protection, the CA device may be left permanently connected.

A small pressurisation unit can be used with a type AB air gap. A filling loop and Double Check Valve may be legally used for filling a **house** system.

NON HOUSE BACKFLOW PROTECTION– UNVENTED (SEALED) PRIMARY

Midi-Fill Digital –Fluid Category 5

Many Consultants are designing sealed heating systems for non-house applications. If the system is risk assessed by the water supplier, the level of backflow protection required can be downgraded to a Fluid Category 3 risk. Such a system could be filled via a removable filling loop comprising of a Double Check Valve. A better solution is a CA device. This, unlike a Double Check Valve, can be left permanently connected and subsequently used to fill and pressurise the heating system.

All non-house systems are initially classed as Fluid Category 4 by default, if they are not subsequently downgraded they should be filled via a BA device or air gap. Small pressurisation units often have an electro-magnetic piston pump suitable for pressurising only. For longevity reasons, these should not be used for filling the system. The primary circuit should be filled through a BA device (RPZ valve) or from a Break Tank (and typically a multistage centrifugal pump) with a type AB air gap – available from Arrow Valves model MFD.

The BA device could be fitted upstream of a conventional pressurisation unit. Here, a filling loop could be used (and left permanently connected) because the BA device offers the appropriate protection. Alternatively the BA device could be on the filling loop – providing the pressurisation unit incorporates a type AA or AB air gap. The filling loop need not be a flexible pipe because it is permanent. The BA device requires the mandatory resilient seat valves, fine strainer and a Pressure Reducing Valve (PRV) or other pressure control arrangement.

Using a filling loop is an offence even if the system was installed before the introduction of the regulations (July 1999). The act of connecting the loop today will be deemed the time of the offence. Similarly it is no defence to argue the filling loop was already connected because that too would be an offence! In this sense the regulations could be described as retrospective. Remember, it is an offence to contaminate the supply pipe **at any time.**

THE LOGICAL CONCLUSION

Autofill Pressurisation Unit Fluid Category 3 (AFCA) or 4 (AFS) – no filling loop or tank

Since a BA device can be permanently connected and permanently turned on, it can be used to **fill and pressurise** the system with mains water without the need for a conventional pressurisation unit. It is important not to over pressurise the system, so a Pressure Reducing Valve (PRV) or other arrangement is necessary. Mains pressure can range from 1.2 to over 10 bar at ground level. The water companies are obliged to supply 10 m of head at the boundary at 9 litres/min. The minimum static head is therefore assumed to be 1.2 bar. However pressures below 1.5 bar are rare and 3 bar is typical. Many Combi boilers, electric showers etc. require at least 1.5 bar and water companies aim to achieve this with a margin to avoid complaints. The water company can advise the pressure for a particular location. Most water company distributing networks are gravity controlled and the pressure should be consistent on a long-term basis. If the pressure drops at some time during the day, it should not matter because pressurisation can take place when the pressure recovers at some stage every 24 hours.

Pressure Reducing Valves perform well with minimal differential when the fluid is clean. PRVs can “creep” - viz. fail to close tightly at the set pressure - when debris (brass & copper swarf) becomes trapped between the seat and rubber washer. Most PRVs have plastic seats, which are more prone to damage. Model PRV536 has a stainless steel seat. Applications with no regular draw off, such as a sealed heating system, could be over pressurised and the high cut-out switch may stop the boiler. A fine strainer upstream of the PRV reduces this potential problem.

Note, many PRV’s have an integral strainer but these are often far too coarse. An alternative method is a solenoid valve controlled by a pressure switch. The solenoid (especially servo types) will have a high closing force and small debris is often accommodated in the rubber seal. This type avoids water hammer. Again, a fine filter assists greatly. This option is available on the Autofill in place of the PRV – Autofill model AFS.

SUPPLY PRESSURE

BA devices are designed to meet the Regulator’s Test Criteria. As such all makes will have a pressure drop of approximately 0.6 bar. This pressure is required to open the device. The system pressure is normally the static head plus 0.2 bar. A mains pressure of 3 bar can therefore fill 22 metres, whereas 1.5 bar would be suitable for a head of 7 metres. A BA device can therefore be used for all ground floor and virtually all first floor situations.

Where a coldfill pressure higher than that possible from the mains is required, the Autofill should be supplied from the **boosted cold water service** if available. The booster set will normally provide at least 2 bar at the top floor for the domestic services, so there is plenty of pressure for the BA device. Remember, there is no problem supplying the Autofill with wholesome (drinking) water from the mains or boosted circuit because it provides the required backflow protection.

Where there is no boosted cold water circuit, the Autofill can be supplied with an integral pump model AFP. Again this is a change of philosophy. A Break Tank is not necessary if the pump is incapable of drawing more than 0.2 litres/second (regulation 5, table 4d). The Autofill is available with an optional electro-magnetic pump to boost up to 5 bar. Fast filling is provided - without a filling loop - and the pump is only switched on once the system is filled using mains pressure. This design avoids the unreliability problems of a float valve and having no cistern eliminates the risk of airborne legionellae. Furthermore open cisterns can accumulate debris, which can cause electro-magnet pumps to seize.

BA Device (RPZ Valve) Requirements

WRAS (or KIWA UK) BA devices that are correctly used, installed and maintained will conform to the Water Regulations. They are reliable and compact (Autofill is 300 mm square x 200 mm deep). BA devices need to be commissioned and tested annually. This needs to be done by an accredited tester (Arrow Services have regional accredited testers throughout the UK mainland and can offer commissioning and annual testing of BA devices on behalf of Arrow Valves). Normally testing the BA device will be done at the time of the annual system check - such as recharging the pressure vessel, testing the pressure switches and safety devices. There are a number of recommendations for BA devices - refer to WRAS document AIM 08-01 Issue 1. This includes the provision of resilient seat isolating valves, appropriate strainer, sufficient rear clearance, discharge tundish and a tamperproof environment or cabinet. The 'Autofill' complies with all these requirements. The remaining installation requirement is the height of 300 – 1500 mm from the floor, which is a typical installation height anyway. See our specification clauses on our website for further details.

WATER METER

Dosing Pot (model DP) Supplied with five full-bore spherical servicing valves, safety check valve, funnel and mounting brackets

For large non-house heating systems - both vented and un-vented – it is sensible to have a Water Meter connected to the supply. Most systems only require a DN15 or DN20 supply. The meter should feature a digital display with per litre increments. The meter can be used to determine the system capacity, which is essential for knowing the quantity of inhibitor to add. Secondly a meter will indicate any leaks in the system and again this information can be used for calculating the quantity of inhibitor to add. The 'Midi-Fill Digital' Pressurisation Unit includes an integral Electronic Water Meter, the 'Autofill' Pressurisation Unit can be supplied with a Volumetric Water Meter – model WMV.

DOSING POT

For adding liquid chemicals, such as corrosion inhibitors and anti-freeze solutions, to sealed heating and chilled circuits – model DP.

EXPANSION VESSEL

Accommodate thermal expansion of sealed heating systems. Model EVCP is 4, 5 or 6 bar rated depending on size and approved for primary circuit, unvented heating applications.

Expansion Vessel (model EVCP)

SUMMARY

1. Do not use a filling loop with a Double Check Valve for filling new or existing non-house sealed heating systems – it is an offence to do so.
2. Use a BA device (or Break Tank with type AB air gap and pump capable of filling the system) for filling non-house sealed heating systems unless it has been risk assessed and downgraded by the water supplier, in which case use a CA device.
3. Consider using the BA device for pressurising the system with appropriate controls.
4. When using a BA device for pressurising, use a pump where the mains produced pressure is insufficient (e.g. second floor and higher).
5. Ensure all BA devices are correctly installed and commissioned.
6. Ensure vented systems in non-house situations have a type AB air gap and at least 4% expansion capacity in the cistern before overflowing.

Thank you for your interest