Unit 208: Central heating systems

Outcome 1 (part 2)

Types of domestic central heating systems installed in domestic dwellings

Components

Feed and expansion cistern
Used in an open vented system to fill the system up with water. Commonly located in the loft to locate it at the highest point of the system.

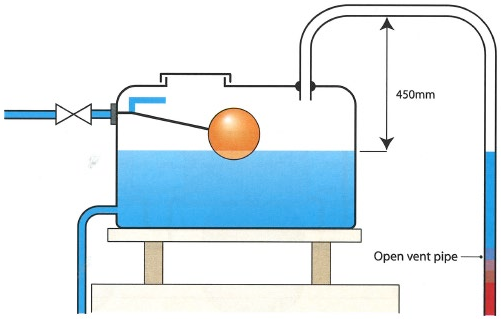
The base of the F&E should be at the same level as the cold water storage cistern and be fully supported over its base.

The main purpose of the F&E is to allow the heated water in the system to expand and to operate at atmospheric pressure.

Components

Feed and expansion cistern

- The F&E is commonly an 18-litre, black plastic cistern
- The 15mm cold feed is located to the side of the F&E and should not have any valves



The 22mm open vent from the primaries is located over the top of the F&E and must rise a minimum of 450mm above the water level. It should not have any valves.

The F&E should be located a minimum of 1 metre above the circulator.

Components

Float operated valve (FOV)
The rising main supplies the BS 1212 FOV installed in the F&E. Prior to the FOV there must be a service valve installed to allow for maintenance.

The water level set by the FOV in the cistern should be at a low level, just covering the cold feed exit. This will allow for plenty of expansion.

The system water will expand by 4% when heated, and this expansion needs to be taken up in the F&E.

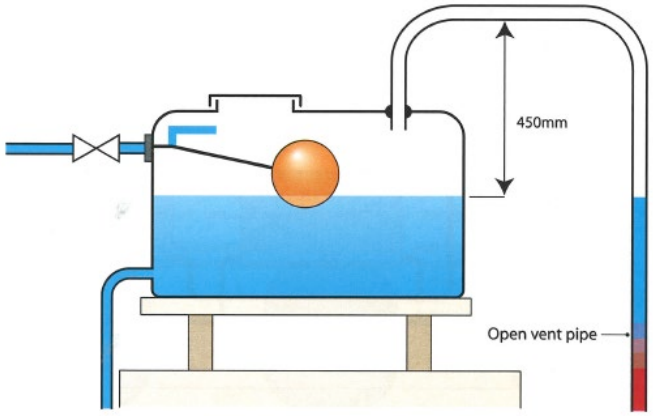
Components

Open vent pipe

The primary function of the open vent pipe is to provide a safety outlet should the system overheat. It also allows the system to operate at atmospheric pressure.

Whilst filling the system with water and also in operation, the open vent allows the air to escape from the system. The open vent should not have any valves attached, as this could have disastrous effects if the valve was closed and the cold feed became blocked.

The vent needs to be a minimum of 450mm above the water level to prevent the surge effect of the pump. The minimum pipe size is 22mm.



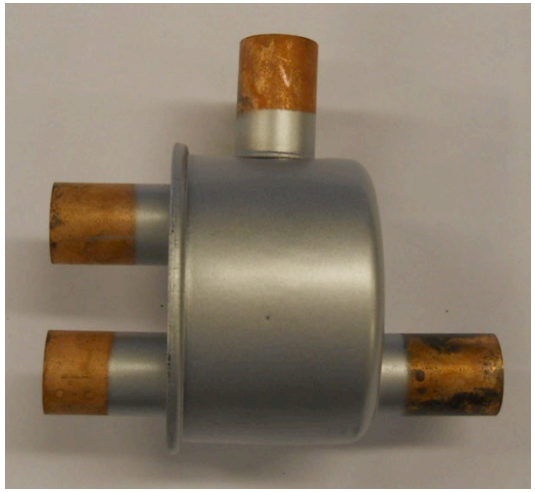
Components

Components

Air separator

The use of an air separator allows close proximity or close coupled pipework when positioning the cold feed and vent pipe.

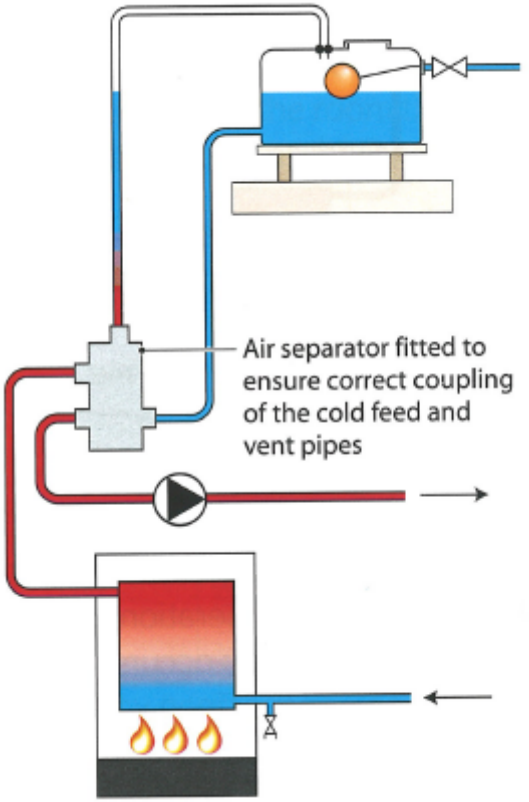
The air separator is basically an oversized pipe with a cold feed and vent pipe connections. The water swirls around, separating the air.



Components

Air separator

The correct layout of pipework and removal of air from the system reduces the noise in the system and lowers the risk of corrosion.



Components

H frame

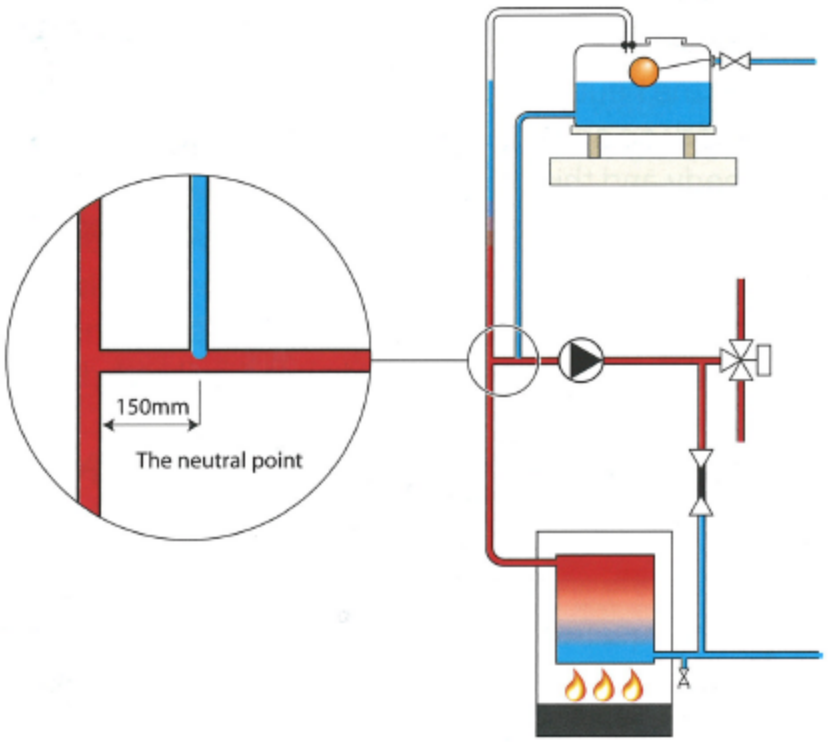
Instead of an air separator, an H frame configuration is commonly used.

The vent and the cold feed need to be installed on the flow from the boiler, on the suction side of the circulator, with a maximum of 150mm between them, ensuring that the circulator always draws on the cold feed.

Components

Air separator and H frame

The correct layout of pipework ensures the neutral point of the system is at the base of the cold feed.



Components

Circulator

The positioning of the pump is very important to produce **positive pressure** in the system and to avoid air entering the system and creating corrosion.

The golden rule is that the circulator must **always** draw on the cold feed.

The circulator may have speed settings, which need to be set correctly to allow the system to heat up efficiently without any system noise.

Components

Circulator

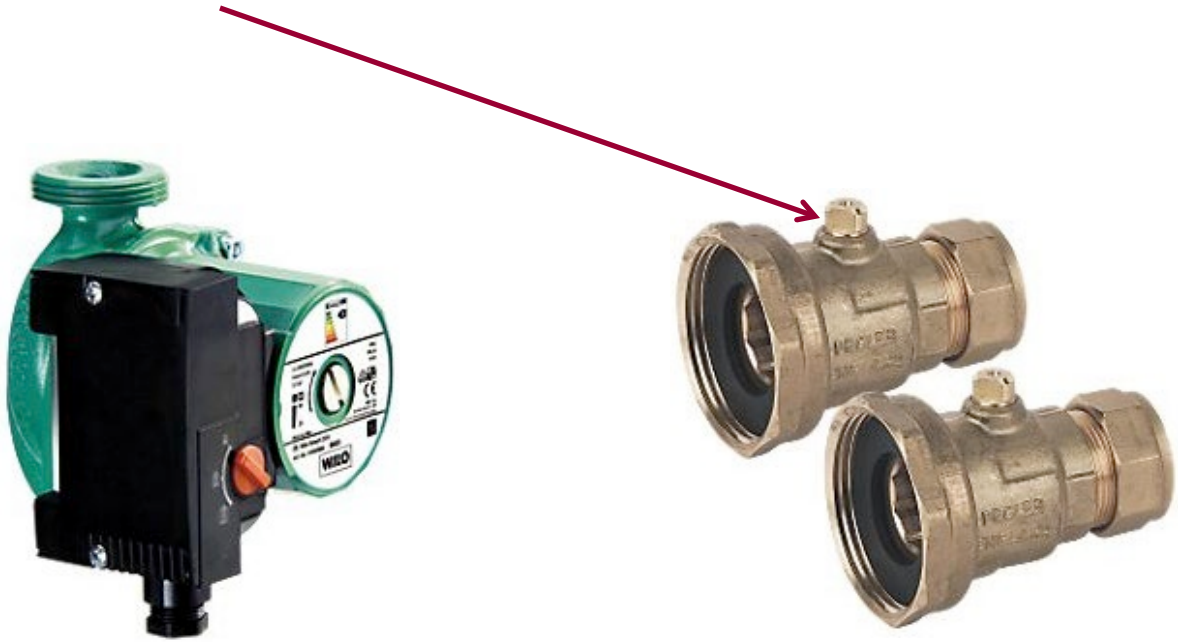
The circulator is located in position by pump flanges. These either have rubber or fibre washers to maintain the watertight seal. The full bore valves at either side of the flanges can be closed to allow the pump to be removed without draining the system.

Note: If the radiators are not heating up and the hot water is only lukewarm, it could be due to a sluggish or poor performing pump that requires replacement.

Components

Circulator

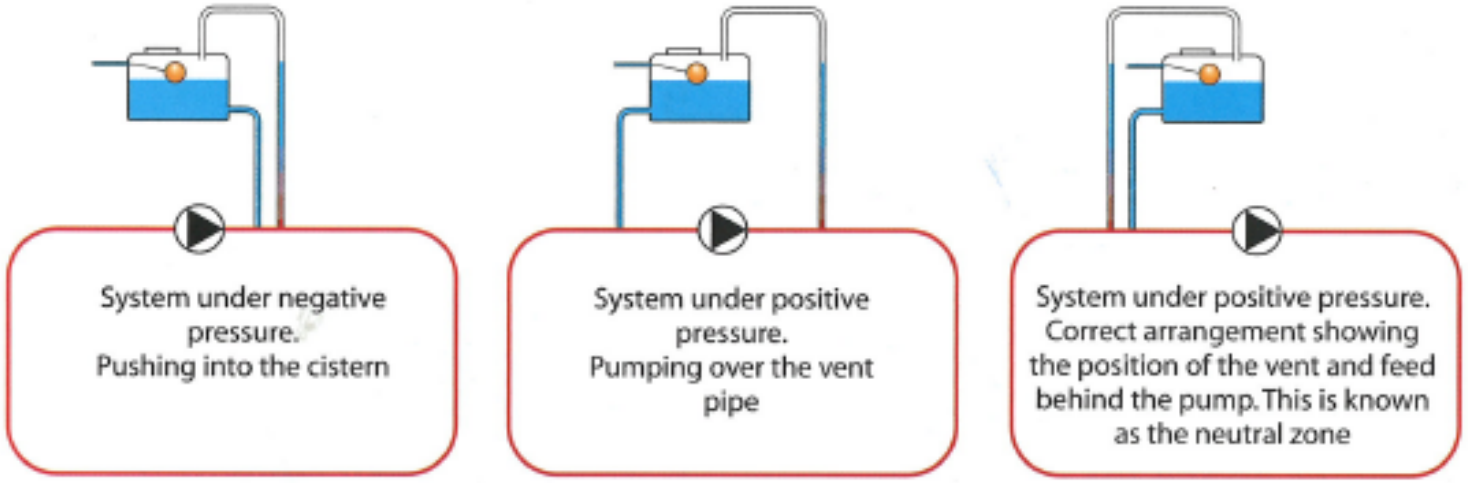
Either side of the pump, integral to the flanges, are isolation valves, which allow easy maintenance.



Components

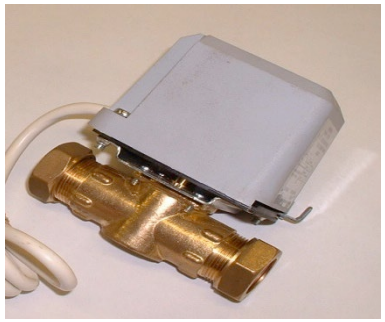
Circulator

As the system requires positive pressure, the position of the circulator is important in relation to the cold feed and vent pipe.

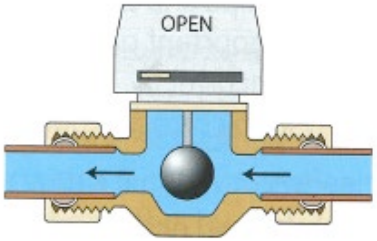


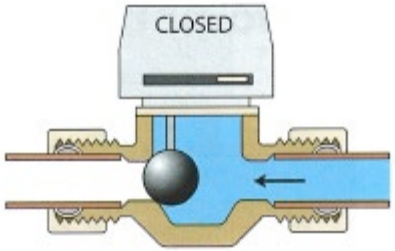
Components

Two port motorised valve
Commonly know as a **zone valve**, this can be activated by a room or cylinder thermostat. This allows hot water and the heating circuits to be controlled separately.



When there is a call for heat, the zone valve opens and allows water from the boiler to circulate around the pipework. Likewise, when the thermostat is up to temperature, the zone valve is closed (isolates).





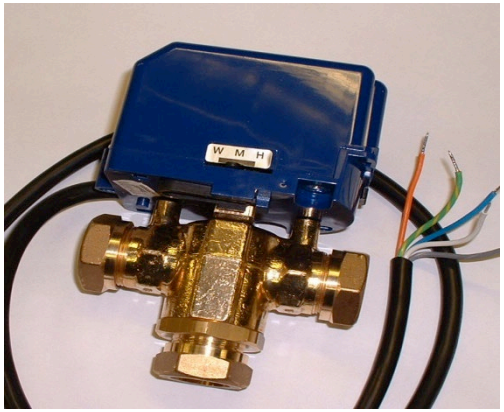
Components

Three port mid-position valve

This valve controls the flow of water to both the heating and hot water circuits. It reacts to both the cylinder and room thermostat.

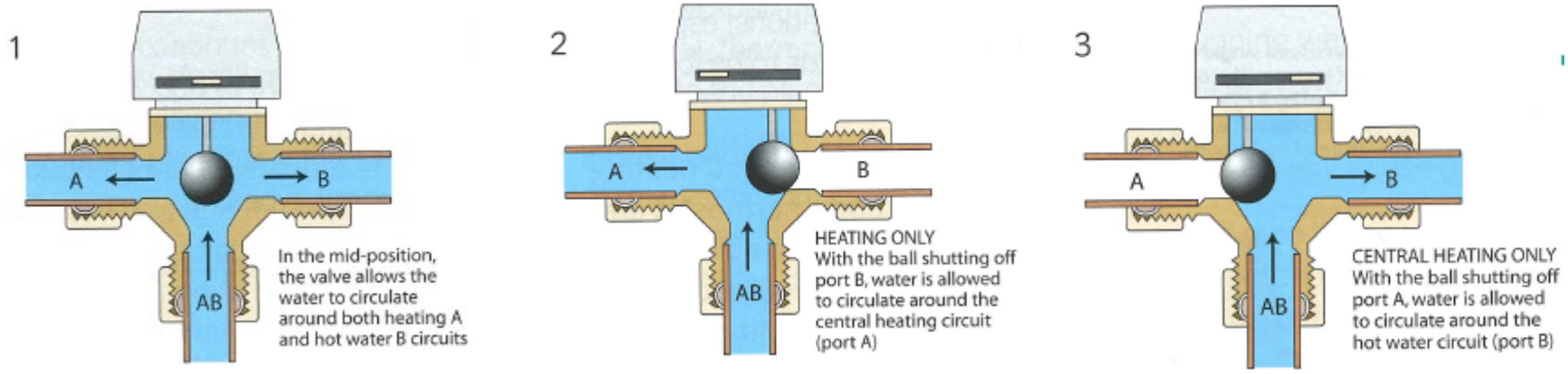
The three ports are labeled:

- AB = flow for the boiler
- A = central heating
- B = hot water



Components

Three port mid-position valve



Water can always flow through this valve

Components

Cylinder thermostat
Situated one-third of the way up a hot water cylinder, governing the temperature of the hot water. This is linked to the zone valve or three port valve.

These can be a bi-metallic strip, volatile liquid or gas type. Commonly set to a maximum of 60^0C.

Components

Room thermostat

Situated 1.5 metres up a wall and approximately 3 metres away from a heat source, and not on an outside wall.

These can be a basic bi-metallic type, or nowadays a programmable, Wi-Fi, app-activated and digital type, according to the customer's requirements.

More commonly, a compensating room thermostat can be fitted.

Components

Boiler thermostat

This is located on the boiler and governs the temperature of the primary water. This water heats up the heat exchanger in the hot water cylinder, as well as heating the heat emitters in each room.

These commonly have a phial attached to the return pipe of the boiler indicating when the system is up to temperature.

Components

Programmer
These allow independent timed control of both the hot water and the central heating. They are commonly situated in the kitchen or airing cupboard of a property.

They often have a **boost** or **override** button to allow the system to operate outside of the programmed timings.

Components

Frost thermostat and pipe thermostat
These are incorporated into a system to stop vulnerable parts of the system from freezing.

They override the programmer and other thermostats, and should be set between 3^0C and 5^0C.

The frost thermostat is positioned in vulnerable areas and the pipe thermostat is strapped to vulnerable pipes. They will activate the circulator and boiler briefly to warm up the system water.

Components

Working safely

Prior to working on any electrical component, including the boiler, ensure that no one can accidentally turn on the system by using the safe isolation procedure.

To do this, switch off the fused spur, remove the fuse, lock off the fuse holder and place a sign indicating the system is being worked on.

When working on a domestic system don’t forget to let the customer and any other person in the property know approximately how long it will be out of service for. This also applies when decommissioning a system.

Components

Magnetic system cleaner

There are many different styles and makes but essentially they contain a magnet that collects all the corroded iron particles – magnetite. The magnet is removed when the system is serviced, flushing the magnetite away and keeping the system water in good condition.

Components

Inhibitor

A chemical protection against scale and corrosion within a central heating system. This can be added via the F&E or through a radiator. The inhibitor level can be tested and topped up if necessary.

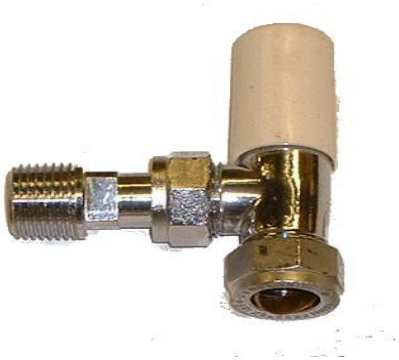
Companies claim that inhibitors extend the life of the system and ensure maximum efficiency and minimum fuel usage. (The primary vent **must** terminate over the F&E due to the chemical content of the primaries.)

Components

Radiator valves

A radiator valve is fitted at either end of a domestic radiator: one with a wheel head, which the customer can turn. This alters the flow of water into the radiator to suit the customer's needs.

The other end will be a lock shield valve. This is an identical valve, but the wheel head has been removed and a lock shield cap put in its place. The lock shield valve is for the engineer to use so the system can be balanced.



Components

Balancing the system

The lock shield valve is used to balance the system when the system is commissioned.

If the system is left unbalanced, the radiators will not warm up uniformly and there will not be the required 10^0C temperature difference between the flow and return pipework.

Components

Balancing the system

As the system water is circulated around the system, there is resistance offered by the pipework, fittings and types of bends.

As water will always take the easiest option, this resistance means some radiators will heat up more quickly and some radiators may stay cool.

To balance the system correctly, the index radiator needs to be identified. This is the radiator that heats up last and therefore has the greatest resistance.

Components

Balancing the system

1.Open all the radiator valves on the system fully.
2.Fire the boiler.
3.Feel which radiator heats up first, mark it **1** and close the wheel head valve off.
4.Feel for the second, third, fourth radiator etc until all the radiators have been marked in sequence of heating.
5.The final radiator to heat up and to be marked should be the index radiator.

Components

Balancing the system

Now count the number of full turns it takes to close the lock shield valve from the open position.

Divide the number of turns by the number of radiators, plus one installed in the system.

Eg: My system has 9 (9 + 1 = 10) radiators and the lock shield valve rotates 5 full turns

$$\frac{5}{10}$$

= half a turn

Components

Balancing the system

Work from the index radiator back to the first radiator to warm up.

- Leave the index radiator lock shield valve fully open
- Radiator 9: close the lock shield valve half a turn
- Radiator 8: close the lock shield valve one full turn
- Radiator 7: close the lock shield valve one-and-a-half turns etc
- Radiator 1: leave the lock shield valve just open

This is a **rule of thumb method** but shows the principle of balancing a system.

Components

Balancing the system

Now fire the boiler up again and allow the system to warm up and reach temperature.

Feel the radiators as they warm up. They should be warming up uniformly.

When the system is warm there should be a 10^0C temperature difference between the flow and return pipework. This can be measured by using clip-on thermometers or digitally.

Components

Radiator key

To make up a radiator, you will need PTFE tape or hemp and paste to create the watertight seal on the threads. The valves are screwed into the radiator using a radiator key.

TBOE – top bottom opposite ends

BBOE – bottom bottom opposite ends

To bleed the radiator of any air or gas, you will need a bleed key for the top of the radiator.

Components

Bleed key

At the top of every radiator and towel rail there is an air release valve to allow the manual release of air.

Components

Thermostatic radiator valve
Building Regulations part L and the Heating Compliance Guide require TRVs to be fitted on systems.

This valve replaces the wheel head valve, allowing the customer to control the temperature of a single radiator. It has a special head fitted to the valve, which reacts to **ambient air** temperature. Within the head there is a sensor containing a volatile liquid, which expands when heated. The warmer the room the greater the expansion, which closes off the valve by pushing a pin down in the valve.

As the room cools so the liquid contracts, opening the valve and allowing the radiator to heat up.

Components

Thermostatic radiator valve

One radiator in the circuit **must** be left without a TRV fitted. Building Regulations state this should be the radiator in the same room as the room stat.

If a radiator fitted with a TRV is removed for decorating, it is important to fit a decorators cap over the head to the valve. If the customer has long curtains and requires a TRV to be fitted, a remote head could be installed.

TRVs used to be fitted only on the **flow** but nowadays they are reversible. Be careful when fitting these otherwise the customer could end up with a noisy radiator.

Components

Thermostatic radiator valve

These items can be fitted with remote sensors, which allow the TRV to operate if long curtains or other furniture could interfere with the operation of the phial.

Components

Automatic bypass valve

Most modern systems are fitted with an ABV. This allows a build up of system pressure due to thermostatic radiator valves closing, with the circulator still working. This is released through the system pipework, thus prolonging the pump life.

The ABV is fitted between the primary flow and return pipe; some boilers have an ABV already installed. This allows the flow of water through the boiler if the TRVs and zone valves close.

Components

Filling loop

A flexible, temporary connection between the incoming mains and the central heating system. It is used on pressurised sealed systems, including combination boilers.

The Water Regulations require the loop to be disconnected after use. Either side of the loop is a quarter-turn isolator and the incoming mains is protected by a double check valve, as required by the Water Regulations.

Components

Expansion vessel

These are used on a sealed system to take up the 4% expansion of the heated water and are sized according to the system. Inside the vessel is a rubber diaphragm or bladder. On the dry side it is charged through a schrader valve to 1bar pressure. On the wet side the expanded water pushes against the diaphragm, compressing the air but containing the expansion.

Components

Pressure relief valve

In case the sealed system over-pressurises a PRV is installed, allowing the excess pressure to be discharged safely. The discharge pressure is factory set.

A common cause for the build-up of pressure is when the expansion vessel fails or loses its charge.

Components

Automatic air release valve

Fitted at high points in the system, these are commonly found fitted inside boilers. They allow air to be released from the system, closing automatically.