Unit 206: Domestic hot water systems

Outcome 2

Components used in domestic hot water systems

Components

Cylinders

- Direct
- Indirect
- Single feed
- Double feed
- Unvented
- Single coil
- Multi coil
- High recovery
- Un-lagged
- Pre-lagged

Components

Direct cylinders

A direct cylinder has no heat exchanger (coil) inside it. The water inside the cylinder can be heated in two ways:

1. Directly from the boiler

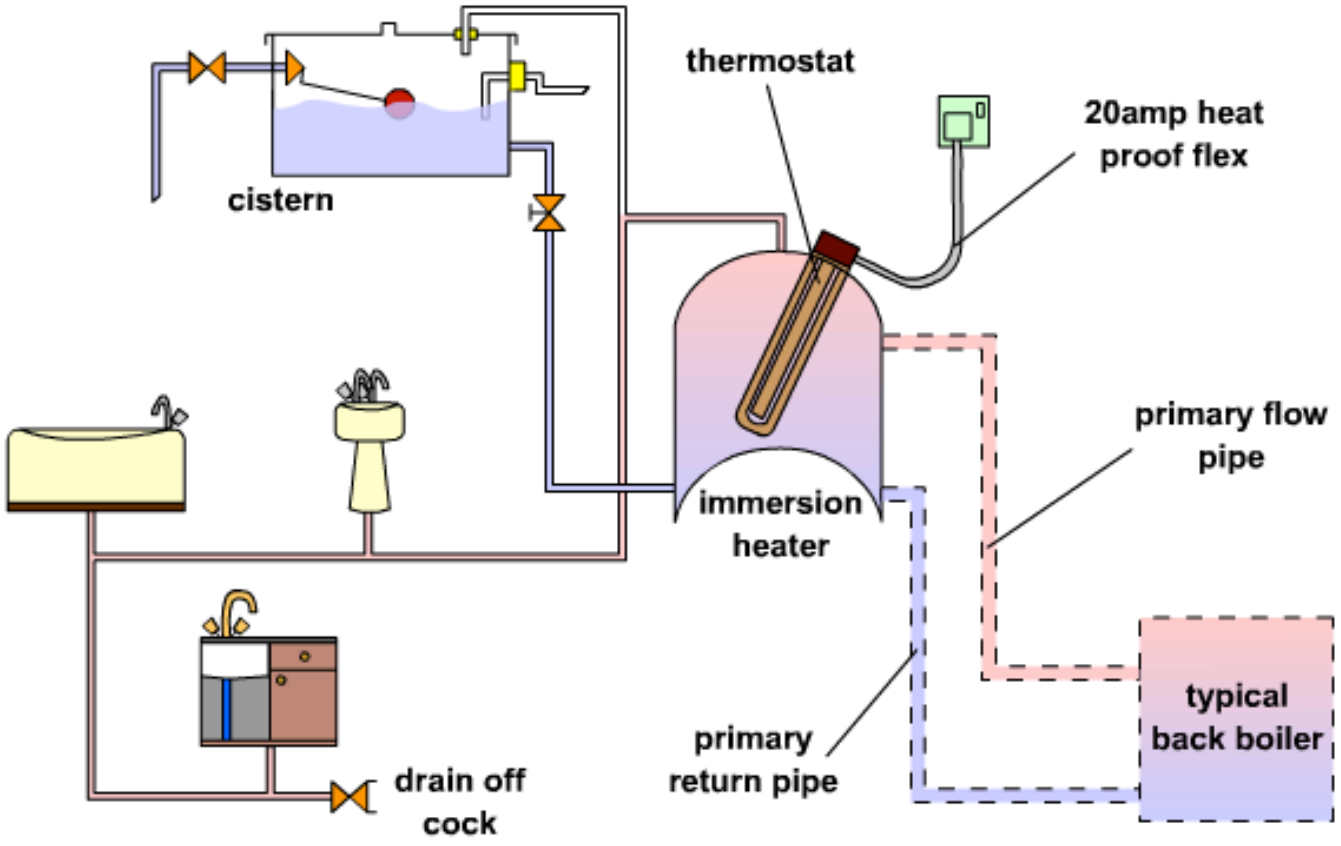
This is the older method of heating the hot water and is not generally used today, due to the lack of temperature control and the discoloration of the secondary water.

2. Via an immersion heater(s)

This is the current method of heating the hot water in a direct cylinder and offers better temperature and time control, as well as no discoloration to the water.

Components

Direct cylinders



Components

Direct cylinders

Using a direct cylinder means the system only requires one feed – hence the term **single feed**, along with a single cistern at higher level.

The CWSC (100 or 200 litres), supplies the cylinder via the cold feed pipe. This has a gate valve located for isolation.

Components

Indirect cylinders

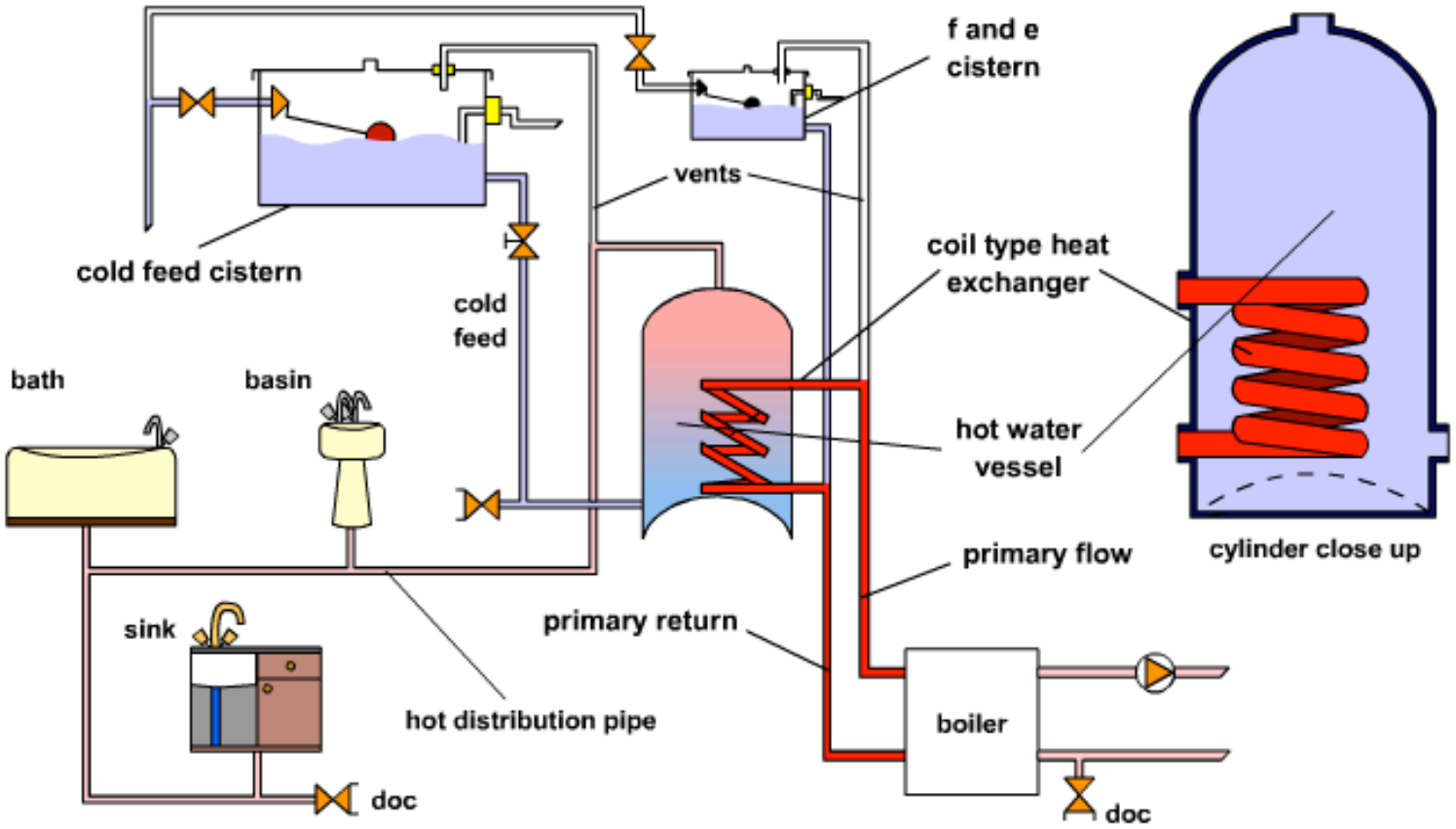
This type of cylinder uses a heat exchanger, generally a coil, to separate the primary and secondary waters.

The boiler will heat the primary waters to about 85^0C. This heated water is pumped up the primary flow pipe to the cylinder. It flows around the heat exchanger giving off its heat to the secondary water, which is inside the cylinder. The primary return pipe allows the cooler primary water to return to the boiler to be reheated.

This separate primary circuit allows an inhibitor to be used.

Components

Indirect cylinders



Components

Indirect cylinders

Using an indirect cylinder means the system requires two feeds – hence the name **double feed**, along with two independent cisterns at higher level.

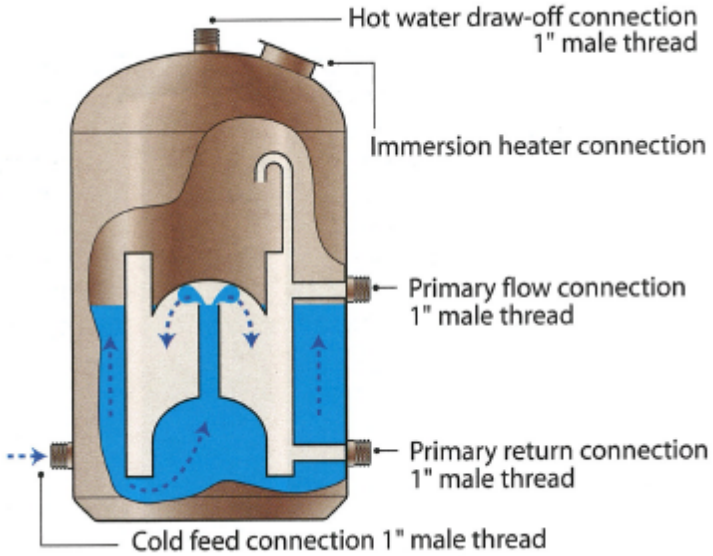
The larger (100 or 200 litres) CWSC supplies the cylinder via the cold feed pipe. This has a gate valve located for isolation.

The smaller (18 litres) feed and expansion cistern maintains the water level in the primaries via a feed pipe to the primary return.

Components

Primatic cylinders

This is an older type of single feed cylinder using a basic form of heat exchanger. As the CWSC fills the cylinder, so the primaries are filled at the same time.



Components

Unvented cylinders

These cylinders and systems do not have an open vent.

They operate under mains pressure, so are known as high pressure systems. This also means they do not require a CWSC in the loft, as their feed is from the rising main.

Components

Unvented cylinders

These cylinders can be direct or indirect in the way that they are heated, and can be purchased either pre-pumped or not.

Components

Hot water cylinders

Indirect cylinders in a standard system will only be fitted with one coil, which is heated by the boiler. If the hot water system is changed to incorporate a renewable or alternative heat source, additional coils in the cylinder are required.

Components

Hot water cylinders

A common renewable heat source is solar heating but there are options for other heat sources to be linked in via additional coils in the cylinder:

- Triple coil
- Quad coil

Components

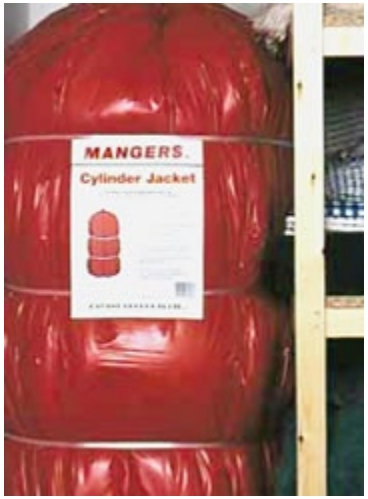
Hot water cylinders

The cylinders are commonly made of two materials:

- Copper
- Stainless steel

Nowadays, the cylinders that are produced are already insulated (50mm) and their heat recovery time (max of 25 minutes) is in line with the Building part L requirements.

Older cylinders may need lagging with a cylinder jacket.



Components

Hot water cylinders

If the customer requires a faster heat recovery time, there are high heat recovery cylinders available. They can bring the recovery time down from 25 minutes to 10 minutes.

This is done by increasing the size and surface area of the coil.

Components

Sacrificial anode

Hot water cylinders can suffer from galvanic corrosion, where there are two or more dissimilar metals joined together. This is more prone in soft water areas due to the acidic nature of the water producing a stronger electrolytic corrosion.

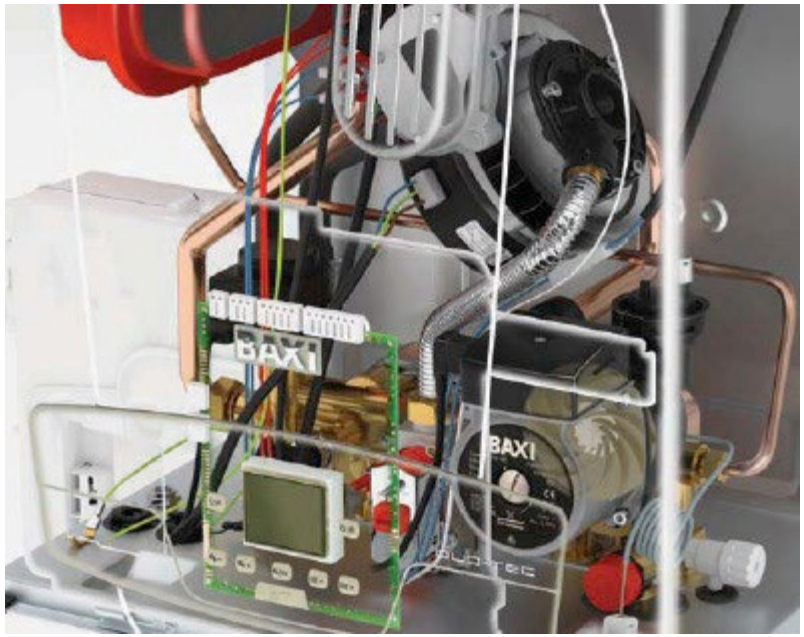
This is commonly overcome by cylinder manufacturers fitting a magnesium rod or sacrificial anode in the bottom of the cylinder.

Likewise, boiler manufacturers sometimes fit one in the heat exchanger of the boiler to protect the boiler parts.

Components

Thermostat

The boiler has a thermostat that regulates the primary water temperature, which flows to the coil. When the primaries are up to temperature, the boiler will cut out until the temperature reduces.



Components

The cylinder has a thermostat that regulates the domestic hot water temperature. This is placed one-third of the way up the cylinder. When the water is up to temperature, this operates the motorised valve and stops the primary water from circulating through the coil.

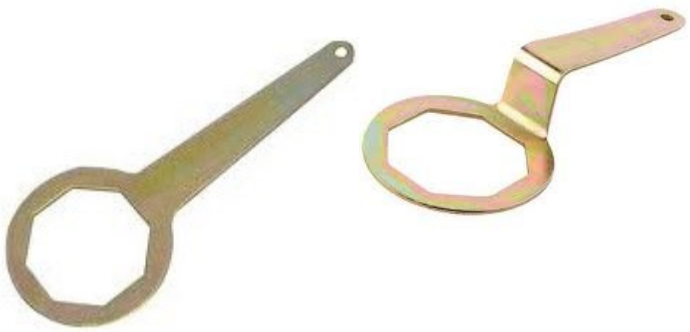
Components

Immersion heater

A direct hot water cylinder will have a single immersion heater to back up the primary heat source: top entry.

An indirect hot water cylinder may have two immersion heaters – one at high level and one at low level. This allows part or full cylinder heating: side entry.

To tighten or release an immersion, an immersion key or spanner will be required.

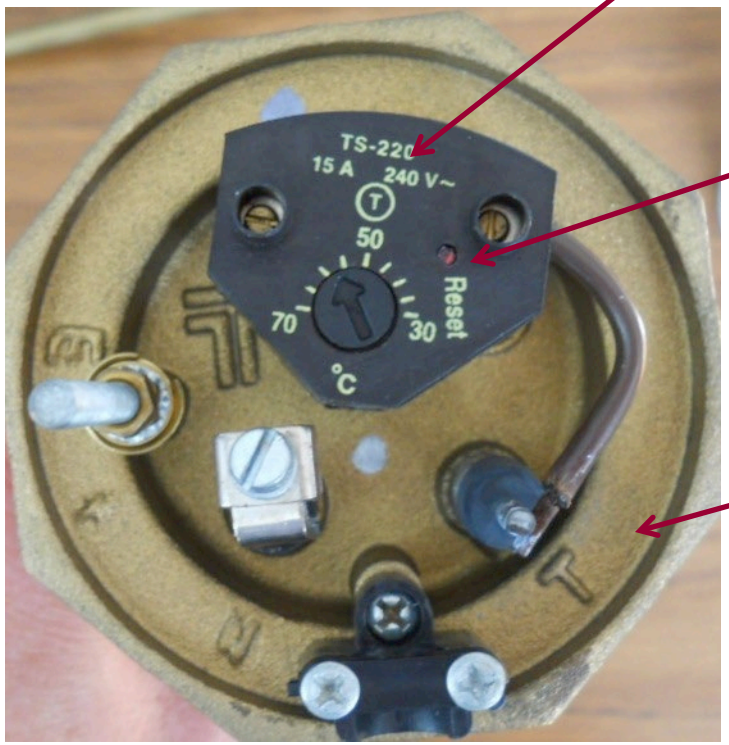


Components

Immersion heater

Immersions are generally rated at 3kW.

Special 1.5mm heat resistant butyl cable must be used when installing and must be isolated by a double pole isolator.



Immersion thermostat

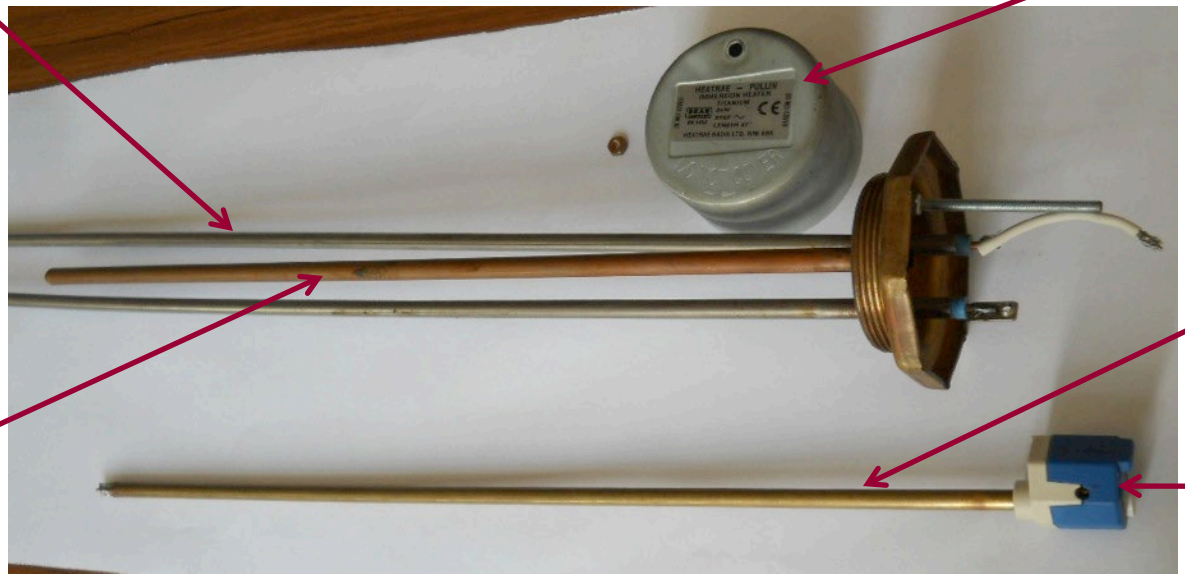
Legally required non-self-resetting button

Immersion body

Components

Immersion heater

After safe isolation, an immersion can be replaced, or allow the thermostat to be replaced.



Components

Control

- A programmer or timer will activate the system
- The boiler is controlled by the boiler stat
- The immersion is controlled by the immersion stat
- The hot water temperature is controlled by the cylinder stat

If the immersion is a back-up heat source, it can be switched on manually.

Components

Control

On some older systems you may come across a tap stat. This does not use a cylinder stat.

The valve is located on the primary RETURN and the phial is located where the cylinder stat would have been.

As the domestic hot water heats up, so the phial is heated; the liquid inside the phial expands and begins to close off the valve.

Components

Temperature control

The control of the domestic hot water temperature is very important for many reasons:

1. Scalding

Building Regulations part G now states that hot water delivered to a bath should not exceed 48^0C. This is accomplished by using a blending valve. (Shower valves are now fitted with a safety stop set at 38^0C.)

Components

Temperature control

2. Boiling

Building Regulations part G also states that stored hot water must never be able to reach 100^0C:

- Explosion
- Boiler stat
- Cylinder stat
- Overheat cut off device
- Expansion vessel/PRV/TPRV

Online resource:
http://www.youtube.com/watch?v=9bU-I2ZiML0

Components

Temperature control

3. Legionella

To prevent any waterborne pathogens being present.

- Temperature between 20^0-46^0C, legionella will grow
- Temperature between 47^0 and above, legionella will be killed off

Components

Temperature control

4. Economy
Any wasted hot water is wasted energy. The customer will be paying to heat up the water so Building Regulations part L requires an efficient system to be installed; the controls to be set correctly and the customer shown how to operate the controls.

Components

Temperature control

5. Environment
Whether the domestic hot water is heated by electricity, gas or solid fuel, one of the by-products is carbon dioxide gas, which is the main gas responsible for global warming and ozone depletion.

We now have to install condensing boilers which are high efficiency (HE) boilers: – SEDBUK rated A

Online resource:
http://www.worcester-bosch.co.uk/homeowner/boilers/gas-boilers

Components

Temperature control

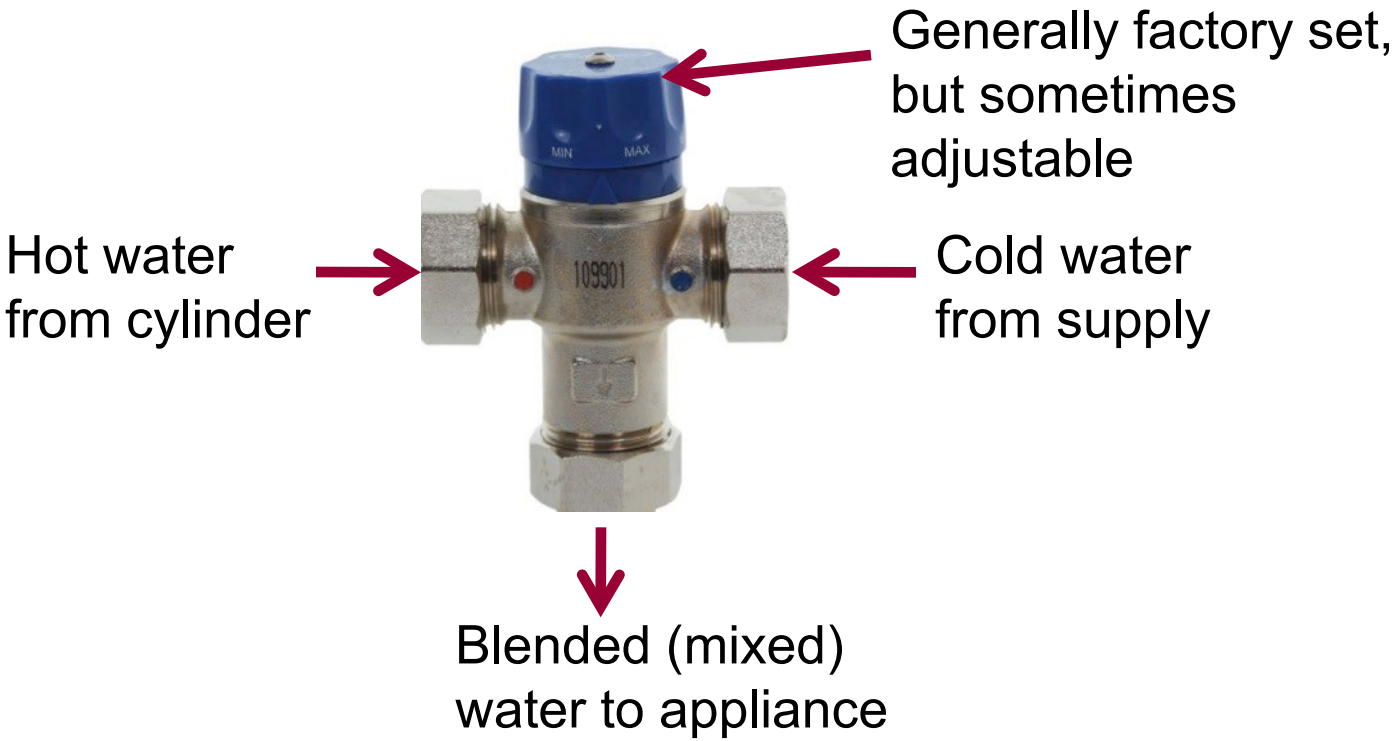
6. Scale

- If hard water is heated to 65^0C or above limescale is produced. Generally the cylinder stat is never set above 60^0C
- Scale blocks up components and pipework
- Scale reduces the efficiency of systems and appliances
- Scale is unsightly on appliances

Components

Temperature control

A blending valve is now required to restrict the hot water being discharged above 48^{0}C in a bath. In public areas 43^{0}C is commonly used for most appliances.



Components

Blending valves

Hot water should not be stored above 60^0C in a property, but this is far too hot to use safely.

In 2010 the new Building Regulations part G stated that all new-builds or refits need to have a temperature control to the bath, so the outlet temperature does not exceed 48^0C. The Care Standards Act also requires that any public access to hot water should be limited to 43^0C.

This means a blending valve must be fitted and set to the correct temperature. This valve uses a temperature sensitive element (wax cartridge) to control the temperature. The length of pipe after the valve **must** be as short as possible.

Components

Temperature control

Boiler stat

Shower mixer valve

Cylinder stat

Mixer tap

Tap stat

Components

Temperature control

Immersion stat

Blending valve

Temperature/pressure release valve

Pressure release valve

Components

Showers

There are many manufacturers and shower types on the market today. They can mainly be divided into three areas:

Gravity showers

Rely on head of water in the storage tank to push the water out of the shower head.

Pumped showers

Use an additional pump to force water out of the shower head.

Electric showers

Rely on mains water pressure to push the water through the shower head.

These will be detailed in a later outcome.

Components

Other ways to heat water

Instantaneous water heater

- A point-of-use water heater
- Heats cold water from the mains when it is flowing
- Can have electric element, which heats water as it passes through small internal cylinder. The water exits via a swivel spout, which also acts as the open vent
- Can be gas fired with water being heated by an internal heat exchanger

Both types are inlet controlled.

Components

Other ways to heat water

Over sink storage heater

The water is heated via an immersion heater and dispensed through a swivel spout, which acts as the open vent (it stops the unit from over-pressurising as the water expands). Hence inlet controlled, having stored a limited amount of water inside a small internal cylinder.

Components

Other ways to heat water

Under sink water heater

As suggested, it is fitted under a kitchen sink or basin. It is very similar to the over sink unit, except it **must** be installed with a special sink-mounted tap that acts as the open vent.

Components

Other ways to heat water
Unvented under sink storage heater

These are connected to the mains water and store under 15 litres of hot water. This means they are not subject to the stringent regulations of the larger unvented cylinders but require:

- Pressure reducing valve
- Single check valve
- Expansion vessel
- Pressure relief valve
- Discharge pipework

Components

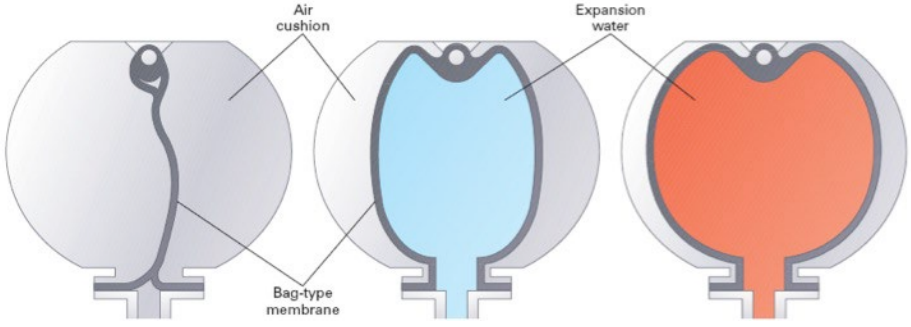
Pressure reducing valve (PRV). This controls the mains pressure before it enters the heater. Quite often pre-set by the manufacturer.

Single check valve (non return valve). The positioning of this is important, as it stops the heated water back-flowing into the cold water mains.

Components

Expansion vessel: This is required to take up the expansion of the heated hot water if the pipework cannot take up the expansion.

The vessel is divided by a rubber membrane – one side of the membrane is charged with air, the other side is taken up by system water. As the water heats so the membrane gives, allowing for expansion. Care must be taken to allow water to flow through the vessel and not become stagnant.



Components

Expansion relief valve (pressure relief valve) This is required in case the system over pressurises due to the failure of the expansion vessel or PRV. At a pre-set pressure this valve will open, relieving the pressure back to a safe level.

Discharge pipe and tundish. These safely remove the water discharged by the PRV. It runs to a safe location outside the building. The tundish maintains an air gap between the heater and discharge pipework, as well as being a visible warning to the customer.

Components

All hot water systems, whether centralised or localised, need to have the advantages and disadvantages outlined to the customer.

Before suggestions are made the engineer needs to consider:

- Property size
- Storage capacity
- Usage
- Fuel type
- Installation cost
- Efficiency

Components

Keeping efficiency

Once the water is heated, the system needs to retain the heat and supply hot water effectively to the outlet on demand.

Heat loss is minimised by the use of insulation on the cylinder and pipework. (Building regulations part L.)

There also needs to be a control on the length of pipe used to deliver the hot water to the outlet.

1. Waste of cold water before the hot water is drawn off.
2. Hot water is left in the pipe which cools down.

Components

Keeping efficiency

BS6700 states the maximum length of pipe before it becomes a dead leg:

12-22mm – 12m
22-28mm – 8m
Over 28mm – 3m

Water Regulations recommend that the temperature at a terminal fitting must not be less than 50^{o}C within 30 seconds after fully opening the terminal fitting.

Components

Contamination

The single check vale is the simplest form of mechanical back flow prevention. It is basically a spring loaded one way valve and can be used where wholesome water is at risk from a cross contamination from category 2 water.

Example:

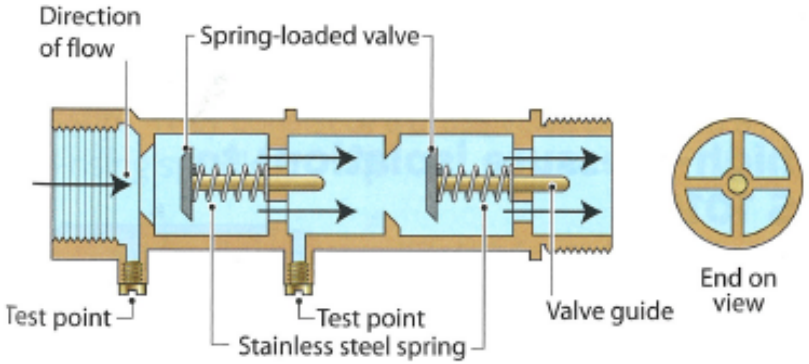
A basin monobloc mixer tap is connected to both hot water (category 2) and cold water (category 1). A single check must be used to stop the hot water entering the cold water pipe as the tap acts as a cross connection.

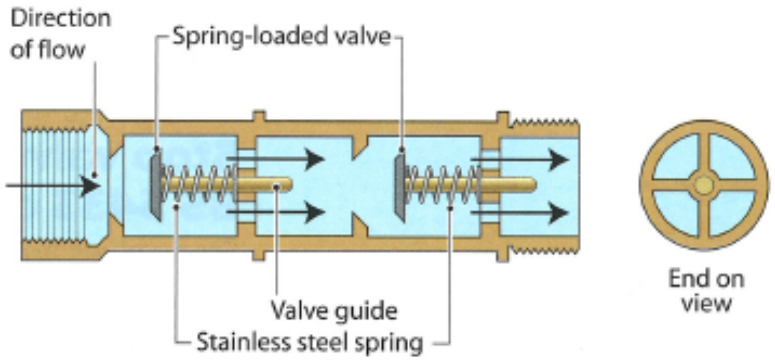
The same happens for a shower mixer valve or mixers that have hot water supplied under mains pressure.

Components

Contamination

Double check valve is used in the supply pipe to prevent backflow and allows the water to flow in one direction only. Again these can be verifiable or non-verifiable.





Components

Contamination

The double check valve offers greater back flow protection and is used to protect wholesome water against the back flow of category 3 water.

Example:

Instantaneous shower, hose union bib tap (outside tap), filling loop on a combination boiler.