Learn the term used in hot water storage systems:

- Different type of valves and symbols

Objective: To understand domestic cold and hot water systems. +

- A water system (http://www.home-heating-systems-and-solutions.com/cold-water-systems.html)

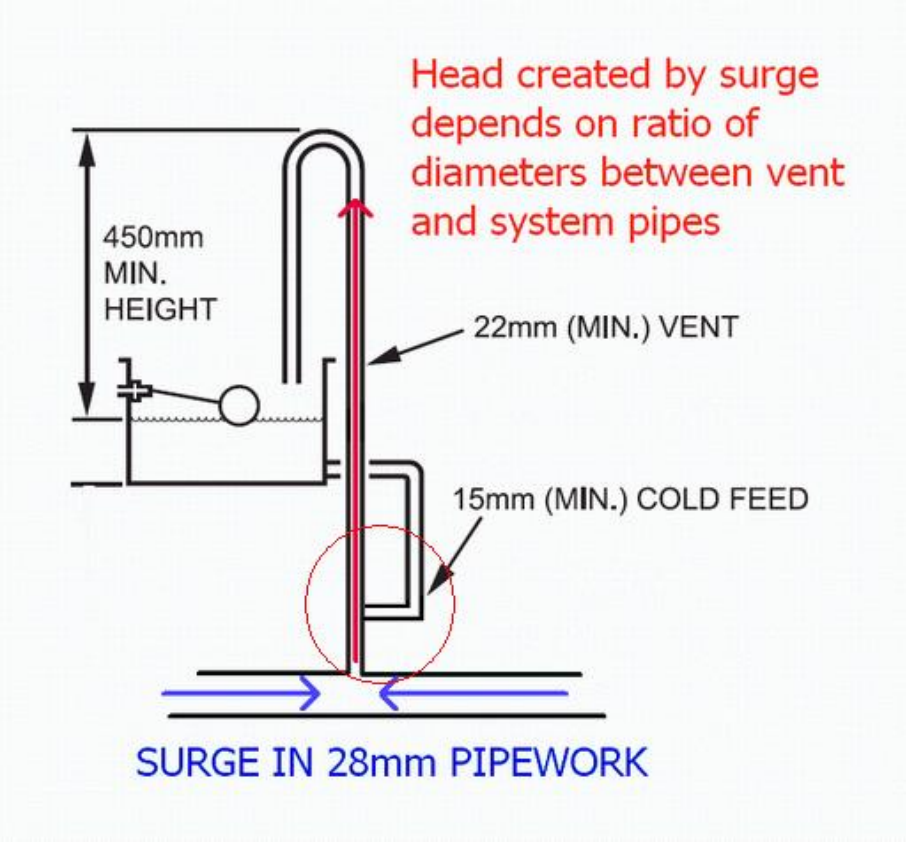
1. Types of hot water supply Systems

2. Centralised hot water storage system

- 3. What are vented and unvented cylinders ?
- 3-A More about unvented hot water cylinder
- 3-B Who needs a G3 certificate ?

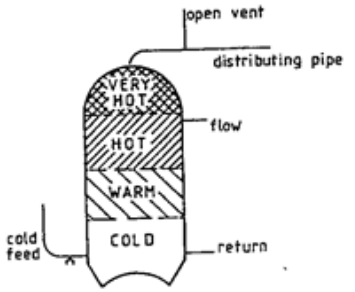
4. Open Vented Hot water Storage Systems:

- 5. What is the capacity of cistern ?



(diynot.com)

- 6. More points about open vented hot water system:
- 7. There are two types of open vented hot water storage system
- 8. Open vented direct hot water storage system

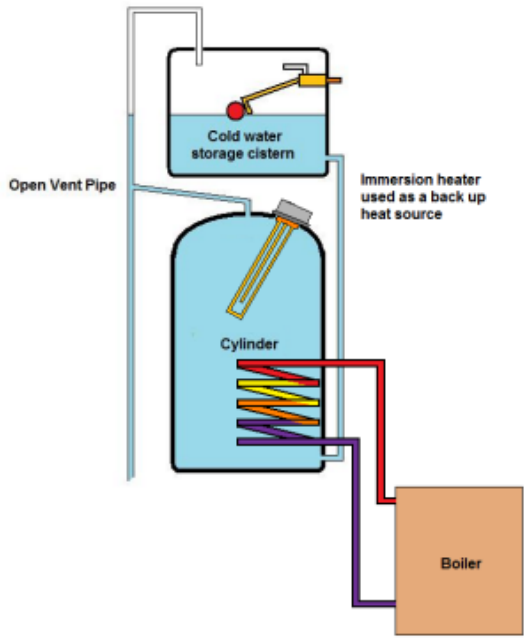


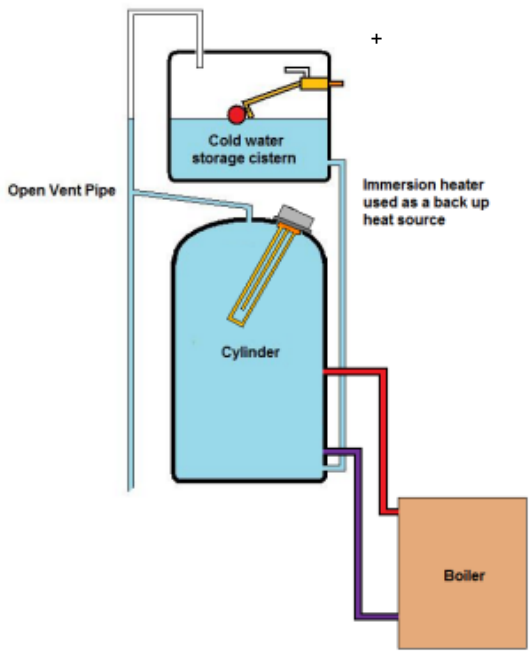
(a) Vertical cylinder

Vertical cylinder preferred to give better stratification and ensure that the hottest water is drawn off.

- 9. Boiler used in *direct hot water storage system*
- 10. Pros and Cons of direct Systems

The two diagrams below show the general layout of open vented hot water systems:





- 11. A direct hot water system with immersion heaters
- 12. Immersion heaters
- 13. Criteria of choice for direct Systems
- 14. What is Primary and secondary water ?
- 15. Indirect hot water storage systems:
- 16. Indirect double feed system (not cylinder!)
- 17. The Open vented indirect (double feed type) hot water storage systems
- 18. The double feed indirect cylinder -1
- 19. The double feed indirect cylinder -2
- 20. What is existing double feed indirect systems:
- 21. What are new double feed indirect systems:
- 21 - A. Where does the difference lie in **Direct and indirect hot water storage cylinder** ?
- 22. Describe the following:
- 23. How many grades of cylinder we have?
- 24. Copper cylinders are manufactured to the following standards
- 24 - A Different type of Hot water cylinders
- 24 -B Combination open vented water storage cylinder
- 24 -C Quick Recovery cylinder (Superduty cylinder)
- 24 - C- A - Difference between S and Y plan
- 24 -D Indirect cylinders for renewable energy hot water supply
- 25. Unvented hot water systems
- 26. What are **primatic cylinders** ?
- 27 How to name a system from a given diagram ?
- 28. Name the given / shown system.
- 29. Name the hot water system shown in the diagram
- 30. Name the hot water system shown in the diagram
- 31. Gravity fed system and its advantages
- 32. What is the minimum distance of vent pipe from the cylinder
- 33. The need for secondary circulation system
- 34. More about secondary circulation System
- 34-A Secondary circulation pump on unvented system
- 34-B Secondary Circulation on **Large Open vented hot water storage system**

- 34-C How to prevent reversed circulation in the secondary circulation system
- 35 What is Thermostatic Missing Valve (TMV)
- 35-A Internal view of TMV +
- 35-C Need of TMV
- 36 Type of Thermostatic mixing valve
- 37. **Group / Centralised** Mixing
- 38. Expansion of hot water pipework
- 39. Which one expands more copper or plastic
- 40 instantaneous Hot water system
- Single point of use heaters
- 40 Shower mixing valve and shower boosting pumps
- The procedure for safe isolation to check the electric immersion heater
- 41 Anodic corrosion protection of hot water storage cylinders
- Heating boilers / heaters
- What are system boilers ?
- Combination Boilers (instantaneous)
- What is commissioning / Testing ?
- Soundness test :
- Cold water pressure testing:
- Pipe sizes in open vented hot water storage system
- Different terms from Schedule 2 (https://www.legislation.gov.uk/uksi/1999/1148/schedule/2)
- What is Positive and Negative head in terms of plumbing ? (https://www.anchorpumps.com/blog/positive-negative-shower-pumps-explained/#:~:text=The%20bathroom%20on%20the%20top,tank%20and%20the%20shower%20head.)
- Single or Twin impeller pumps ?
- Do I need a **centrifugal or regenerative** pump ?
- What is baffle ?
- What are different fuel sources ?
- Different kind of showers
- The use of trace heating instead of secondary circulation ?
- [What is a flange ?] (https://www.salamanderpumps.co.uk/ (https://www.salamanderpumps.co.uk/))
- Water system in UK?
- What is a static / dynamic pressure ?
- What are the two things that WRAS (water regulation advisory scheme) does ?
- What gives an open vented system its working pressure ?
- The size of Earth wiring for continuity testing
- Why do we have Earth wires attached to water supply copper pipes in home water piping ?
- Fill in the blanks
- What is the advantages of an indirect cylinder ?
- [What are the rules for notching joists and timber beams] ?
- A depth of the timber joist is 8inches (or 203.2mm)
- Between what temperatures is there a risk that legionella could grow?
- Hot water should be stored at what range ?
- What is the minimum size of the open vent pipe ?
- Which one of the following component parts is installed after the incoming stop valve ?
- Which one of the following is the maximum depth a water main service should be laid ?
- To ensure correct operation, a single feed indirect cylinder requires which one of the following to be formed ?
- Which one of the following is used by gravity primary pipework to circulate the water ?
- What is the minimum distance from the distribution pipe from the cylinder before it connects to the open vent ?
- Installing which one of the following would overcome problems caused by long pipework ?
- Stratification is most likely to take place in a
- A full way gate valve is installed in the
- A single impeller shower pump is installed between the

- The minimum vertical height required (minimum head height) for a gravity shower to work is:
- Rigid hot water pipe work should be tested at 1 1/2 (one and half) times the system working pressure for
- Which one of the British Standard specification covers soundness testing ?
- What is the maximum length of dead leg for a 15mm or 22mm pipe before a secondary return system has to be installed?
- What are the following British Standard Specification deals in ?
- Grade 3 copper cylinder has the following specification
- Which one of the cylinder can be connected directly from the main pressure supply
- What is the main pressure of a cold water when it is fed to pressurised unvented cylinder using regulators ?
- A electric shower is classes as
- Which one of the following is the minimum size for gravity primary pipework from a continuous burning appliance. ?
- Which is the minimum pipe diameter of a primary open vent from a gravity fed indirect hot water storage cylinder to feed and expansion cistern in a domestic property ?
- What is minimum size of a secondary cold-feed pipe (DHW) from a cold-water storage cistern to a hot water storage cylinder is a domestic property ?
- A secondary return incorporates a pump made from
- A cylinder thermostat is located
- Which one of the following calculations is used to work out the height that the vent from the cylinder should rise above the maximum water level in the cold water storage cistern before it inverts ?
- What would be the height of vent from the cylinder if it has 1.5 head height ?
- Which one of the following is the correct position of the feed to the cylinder in a cold water storage cistern ?
- The legal requirements for installing hot-water system are laid down in which of the following documents ?
- What is the minimum size of primary flow and return pipe ?
- Which type of immersion heater should be used in a new hot-water storage cylinder ?
- The pump used in a secondary circulation system may be manufactured from :
- Which of the following types of service valve should be used on the cold feed pipe from cistern to cylinder ?
- The maximum temperature on Bath in new a build home
- An electric shower is a form of ?
- What British standard covers Hot water installation
- Building regulation Part L states that a cylinder must heat in how many minutes ?
- If a flow switch on a pumped shower does not work, what would be the result ?
- In which one of the following locations is it a requirement to insulate hot water system pipework ?
- During soundness test on an open vented hot water system
- What should be fitted to a hot water storage cylinder to provide protection against type 1 pitting corrosion ?
-
- A method of preventing energy and water wastage in hot water pipework with long dead-legs is known as
- What is the required soundness test pressure for hot water pipework which will normally be subject to a static head of 6 metres (assuming that 1 metre head of water is about 0.1 bar pressure)?
- A shower pump should be set on
- The minimum recommended head of water between the base of a cold water storage cistern adn the shower head (outlet) with a gravity fed shower is :
- If you wanted heat your water using a boiler and a renewable heat source, what would happen to the standard hot water cylinder fitted in the property?
- If you are to decide between the following living in hard water area which immersion element should it be ?
- What is size of pipe feeding to shower
- A low pressure manual shower mixer vlave must be supplied with
- What type of flange it shown in the figure ?
- A TMV should blend the hot and cold water to a bath or shower valve to what maximum temperature
- The choice of Hot water system depends on which of the following points ?
- If the CWSC is 5m above the Hot water cylinder the pressure of the hot water will be
- Water Regulations recommend that the temperature at a terminal fitting must not be less than 50oC within how many seconds after fully opening the terminal fitting.
- If a low pressure is coming from the main what system would you install
- The device shown below is used for

- What type of hot-water storage cylinder is shown in the following diagram ?
- When draining down a sealed central heating system its best to: (central heating question)
- What is one pipe circulation ?
- Requirements that heating system expansion (cistern) should have
- Vented central heating system with open vented hot water cylinder

+

Tue, Mar 29, 2022

97 min read

Hot-Water-System

Hot Water Systems

Learn the term used in hot water storage systems:

1. Gravity / main feed: A gravity feed system allows a cistern (which is properly sealed) to be used on the top of the roof in loft in open space. This provides the pull of gravity to create enough constant pressure as oppose to main that is always dependant upon the main pressure. It is classes as low pressure system . As the demand of high pressure taps and showers is increasing it may be necessary to fit a pump into a gravity fed system to increase both pressure and flow to either an appliance or to a bath or to a whole house.
2. Direct / indirect cylinder: A direct cylinder is called direct because it comes into contact with the water directly via an electric immersion heater. Though it can also be connected through a small boiler primary flow and return but it does not contain the coil.They are not suitable for heating as there is no control over temperature. They are susceptible to boiling. While an indirect cylinder always have a coil inside a cylinder that heats up the water present in the cylinder. Since the water does not come into contact with the water that is running inside the coils it is called an indirect cylinder. They are used in central heating and if the water boils there is always a method present for water expansion.
3. single / double feed: As the name suggests the single feed hot water system are fed only by a single water storage while in double feed there are two storage that feeds the cylinder.
4. Open vented (vented / un vented) system : Vented cylinders are gravity fed from a water storage tank called cistern. This cistern is placed generally in the loft area above the cylinder. The height of the water storage tank **head Hight** is what governs the pressure to the hot water outlets. They are also designed for renewable energy such as solar, geothermal and ground source heat pumps . The cylinder contains two heat exchanger, first coil is used with conventional

heat source while the other or second coild is dedicated to renewable energy source. Poor hot water shower or other pressure problems can be overcome by use of pumps but if it is not resolved, it is a time to change the cylinder to **unvented type**. The unvented type cylinder pushes the hot water with built in pressure and not dependent upon the height of the cold water cistern to genarate pressure. It does away with cistern. If unvented cylinder is used there is no need for extra **shower pump**.

5. lag / leg in pipe working : legging is used to describe stagnation that creates a bacteria called legionella while lagging is to provide insulation to prevent heat loss. All new hot water cylinder comes pre lagged and no need for an external blanketing or known as **insulation jacket**.
6. CWD : Cold water distribution pipe serving cold water directly from the cistern to appliances, it comes from cistern. Another pipe also comes from cistern and feeds the cylinder.
7. HWD : Hot water distribution pipe serves hot water to appliances, it is 22mm pipe that comes out from a boiler and also knows as hot water drawn off pipe or DHD domestic hot water distribution , and always rise 150mm above and kept 450 mm away from the cylinder
8. DHW : It is knows as domestic hot water feed, it is a pipe that comes from cistern and feeds the cold water to cylinder (should have been called cold water feed ?)
9. Flow of Water : Water flows from height pressure to low pressure, thus if a gravity feed water system is not present, water is stored in a cylinder with very high pressure. When the tap is opened, from one place hot water leaves the cylinder with a pressure but at the same time the cold water enters the cylinder. It is needed to keep the pressure and provides the push or flow to the water.
10. Primary/secondary : The concept is simple primary is used for the water that is heated directly though (any means like boiler, lpg etc) to heat the secondary water that comes out from the tap. Both primary circuits and secondary circuits can take help from external pump and are named as primary or secondary pumps . Or called secondary circulation system.
11. single point / multi point Hot water heaters: A single point heater serves only one location i.e, a sink , a basin etc. While a multi point boiler serves more than one draw off point (tap / faucets) in a home. A combi boiler is a multi point water heater (condensing or non condensing)
12. single feed / double feed : In single feed you get an air bubble, it relies on air bubble to separate the primary and secondary water both are filled with a single feed from CWSC. wile the double feed you do not get an air bubble because it uses an indirect cylinder, primary and secondary water are

separated by a coil. Primary water is filled with F&E and the secondary water is filled with CWSC.

13. Linear / Rotary valves : Both are control valves they control the flow of fluid, the difference comes from their mechanical working, linear valves used spindle to open or close the gate for the fluid to move through it. Gate and Glove valves are example of linear valves. Rotary valves use a ball to open or close they only turn 90 degree to fully open or closed. Ball valves are example of rotary valves. Isolation valve is just a name of these kinds of valves (this can be either a stop valve , wheel head/gate valve, or a service ball valve)
14. Open vented (low pressure) / Closed vented (hight pressure) .

Different type of valves and symbols

- Ball valves , globe valves / service valves and Gate valves are kind of Shutt off / stop valves.
- Types of Stop Valve are mentioned below. They are designed to accommodate the flow pattern of the liquid flowing though.
- These may be **straight or angled.**

1. **Ball valves.** Uses a rotary ball with a bore and a stem. Handle is attached with a stem that rotates the ball to open or close the valve. It is also called a quarter turn valve because the handle only need the 90 degree turn to allow or stop the flow mdia.

2. **Gate Valves.** They are linear valves and belong to the shut-off valve family . They use a gate to control the flow of the media and are only **unidirectional.** The gate is lifted to open the valve and is returned to its original position to close the valve. It is also called multi turn valve because it takes more than a 360 degree turn to fully open or close

the valve. They are designed for media isolation purpose. They can not handle the pressure of the media flowing though it by providing **full flow or full shut**. They can not change the direction of flow. For high pressure and semi open or semi close purpose and for change of direction Globe valves are used.

3. **Globe Valves**. They are also linear valve and provides **multi direction flow**. Service valve or Globe valve are different names for the same product. They are also known as **service globe valve**. They have complex structure since their internal parts are inside the cavity. The main purpose of the globe valve is to provide positive shut off and throttle. Globe valves can also change the flow direction and flow rate which causes high pressure drops. Since they can withstand the pressure and the direction they are also knows and **Control valves** and easily regulate the media flow and have less chance of leakage. When safety and leaks are the main concerned, globe valves are the main choice.

Note: The symbols for gate valves may differ a bit in different organisation. Following are all symbols of gate valves.

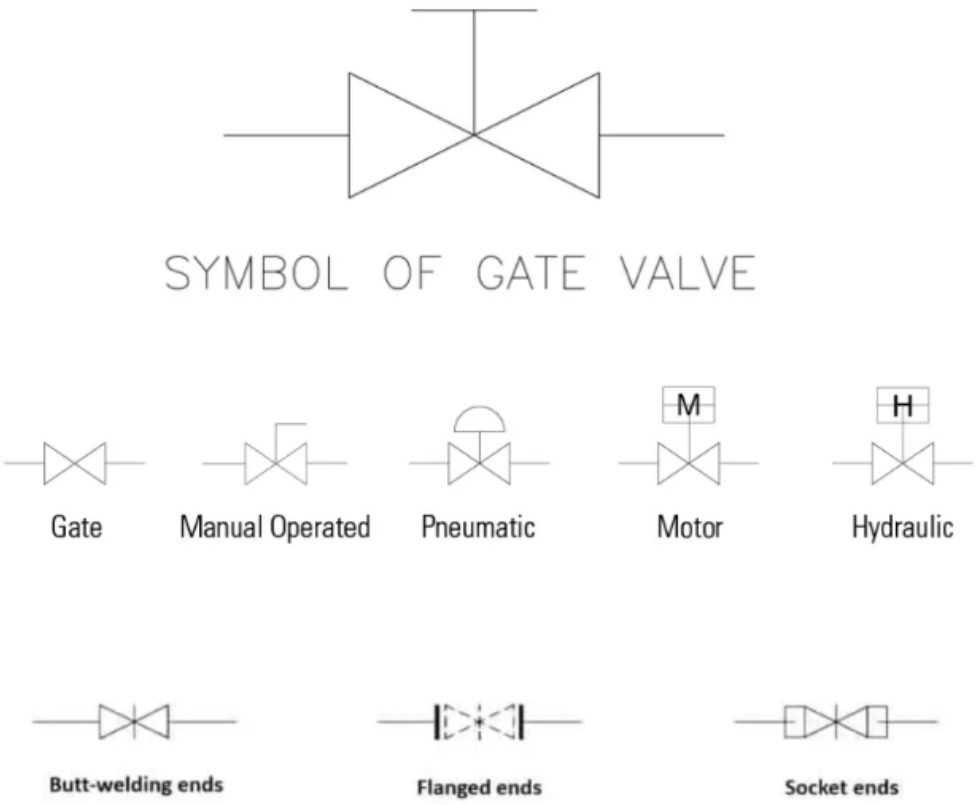
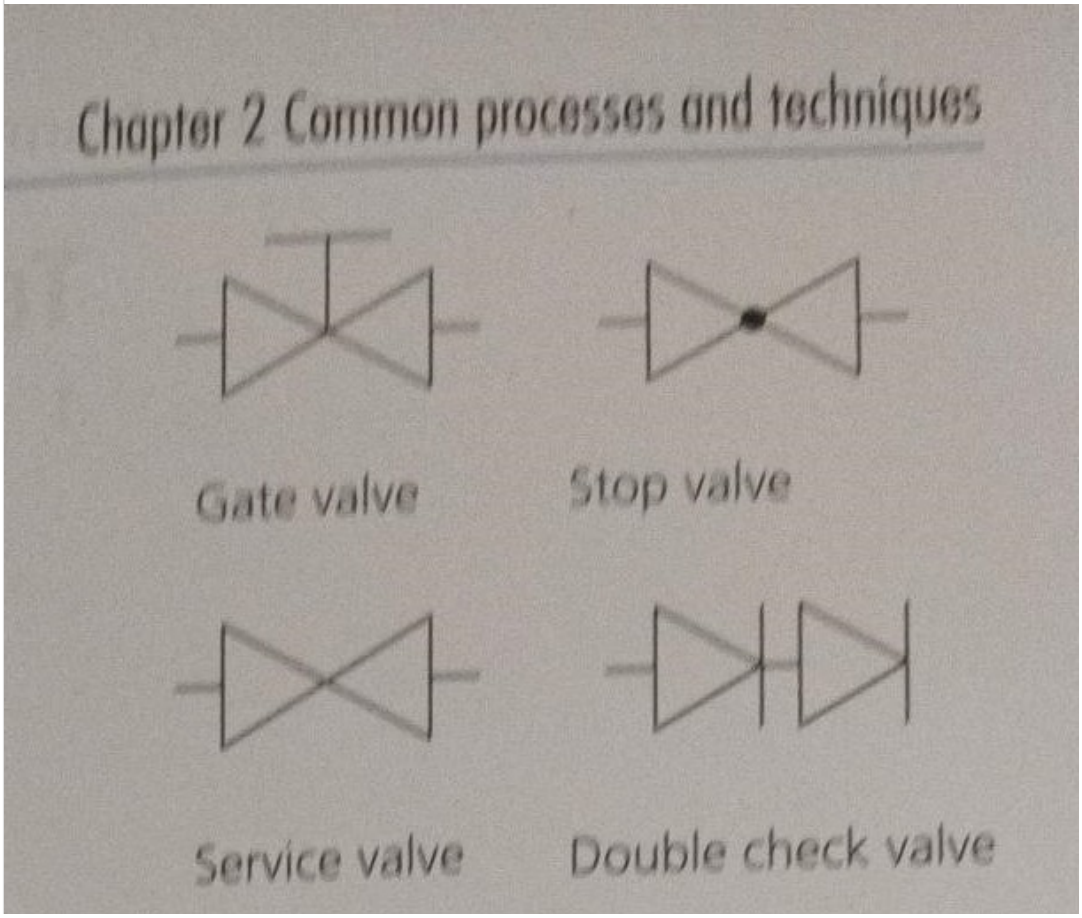
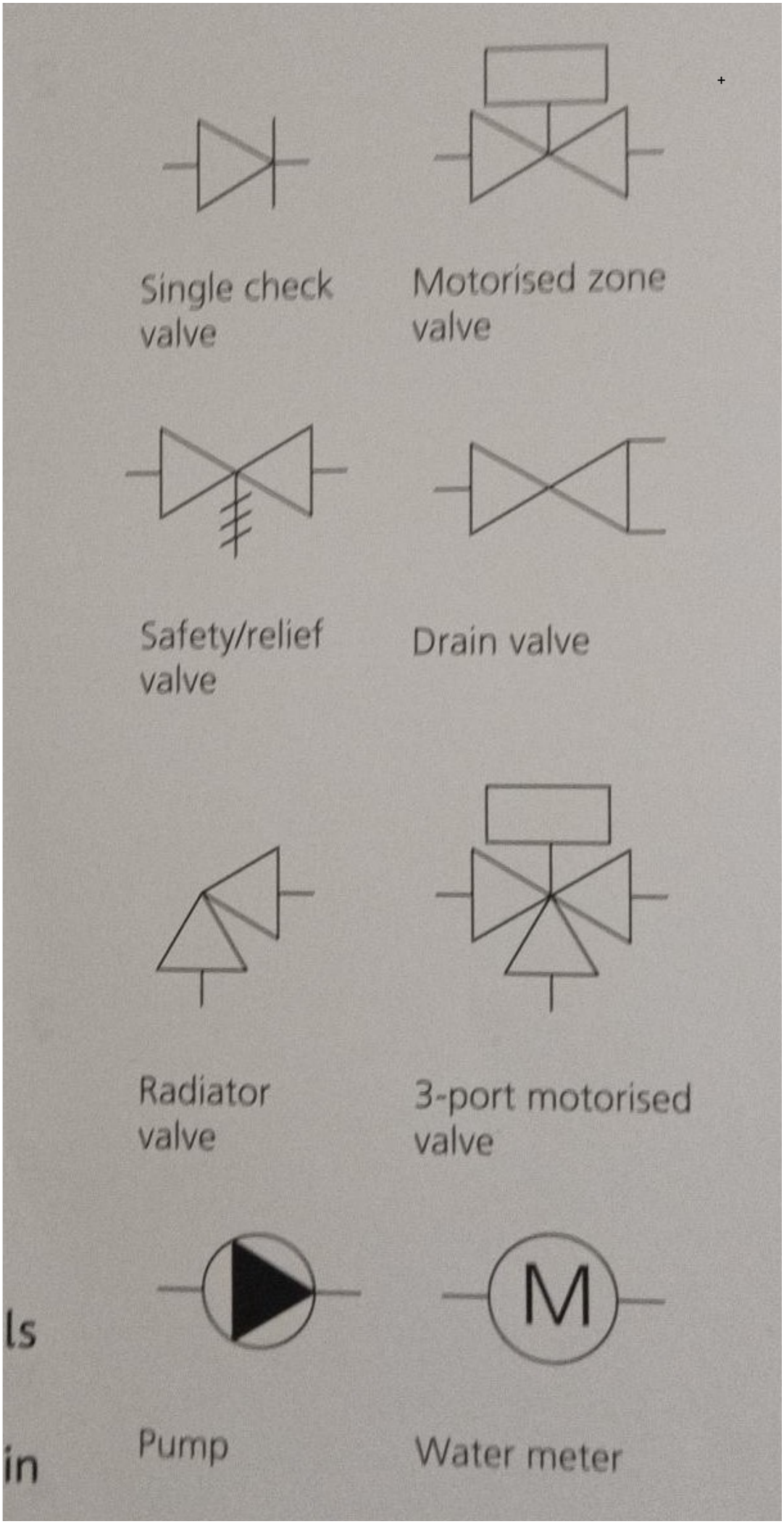
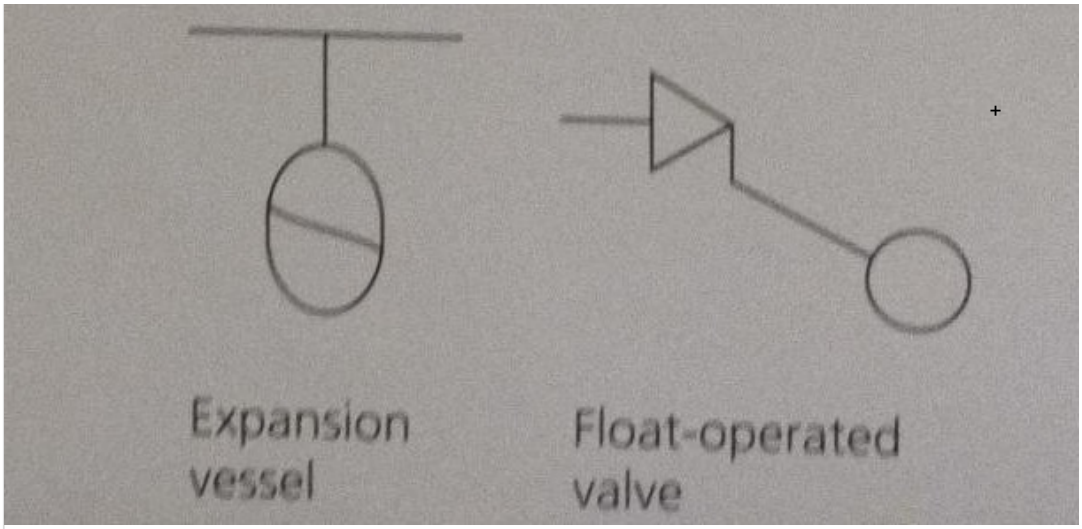


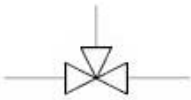
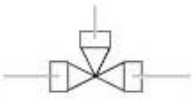
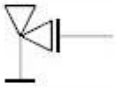
Fig. 9: Gate Valve Symbols

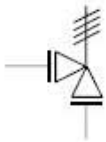
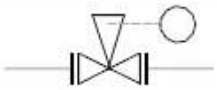
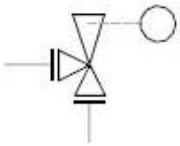



Single check valve
Motorised zone valve
Safety/relief valve
Drain valve
Radiator valve
3-port motorised valve
M
Pump
Water meter



- Other symbols

Image	Valves	Butt weld Symbol	Flanged Symbol	Socket or Threaded Symbol	Valves	Image
	Gate				Gate	
	Globe				Globe	
	Ball				Ball	
	Plug				Plug	
	Butterfly			...	Butterfly	
	Needle				Needle	
	Diaph	...			Diaph	
	Y-type				Y-type	
	Three way				Three way	
	Check				Check	
	Bottom	...		...	Bottom	

	Relief	...		... +	Relief	
	Control straight	...		...	Control straight	
	Control angle	...		...	Control angle	
Image	Valves	Butt weld Symbol	Flanged Symbol	Socket or Threaded Symbol	Valves	Image

- Isolation valve (this can be either a stop valve , wheel head/gate valve, or a service ball valve)

Objective: To understand domestic cold and hot water systems.

- Most of us do not know which system is used in our houses because most of the items are hidden from us excepts the taps/faucets that we use to draw the water.
- It is worth knowing what type of system we have installed at home. and how to isolate them when and if things go wrong. For example we many encounter the need to
  - Isolate the system.
  - Drain the cold and hot water taps / pipes
  - Drain the WC cistern.
  - Drain the cold water storage tank
  - Drain the hot water cylinder
  - Draining and Refilling the entire system
  - Fixing an airlock
  - Repairing or replacing items

A water system (http://www.home-heating-systems-and-solutions.com/cold-water-systems.html)

A direct cold water system

- Ideally the water we get or supplied can directly be used to get cold water though taps/faucets , WC (toilets) etc. but it does not happen and a cold

water storage vessel is used to store the wather and known is **cistern**.

- But if we need to use hot water too. Then it must be supplied though some means / system. It is usually provided though an open vented hot water cylinder (also known as low pressure cylinder).
- When it happens what we get **unbalanced** cold water system because the cold water pressure is different from the hot water pressure. This is knowns as **direct cold water system**. So a water system is known as direct cold water system when no cistern is installed.
- To get the balanced cold water system, a cistern is removed (if present) and the open vented cylinder is replaced with unvented one with water is supplied thorough main and it becomes **balanced** system.

An indirect cold water system

- When water is supplied at mains pressure (that is coming from the outside) to cold water storage cistern using a 28mm rising main.
- A branch off pipe delivers drinking water to the kitchen and the garden tap. The rest is delivered though cistern. this is knowns as **indirect cold water system**
- As we need hot water a similar hot water storage cylinder is also supplied with cold water from the cistern. With this
- With an indirect cold water system there is always a temporary back up of stored water in the event of a mains failure. Also, because it is a low pressure system it is generally quieter therefore eliminating noise like ‘water hammer’ which can occur when high pressure water tries to negotiate tight bends in the pipework.
- To reduce the risk of impure water being siphoned back into the mains both in direct and indirect system a **non return valve or check valve** is installed immediately after the main stop-valve supplying the water to the house. It permits water to flow only in one direction.

Isolating the System

- The entire system in both system can be isolated by closing off the main **stop valve**
- The water to cistern can be stopped by using the stop valve on the rising main just before the cold water cistern.
- Similarly the water to individual appliances can be stopped by installing and closing off the the stop valves just before the feeding to the main appliances.
- The cistern have the ball valve mechanism that stop the water automatically but if if fails then there could be damage to the property. Thus all water

storage tank must have a warning pipe called an overflow pipe designed to discharge the water out of the property.

- Most modern WC in case of overflow discharge the water in toilet bowl. However high level WC cistern overflow pipe discharges externally.
- The water supply from the cistern to the cylinder can be isolated by closing off the gate valve. It is a **full bore** valve designed to allow full water flow through it and should ideally be installed in the vertical section of piping before connecting to the hot water cylinder. A drain valve is also necessary at the bottom to drain the hot water cylinder.
- Unvented cylinders are isolated by the main stop-valve on the supply pipe before the cold water control valves or a stop valve before the cylinder connection or an integrated stop valve if using a composite valve set up.
- A **composite valve / combination valve** is comprised of a line strainer, a pressure reducing valve, a non-return/check valve , an expansion realise vale and a isolation valve designed to speed up installation of unvented cylinders.
- All water pipes servicing taps/faucets, baths, basins, sinks and appliances such as dish washers and washing machines etc should ideally be fitted with service valves on both the hot and cold service pipes. This will enable easy isolation for repair or upgrade without having to isolate the entire house or property.

Draining Cold water Taps/ Fausces and ipes

- In a direct cold water system close off the main stop-valve and open all cold taps to drain, in multi level properties the kitchen tap/faucet will be the last to drain. Further draining can be done through a drain valve if fitted.

- With an indirect cold water system to isolate the bathroom taps/faucets close off the gate valve on the appropriate cold feed pipe from the cold water storage cistern/tank, then open all bathroom cold taps/faucet to drain.

If you can't find the appropriate cold feed isolating valve then close off the stop-valve before the cold water storage cistern/tank. Failing that you can place a wooden batten across the top of the cistern/tank and tie the float valve to it preventing it from opening then open bathroom taps/faucets to drain. However, if you can't access the loft then close off the main stop-valve.

1. Types of hot water supply Systems

- There are two types of supply Systems
  - **Centralised Systems**: Where hot water is delivered from a **Central point** to all to water outlets in the dwelling/house. The water may be heated from different sources. So the main source of hot water supply is fitted / sited centrally in the property for the distribution to all the taps. They are installed usually in tree to more bedroom houses.
  - **Localised Systems**: also known as **single-point or point of use system**, the hot water is delivered by a small water heater at the point where it is needed.

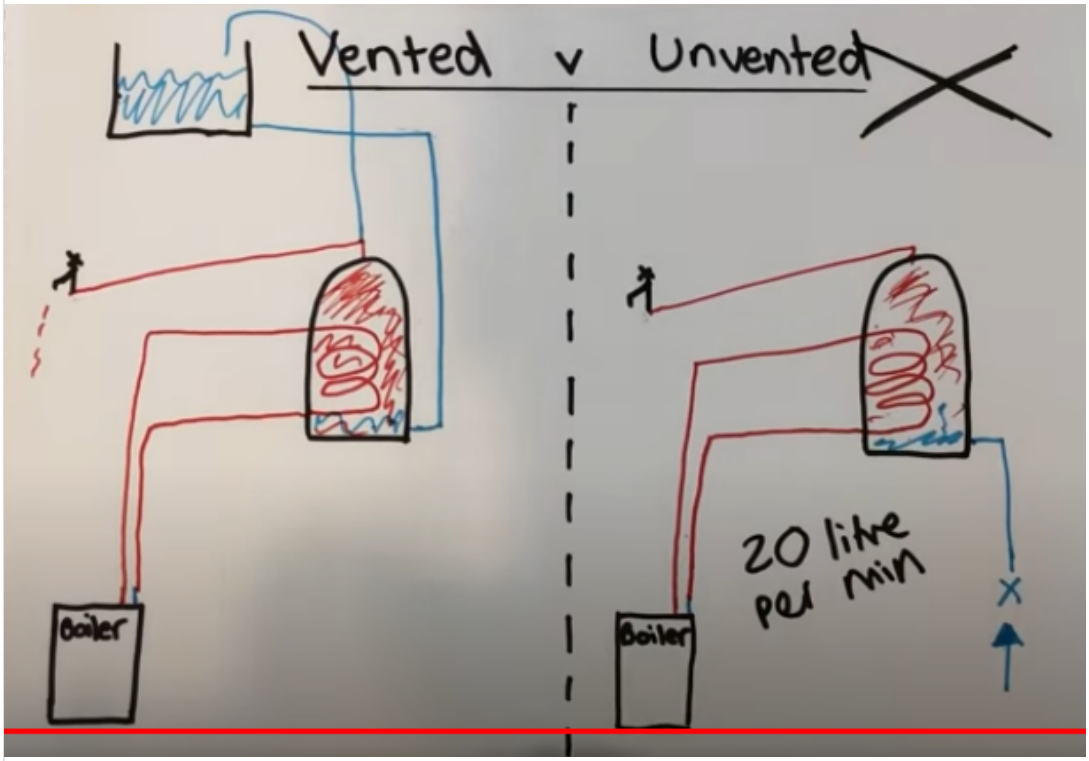
Note: The main supply of cold water to home and from home entry to the cistern is carried out by using a *28mm* pipe with fully-way valve.

2. Centralised hot water storage system

- They are divided into the following type:
  - **Open vented System**: The term open vented comes from a vent pipe that is used and open to the atmosphere. These are system where water is fed from the storage located at certain height in dwellings. These storage are known as **cistern** located usually in the roof space called attic. Since they contain a **vent pipe** thus known as **open vented system**. There are two types of open vented hot water, direct and indirect.
  - **Unvented System**:they are fed directly from the cold water main, and utilise an expansion vessel or an internal air bubble to allow for expansion to create enough pressure to supply the hot water to all outlets. Since it does not have any vent pipe it is said to be unvented. They are designed to do away with the storage cistern and operate at much higher pressure than the open vented system.

3. What are vented and unvented cylinders ?

- Vented cylinders uses a vent pipe that ends into cold water storage / cistern.
- While unvented cylinders does not have vent pipe but it is fed from a cold water with at least 20liter/m pressure so that it can supply enough pressure for all out lets.



How to calculate the height of the vent pipe above the feed and expansion cistern ?

1 We must find out the height / length form the overflow pipe to the lowest part of the cold feed pipe at the cylinder. If it is say 3m, multiply it to 40 then add 450 into it.

=> (3 * 40) + 150 = 270mm

- This is the height of the vent pipe from the overflow pipe when base height given is 3m.

3-A More about unvented hot water cylinder

- It holds the water at the **extreme pressure**, feeding house hold appliances when turned on instantaneously.
- It is extremely pressurised and since does not have any vent pipe, special equipment's are installed to release the temperature and pressure when

necessary.

- The cold water is fed from the main keeping at constant pressure, the flow of water and consistency is better than a vented water system but it is pricy to install and maintain.
- It has only two main components a **boiler** and a **storage tank**.
- The system has an expansion vessel to maintain the pressure and water level.
- It can only be installed by someone holding a G3 certificate .

3-B Who needs a G3 certificate ?

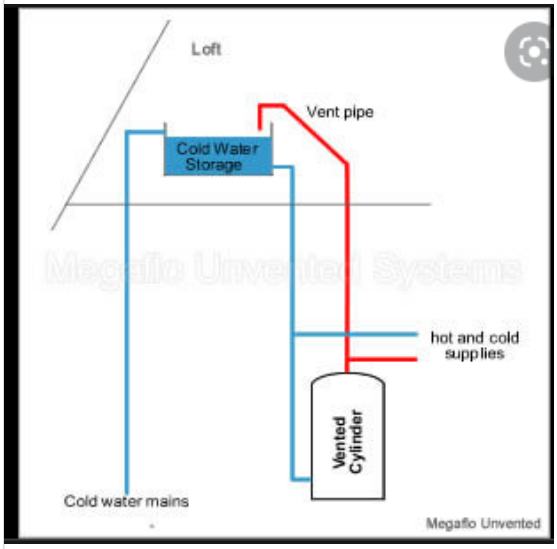
- The G3 ticket is also needed if you'll be working with solar thermal hot water installations or heat pumps, which in the future as the UK decreases its reliance on fossil fuels.
- A G3 qualification (G3 unvented course) is typically a one to two-day course and costs 200-250 pounds.
- To do the course, you'll need to prove you know your plumbing stuff already, for example by showing your NVQ 2 - certificate or equivalent plumbing and heating qualification and experience.

4. Open Vented Hot water Storage Systems:

- They are also known as **Conventional system** which consist of three main components a **storage tank, cylinder and / or a boiler**.
- Water is transferred from a cold water storage tank knows as **cistern**, to a **cylinder** or to a **boiler**(depending direct / indirect system is used) where it is heated, next it is sent to cylinder where it stays until it moves when taps are opened.
- Water can be heated by a **immersion heater or/and from a boiler**.
- It works better, where main pressure is lower using the gravity created pressure and serves multiple rooms better.
- Open vented system contain a vent pipe which remains open to the atmosphere ensuring that the hot water can not exceed 100 degree C. That is if a pipe carries more than 100 degree it gets vaporised in atmosphere.
- It **acts as a safety relief if the system becomes overheated**. It is sited over the cold feed cistern in the roof space.
- The main function is to maintain atmospheric conditions in the pipe-work and permit the escape of air which has entered the system and if the water gets over heated

allows it to discharge over the feed cistern .

- It is made sure that the vent pipe is terminated well above the flood-level, not the overflow level of the storage cistern. If this is not done, should the vent become submerged, cold water could be siphoned out of the cistern when a how draw off is opened.
- A vent pipe should also be insulated

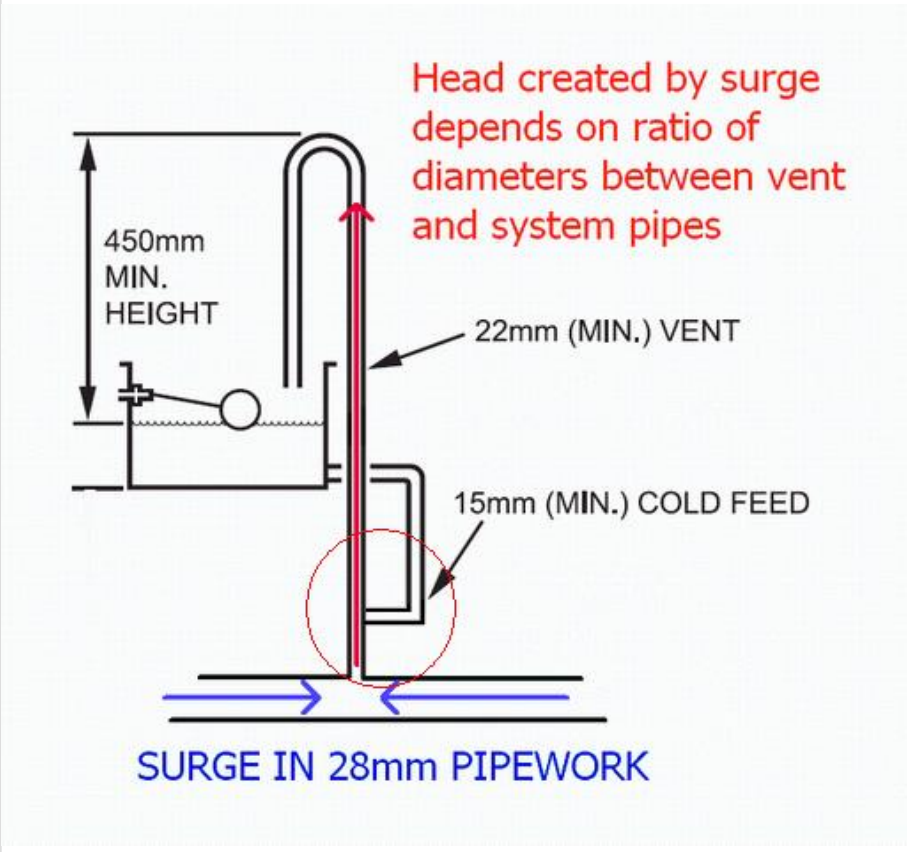


5. What is the capacity of cistern ?

- BS6700 recommends that the capacity of the cistern feeding cold water to a hot water storage vessel must be at least equal to that of the hot water storage vessel.
- But if the cistern is used to supply the cold water to appliances (CWD) then capacity should not be less than 220 litters .

Note: The open vent pipe **must not be smaller than 22mm pipe**, insulated for at least the first meter of its run and it must run continuously upwards to tis maximum height otherwise it can not act as a vent pipe. It should also rise **450mm** above the water level before coming down into the tank.

1. The height of the open vent should be a minimum of **450mm** from the water level in the cistern to the top of the open vent pip.(page 449). This is to prevent **parasitic circulation** from occurring also known as (pipe circulation).
2. This pipe must not be taken directly from the top of the hot water storage vessel but should be bent and kept 450mm away from this point and then raised above.

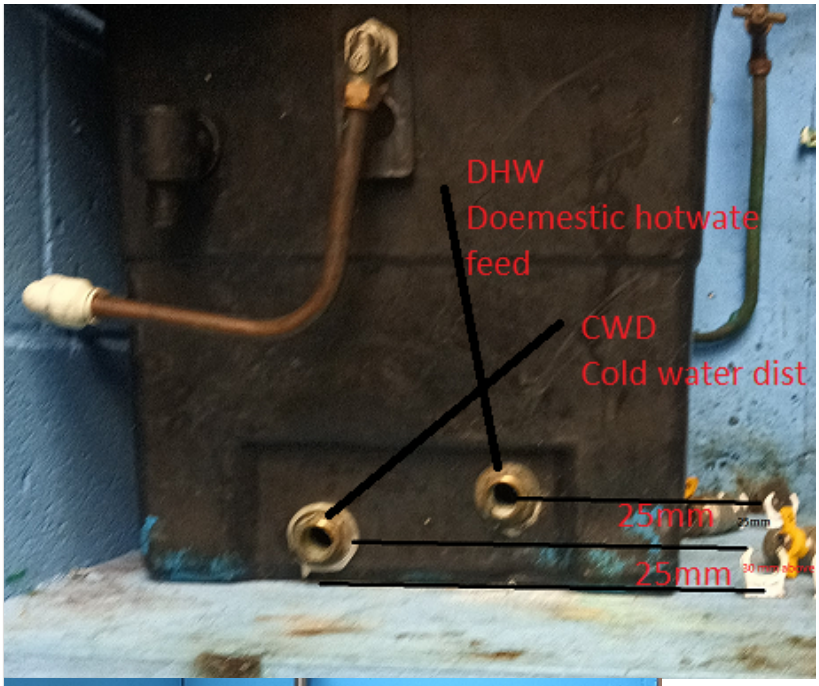


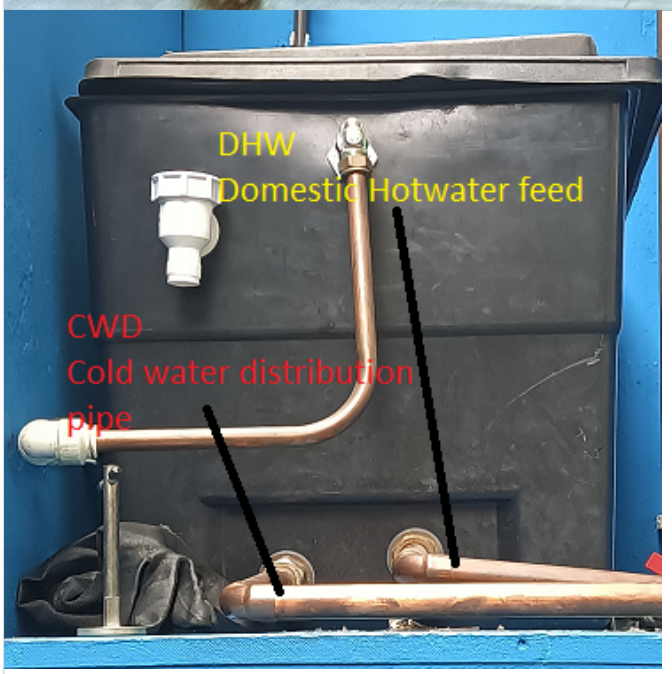
+

(diynot.com)

6. More points about open vented hot water system:

1. The cistern should be placed as high as possible to increase the pressure.
2. All pipes should be laid with a **slight fall to prevent air locks** within the system. (except the hot water drawn - off pipe)
3. The cold feed pipe or DHW (domestic hot water feed) from the storage cistern should only feed the hot water storage cylinder.
4. Another pipe that comes out of the cistern knows as CWd has to abide by the regulation. That is the bottom pipe is always the CWD pipe which is fitted 25mm from the base of the cistern. And 25mm above comes out is DHW as shown in the figure.
5. A drain-off valve should be fitted at the lowest point of the cold feed pipe.





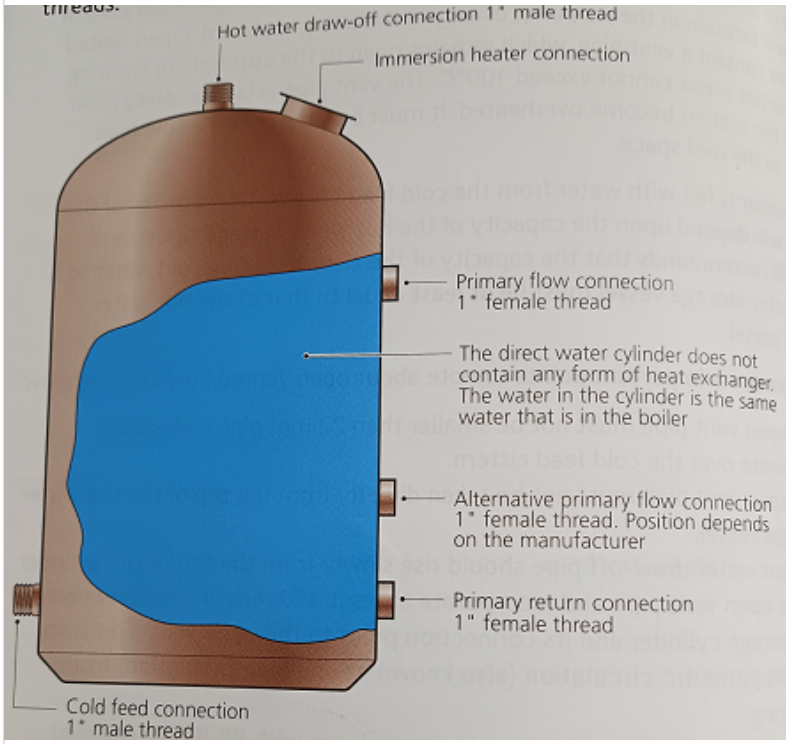
7. There are two types of open vented hot water storage system

1. **Open vented direct hot water storage system.**
   - The direct means the same water is used from the storage tank / cistern down to the cylinder (where it is heated either using the immersion heater) or using a small boiler where it is heated. Then back up to the cylinder where it is stored.
2. **Open vented indirect hot water storage system.**
   - The indirect means that there are two different water contents are present that do not mix up. One remains in the heat exchanger and knows as primary water. It is used to heat up the secondary water that is supplied to the home without ever coming into contact to the first one.

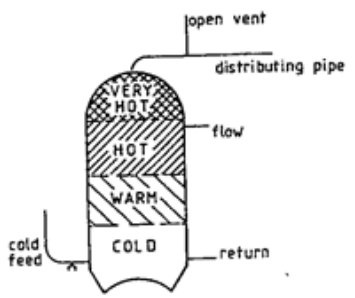
- Indirect hot water storage system can be of two types:
  - Single feed type
  - Double feed type / uses an extra cistern to feed the water

8. Open vented direct hot water storage system

1. This system uses a cylinder that is said to be of **direct type cylinder**. A direct type cylinder does not have any **heat exchanger** but the water in the cylinder is heated through and emersion heater fitted into it { or from a small boiler}. Since it is fed through a small boiler or uses an emersion heater, it is not suitable for **central heating**. As Central heating requires a constant supply of heated water. (see page 358-9)



- Hot water layers in cylinder



(a) Vertical cylinder

Vertical cylinder preferred to give better stratification and ensure that the hottest water is drawn off.

9. Boiler used in *direct hot water storage system*

- The boiler can be **gas-fired** hot water heater known as **gas circulator** designed to heat the water directly. Or a small back boiler situated behind a solid fuel fire { However these back boiler does not conform to **building Regulation Documents L**}.
- These boilers since feed the water into the cylinder which in turns send the water back to the boiler, they should be made of a suitable material like **copper,stainless steel, bronze** to prevent rusting. It happens because the water touches the boiler inner walls and if it is made of iron or any other unhealthy material the drinking water will get contaminated and becomes **dirty or rusty**.
- The hot water is circulated though the principle of **convection** also said to be using **gravity**(when heated becomes light and goes up / there is no pump used to push the water).Hot water goes from the boiler to the cylinder through the primary flow and the cold water comes back through the primary return.
- The water does not heated uniformly but the layers that get heated goes to the top and eventually sends to the cylinder and so on.
- The top layer is usually 10 degree hotter than the bottom layer.
- This hot water layering is called the process of **stratification**. And it is necessary to happen in hot water cylinder so that a good circulating is maintained.

Note: Primary flow and return must be of **28mm**. (unless stated differently in manufacturer instructions)

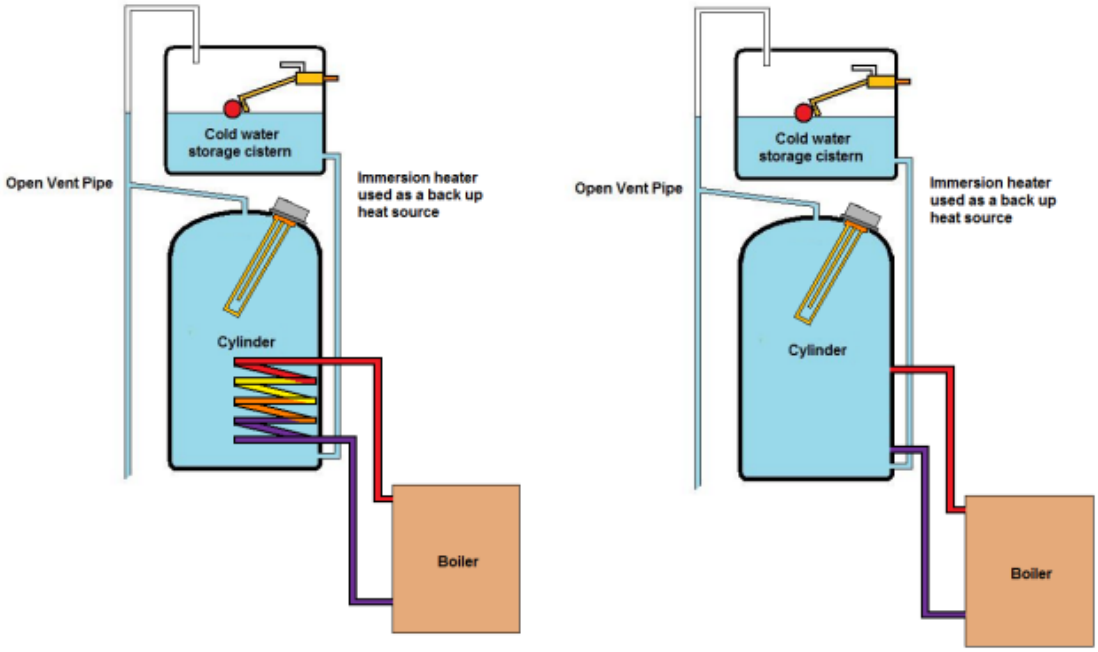
10. Pros and Cons of direct Systems

- The advantage is that it is cheap to install and quickly heats up the water. (but may have slow recovery period ?)
- The disadvantage is that if the wrong boiler is used the **rusty water can be drawn off the tap**.
- High risk of **scale build-up** in hard water areas if the water temperature exceeds 65 degree centigrade.
- High risk of **scalding** being burnt by the hot water because of not having thermostatic control.

The hot water temperature through outlets must be maintned between (38 - 40) to prevent discomfort and scalding. +

- Following diagram shows indirect and direct vented hot water systems

The two diagrams below show the general layout of open vented hot water systems:



11. A direct hot water system with immersion heaters

Note: There are Two different things: 1. direct/ indirect cylinders 2. Direct / indirect hot water/Coldwater systems: We are discussing direct hot water system

- A cylinder that has a built in immersion is said to be a direct cylinder without having to have any heat exchanger in it. So the term that water is heated directly inside the cylinder. While other call this an **alternative direct system** (page 360). But some direct cylinder can be fed from a small boiler that is not used in heating.
- They are understood to be the direct system because only one content of the water is used **from the cistern to cylinder and to boiler.** Then it is feed back from boiler to cylinder again.

Note: A direct hot water storage system can have both **an immersion heater and a supply from a small boiler**. There is no heat exchanger at all in direct system.

The same system becomes indirect if there is an heat exchanger fitted in the cylinder. This heat exchanger has water inside it that is heated by a different boiler (not a small one!). The water in the heat exchanger and the cylinder do not meet and are known as primary and secondary water respectively. This is known as indirect hotwater system

12. Immersion heaters

- A direct cylinder or a direct hot water storage system can either have a single **3kw** or two **1.5kw** immersion heaters present in the cylinder. Most modern cylinders utilises two 300mm, 1.5 kw immersion heaters.
- The reason to have two immersion heaters of 1.5 kw is to save the electricity cost .
- One immersion heater is placed on the bottom to heat all the contents and a second one is placed half way up for a day time top up . That is the top one only heats up the water present at the top or top third f the cylinder for day time. whilst the bottom up heats up the entire cylinder.
- These immersion heaters are wired to a **timer** to use cheap rate electricity over night.
- The temperature of immersion heater/elements should be set at 60 0c and can be controlled using a thermostat to prevent scalding. It is set to be tripped if exceeds 65 degree centigrade.

Note: most immersion heater elements are rated at 3 KW but cylinders can have 1 - 4 elements. All immersion heater must comply with **BS EN 60335-2-73**. They all should have a **resettable double thermostat (RDT)**

- A thermostat set to the desired temperature – 55°C to 60°C is optimum.
- A second thermostat, called a high limit thermostat (or energy cut out) set to operate should the maximum temperature be exceeded. This is known as a second tier of control.

Below is a table of how this can be achieved.

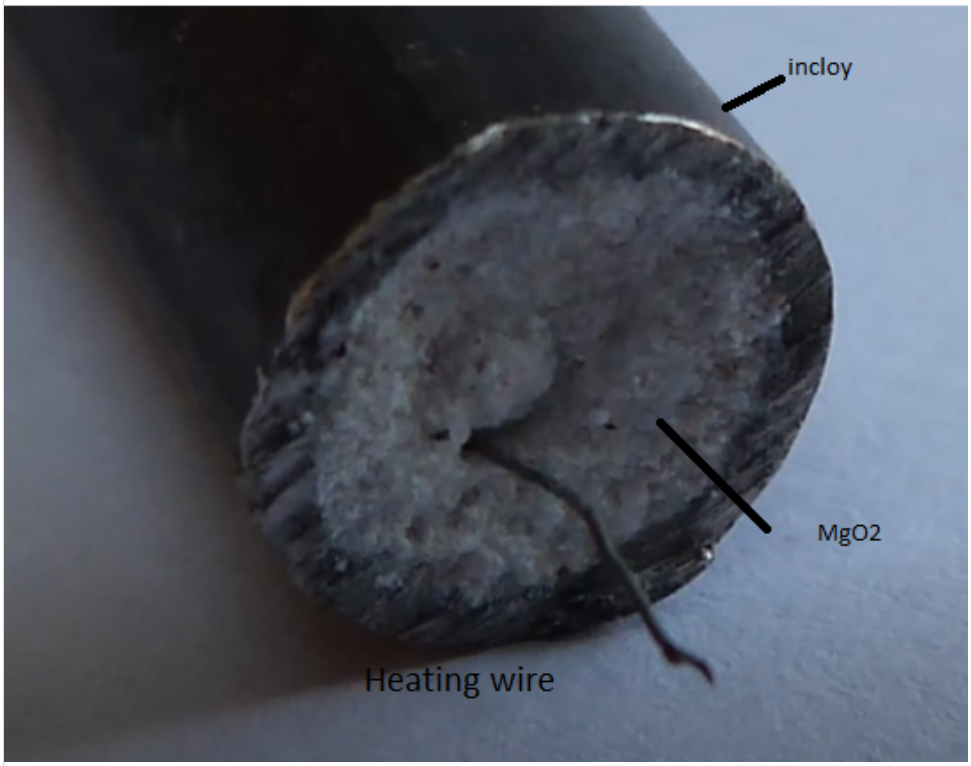
Hot water storage systems containing an immersion heater.

Immersion heater and thermostat

Immersion heaters have a double thermostat. The control thermostat is set to the desired temperature of 55°C to 60°C, whilst the second energy cut-out thermostat is set to 85°C. however, most energy cut-out temperatures can be altered and should be set to at least 15°C above the control thermostat setting.

Thermostats are available in re-settable and non-re-settable types. Non-re-settable thermostats must be replaced if the high limit energy cut-out activates.

- A Commonly used immersion heater in cylinders are made of **incloy**. This is outer layer, the inside is filled with MgO2 (magnesium oxide). This outer layer can be of stainless stell (1200 degree), stell (750 degree) and of copper (176 degree). But incloy can bear the maximum heat up to 815 degree the other are less respectively.
- Through this a small heating wire completes the electricity connection. When the current passes through this wire it generates the heat that is absorbed by the MgO2 and evenly dissipated to incloy.



- There are two different types of elements: **Low density and high density**
- **High Density Heating elements**: They take small surface area and generate more heat and by generating more heat per square inch thus gather more **limescale.** Hence they are only recommended for use in areas with soft to medium water.
- **Low Density Heating elements**: These elements as shown in figure uses a greater surface area, uses same amount of energy as their higher-density counterparts. By using a larger surface area they do not wear down quickly and produce less heat per square inch than high-density elements as a result attracts less limescale. If you live in a hot water areas as London you are better off using this element.

High-density heating elements

These elements feature a smaller surface area and **generate a lot of heat.** High-density elements gather more limescale due to their smaller surface area. As such, they are **only recommended for use in areas with soft to medium water** as your electric consumption will increase as the element degrades.

Low-density heating elements

These elements **feature a greater surface area and use the same amount of energy as their high-density counterparts.** As these elements feature a larger surface area, they do not wear down as quickly. They produce less heat per square inch than high-density elements meaning they **attract limescale more slowly.** This is an **important factor to take into account if you live in an area with hard water.**

13. Criteria of choice for direct Systems

- The storage capacity of the direct hot water storage system varies according to the occupants. **For four people 210 litre is recommended**
- Least expensive if the boiler and circulators are not fitted.
- Economy 7 electricity is 100% efficient but tariffs can be very expensive.

Note: Stainless stell cylinder and immersion heater is also available in the market.

14. What is Primary and secondary water ?

- A **primary water** is the water that is heated in heat exchanger so that we can get the hot water through the tap. The water that we recive though the tap is known as **secondeary water.**
- The primary water is found in the boiler, central heating system, and in the heat exchanger of an **indirect type hot water storage cylinder / vessel.**
- The primary water always heats up the secondary water indirectly though the heat exchanger.
- It is called primary because it is heated from the primary (main source) source that is boiler. The pipe that carries these water to the cylinder

are called primary flow and primary return. They are of 28mm pipes. That connects to the female adapter present in the cylinders.

Note: Cylinders have two male adapters, one is for hot water drawn-off pipe and the second one is for cold water feed both are of 1 inch size. The rest two or more are female type adapter of 28mm

15. Indirect hot water storage systems:

- As the name suggest it heats the water indirectly. And it is done by using a heat exchanger to heat the secondary water. There are two distinct types:

1. The single feed, (self venting) indirect hot water storage cylinder.
2. The double feed indirect hot water storage cylinder.

Note: The only difference between direct and indirect as discussed above is to use the heat exchanger in the cylinder that keeps the primary and secondary water separate.

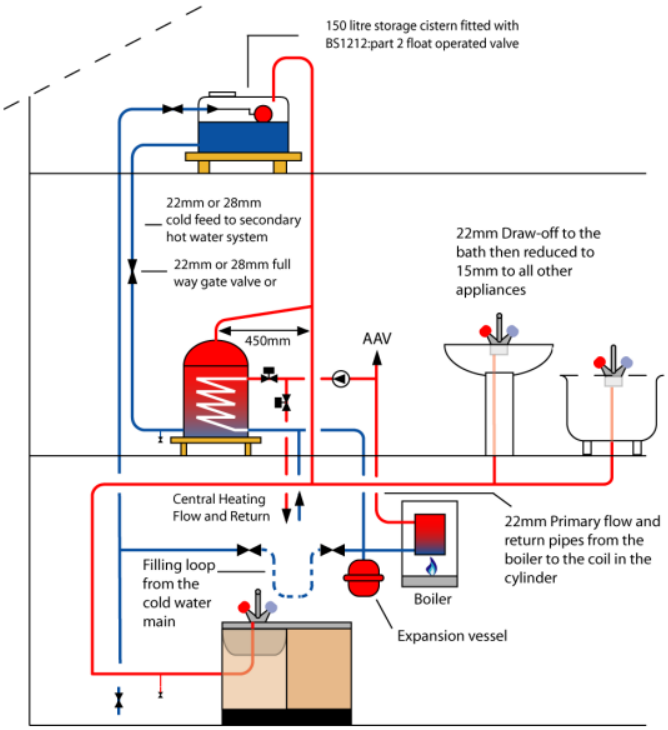
As far single feed and double feed is concerned , a double feed system is used when an extra 18 l cistern is installed, known as **Feed and expansion** system. The rest remain the same. This extra cistern is needed to overcome the expansion of the hot water. When the hot water is heated in indirect system it needs a way to expand. That is when water is heated its volume increases by 4% thus an extra cistern is required to hold the water.

16. Indirect double feed system (not cylinder!)

Indirect double fed diagram with pumped circulation.

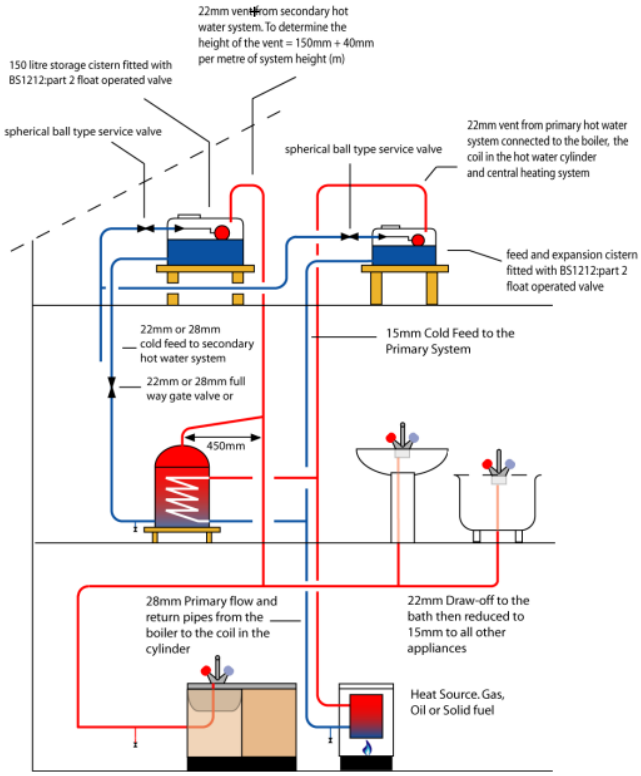
indirect double feed system

Indirect double fed diagram with pumped circulation.

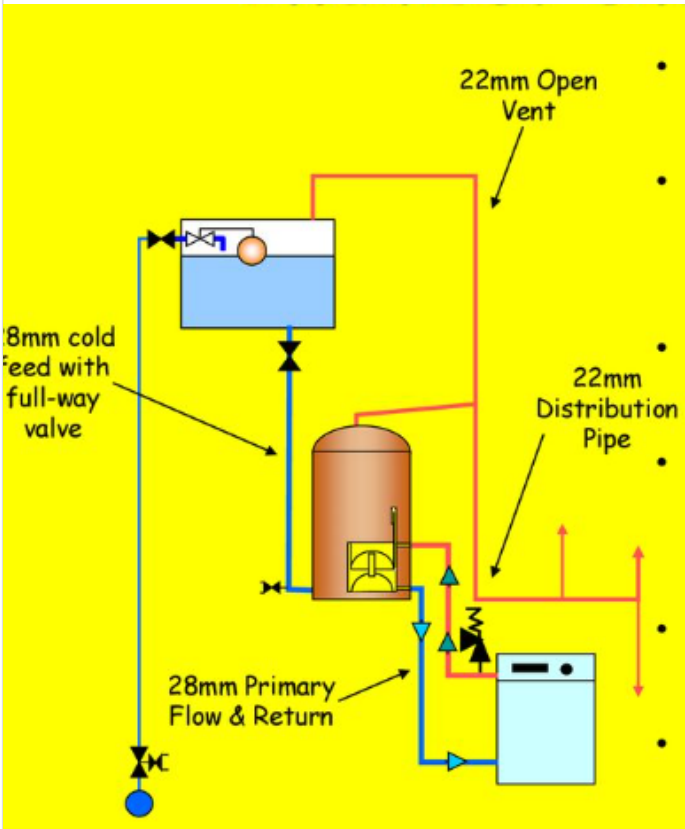


The indirect hot water system with pumped primary circulation

indirect double feed system



- Indirect single feed system



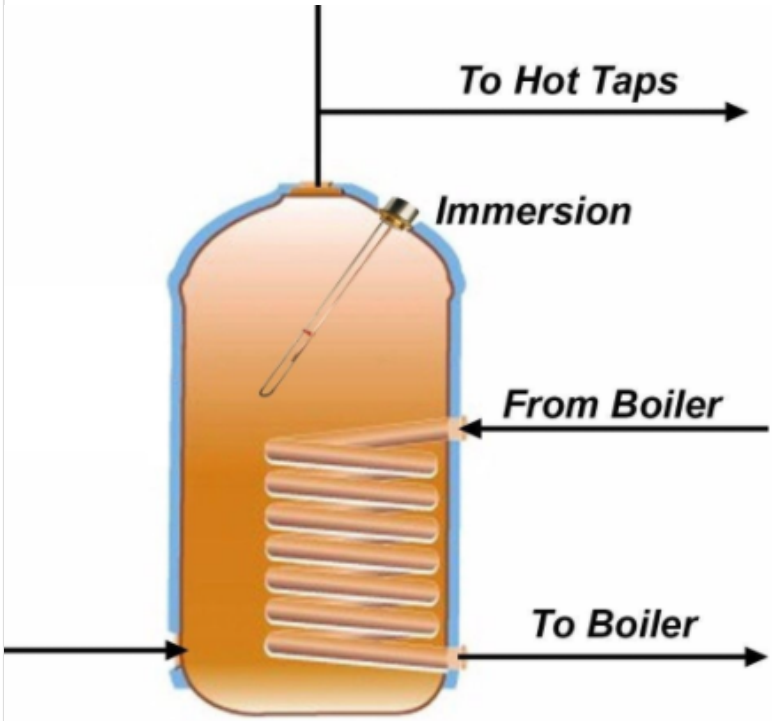
17. The Open vented indirect (double feed type) hot water storage systems

1. Most common of all **hot water delivery systems** installed in domestic properties.

2. It uses an indirect hot water cylinder that contains a heat exchanger.
3. This heat exchanger is usually a copper coil.
4. It is called indirect because the the secondary water in the cylinder is heated indirectly by the primary water present in the copper coil (heat exchanger)

18. The double feed indirect cylinder -1

- It contains a heat exchanger and suitable for central heating system.
- The connections for the **cold feed, primary flow and return are usually 1-inch male threaded connection**



It is now a general practice to install indirect cylinders in preference to direct types, even if the indirect flow and return are capped off.

19. The double feed indirect cylinder -2

- The indirect cylinder allows the use of boilers and central heating systems that contain a variety of metals, such as steel, and aluminium because the water in the cylinder is totally sperate from the water in the heat exchanger.
- This simply means that there is no risk of dirty or rusty water being draws off at the taps.

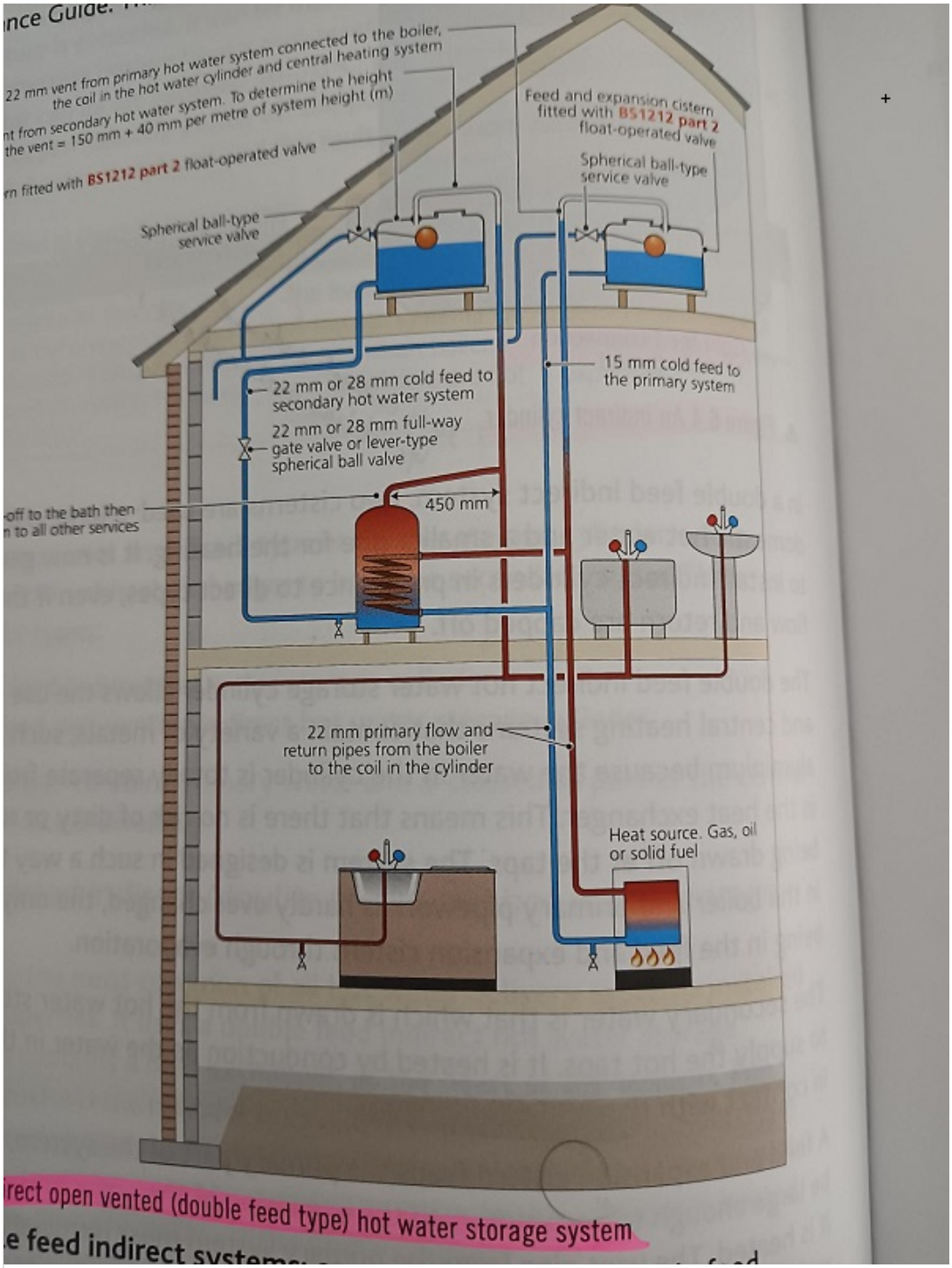
- The system is designed in such a way that a boiler and primary pipework is hardly ever changed, the only loss of water being in the feed and expansion cistern though evaporation.

Note: the secondary water that is drawn off from the tap is heated through the primary water due to **conduction**. As it touches the coil in cylinder.

- The hot water storage cylinder must conform to **BS 1566** which specifies the minimum heating surface area of the heat exchanger.

20. What is existing double feed indirect systems:

- They are no longer used or installed as they waste energies. Documents **L1B** fo the **Building Regulation** recommends that these systems should be replaces with fully pumped systems wherever possible. (page 362).

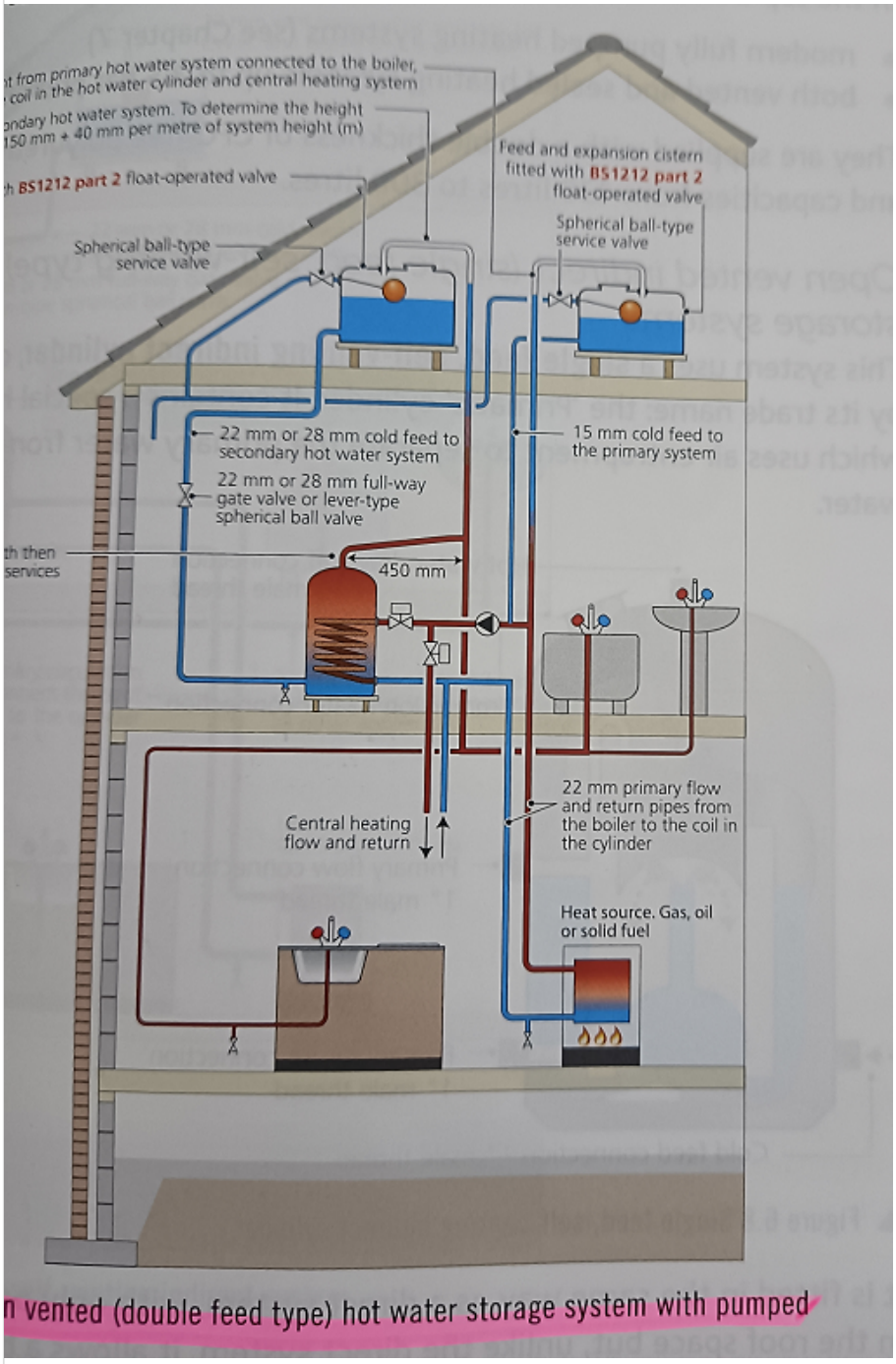


- It does not have any primary pumped circulation.

21. What are new double feed indirect systems:

- The document **L1A** of the building regulations dictates that all new installations must have **pumped primary circulation with controls that prohibits energy wastage.**
- This is achieved by installing a thermostatic control over the hot water storage cylinder.
- It is installed in combination with **modernized / motorised zone valve arrangement..** It is necessary to install **pumped primary circulation.**

- Here an extra cistern is installed knows as **fixed and expansion cistern.** with **BS1212 part2** shown above.



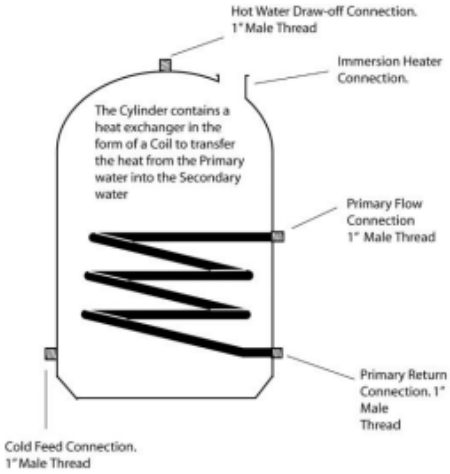
n vented (double feed type) hot water storage system with pumped

- It has primary circulation pumped installed.

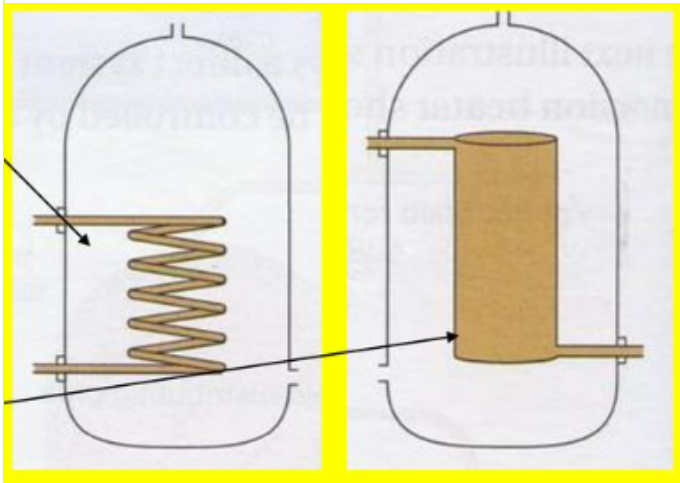
21 - A. Where does the difference lie in Direct and indirect hot water storage cylinder ?

- They both look same from the the outside. The difference is present internally.
- Indirect hot water storage cylinder contains a heat exchanger to transfer the heat into the water.

- Indirect Cylinder can be used with central heating systems and it is the central heating boiler that is the primary heat source for the systems.



- Some indirect cylinders uses a **copper jacket** instead of **coil,** often used in large cylinders.



The double feed indirect system has two cisterns. A large cold feed cistern that supplies the cold water to the hot water system via the cold feed pipe and a **smaller feed and expansion cistern to supply water to the boiler, hot water heat exchanger and central heating system**. Here the hot water circulates via the primary flow and return pipes, with the aid of a circulating pump or without a circulating pump through gravity

- There is another type of hot water cylinder that uses a special type of heat exchanger when compare to normal coil heat exchanger.
- It uses as **single feed** and has a mechanism to **self vent** itself. Since it uses a separate compartment to heat the water it is also known as **indirect.** It uses air entrapment to separate the secondary water from the primary water.
- It is knows as **Single feed, self-venting indirect cylinder**
- Its trade name is **Prismatic cylinder of IMI Ltd**

- It has another version of it known as **Aeromatic** which has a air release valve on the side of they cylinder near the heat exchanger.

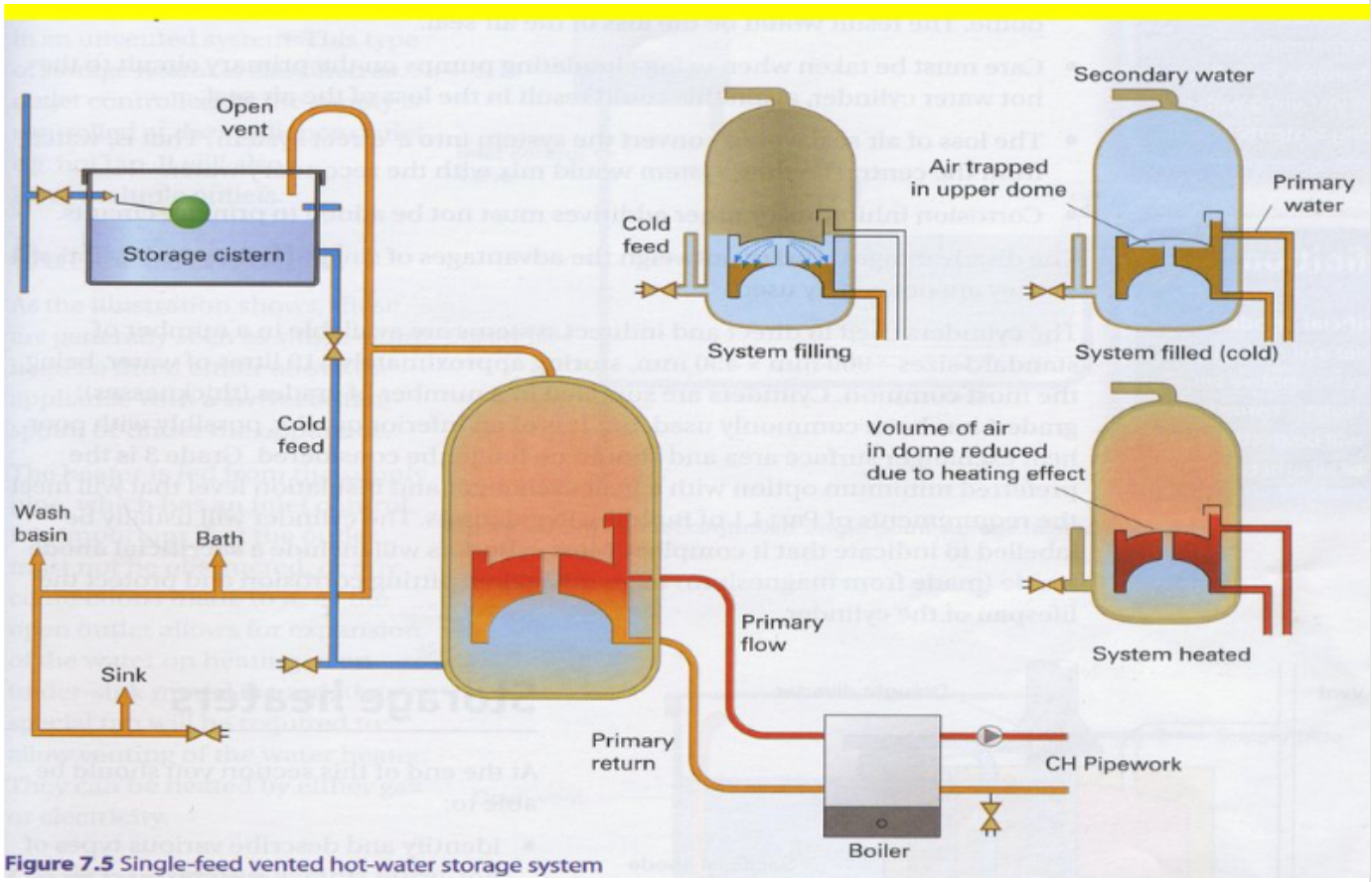


Figure 7.5 Single-feed vented hot-water storage system

- How it works ?
- Water enters the cylinder though a number of holes.
- The system is self venting via the vent
- Primary circuits fills then the secondary circuit.
- Two air sealed formed and a permanent seal is maintained
- The water is heated and expands into the upper dome
- Disadvantages: The disadvantages outweighs the advantages of single feed self venting cylinders so they are not widely used. If using **circulating pump on primary circuit** care must be taken this could result ins seal loss. Similarly primary circulation must not be too large, excessive water once expanded could displace the seal. Once the seal is loss (air seal) it would convert into **direct system** and water from the central heating system would mix with the secondary water.

22. Describe the following:

- Open vented direct single gravity fed hot water system

The system:

- It is hot water storage system that incorporates a principle of gravity for the water circulation without having to use any external pump to push the water from A to B.
- In gravity feed system if boiler is used the water is heated through a gas fire circulators. When it is heated becomes light and goes up thus using the principle of gravity system. Along with the boiler to heat up the water, a cylinder is used to store the water. This cylinder is said to be of direct type as it does not use any heat exchanger in it.
- This cylinder is fed directly from the cold water cistern which capacity should either be equal to of the cylinder capacity or if it is to be used for cold water distribution (CWD), it should not be minimum of 220 litters. This cistern gets the water from the main 28mm pipe from the outside using a full gate valve and hence feed the boiler using 22 or 28 mm pipe. Since it is the only source of water for the boiler,it is said to be a single fed.

Parts and Measurements:

- A boiler can use any heat source (gas, coal, oil, lpg , wood etc). Previously a back boiler were used which are not longer allowed due to not having any control over them. Commonly a gas-fired boiler are used which are called gas circulators. These boilers feeds the water using the principle of heat exchange knows as **convection** whereby the hot water goes up through a 28mm copper pipe called primary flow. This pipe is fixed in cylinder female port on top. From the bottom of the cylinder another female port of 28mm allows the primary return to go back into the boiler again.
- The cylinder used can be of any grade. The copper cylinder usually comes in three grades. In domestic homes Grade 3 is commonly used with a PH of 7.5. The grades are measured in heavier material or thickness of the copper sheet used to make a tank. A British standard allows you to buy a cylinder for home that is at leas has 75mm thickness. These copper tank has a layer of insulating material around it. If it is not properly insulated,it can be insulated using different foam comes for this purpose they are properly wrapped around the cylinder. These cylinders have two male 1 inch thread adapter present one is for cold water feed and the other is for hot water drawn off pipe. The rest three holes are present one female for immersion heater and the rest two are female 28 mm hole for primary and return flow. The standard used in copper cylinder is knows as of **BS 1566: 2002 Direct/indirect/ single/doulbe/feed**

23. How many grades of cylinder we have?

- Cylinders comes in three grades

- Grade 1: 25 metres maximum height == 82 feet with 3.65 maximum bar pressure.
- Grade 2: 15 metres maximum height == 49 feet with 2.2 maximum bar pressure.
- Grade 3: 10 metres maximum height == 33 feet with 1.45 maximum bar pressure.

The maximum pressure is for testing the operating pressure is 1,2 and 3 bars.

24. Copper cylinders are manufactured to the following standards

- BS 1566: 2002 Direct Copper Cylinders
- BS 1566: 2002 Double Feed Indirect Copper Cylinders
- BS 1566: 2002 Single Feed Indirect Copper Cylinders
- BS 3198: 1981 Combination Units

Cylinders are normally insulated with CFC free polyurethane foam

24 - A Different type of Hot water cylinders

- There are several categories of cylinder that can be split into further types. Lets first deal with categories:
  - Vented
  - Unvented
  - Thermal store

These categories depends on how we intend to supply **cold water to the cylinder** which would determine what we can expect in the way performance form the cylinder.

- There are 2 methods to supply water to cylinder.
  - Directly from the incoming cold water main , known as a **mains pressure supply**
  - From a tank known as Cistern, Header Tank or a Storage Tank they are known as **gravity supply**
- Only Unvented and Thermal storage cylinders can be connected to a directly with main pressure supply using regulators that makes sure that cold water is always fed with 3.5bar pressure to a cylinder.

- Unvented cylinders are pressure vessels, water is supplied with a constant pressure using a regulator. Water is heated by any means (using …). It supplies constant hot water to appliances.
- Vented cylinders are gravity Cylinders and are designed to deal with low pressure, they are graded for the head of water they can handle.
- Thermal storage / stores: A thermal store could be linked to a large bucket. The water in the bucket is heated by whatever means. The advantage of a thermal store over an unvented cylinder is the Thermal storage can remain open vented that is to say there is no pressure in the stored water. This makes the thermal stores inherently much safer. Whilst rare unvented cylinders have been known to go over temperature / over pressure which has lead to explosion. for reasons of safety the installation of unvented cylinder is governed by Section G3 of the Building Regulations .

Note: Thermal Store Unvented system that is high pressure cylinders can be direct or indirect but heat source must be controllable They are solar compatible. They require **F&E tank**. Can be configured to handle multiple heat sources(direct, indirect, solar) simultaneously.

24 -B Combination open vented water storage cylinder

- It has its own cold feed cistern attached on the top of the cylinder and factory fitted cold feed and vent pipes. They are known as **Fortic Cylinder** they are available in both direct (immersion heater only and circulator / boiler types). they come in variety of sizes.
- They are usually installed in flats where no place of over head tank is present and space is tight. Ideal for rented accommodation due to its low maintenance requirement.
- By design there is very low static pressure and they should be installed as high as possible. Similarly power shower pump can cause the problem because the cold water cistern can not replenish itself quick enough to feed the

shower pump. The cistern is not designed to supply hot and cold water systems and so shower pumps must not be fitted to his type of hot water supply .

- They are fully compatible with Doc L of the Building Regulations.
- They can be said to centralised combination indirect open vented cylinders .
- The hot water draw off pipe is from the side.

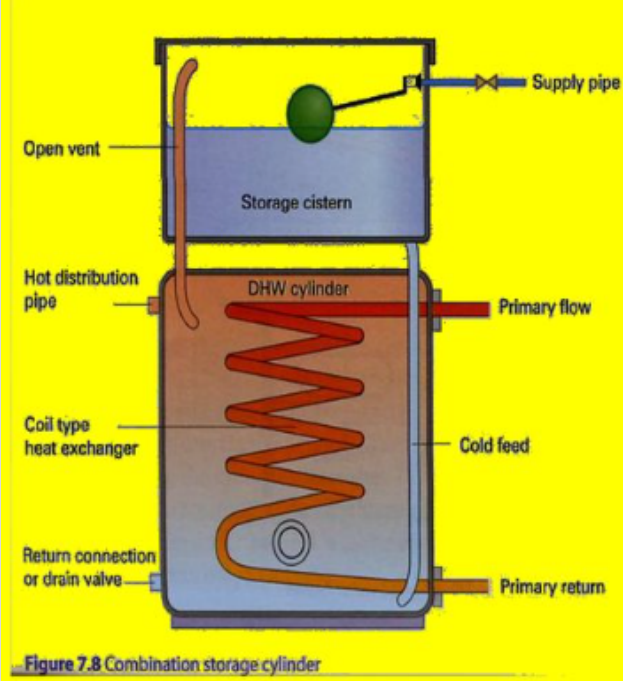


Figure 7.8 Combination storage cylinder

Note Thermal Stores can also be supplied as cylinder type or combination type and configured as twin coil indirect cylinder or as as single coil direct cylinder. Additional features can be added to they cylinders.

Direct and Indirect Thermal Stores

As their name suggests a thermal store collects and stores thermal energy. Being able to store energy from multiple heat sources (some of which can be uncontrollable by nature) offers a huge advantage over unvented mains pressure cylinders. Once captive, the stored energy can be returned as mains pressure hot water or hot water for central heating. Ideal for wood burning stoves and AGA or Rayburn type range cookers. Now your stove can centrally heat your house.

Above:
Combination thermal store

Available as cylinder or combination unit
A **Thermal Store** can provide mains pressure hot water by passing incoming mains pressure water directly through a large heat exchanger immersed within the store.

Combination Thermal Stores
This range of stores provide their own attached feed and expansion (F&E) vessel - necessary to ensure the store stays topped up and for the lower (hot) part of the store to breathe into.

The 'cylinder only' version
Require a separate F&E tank (not included) for the same purpose. It often suits the system configuration to choose this option.

A Thermal Store
can be configured to install almost anywhere within a property. Simple to install with no requirement for an unvented certificate and being able to take various heating inputs the **Thermal Store** offers far greater flexibility than an unvented cylinder.

Above:
Cylinder type thermal store with optional metal jacket

The beauty of a thermal store is its safety
Unlike other methods of providing mains pressure hot water (namely: the unvented cylinder) a thermal store is inherently safe. With no way to build up dangerous pressure explosion is simply not a possibility let alone a risk. So, all the benefits, none of the risks.

Thermal stores can take heat from sources considered too dangerous for unvented cylinders
A massive advantage a thermal store has over an unvented cylinder is the ability to take heat inputs from uncontrollable sources (wood burning stoves, AGAs, etc) safely and simultaneously.

Attempting to feed such energy into an unvented cylinder could result in explosion from an over-pressure/themperature scenario. All a thermal store requires is a heat dump.

All in all a thermal stores offer a fantastic way to harness multiple heat sources, controllable or otherwise, and give back the energy as either domestic hot water and/or household heating.

Because this range of store has no moving parts it is ultra-reliable and won't require an annual service for safety.

Thermal Stores can be supplied as a **cylinder type** or **combination type** and configured as an **twin coil** indirect cylinder (cold to hot mains pressure coil, and boiler input coil), or as a **single coil** Direct cylinder (cold to hot mains pressure coil with electrical immersion heaters and/or direct input from heat source/s. Additional features may be added to the cylinder (some at additional cost) as per the table below:

24 -C Quick Recovery cylinder (Superduty cylinder)

- It has **multi-coil** heat exchanger that is made up of serval smaller bore coils rather than one large one. It is said to be a **special high performance heat exchanger** that reduces the boiler cycling and maximise the time the boiler can operate in **condensing mode.**

+

- Due to greater surface area it provides rapid recovery of the hot water.
- They work in a similar way of instantaneous hot water cylinders and are replenishing the hot water while it is being used. This reduces the amount of storage required and can save up to 40 % on fuel bills when compared to the standard cylinder type.
- Small storage cylinder means more space in the airing cupboard
- Reduces boiler cycling
- Saves on fuel boilers
- Can be used with conventional fully pumped systems
- they work at their most efficient when installed alongside condensing boilers running at maximum temperature. This will ensure that recovery times are at their absolute minimum and the lower return temperature of the condensing boiler will maximise the time boiler spends in condensing mode.

▲ Figure 6.13 Quick recovery (Superduty) cylinder

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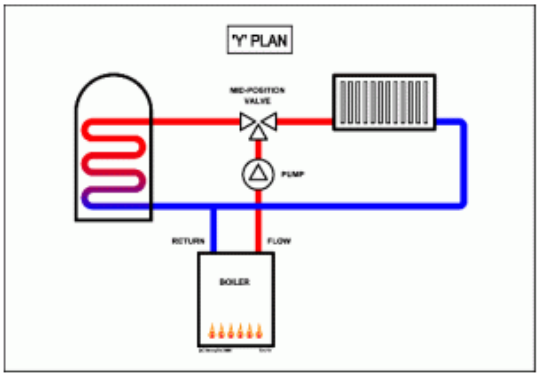
- Superduty Cistern flow cylinders are suitable for fully pumped primary systems fuelled from mains gas, lpg or oil boilers. - They are compatible with W, Y and S plan systems . Quicker reheat times are achieved with W plan systems .
- A probe type insertion thermostat is required to provide increased temperature sensing and accuracy over that of the strap-on type. A connection is provided on each Superduty for this fitment.
- They are to be 2010 Part L1b compliant.

24 - C- A - Difference between S and Y plan

- **Y-plan** heating system
- It is also referred as fully pumped three-port valve (mid-position / diverting) (Y/W Plans).
- As central heating designs can differ from house to house based on the requiements of the property ensuring that heated water is diverted to the correct areas. S and Y plans are also a way to ensure that your boiler interlocl works.
- That is the boiler automatically switches itself off when there is no demand ofr central headting of hot water in your home.

- Y plan has a three-port valve supplying both the cetnal heating and / or hot water. This three port valve is shaped like the letter **Y** when you look at the layout of pipe work point of view.



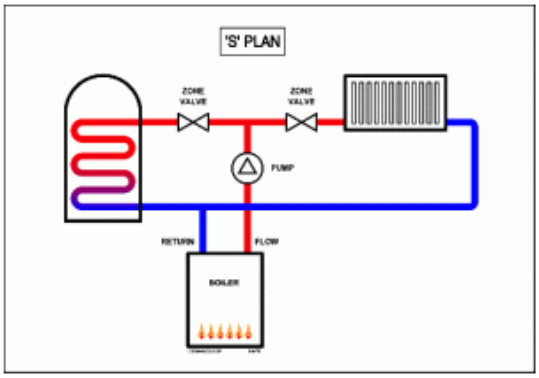
- In Y plan water comes through the bottom of the valve. This valve then sends this flow of water to either Port A, which is the heating port, or Port B the hot water port or through both to work both the central heating and hot water simultaneously.
- A Y-plan heating system has fewer components than an S plan heating system making it a more compact and easier installation.
- A Y-plan that includes a three-port valve is called a **mid-position** valve as shown below.

- A Y-plan is built with one three-port motorised valve which controls both the central heating and the hot water at the same point. It also has a room thermostat, a cylinder thermostat and a programmer.
- There are following benefits of having a Y plan Heating system which includes
  - Close temperature control on the hot water system and heating system.
  - Times operation of all heating components
  - Saves money of fuel
  - Easier to install due to having few parts.
- But there are limitation as well the first one being that of having only one control zone. As a result both the central and hot water system is controlled by it and the flow rate is to

be shared between them. Another limitation is having only one zone and one valve means that if it fails you will be without the hot water and heating.

- Another issue is that when demand of both are less the valve can get stuck due to not being used. And the head of the motor can get burnt out when the motor head tries to move the position of the valve.

- **S-Plan** heating system (https://www.warmzilla.co.uk/blog/s-and-y-plans-explained)
- It is also referred as fully pumped, 2 * two-ports valves.
- An S plan heating system has two separate motorised valves. One that control the heating and the other controls the hot water. They can be used individually to control the heating system providing different zones. With S-plan further zones can be added by adding additional thermostat and motorised valves to each circuit.
- Whenever it is to be turned on due to the demand of water, 230 v are sent down to Motor live wire, in turns motor turns the valve, opening the body of the valve allowing the heating pump to push water though.
- Once the valve is pushed all the way open, it also pushed down a microswitch, activating the circuits between the Permanent live wire (usually grey) and the Switch Live wire (usually orange in colour). Once the 230v hits the switch live the boiler ignites.
- Once the demand of the hot water is fulfilled (either the timer is turned off or the thermostat reaches the desired temperature) the power to the motor live wire is lost so the valve body springs back and shuts off the flow though the valve.



- Having S-plan installed means that one can have both hot water and heating isolated and additional zones can be installed. Adding zone heating system provides a greater level of flexibility, comfort and energy efficiency.

Note: there also exist a version of S-plan that is knows as S-Plan +, it is fully pumped 3 * two-ports valves +

24 -D Indirect cylinders for renewable energy hot water supply

- Open vented cylinders have been developed for installation onto renewable energy hot water supply systems, such as **solar, geothermal and ground-source heat pumps.**
- The cylinder contains two heat exchanger coil. The first coil is used with a conventional fuel source such as gas or oil and this accounts for 70% of the cylinder hot water volume.
- The second coil has 30 percent volume dedicated to the renewable energy heat source and is usually situated in the top third of the cylinder. They are suitable for
- Modern fully pumped heating systems.
- Both vented and sealed heating systems up to 3.5 bar pressure.
- They are supplied with a double thickness of CDC-free polyurethane insulation and capacities from 130 liters to 300 litters.
-

25. Unvented hot water systems

- It was a European idea to have them without having to have the use of water tank.
- It is just a cylinder with expansion tank. The expansion tank works like our lungs that expands and contracts.
- To install this on your place it must conform to manufacture specification and one of them is that you should have the main water coming into your house with minimum of 20/minute flow rate.
- They are complicated system and have many more parts involved in installation. They are subject to the legal requirements of **Building Regulation G3** and can only be installed by a **competent person** to ensure the installation is safe and that all essential safety components are correctly installed.
- In simple words you have to have a G3 certificate (G3 qualified engineer) to install an unvented pressurised cylinder in domestic or commercial properties.
- Followings are main part of this system.

1. **Pressure Reducing / Relief Valve**: This is placed on the incoming cold water main pipe to the hot water system to reduce the water pressure slightly and keep it at a constant level of pressure. So the pressure within the mega flow cylinder and pipe work remains safe limits. If it exceeds this limit (6 bar), the valve will open automatically and release the pressure. The water discharge should be visible thought the Tundish

Megaflo Pressure Relief Valve

2. **Temperature and pressure / expansion Relief Valve (TPR)**: This is designed to relief the pressure if the cylinder or system pressure exceeds a pre-determined limit (e.b 10 bar).This valve is also part of the 'sealed'heating system. Additionally this valve will release if the temperature within the cylinder reaches **90-95** degree centigrade so that water does not reach 100 deg C.

Megaflo TPR Valve

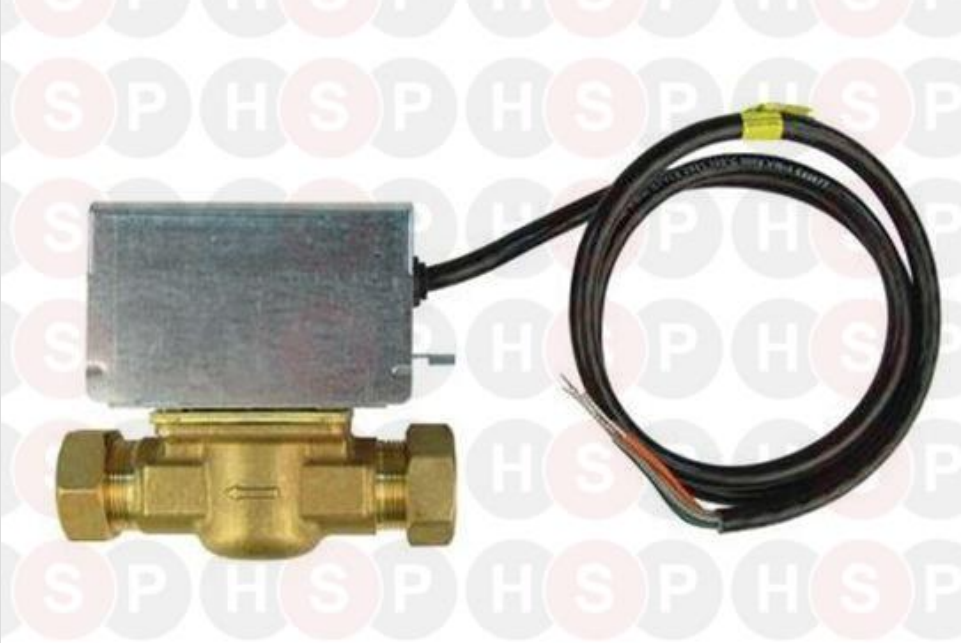
3. **The Tundish**. This is connected to the pipe coming from the relief valve. This device is placed in the pipeline to alert you to a fault in the system. As you will be able to see the water flowing our of the safety valve. It provides a visual point of discharge warning signal that something is not quite right and further investigation should be sough as soon as possible.

+

4. **Motorised Valves**: These are required by indirect system along with other zone valve for the **primary heating circut**. A zone valve as name suggest serves a particular zone of the house e.g a bed room or a floor

Megaflo Motorised Valve

- 22MM 2 Port Motorised Valve also knows as `s-plan`



- Honeywell home 3 port mid position 22mm valve also knows as `Y-plan`

- Other parts: **Expansion Vessel, Auto ari vent and circulation pump.**: Just like in vented indirect hot water storage and heating system an extra cistern is suppled to accommodate water expansion. In unvented system the expansion vessel is designed to store this extra water an stop the parts of the system bursting / damaging. If no mechanism is provided the system will burst.
- Auto air vent is a part of this system there may be some additional one required.
- Pump / Circulation pump: They are used for heating circuit and the Mega flow cylinder.

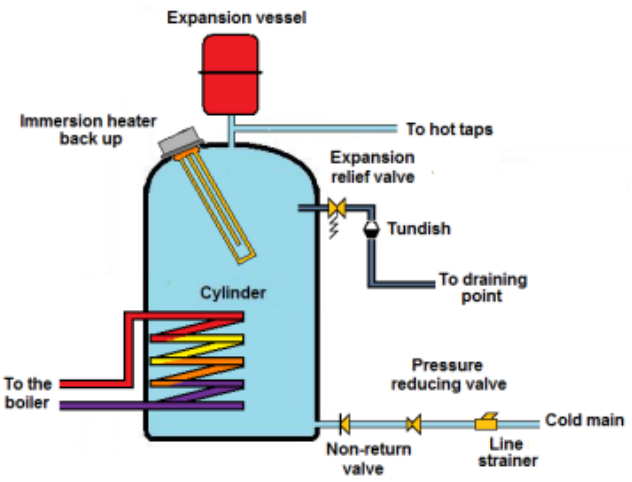
Auto Air Vent

Circulation Pump

- How they all work together

How does it all go together?

The diagram below shows the general layout of an unvented hot water system:



- The inner view of direct hot water cylinder

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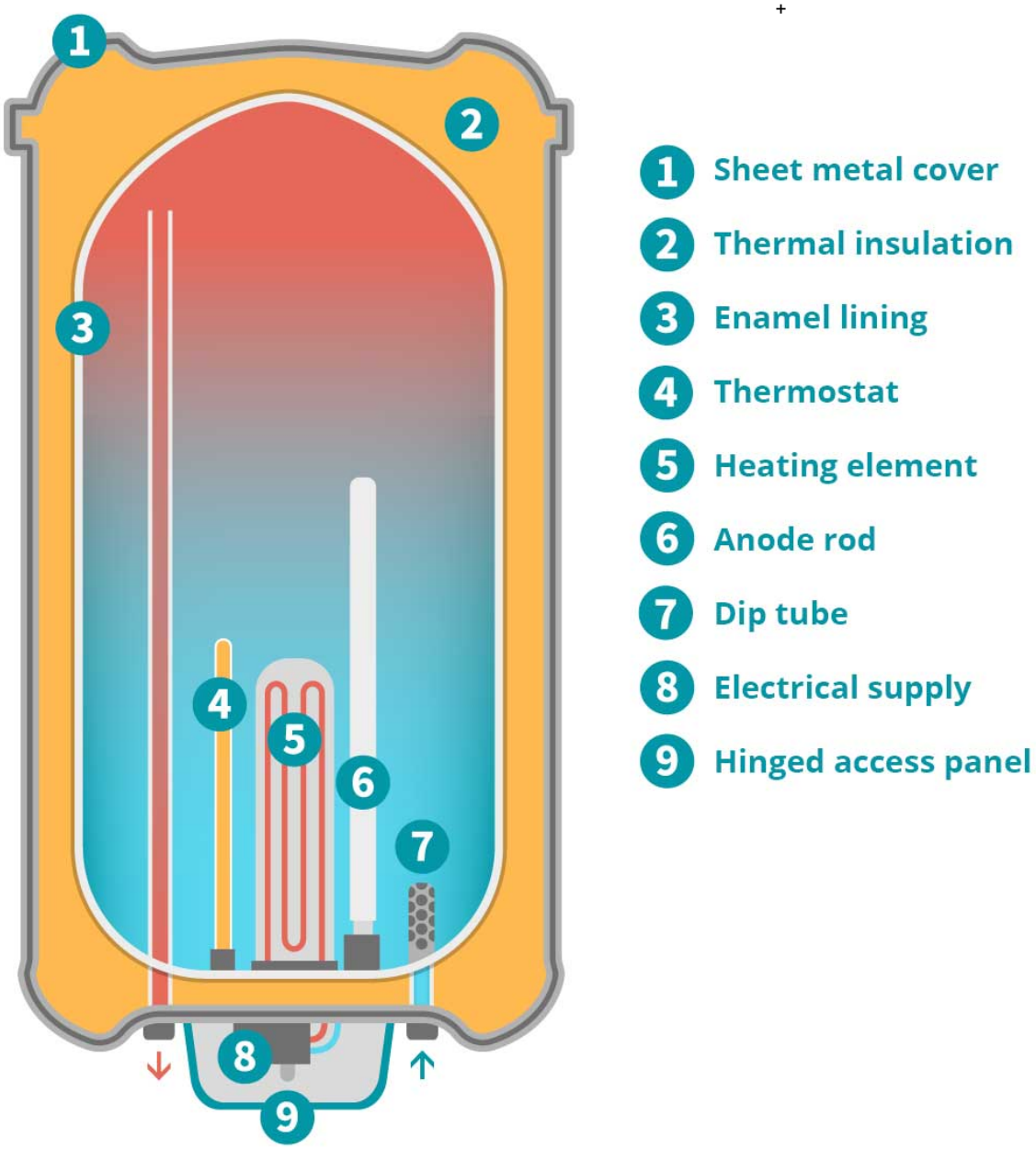


- Water heater anode rods:
- The tank of your water heater is covered with a glass lining to protect it from corrosion. However, this lining can feature tiny cracks where rust can set in. To prevent these micro cracks from corroding, all hot water cylinders are equipped with an anode rod which acts as an anti-corrosion device (known as cathodic protection).(aource https://www.manomano.co.uk/advice/direct-hot-water-cylinder-buying-guide-2969 (https://www.manomano.co.uk/advice/direct-hot-water-cylinder-buying-guide-2969))

26. What are **primatic cylinders** ?

- Prismatic cylinder is a **trade name of IMI Ltd.** It uses a **Single feed, self-venting, indirect cylinder.** Thewe cylinders do not use copper coil heat exchanger but a special heat exchanger which uses **air+ entrapment** to seprate the primary water from the secondary water.
- It is fitted in the same way as direct system with only one cold feed cistern in the roof but unlike the direct ssytem it allows a boiler and central heating to be installed.. It does not require a separate feed and expansion cistern.

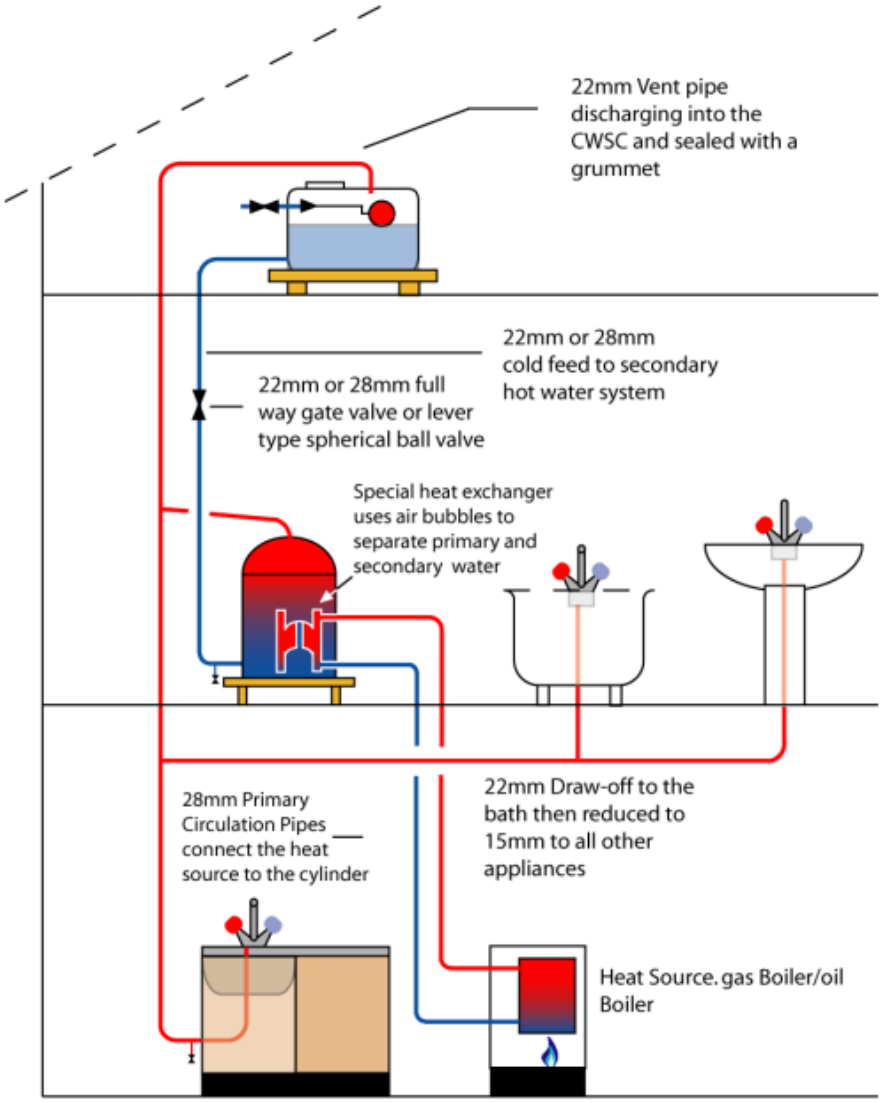
Note: Thee cylinders are no longer allowed for new or replacement cylinders.

- Instead a double feed-type cylinder must be use on all replacement.

27 How to name a system from a given diagram ?

- Starts with **open vented or unvented**
- Then bring **direct or indirect**
- Then bring **single or double feed**
- Then use **hot water storage system**
- In the end use **gravity or main feed.**

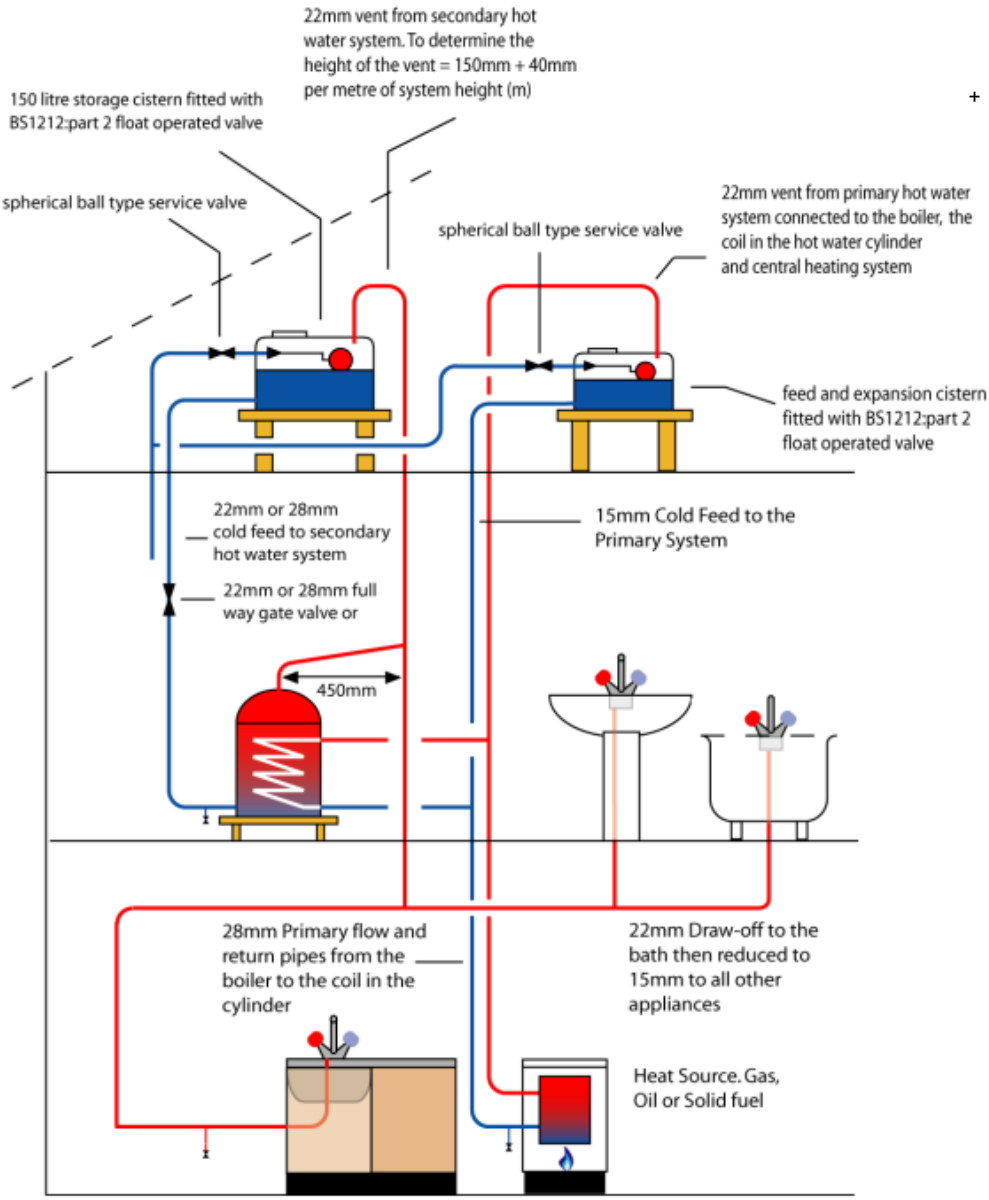
28. Name the given / shown system.



The indirect, single feed hot water system

- The above system can be named like this starting the above rule.
- it is an **Open vented, indirect single feed hot water storage system utilising gravity circulation**
- The vent pipe tells us that it is *vented / open vented*
- The special type heat exchager presen in the cylinder tells us that it is *indirect*
- One cold water feed is used thus *single feed*
- As there is no feed and expansion cistern is used it is not double feed as in modern system a **sealed

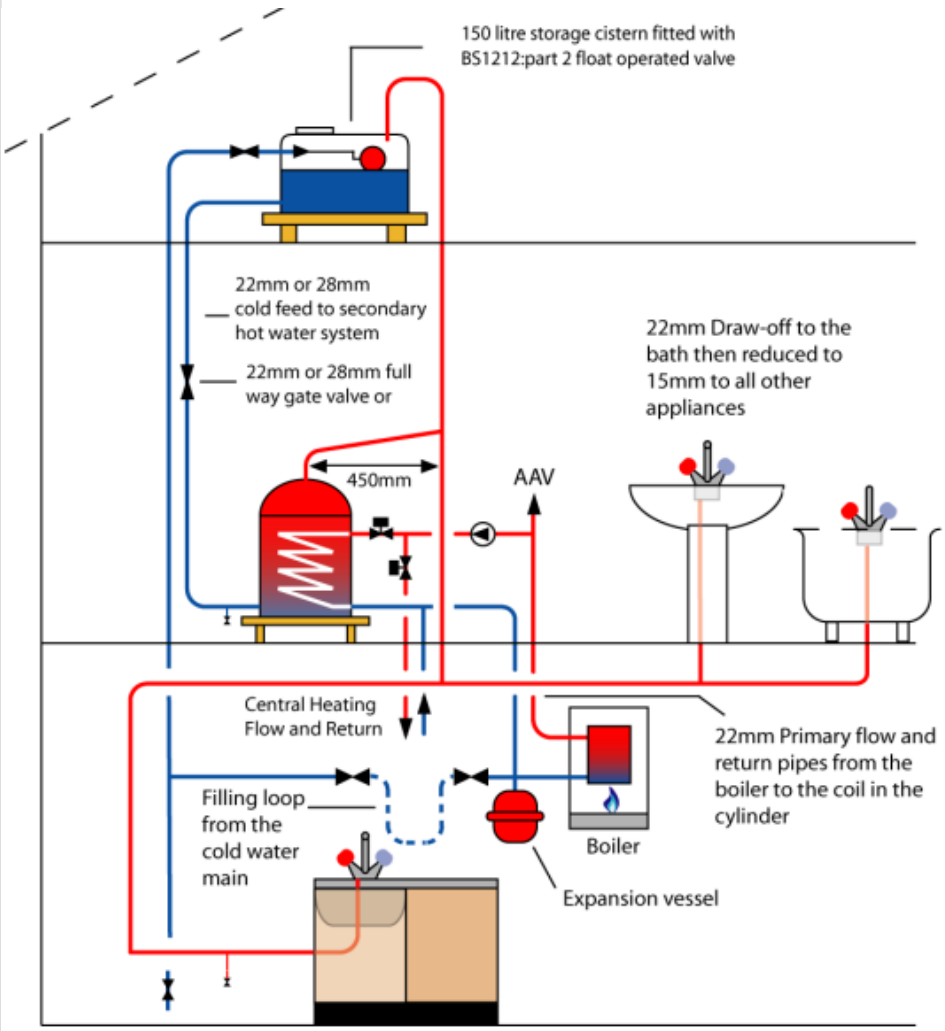
29. Name the hot water system shown in the diagram



- The above system can be name using the same rule starting with **Open vented indirect double feed hot water storage system with gravity primary circulation**
- It is said to be double feed because it utilises extra cistern. A large one same as used in single feed but the second one, smaller `fed and expansion` is of 18 l is used to supply the water to boiler and hot water heat exchanger.
- The `feed adn expansion` cistern only provides water to primary part of the system and must be large enough to accommodate the expansion of water.
- Modern system use a **sealed central hating system** which eliminates the need for a `F & E` cistern.

Note: the above **gravity feed** system can take help from a **secondary circulation pump**. But in this case allowances should be made (?)

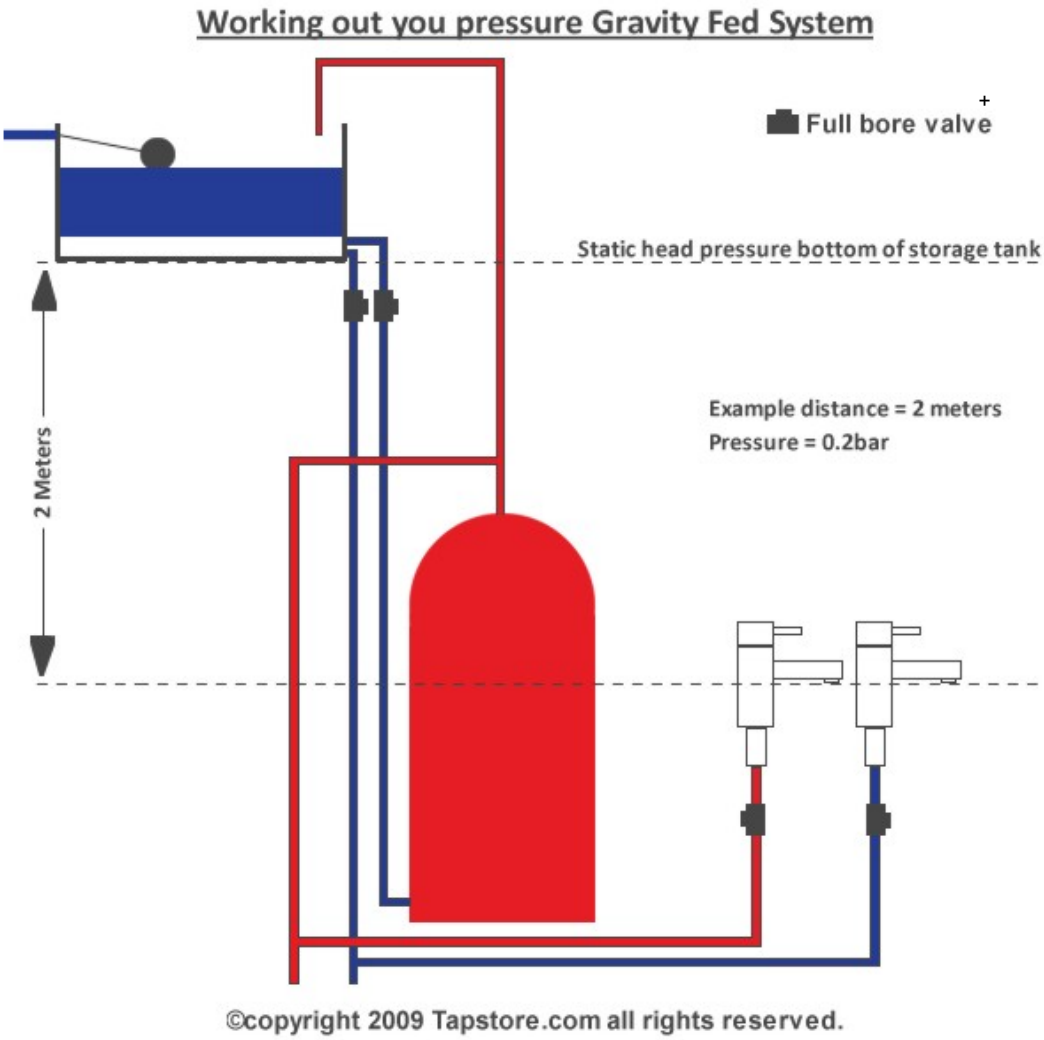
30. Name the hot water system shown in the diagram



The indirect hot water system with pumped primary circulation

- Using the same principles, it is **open vented indirect sealed heating system with pumped primary circulation.**
- It can be with or without pumped primary circulating.
- The system being filled via filling loop and the expansion of water being accommodated in an expansion vessel.
- These advances system does not rely on gravity circulation to heat the water instead they use a circulatory pump to circulate the primary water in heat exchanger.
- The reason to pump primary water is to provide continuous circulation as gravity pressure is not present.

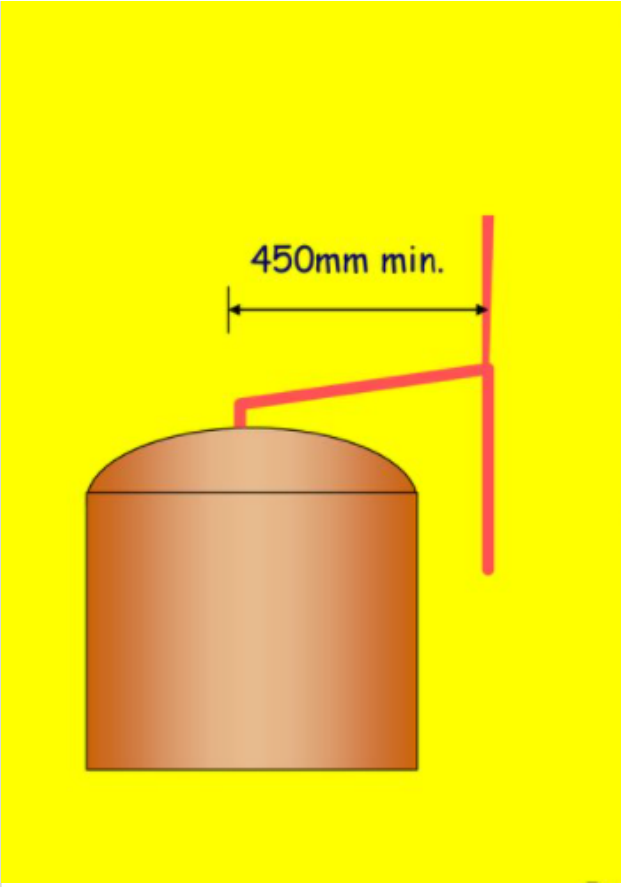
31. Gravity fed system and its advantages



- It has following advantages over **mains feed water system**
  - Water is stored at the required temperature as you are using hot water cylinder.
  - You are not dependant upon the main pressure in your area.
  - Can have flexible design to your water system and pump.
  - Modern solar and ground source heat system will work with gravity fed system.

32. What is the minimum distance of vent pipe from the cylinder

- It is 450 mm minimum.
- Hot water distribution pipe is always kept at least 450mm away from the cylinder to avoid heat loss through one pipe circulation.



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33. The need for secondary circulation system

- when a tap is turned on , there is certain amount of cold water comes before the hot water arrives. This is known as **dead leg.**
- The dead leg occur in the sections of pipe that are abandoned or capped such that water can not flow through them or water stays in the section of pipe for long enough to create bacteria known a **legionella**. These bacteriuria are also found in stagnant water.
- In hot water system, if the water takes more than 30s to reach the tap the need of secondary circulation system is required to circulate the hot water from the source to the tap and back again.
- The problem was first noted in hospital where a large system is present and when the tap is turned on it takes ages for the hot water to come through the tap. So this idea comes that why not crate a loop and fit a pump so the hot water is always running in that loop so as soon as the tap is turned on the hot water is available.
- The loop is crated from the far end and it end in the secondary return back to the cylinder and from the loop all the connections are provided.
- **secondary circulation** is required if the hot water draw-off to the taps exceeds the certain distance. Secondary circulating is achieved by fitting a secondary return pipe after the last

hot water connection on the system. The secondary return should connect to the top third of the hot store vessel; if this is not done the hot water will mix with the cooler water in the vessel reducing its temperature.

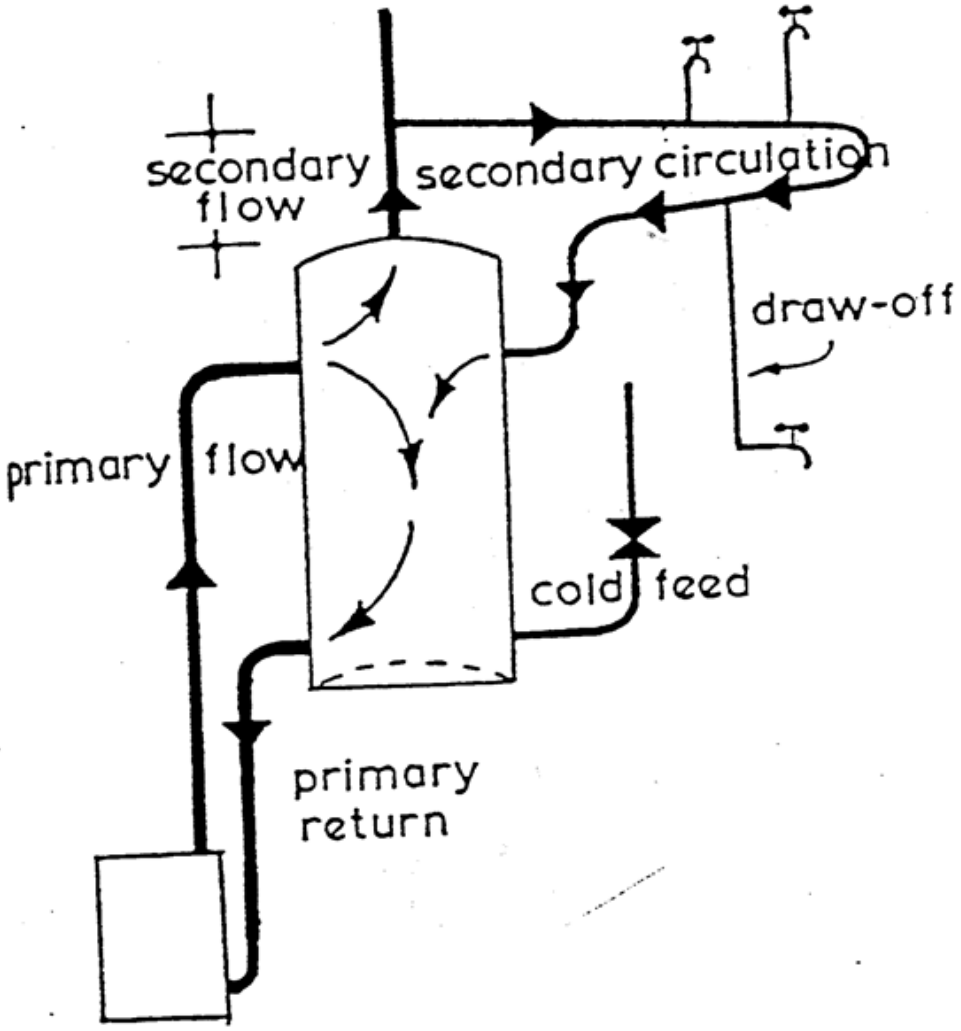
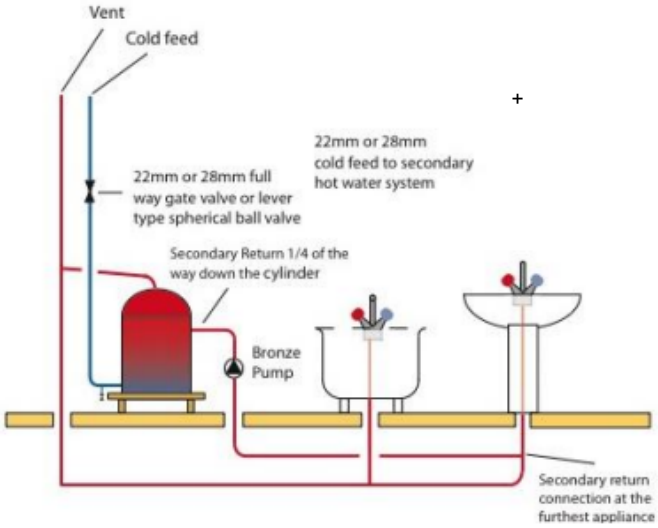


Figure 9. Secondary Circulation

In system wehere it is not possible to attain secondary circulation by gravity, a non-corroding circulating pump should be installed to ensure that water within the secondary circuit remains hot. The pump should be loacted on the scondary return pipe close to the cylinder.

Maximum recommended lengths of un-insulated hot water pipes	
Outside diameter of pipe mm	Maximum length m
12	20
Over 12 up to and including 22	12
Over 22 up to and including 28	8
Over 28	3



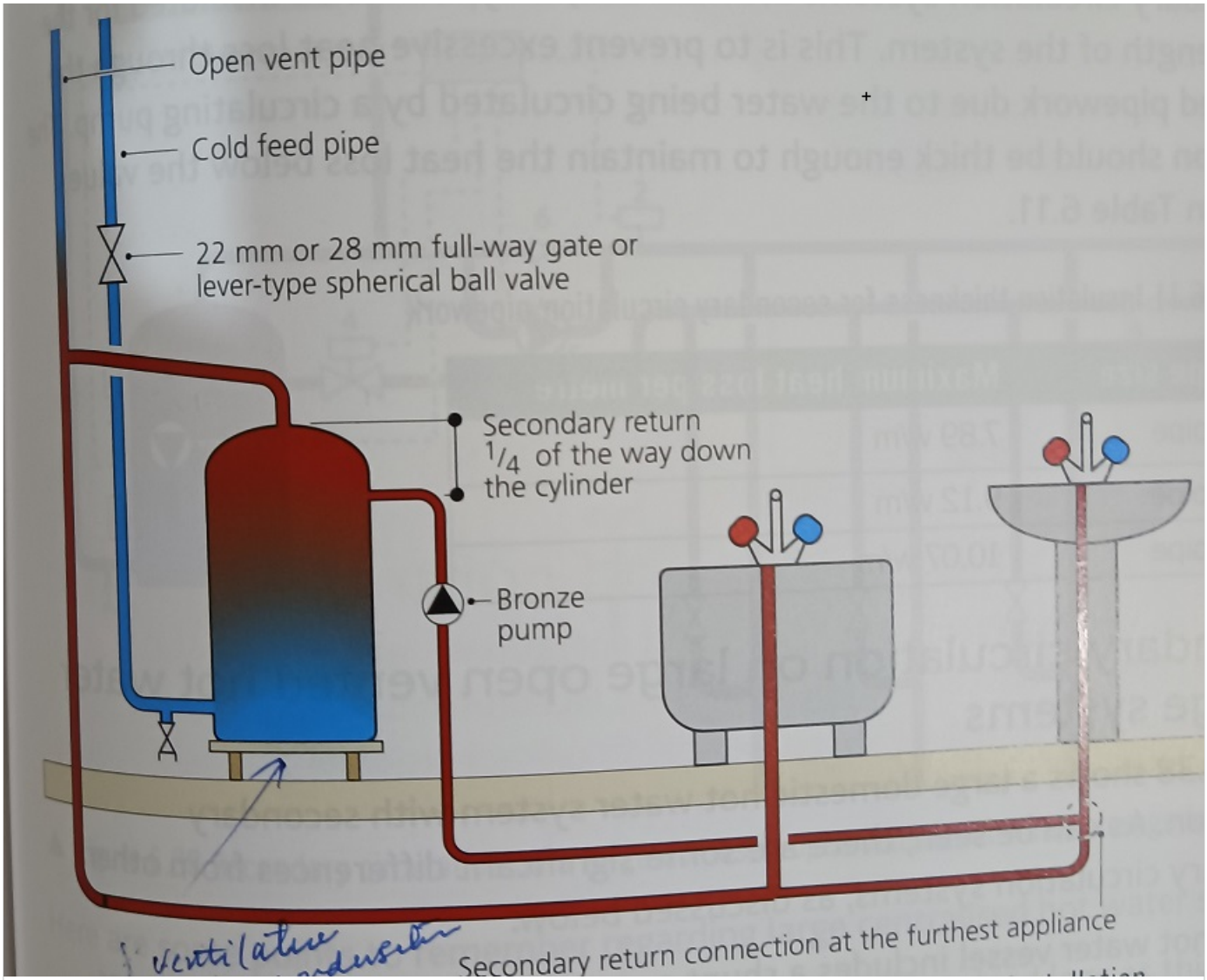
Secondary circulation

A bronze pump

The secondary circulation system uses a bronze bodied pump positioned on the secondary return pipe, close to the cylinder to circulate the water to the cylinder. The secondary circulation connection is usually positioned about $^1/_3$ of the way down from the top of the cylinder. Only a bronze bodied pump must be used to prevent rusty water being drawn from the hot taps.

- It is made up of bronze metal to eliminate the discoloured water and subsequent contamination.
- Bronze is a non ferrous metal.
- If a cylinder does not have the secondary return connection available, an Essex flange can be used and a hole can be made in a cylinder using a drill machine.

Note: THESE BRONZE METAL PUMP ARE SIMILAR TO **CENTRAL HEATING CIRUCLATOR** BUT CENTRAL HEATING CIRCULATER ARE MADE OF CAST IRON OR STELL BODY AND WOULD RUST IF USED ON SECONDARY WATER / SECONDARY CIRULATION SYSTEM.



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34. More about secondary circulation System

– Secondary circulation helps reduce the delay from turning on your hot tap to actually getting the hot water.

- This is often beneficial for larger installations with longer pipe runs. Water sitting in the pipes firstly needs to be drawn off, (and typically wasted!) before the hot water arrives from the cylinder.
- Furthermore, the replenished hot water in the pipe will again cool down over time. Only to be drawn off again, the next time the tap is used. This is inefficient and encourages water wastage; a volume of water is heated, allowed to cool and then drawn off.
- A secondary hot water circuit circulates a loop of hot water around the property, in close proximity to the outlets. Such as the kitchen and bathrooms. Therefore, whenever a tap is turned on, the hot water is almost instantaneous, coming from the nearby loop.

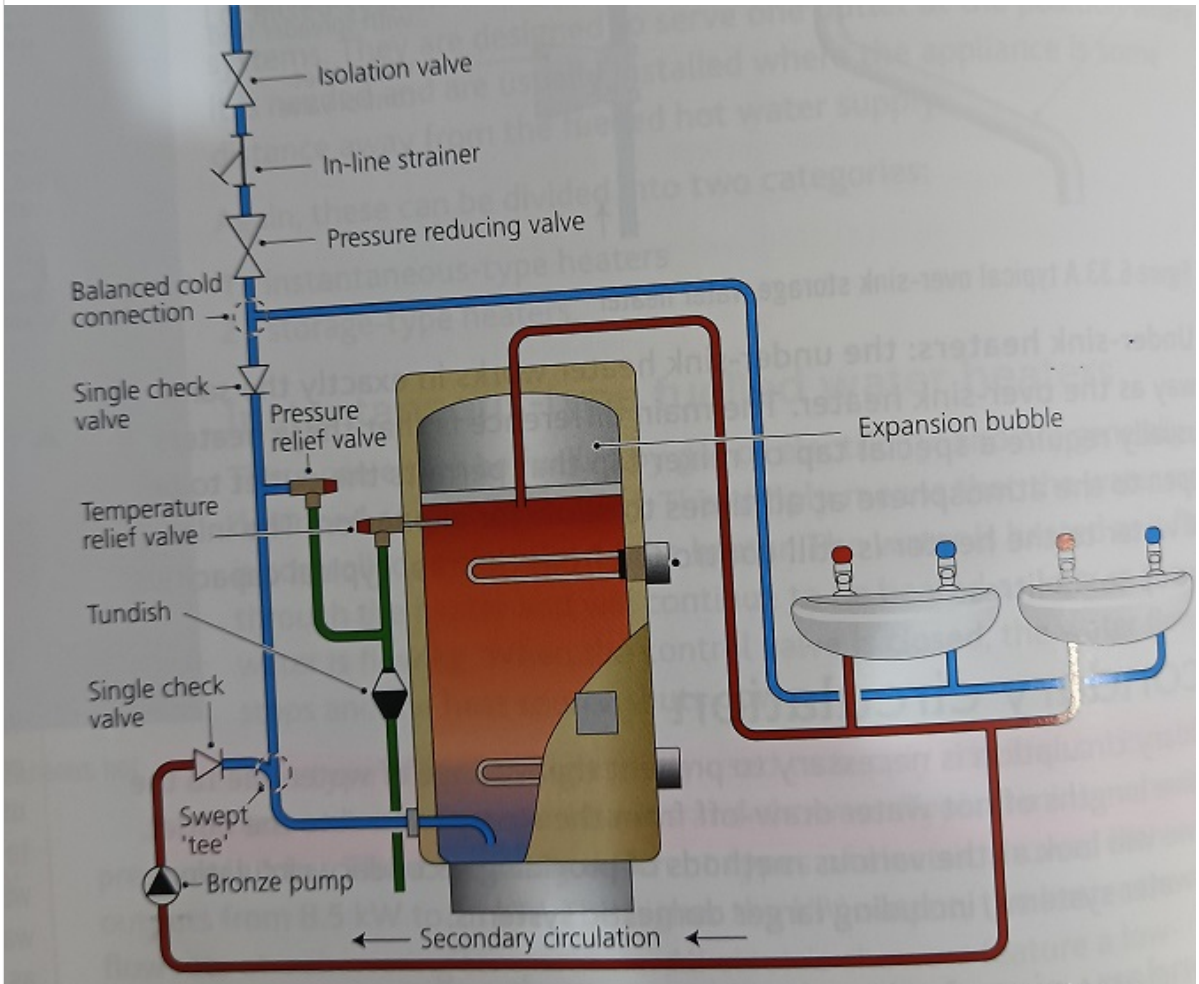
- Secondary Circulation circuits can generally be retro-fitted to existing systems, but the amount of work (and cost) involved ultimately depends on the existing system layout and design. Normally, the issue is in gaining access to lay the new pipe work!
- The simple function of a secondary return pump is to draw or pull the hot water that has cooled down through heat loss from long pipe runs back to the hot water cylinder for reheating so that hot water is available almost instantly at the hot water outlets or taps, so that you are not waiting long periods of time for it to travel from the hot water cylinder to the taps.

34-A Secondary circulation pump on unvented system

- It is always installed on the secondary water (with an exception of large open vented hot water system)
- It is usually installed on open vented hot water storage cylinder and must be insulated to prevent heat loss.
- It can not be installed on unvented hot water storage cylinder directly like in open vented storage cylinder, but if it needs to be installed (see figure below) is to be installed to the cold water feed connection using a

swept tee just before the cold feed enters the unit, with single check valve using the bronze pump.

- The pump should always be fitted close to the hot water system.



▲ Figure 6.35 Secondary circulation on an unvented hot water storage installation

- The secondary circulation system return pipe comes from the farthest hot tap back to the cylinder.
- The secondary return pipe (hole if not present) is made just 1/4 of the cylinder height using Essex flange. The hot water drawn off pipe becomes/can be taken as the secondary flow pipe as well and should have at least 60 degree C.
- And bronze pump is fitted there close to the cylinder on the return pipe as its job is to first suck the replenished water in the system.
- Isolation valve must be installed on both sides so that it can easily be replaced.

34-B Secondary Circulation on Large Open vented hot water storage system

- It is different from a domestic installation.
- The hot water cylinder is installed with a **shunt pump.**

- It is installed to make sure that stratification does not occur and the whole cylinder water content are kept to the same temperature to avoid possible risk of **legionella pneumophila**.
- The shunt pump should be set to be turned on at low demand timing or over night, when circulation is less and chances of stratification is high.
- The cylinder should be capable of being heated to 70 deg C. Need good grade cylinder.
- The secondary circulation bronze pump is installed on **Secondary flow** and not on return as with smaller system (no 5).
- A non return is also installed (no 6) to make sure that reverse circulation does not happen
- A cylinder stat or (thermostat) is also attached to keep the cylinder hot water temp at the max of 60 (or 70 degree ?)
- A pipe stat (no 2) is installed on the secondary flow to maintain the temperature at a minimum of 50 deg C.
- A motorised valve (no 4) is installed near the cylinder to prevent that water is not drawn from the secondary return when the secondary pump is not operating.
- The secondary circulation system, shunt pumps and thermostats are controlled though a control box (no 1)
- **Lock shield gate valve** are provided to balance the system to ensure even circulation thought the secondary water system.

34-C How to prevent reversed circulation in the secondary circulation system

- If a reverse circulation were to occur, the water in the cylinder would never reach the disinfecting temperature of 60 deg C and so would always be at risk of a Legionella outbreak.
- The reason is that the water returning to the bronze pump has temperature less than 60 degree which is prone to legionella risk.
- To prevent this happening a **single check valve** on the return and positioning it between the pump and the cylinder reverse circulation is prevented.
- The secondary circulation pump should be controlled through a time-clock so that circulation pump is not running 24hours a day.
- The time clock should be set during the period of demand and should be wired in conjunction with **pipe thermostat** known as **aquastat** to switch off the pump when the system is up to the correct temperature and circulation is not required.

- Similarly the timer with conjunction with aqua stat activate the pump when the water temperature drops.
- +

35 What is Thermostatic Missing Valve (TMV)

1. A thermostatic Mixing Valve (TMV) mixes water from the hot and cold supplies to a temperature that is safe to use. It can not be installed on kitchen because its temperature needs to be up to 60 degree centigrade maximum

(Thermostatic Missing / Blending valves)

- They mix hot and cold water to provide safely blended warm water to taps and others water outliets to ensure users are never scalded.

Inta Intamix TMV3 Thermostatic Mixing Valve (15mm or 22mm)

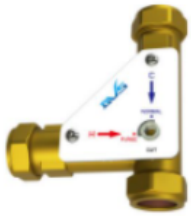
As low as: **£24.00**

Bristan Sirrus 15mm TMV3 Thermostatic Mixing Valve

As low as: **£30.00**

Twyford TMV3 Thermostatic Mixing valve (15mm)

£38.50



DVS Thermal Disinfection Valve

£53.00

Delabie Compact Nano TMV3 Thermal Mixing Valve

As low as: **£60.00**

Ideal Standard thermostatic mixing valve (15mm or 22mm)

As low as: **£82.00**

DVS Thermostatic Mixing Valve 4 in 1 TMV3 15mm/22mm

£87.00

Delabie Premix Compact Thermostatic Mixing Valve

£106.00

Rada Meynell 15/3 Thermostatic Mixing Valve

Franke Thermostatic Mixing Valve (TMV)

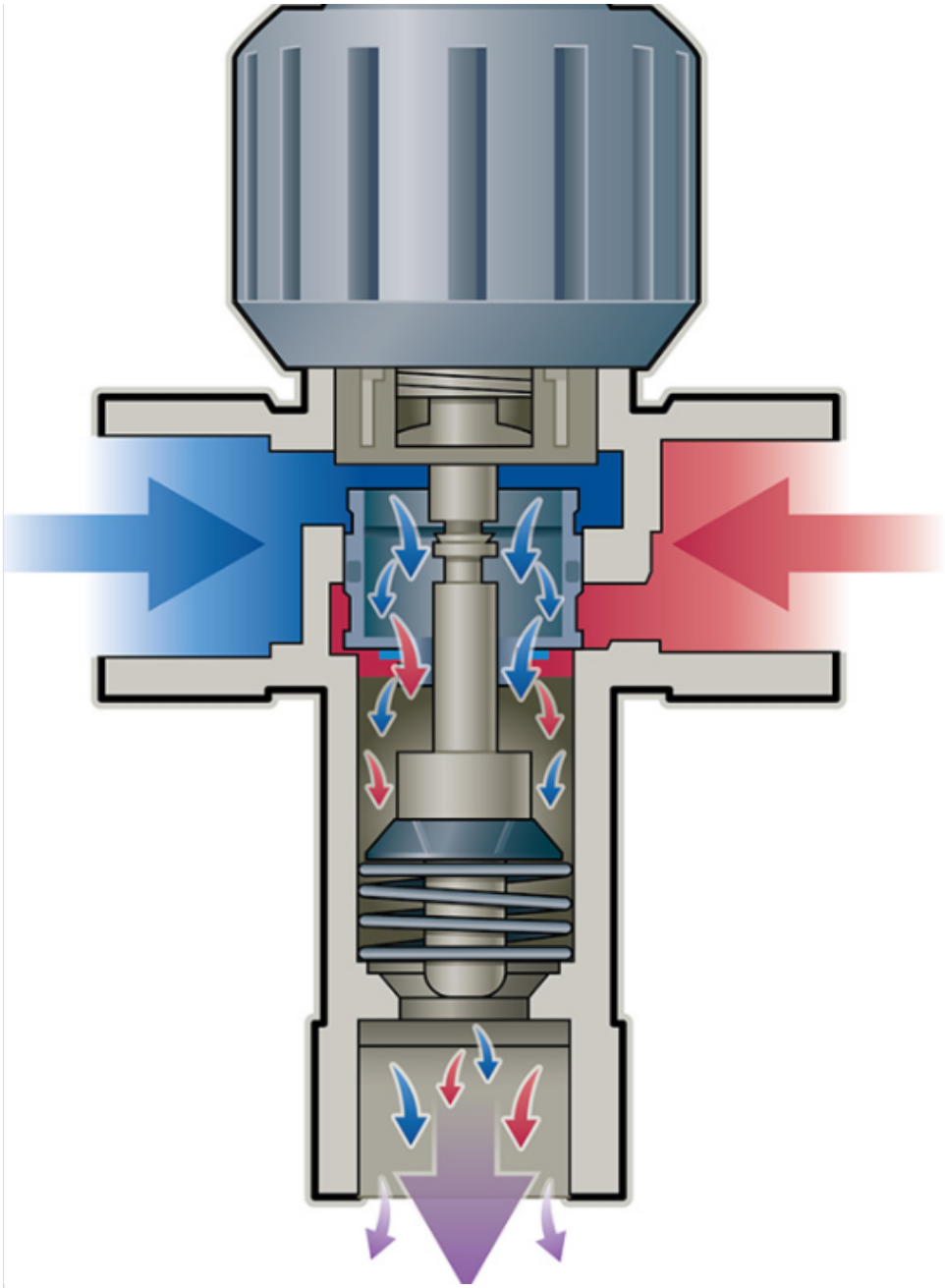
Intamix Pro Thermal Mixing Valve (TMV) with Isolation

Bristan 22MM Group Thermostatic Mixing Valve

(Different brands of TMV)

Note: A TMV can not be installed in kitchen sink, as kitchen needs a hot water up to 60 degree c to clean the grease. In hospital and Vulnerable places this is kept up to 48 to avoid scalding.

35-A Internal view of TMV



- When only one TMV is used with a number of similar outlets the length of the pipe work from the TMV vale to the outlet should be kept s as short t as possible so that the mixed water reaches the furthest tap within 30s
- If the pipe runs in excess of 10 m. it runs a risk of **Legionella.**
- It is pronounced as `le-ge-nila`. they can survive over a year inside pipes.
- It is caused by poor maintenance or poor management of a water system. Corroded and dirty water tanks in a warm loft spaces or dead legs in the pipe work, where stagnant water has no where to go.
- It is also found in pounds and still water.
- Legionella thrives on impurities such as rust and lime-scale, and in water temperatures between 20°C and 45°C. In rare circumstances, it can also spread in contaminated showers.
- Landlord must carry out a risk assessment for Legionella

- Landlords who fail to protect tenants from health hazards can be prosecuted under the HSWA Health and safety work act.
- Under section 3 of the Health and Safety at Work Act, you could be prosecuted for failing to take reasonably practicable steps to avoid exposing your tenants to health and safety risks, including legionella. The maximum penalty for a breach of this section of the act is either an unlimited fine, up to two years in prison, or both.

Legionella can lead to a number of diseases, including the potentially fatal lung infection Legionnaire's Disease, which is most common in the summer months.

35-C Need of TMV

- The need arises when hot water is used and there is a danger of scalding.
- It ofen happens at **washbasins**, a typical temperature of (38 - 41) is to be maintanined.
- While at **kitchen sinks** the temperature is maintanied between (46 - 48) as here grease is to be throughlly removed.

36 Type of Thermostatic mixing valve

- TMV are certificated under a third-party certification scheme set us and administrated by **Building Cert Scheme**.
- They are divided into two groups: **TMV2 and TMV3** depending upon their use.
- **TMV2"**: Documents G requires that the hot water outlet to a bath should not exceed 48 degree C. It states that valves conforming to **BS EN 1287** are suitable for this purpose.
- **TMV3**: These valves are manufactured and tested for **Healthcare and thermostatic installation** and use the NHS specification D0* as a bias for the thermostatic valves performance testing.

37. Group / Centralised Mixing

- A TMV can be installed singly to serve the Bath but it can also be installed to server the group of similar appliances used.
- For example if three or four basins are to be served, it can also be used providing guide lines are to be followed that is the water should reach in 30s, measures should be taken that no legionella is to be produced.

- If in a group mixing a pipe work runs more than 10m what precaution to be taken to tackle legionella?

1. Should legionella be detected, shower heads or affected area are either cleaned with very hot water or disinfectant be used.
2. If group showers are used, the temperature should not exceed more than 43 for safety reasons, the same temperature is used in group washbasins.

- Centralised mixing is similar to group mixing but occurs when there are groups of different hot water appliances to be served from a single TMV.

38. Expansion of hot water pipework

- When the pipework is filled with hot water it expands and when it cools down it contracts. This expansion and contraction must be accommodated for during the installation process. Otherwise noise within the installation will result.
- If pipe is passing though the walls and enough room is not left **tic** and **creak** takes place as a result of Expansion / contraction.
- The rate of expansions depends upon the material the pipe is made of and known as co or Coefficient of linear expansion .
- The co for copper is = .000016 per meter per C.
- The co for plastic is = .000018
- Calculating the amount of expansion that takes place on a given length of pipe:

```
Exapnasion on copper = l( length of pipe) * co ( coef...) * temperature rise
```

39. Which one expands more copper or plastic

- Plastic pipe co is 0.000018 which is greater than copper that is 0.000016 hence the plastic pipe will expand or contract more than a copper pipe.
- Q) What is the expansion on a 15mm polybutylne pipe which is 6m in length when the peep is heated from 10 to 60 degree.

Expansion = 6 * .000018 * (60 -10) Expansion on polybutylne pipe is ==

40 instantaneous Hot water system

- They do not contain any stored hot water. They heat the water directly from the cold sypply as and when it is needed. There are several different types:

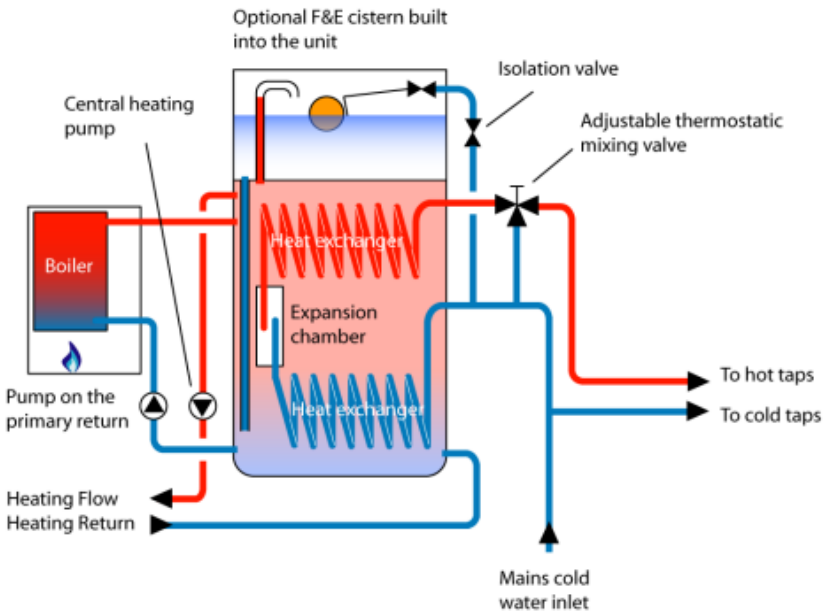
1. Thermal Stores
2. Instantons multipoint water heater
3. Combination (combi) boilers
4. Single point heaters

1. **Thermal Stores**

-
- Thermal store (also known as water jacketed tube heaters) are centralised instantaneous multipoint water heaters that work by passing water direct from the cold water main through a series of heat exchangers.
- These heat exchangers are completely surrounded by water at around 80 degree C inside a large hot water vessel that is directly heated by a boiler.
- They look very similar to indirect hot water storage cylinders but actually work in reverse.
- Water from the mains cold supply enters the thermal store, passing though the first heat exchanger where the water is warmed. After passing through the expansion chamber, the water flows though the second heat exchanger where it is heated to full hot water temperature.
- As the water temperature should not exceed a temperature of 60-65 degree C, the water is blended with the cold water through an adjustable thermostat blending valve on the outlet of the thermal store.

The water in hot water vessel is completely separate from the domestic hot water and is heated by a boiler. The system can be used for properties with the central heating system.

a) Thermal stores



A thermal store also known as a water jacketed tube heater

- A thermal store can use different fuel sources (such as solid fuel, solar energy ,)

Thermal energy refers to the energy contained within a system that is responsible for its temperature. Heat is the flow of thermal energy. Almost every transfer of energy that take place in real world physical system does so with efficiency less than 100% and results in some thermal energy. This energy is usually in the form of `low-level thermal energy`. This low level thermal energy represents the end of the road of energy transfer. The energy is lost to the environment.

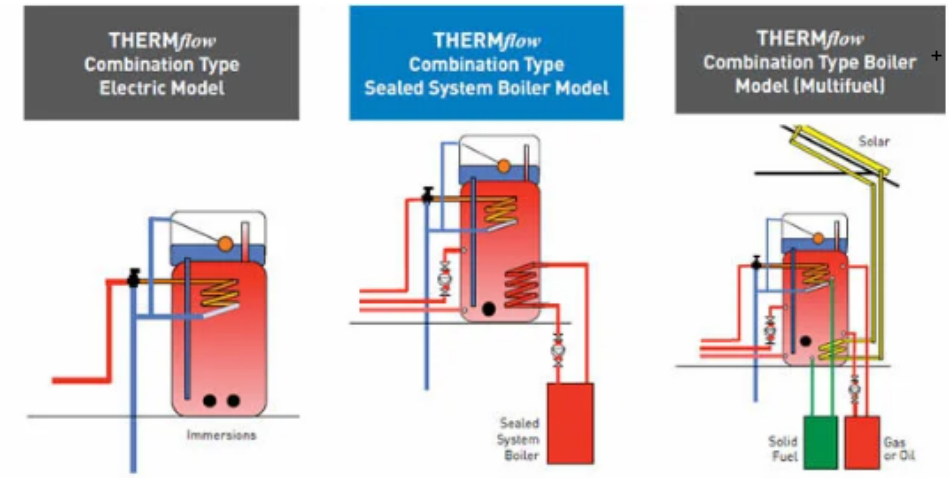
- We can also say that energy possessed within the object or system due to movement of the particles within the object system is knows as thermal energy.

Why they are called thermal store / cylinder ? (https://www.gondwanagreenheat.co.uk/thermal-store-versus-a-hot-water-cylinder/)

- They store the heat produced within the system for maximum time. And for this reason they are better insulated than unvented cylinders.
- They work best when combined with more than one source of heat.
- Main advantages of thermal store.

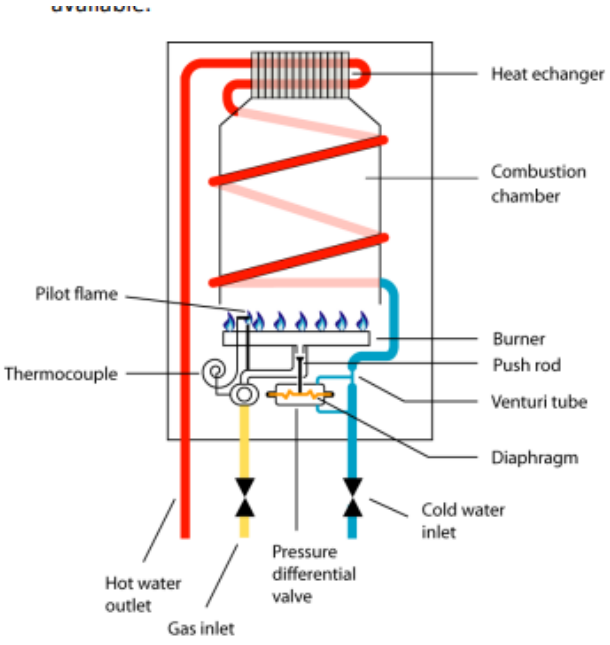
1. No expensive mandatory servicing
2. Unvented cylinders require qualified personnel to fit, maintain and certify. Thermal stores don’t require this.
3. Mains pressure hot water

4. Thermal store cylinders are typically much better insulated than hot water cylinders
5. Multiple heat sources can be combined easily, allowing you to use cheaper energy sources to heat your property.
6. Solar thermal and other renewables can be incorporated which can benefit heating as well as hot water to taps (You don’t get that option with a unvented hot water cylinder).
7. When heating demand is low, heat can be drawn from the thermal store without firing up the boiler, meaning less boiler use (cycling).
8. Longer boiler lifespan
9. Reduced fuel consumption due to boilers hard working in condensing mode
10. No large heat leak radiators wasting your heat (solid fuel installs).
11. Safety. Systems can be vented or sealed depending on heat sources used. Equally different heat sources can be separated through coils within the thermal store, meaning some vented or sealed.
12. A thermal store enables you to use low temperature heating circuit which typically save homeowners 20% off there heating bills.
13. Future proof. A quality thermal store is future proof, enabling you to incorporate different heating technology’s as the world changes.
14. Safety. Additional safety features can be incorporated like overhead coils (scorch coils) within thermal storage cylinders, this gives systems an additional layer of safety and can prevent overheating in solid fuel and solar installs.
15. Thermal stores can be made of a different materials and different sizes depending on the size of the property, door widths, dhw demand, heat demand etc. Sizes range from 50 litres to 200,000 litres
16. Thermal stores can heat multiple buildings from one thermal store. This means simpler installs as well as energy savings.

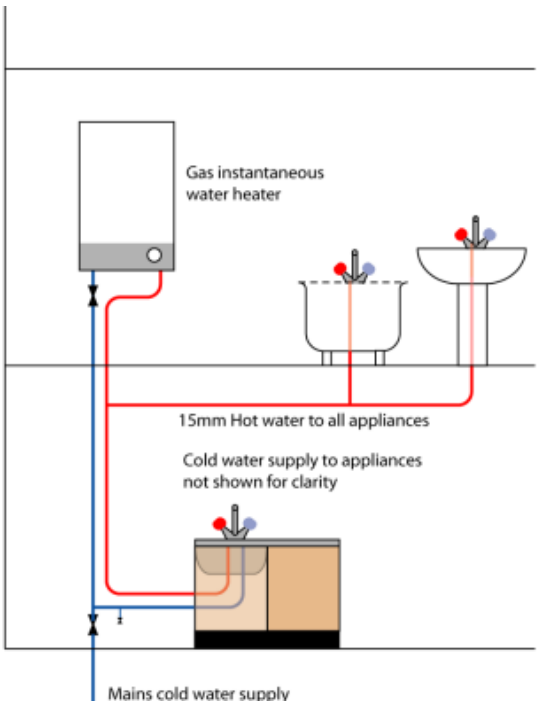


2. Gas-fired instantaneous multipoint water heaters

- They uses a principle of `pressure difference`. When tap is opened, the movement of water through a venturi tube creates as difference in pressure over a rubber diaphragm inside the pressure differential valve.
- The difference in pressure flexes the diaphragm inside the valve and this opens a gas valve.
- The gas passes through the gas burner where it is ignited by either a pilot light or piezo ignitor.
- The water is then heated. When the tap is closed, the pressure is equalized and a spring in the valve closes the valve, shutting off the flow of gas.
- They can provide enough hot water for a small domestic dwelling but the hot taps should only be used at a time as these hot water heater can not generate enough flow rate to supply two open hot taps simultaneously.

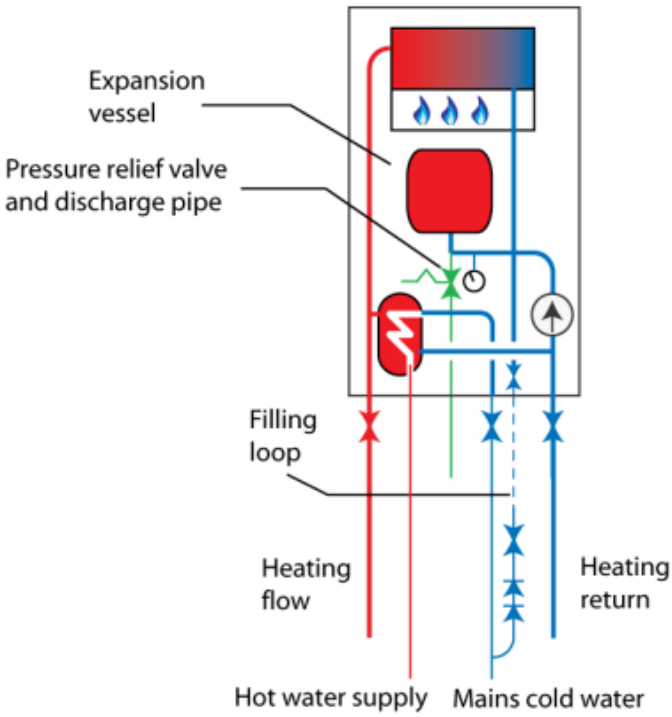


A gas fired instantaneous water heater



3. Combi Boilers

- They are becoming one of the main sources of hot water supply in small to medium sized dwelling in the UK. They combine hot water supply and heating in a single unit that can be sited anywhere in the property.
- They use the same principle as thermal heaters that is heating the water through `water to water` heat exchanger. This is knows as `plate heat exchange` .
- The heat exchanger can alternate the flow of water through a diverter valve to heat either the hot water instantaneously or the central heating system.
- They are hot water priority appliances which means that if the central heating is on and a hot tap is opened. All energy created by the appliance will be transferred into generating hot water supply to the open tap.



A combination boiler

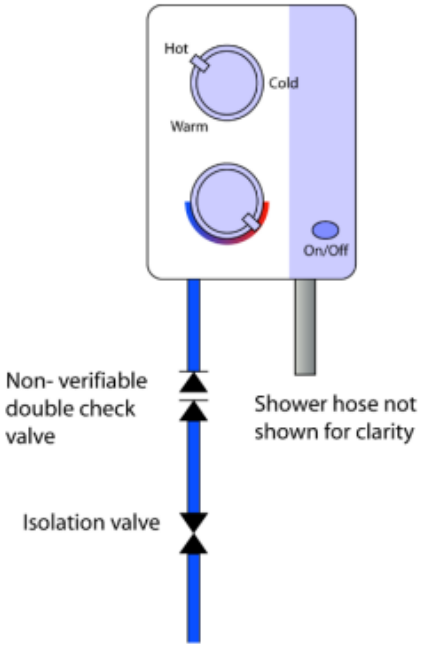
- There are different types of combination boilers available ranging from 24Kw to 50Kw in output. Some combis even have a small amount of hot water storage (less than 15 litters), which means hot water is delivered quickly to the hot taps. They are fitted in the same way as multipoint instantaneous hot water heaters.

Single point of use heaters

- Localised hot water systems are installed in places where connection to the main source of hot water is difficult or impractical. They are often referred to as point of use heaters. They are usually installed over or under the appliance that they are serving with the water being discharged

usually from a swivel spout for over sink types. They can be fuelled by either electricity or gas are usually `inlet controlled`

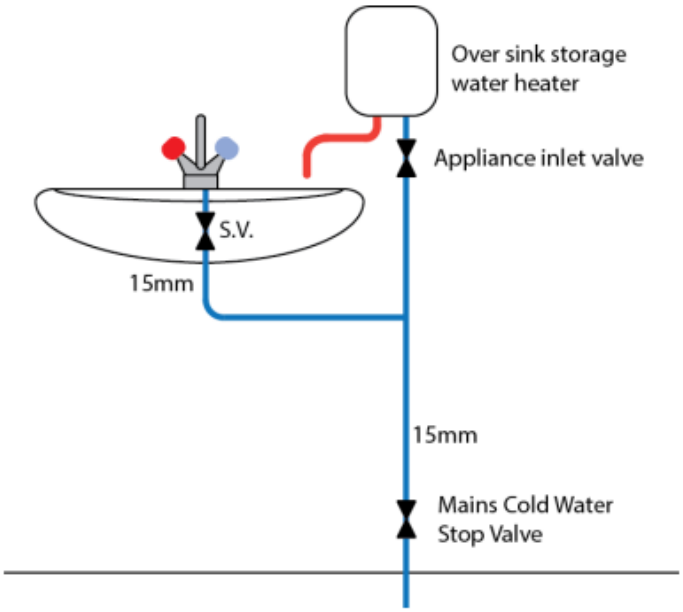
- it means that the water is turned on as it enters the heater. Some storage type single point heaters are outlet controlled. They are two specific types:
  - Instantaneous single point water heaters
  - Storage single point water heaters



An electric shower

Instantaneous single point water heaters

- These provide instant hot water to a single appliance and are usually fuelled by electricity. There are two basic types:
  - `Hand wash type` : They are small water heater, around 3kw output, fitted over a single washbasin. They are inlet controlled. The temp of the water depends on the flow rate through the heater. The faster flow rate, the cooler the water. Flow rates are generally poor but adequate from hand washing.



- Electric showers : Up to 12kw, many showers feature sophisticated microchip technology allowing temperature stabilisation at low and high flow rates.
- Electric showers feature a low pressure cut-out to guard against scalding if the pressure or flow rate suddenly drip.
- Flow of water is controlled by an electrically operated solenoid valve that operates when the electricity supply is on to the heater.

Storage single point water heaters

- Storage point of use heaters are small water heaters that store a small amount of hot water, usually of less than 15 litres capacity, for use at a single appliance or small range of appliances. They can be either outlet or inlet controlled depending on the type. There are 3 basic types:
  - Over sink point of use storage water heater
  - Under sink point of use storage water heaters
  - Unvented under sink point of use storage water heaters

40 Shower mixing valve and shower boosting pumps

The procedure for safe isolation to check the electric immersion heater

1. Turn off MCB16 (miniature circuit barker), put a padlock and put a warning sign there.
2. Turn off switch spur, take off 13amp fuse.

3. Use the multi meter to test if immersion heater is working or not. It is done by connecting multimeter probes to two points on the immersion heater. If there is a sound a beep sound then it means the element is good and working but if there is no sound it means it is broken or not working.
4. Continuity test is done with mustimeters set to resistance, if it is good it should show between 10 to 16 ohms reading.

Note: A flex wire coming out of cylinder going to switch fused spur can not be any longer than 1m(3 feet). I should withstand up to 80 degree centigrade. The cable running from the switched fused spar to MCB16 should be of 2.5mm

- What is power on / power off polarity test ?
- Turn off the main take off the fuse then check

1. live and neutral (should get zero)
2.

41 Anodic corrosion protection of hot water storage cylinders

- Hot water storage cylinders can suffer from **electrolytic corrosion** where there are two or more dissimilar metals present, especially in areas where the water is soft as this is aggressive to certain metals .
- Placing two different metals in aggressive water produces a very small electric current, which flows from the weaker (anodic) metal to the noble (cathodic) metal where the anodic metal is gradually eaten away. This occurs commonly when some types of brass fittings are used.
- Hot water cylinders can be protected from electrolytic corrosion by the use of a magnesium rod , which is either fastened to the bottom of the storage cylinder during manufacture or by simply dropping the magnesium rod in the draw-off connection during installation.
- This magnesium rod is knows as the **sacrificial anode**.
- It works by the distracting the corrosion away from the weaker anodic metal in the installation to be eaten away itself. if necessary, it can be replaced once the anode has been completely destroyed.

Heating boilers / heaters

- There are a number of different types of gas, oil and solid fuel boilers for home heating on the market and they can be free/floor standing or wall hung/mounted

- Conventional boilers can be **condensing or non condensing.** A condensing one reuses the heat from flue gases to reheat the system making it more efficient, enabling it to be able to opereate at lower temperatures saving energy and reducing costs.
- A non condensing boiler does not reuse the heat from the flue gas .
- Difference between condensing and non condensing boilers

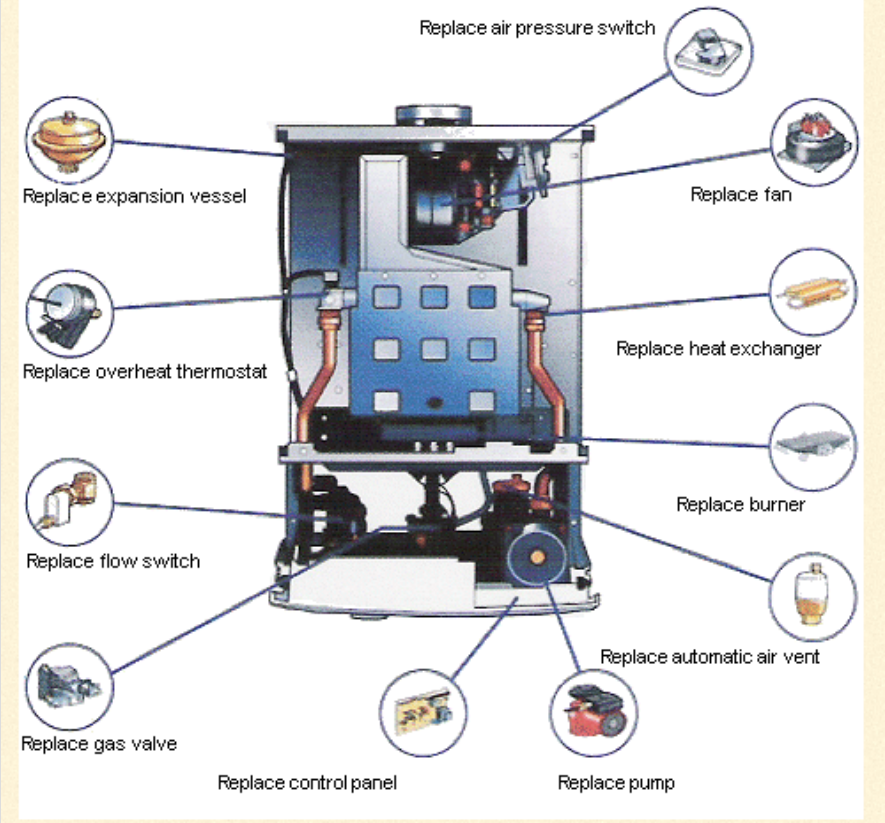
Differences between Condensing & Non-Condensing Boilers

Condensing Boilers	**Non-Condensing Boilers**
One or more larger heat exchangers	Single combustion chamber and single heat exchanger
Lower temperature of combustion products (around 55°C)	Higher temperature of combustion products (around 180°C)
Exhaust gas is recycled through the condensing heat exchanger	Combustion gases go into the flue and
30% of the heat is wasted	
Help combat climate change by reducing CO2 emissions	Higher carbon footprint
Higher initial cost, but cost efficient in the long-run	Lower initial cost, but very costly venting

What are system boilers ?

- They are low water content boilers (System boilers can be either condensing or non-condensing type.), it only holds a small amount of water in the heater exchanger that incorporates within them some of the central heating system components that are installed independent of a conventional boiler in central heating system using that type of boiler.
- components which are in the system boiler are:

1. Circulator pump
2. Automatic by pass valve
3. Diverter valve
4. Automatic air vent
5. Expansion vessel
6. flow and return pipe temperature sensor
7. Filling loop



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Combination Boilers (instantaneous)

1. The combination (Combi) boiler is one of the most popular types of domestic home heating boiler. Because it is an instantaneous boiler it heats water on demand (direct acting), and so allows you to free up loft space (if you have a loft) by the removal of the cold water storage cistern/tank and associated pipework and fittings, saving you money on installation costs.

They are main fed and must have a water pressure to operate

What is commissioning / Testing ?

- A process in which an appliance/appliances are checked if they are working correctly and can be used safely.
- There are step by steps procedures.

Soundness test :

- It can be for **cold water , hot water and central heating.**
- BS6700 requirements for testing copper / plastic pipework

Testing is done after first time installation to check whether the installation is water tight or not. Soundness testing is different from **pressure and sanitary systems**.

- Pre testing Commissioning : Before Commissioning take place do the following:

1. Visual Inspection: Walk around the installation and check that you are happy that the installation is correct and meets installations standards.
2. Check that all opened end are capped off and there are no obvious issues. close all taps
3. Check that all capillary joints are soldered and al compression joints are fully tightened.
4. Check that **sufficient pipe clips, supports and brackets are installed and that all pipe workd is secured.**

- **Testing Procedure**: It differs from Rigid piping (copper and steel) to non Rigid piping (plastic)
- Both involve filling the system with water to a specific pressure and letting it stand for a specific time to temperature stabilise and then checking it for pressure loss.

Copper Tubes and low carbon steel pipes : The system is always tested to one and half of the main pressure. So if the main pressure is 1 bar testing pressure would be 1.5, and if it is 2 bar the testing pressure would be 3 bar and so on.

- Once a system is filled with a pressure it should be left for 30 minutes to allow for temperature stabilisation and then left for a period of one hour with no visible pressure loss
- Detailed procedure:
    - Make sure all drained valves are off (closed).
    - All opened end valves are capped off.
    - Using hydraulic pressure piping system is filled with required pressure (1.5 times the main pressure).
    - Once filled it is left for half and hour for temperature stabilisation.
    - If there is no leak it is left for one hour to see if any pressure loss (due to leak or any other reason). If there is a leak, it is repaired and procedure is repeated.
- **Procedure for plastic pressure pipe system:**
- They are tested differently than rigid pipes. There are two types of testing

- Tesing Type A: Slowly fill the system with water and raise the pressure to 1 bar.
  - Check and re pump the pressure to 1 bar if the pressure drops during this period provided there are no leaks. Check the leaks.
  - After 45 minutes increase the pressure to 1.5 times normal operating pressure and let they system stand for 15 minutes.
  - Now release the pressure in the system to one third of the previous pressure and let it stand for a further 45 minutes.
  - The test is successful if there is no leaks.
- Test Type B : Slowly fill the system with water, pump the system up to the required pressure and maintain the pressure for a period of 30 minutes.
- Note the pressure after this time. If there is no pressure drop let it continue for further 30 minutes. If the pressure loss is less than .6 bar, the system has no visible leakage.
- Visually check for further 120 minutes. The test is successful if the pressure loss is less than .2 bar.
- …

Test A	**Test B**
(i)the whole system is subjected to the the test pressure by pumping for 30 minutes, after which the test continues for 90 minutes without further pumping.	(i)the whole system is subjected to the test pressure by pumping for 30 minutes, after which the pressure is noted and the test continues for 150 minutes without further pumping;
(ii)the pressure is reduced to one third of the test pressure after 30 minutes	(ii)the drop in pressure is less than 0.6 bar (60kPa) after the following 30 minutes, or 0.8 bar (80kPa) after the following 150 minutes; and
(iii)the pressure does not drop below one third of the test pressure over the following 90 minutes; and	(iii)there is no visible leakage throughout the test.
(iv)there is no visible leakage throughout the test.	..

Cold water pressure testing:

1. Shut off the cold water at the faucet (a tap in the UK is called faucet) behind the washing machine and the disconnect the hose from the faucet. Screw the pressure gauge onto the faucet and the open the faucet all the way to test the pressure. (not complete answer !)

Pipe sizes in open vented hot water storage system

1. The correct flow is achieved by using the correct pipe sizes.
2. Staring from cold feed pipe to cylinder from a cistern depends upon the size of the system but in normal domestic houses in U.K the minimum is 22mm with a full gate way valve
3. But this cold feed can go up to 28mm if there is more than one bathroom in the property.
4. The drain valve is always fitted at the lowest point of the feed to allow the complete drain of the hot water cylinder.
5. The connection of the cold feed must me at least 25mm above the CWD or cold water distribution pipe to allow hot water to stop first in case of no water from main.
6. The hot water drawn off pipe should have a gradual rise and must me 450mm away from this point before it starts to Turn vertically. It is to make sure that parasitic circulation does not occur.
7. The vent pipe and hot water drawn off pipe must be of 22mm minimum . This size the reduce to 15mm to all outlets in home with one exception to bath taps where minimum 22m is used due to its requirements to have better flow. Otherwise a 15mm pipe to bath will take more time to fill the bath tub.
8. All appliances should be fitted with an isolation valve. Though it is a good practice but not the requirement.
9. The pipe work should have a gradual incline towards drain-off vales to the permit total draining.
10. If the double feed indirect cylinder is installed, the primary circuit must contain a separate feed and expansion cistern and an expansion vessel with disonnectable filling loop . This loop disconnects the primary water from the secondary water.
11. The cold feed from the primary system (F & E) can be installed in 15mm pipe work and should not contain any form of isolation valve .
12. The size of the primary went to the F&E is 22mm and can not be of 15mm .
13. The height of the vent pipe in F&E above the cistern should not be less than 150mm plus 40mm for every meter in height.

- The F&E cistern must be capable of accommodating an expansion of 4% of the total amount of water contained in the primary system and any heating system installed.

Note contrary to cold feed pipe from normal cistern the pipe size is small from F&E cistern. It is due to the water quantity. The F&E cistern only contain 18l of water compare to normal cistern that contains 230l of water.

Different terms from Schedule 2 (https://www.legislation.gov.uk/uksi/1999/1148/schedule/2)

- **Backflow**: means flow upstream, that is in a direction contrary to the intended normal direction of flow, within or from a water fitting.
- **Cistern**: means a fixed container for holding water at atmospheric pressure.
- **Combined feed and expansion cistern**: means a cistern for supplying cold water to a hot water system without a separate expansion cistern.
- **Combined temperature and pressure relief valve**: means a valve capable of performing the function of both a temperature relief valve and a pressure relief valve
- **Contamination**: Includes any reduction in chemical or biological quality of water due to a change in temperature or the introduction of polluting substances
- **Distributing pipe**: means any pipe (other than a warning, overflow or flushing pipe) conveying water from a storage cistern, or from hot water apparatus supplied from a cistern and under pressure from that cistern.
- **Expansion cistern or expansion vessel**: means a cistern or vessel connected to a water heating system which accommodates the increase in volume of water in the system when the water is heated from cold.
- **Expansion valve** means a pressure-activated valve designed to release expansion water from an unvented water heating system.
- **Flushing cistern** means a cistern provided with valve or device for controlling the discharge of the stored water into a water closet pan or urinal.
- **Overflow pipe** means a pipe from a cistern in which water flows only when the water level in the cistern exceeds a predetermined level.
- **Pressure relief valve**: means a pressure-activated valve which opens automatically at a specified pressure to discharge fluid.
- **Primary circuit**: means an assembly of water fittings in which water circulates between a boiler or other source of heat and a primary heat exchange inside a hot water storage vessel, and

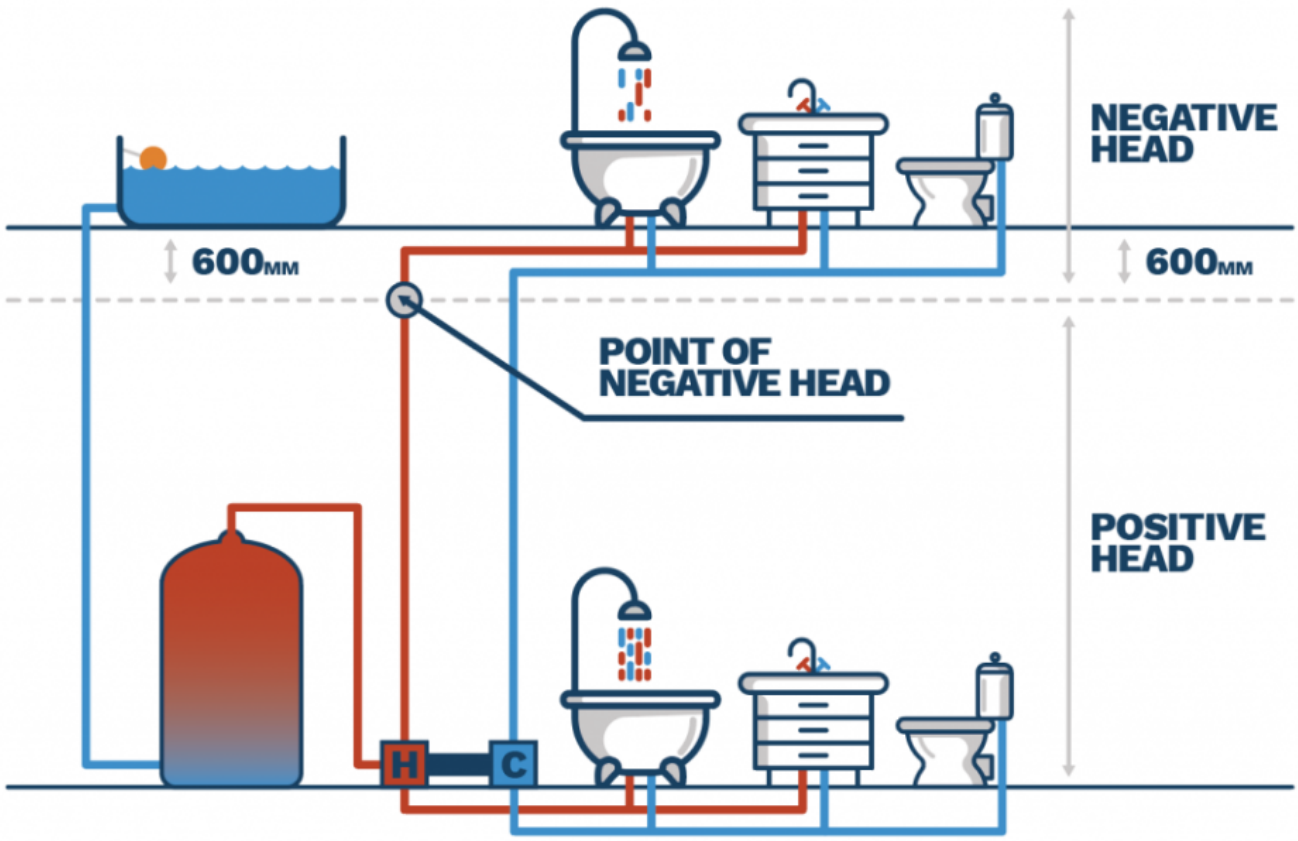
includes any space heating system.

- **Secondary circuit**: means an assembly of water fittings in which water circulates in supply pipes or distributing pipes of a hot water storage system.
- **Secondary system** means an assembly of water fittings comprising the cold feed pipe, any hot water storage vessel, water heater and pipework from which hot water is conveyed to all points of draw-off.
- **Servicing valve**: means a valve for shutting off for the purpose of maintenance or service the flow of water in a pipe connected to a water fitting;
- **Stop valve means**: a valve, other than a servicing valve, used for shutting off the flow of water in a pipe
- **Storage cistern**: means a cistern for storing water for subsequent use, not being a flushing cistern.
- **Temperature relief valve**: means a valve which opens automatically at a specified temperature to discharge fluid.
- **Terminal fitting**: means a water outlet device
- **Vent pip**e means a pipe open to the atmosphere which exposes the system to atmospheric pressure at its boundary.

What is Positive and Negative head in terms of plumbing ? (https://www.anchorpumps.com/blog/positive-negative-shower-pumps-explained/#:~:text=The%20bathroom%20on%20the%20top,tank%20and%20the%20shower%20head.)

- The word **head** comes into play when we measure the pressure in terms of **head height**. It is considered when shower at home is not powerful due to less head height as a result of providing low pressure.
- So if shower pump needs to be installed, one need to consider whether positive or negative head shower pump is needed. And it all depends where the water tank is located.
- In gravity fed system a cold water tank is located in a space while hot water cylinder is located in airing cupboard. This is regarded as **positive head** as cold water tank is positioned **600mm** higher than the shower so water flows downwards via gravity.
- So it all depends whether water is flowing down to shower or flowing up to shower! because it creates a pressure.
- Positive head pump needs at least **o.6 bar** pressure.
- In contrast where the distance between a shower head and the tank is less than **600mm** as a result less pressure is build a **Negative head shower pump** is required.

- For this purpose a negative head pump incorporates a **flow switch** that starts a pump (?) automatically when water begin to flow.
- This situation occurs when bath room (a shower head) is either located above the wather tank or at a height less than 600mm. The following diagram shows this scenario.
- A positive head pump will start automatically with a flow switch set to be activated at 1 litre in 30 second per side of the pump .



- Cold water to shower comes from a cold water feed while hot water comes from hot water drawn off pipe
- Do the flow test,If you get one litter water in a minute then you can use a positive head pump but if you don't have this then you would use either negative or universal head pump.

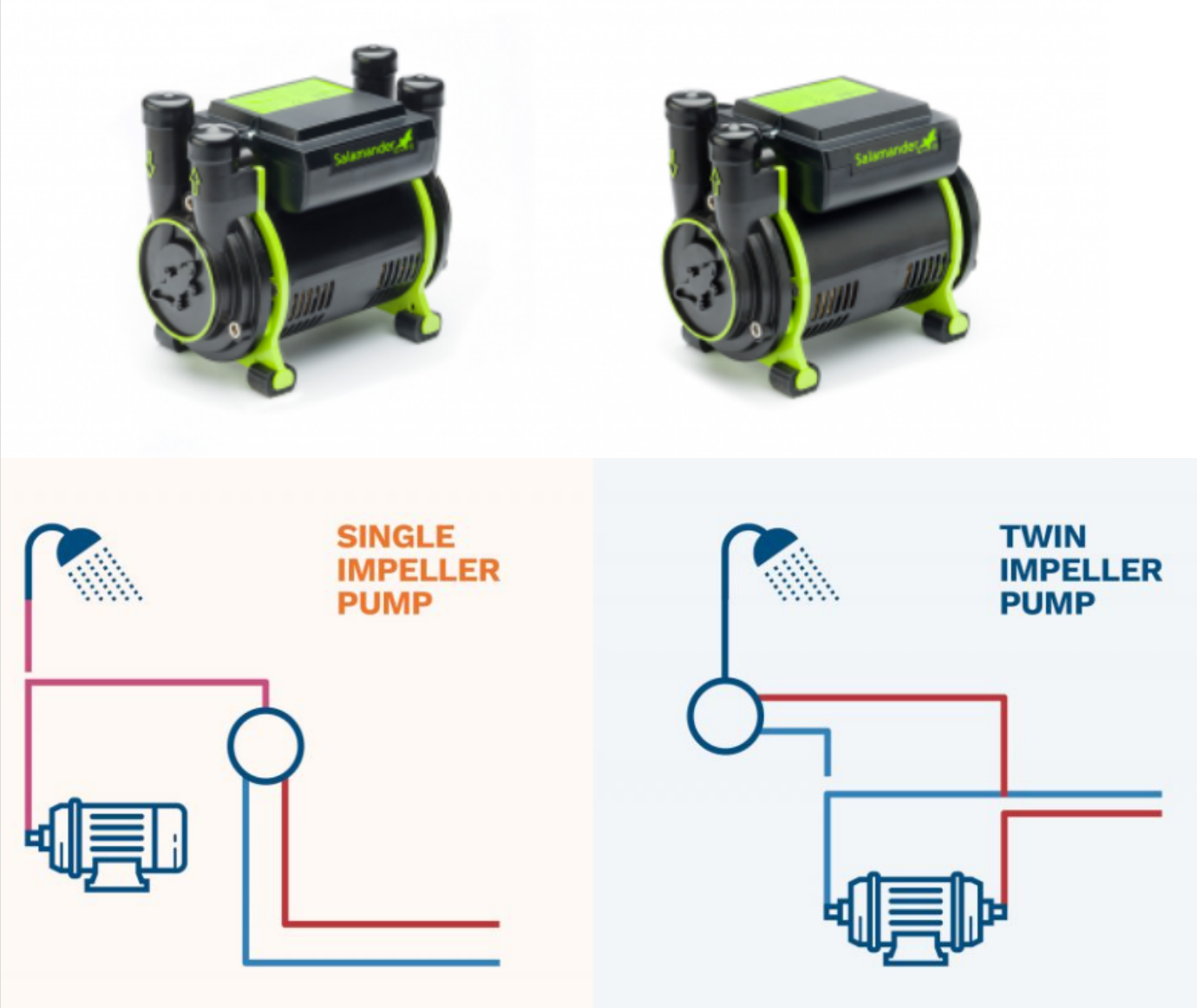
A negative head pump usually has a pressure vessel which acts as a buffer to stop false activation.

negative-head-pump.png

- A negative pump is also needed at places where pumped water meets the main water and appliances containing solenoid valves.

Single or Twin impeller pumps ?

- A pump is used to boost the flow of water hence if the flow of water is very slow in shower, installing a shower pump is a solution. or If the whole house needs a good flow then a whole house pump is to be installed.
- Shower pumps are available in both single and twin impellers.
- **Single vs double** impeller pumps: Twins impellers pumps are designed to supply both hot and cold water to showers, bathrooms and whole house installations, while single impeller pump supply either cold or hot water to a single or multiple outlets. This can happen when the cold water is mains fed and the hot needs to be boosted to match this pressure.



Do I need a centrifugal or regenerative pump ?

- A regenerative pump incorporates cheap or of lower quality parts hence it is cheap and also easy to install (specially on combi boiler). But it makes more noise and performance is not as good as of centrifugal one.

- A centrifugal pump is made of higher quality components, it reduces noise and has a better life span for th pump.
- What size shower pump do I need ?

The pressure at home decides the size of the pump?

- You need to consider how much pressure is needed to drive water to the taps and showers ?
- How many appliances (water outlets) one pump will be used for at one time.
- Does a house has more than one shower ?
- How big is a home ?

Therefore a cheaper shower pump would not be suitable for a big family.

- A small flat with a couple would need to purchase a pump with 1.5 to 2.0 bars worth of pressure. Similarly a 2 bed house the requirement would be of 2-3 bar pressure. A family of four that is a 3 bed room house would require at least 3 bar pressure. But if a house has multiple showers and tap in use at one time than a pump over 3 bar like 3.6 bar pressure would be needed.

What is baffle ?

-Baffles are flow-directing or obstructing vanes or panels used to direct a flow of liquid or gas. It is used in some household stoves[1] and in some industrial process vessels (tanks), such as shell and tube heat exchangers, chemical reactors, and static mixers.(Wikipedia)

- They reduce cylinder Temperatures.
- A baffle is also used to balance water evenly in a vessel. For example if you have a portable vessel / cylinder / engine where the air/water is moved side by side then baffle can easily provide protection.

What are different fuel sources ?

- Natural gases
- Lpg
- Solid fuel
- Bio fuel
- oil

- Electric

+

Different kind of showers

- Gravity Showers: They do not need any pump, the head pressure is enough to provide pressure for the shower
- **Manual shower**: It takes water from the thot and cold supplies and then combines them within the shower unit. They can be used with all water system. Since they take water from existing supply the flow of water can decrease if water is being used in home. It is usually come as a deck mounted unit an has shower handset integrated. They also work with shower enclosures. Minimum pressure required is 0.1 bar can be used with shower pump to increase the pressure.
- **Electric shower**: It does not rely on the boiler for hot water instead it takes water from a cold-water supply and uses its own heating elements within the unit to heat the water up. They should not be confused with Power shower. They can be used with any plumbing system (hot water system) but best used with gravity fed system. It requires minimum pressure: 0.1 bar (which all homes will have).Temperature not affected by hot water use elsewhere in the home and are compatible with all plumbing systems.
- **Power Shower**: They are not same as electric shower. They require both a hot and cold water supply. They have a built in **booster pump** and installed in homes with a gravity fed low pressure system.
- **Thermostatic mixer shower**:These showers are equipped with **thermostatic valve** to prevent scalding and regulate the temperature even if you are using water else where it maintains the temperature. Suitable for housed with children and vulnerable but require 1.5 bar pressure at least, they work with all water system with one exception that is if gravity fed is used it requires a twin impeller pump.
- **Digital Shower**:
- **Smart Shower**:

The use of trace heating instead of secondary circulation ?

[What is a flange ?] (https://www.salamanderpumps.co.uk/ (https://www.salamanderpumps.co.uk/))

- A flange is a device that stops air coming into the pump from hot water cylinder.

- It happens when water is heated in the cylinder air bubbles are formed and collect around the sides or the top of the cylinder.
- The bubble then rise up to the top of the vent pipe. +
- If a flange is not installed these bubbles starts to enter into the hot water drawn off pipe.
-

Water system in UK?

- There are three main types of water system in UK.

1. **Gravity Fed:** Fairly common in the UK, and tends to have a cold-water tank in loft space as well as water cylinder tucked away in the airing cupboard. If the water pressure is low one can use a shower pump to boost it.
2. **Combi boiler**: You can not use a shower pump with them. It has no cylinder and tend to have high water pressure and provide hot wather on demand.
3. **Unvented** This is where a water cylinder is heated by a high pressure boiler or an immersion heater. As a result large volumes of water can be suppled to the shower.

Note : Bothe combination boiler (or combi boiler) and unvented cylinder use **main fed** or are main fed.

What is a static / dynamic pressure ?

- A static pressure is the pressure in the body of water when the water is at rest.
- A dynamic pressure is the static pressure plus the momentum of the fluid in motion.

What are the two things that WRAS (water regulation advisory scheme) does ?

1. Prevent water loss
2. Publish water regulating guide

What gives an open vented system its working pressure ?

- The head height of the CWSC (Cold water storage cistern).

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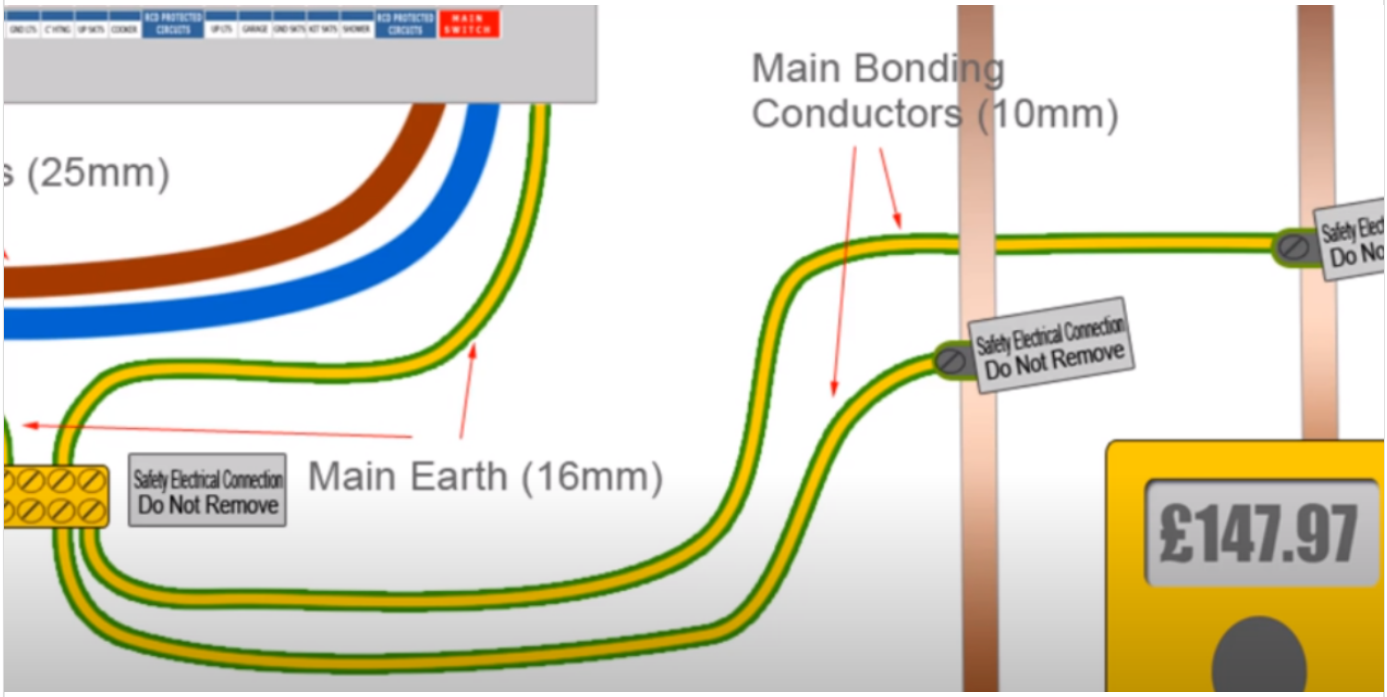
The size of Earth wiring for continuity testing

- The Earth wire should be of 10mm attached to piping.
- While the main Earth wire should be of `16mm` as shown in the figure.



Why do we have Earth wires attached to water supply copper pipes in home water piping ?

- Water and copper are good conductors of electricity.
- If a live wire touches the copper piping used for supplying the water there is a 240v running in copper pipes consequently water is also carrying the same voltage enough to electrocute a human being.
- To avoid this situation all pipe works are attached to a earth wires which should be connected to each other without any fragment is left. This ensures that if in any case there is a current in copper pipe it will be detected though earth pipe which is grounded and when the current goes to the ground it automatically sends the message to your main switch box which will trip the electricity.
- In other words if pipes are earthed the earth leakage will trip the RCD as soon as it happens.

The Earth wire from the Electric system is bonded (connected) to anything that has the potential to become energized / live. This includes plumbing for water, gas, metal building frame and metal sheeting on the building or anything that is a conductor and run through the house.

- The idea is that all the metal stuff remains at the same electrical potential.
- If for some reason one metal has a different electrical potential than the other one, it provides a way for current to flow from high voltage to a lower voltage resulting in a electric shock if you touch both at the same time. Thus by connecting all pipe works to each other using earth wire (called bonding), you create an equipotential bonding .
- Bonding ensures that there is a zero volts between everything metal used in home.

Fill in the blanks

- BS6700 states that an open vent must be a minimum of 22mm and have no valves in it at ll. the hot water distribution pipe, as it leaves the hot water cylinder should rise slightly and should be a minimum of 450mm long in horizontally before it connects to the vent pipe . The primary function of the vent pipe is to act as safety valve device .
- A cistern fed showers require equal pressure. A cold water must be fed from CWSC . The safest valve to use is the thermostaic valve . The minimum head height required for effective operation is 1m for the shower to work.
- A cistern fed shower with booster pump (twin impellor) will increase the pressure for both hot and cold water . The feed from the hot water cylinder is often made via an essex flange . The connections from the pump to the pipework should be flexible . The pump is operated by a flow switch .
- Mains feed showers are generally fed from an unvented cylinder or from combi boiler or from a heater . The system runs with a high pressure . A special valve may be required called a pressure regulating / reducing vavle .
- A water flow is measured in liters per minute
- If an isolation valve when closed off is leaking it is due to Limescale buildup, debris or an O ring may be damaged .
- The most likely cause of a creaking noise under floor boards in a house when they run hot water to the bath is due to the notching of the joist to accommodate the pipes is incorrect .

- BS6700 stats that the velocity (flow rate) of the hot water should not be too high or it could be heared in the pipe work. The right velocity is 3meters per second .
- The common ways to overcome water hammer are inspect FOV (float operated valve) and replace with washer, install flow resistor, change to an equilibrium valve, inspect clipping distance to make sure they are correct.
- The cylinder thermostat could fail in two positions and they are Fail in open position resulting no hot water and fail in closed position and the hot water tempartatue continue to rise .
- After a soundness test Flushin and disinfecting should take place to remove any debris and biollogicl matter.
- Chlorine or sodium hypochlrite is used to disinfect a system.
- Plumbers should make sure that the parts installed are WRAS approved.
- British Standard BS8000 is concerned with good workmanship when installing a hot water system.
- In F&E system the primary vent is over F&E CWSC and the secondary over the CWSE otherwise it would lead to contaminating the CWSC. see point 16 figure.
- Building Reg Part L requires that all pipework up to 1m away from the cylinder in the cupboard must be insulated
- In hard water areas maximum cylinder state is set to 65 degree otherwise limescale start to form.
- If an extension is done at home away from HWSC (hot water supply cylinder), it could create a dead leg and in this case secondary circulation could be installed or locallised heater is to be installed
- A mains feed instantaneous heater is required if a loft conversion is done to provide water in loft.
- 15mm and 22mm coper pips are also knows as R250 half hard copper .
- A Hydrolic test kit is used to test cold water pipe work pressure and soundness test. It is also used in hot water soundess test to pump the water to a testing pressure .
- The central heating and hot water is controlled by twin channel programmer control .

- A gate valve is designed for a low pressure and it is unidirectional .
- A single point water heater is fitted with a 15mm + minimum from the connection to the heater.
- A vent pipe must be insulated for at least 1m of its run.

What is the advantages of an indirect cylinder ?

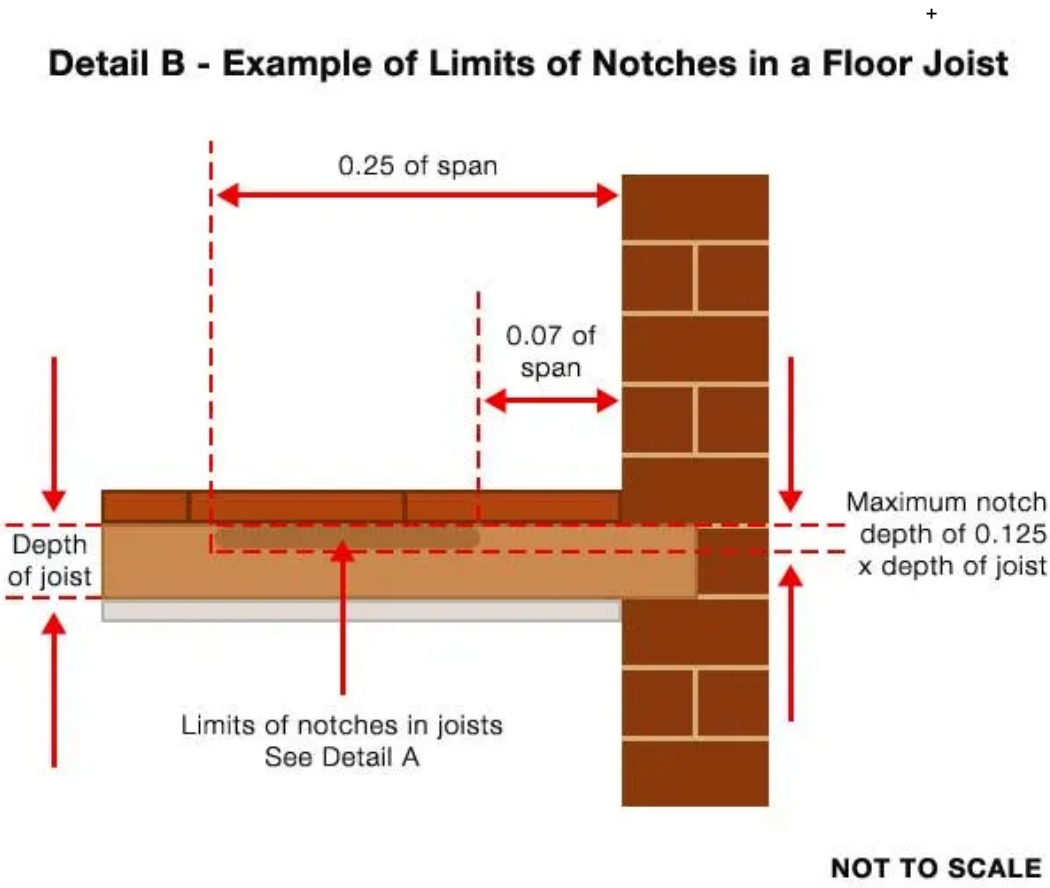
- Part L compliant
- Various size of cylinders
- The system can be fully pumped
- Water is heated and stored centrally and distributed from that point to all appliances.

[What are the rules for notching joists and timber beams] ?

- A timber joist is wooden part of a construction that supports the load. Common types are found in **floor and ceiling**.

- When pipes are passed through the roof or under the floor. Care must be taken as any hole made in timber joist weaken the support.
- The rules to ensure that one is not compromising the structural integrity of any joist are to make sure that **notches and holes** are in safe areas, the rules are given as Followings
- Notches should not be closer to a support than **0.07** times the span.
- Nor further away than **0.25**times. Or (1/4) times the span.

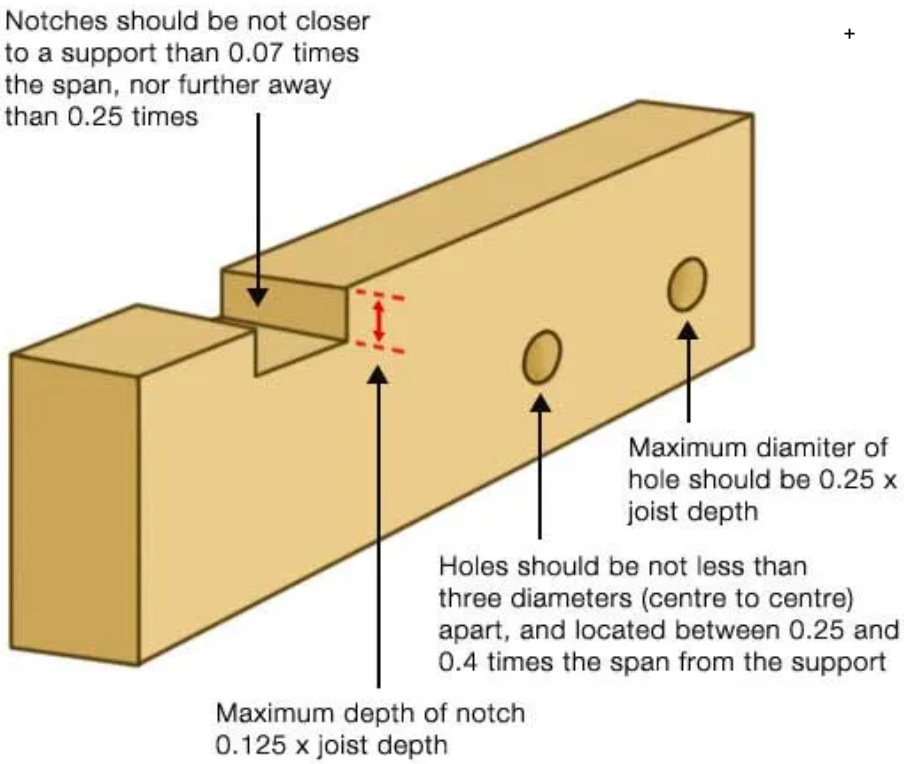
- The depth of the notch in joist should not be more than **0.125 * depth of the joist**



The rules for positioning notches in floor joists – Image courtesy of NICEIC)

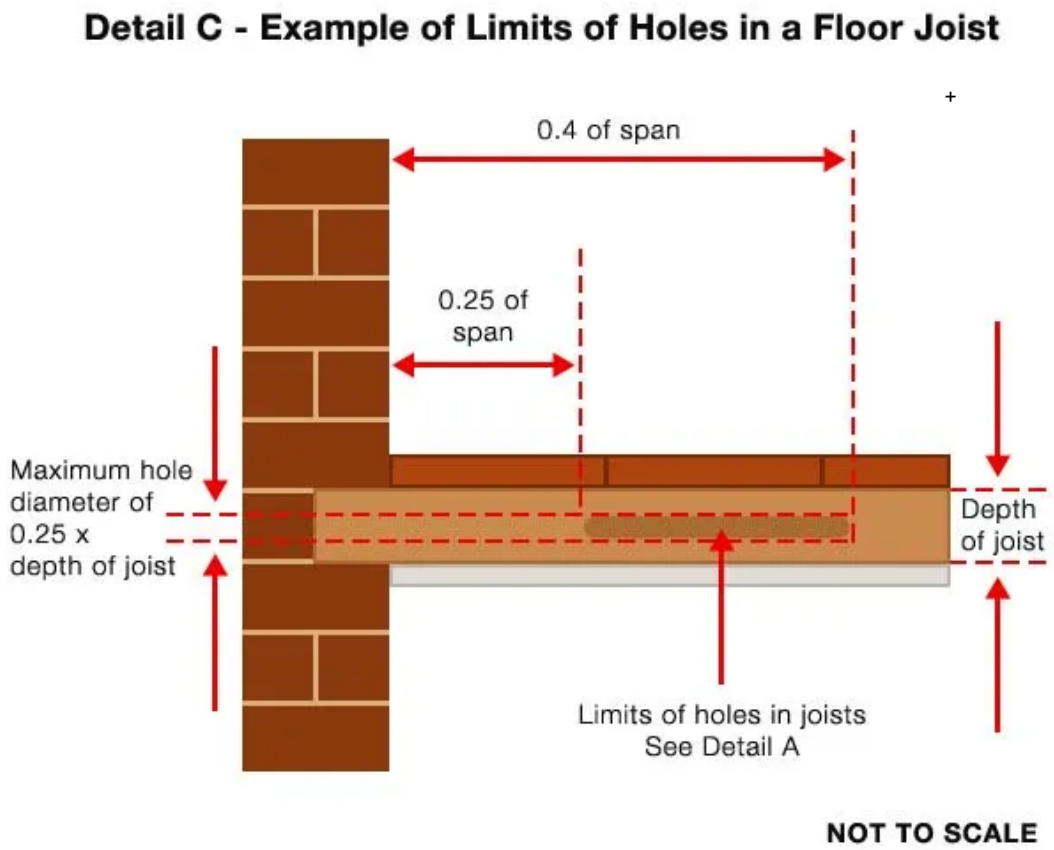
- Holes should only by made or drilled on the central line of the joist.
- Maximum diameter of the hole made in joist should **0.25 * joist depth**
- Similarly holes should not be less than three diameters (centre to centre) apart, and should not be located between 0.25 and 0.4 times the span from the support.

Detail A - Example of Limbs of Holes & Notches in a Floor Joist



Where larger notches and holes in joists should be and how they should be made

- HHoles should not be no closer to the support than 0.25 times the span and nor no further away than 0.40 times the span.



Rules for positioning holes in floor joists

Multiple choice questions

A depth of the timber joist is 8inches (or 203.2mm)

- What would the maximum size of hole one can make ?
- The size of the hoe would be **0.25*203.2==50.8mm**
- How far would be the next hole from the first hole ?
- Since it should not be less than three times the diameter it would be **3*50.8=152.4mm** apart

Between what temperatures is there a risk that legionella could grow?

1. 20-30 degree centigrade
2. 30-40
3. 05-20
4. 45-50

5. 20-46 (A)

+

Hot water should be stored at what range ?

1. 30 - 35 %
2. 40 - 45 %
3. 50 - 55 %
4. 60 - 65 % (A)

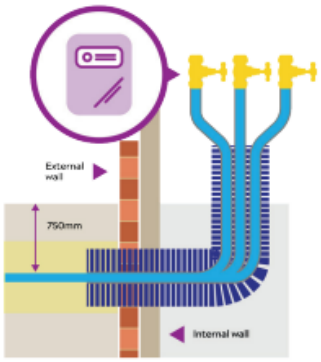
What is the minimum size of the open vent pipe ?

1. 15mm
2. 22mm (A)
3. 25mm
4. 28mm

Which one of the following component parts is installed after the incoming stop valve ?

1. Drain off (A)
2. Air Vent
3. By pass valve
4. Water meter

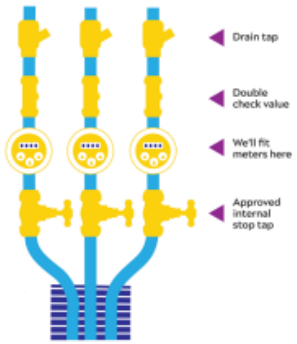
Water meter



In flats, most water meters are located on the outside.

If you are planning to locate your water meters inside, you'll need to build a meter cupboard, with a manifold, in a communal area.

Communal areas

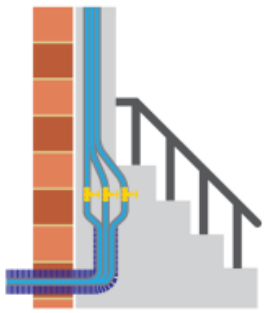


A stop tap should be installed where the pipe enters the main part of the building.

A double check valve and drain tap should also be installed.

Leave adequate spacing so that the meter can be easily fitted.

Communal areas



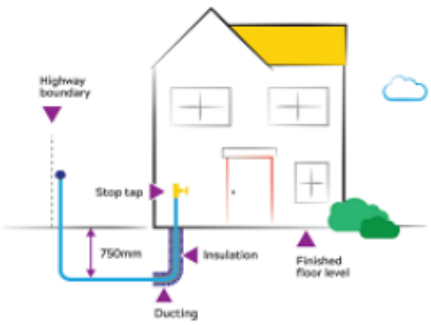
Pipework must be fed through communal areas, such as stairwells and corridors.

Pipework must not be fed through flats that the supply does not serve.

Which one of the following is the maximum depth a water main service should be laid ?

1. 750mm (this is the minimum)
2. 1000mm
3. 1350mm (this is the maximum) (A)
4. 1650mm

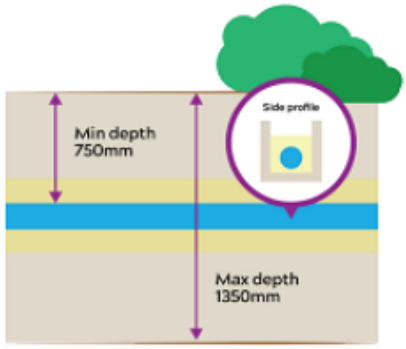
Using your Survey



- Dig your trench and lay your pipework from your project to the location we've agreed with you in your **Survey.** This is normally up to the highway boundary.
- Use the right size pipework and material. This information is also provided in your **Survey.**
- Pipework must comply with Regulation 4 of the Water Fittings Regulations.

See wras.co.uk for more information

Depth



- Pipework should be laid at a minimum depth of 750mm from finished ground level (measured from the crown of the pipe)

  Do not lay your pipework more than 1350mm deep.
- Pipework must be bedded down well for protection. Use sand or a similar suitable material.

To ensure correct operation, a single feed indirect cylinder requires which one of the following to be formed ?

1. A heat exchanger (A)
2. An air bubble
3. An annulus
4. A flute

Which one of the following is used by gravity primary pipework to circulate the water ?

1. A circulating pump

2. Conduction
3. Radiation
4. Convection (A)

What is the minimum distance from the distribution pipe from the cylinder before it connects to the open vent ?

1. 450mm (A)
2. 750mm
3. 1350mm
4. 1650mm

Installing which one of the following would overcome problems caused by long pipework ?

1. A primary circuit
2. A heating circuit
3. A secondary circuit (A)
4. A gravity circuit
5.

Stratification is most likely to take place in a

1. Cold water storage cistern
2. Feed and expansion cistern (A)
3. Float operated valve
4. hot water storage cylinder

A full way gate valve is installed in the

1. Cold feed pipe work (A)
2. Incoming main pipework (A)
3. Hot feed pipework (A)
4. Feed from the F&E cistern (A)

? explanations

A single impeller shower pump is installed between the

1. Cold water cistern and the shower valve
2. Hot water cylinder and the shower valve (A)
3. Shower head and the shower valve
4. Shower head and the cold feed

The minimum vertical height required (minimum head height) for a gravity shower to work is:

1. 1 meter (minimum) (A)
2. 2 metres
3. 3 metres
4. 4 meters

Rigid hot water pipe work should be tested at 1 1/2 (one and half) times the system working pressure for

1. 30 minutes
2. 45 minutes
3. 60 minutes (A)
4. 90 minutes

Note the total time is 90 minutes 30 minutes for temperature stabilisation

Which one of the British Standard specification covers soundness testing ?

1. BS1192
2. BS5495
3. BS6600
4. BS6700 (A)

What is the maximum length of dead leg for a 15mm or 22mm pipe before a secondary return system has to be installed?

1. 12m A

+

What are the following British Standard Specification deals in ?

How to read Standards : BS 1566-1:2002 means British standard 1566 part 1 of 2002

- BS 1212 part 2 : Deals with cistern installed with float
- BS EN 60335-2-73 : Immersion heater must comply with this standard
- BS 6700 : installation of cistern , soundness testing,…
- Section G3 of Building regulation : deals with installing unvented high pressure cylinders.
- BS 1566 part 1 : Copper indirect cylinders for domestic purposes Part 1: Open vented copper cylinders - Requirements and test methods
- BS 1566 : Hot water storage cylinder specifies copper cylinder grades direct/indirect/single/double feed. It also specifies minimum heating surface area of the heat exchanger.
- BS 1566 part 2 : Copper Indirect Cylinders for Domestic Purposes - Part 2: Specification for Single Feed Indirect Cylinders .
- Water fitting regulation 1999 : for design, installation and maintenance of plumbing systems , water fittings-using appliances.
- Document L Building Regulations : Deals with conservation of fuel and power .
- Document L1A Building Regulation : Deals with the same in new dwellings 2013-2016 . It dictates that all new installation must have a pumped primary circulation with controls that prohibits energy wastage. It covers insulation and performance of hot water cylinder.
- Document L1B Building Regulation : Deals with the same in existing dwelling 2010 . It recommends that existing double feed indirect system should be replaced with fully pumped systems.
- BS EN 806 : In 2012 BS 6700 was deactivated to be replaced by BS EN 806. the specification covers installation of systems used for delivery of water for human consumption inside a building. It also Covers indirect hot water system. BS6700 was introduced in (2006 and revised in 2009) and has now been withdrawn after BS 806 all parts have been published. But it is still used in books recently published but in future this will change.
- BS 8558 : covers access to hot water pipe work
- BS EN 1287 : Deals with Thermostatic valves explained in Document G.

- Document L8 : Guidance for the control of legionella bacteria in water system
- The water Regulation 1999 and building regulation Part G : covers hot water system.

Grade 3 copper cylinder has the following specification

1. 10m maximum height with 1.45 maximum bar pressure (A)
2. 25m maximum height with 3.65 maximum bar pressure
3. 15m maximum height with 2.2 maximum bar pressure

Which one of the cylinder can be connected directly from the main pressure supply

1. vented / open vented cylinders
2. unvented cylinders (A)
3. thermal store (A)

What is the main pressure of a cold water when it is fed to pressurised unvented cylinder using regulators ?

1. 1 bar
2. 3.5 bar (A)
3. 2 bar

A electric shower is classes as

1. An instantaneous heater (A)
2. A storage heater
3. A multi heater
4. A centralised heater

Which one of the following is the minimum size for gravity primary pipework from a continuous burning appliance. ?

1. 15mm
2. 22mm (minimum) (A)
3. 28mm (maximum) (it for DHW as well)

4. 35mm

+

Which is the minimum pipe diameter of a primary open vent from a gravity fed indirect hot water storage cylinder to feed and expansion cistern in a domestic property ?

- 22mm (A)

What is minimum size of a secondary cold-feed pipe (DHW) from a cold-water storage cistern to a hot water storage cylinder is a domestic property ?

- 22mm (minimum) (A)
- 28mm (maximum)

A secondary return incorporates a pump made from

1. Cast iron
2. brass
3. bronze (A)
4. aluminium

A cylinder thermostat is located

1. 1/3 down from the top
2. 1/3 up from the bottom (A)
3. 1/4 down from the top
4. 1/4 up from the bottom

Which one of the following calculations is used to work out the height that the vent from the cylinder should rise above the maximum water level in the cold water storage cistern before it inverts ?

1. 150mm for every meter head plus 450mm
2. 150mm for every meter head plus 50mm
3. 50mm for every meter head plus 150mm
4. 40mm for every meter head plus 150mm (A)

Note: Say a head height is 10m then (40 * 10 = 400 + 150 = 550mm total height)

What would be the height of vent from the cylinder if it has 1.5 head height ?

- 150 (for one meter height) + 75 (for half meter height) + 450 =
- Using the above formulae

Which one of the following is the correct position of the feed to the cylinder in a cold water storage cistern ?

1. Below the warning pipe
2. Below the cold water distribution pipe
3. Above the cold distribution pipe (A)
4. Above the hot distribution pipe

- The bottom pipe is cold distribution pipe CWD and it is situated 25mm above the bottom then comes the cold feed pipe HWD pipe which is also 25mm above from CWD.

This is done to ensure that if the water in case runs out to the cistern, first hot water runs out (cold feed), and then runs out the cold water to different feeds (cold water distribution).

The legal requirements for installing hot-water system are laid down in which of the following documents ?

1. BS 5449
2. BS 6700
3. Water Regulations (A)
4. Health Safety Regulations

What is the minimum size of primary flow and return pipe ?

1. 28mm (maximum)
2. 15mm

3. 22mm (minimum) (A)
4. 30mm

+

Which type of immersion heater should be used in a new hot-water storage cylinder ?

1. Heater with control thermostat
2. heater with pressure valve
3. heater with thermistor valve
4. Heater with control and overheat thermostat (A)

Note: It is legal requirement to provide reset button / Thermal cut out on the immersion heater in case of immersion heater fails.

- Building Regulation Part G requires that a new immersion heater should have

  Non-resetting overheat thermostat

The pump used in a secondary circulation system may be manufactured from :

1. Low carbon steel
2. Bronze (A)
3. aluminium
4. Copper

Which of the following types of service valve should be used on the cold feed pipe from cistern to cylinder ?

1. Double check valve
2. gate valve (full gate valve) (A)
3. Screw down stop valve
4. Globe valve

The maximum temperature on Bath in new a build home

1. 43
2. 48 (A)

3. 60
4. 38

+

An electric shower is a form of ?

- Direct single point hot water A
- Indirect single point hot water
- Multi point hot water

What British standard covers Hot water installation

- BS 6700
- BS EN 806 A This replaces BS 6700

Building regulation Part L states that a cylinder must heat in how many minutes ?

1. 30m
2. 60m
3. 25m (A)
4. 35

If a flow switch on a pumped shower does not work, what would be the result ?

- The pump will not be activated by the electric A

In which one of the following locations is it a requirement to insulate hot water system pipework ?

- In a loft space (A)

During soundness test on an open vented hot water system

1. The cold feed gate valve to the cylinder should be opened
2. The open vent pipe should be closed (A)

What should be fitted to a hot water storage cylinder to provide protection agains t type 1 pitting corrosion ? +

- Sacrificial anode (A)
- Pressure relief valve

A method of preventing energy and water wastage in hot water pipework with long de ad-legs is known as

- Trace heating

What is the required soundness test pressure for hot water pipework which will nor mally be subject to a static head of 6 metres (assuming that 1 metre head of water is about 0.1 bar pressure)?

Note: A 6m static head means there is some pressure in the system, if using 1m = 0.1 bar then 6m will give 0.6 bar. Then the required soundness test is 1 and half of 0.6 which comes to (0.6 + 0.3 == 0.9 bar)

- 0.9 bar (A)
-

A shower pump should be set on

1. A solid floor directly
2. A timber floor directly
3. Anti vibration mountings A
4. Anti static maintains

The minimum recommended head of water between the base of a cold water storage cis tern adn the shower head (outlet) with a gravity fed shower is :

1. 0.75 m
2. 1.0 m (A)
3. 1.5 m

If you wanted heat your water using a boiler and a renewable heat source, what would happen to the standard hot water cylinder fitted in the property?

1. Be replaced with a twin coil cylinder: one coil for the boiler and one for the RHS (A)
2. Turned off
3. It would be removed and replaced with a combi
4. Not possible

If you are to decide between the following living in hard water area which immersion element should it be ?

- High density element
- Low density element (A): It takes greater surface area and attracts limescale Slowly

What is size of pipe feeding to shower

- All appliances are fed using 15mm pipes with an exception of bath tub that is supplied with 22mm pipes both cold and hot water as the bath requires a lot of water and by increasing the size more water flows through 22mm pipes than 15mm pipes.

A low pressure manual shower mixer vlave must be supplied with

1. Hot and cold water from storage
2. Hot and cold water from a supply pipe
3. Cold water from supply pipe and hot water from storage.

What type of flange it shown in the figure ?

+

- A surrey flange A

A TMV should blend the hot and cold water to a bath or shower valve to what maximum temperature

1. 50
2. 40
3. 38 This is minimum
4. 43 A
5. 55

The choice of Hot water system depends on which of the following points ?

1. The number of hot water outlet A
2. Running cost and fuel efficiency A
3. Number of occupants A
4. The number of cold water appliances

If the CWSC is 5m above the Hot water cylinder the pressure of the hot water will be

1. 0.5 bar

In domestic home a grade 3 storage cylinder is used and fitted with 10 m height that provides 1 bar. Hence 5m would provide 0.5 bar

Water Regulations recommend that the temperature at a terminal fitting must not be less than 50oC within how many seconds after fully opening the terminal fitting.

- 30 seconds A

If a low pressure is coming from the main what system would you install

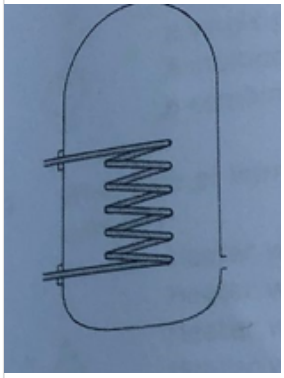
1. Install a direct hot water system
2. Install an instantaneous system
3. Install a storage system A

The device shown below is used for

+

1. Measuring water flow
2. Sizing hot-water cylinder
3. Establishing the pH of water
4. Measuring water pressure (A)

What type of hot-water storage cylinder is shown in the following diagram ?



1. Direct cylinder
2. Combination cylinder
3. Double feed indirect cylinder with annulus
4. Double feed indirect cylinder with coil (A).

When draining down a sealed central heating system its best to: (central heating question)

1. Open the bleed valves to let the air in

2. Ensure the filling loop is open
3. Close the lock shield but open the thrives
4. Close all drain valve.

What is one pipe circulation ?

- A one pipe circulation is a term used when a vent pipe is directly drawn above from the hot water cylinder without running the hot water drawn off pipe horizontally at least 450mm before it is run above for vent pipe. If this happens the circulatory flow and return happens in the same pipe resulting in **waste of heat** and risk of creating **legionella.**

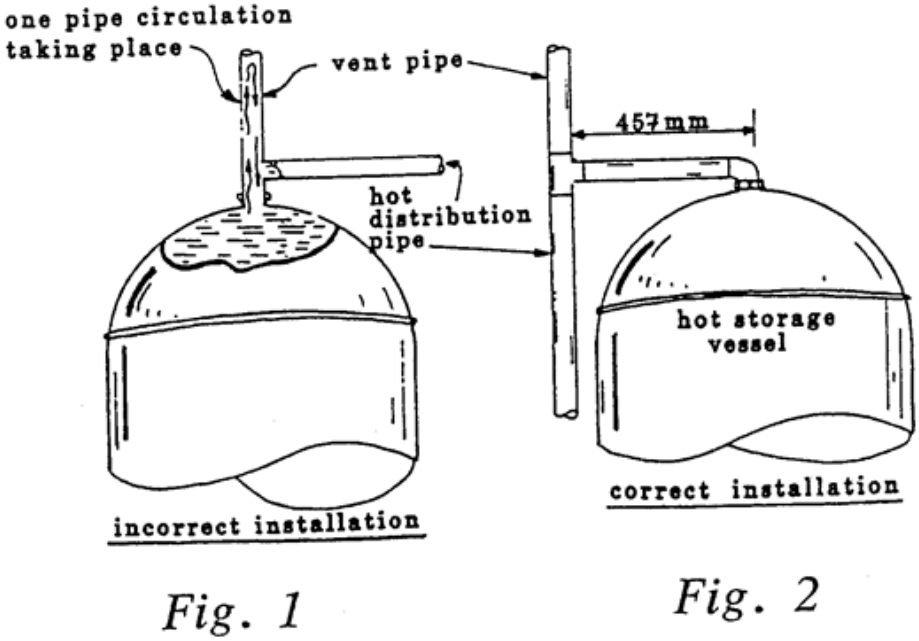


Figure 7. One Pipe Circulation

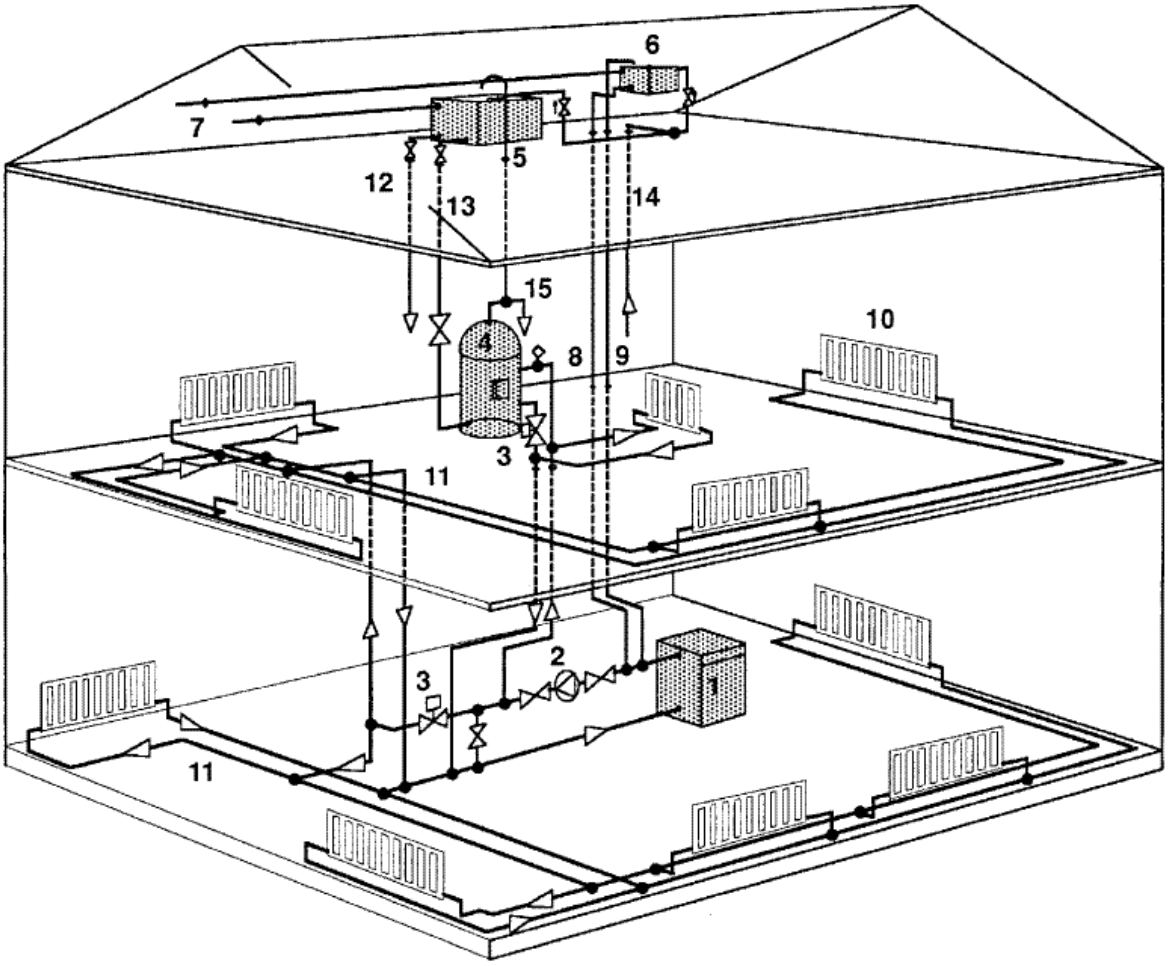
Requirements that heating system expansion (cistern) should have

- First of all these cisterns are not tanks as the tanks are closed from the top like oil tank. Cistern are open topped with lids.
- There are 10 critical requirements that a heating system cistern should have.

1. A purpose made non absorbent lids
2. A full supporting water resistant base if the cistern is made of plysteyrene.

Vented central heating system with open vented hot water cylinder

Vented central heating system with open vented hot water cylinder



1 Boiler
2 Circulating Pump
3 Motorised Valve
4 Hot Water Storage Cylinder
5 Cold Water Storage Cistern
6 Feed and Expansion Cistern
7 Overflow Warning Pipes
8 Open Safety Vent Pipe
9 Feed and Expansion Pipe
10 Radiators
11 Circulating Pipework
12 Cold Water Supply
13 Cold Feed to Hot Water Storage Cylinder
14 Mains Water Supply
15 Hot Water Supply

+

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(https://plus.google.com/share?url=%2f%2flocalhost%3a1315%2fpost%2fslides%2fplumbing%2fhotwater%2f)
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