Water Supply to Houses

A number of systems are used to supply and distribute water within a house:

- a cold water supply to appliances (*appliance* is the term used to describe a sink, shower, washing machine, dishwasher or similar equipment),
- a hot water supply to appliances,
- a hot water supply for the heating system.

Design Features of a Water Supply System

A water supply system is designed to meet the following performance requirements:

- Leakproof Pipework – Leaks from pipework can cause great damage and be costly to repair. It is essential that every joint is properly sealed to prevent leaks. Also, the pipework used must be capable of withstanding the stresses caused by changes in water pressure and temperature. For example, the pipework will expand when conveying hot water and contract when the water cools – this movement should not cause the pipework to crack.
- Means of Isolating Appliances – It is important that appliances (e.g. radiators) can be isolated to facilitate maintenance or replacement.
- Means of Draining Pipework and Appliances – Once an appliance or circuit of pipework has been isolated there should be a way of draining the water from that area of the system.
- Overflow Mechanisms – Any appliance that stores water (e.g. cistern) should have an overflow device to prevent flooding.
- Prevention of Back Pollution of Public Supply – This applies in particular to older direct systems. It is possible that older systems could contaminate the main supply, e.g. if there was a drop in main pressure and contaminated water from a house flowed back into the public mains.

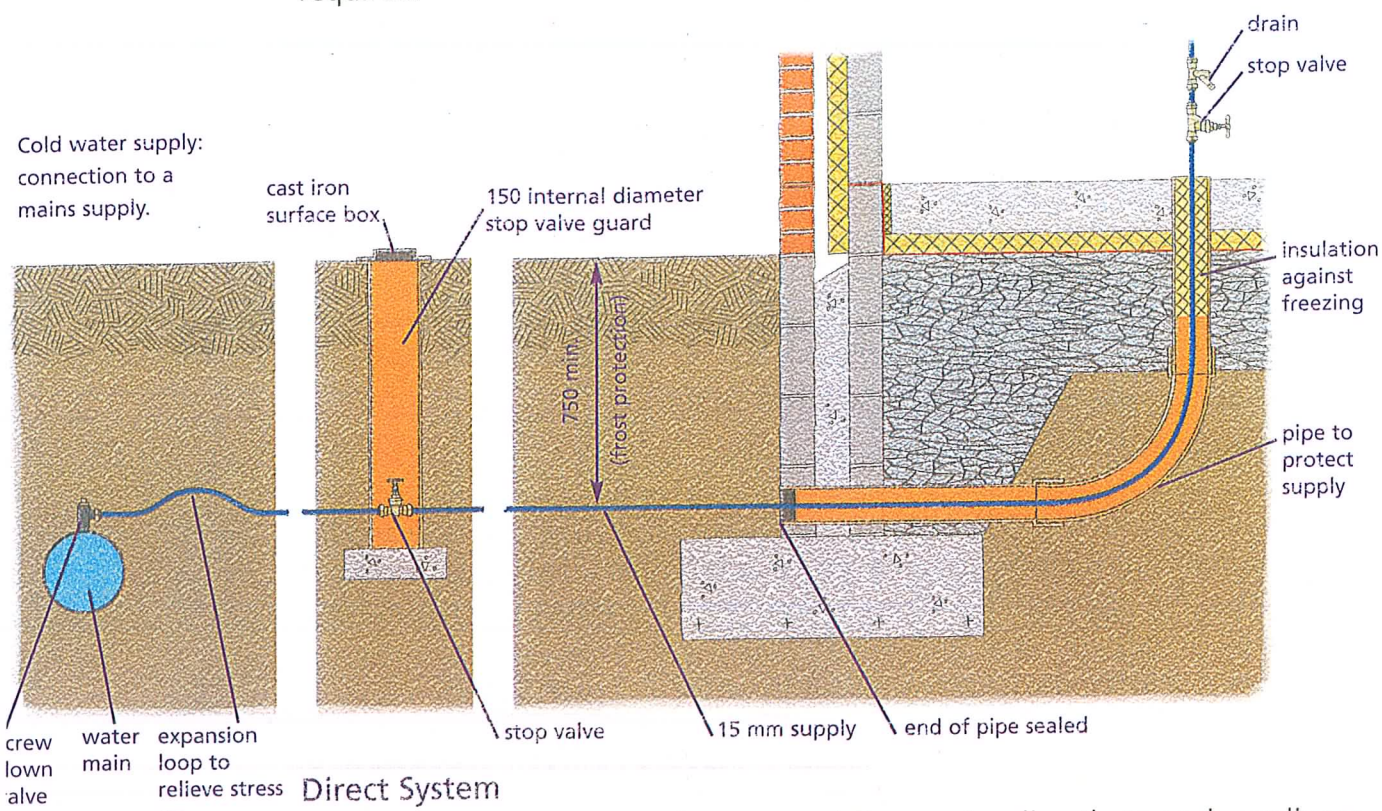
Cold Water Supply

Functions

The function of a cold water supply is to deliver a continuous supply of clean water suitable for human consumption at constant pressure.

A typical domestic cold water supply begins with the connection to the mains. This connection is usually made near the roadside. This facilitates maintenance access by the local authority, if necessary. The connection to the main is immediately followed by a stop valve which allows the supply to the house to

be shut off easily and quickly in the event of a leak or if maintenance is required.

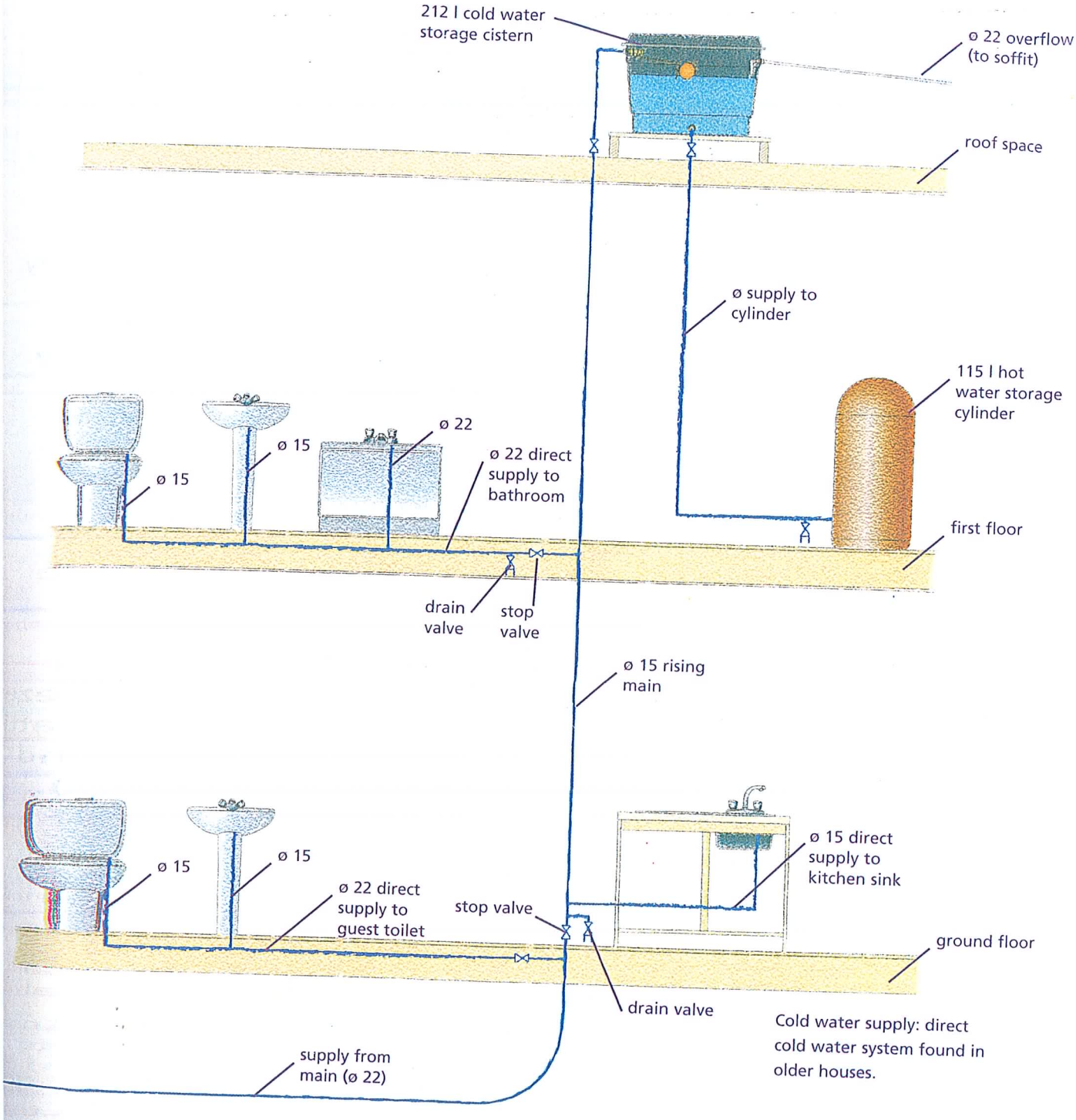


Direct System

Traditional cold water supply systems deliver water directly to each appliance. This system has the advantage that drinking water is available from all cold water outlets. However, there are a number of disadvantages including:

- There is no stored water in reserve in case the supply is temporarily cut off.
- There is a risk of back syphonage due to negative mains pressure.
- There tends to be a drop in pressure during peak demand periods (i.e. most households use more water in the evening).
- Higher pressure at appliances tends to cause early wear and tear of fittings (e.g. dripping taps).

The direct system is no longer installed for these reasons. However, it is important to understand how it works because many older homes use this type of system.



Cold water supply: direct cold water system found in older houses.

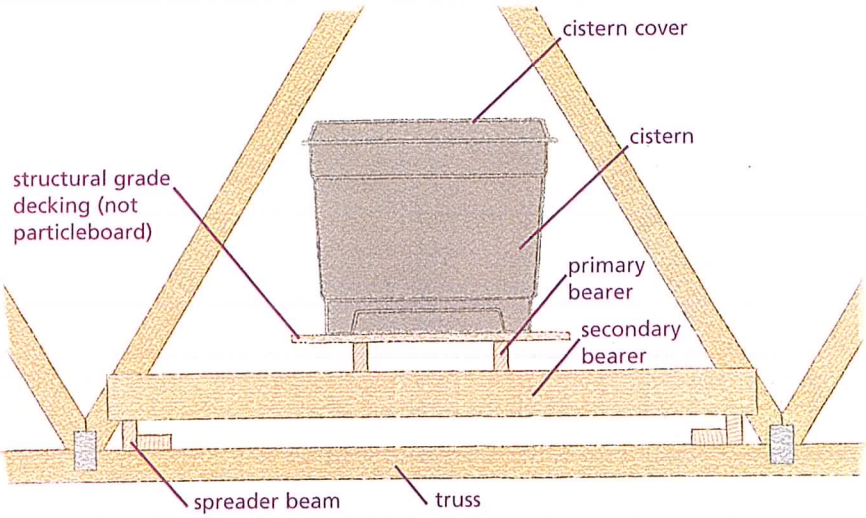
rect System

lern cold water supply systems deliver freshwater to a storage cistern in attic. Water is gravity-fed from the cistern to the appliances around the e. This type of system is called an indirect system. The advantages of the ect system include:

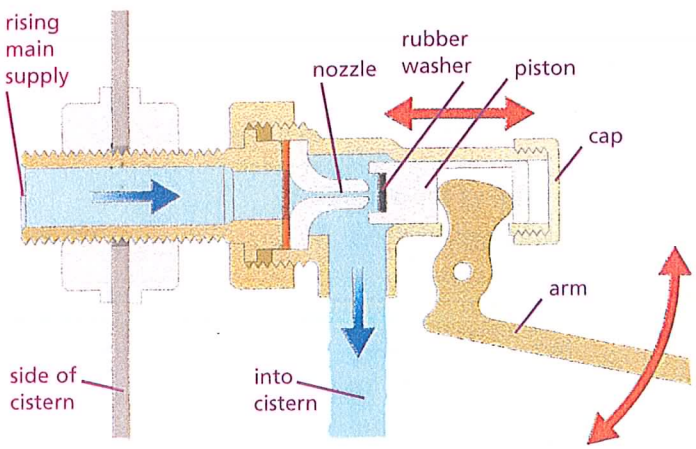
- reserve supply in case of mains failure,
- balanced pressure to all appliances,
- less pressure on the taps and valves resulting in less wear and noise,
- less demand on main supply during peak periods,
- fewer fittings to main – less risk of backflow.

Cistern capacities vary from 212 litres (minimum for a three-bedroom house) to 340 litres (houses with four or more bedrooms). The kitchen sink is the only appliance that is directly fed from the mains. For this reason it is the only source of potable water in a typical house. Cold water should not be drunk from sinks that are indirectly supplied (e.g. bathroom taps) as this water may have been sitting in the cistern for long periods and may have become contaminated.

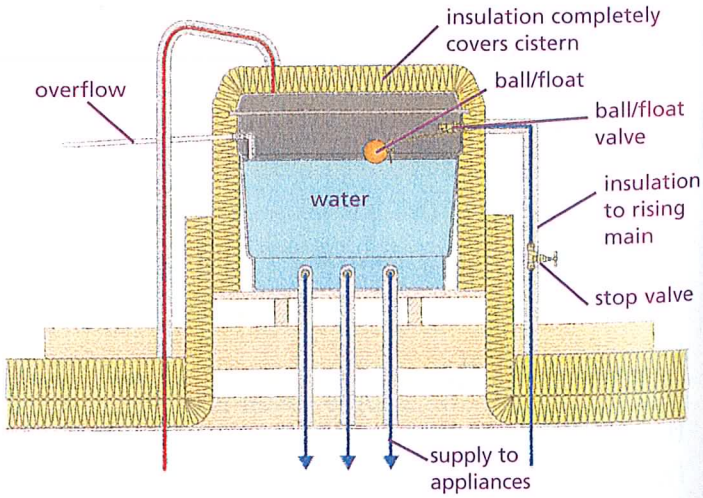
It is very important that the storage cistern is properly insulated and supported. If the cistern and its associated pipework are not properly insulated there is a risk that a pipe might burst during a freeze in the winter (remember the attic is ventilated to the outside and so can be very cold in winter).



Cold water storage cistern: timber supports must be provided to spread the load over at least four roof joists.

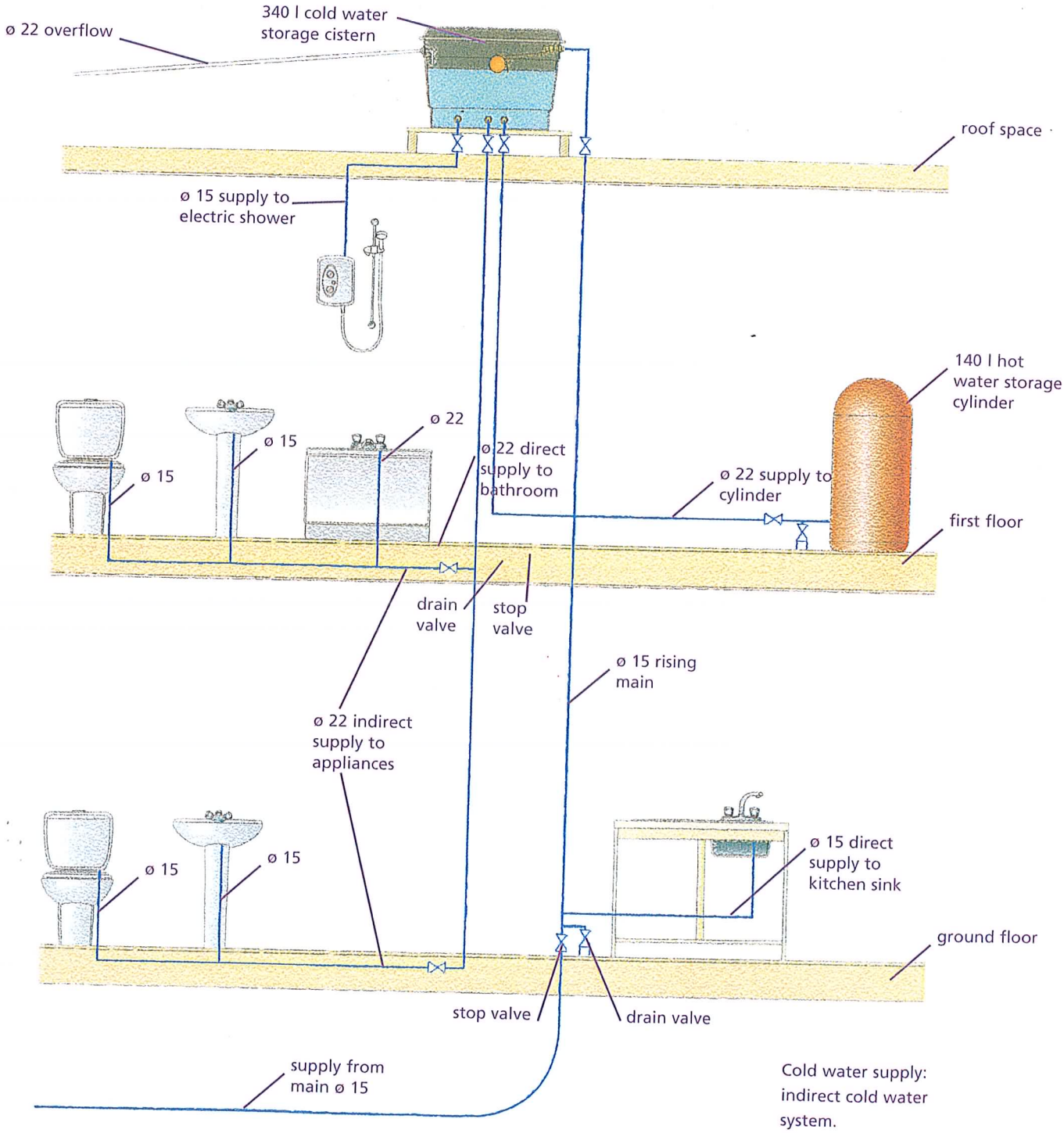


Cold water storage cistern: sectional view of a ball/float valve showing how the up/down movement of the ball/float closes/opens the valve to refill the cistern when required.



Cold water storage cistern: insulation should be provided to the cistern and all exposed pipework. Insulation is not installed under the cistern.

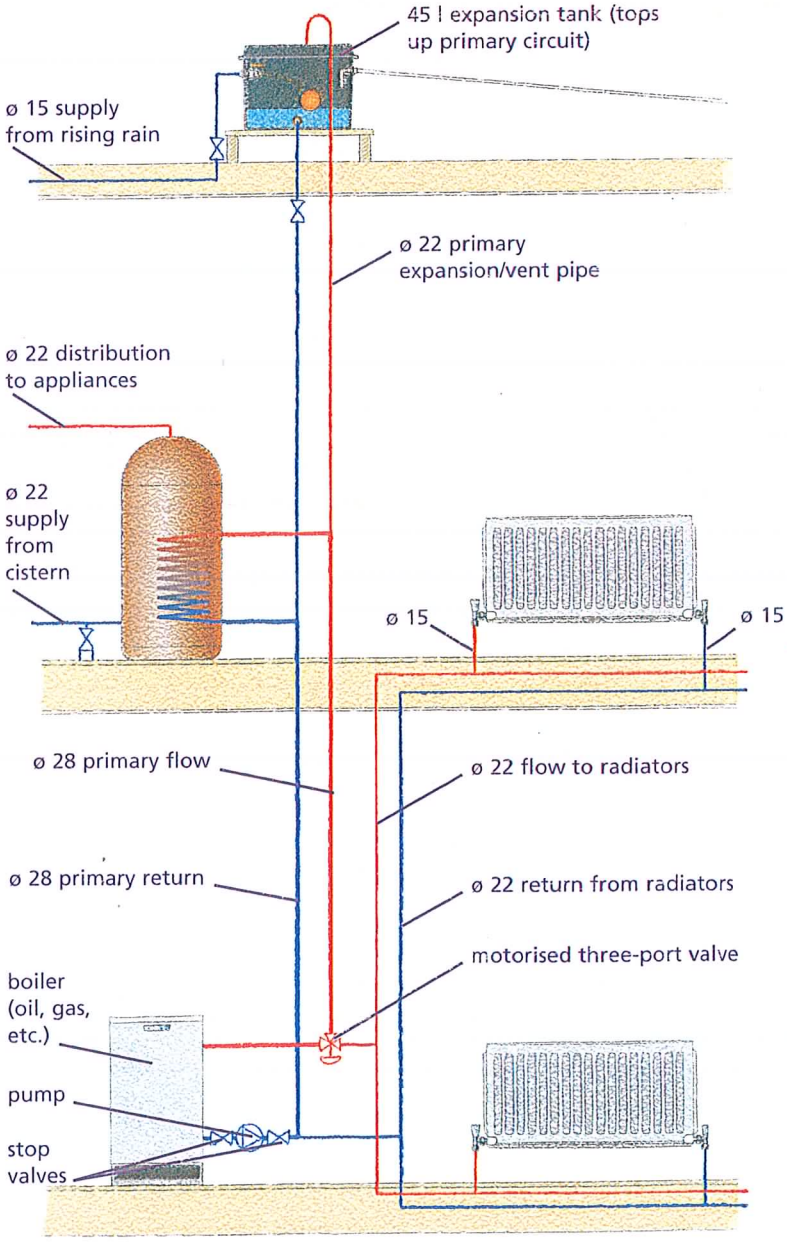
Also, over 200 litres of water is a lot of weight concentrated in a small area of the attic. It is essential that the load is evenly spread over at least four trusses or joists. The flow of water into the cistern is controlled by a float and ball valve to prevent overflow. Should the ball valve malfunction an overflow pipe will carry the water out through the eaves of the house.



Cold water supply: indirect cold water system.

Many plumbers now prefer to use plastic (polyethylene) components. The advantages of plastic pipework include:

- flexibility – this means that less joints are required thereby reducing the likelihood of leaks, (e.g. no joints needed at bends),
- not damaged by freezing temperatures,
- smooth inner surface resists limescale build-up,
- lower thermal conductivity – less heat loss and expansion when water is hot,
- can be joined using push fittings (faster installation).



Indirect hot water supply system: the primary circuit heats water in a boiler and circulates it to the storage cylinder and radiators.

Hot Water Supply

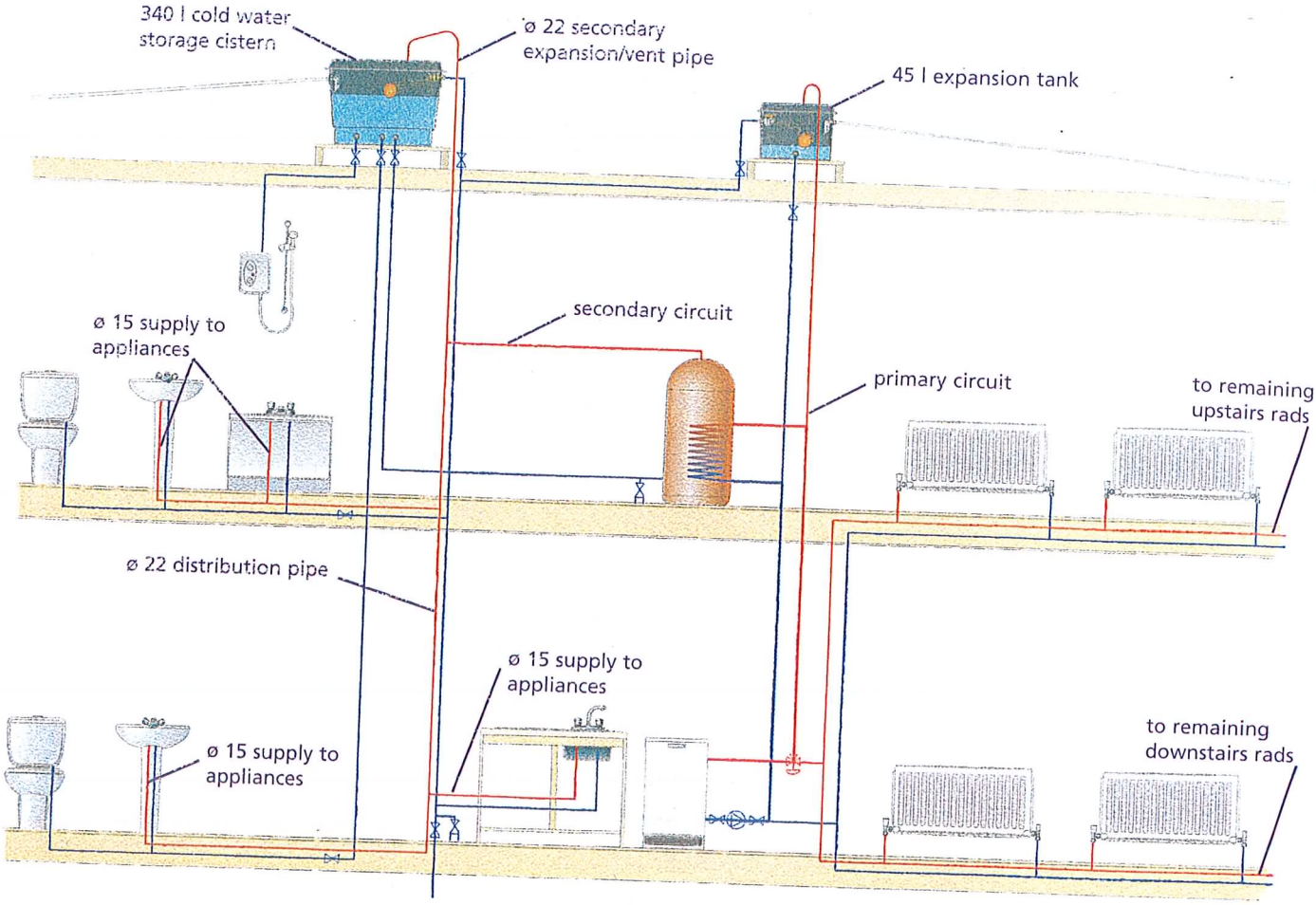
Functions

Hot water heating systems have two functions: water heating (sinks etc.) and space heating (radiators). In simple terms, a hot water system takes cold water from the cistern in the attic, heats it, stores it in a cylinder and supplies it to the appliances when demanded while also supplying hot water to heat the radiators.

Water Heating

Modern houses use an indirect hot water supply system. This type of system consists of two circuits: a primary circuit and a secondary circuit. The primary circuit heats water in a boiler and circulates this hot water through a coil in the storage cylinder (usually found in the airing cupboard). The coil heats the water in the cylinder.

The primary circuit also sends hot water to the radiators which heat the various rooms around the house. This is a closed circuit – the water never leaves the circuit it just goes round and round. The opposite diagram indicates typical sizes of the components used for the primary hot water circuit of a house.



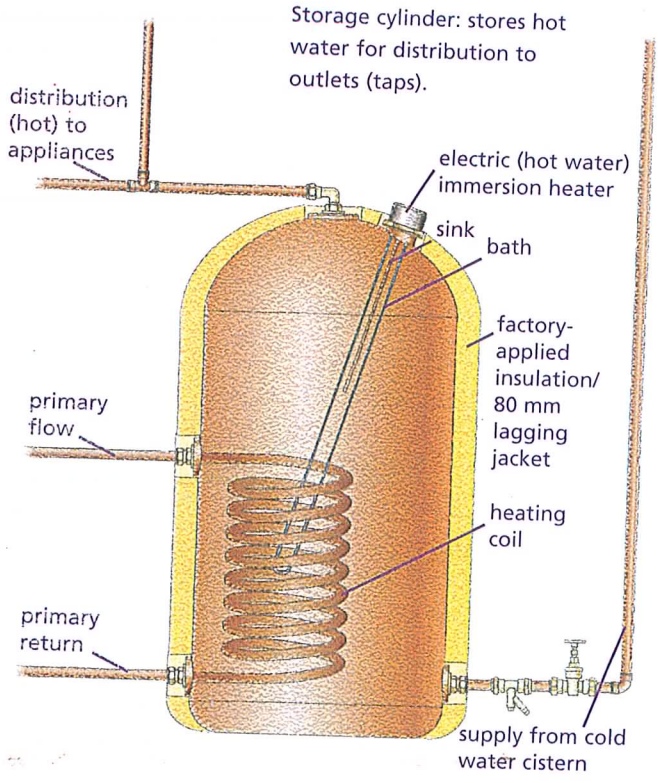
Indirect hot water supply system: the secondary circuit delivers hot water to the various appliances around the house.

The secondary hot water circuit delivers hot water to the various appliances around the house.

The storage cylinder is a vital component of this system. It is here that the heat energy is transferred from the primary to the secondary circuits. It is essential that the cylinder is adequately insulated to prevent heat loss.

Safety Features

Safety is an important consideration when designing hot water supply systems as the build-up of high temperatures and pressures in the storage cylinder, boiler or pipework could be dangerous. To prevent this, a number of safety features are built into the system:

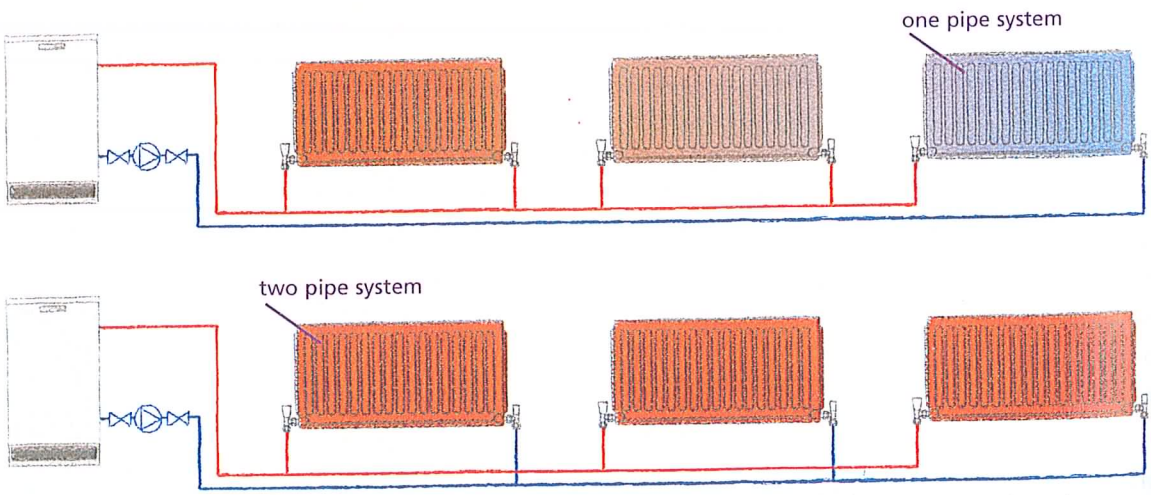


- Expansion (Vent) Pipe – prevents pressure build up in storage cylinder.
- Pressure Release Valve – prevents pressure build-up in primary circuit.
- Boiler High Limit Thermostat – prevents overheating of boiler. Factory-set thermostat automatically switches off boiler if excessive temperatures are reached (cannot be adjusted by home owner).
- Output Control Thermostat – controls temperature of water to prevent scalds from hot taps.
- Boiler Control Timer Switch – switches boiler on and off to prevent overuse.
- Vent Valve to Boiler – prevents build-up of pressure in boiler.
- Fire Valve on Fuel Supply – shuts off fuel supply to boiler in the event of fire.
- Frost Thermostat – intermittently switches on boiler to prevent frost damage if the system is not in use during winter.

The indirect system requires the use of a second (45 litre) storage cistern (expansion tank). This tank automatically tops up the primary circuit as necessary. This is necessary due to losses through evaporation in the expansion pipe, bleeding of radiators (i.e. releasing trapped air) and maintenance of the system.

Space Heating

Space heating of houses is traditionally achieved in Ireland using radiators linked to the primary circuit. However, underfloor heating is now commonly used, particularly in larger single houses. The two main methods of supplying hot water to radiators are the one pipe system and the two pipe system.



Space heating: the one pipe system loses heat as the water circulates, whereas the two pipe system ensures that each radiator operates at the same temperature.

One Pipe and Two Pipe Systems

The pipework supplying water to radiators can be small-bore (12, 15 or 22 mm diameter) or micro-bore (6, 8 or 10 mm diameter). It is important that the correct size of pipe is used to supply the radiators with the correct amount of heat. The size of radiator used depends on the floor area of the room, the

number of radiators per room and the temperature at which the radiator will be required to operate.

One pipe system

Advantages
- easier to install,
- less materials required (cheaper),
- less time to install.

Disadvantages
- water cools as it flows through the system,
- minimal control of individual room temperatures.

Two pipe system

Advantages
- equal heat delivered to each radiator,
- control of individual room temperatures possible,
- warms up whole house faster.

Disadvantages
- slower to install,
- more materials required (more expensive).

System Controls

Space heating system controls are fitted to heating systems in buildings to ensure:

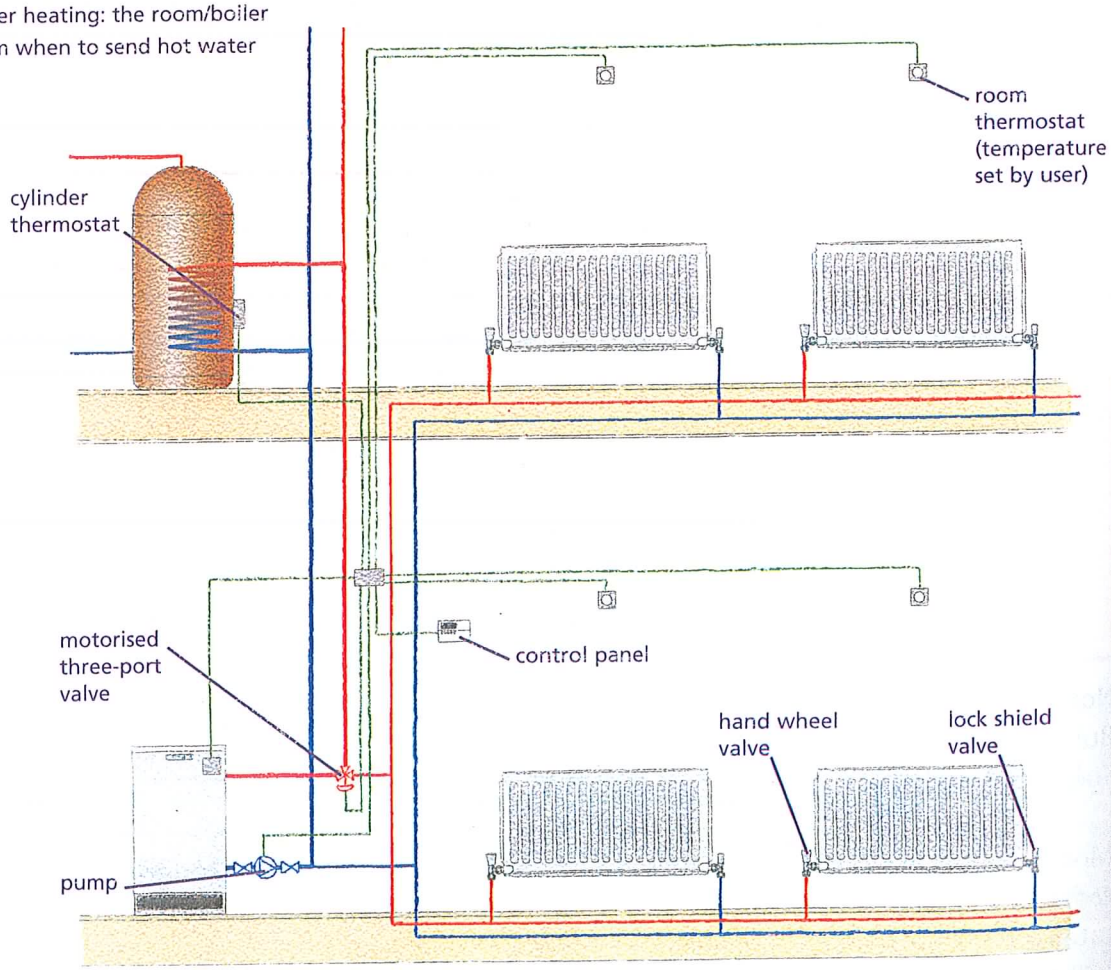
- Correct temperatures are maintained in each space.
- Heat is delivered at the required time of the day.
- Energy is conserved by:
  - separate and independent automatic time control of space heating and water heating,
  - space heating where control is based on room temperature,
  - water heating where control is based on stored water temperature.
    - Controls switch off boiler when there is no demand for space or water heating.
  - Separate time and temperature control in two or more zones where floor area of dwelling is greater than 100 m^2.

Note: These energy conservation measures are requirements under the Building Regulations 2005 (Technical Guidance Document L: Conservation of Fuel and Energy).

Most controls are designed to adjust the rate of flow of water through the radiators – because the temperature of the radiators is directly linked to the rate of flow. Controls usually used include:

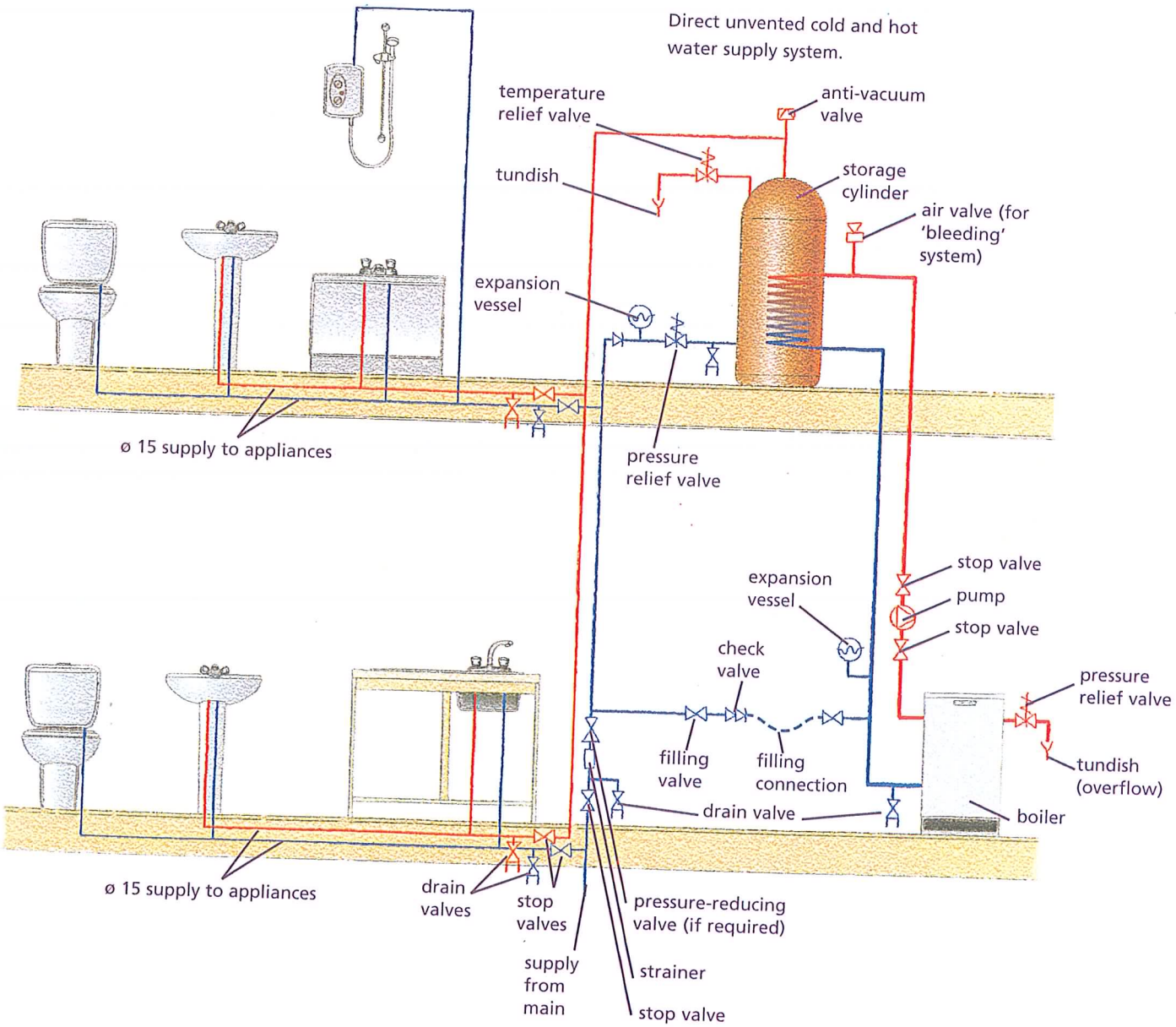
- Circulating Pump – positioned on the return pipe beside the boiler, pumps the hot water to all radiators.
- Radiator Valves – each radiator has two valves:
  - A Hand Wheel Valve – adjusts the flow of hot water to the radiator (or thermostatic valve that contains a shut-off valve that responds to the air temperature of the room).
  - Lock Shield Valve – fitted on the return side to balance the amount of heat in each radiator.
- Air Vent – located at the top of the radiator to allow trapped air in the radiator to be released.
- Gate Valves – used to isolate a section of the system without having to drain the entire system.
- Boiler Thermostat – controls the temperature of the water in the boiler.
- Room Thermostat – set to the desired room temperature (electrically controls the circulating pump).

Controls for space and water heating: the room/boiler thermostats 'tell' the system when to send hot water to the rooms/cylinder.



Unvented System

The direct unvented system is a modern alternative to the indirect cold and hot water systems. This system is mains-fed avoiding the need for storage cisterns in the attic. This is useful in buildings that have limited attic space (e.g. dormer bungalows, duplex apartments). The principle is simple – the water is delivered at a controlled pressure directly into the hot and cold water systems. Special expansion chambers are used to accommodate the increases in volume and pressure generated when the water is heated. One of the major benefits of this system is the delivery of hot water at consistent temperature and pressure to all appliances.



Direct unvented cold and hot water supply system.