A guide to the application and benefits of buffer tanks

What is a buffer tank / how and why are they applied

Buffer tanks can be anything from 50L to in excess of 500L in capacity. The size of buffer required depends on the specific application. Typically buffer tanks have four primary applications.

1/ Mitigation of a potential for system demand to short cycle a heat source appliance.
2/ Maintaining desired or required/differing flow rates across an appliances and through a system.
3/ Facilitating greater control over delivery temperatures, especially in mixed temperature systems.
4/ Facilitating the introduction of multiple heat source input into a single system.

A buffer tank can also provide supplementary benefits such as…

Providing a highly effective air relief point
Providing a trap preventing debris reaching the more vulnerable parts of appliances
Option for secondary pre heating of Domestic Hot water

All too often dismissed as unnecessary, Buffer tanks can be applied effectively in both Radiator and Under-floor heating systems where the heat source is uncontrolled, partially controllable or even fully controlled.

Here we overview some typical uses in various scenarios.

Gas Boilers.

The latest generation of Gas boilers have modulation capacity which depending on the manufacturer will be anywhere from 4:1 up to a 10:1 ratio. At the lower end, 4:1 rating the heating output of a 36Kw boiler will short cycle (stop and start too frequently) if the load upon it from the system is below 9KW (*one 4th of the total capacity - its lowest modulation*).

In a zoned system, a system where partial use is likely, or a system that has been fitted with a large combination boiler for domestic hot water flow rate performance, sub 9Kw demand is probable at least some of the time. At this point consideration of a small buffer tank is sensible as It will keep the boiler in condensing mode for longer periods thus improving efficiency.

Our advice; Though they can be beneficial, it is of course fair to say it is not essential to use a buffer tank with a gas boiler. That said, do look for a high modulation rate when selecting a boiler This will reduce your running costs! A 36KW boiler with 10:1 modulation will cope efficiently right down to a low 3.6Kw load upon it.

The Beretta Exclusive range available from Heat IQ have class leading 10:1 modulation

Diesel Boilers.

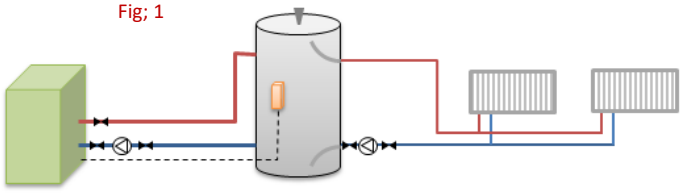
Though considered to be a controlled heat source a diesel boiler does not modulate, the only means of regulating output is via the selection of a nozzle within the boilers range which will typically give a boiler fixed output somewhere within the range of the appliance eg: 15-21Kw 21-26Kw 26-33Kw or 33-44Kw.

Radiator systems

In diesel boiler/Radiator applications demand for heat from the heating system can often be much lower than the pre-set output delivered from the boiler. When this is the case, the boiler will short cycle dropping efficiency dramatically (*especially if the boiler is a condensing model*). This will probably result in premature flue way contamination issues within the boiler.

Our Advice, If the system load may be limited or there is a system design feature in a diesel/radiator system such as zoning, then a buffer tank with differential input control should be seriously considered to prevent short cycle, improve boiler reliability and increase system efficiency.

Fig; 1



Floor Systems

Because of the way floor systems work, using the floor as thermal mass storage. Diesel under-floor systems are particularly suited to the use of a buffer tank when maintaining the heat with lower demand after the higher demand of initial heat up.

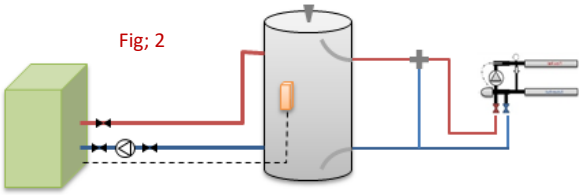
Also, heat input to a floor is required at a much lower temperature than the ideal operating temperatures of a diesel boiler. Now the buffer provides hydraulic separation, allowing the buffer to be maintained at 65 degrees +, while delivering a modest 35-40 degrees to the floor via a flow from the buffer that is blended by the floor loop return.

Control over boiler input to the buffer is achieve through the use of a differential thermostat with a 15 to 20 Degree switching differential which totally eliminates any short cycle potential.

Our Advice; In a diesel/under-floor system using a buffer is strongly recommended, it will improve system performance, appliance reliability and give viable energy cost savings of 10 to 15% . In most Domestic systems a 100L buffer will be ideal,

Of note; *many of the main European brand Oil Boiler manufacturer's installation manuals advise that direct connection from their oil boilers to a floor system should not be done! In some cases it will void warranty*

Fig; 2



Uncontrolled wood and coal fired appliances

Including partially controlled gasification boilers

These systems really must incorporate a buffer tank with the primary flow and return circulation to the buffer via thermo syphon, not pumped. Radiators and domestic hot water are then on supplied from the buffer. *Under-floor is not typically recommended off solid fuel systems.*

The radiator system is then hydraulically separated from the heat source, as is if included, the domestic hot water cylinder. Separation allows control over delivery temperatures to the system. A differential control thermostat in the buffer is used to control the system pump

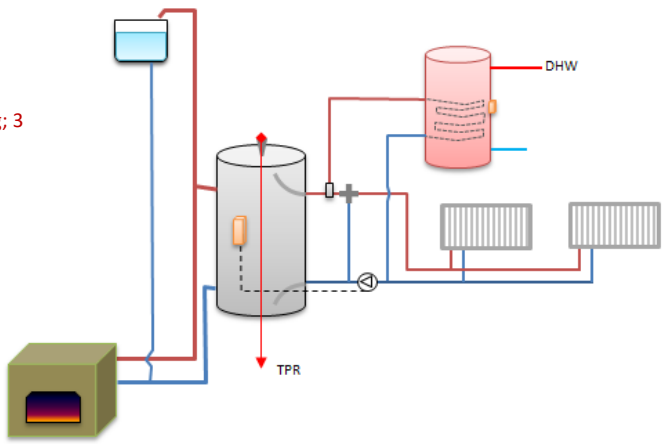
For example when the buffer gets to say a 75 deg C trigger point the circulation pump is energised via the differential thermostat. The system draws from the buffer, blending output with the systems return to deliver a safe flow of 65 Deg C. Then when the Temperature in the tank falls below 65 Deg C the pump is powered off until the buffer again reaches 75 Deg C
It is a common error to use a simple tank thermostat rather than a differential thermostat, this will result in premature pump failure and a less effective system

Our advice; It is critically important for Buffer tanks in uncontrolled system applications to be correctly sized. **(Heat IQ can advise and size)** Overheat safety devices and or heat dump features may also be required.

Note; By default unless the manufacturer advises otherwise All Uncontrolled systems should also be open vented with a header tank to protect the system from overheating, over pressure and from running dry.

Fig 3 sets out a typical open vented system the vent prevents over pressure and discharges to the header tank to avoid discharge of inhibitor. The temperature relief in the buffer prevents a situation of overheat of the system.

Fig; 3



Air to Water Heat pumps

Essentially there are two kinds of Air to water heat pump. Standard units and Inverter units. The difference is that an Inverter HP can modulate output. High levels of efficiency through modulation is the big selling point used to promote inverter units. However a standard unit in conjunction with a buffer tank can be just as energy efficient. The buffer compensates for modulation and arguably provides a more flexible option.

If for example you want to introduce solar thermal input, input from a wetback or even dump excess energy from a PV solar power system then a Buffer tank with a secondary source coil or element port will allow this.

In terms of capital cost the addition of a buffer tank to a standard unit will often come through lower than the cost of an inverter unit. In the long term inverter complexity can also lead to costly fixes when faults present.

Use of a buffer in an inverter system remains optional or as advised by the appliance manufacturer

Our advice; A buffer tank is essential for a floor system off a standard HP when the floor is control zoned. If the entire system is a single control zone (which we don't recommend) a buffer tank can theoretically be substituted with a hydraulic separator providing the system volume is greater than 12.5 L per kw rating of the HP *eg; 12KW HP = total system volume over 150 Litres.* For most systems we don't believe an inverter offers enough advantage to warrant recommendation.

Heat IQ can provide both Standard and Inverter Heat pump options, our advice is considered

Fig; 4

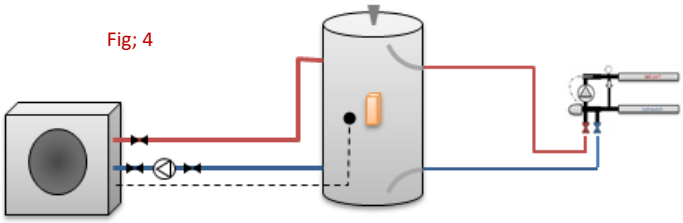
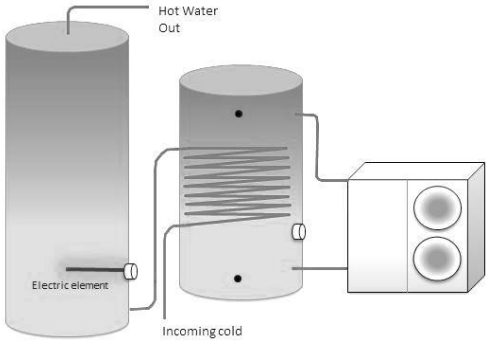


Fig 4a

Shows how a buffer tank can be used as an energy efficient simple and cost effective pre heater for DHW in heat pump systems – as an alternative to using a three way valve heating through a coil into a DHW cylinder,



Options ! Buffer tanks can be in two or four port connection format

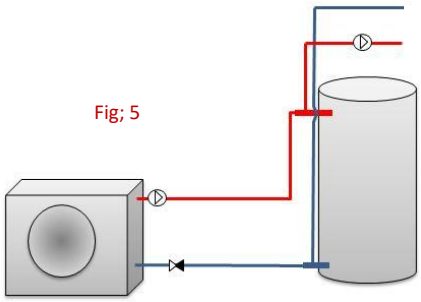
Two port buffer tanks

have characteristics that can suit some applications notably this method can allow the heat source output to flow directly to the system with no temperature dilution from the buffer, which may suit some HP applications by speeding up initial or re heat of the system from setback which is arguably slightly more efficient.

In this configuration it is critical to have the tees (A & B in fig 5) as close as possible to the buffer to minimise the shared section, the shared section should also be of a larger diameter than the connections to it.

A spring check valve will be required to prevent backflow to the appliance when it's pump is not operating but the system pump is on.

Heat IQ Buffer tanks can be Used in Two port format by Blanking the Connections with the Dip tubes



Fig; 5

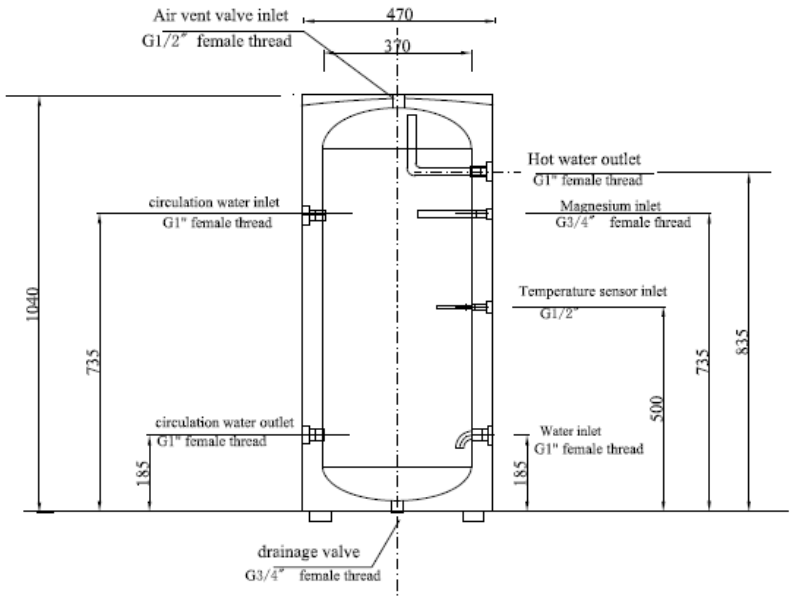
Two pipe configuration

Four port buffer tanks. As shown in Fig; 1 to 4. Recommended

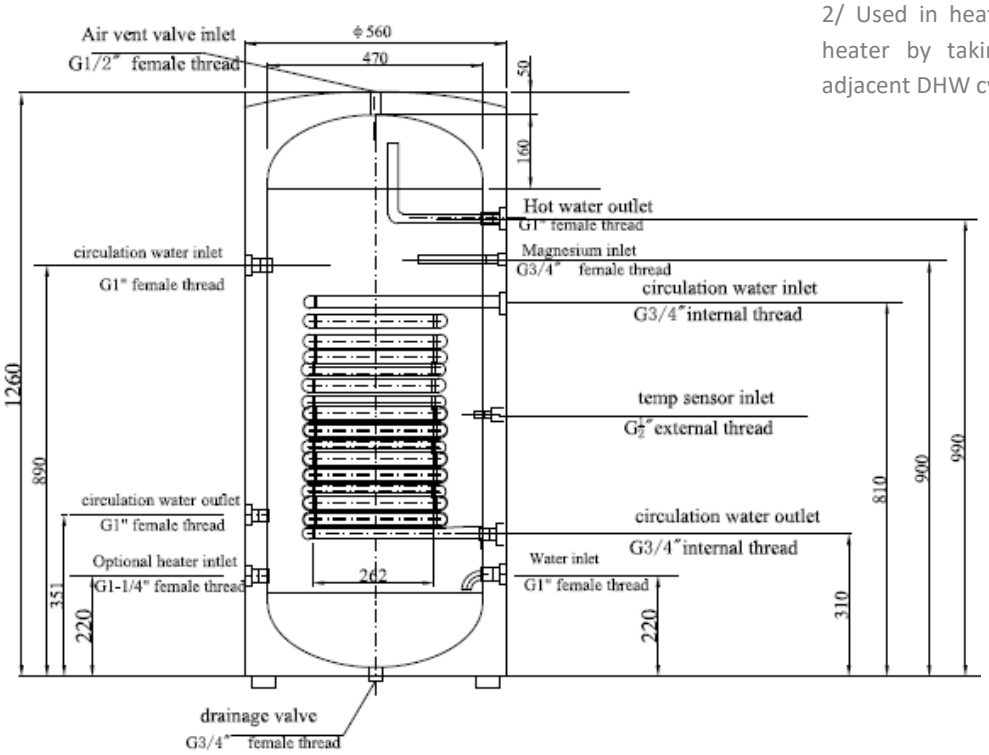
Our advice Where the two port buffer may have a place in some applications the four port configuration is more flexible and Generally a little more fool proof. We recommend using four port configuration unless there is a specific reason not to adopt it.

In General, It should be noted that there are numerous suppliers offering various buffer tank configurations in principal the better buffer tanks are those where the tank inputs are as far to the top and bottom of the tank as practical – The output to the system should also draw from as near the top as possible, and where control is via a sensor in the buffer it should be central in the tank. Be cautious of buffer tanks that have either input or output flow and returns both above the half way point.

The following page shows examples of Heat IQ buffer tanks



100L standard option



200L with coil option

Heat IQ Buffer tanks

To the left is a detail for our standard 100L Stainless steel insulated buffer tank.

150 & 200L versions are also available

The system side outlets are fitted with dip tubes ensuring only the fully heated store is drawn and minimising the risk of cross flow

A probe pocket air relief port, drain plug and magnesium anode are included. The Anode is supplementary as in most cases inhibitor is protecting the system

We also include an element port for those wanting to input solar PV

Coil options

Our buffer tanks are also available with a coil option - the coil is 25m in a 150 or 200L buffer and 12m in a 100L buffer.

This coil can be used

1/ Used for secondary input from another heat source.

2/ Used in heat pump systems as a pre heater by taking the cold feed to an adjacent DHW cylinder through the coil .