

Buffer vessels are simply a tank that contains a volume of water, increasing the overall volume of the heating distribution system. This extra volume of water is designed to absorb any extra heat generated by the heating appliance in low load conditions, which the building does not yet require.

If the building cannot absorb the extra heat generated the return temperature to the heating appliance (in this case a heat pump) will increase and will turn off. If the temperature drops in the water returning to the heating appliance, then it will turn itself back on. If this cycling occurs at a greater frequency than the minimum run time for the appliance this is classed as short cycling. The aim of a buffer vessel is to remove the possibility of any short cycling of the heating appliance.

For a heat pump the minimum run time is set by the number of compressor starts within an hour. For a single compressor heat pump this is usually around four. This means that typically for low loads which are below a quarter of the maximum heat output short cycling can occur.

The size of the buffer vessel and the temperature at which it operates will determine its effectiveness and efficiency. Fitting a buffer vessel can lower the overall efficiency of the heat pump system depending on the type of vessel. This is due to a number of factors which can include:-

1. The requirement (in most designs) for an additional water pump on the outlet from the buffer vessel to the heating distribution system and its associated electrical usage.
2. The heat loss from the tank, although this can be reduced by adequate insulation and if installed within the fabric of the building any heat loss will be helping to heat the building.
3. The requirement for a higher temperature from the heat pump (if the buffer vessel has an indirect coil or is a thermal store system) to drive the heat into the heating distribution system. This reduces the operating efficiency of the heat pump and every 1°C temperature rise at the heat pump equates to approximately 3% increase in energy costs.



## Facts at a glance:

### Buffer Vessels

The aim of a buffer vessel is to remove the possibility of any short cycling of the heating appliance.

### Kensa Heat Pumps and Buffer Vessels

Kensa's system designs are specifically designed to remove the need of buffer vessels, by leaving approximately 25% of the heating zones hydraulically open.

### System Efficiency

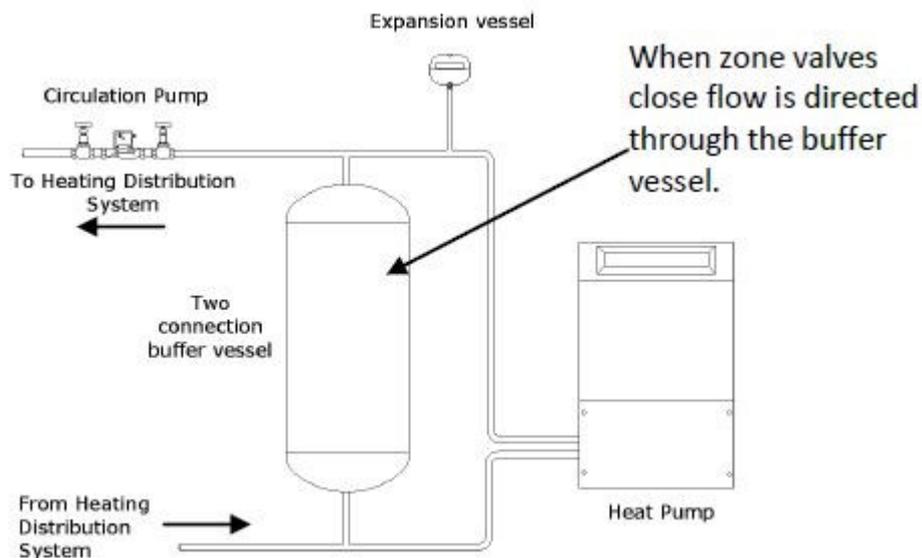
If not designed correctly buffer vessels can be a cause of inefficiency, due to extra water pumps, heat losses and the possible requirement for running the heat pump at a higher outlet temperature.

### Fully Zoned Heating Systems

If full control is required over all the heating zones then Kensa would recommend the use of a twin connection buffer vessel as this is the most efficient way of using a buffer vessel.

Kensa's system designs are specifically designed to be able to operate without a buffer vessel between the heat pump and heating distribution system to maximise the efficiency of the system. This is achieved by using the volume contained within the heating system itself as the buffer vessel. This means approximately 25% of the underfloor zones or radiators should remain hydraulically open, i.e. no control valves fitted. These areas should provide a minimum load on the heat pump to avoid short cycling. The areas that are left 'open' should be areas where close temperature control is not required i.e. hallways, bathrooms, etc.

For buildings where 'open' zones are not desired, Kensa would recommend the use of a two connection



For Kensa compact heat pumps the buffer vessel should be sized for 10 litres per kW of heat pump output for single compressors and half this for twin compressors (as twin compressors as the name suggests contain two compressors). For example for a 20kW heating load using a twin compressor heat pump, the buffer vessel should be approx  $(20 \times 10)/2 = 100$  litres.

In some continental countries, it is obligatory to have a buffer tank in order to obtain a particularly attractive electricity tariff. This allows the electricity supplier to turn off the power to the heat pump for many hours when demand is high, on the basis that the interruption will not affect the space heating of the building. This is why some continental heat pumps always have a matching buffer tank; however these are not usually required in the UK as there are no such tariffs.

Thermal stores are slightly different from buffer vessels and work on a similar basis as an unvented hot water cylinder. The difference being that instead of the primary heating coil being the source of heat, it is reversed so that the hot water is actually passed through the coil or tank-in-tank and is heated by the surrounding water within the thermal store. Thermal stores act as buffer vessels but the greatest benefit is that many different sources of heat can be connected to it (this can be solar, ground source or even solid fuel) and it is possible to provide space heating and domestic hot water from the single thermal store. However it is important to remember the heat pump efficiency maybe compromised due to the higher temperature required by the thermal store to drive the heat into the heating distribution system.