HEATBASE Ltd FACTSHEET 16
Expansion Vessels and system pressure

Version 2 April 2015

If we have issued you with this factsheet it means you have either had a problem with system pressure, or that we are informing you that the system pressure was lower than it should have been. In either case please ensure you read this factsheet so you understand the importance of checking the pressure and the implications or consequences of not checking or keeping the pressure at correct levels.

The most important thing a customer with a sealed/pressurised system can do is to regularly check the pressure in their system and in the correct manner. Sealed or pressurised systems require regular attention from the householder and the pressure should be routinely checked once per month or more frequently if there has been a pressure related problem. Although theoretically the pressure should never drop; in reality most systems will lose pressure over a period of time and unless this has been checked on a regular basis and in the correct manner, no one can be sure at what rate the pressure drop is occurring. Bleeding a radiator will also cause the system pressure to drop. If the pressure becomes too low the water will become excessively hot, air gaps will form within the water and steam can also be produced. Overheat protection thermostats are designed to shut off between 110-120 degrees C as water does not boil until 140 degrees C under pressure. If the pressure drops too low, water will boil at 100 degrees C but the boiler will have no failsafe protection until it reaches 110-120 degrees C. The components of the boiler such as circulating pumps, diverter valves, expansion vessels, pressure relief valves and auto air valves are not designed to be run dry, or be used under excessive temperatures and in effect become overheated or boiled. This will lead to failure or weakening of components and if left unchecked will lead to an endless stream of callouts and replacement parts. Once an issue over lack of pressure is resolved the system will then run at a higher pressure than before, but due to previous weakening of components due to excessive temperatures caused by the lack of pressure; components may then fail suddenly afterwards.

The pressure should only be checked when the boiler is fully cold i.e. when both Hot water and Heating have been turned off either over night or for at least 6-8 hours (some combi boilers have been wired to be on 24 hours per day meaning unless they are turned off at the main switch on the wall, the boiler is actually fully up to temperature); this is the only point at which the pressure is constant and therefore it is the only way to ensure the correct pressure has been set. Dependant on various parameters, the system will need to be topped up to a specific pressure. The standard setting is 1 bar cold, but depending on the design of the system or appliance it may differ.

Once the system pressure has been set with the boiler cold and the boiler is turned back on, the water within it will start to heat and expand. This causes the pressure to rise within the system and is perfectly normal. On an old Open vented system the water would expand up the Cold feed and expansion pipe and into the Cold feed and expansion tank (header tank). With a sealed/pressurised system the expansion vessel takes over this situation.

An expansion vessel is a unit of two halves separated by a diaphragm. One side is charged with air, the other side is empty which allows water to expand into it during the heating and expansion process. The diaphragm and air charge act like a shock absorber and absorb some of the expansion (and pressure rise) of the system water; the larger the vessel the more expansion (and pressure rise) will be absorbed by it. When the system cools the pressure will drop, the water contracts and the diaphragm should push the water back into the system.

The size of expansion vessel required is dependent on the volume of water within the boiler, radiators and associated pipework and coil of the cylinder, as well as the Initial air charge of the vessel (which varies depending on how many stories a property has) and the pressure the system is charged to when cold, the rating of the pressure relief valve and other factors are also taken into consideration. There is then a calculation to determine the correct size of vessel required. The installation to connect the vessel to the system would then be made at the coolest point; which is usually the return pipework from the heating circuit (It is still connected to the circuit if you are not using your heating).
The problem with combi boilers and purposely designed system boilers is that the expansion vessel supplied is rarely big enough to cope, but it is all that they can fit within the boiler casing; meaning you have to fit another one external to the boiler to make up the difference. Also the connection of the expansion vessel to the system tends to be on the boiler shell, which in fact can be the hottest part of the system. Excessive prolonged heat will damage the diaphragm resulting in a reduced life of the vessel. The diaphragm will be stretched excessively if the vessel is not large enough for the system; again reducing the life of the vessel. Through time the diaphragm will distort or split. Once it splits the vessel will need to be replaced, if it distorts the vessel can be recharged but it will have effectively become a smaller vessel as the diaphragm has lost its elasticity and ability to absorb the pressure rise. If the expansion vessel does not push all the water back into the system when cold it should be replaced as the diaphragm is damaged.

Oil boilers have a high water content compared to gas boilers and therefore a larger vessel will be required for the equivalent sized system using Oil; otherwise the pressure within the system will run at a higher level. It is common to see an oil combi run at 2 ½ Bar when fully hot from a cold water charge of 1 Bar, this means the expansion vessel is undersized or faulty. This poses a problem as due to wear and tear on the vessel the pressure in the system will increase further. If the pressure reaches 3 Bar on most boilers and 2½ Bar on Grant boilers, the pressure relief valve will open to drop the pressure and protect pipework and fittings from excessive pressure. This would indicate a larger vessel may be needed, or a lower cold water charge may be required. Unfortunately, if the pressure relief valve operates and drops the pressure, the system will now have insufficient pressure which can then raise the temperature excessively or allow components to run dry, thereby causing further damage!

The problem with fitting two separate vessels is that they may wear at different rates causing more stress on one or the other, leading to a vicious circle of replacing one then the other and so on. Under sizing the expansion vessel required on a system will cause problems; over sizing it will not.

If after regular routine checking of the system pressure (in the correct manner), the pressure is regularly found to be dropping it would most likely indicate an undersized or faulty expansion vessel, a blockage in the expansion pipe, or a leak on the boiler or system. **Leaks can be so slight they may not be visible even in slightly warm conditions. Sometimes a boiler and system may need turned off and left to stand a minimum of 24-48 hours before the slightest of leaks become noticeable** and if the leak is inside the combustion chamber it may never be discovered as any water would boil off with the heat of the flame and disperse through the flue system. Leak sealing chemicals can be injected into the system and may seal slight weeps or leaks; they are not a permanent solution and should not be used on a regular basis as they may cause blockages within heat exchangers.

Care should be taken if you have to regularly top up the system pressure as this will dilute corrosion inhibitors as well as introducing fresh oxygenated water into the system which can then lead to corrosion, which in turn will lead to loss of efficiency, leaks and reduced life of the boiler and components as well as localised boiling conditions; which will cause higher pressures, too much heat on components and the circle begins again.