

Yacht Plumbing



Marine Engineering and Electronics

This document will talk about yacht plumbing, with the assumption that you are converting an older yacht from a manual pump system to a pressurised system, including hot water.

Yacht Plumbing

Contents

The Old System	4
The Old System	4
Foot Pump.....	4
The new system	4
Taking a feed from the "Old System" to feed the "New System"	5
Hot Water	5
How do we heat the water.	5
Engine	5
Hot Water Tank showing internal coil for heat transfer.....	6
Electricity	6
Alternative Sources of Heat.	6
Isotemp Water Heater Single coil	7
Aldi Sigmar Water Heater twin Coil.	7
Thermostatic Mixing Valve	7
Thermostatic Mixing Valve.....	8
A Pressurised System	8
Water Pressure Pump and Expansion Tank.....	8
The Pressurised System	9
Pressurised Water System	9
Combining Pressurised and pumped systems.....	9
Old and New with 2 Foot Pumps.....	11
The Plumbing	11
Selection of Pipe	12
Copper	12
Plastic Pipe	12
Hose	12
Fittings	12
Stop Cocks.....	13
Hose tails.....	13
Hot Water Heater showing Connecting thread, and matching hose tail.....	13
Mixing pipe work	14

Yacht Plumbing

The Water Tank	14
A regular shaped tank, and a odd shaped tank	14
Level gauge	15
Sight Glass.....	15
Electronic Gauge	15
Twin or more Tanks	15
2 Water Tanks Connections	16
A complete two tank, manual and pressurised system.....	17

North Wales Sailing

Yacht Plumbing

The Old System

When we talk about the old system we are talking about a manual pump system with no hot water.



The Old System

The pumps could either be hand operated or foot pumps, the good advantage of the old system, it meant you couldn't leave the tap running, and hence drain all your fresh water.



Foot Pump

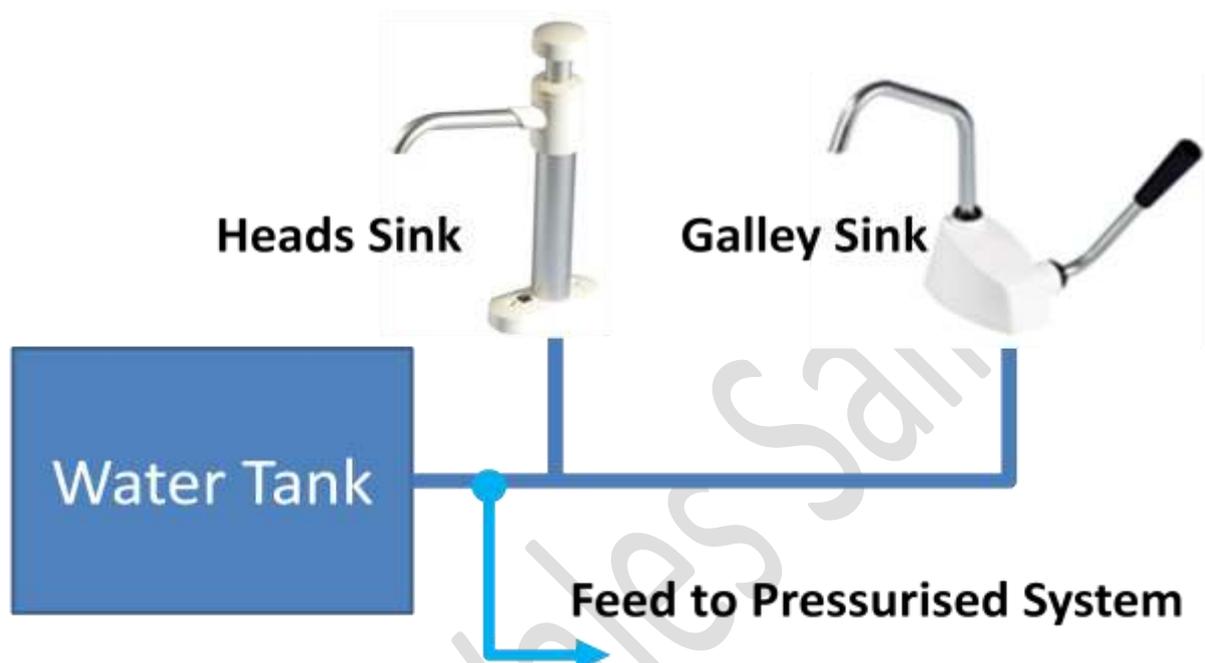
The new system

We are used to a certain level of expectation when we go essentially "on Holiday" when we go boating, running water, and hot water. Both these are easily achieved. Now there is a temptation to remove the "Old System", and put in a pressurised system. The draw back with this is if we lose power, or the pressure pump fails, we no longer have access to the water on board. Many Blue Wter

Yacht Plumbing

cruiser in preparation for their trip at great expense add a water maker etc, but give no thought or money into how they will get to the water in the tank.

Rather than replacing the "Old System", lets add to it. This will leave us with the backup should we have a power failure, or the pump fails.



Taking a feed from the "Old System" to feed the "New System"

Hot Water

How much hot water do we want. The more hot water we want the longer it will take to heat. Perhaps a typical day we might want to have a shower, and do the washing up, both will be crew size dependant. A typical small yacht (less than 40') will have a 20-25Lt hot water tank. Enough for a couple of (short) showers, and the washing up.

How do we heat the water.

Engine

Free hot water, if we run the engine it creates heat, we have a cooling system to remove the heat. If we cut into the engine cooling system, we can transfer the heat from the engine into a tank heating the water in the tank.

Yacht Plumbing

Most marinised engines will have the pipe work to feed a radiator, which is no longer used, it is simple to cut into this, and where once there was a radiator we have a Hot water tank. Some engines will have fittings(if not fitted blanks) to allow pipe work to be added, to incorporate the Hot Water tank.

The Hot Water tank will have a coil inside the tank, the water from the engine flows through, transferring the heat to the water in the tank. With the engine under load (typically 15000 - 2000 RPM) and warm it should take about 30 mins running to get a full tank of hot water. remember if we just idle the engine it may not get warm enough to heat the water much above tepid.

The purist may want to sail onto their mooring or anchorage, but they won't have any hot water.



Hot Water Tank showing internal coil for heat transfer.

Electricity

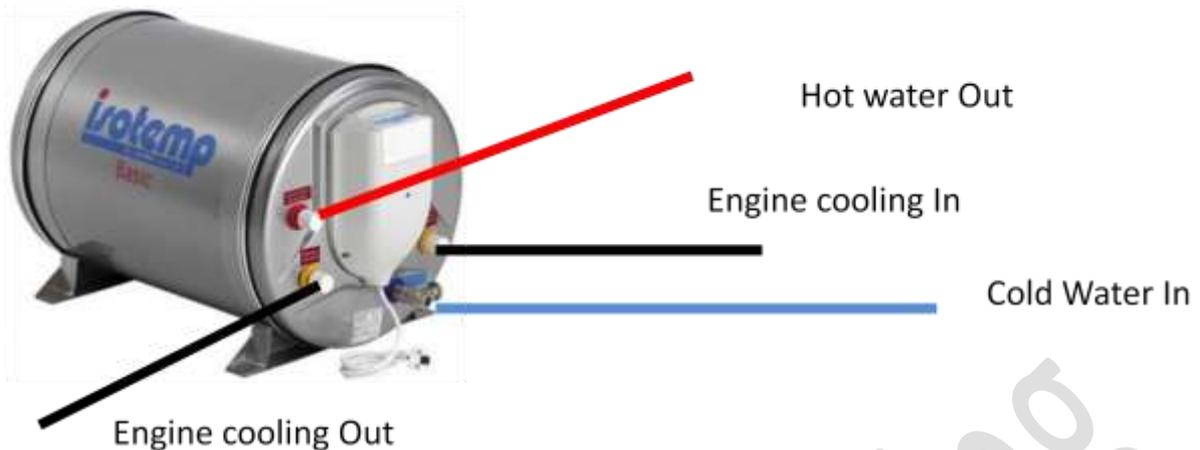
If we have access to shore power, or a gen set giving us mains power, the Hot Water tank can be fitted with an immersion heater. A Typical 20Lt tank will have a 700W heater element. It will take some time to heat the water.

Alternative Sources of Heat.

If you are in the tropics solar may be an option. Some boats may fit a hydronics heating system. The hot water being pumped around the radiators can also be pumped around the hot water tank in the same way the engine is used to heat the water.

If we are going to combine a Hydronics system and the engine, we will need a hot water tank with 2 coils, one for the engine, and one for the hydronics system.

Yacht Plumbing



Isotemp Water Heater Single coil



Aldi Sigmar Water Heater twin Coil.

Thermostatic Mixing Valve

The Hot water from our Hot Water tank can become very hot, hot enough to cause scalds to the user. If using the engine to heat the water, the temperature in the engine cooling system can reach in excess of 80°C, this high temperature can transfer into the water in the Hot Water tank. The electric immersion heater can be set based on temperature, which makes things a little better.

Adding a Thermostatic Mixing Valve can set the Hot water temperature regardless of how we have heated the water. These are typically set at 46°C. They can be adjusted, as an allowance for cooling of the hot water through the pipes.

Yacht Plumbing



Thermostatic Mixing Valve

When we select our Hot Water Tank, some will come with a Thermostatic Mixing Valve as part of the Hot Water Tank. Having this as part of the Hot Water Tanks gives us less plumbing in the system, but may not be suitable if there is a long run from the Hot Water Tank to the First Hot Water Tap.

A Pressurised System

To pressurise the system we will need some form of pump. The pump must react on the demand for water to keep the system pressurised. Pumps are readily available to do this. As the pump is not running all the time, there will be a little delay when we open the tap, this can be overcome by adding an expansion tank. Essentially the expansion tank is a balloon filled with water, the balloon will keep the system under pressure when the tap is closed, and the pump is not running. Once the tap is opened, the initial demand is provided by the expansion tank, while the pump starts up. Once the demand is over the pump will run on refilling the balloon.



Water Pressure Pump and Expansion Tank.

Yacht Plumbing

The Pressurised System

If we add all the parts together, we will have something like this.



Pressurised Water System

We have added a Water Filter into the system, this is not to purify the water, but as a guard against debris in the water getting into the pump. In the above diagram we have only shown 1 set of taps, the number of taps will depend upon the power of the water pump, and the size of the expansion tank.

For the typical small yacht, the water pump would be capable of handling 3 outlets, with a 1lt expansion tank.

Combining Pressurised and pumped systems.

We have already mentioned, you could just add the pressurised system to the existing manual pumped system. we would be adding new taps to the sinks, so each sink would have 1 manual cold tap, with a Hot and Cold pressurised tap. We would have to use a mixer tap to save on space for the pressurised system.

Yacht Plumbing

If we lost power we would still have access to the water. However we would have lost access to the Hot Water, in our Hot Water Tank.

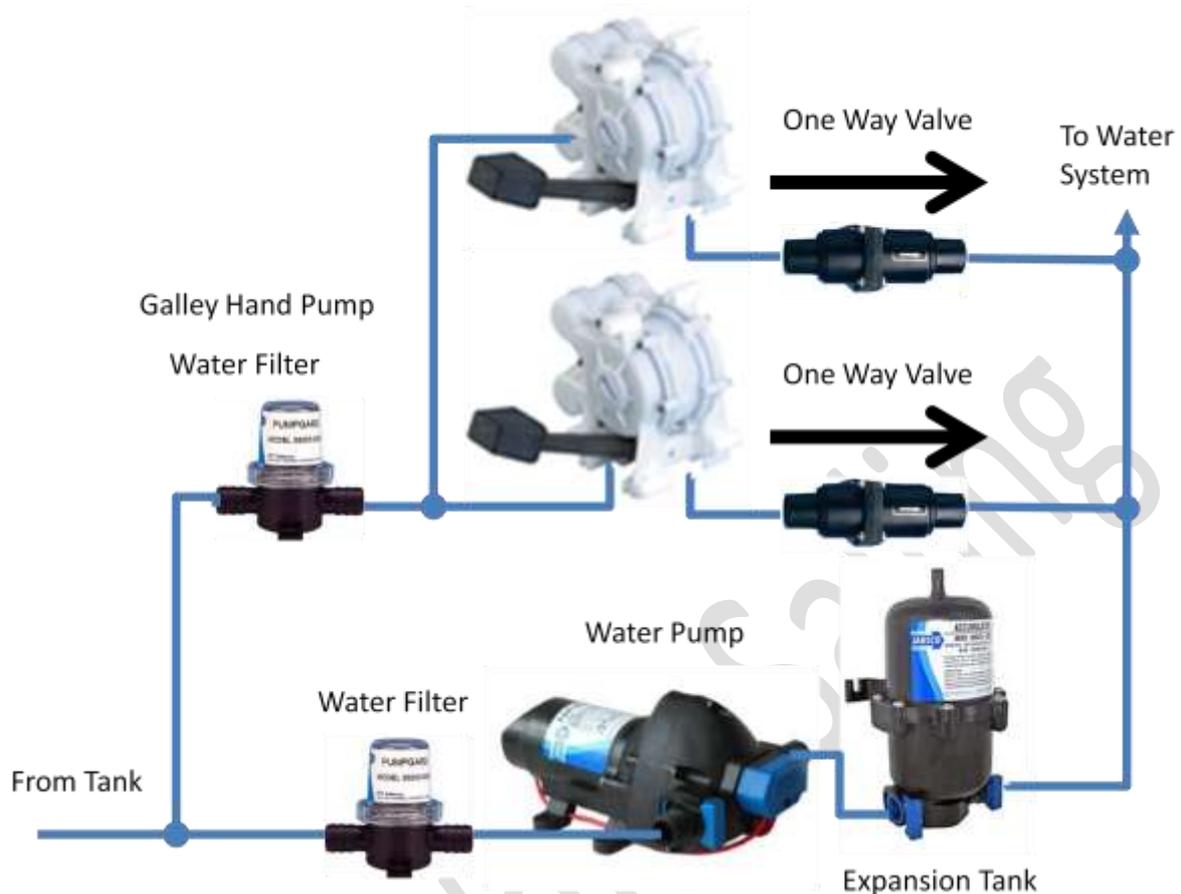
If we engineer things a little we could use a manual foot pump to provide water pressure, this would then allow the Hot Water to be accessed. The manual foot pump taking over from the Electric water Pressure Pump. We would have to add a few one way valves, as to avoid a circular system, which would just let water be pumped around the system by the Water Pump.



Combination of Old and New

The above diagram assumes that there is only one foot pump in the system. the assumption is that the foot pump is in the galley. If we had more than one foot pump, the arrangements would have to be as shown below.

Yacht Plumbing



Old and New with 2 Foot Pumps

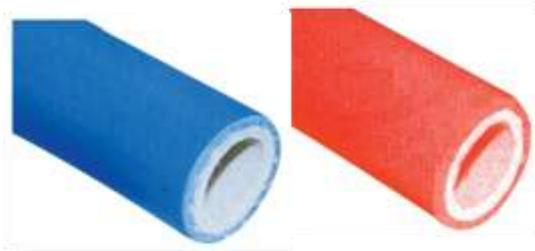
I have had success with one foot pump, but cannot guarantee the system with 2 or more foot pumps.

The Plumbing

What are we going to use to connect all the parts of the system. In our design, we need to minimise the number of joints, as any joint has a risk of leaking. The pipework needs to be safe for drinking water, and we need to identify the OLD system, the NEW system, and hot and cold water.

The standard pipe size used is 15mm. We have 3 types of pipe to choose from, Copper, Plastic, or hose.

Yacht Plumbing



Hose Blue (Cold) Red (Hot)



Plastic Pipe



Copper Pipe

Selection of Pipe

Copper

Copper these days is expensive, and has the tendency to tarnish with the introduction of salt water, this could prove to be a problem when running paperwork below the water line and through the bilges. Price is probably the deciding factor, although we may need a little bit of copper pipe in our system.

Plastic Pipe

Plastic pipe in the household has now replaced copper pipe in most installations, mostly as the price is better. It also comes in longer sections, which reduces the number of joints needed in long runs. Although they are compatible with copper pipe, mostly the fitting used with plastic pipe are push on. the push on fittings make for a very fast installation.

Hose

Hose has many advantages, price, length, and flexibility. The disadvantage with hose, the connections are secured with jubilee clips. Tightening of the jubilee clip can distort the plastic fittings on the pump, expansion tank, etc.

Fittings

In our domestic installation we will have a main stop cock, and check valves for each tap, and toilet. This allows for easy maintenance should we need to change the cistern in the toilet, or a washer in a tap. In our boat if we remove the power from the Pressurised water Pump., once the pressure has been released from the expansion tank, then there is no longer any pressure to force water out of the pipes. Should we have a leak, or need to do maintenance on the system it is easy to empty the water tank to remove the risk of water spillage.

Yacht Plumbing

The boat will not sink if we lose all of our fresh water into the bilge, our automatic bilge pump will happily pump it over the side.

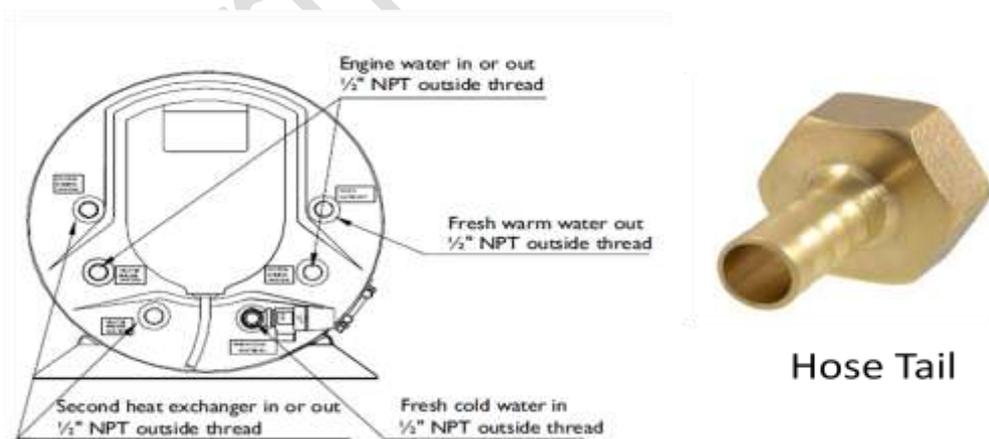
It might be prudent however to fit a stop cock from the Water Tank to the system, if we have an Old system and a New system, a stop cock for each feed.



Stop Cocks

Hose tails

If we are using Hose for our pipe work we will need some way of connecting the hose to the Hot water tank, pumps etc.



Hot Water Heater showing Connecting thread, and matching hose tail

Yacht Plumbing

Matching the correct thread and the correct hose tail will need some work, a mismatched thread will lead to a leak at the joint. Some thread types are tapered, these help with creating a good seal, even with tapered, some form of assistance to get a good seal will be needed, i.e. using pipe compound or PVC plumbing tape.

Mixing pipe work

We may wish to mix the different types of pipe work, copper, plastic, or hose, to maximise the benefits each type give us. The Hot water Tanks readily available favour hose tails, and hose for connections. The taps we may use, may be more suitable for connecting to copper pipe or plastic. At some point we will need to convert from Hose to pipe (either plastic or copper).

The internal diameter of the Hose is approx 15mm, and with the application of heat and a lubricant, will slide over 15 mm pipe(Copper or Plastic), sealed using 2 jubilee clips.

It is possible to get a 15mm hose tails that will connect into a 15mm compression fitting. this allows a better connection between Hose and 15mm pipe.

The Water Tank

It is not likely that we will be replacing the water tank, most boat seem to have the boat built around the water tank. We may however wish to add an additional water tank, to increase our capacity.



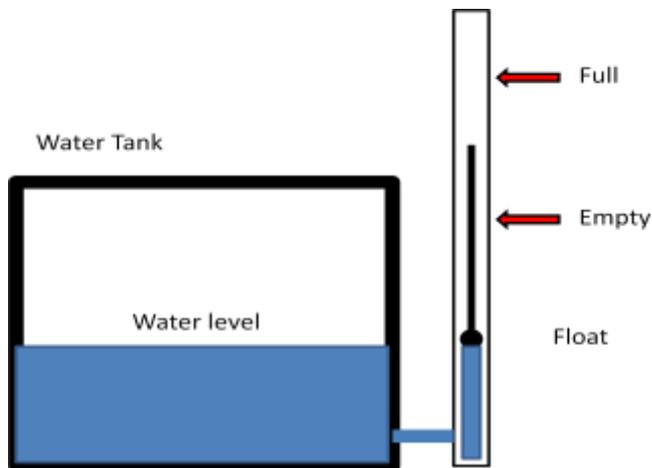
A regular shaped tank, and a odd shaped tank

Knowing our water capacity, and being able to measure the about of water in the tank is quite important. Measuring the physical size of the tank gives us its capacity as 1lt of water is 1000cm³ (10cm x 10cm x 10cm). Easy to do if the tank is a regular shape. Approximate method, using a 5 lt water bottle, measure the time it takes to fill the bottle, then time how long it takes to fill the tank, use a bit of maths to find the volume.

Yacht Plumbing

Level gauge

There are two ways to get a level gauge, electronically, and mechanically. Mechanically, is either a stick we put into the tank, and see how far the water comes up the stick. The stick can then be calibrated. A sight glass



Sight Glass

An electronic gauge is an alternative, it would also be nice if there was a back up for the electronic gauge. If you have an odd shaped tank, the gauge will not accurately read the amount of water in the tank, full and empty will be the only true readings.



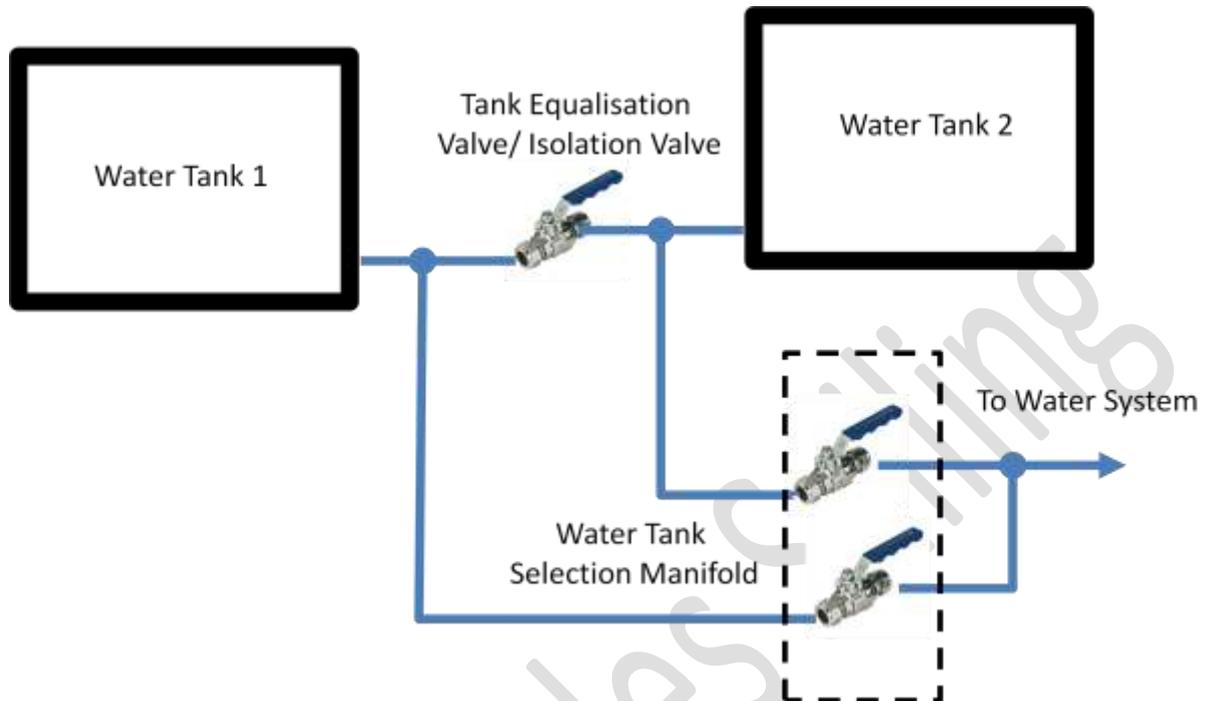
Electronic Gauge

Twin or more Tanks

If we have 2 or more tanks, we need to get water into all the tanks, and be able to get it out again. The advantage of 2 tanks, when one is empty we have a clear sign that we have used half our water supply. Although this is considered cheating in some racing rules, we may also want to pump the

Yacht Plumbing

water between tank, moving the ballast on our boat, the more weight on the windward side the better.

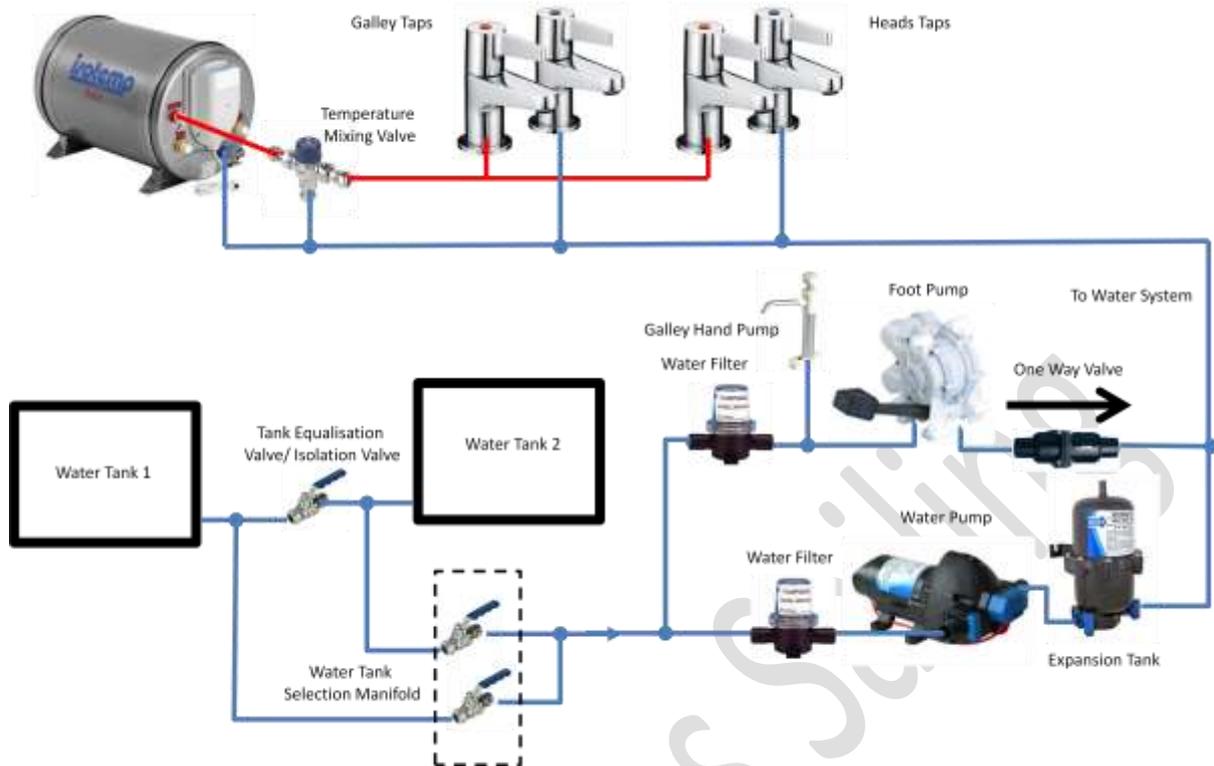


2 Water Tanks Connections

The Tank Equalisation Valve/Isolation Valve in Equalisation mode valve open, will allows the 2 water tanks if open to distribute the water evenly between the two tanks. This equals the weight on both sides of the boat. In Isolation mode valve closed, should the boat be heeled it will keep the water in the windward side, also in some boats, when they are heeled the water tank is above the sink, and in this case the water would drain out through the taps.

The Water Tank Manifold allows selection of which tank should be used to supply water to the system. Once one tank has run dry the tell tale sign is the Water Pressure Pump will continue to run, as it can no longer supply water to pressurise the system. I selecting the pump, it should be capable of running dry. Even so it is not good to run the pump while dry. A careful ear is need to listen for the pump.

Yacht Plumbing



A complete two tank, manual and pressurised system