

# Plumbing

'That which makes life easier'  
by  
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I will split this subject into two parts. The first will be about *fresh water* systems and the second will cover *waste water*.

The fresh water system, on most vessels, consists of a storage tank or tanks, a hot-water tank, a pump system and a distribution system or piping.

Storage of fresh water is done in, either, a single large tank or a series of smaller tanks that are connected or *manifolded* together so that they are filled and emptied as one. Either way, the tank or tanks, should be located as near as possible to the center of buoyancy (fore & aft) of the hull. Positioning the tank or tanks at the center of buoyancy means that the trim of the vessel will not change as water is used thus the paddlewheel depth does not change.

If a single large tank is used, it should be positioned fore-to-aft and also be fitted with baffles to slow the movement of water from end to end and side to side. Positioning this tank sideways in the hull is usually easier, however, if a few people stand to one side on the boat, the water will also flow to that side, in spite of the baffles, and increase the list dramatically. The positioning of smaller tanks side to side, usually, does not cause this problem for it takes a much longer time for the water to shift.

The safest way to distribute the water is through galvanized pipe, however, I feel that most of you will want to use plastic or PVC and that works pretty well too. I do suggest that you spend the little extra money and buy schedule 40 PVC. *Schedule* refers to the thickness of the pipe and schedule 40 will handle the shock and vibrations encountered in a boat better than schedule 20. However, for the distribution of hot water, pipe designated 'CPVC' must be used and this is, usually, only available in schedule 20.

Filling of the tank or tanks is accomplished with two lines that enter the top of the tank(s). One is the fill line and the other is an overflow. They should be placed close together and in a convenient location; close to the deck, for easy access. I generally install screw-on covers for both these lines to prevent insects from building nests inside. If you do this, a third line should be installed from the top of the tank(s) to a position high on the cabin wall for a vent. Fit this, then, with a protective screen cover.

I recommend installing a good filter on the discharge line from the tank(s) just past the main shutoff valve. For those who intend to do a lot of traveling, a filter placed on the fill line of the tank could also prevent a lot of problems. Also, I recommend installing a 'pressure regulator' in the fill line because some towns have very high pressure in their water system; especially at river level.

Next comes the pump and accumulator. The pumps are 12 volt and are sized in gallons per minute to accommodate the number of outlets that you might be supplying at any one time. The accumulator tank is to provide an air cushion so as to reduce the cycling of the pump. The larger the accumulator, the longer the time between pump cycles, but it also increases the running time of the pump when it does come on.

There is another way to develop pressure for a fresh water system and that is to pressurize the entire system including the tank. This pressure is supplied from a compressor either mounted on the main engine or powered by a 110 volt motor or, sometimes, both. Of course, with this system, the tank(s) and all lines must be able to handle the pressure (usually 25 to 35 psi), there is no vent and both the fill and overflow lines must be fitted with valves. This is an excellent system especially if both compressors and an adequate air storage tank is installed. However, a couple words of caution. First, resist the temptation of using an air-conditioning compressor on the main engine. Most of these allow oil to be introduced into the system and this will ruin a good cup of coffee. Been there, done that. Also, be sure to install a valve in the line between the air tank and the water tank so that the system can be 'blown down' and refilled without emptying the entire air storage tank. Also, be sure to install a pressure relief valve set to 'below the working pressure' of the tank(s) and lines.

Routing of the distribution lines should be as high in the hull as possible. This allows the system to be easier drained for winterizing and makes the lines less susceptible to damage when you are moving about in the hull. Also, when penetrating a bulkhead, do so with a 'packing gland'. This is a 3 or 4 inch long piece of steel pipe with an internal diameter  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch larger than the outside diameter of your distribution piping. This gland is welded in the bulkhead, your pipe passes through it and packing is forced in and around the pipe to make a water-tight seal. With this, you maintain bulkhead integrity and the piping is not stressed as the hull twists and flexes.

Some of you may wish to install a secondary water system which draws water from the river for flushing heads and/or washing down decks. This is okay if you use the right method for water pick up. However, DO NOT install *through-the-hull* pick-ups BELOW THE WATERLINE! Anyone who has been around boats for very long will know of one or more vessels that have been sent to the bottom because of the failure of this type of fitting or some related component. A good location for this pick-up is through the 'splash bulkhead' just above the engine room deck. Install the pipe with a 90 degree ell, turned down, and attach to this a length of rigid rubber hose fitted with a foot valve. Of course, place the foot valve deep enough so that turbulence around the paddlewheel doesn't cause it to be exposed. The rigid hose will flex out of the way if a piece of drift or debris comes through but will spring back in place without breaking off. The pump and tank can be placed in the engine room with the rest of the equipment.

This brings us to the subject of waste water. Waste water falls into two classes. One is *gray water* and the other is *sewage or black water*. Gray water is that which is discharged from sinks, showers, lavatories and bathtubs. Sewage, of course, is that discharged from the heads.

Some water-ways do not allow over-board discharge of any water. Some will permit gray water but no sewage. On most rivers, overboard discharge is not permitted, however, to date and to my knowledge, the only vessels forced to follow the rule have been commercial ones. It's probably just a matter of time before all of us will have to comply but, for now, we can still discharge overboard. I have no problem with the discharge of gray water overboard. And, most of the time, I don't have a problem with discharging sewage. However, when attending a regatta and staying tied beside several boats with continuous overboard discharge, in a few days, there tends to be a mess around the boats. For this reason alone, I suggest that you install a holding tank for sewage. This tank can be emptied after leaving the regatta with, I feel, no detrimental effect on the environment. Perhaps this should be discussed further, however, it must be at a later date.

Now, let's look at the three basic types of heads. First is the 'household type'. Most of these now flush on about 1 to 1 and ½ gallons of water. Older models used over 3 gallons. Thus, either of these should be supplied with river water unless you have a very large fresh water capacity, and they must discharge overboard unless you have a very large holding tank. 'Marine heads' come in two basic types. One is equipped with a pump which is operated by hand, foot pedal or a 12 volt electric motor. The electric models are fitted with a 'macerator' which grinds all contents while pumping them. The other type is the 'direct dump' model. These gravity dump straight out the bottom. The pump models can be mounted most anywhere because they force the discharge either into a holding tank or overboard. The direct dumps must either empty straight down into a holding tank or into a very short tube directed overboard.

Either type marine head works well and are my choice over the house type. However, both do have shortcomings. The direct dumps do not have a 'trap' so, if sewage is left in the tank for a few days, an odor can develop which will permeate the boat on the next flush. However, daily treatment of the tank contents with deodorizing chemicals will prevent this. The pump models can be 'easily jammed by foreign objects' and are difficult to clean out.

The discharge lines for either gray water or sewage should be installed as high in the hull as practical and under NO CIRCUMSTANCES should they discharge BELOW THE WATERLINE! For gray water, this is no problem. However, you may ask, how do you install a holding tank for sewage that discharges above the waterline? There are two ways. One is to use a pump that pumps the contents overboard. The second, and my choice, is to mount the tank directly against the underside of the deck. By using larger lateral dimensions and a low height dimension, the bottom of the tank can, usually, be held above the vessels waterline. The discharge line from the tank should be, at least, 3 inch pipe, kept as short as possible and be fitted with a *dump valve* inside the hull and a *cap* outside. There needs to be only one or two inches of drop in this line. Therefore, if your vessel has a freeboard of, say, 18 inches, the height of the tank can be 14 to 15 inches. Then, with lateral dimensions of, say, 36 by 48 inches, you can easily have a tank with a capacity of over a hundred gallons. This, used with a marine head, can take care of your needs for several days.

I realize that this has been a short discussion on the subject but, if you have questions or want more information, contact me at: [gemort@wirefire.com](mailto:gemort@wirefire.com)